PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field Development and Production Plan to Include Development of the Tranquillon Ridge Field

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Plains Exploration & Production Company

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SECTION 1
INTRODUCTION

This document presents proposed revisions to the Point Pedernales Field Development and Production Plan (DPP). The proposed revisions to the DPP address the development and production of oil and gas from the Tranquillon Ridge Field using Point Pedernales facilities. The Tranquillon Ridge Field is located in both Federal and State Waters.

These DPP revisions have been developed to address all of the requirements specified in 30 CFR 250.204(a). The DPP supporting information, as required by 30 CFR 250.204 (b), can be found in the supporting information document, which has been submitted with this DPP revision document.

The proposal is to develop the Tranquillon Ridge Field oil and gas reserves from Platform Irene, which is part of the existing Point Pedernales Field facilities. The locations of the Tranquillon Ridge Field and the Point Pedernales facilities are shown in Figure 1.

Plains Exploration & Production Company (PXP), operator of the Point Pedernales Field, is proposing to drill development wells from Platform Irene. The proposal is to drill a maximum of 17 (14 producing and 3 injection) wells for development of the Tranquillon Ridge Field. However, it should be noted that the number of wells needed to develop the field will not be known until the first few development wells have been completed, placed on production, and evaluated. In addition, ongoing geologic studies and information gained from the drilling of wells may result in changes to the location of the wells specified in this document.

As part of these DPP revisions, PXP has identified the approximate bottom hole location of 14 wells, which will be used to develop the Tranquillon Ridge Field.

All of the wells will be directionally drilled using existing well slots on the platform. The drill rig that will be used will be similar in size to drill rigs that have been used on the Platform Irene in the past. Drilling of the Tranquillon Ridge wells is expected to last up to five (5) years with production lasting up to 15 years.

All the production from the Tranquillon Ridge Field will be combined with the Point Pedernales Field oil and gas and transported to the Lompoc Oil and Gas Plant (LOGP) in the existing pipelines. From LOGP, the combined oil production from the Tranquillon Ridge Field and the Point Pedernales Field will be transported to the Santa Maria Refinery via pipeline. The combined gas production will either be sold and transported via pipeline or used as fuel at the LOGP.

In order to accommodate the oil and gas production from the Tranquillon Ridge Field, three existing 600-horsepower (hp) electrical shipping pumps on Platform Irene will be replaced with three 1,250-hp electrical shipping pumps. In addition, the new Tranquillon Ridge wells will utilize electrical submersible pumps and/or utilize gas-lift technology as need to optimize production. The only additional equipment for drilling will be two new 1,600-horsepower electric pumps for muds/cuttings handling, as well as some refurbishing of the mud/cutting handling system.

In brief, the development and production of the oil and gas reserves from the Tranquillon Ridge Field will be accomplished by drilling extended reach wells from the existing Platform Irene using existing well slots, pipelines, equipment and facilities. Only minor modifications to equipment and facilities will be necessary to handle the production.

This DPP revision document has been divided into six (6) major sections that include the following.

- ***Introduction –*** Provides a brief overview of the proposed DPP revisions, background information on the Tranquillon Ridge Field and a guide to the DPP revision document structure and content.

- ***Proposed Development Schedule for the Tranquillon Ridge Field –*** Presents the proposed development and production schedule for the Tranquillon Ridge Field.

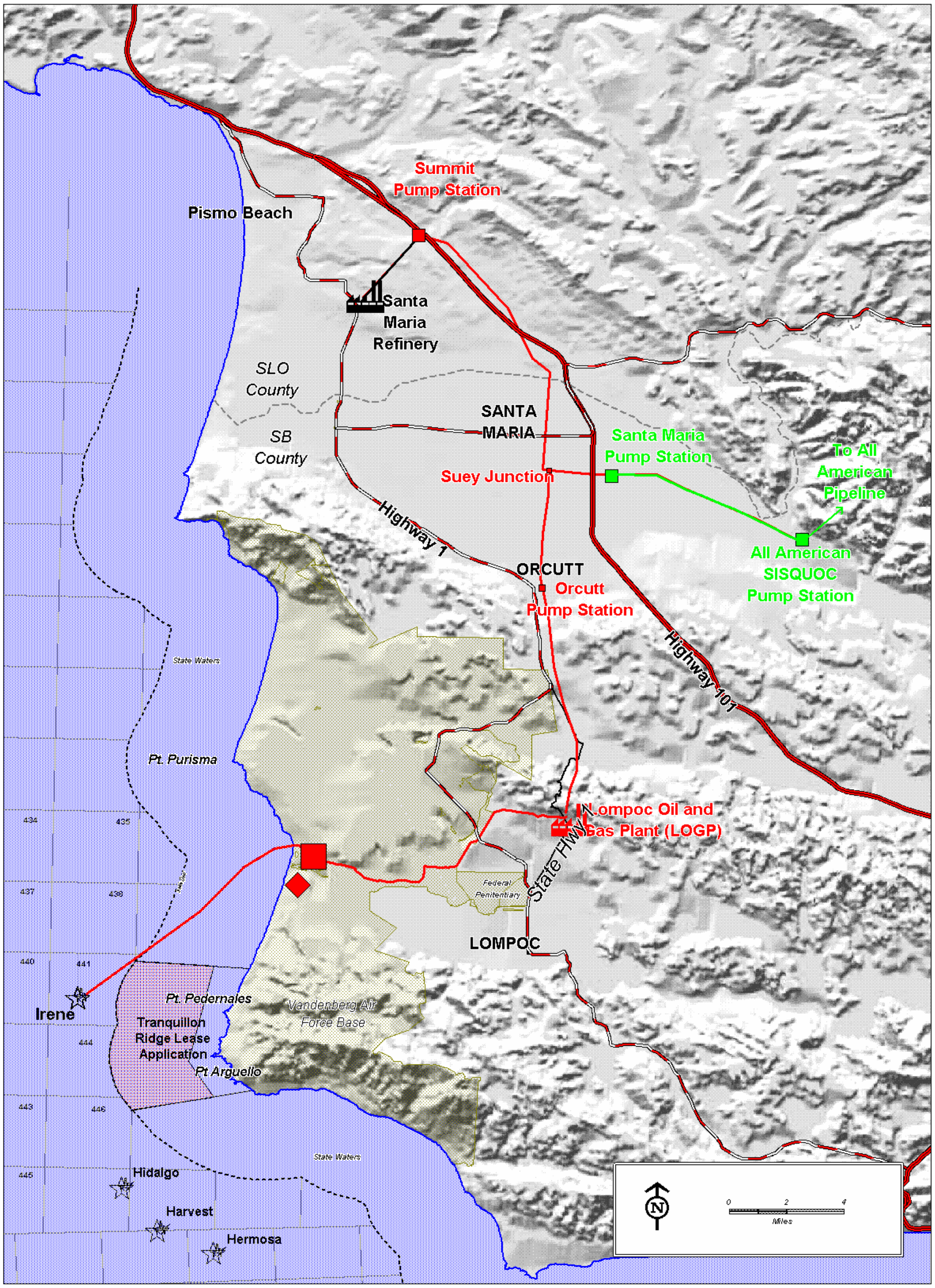
- ***Platform Site and Construction –*** Discusses the fact that there are no new platform sites or construction, other then development wells, associated with development of the oil and gas reserves from the Tranquillon Ridge Field.

- ***Drilling Facilities –*** Provides an overview of the drilling facilities that will be required to develop the reserves from the Tranquillon Ridge Field.

- ***Platform Facilities –*** Contains a description of the oil and gas facilities on the existing Point Pedernales platform and the changes that would be needed to accommodate oil and gas production from the Tranquillon Ridge Field. Oil and gas production from the Tranquillon Ridge Field will use the existing oil and gas production facilities on Platform Irene. The only modifications that would be required would be the replacement of three 600-hp electrical shipping pumps with three 1,250-hp electrical shipping pumps; installation of submersible pumps on some of the new wells; and installation of two 1,600-hp electric pumps for muds handling. Electrical transformer and switchgear upgrades will be ongoing.

- ***Pipeline System –*** Discusses the fact that the existing oil and gas pipeline system for Point Pedernales can handle the production from the Tranquillon Ridge Field.

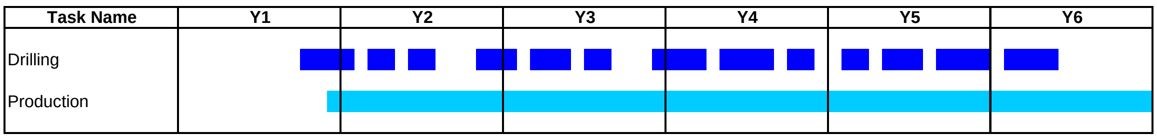
Figure 1 Location of the Tranquillon Ridge Field and Associated Point Pedernales Facilities



SECTION 2
PROPOSED DEVELOPMENT SCHEDULE FOR THE TRANQUILLON RIDGE FIELD

Figure 2 shows the projected schedule for development of the Tranquillon Ridge Field.

Figure 2 Estimated Development Schedule for the Tranquillon Ridge Field



Note: Production from the Tranquillon Ridge Field would continue for approximately 15 years.

Drilling of the first well should occur within four months of obtaining all regulatory approvals for the project. Production would begin two to three months after the start of the first well. The drilling of the 17 wells is projected to take five (5) years.

Depending on geologic interpretation and economic conditions at the time, unsuccessful wells may be redrilled to offset locations. In view of the extended reach of the initial wells, drilling times will likely limit the number of wells drilled and completed per year to between three (3) and four (4), which in turn sets the drilling and production schedule. The delay between the drilling of some of the wells is required to accommodate well work for the Point Pedernales and the Tranquillon Ridge Fields.

The Tranquillon Ridge Project is expected to have a total life of 15 years from the time the first well is drilled; assuming that development of the Tranquillon Ridge Field is successful. It is possible that the initial wells drilled into the Tranquillon Ridge Field may not be commercially viable. Under this scenario, the full development of the Tranquillon Ridge Field would not occur. However, for the purposes of this application, it has been assumed that full development of the Tranquillon Ridge Field will occur.

Based on a 15-year life for the Tranquillon Ridge Project, the Point Pedernales facilities (Platform Irene, the associated pipelines, and the LOGP) would have a total projected life of approximately 35 years (based on startup of Point Pedernales Field operations in 1987). This assumes that the first well for Tranquillon Ridge is drilled in the third quarter of 2008.

The 1985 Point Pedernales EIR/EIS assumed a 20-year life expectancy for Platform Irene and a 30- to 35-year life expectancy for the pipelines and the Lompoc Oil and Gas Plant (formerly the HS&P). However, the 35 year timeframe referenced in the EIR was predicated on the use of the Point Pedernales facilities to process reserves from five additional offshore platforms located in the Central Santa Maria Basin, which were part of the document's Area Study. Two of these platforms were in the Point Pedernales Unit, one was in the Santa Maria Unit, one was in the

Purisima Point Unit, and one was in the Bonito Unit. Based on improvements in drilling technology, the two additional platforms in the Point Pedernales Unit will not be needed. Full development of this unit is occurring from Platform Irene. To date, no development has occurred at the other three units. However, exploration plans for these three units have been submitted to the MMS.

The 1993 Point Pedernales Supplemental EIR (SEIR), which evaluated the relocation of gas processing facilities from the Battles Gas Plant in Santa Maria to the Lompoc HS&P, assumed a life expectancy of 10 to 25 years for the new gas plant. Original estimates of Point Pedernales project life as well as the estimated life of the Point Pedernales facilities with Tranquillon Ridge field development are summarized in Table 1.

Table 1 Summary of Extension of Life Estimates from Environmental Documents

Existing Point Pedernales Facilities			
Project Component	**Original Estimated Life (Years)**	**Estimated Time Frame[a]**	**Source of Estimate**
Platform Irene	20	1987-2007	1985 Pt. Pedernales EIR/EIS
LOGP (HS&P) Gas Plant	30-35[b] 10-25	1987-2022 1997-2022	1985 Pt. Pedernales EIR/EIS 1993 Supplemental EIR
Tranquillon Ridge	15	2008-2022	Project Application
Estimated Increase in Life with Tranquillon Ridge			
Project Component	**Estimated Total Life (Years)**	**Estimated Total Time Frame**	**Net Increase in Life (Years)**
Platform Irene	35	1987-2022	15 [c]
LOGP (HS&P)	35	1987-2022	0 [d]

[a] Current production forecasts (MMS 2004 and CSLC 2001) show a current estimated Point Pedernales project life extending to between 2010 to 2022. Thus, the original project life for Platform Irene may have been underestimated by approximately 3 to 15 years.
[b] This estimate goes beyond permitted development levels, and was predicated on the development of up to six offshore platforms located in the Central Santa Maria Basin.
[c]. Assuming the estimated life of Platform Irene was through 2007, the Tranquillon Ridge Project would extend the life of the platform by 15 years.
[d]. Assuming the estimated life of the LOGP was through 2022, the Tranquillon Ridge Project would not extend the life of the LOGP.

The 20-year life expectancy of Platform Irene, assumed in the 1985 Point Pedernales EIR/EIS was based on an estimated production curve submitted by the Applicant as part of its DPP submitted to the MMS in 1984. With startup in 1987 and an estimated life of 20 years the estimate was that production would continue until 2007. Current production forecasts for the Point Pedernales Field now project that the production will continue until 2012 to 2022, which will represent a 25 to 35-year life. MMS has estimated that operations for Point Pedernales Field will end sometime between 2010 and 2015 (MMS, 2004). These estimates are based on a number of assumptions that could change over time. CSLC (2001) has estimated that operations for the Point Pedernales Field will end around 2018-2022. This represents a life expectancy that is 9 to 15 years greater than what was assumed in the 1985 Point Pedernales EIR/EIS.

The Santa Barbara County permit governing the Point Pedernales facilities contains conditions that address the scope of the project. Condition A-12 stipulates that oil production shall be limited to the Point Pedernales Field, leases OCS-P 0441, 0437, 0438, and 0440. Thus, the permit limits production to only a portion of the offshore development that was analyzed in the 1985 Point Pedernales EIR/EIS. On the other hand, the Santa Barbara County permit (Conditions Q-8 and Q-9) does provide a basis for future discretionary decisions to bring additional production into the Point Pedernales facilities. Based on the permit conditions, the life expectancy of the LOGP would have been based on the Point Pedernales Project only (20 years).

Due to the dynamics associated with developing a coastal California Monterey oil-bearing structure, estimates of project life as well as ultimate recoveries are extremely difficult without extensive production data from a number of wells. This type of data is typically not available during the permitting phase of the project. As such, the production and project life estimates made during the permitting phase are rough estimates and typically change over the course of the project's development. Other factors that affect total recoverable reserves and project life are changes in technology (e.g., enhanced oil recovery techniques), new well development technologies, and the price of crude oil.

If development of the Tranquillon Ridge Project is successful, the expected life of the Point Pedernales Facilities will be extended beyond what was projected for the current Point Pedernales Field operations. However, it is uncertain how long the proposed Tranquillon Ridge Project will extend the life of these facilities. Based on the current projections for the Tranquillon Ridge Project (15-year life), the life expectancy of the Point Pedernales Facilities could be extended up to 13 years beyond what the MMS and CSLC have projected for the Point Pedernales Field.

If the life expectancy assumed in the Point Pedernales 1985 EIR/EIS and 1993 SEIR and the estimated project life expectancy of the Tranquillon Ridge Project are used as the basis for estimating extension of life, then the Tranquillon Ridge project will be expected to extend the life of Platform Irene by approximately 15 years, and the LOGP by zero years.

SECTION 3
PLATFORM SITE AND CONSTRUCTION

There are no revisions needed to this section of the existing DPP for the Point Pedernales Field to address the proposed development of the Tranquillon Ridge Field. No new platforms will need to be built to develop the field. All of the development will occur from the existing Platform Irene using existing well slots and the oil and gas handling equipment on the platform. As discussed in Section 5, replacement and installation of new pumps will be required.

SECTION 4
DRILLING FACILITIES

4.1 Introduction

This section discusses the drilling facilities that are proposed for the development of the reserves from the Tranquillon Ridge Field. It is anticipated that 14 development and three utility wells will be drilled for development of the Tranquillon Ridge Field,

A new well into Tranquillon Ridge will require approximately 60 to 120 days to drill and complete. Drilling duration will depend on the directional program undertaken and the mechanical condition of the hole. Actual drilling will occur within 80 to 90 percent of this total timeframe. The total drilling program is expected to last five years using one rig.

The remainder of this section provides information on the drilling rig, well construction, and drilling safety.

4.2 Drilling Rig

The current plan is to use the existing drill rig on Platform Irene to drill the Tranquillon Ridge Field. A summary of the rig specifications are shown in Table 2.

Table 2 Drill Rig Specifications

Item	Specification
Clear Working Height of Mast (feet)	170
Base Width of Mast (feet)	30
Hook Load-Gross Nominal Capacity (pounds)	1,000,000
Maximum wind load (mile per hour)	125
Motors (hp)	
• Drawworks	2 at 1,000
• Mud Pumps	2 at 1,600
• Rotary Table	1 at 1,000
• Top Drive	1 at 1,000

Given that the drilling program for Tranquillon Ridge is five years long, it is possible, due to new technology or improved rig efficiencies, that a new rig could be used to drill some of the later Tranquillon Ridge wells. If a different drilling rig is needed later in the project life, it will be transported to the platform and placed on the upper main deck (i.e., drill deck). Any future drilling rig will be electrically powered and equipped with a SCR system that will distribute power to individual rig components (e.g., drawworks, mud pumps, and rotary table). A new drill rig might require some minor modifications to the transformer capacity and electrical distribution system on the platform, but no major modifications would be anticipated for installation of a new drilling rig.

The PG&E grid will provide the electrical power that is required for the drilling operations. Additional electrical loads include operation of the drilling rig, cranes, production equipment, oil/water separators, and water injection pumps. Standby diesel generators will be used to power the rig and mud pumps during emergencies, should electrical power fail on the platform.

4.3 Well Construction

A new development well for the Tranquillon Ridge Field will be completed in the Monterey zone and will range in measured depth (MD) of approximately 15,000 to approximately 25,000 feet, depending on bottom hole displacement from the platform. The well construction discussion presented below is what is anticipated for a typical well. The exact casing/cementing design will be approved by the MMS and CSLC through the Application for Permit to Drill (APD) process required for each proposed well.

The 20-inch conductor casing will be set at approximately 800 feet below the ocean floor. Once set, the conductor casing will be cemented with a sufficient amount to cause a return of cement to the mud line or ocean floor. Measured depths of conductor casing may vary because of directional drilling programs and mechanical and borehole conditions, as well as formation pressures and fracture gradients. Installation of casings will follow MMS requirements.

The 13-3/8-inch surface casing will be set at approximately 5,000 and up to 7,500 feet measured depth. The surface casing will be cemented with a sufficient amount to cause a return of cement to the mud line. Measured depths of surface casing will vary slightly because of directional drilling programs and mechanical and borehole conditions, as well as formation pressures and fracture gradients.

The 9-5/8-inch intermediate casing will be set above the reservoir zone to be produced (i.e., Monterey) and cemented with a sufficient quantity of light cement to allow for a maximum of 3,000 feet of cement above the 9-5/8-inch casing shoe. The plan is not to bring the cement cap of the intermediate casing string above the shoe of the surface casing. Using this approach, the intermediate casing string can be cut and pulled to accommodate future redrills. The intermediate casing setting depths will range from approximately 11,000 ft to 20,500 ft measured depth, depending on the geological top of the Monterey zone. All zones which contain oil or gas will be fully protected by casing and cement.

An 8-1/2-inch hole will be drilled from below the 9-5/8” intermediate casing to total depth ranging from 15,000 ft to 25,000 feet. Electric line logs may be run from the shoe of the intermediate casing to total depth. If the zones are productive, then a 7-inch casing will be run to total depth and hung from the intermediate casing, with a minimum of 150 feet of over lap inside the intermediate casing. The 7 inch casing will be cemented in place. The hydrocarbon bearing zones across the cemented 7-inch casing will be jet perforated using tubing or wireline conveyed perforating tools.

Production tubing will be lowered near 200 feet above the 7-inch liner bottom. The 4-1/2-inch tubing string may consist of a 7-inch casing packer, gas lift mandrels, chemical injection mandrel, and surface controlled subsurface safety valve to allow delivery of hydrocarbons to the wellhead. It is possible electric submersible pumps may also be used to lift the production.

4.4 Drilling Safety

Drilling operations will be performed with “good engineering practices” using conventional drilling equipment and procedures, and will be in compliance with the current MMS and CSLC regulations. MMS and CSLC-approved drilling operations and procedures will not be altered without the prior approval of MMS and CSLC.

A blowout prevention (BOP) system will be used to shut-in the well in the event of an emergency and is designed to prevent any well fluids from entering the environment. The system is composed of an annular preventer, blind ram, two sets of pipe rams, choke and kill lines, and a diverter system. Attachment A, which is part of the supporting information document, contains a detailed description of a typical well control program.

Lifesaving and fire suppression systems are maintained on the platform at all times. Evacuation and fire drills will be held on a regular basis to ensure familiarity with the equipment and with the responsibilities of individual crew members. Drills will be coordinated with production personnel to maximize effectiveness.

The platform is equipped with Class 1 U.S. Coast Guard-approved navigational aids. All navigational components are connected to an emergency standby generator. Sufficient numbers of escape boats, PPE, and life jackets are readily accessible in the event evacuation of the platform becomes necessary.

For all phases of the drilling operation, lighting will be in place around the rig and its components (including the derrick), the cementing unit and its components, and the drill deck itself. All electrical work for the lighting will be Class 1, Division 1 or Division 2, as outlined by API Recommended Practices 500 or API Recommended Practices 505.

Crane lifts will be conducted from attendant supply and crew boats only when meteorological, oceanic, and logistical conditions allow for safe operations. All crane operators will be trained according to the API Recommended Practice 2D. The cranes will have regularly scheduled maintenance with pre-use daily, monthly, quarterly, and annual review of specific components according to manufacturer’s recommendations and as provided for in APR RP 2D. The cranes are inspected and certified annually.

The drilling or production supervisor on a regular basis—to promote safety awareness—will conduct safety meetings. These meetings will cover a wide variety of subjects relating to the current activity (e.g., cementing, well control familiarity, wireline work, etc.).

The Point Pedernales Field has an approved H_2S Contingency Plan, which will be used during the drilling program. At the request of the California State Lands Commission (CSLC), revisions to this plan were submitted to MMS and CSLC on February 7, 2005. The reader is referred to this plan for further information.

SECTION 5
PLATFORM FACILITIES

This section provides some general information on the Point Pedernales Field drilling and production platform, and a brief discussion of the oil and gas handling operations. The discussion presented below represents what may occur with the development of the Tranquillon Ridge Field.

5.1 Introduction

PXP proposed to develop the Tranquillon Ridge Field from the Point Pedernales Field platform—Platform Irene. No new offshore structures will be needed to develop the field. It is anticipated that wells will be drilled from Platform Irene using extended reach drilling (ERD) technology. Table 2 provides general information on Platform Irene. Please refer to Figure 1 for the location of the platform.

Table 3 General Data for Platform Irene

Platform Irene	
Water Depth at Platform, ft	242
Platform location	UTM Zone 10 (m) East=0708100 North=3832189
Well Slots	72
Number of Well Slots Used for the Point Pedernales Project	28
Projected Number of Well Slots Needed for the Development of the Tranquillon Ridge Field[1]	17
Projected Future Well Slots for the Point Pedernales Project	5
Well Slots Available for Future Development	22
OCS Lease	OCS-P 0441

1. Actual number of new wells will depend on results for initial production wells.

Platform Irene is located approximately six miles west of Point Pedernales, California.
The platform sits in 242 feet of water on Lease OCS-P 0441. Irene was set in April 1986.
A total of 72 well slots are contained on the platform. Oil and gas production is derived from the Point Pedernales Field.

Development drilling started in April 1987. Twenty-eight wells were drilled, with a maximum of 15 wells producing in a given month. There are presently 13 production wells in service. The year-to-date average production from Irene (through October 2007) is 7,634 barrels of oil per day, 54,930 barrels of water per day, and 6.8 million standard cubic feet of gas per day.

Production is transported via pipeline to the LOGP located north of Lompoc, California. Three pipelines in a single corridor are used: a 20-inch wet oil line, an 8-inch gas line, and an 8-inch produced water return line for disposal at the platform. The three lines reach landfall just north of the Santa Ynez River and cross Vandenberg Air Force Base and PXP fee property. Oil and gas are sold and distributed via pipelines from the plant. The majority of the produced water is injected onshore at the Lompoc Oil Field with the remaining returned to Irene for offshore injection. Power is supplied to Irene via a subsea power cable from an electrical substation located on Southern Pacific Railroad property at Surf. The substation is connected to the Pacific Gas and Electric power line north of Lompoc.

Employees are housed on the platform and transported by helicopter. An average of 3 helicopter trips (round trips) per day is allowed; however, during normal operations, there are approximately 5 flights per week. The platform has a work force of 12 employees working on shift. Equipment and supplies are supplied by work boat. During normal operations, supply boat trips average 1 to 2 trips per month. During drilling, supply boat trips can increase to a maximum of 1 trip every 3 days. Manpower requirements and boat schedule can vary depending on the workload.

The following discussion details the upgrades and minor modifications that are required on Platform Irene to integrate the development of the Tranquillon Ridge Field with the current development of the Point Pedernales Field.

Development of the Tranquillon Ridge Field will require installing new pumps on Platform Irene. The three existing 600-hp electrical shipping pumps will be replaced with three 1,250-hp electrical shipping pumps. In addition, approximately 8 of the new Tranquillon Ridge wells will utilize new 300-900 hp electrical submersible pumps. The other production wells will utilize gas-lift technology. Ongoing maintenance and upgrades of the electrical transformers and switchgear on the platform for these additional pump loads will continue.

Drilling activities and equipment will be similar to those of ongoing drilling programs, but with different frequency and duration. The existing drilling rig on Platform Irene will be used to drill the Tranquillon Ridge wells. The only additional equipment for drilling will be a new 1,600-horsepower electric pump for muds handling, as well as some refurbishing of the existing mud system. As discussed previously, it is possible, due to new technology or improved rig efficiencies, that in the future, a new drill rig could be used to drill some of the later wells in the Tranquillon Ridge Field.

During the Tranquillon Ridge drilling operations on the platform, the muds and cuttings will be batch discharged into the ocean in accordance with the current National Pollutant Discharge Elimination System (NPDES) Permit. This permit allows for discharge of muds and cuttings from the Point Pedernales drilling operations. As proposed, this effluent will be discharged at a point approximately 150 feet below mean lower low water (MLLW). Any cuttings or muds which do not meet the current NPDES permit requirements will be stored in bins and hauled to a permitted disposal site onshore, or injected if feasible. For example, if oil-based mud is used, the cuttings and excess muds will be stored in bins and transported to a permitted disposal site onshore, or injected offshore at the platform.

The existing 8-inch produced water return pipeline is currently used to return part of the Point Pedernales produced water from the LOGP to Platform Irene for offshore water injection (a part is injected onshore into the Lompoc Oil Field). For the proposed development of the Tranquillon Ridge Field, a part of the produced water will continue to be transported offshore. This water will either be discharged to the ocean under the NPDES permit or injected offshore in accordance with the MMS authorization. Approximately 40,000 bpd of water produced from Point Pedernales and Tranquillon Ridge combined will be shipped from the LOGP to Platform Irene for discharge. The operator is authorized to discharge to the ocean from the platform up to 153,000 barrels of water per day in accordance with the current NPDES Permit. A part of the produced water that will be shipped to Platform Irene may still be injected into Point Pedernales reservoir wells, as is currently the operation. Offshore water injection will be conducted as authorized by the MMS.

5.2 Platform Safety Systems

Safety systems can be broadly classified as those devices and practices that safeguard life and limb, the environment, and equipment. They relate specifically to good design practices, personnel training and operational and emergency modes. The safety features on Platform Irene include:

- Fire detection and suppression systems;
- Navigational aids;
- Corrosion control program;
- Hydrogen sulfide (H_2S) contingency plan;
- Emergency power and lighting;
- Communication facilities;
- Escape and lifesaving equipment; and
- Oil Spill Response Plan.

Each of these safety systems is briefly described below.

Fire Detection and Suppression Systems

Platform Irene is equipped with fire protection systems. This equipment includes fire and smoke/heat detectors, fire monitors, combustible gas detectors, fire alarms and alarm pulls, fire extinguishers, hose reels, and breathing apparatus systems. Foam concentrate is stored in a 300-gallon tank. Foam can be delivered to hose reels, spraying systems, and to sprinklers, which are strategically located throughout the platform. Water to the foam system can be supplied by two electrical firewater pumps or by a vertical turbine pump with a diesel engine. All three pumps use seawater. In addition, the two electrical firewater pumps can also utilize water from the 8-inch produced water return pipeline.

Because of the specifics of the offshore location, personnel are instructed to evacuate in case of any major emergency including a large fire. Survival capsules are provided for these types of emergencies.

Navigational Aids
Platform Irene has been painted in accordance with United States Coast Guard (USCG) recommendations to increase the visibility of the platform to ocean vessels. In addition, the platform is equipped with navigational lights and fog horns in accordance with Federal requirements. The USCG has also established a 500 meter exclusion zone around the platform.

Corrosion Control Program
Corrosion on the platform is controlled using corrosion-resistant coatings on the top-side structures and equipment. For the underwater portions of the jackets, a sacrificial anode system is used to control corrosion. A number of the vessels and piping on the platform have an internal coating to control corrosion. In addition, a corrosion inhibitor program is used to provide additional corrosion control.

H_2S Contingency Plans
H_2S contingency plans have been developed that detail emergency plans to be followed when encountering formations that contain H_2S while drilling. The platform is equipped with self-contained breathing apparatus for all working crews and supervisors. Spare air bottles with refill capability are also available. Releases of H_2S can also occur during production operations from accidents involving the gas wells or gas processing equipment. H_2S sensors and alarms are located at the intake for the air ventilation system, and in other process areas where concentrations of H_2S are likely to occur. In these areas, H_2S sensors have both visible and audible alarms set to activate if a concentration of 10 ppm is reached.

Emergency Power and Lighting
Emergency AC power for lighting, communications equipment, hazard detection systems, quarters, controls, and minor utility systems is provided by a battery-backup uninterruptable power supply. Battery-powered emergency lighting units are installed in several areas of the platform to illuminate critical escape or facility work areas. Battery chargers and battery systems are provided for aids to navigation, communications, general alarm systems, generator starting, electrical switchgear control, and control and monitoring systems.

Communication Facilities
Platform communication utilizes hardwired speakers and handsets. Additionally, there are hand-held portable radios for operational communication. For external communication with crew boats, supply boats, helicopters, shore bases, etc., there is a wide-area radio system for the platform, as well as a microwave system to provide telephone service and circuits for the pipeline leak detection system and onshore emergency shutdown system. In addition to the above, the platform has intrinsically safe cell phones for emergency use.

Escape and Life-Saving Equipment

The platform is equipped with USCG-approved escape capsules or life boats, plus an adequate number of life preservers, life floats, ring life buoys, first aid kits, litters, and other lifesaving appliances as required by 33 CFR144.

Oil Spill Response Plan

An Oil Spill Response Plan for Platform Irene, which describes the measures that will be taken in the event of an oil spill and the personnel and equipment available to implement spill containment and cleanup procedures, has been developed and submitted to and approved by the MMS. The basic procedure for a spill is to immediately ensure personnel safety, stop the pollutant flow, begin the containment and cleanup procedure, and contact designated company personnel and Government agencies. The platform personnel would conduct the initial response activity. For a spill beyond the capability of the platform personnel and equipment, the primary sources of assistance would be the industry-sponsored spill containment cooperative—Clean Seas.

Additional information on oil spill equipment and response can be found in the Oil Spill Response Plan that has been submitted to and approved by the MMS.

5.3 Oil and Gas Handling and Metering for the Tranquillon Ridge Field Oil and Gas

The produced oil, gas, and water will typically be separated on the platform. The oil, gas, and water volumes will be prorated back to the individual wells based on periodic well test information for each well.

The wells for the Tranquillon Ridge Field and Point Pedernales will be allocated their fair share of production based on the well test information applied to the allocation meter readings. At the LOGP the oil will pass through another meter (leak detection only), be treated and heated, and finally pass through one of two lease automatic custody transfer (LACT) meters. These LACT meters are the ones that determine the volumes of oil that are subject to royalty.

When and if development of the Tranquillon Ridge Field is approved, changes to the Measurement and Allocation Plan in effect for Point Pedernales will be needed, which would include a full description of the measurement points, allocation procedures, and products subject to royalty for the Tranquillon Ridge production streams.

SECTION 6
PIPELINE SYSTEM

There are no revisions needed to this section of the existing DPP for the Point Pedernales Field to address the proposed development of the Tranquillon Ridge Field. No new pipelines will need to be built to develop the field. The existing pipelines from Platform Irene to the LOGP will be used to move the production from the Tranquillon Ridge Field.

PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Supporting Information Volume
Geology

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Pacific OCS Region

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Geology Section

Pursuant to the Freedom of Information Act (5 U.S.C. 552) and its implementing regulations (43 CFR Part 2) and as provided in 30 CFR 550.199(b), the information contained in this section is deleted from the public information copy of this submission.

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PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Supporting Information Volume
Reservoir Evaluation

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Plains Exploration & Production Company

May 2008

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Reservoir Evaluation Section

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Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Supporting Information Volume
Cementing Program and Muds and Cuttings

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
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May 2008

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This application for revisions to the Point Pedernales Field DPP is for development of the Tranquillon Ridge Field. Tranquillon Ridge Field is geographically located within Federal and State waters approximately one and a half miles due west of the coastline at Point Arguello, offshore California. The field is east and adjacent to federal offshore tracts OCS-P 0441 and OCS-P 0444, both of which are parts of the Pt. Pedernales Unit.

1.0 Cementing Program

A cementing system will be used to force cement down the well to seal the annulus between the casing and the hole or between concentric casing strings. The cementing program details are provided in Table 1.

2.0 Mud System

A mud system is used to control well pressure, lubricate the drill pipe and bit, and return drill cuttings to the surface. It is possible that mineral oil based muds may be used for drilling the longer portions of the wells. In addition, muds containing additives not approved by the EPA, or containing concentrations above EPA limits will be taken ashore via boats. Mineral oil based muds will be collected on the platforms and sent ashore for recycling and/or disposal. Attachment B provides a more detailed description of the mud equipment. Attachment C contains the estimated mud composition for a sample well (Irene B-1).

Mud monitoring equipment will be installed and maintained for all drilling below the 20-inch diameter conductor casing, primarily for the purpose of well control. The equipment includes: sensors, which continuously record mud pit level and flowline flow; alarms at the driller’s station will indicate lost circulation displacement volume; and on-bottom kicks.

The trip tank monitors fluid gain or loss from the wellbore while the drillstring is being pulled out of the hole.

Table 1 Cementing Program Details

Casing Diameter (in)	Set Depth (ft) MD	Type	Mix Seawater or Fresh	Density (ppg)	Yield, (cft/sack)	Top of Cement[1] (feet) MD	Openhole Excess (%)	Number of Sacks	13-3/8" casing tvd 3200 ft 9-5/8" casing tvd 4077 ft 7" casing 4500 ft
20	800	Lead	Seawater	11.5	3.02	362 (mudline)	100	358	Class G + 54 ghs A-7L (liquid Calcium Chloride) + 68 ghs A-3L + 2 ghs FP-6L
20	800	Tail	Seawater	15.8	1.19	600	100	786	Class g + 5 ghs CD-31L + 40 ghs A-7L + 2 ghs FP-6L
13.375	7,500	Lead	Fresh water	11.5	2.81	362 (mudline)	50	2184	Class G + 68 ghs A-3L + 2 ghs R-8L + 2 ghs FP-6L
13.375	7,500	Tail	Fresh water	15.8	1.15	6,000	50	1414	Class G + 8 ghs CD-31L + 20 ghs FL-67L + 6 ghs R-21L + 2 ghs FP-6L
9.625	15,200	Lead	Fresh water	11.5	2.97	12,200	25	264	Class G + 68 ghs A-3L + 10 ghs R-8L + 2 ghs FP-6L
9.625	15,200	Tail	Fresh water	15.8	1.15	14,200	25	369	Class G + 22 ghs FL-67L + 6 ghs CD-31L + 3 ghs ASA-301L + 8 ghs R-21L + 2 ghs FP-6L
7	19,000	Tail	Fresh water	13.5	1.25	13,700	25	873	Texas Lightweight Cement + 7 ghs R-21L + 5 ghs CD-31L + 2 ghs ASA-301L + 2 ghs FP-6L + 20 ghs FL-67

1. *Measured from rig floor. Casing setting depths are an average based on the 22 proposed well locations.*

Nomenclature:

ghs – gallons per 100 sacks of cement
cft/sack – cubic feet per sack of cement
A-3L – liquid sodium metasilicate, extender
CD-31L – liquid cement dispersant, friction reducer
FL-33L – liquid fluid loss
FL-63L – liquid fluid loss
ppg – pounds per gallon
FP-6L – liquid foam preventer
A-7L – liquid calcium chloride, accelerator
FL-33L – liquid retarder
R-8L – liquid retarder
ASA-301L – liquid anti-setting

As is evident by the lengthy production history of the Point Pedernales Field it is not expected that any shallow gas will be encountered. However, it is possible that shallow gas could be found in the Foxen formation. Diligent efforts will be maintained to keep the wellbore full of fluid whenever possible.

3.0 Drilling Fluids and Cutting Disposal

The estimated water based cuttings and mineral oil based cuttings and drilling fluid volumes for the fourteen (14) proposed wells is provided in Figure 1. The information in this figure is based on use of an environmentally acceptable water base drilling fluid for a portion of each well and mineral oil based drilling fluids for the longer reach portions of each well. It is expected that the mineral oil based drilling fluid will be used for the 12 ¼" and 8 ½" drill hole size only. The other drill hole sizes will use water based drilling fluids. Figure 2 shows the estimated mineral oil based muds and cuttings that would be generated from each well for drilling the 12 ¼" and 8 ½" hole sizes.

Table 2 provides an estimate of the properties of the water based and mineral oil based drilling fluids that will be used for the drilling program.

Table 2 Proposed Water and Mineral Oil Based Drilling Fluid Properties

Property	26"	17 1/2"	12 1/4"	8 1/2"
MW, ppg	8.6 - 8.7	9.0 - 9.4	9.0 - 10.2	8.6 - 9.2
Visc (sec/qt)	100+	50 - 58	55 - 65	40 - 50
Fluid Loss (cc 30 min)	NC	<25	NA	NA
HTHP @ 300 F	NA	NA	6 - 8	6-8
3 RPM Reading	22	8	> 8	> 6
Solids Content	NC	<7 % LGS	< 6 % LGS	< 6 % LGS
Mud Components	Seawater Durogel Soda Ash	Gel M-I Bar Soda AsH SP101 Drilzone Lube 167	Versa-mul Versa-coat VG plus Lime CaCl2 VG Supreme M-I Bar	Versa-mul Versa-coat VG plus Lime CaCl2 VG Supreme M-I Bar

Figure 1 **Estimated Volume of Water Base and Mineral Oil Based Muds and Cuttings for Entire Well**

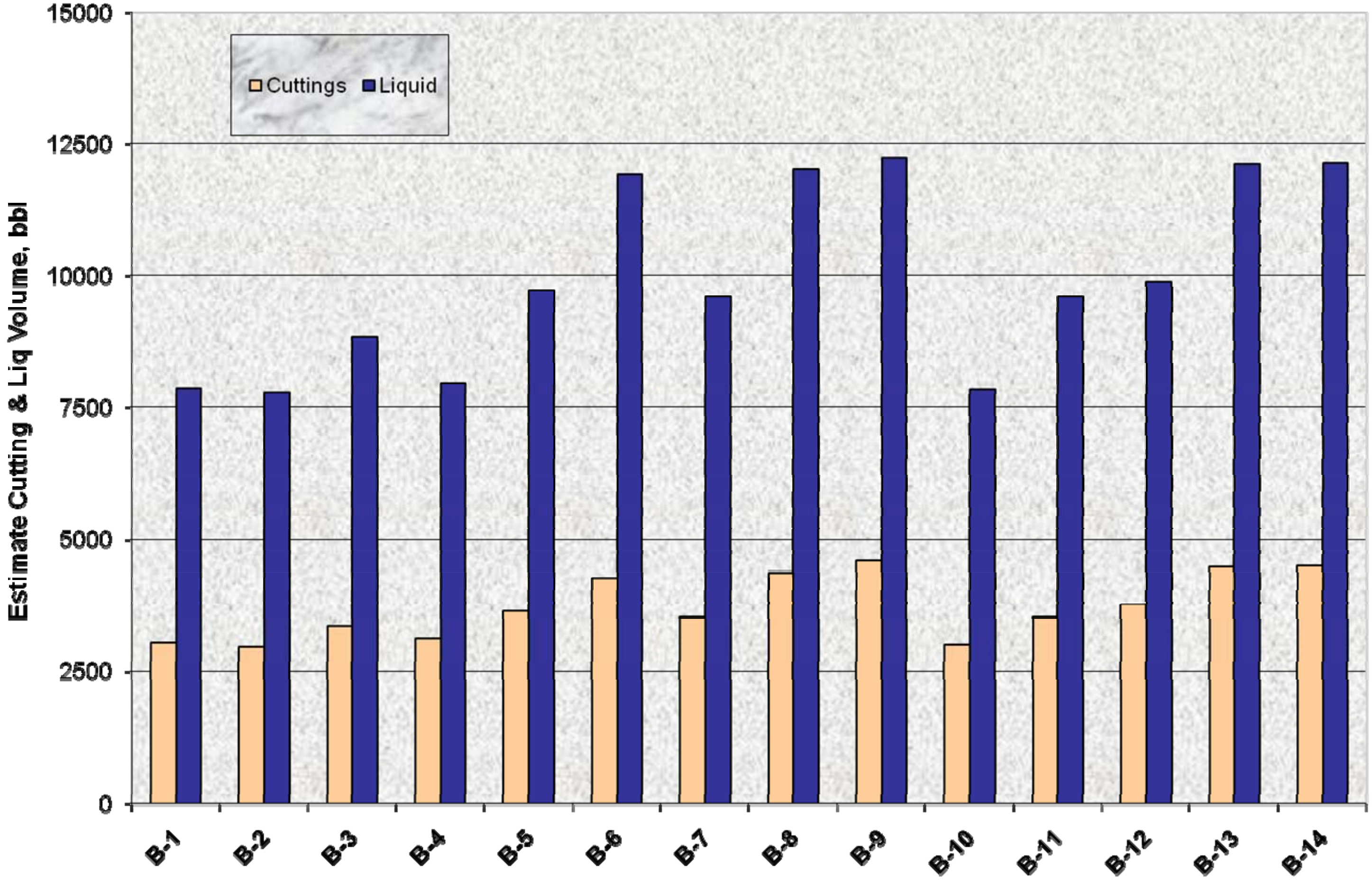
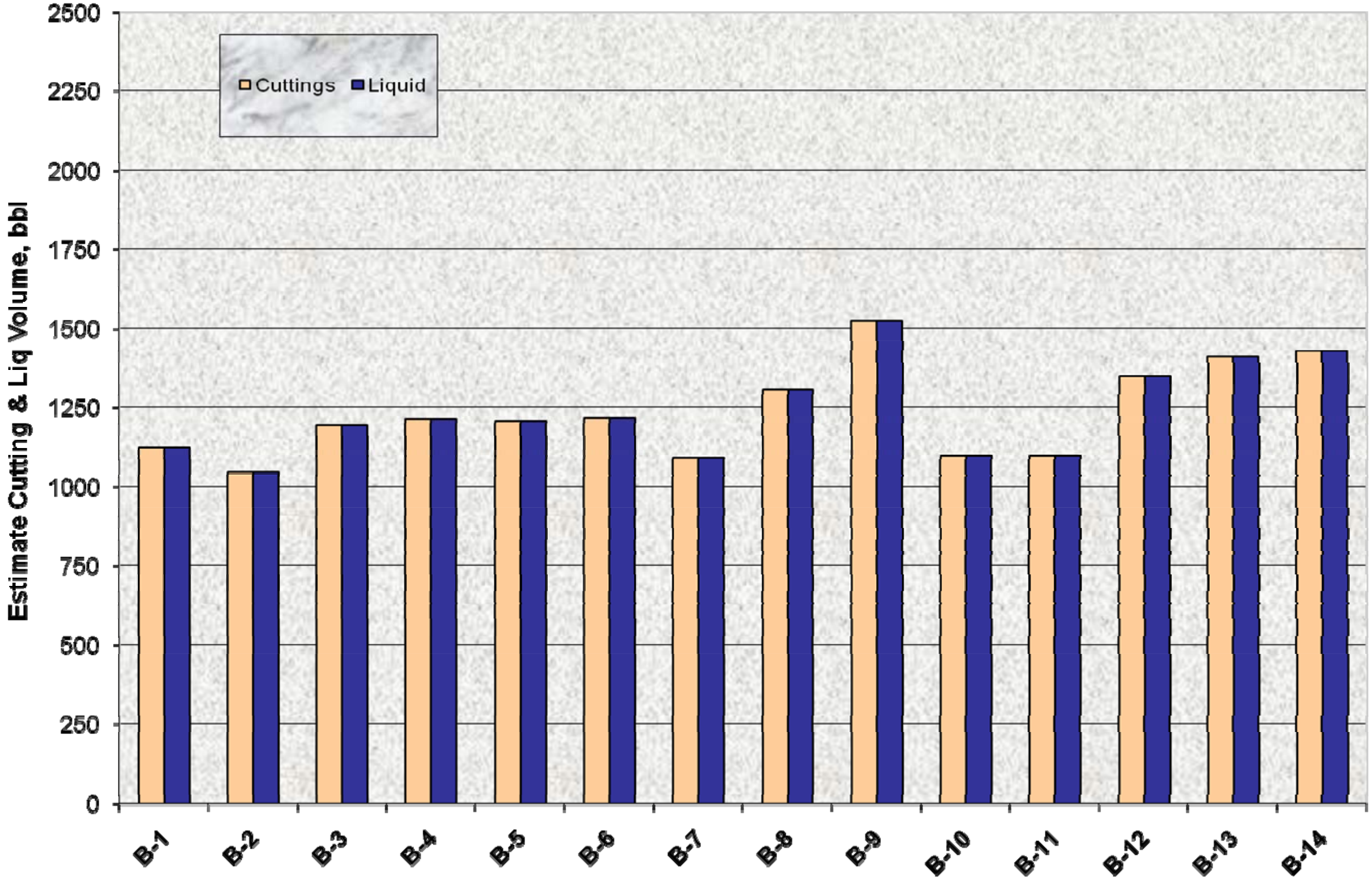


Figure 2 **Estimated Volume of Mineral Oil Based Muds and Cuttings from Drilling the 12 ¼" and 8 ½" Hole Sizes**



It has been assumed that mineral oil drilling fluids will be used to drill some of the longer portions of the wells. There will be no discharges of the mineral oil based drilling fluid or cuttings into the ocean, except as may be allowed by the EPA. The drilling fluid company typically purchases the used mineral oil drilling fluid. The cuttings spoils generated with mineral oil base drilling fluids will be disposed of at an approved onshore disposal site or facility. The cuttings will be collected in steel roll-off bins, and then transferred to shore on regularly scheduled supply boat trips. The bins that will be used offshore will be liquid tight. They will be purchased with a rubber seal installed around the door area to help prevent any liquid from leaking. These seals will be periodically checked to and replaced if needed.

In addition to the rubber seal a polyurethane resin foam material will be applied around the door seal area. Inside the bin there will be two plastic-poly bin liners to further protect against any leakage.

The roll-off bins will be taken via roll-off truck to the designated disposal site. Used drilling fluid will be emptied into Coast Guard-approved closed top tanks and sent to shore via regularly scheduled supply boats. Once on shore, vacuum trucks will transport used drilling fluids to the drilling fluid suppliers’ operations base.

Another possible option for disposal of the low toxicity mineral oil drill cuttings is injection back into the underground formation, as performed at Rocky point Filed. The typical process that is used for injection of cutting into an underground formation is described below. The cuttings are ground to a fine particle size and mixed with seawater in various ratios to obtain desired density (10.0-12.5 lb/gal) and viscosity (60-90 sec/qt funnel). In addition to slurried cuttings, typically all wash water, contaminated rain water and displacement interface fluids collected are injected along with the cuttings.

For a typical proposed well about 16,000 bbls of material will be injected into the underground formation. This would include approximately 4,500 bbls of cuttings and absorbed fluids for the mineral oil based portion of the well. About 450 bbls of interface and contaminated drilling fluid, about 7,500 bbls of seawater for building slurry, and about 3,550 bbls of wash water and contaminated deck drainage would be injected into the casing annulus.

The typical process for handling the cutting for injection is as follows. The cuttings are transported from the shale shakers, using a vacuum transfer system, into a slurry tank. The cuttings are then mixed thoroughly with water and circulated through a centrifugal shredding pump. Any particle larger than about 20 mesh equivalent is screened out over a shaker screen and returned to the slurry tank for further particle size attrition. Once the desired slurry properties are achieved, the fluid is transported into a holding tank. An injection pump is then used to inject the slurry down the casing annulus or into a dedicated cuttings disposal well on the platform. If needed, the drill rig cement unit pump can be used as a backup for the injection pump.

For each proposed well the injection of the mineral oil based cuttings would occur over a period of approximately 50 to 70 days.

PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Supporting Information Volume
Onshore Facilities

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Plains Exploration & Production Company

May 2008

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1.0 Introduction

Plains Exploration and Production, Inc. (PXP), as Operator of the Point Pedernales Field, is requesting revisions to the Development and Production Plan (DPP) for the Point Pedernales Field to develop (drilling and production operations) a California State Lease (Tranquillon Ridge Field). The proposed development of the Tranquillon Ridge Field will introduce Tranquillon Ridge production into the existing Point Pedernales facilities and production operations with minimal modifications to existing facility equipment.

The original Point Pedernales Project (94-DP-027), including Platform Irene and the Lompoc Oil and Gas Plant (LOGP) facility (formerly the Heating, Separation, and Pumping [HS&P] facility) located north of the City of Lompoc, was approved by the Santa Barbara County (SBC) Board of Supervisors in 1986. The MMS approved the federal portion of the project and the California Coastal Commission (CCC) concurred in a consistency certification in 1985/1986. The facility has operated since 1987. Gas treatment facilities were installed in 1997 that allowed for the production of sales quality natural gas at the LOGP.

This section of the document provides a general description of the onshore Point Pedernales facilities that currently exist and the modifications necessary to handle the production from the Tranquillon Ridge Field. This information is included as part of the DPP supplemental information to assist the reader in understanding the activities that occur at the Point Pedernales facilities since the production from the Tranquillon Ridge Field will use these existing facilities.

The Point Pedernales facilities include the following:

- An oil and gas drilling and production platform, Platform Irene, located on outer continental shelf Lease OCS-P 0441;
- An oil dehydration and gas processing facility located 3 miles north of the City of Lompoc, known as the Lompoc Oil and Gas Plant (hereafter LOGP);
- Three pipelines, in one corridor, connecting Platform Irene with the LOGP: a 20-inch wet oil line, an 8-inch gas line, and an 8-inch produced water return line for discharge at the platform. The pipelines reach landfall just north of the Santa Ynez River and cross Vandenberg Air Force Base (VAFB) and PXP fee property;
- A power supply system consisting of an electrical substation located on Southern Pacific Railroad property at Surf, a subsea power cable from the substation to Platform Irene, and an upgraded transmission line from the Pacific Gas and Electric power line north of Lompoc to the substation;
- A 12-inch sales gas pipeline from LOGP to Righetti Valve Box and a 6-inch sales gas pipeline from Righetti Valve Box to The Gas Company gas transmission line #1010; and,
- Three onshore produced water disposal lines, one 10-inch and two 12-inch lines, used to transport wastewater from the LOGP to the Lompoc Oil Field for injection.

The proposed Tranquillon Ridge development project will utilize the above existing facilities. Tranquillon Ridge development can fit within the existing framework of facility infrastructure at Platform Irene and the LOGP. Figure 1 shows the location of the Tranquillon Ridge Field, the Point Pedernales Facilities, and other facilities that are associated with the movement of the Point Pedernales oil and gas from the LOGP.

Currently, the Point Pedernales Project is permitted to operate under the following SBC Final Development Plan (FDP) production/processing capacities: 36,000 barrels per day (BPD) of dry oil; 15 million standard cubic feet per day (MMSCFD) of natural gas with a maximum hydrogen sulfide (H2S) concentration level of 8,000 parts per million (ppm); 9.205 MMSCFD of onshore gas reinjection (only during upset conditions); and a monthly average of 2.3 liquefied petroleum gas/natural gas liquids (LPG/NGL) truck trips per day.

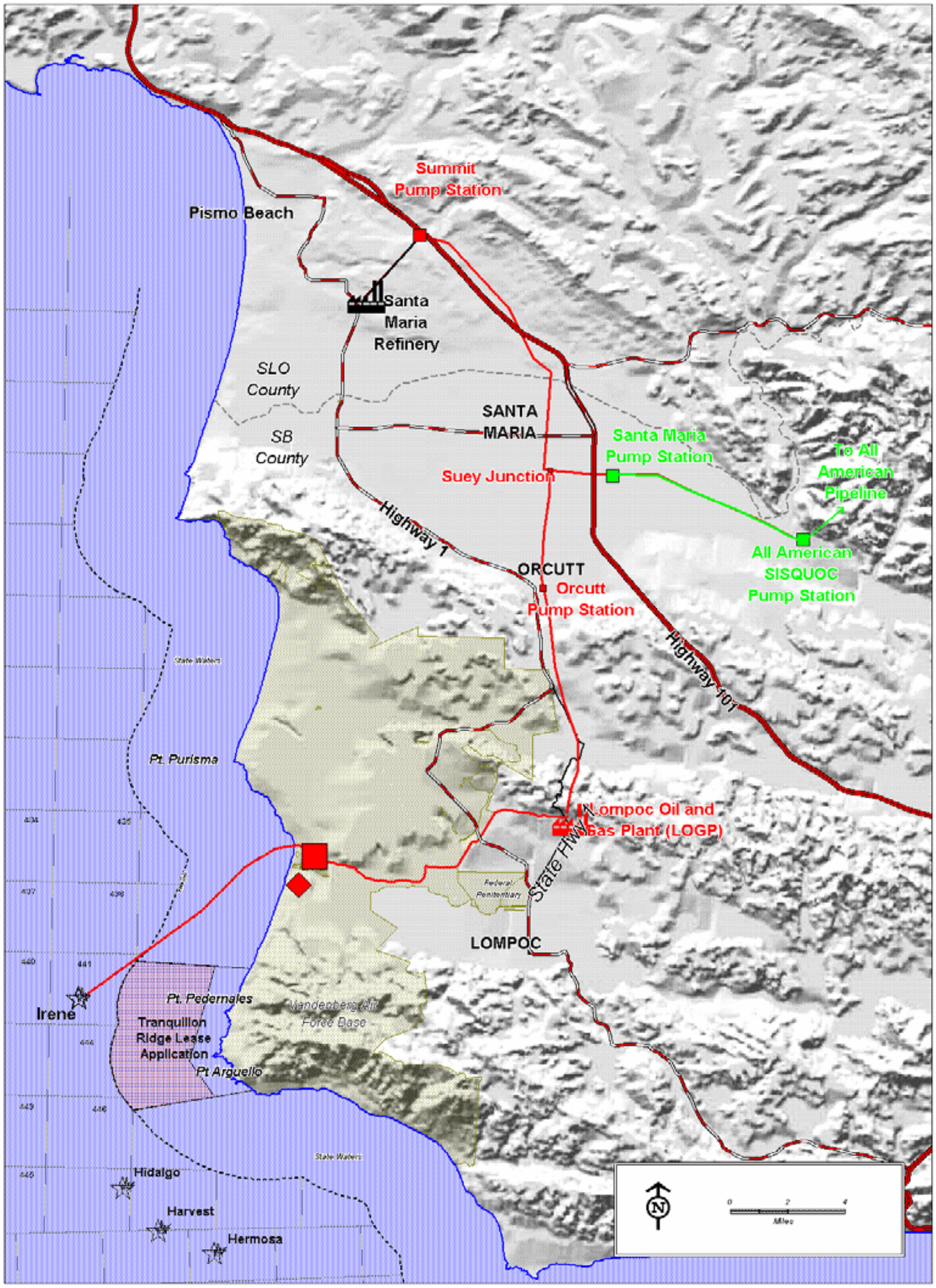
Current Point Pedernales operations include drilling and production at Platform Irene, transportation of production via pipeline from offshore to onshore, oil dehydration and gas processing at the LOGP, and shipment of product for sale or further processing by pipeline or LPG trucks.

The produced liquid from Platform Irene is a combination of crude oil, gas, and water. The gas exists as free gas or is in solution in the oil, and the water exists both as free water and emulsion in the oil. The liquid stream is transferred to the LOGP through the 20-inch emulsion pipeline. The primary function of the LOGP is to lower the basic sediment and water content of the oil stream to less than three percent (known as dehydration) so the oil can be shipped and processed at a refinery and to compress, sweeten (remove the carbon dioxide (CO_2) and hydrogen sulfide [H_2S]), dehydrate and process the associated gas streams for sale and use at the LOGP.

Process operations at the LOGP include oil dehydration, produced water treatment, and shipment for reinjection offshore at Platform Irene and onshore into the Lompoc Oil Field, oil reclamation, oil storage, oil shipment, gas compression, gas reinjection, gas sweetening, gas dehydration, gas sales, LPG/NGL stabilization and storage, LPG/NGL and sulfur truck loading, and NGL/crude oil blending. The oil dehydration system is used to dehydrate a current average of 60,000 to 65,000 barrels per day of oil emulsion. The produced oil is characterized as heavy oil (16 degree American Petroleum Institute [API] gravity).

The Point Pedernales Project currently includes three subsea and buried pipelines between Platform Irene and the LOGP. The total pipeline route is 22.2 miles long with approximately 12.1 miles located onshore. The pipelines include one 20-inch diameter wet crude oil line, one 8-inch produced water return line, and one 8-inch produced gas line.

Figure 1 Location of the Tranquillon Ridge Field and Associated Point Pedernales Facilities



There are ten valve sites located on the oil pipeline, and four valve sites located on the water return and gas pipelines. Nine of the valve sites are located in underground vaults.

Valve Site #2 is an aboveground facility located on VAFB and is approximately 100 feet by 100 feet and fenced. Valve Site #2 has two block valves on each of the three pipelines.

Current pipeline operations include performing ongoing routine internal and external pipeline surveys. Pipeline surveys include, but are not limited to, smart pigging, corrosion checks, pressure tests, air and ground patrols, visual surveys using a video camera, and cathodic protection surveys. These periodic internal and external pipeline inspections are performed on a schedule specified by MMS, SBC, and Santa Barbara County Air Pollution Control District (SBCAPCD) permits. These inspections also satisfy the requirements of the Department of Transportation (DOT) and the California State Fire Marshal for the onshore portions of the pipelines.

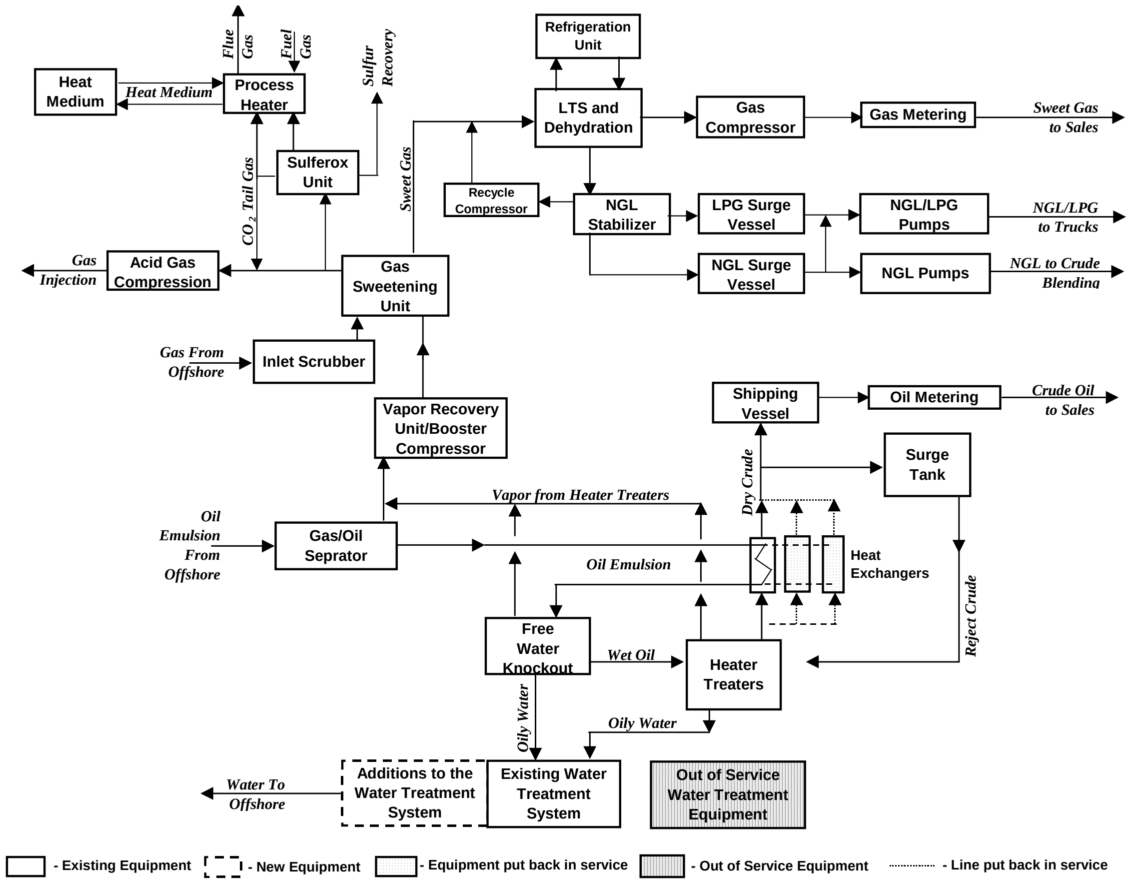
2.0 Onshore Oil Handling

2.1 Lompoc Oil and Gas Plant (LOGP)

Platform Irene ships its entire produced product to the LOGP. The LOGP is monitored through the August System Programmable Logic Controller (PLC) system. The control system is operated from the control room, which is manned 24 hours per day. The operator monitors operating pressures, levels, temperatures, flows, and other operating conditions. The LOGP is equipped with emergency alarms and equipment including hydrocarbon gas and hydrogen sulfide detectors, infrared fire detectors, fire hydrants, fire water line, fire monitors, foam capabilities, and other safety equipment. PXP maintains offshore and onshore spill response plans (the Point Pedernales LOGP Oil Spill Contingency Plan, Point Pedernales 20-inch Wet Oil Pipeline Spill Contingency Plan, Platform Irene Oil Spill Response Plan and the Point Pedernales Onshore Emergency Response Plan). The oil dehydration facility has operated since 1987, and the gas plant began operation in September 1997.

The LOGP receives oil/water emulsion and sour gas from Platform Irene and sour gas from the Lompoc Oil Field. Process operations at the LOGP include oil dehydration, produced water treatment, produced water injection offshore and onshore into the Lompoc Oil Field, oil reclamation, oil storage, oil shipment, gas compression, gas reinjection, gas sweetening, gas dehydration, LPG/NGL stabilization and storage, LPG/NGL truck loading, and NGL/crude oil blending. Figure 2 shows a simplified process flow diagram of the LOGP.

Figure 2 LOGP Block Flow Diagram



The existing oil processing and storage equipment at the LOGP includes heat exchangers, separators, free water knockout vessel, three heater treaters, SO_2 minimization scrubber, flare system, pressurized shipping vessel, wash tank, reject tanks, reclaimed oil storage tank, surge tank, vapor recovery system, gas compressors, and other miscellaneous pumps and equipment. Once the oil is dehydrated, it is sold to ConocoPhillips and shipped by pipeline from the LOGP to the Orcutt Pump Station and then to the Santa Maria Refinery, in San Luis Obispo County, for further processing.

Point Pedernales treated oil is shipped from the LOGP to Santa Maria Refinery by a system of pipelines known as the UNOCAP network, also known as Line 300, which is owned by ConocoPhillips. The oil from LOGP is transported northward through a 12-inch pipeline to the Orcutt Pump Station where it commingles with oil form the Orcutt area. It then flows northward through an 8-inch pipeline to Suey Junction where it commingles with oil from the Sisquoc and Santa Maria Pump Stations. The combined stream then flows northward through a combination 10-inch and 12-inch pipeline to the Summit Pump Station. There is also an 8-inch pipeline which roughly parallels the 10/12-inch pipeline from Suey Junction to Summit. This pipeline is currently idle; however ConocoPhillips is preparing to resubmit an application to use this line for emergency purposes. From Summit, the oil flows westward to the Santa Maria Refinery through a 12-inch pipeline. These facilities are discussed in detail in the Tosco Sisquoc SEIR (2001).

2.2 Modifications to Lompoc Oil and Gas Plant (LOGP)

The following minor modifications at the LOGP will be required in order to handle production from development of the Tranquillon Ridge Field.

It may be necessary to heat the water and oil emulsion to aid in separation. If this is necessary, then PXP will return to service two existing plate and frame heat exchangers and install piping for the heat medium with the existing heater treater water outlets. All of this existing equipment is fully permitted and offset. In addition, PXP will install a new duplex feed strainer on the 20-inch pipeline inlet between the first and second plate and frame heat exchangers. One of the reasons the existing plate and frame heat exchangers are currently out of service is fouling from solid material in the emulsion stream.

The installation of a feed strainer will facilitate the removal of solids, extend the time between cleaning, and maintain the efficiency of the exchangers. The duplex design will allow cleaning of one strainer while the other is online.

Other modifications include: installing internal coalescing assemblies inside the existing free-water knockout vessel and insulating its exterior; and, installing internal coalescing assemblies and four externally adjustable baffles on the three existing heater treaters. Installing baffles in the existing free water knockout and heater treaters will expand their emulsion breaking capacity. They will also aid in the water clarification process.

Insulating the free water knockout will aid in heat retention and reduce the fuel consumption in the heater treaters.

Due to the increased use of the heater treaters for heating of the crude oil, natural gas consumption could increase by 100%. Electricity consumption at the LOGP could increase by approximately 30% due to the increased operations of the existing equipment. Increases in maintenance and service of the new equipment will not require additional new employees.

Currently there are 2.9 LPG/NGL truck trips per week (year 2000 annual average). It is expected that the Tranquillon Ridge project will generate up to two additional trips per week. All LOGP upgrades and modifications will occur within the existing boundaries of the facility. No new grading will be required. No new lighting will be required at the LOGP. Table 1 summarizes all the changes to the LOGP facility that will occur with development of the Tranquillon Ridge Field.

Table 1 Summary of Changes to the LOGP with Development of the Tranquillon Ridge Field

Changes with Project	During Normal Operations
Additional Employees	None
Additional LPG/NGL Truck trips	Approximately 2 per week (to a total of 5 per week[a])
Additional Equipment or Equipment Modifications	1) Return to service of two heat exchangers. 2) Addition of duplex feed strainer. 3) Addition of internal coalescing assemblies inside the existing free-water knockout vessel and insulation of its exterior. 4) Addition of internal coalescing assemblies and four (4) externally adjustable baffles on the three existing heater treaters.
Additional Maintenance	To be handled by the current employees.
Additional Electrical Power Requirement	30%[b]
Water Disposal Onshore	No increase

hp – horse power.
a. Based on the ratio of oil that could be generated to currently being produced.
b. The increase is due to increased operations due to production from Tranquillon Ridge.

2.3 Oil Emulsion Pipeline

The oil emulsion pipeline, or the wet crude pipeline, between Platform Irene and the LOGP has a 20-inch outer diameter (OD) with a Maximum Allowable Operating Pressure (MAOP) of 1,194 pounds per square inch (psig).

Wall thickness of the pipeline is 0.625 inches onshore, 0.688 inches offshore. The steel grade is API 5L-X52 electric resistance welded (ERW) onshore and API 5L-X46 ERW offshore. The entire length of the pipeline is coated with PRITEC 70/15 (70 millimeters polyethylene, 15 millimeters butyl adhesive). The average age of the pipeline is approximately 14 years, which includes sections replaced due to corrosion. The pipeline currently operates at a discharge temperature of 185°F.

Approximately once every 2 weeks, the 20-inch oil pipeline is batch pigged with 400 gallons of corrosion inhibitor and 400 gallons of diesel. The corrosion pill is followed by a wiper pig. Corrosion inhibitor chemical is also injected continuously. Oil residuals are frequently analyzed for metal deposits and chemical residuals. Corrosion coupons are pulled every six months at the LOGP and Platform Irene. There is a flush mounted coupon probe at Valve Site #2 for continuous corrosion monitoring of the oil pipeline, where Beta foil records corrosion potential on the pipeline.

PXP conducted a comprehensive study on the life expectancy of the Point Pedernales pipelines. The study was presented to and accepted by Santa Barbara County and their consulting engineer. It evaluated corrosion monitoring, control programs and maintenance programs. The findings of the study showed that the pipelines have an expected life, assuming no human interventions for repairs, of greater than 200 years. The investigation concluded the present program for corrosion control and monitoring has demonstrated effectiveness in controlling the corrosion penetration rate to less than 0.239 mils per year (mpy) for the oil line and 0.23 for the 8” water line and gas line for 2003 and 2004. This is better than industry standards.

The .239 mpy average gives a life expectancy, without pipeline repair or replacement of greater than 200 years for both the onshore and offshore segments of the 20” oil pipeline. The same parameters applied to the 8” water pipeline give a life expectancy of greater than 200 years for both the onshore and offshore segment.

PXP has expanded the corrosion control program and will ensure that the pipelines are maintained within acceptable corrosion penetration rates through their monitoring, corrosion inhibition and cleaning programs. In addition, periodic pipeline integrity reviews including Santa Barbara County and their consulting engineer, have been established to ensure the program is being followed.

The 20-inch crude pipeline is equipped with alarms and controls that allow operation of the equipment and protection during upset conditions. The pipeline is equipped with a shutdown valve at both the inlet and outlet. The inlet shutdown valve (SDV), SDV-171, is located at the outlet of the shipping tank prior to the pig launcher on Platform Irene. SDV-171 is actuated by the platform Emergency Shut Down (ESD) as well as interlocks on the pressure transmitter (PT), PT-171, located directly downstream of the SDV-171.

Outlet shutdown valve, SDV-40, provides automatic protection and isolation at the pipeline outlet at the LOGP facility upstream of the gas-oil separation vessel. SDV-40 is actuated manually by the “Oil Process Stop” button, and automatically by the LOGP facility ESD as well as by a number of pressure and level transmitters. Additional information on the pipeline pressure and level transmitters can be found in the Emergency Response Manual. The onshore portions of the pipelines are protected from external corrosion by a rectifier and deep-well anode bed that is installed adjacent to

Valve Site #8. Test stations are installed at one-mile intervals to monitor the performance of the system. Insulating joints have also been installed at the beach, and at the LOGP facility on each of the pipelines.

The pipeline is equipped with a leak detection system. This system is used to detect leaks when the pipeline is operating. The major component of the leak detection system is the supervisory control and data acquisition system (SCADA), which is used to monitor various operating parameters of the pipeline such as flowrates and pressures. The SCADA system collects the data, processes the data, and provides the inputs to the system alarms and automatic shutdowns. Through the remainder of the document, SCADA and leak detection system are used interchangeably.

The oil/water emulsion is metered at Platform Irene prior to shipment via the 20-inch pipeline and as received at the LOGP facility. Flow meters are located adjacent to the shut-down valves. The signal from the LOGP flow meter is transmitted to the control room where it is compared with the flow meter reading from the platform. Should the total fluid production fall outside the following limits, an alarm will sound at Platform Irene indicating a potential pipeline leak.

- 6% – more than 15 minutes or 62 barrels (based on 100,000 bpd)
- 4.5% – more than 2 hours or 375 barrels (based on 100,000 bpd)

In the event of a large release from the oil pipeline Motor Operated Valves (MOV) would close along the pipeline within a few minutes after the operator initiates the appropriate shutdown of the pipeline. The locations of MOV are addressed in the following sections. Smaller leaks would also be detected but would take a longer time depending on the size of the leak. To aid prompt leak detection, PXP conducts pipeline overflights and ROW inspections at least twice per week.

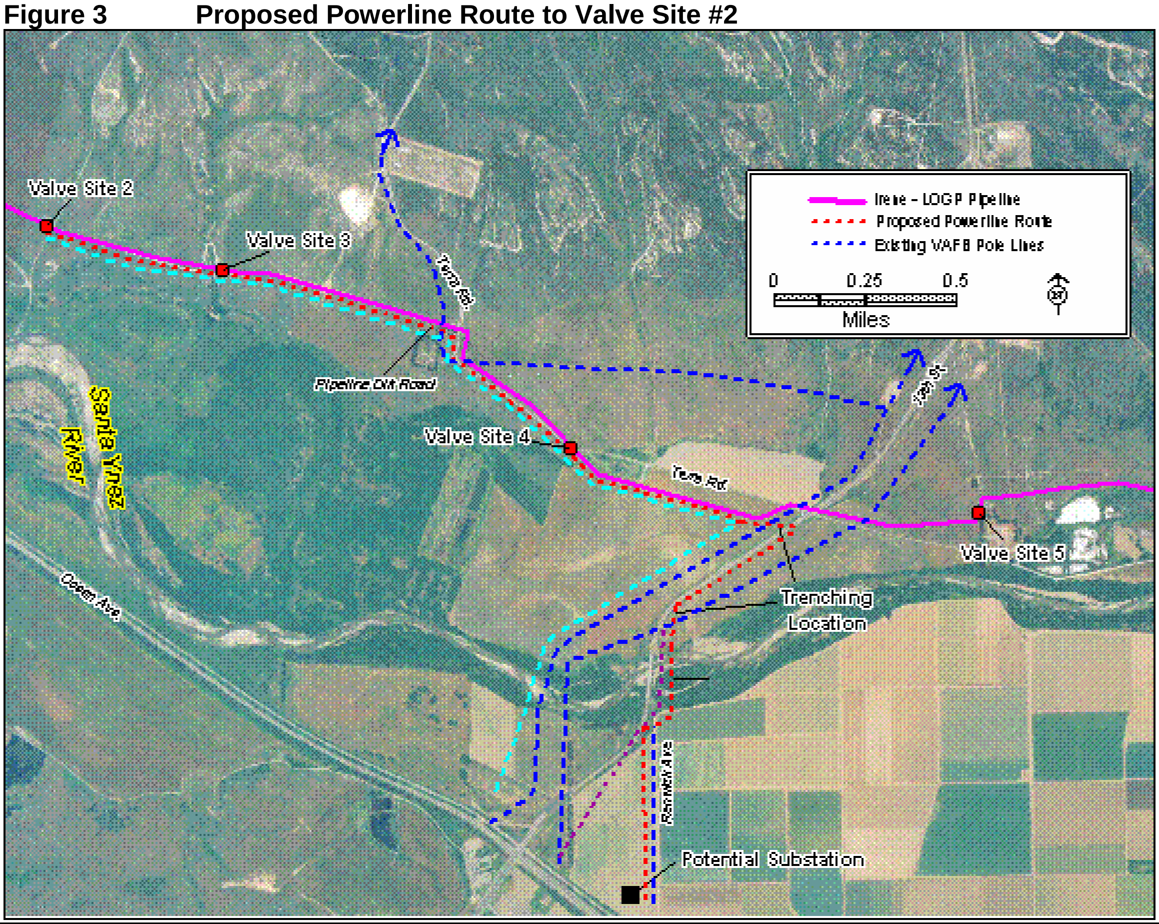
2.4 Modifications to Oil Emulsion Pipeline

The Tranquillon Ridge development project includes the possible installation of crude oil booster pumps and upgrades to the electrical equipment at Valve Site #2. No other modifications are proposed for the Platform Irene to LOGP pipelines. Monitoring of the pipelines will continue, and sections of existing pipe will be replaced with new pipe, as required, to maintain a sufficient MAOP in order to continue operation of the Point Pedernales Project with the Tranquillon Ridge project. Only minor changes in normal operations would be necessary as a result of the production from the Tranquillon Ridge Field.

The expected volume of oil/water emulsion produced by Point Pedernales and Tranquillon Ridge combined is 90,000 bpd. Currently, the pressure rating on the 20-inch emulsion pipeline from Platform Irene to the LOGP is sufficient for the expected operation. However, during the course of Tranquillon Ridge project, if the MAOP of the 20-inch pipeline needs to be lowered (i.e., the pipeline derated to less than 1,000 psig), then operation at the pressures needed to transport 90,000 bpd of emulsion would not be possible. In this case, three new 1,250-horsepower, electric booster pumps would be installed at Valve Site #2 in order to minimize the operating pressure of the offshore pipeline segment of the 20-inch oil pipeline. Two pumps will be operated with the third pump on standby. Apart from the power lines, all equipment modifications will be accommodated within the existing footprint of Valve Site #2 and will be integrated into the existing safety systems at the LOGP.

If the booster pumps are installed, the existing electrical system will be upgraded at Valve Site #2. Upgrading the system will consist of installing a new power line. Power is proposed to be supplied from one of two locations. The first choice is to supply power from the 115 kilovolt (kV) line that exists along Renwick Avenue in Lompoc. In this case, a substation will need to be constructed to step power down from 115 kV to 34.5 kV. The substation will be placed in the farm field on the northwest corner of Renwick and Ocean Avenues. The new power line poles will be installed along Renwick Avenue in the northerly direction. The second choice is to supply power from the existing 12 kV power line. There will be no need for the substation and the power line could be placed on the existing poles along Renwick Avenue. Figure 3 shows the route of the proposed powerline to Valve Site #2.

Figure 3 Proposed Powerline Route to Valve Site #2



At the northern end of Renwick Avenue the line will need to cross Santa Ynez River. The power line will cross the Santa Ynez River on a new set of poles that will be installed on both sides of the river. After crossing the river and crossing under the VAFB power line via trenching, the new power line will run along 13th Street on the east side, until the intersection with Terra Road. Once at Terra Road, the new power line will be run under 13th Street and under another VAFB power line that follows 13th Street in this location. This crossing will be done via trenching. After the power line emerges on the west side of 13th Street, it will follow Terra Road and the right of way of the Platform Irene to the LOGP pipeline route until it reaches the Valve Site #2.

For the portion of the route along Terra Road, the power line will be placed on new poles. The average height of power poles will be 60 feet and the average span between the poles will be 350 to 400 feet depending on the terrain. Installation of the power poles will require minimal grading and clearing around each installed pole as required by the fire department. Table 2 summarizes the changes to the Point Pedernales pipelines and associated facilities.

Table 2 Summary of Changes to Valve Site #2 with Development of the Tranquillon Ridge Field[a]

Changes with Tranquillon Project	During Normal Operations
Additional Equipment	1) Three 1,250 hp electrical booster pumps on 20-inch oil pipeline with an additional transformer and required switchgear. 2) New power-lines with power poles, and possibly a new substation.
Additional Maintenance	One personnel month per year for maintenance to pump station equipment.

a. These changes will only be necessary if the 20-inch emulsion pipeline MAOP is derated.

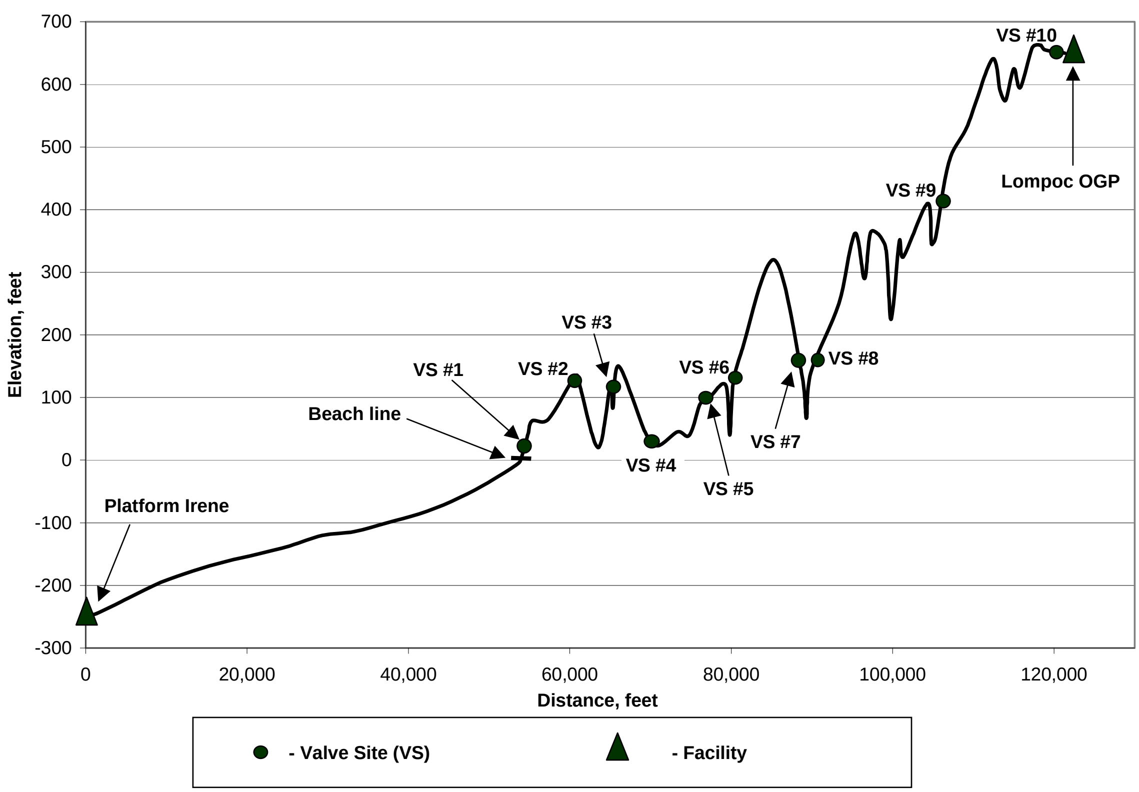
The proposed oil pipeline operating pressure profile is based on an anticipated emulsion volume of approximately 90,000 barrels per day with a water cut rate of approximately 70%. The discharge operating pressure of the pumps on Platform Irene will be approximately 750 psig to 1,000 psig. The inlet receiving pressure at the LOGP will be approximately 140 psig.

The installation and operation of the booster pumps at Valve Site #2 may only be necessary if the offshore segment of the oil pipeline is derated below the current 1,000 psig. The use of the booster pumps at Valve Site #2 will provide flexibility for the continued operation of the oil pipeline with a decrease in operating pressure for the offshore segment.

With operation of the booster pumps at Valve Site #2, the discharge operating pressure of the pumps on Platform Irene will be approximately 200 to 400 psig. The suction pressure of the booster pumps at Valve Site #2 will be approximately 150 psig. The discharge pressure of the booster pumps at Valve Site #2 will be approximately 600 psig. The inlet receiving pressure at the LOGP will be approximately 140 psig.

With inclusion of the booster pumps at Valve Site #2, there will be a decrease in the shipping pump pressure at Platform Irene. The elevation differential between Platform Irene and Valve Site #2 is only 85 feet and the distance is 61,000 feet. However the elevation differential between Valve Site #2 and the LOGP is 528 feet while the distance is only 58,000 feet. Therefore, the discharge pressure of the booster pumps at Valve Site #2 is much higher than the discharge pressure of the shipping pumps at Irene, even though Valve Site #2 is approximately at the midpoint between Platform Irene and the LOGP. Figure 4 shows the elevation profile for the 20-inch oil emulsion pipeline.

Figure 4 Platform Irene to LOGP 20-inch Oil Emulsion Pipeline Elevation Profile



3.0 Onshore Gas Handling

3.1 Lompoc Oil and Gas Plant (LOGP)

The majority of the produced gas is separated from oil/water emulsion at Platform Irene and is shipped to LOGP via an 8-inch pipeline. The LOGP also receives produced gas from the Lompoc Field; this gas is shipped from the field via a separate 6-inch gas pipeline. At the LOGP, gas that remained dissolved in the oil/water emulsion is further separated from the emulsion. The vapor recovery system collects vapors from all the tanks, including the heater treaters and other miscellaneous vessels. Gas delivered by the two gas pipelines, gases collected by the vapor recovery system, and the solution gas separated from the emulsion are combined and compressed to the inlet of the gas sweetening and processing equipment.

A portion of the produced gas from Platform Irene, which is not in solution in the liquid stream, is separated from the liquid and is transported to the inlet of the LOGP gas sweetening and processing equipment through an 8-inch pipeline. Prior to being transported to the LOGP, the produced gas is dehydrated offshore.

Gas generated within the LOGP comes from two sources. One source is the solution gas separated from the emulsion, and the other from the vapor recovery system. The vapor recovery system collects vapors from all the tanks. Gases collected by the vapor recovery system and the solution gas separated from the emulsion are combined and compressed to the inlet of the gas sweetening and processing equipment.

The existing gas sweetening and processing equipment at the LOGP consists of an amine gas sweetening skid with an associated acid gas handling (Sulferox) system, a low temperature separation (LTS) skid, LPG/NGL stabilization skid and storage, LPG truck loading, and NGL/crude oil blending.

The H_2S removed from the combined inlet gas streams is reduced to mostly elemental sulfur in the associated Sulferox unit. The recovered sulfur is trucked from the LOGP. The sweetened gas then flows into the LTS skid where it is dehydrated and the NGL/LPG is removed. The raw NGL formed during this process then flows to the LPG/NGL stabilization skid. LPG gas comes off the top of the stabilizer column and is condensed and stored for transported to other facilities for further fractionation. The LPG gas has never been used at the LOGP for fuel. The stabilized NGL liquids flow to the NGL surge tank for blending into dry crude oil to the maximum extent feasible. The processed “sweet” natural gas is sold and shipped by pipeline and/or used as fuel at the LOGP.

3.2 Produced Gas Pipeline

The gas separated from emulsion and dehydrated at Platform Irene is shipped to LOGP via an 8-inch pipeline. The gas pipeline is an 8.625-inch OD pipe with a wall thickness of 0.312 inch onshore and 0.438 inch offshore. The pipe is made of steel grade API 5L-X42 ERW onshore and API 5L-Grade B ERW offshore. The entire length of the gas pipeline is also coated with PRITEC 70/15 (70 mm polyethylene, 15mm butyl adhesive). The gas pipeline operates at 80°F and with a MAOP of 730 psig.

The onshore section of the pipelines is covered to a depth of at least 36 inches. Four valve sites are located along the onshore portion. MOVs are located at Valve Sites #1, 2, 8, and 10 (see Attachment A). These valves can be operated manually or remotely from the LOGP. The gas pipeline is equipped with an SDV at the inlet (Platform Irene, SDV-401) and outlet (LOGP, SDV-100). The inlet SDV is actuated by the platform ESD as well as interlocks on PT-401, located on the platform downstream of SDV-401.

The pipeline pressure, valve positions, and shutdown signals are displayed in the control room on the platform. The pipeline is also equipped with a dew point analyzer, which is used to help prevent liquids from forming in the pipeline thereby reducing corrosion.

SDV-100 provides isolation at the LOGP. SDV-100 is actuated manually by the “Gas Stop” button as well as by the LOGP ESD procedure. The LOGP isolation valve (SDV-100) will automatically close based on signals from a number of pressure transmitters located throughout the plant. Additional information on the isolation system can be found in the Emergency Response Plan and Pipeline Operations Manual.

Co-located H_2S sensors have been installed along the gas pipeline in the following locations: (a) at the pipeline’s crossing of Highway 1, (b) upwind of Cabrillo High School, and (c) upwind of the north/northeast boundaries of Vandenberg Village. When any pair of the co-located sensors detects 40 ppm of H_2S, the pipeline would normally be shutdown at the inlet (Platform Irene) and the situation investigated.

The onshore pipeline is cathodically protected in the same manner as the oil pipeline and has the same monitoring programs as the oil emulsion pipeline.

3.3 Sales Gas Pipeline

Sales gas is shipped from the LOGP through a 12-inch sales gas pipeline to the Righetti valve site. The length of this line is approximately 6.5 miles with operating pressure ranges from 800 to 1,000 psig. The 12-inch sales gas line is API 5L-Grade B ERW pipe with 0.375-inch wall thickness. Sales gas is then shipped through a 6-inch sales gas pipeline from Righetti valve site to The Gas Company gas transmission line # 1010. The Righetti valve site is located approximately 1.3 miles northeast of the intersection of Highway 1 and Highway 135.

4.0 Onshore Water Handling

4.1 Lompoc Oil and Gas Plant (LOGP)

The existing water treatment equipment at the LOGP consists of the Wemco flotation cell (currently out of service), wash tank, clean water tanks, and injection pumps. After treatment through this system, the water is shipped via the 8-inch produced water return line to Platform Irene for offshore injection and shipped via onshore produced water disposal lines (one 10-inch and two 12-inch lines) to the Lompoc Oil Field for onshore injection.

At the LOGP, water that has been removed from the gross fluid stream is treated with emulsion breaking chemicals to separate the trace oil, which is contained in the water. This oil is collected and sent to the reclaim oil tank for treatment. After the water is treated to recover the hydrocarbon liquids, the treated water is reinjected into the Lompoc Oil Field and shipped out to Platform Irene via the water pipeline for reinjection.

Currently, 15,000 to 20,000 b/d of produced water is being injected at Platform Irene and 35,000 to 40,000 b/d of Point Pedernales produced water is being injected at the Lompoc Oil Field.

Another outlet for Point Pedernales produced water is offshore disposal. Prior to 1991, LOGP produced water was shipped to Platform Irene for discharge offshore. PXP retains a valid National Pollutant Discharge Elimination System (NPDES) permit authorizing discharge of produced water offshore from Platform Irene.

4.2 Water Return Pipeline

The MAOP of the water return pipeline is 1,311 psig. The water pipeline pressure at the LOGP is 300 psig and the water pipeline outlet at Platform Irene is approximately 500 psig. Repairs on the 8-inch water line were conducted in Fall of 2001 to address corrosion discovered during annual surveys. The water pipeline does not have a SCADA leak detection system.

The water pipeline is 8.625-inch OD with a wall thickness of 0.312 inch onshore and 0.438 inch offshore. The pipe is made of steel grade API 5L-X42 ERW onshore and API 5L-Grade B ERW offshore. The entire length of the water pipeline is also coated with PRITEC 70/15 (70 millimeters [mm] polyethylene, 15 mm butyl adhesive). The age of the pipe is approximately 14 years. The water pipeline operates at 125°F.

The corrosion program for the 8-inch water pipeline includes the following activities:

- Continuous injection of corrosion inhibitor;
- Pigging three times per week;
- Annual smart pigging evaluations;
- Taking residual readings frequently for detection of chemical and metal deposits; and
- Pulling corrosion coupons every 6 months.

There are no anticipated changes to the corrosion control program, however, the frequency of the maintenance pigging may increase or decrease based on pipeline parameters. If, for example, the pipeline smart pigging demonstrates increased corrosion rates, then pigging would occur more frequently.

The 8-inch return water pipeline has four MOVs at Valve Sites #1, 2, 8, and 10, which can be operated locally or remotely from the LOGP. Position indication of the valves is transmitted to the August Systems' controller at the LOGP facility.

The 8-inch water pipeline is equipped with alarms and controls to provide for operation of the equipment and protection during upset conditions. The pipeline is equipped with a shutdown valve at both the inlet and outlet. Inlet shutdown valve SDV-400 is located at the outlet of the clean water tank at the LOGP facility before the shipping pumps. SDV-

400 responds solely to level controls on the clean water tank and the LOGP facility ESD. The valve position is displayed in the control room at the LOGP facility.

Inlet shutdown valve SDV-612 provides automatic protection and isolation on the pipeline on Platform Irene. SDV-612 is actuated by platform ESD as well as the high/low pressure switch, PSHL-612, located downstream of the SDV. The pressure, SDV position and shutdown signals are displayed in the control room on the platform.

PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Environmental Evaluation

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Plains Exploration & Production Company

May 2008

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List of Abbreviations and Acronyms

ADT	Average Daily Traffic
AADT	Annual Average Daily Trips
AADT	Annual Average Daily Traffic
AAPL	All American Pipeline
AFY	acre-feet/year
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATC	Authority to Construct
AQAP	Air Quality Attainment Plan
Bbls	Barrels
BMP	best management practices
Bod	biological oxygen demand
bpd	barrels per day
BTEX	benzene, toluene, ethylbenzene and xylenes
CAAQS	California Air Quality Standards
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CaMP	California Monitoring Program
CAMP	California Offshore Monitoring Program
CAP	Clean Air Plan
CARB	California Air Response Board
CCAA	California Clean Air Act
CCC	California Coastal Commission
CCCCS	Central California Coastal Circulation Study
CCIC	Central Coastal Information Center
CCMP	California Coastal Management Program
CCPS	Center for Chemical Process Safety
CDFG	California Department of Fish and Game
CDMG	California Division of Mines and Geology
CDOGGR	California Department of Geology and Geological Resources
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic foot per second
CH_4	Methane
CHL	California State Historic Landmark
CINMS	Channel Islands National Marine Sanctuary
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level

CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
COOGER	California Offshore Oil and Gas Energy Resources
CPFV	commercial passenger fishing vessel
CSFM	California State Fire Marshal
CSLC	California State Lands Commission
CSC	California Species of Concern
CV	check valve
CWA	Clean Water Act
CZARAA	Coastal Zone Act Reauthorization Amendments
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	decibel
dBA	decibel A-weighted
DFG	Department of Fish and Game
DOCD	Development Operations Coordination Documents
DOGGR	Division of Oil, Gas, and Geothermal Resources
DOT	Department of Transportation
DPP	Development and Production Plan
EDL	elevated data levels
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Study
ERD	extended-reach drilling
ERL	effects range-low
ERM	effects range-medium
ERP	Emergency Response Plan
ERPG	Emergency Response Planning Guidelines
ERW	electric resistance welded
ESA	Endangered Species Act
ESD	emergency shutdown
ESE	Entire Source Emissions
FAA	Federal Aviation Administration
FBE	Fusion bonded epoxy
FDP	Final Development Plan
FHWA	Federal Highway Administration
FMC	Fishery Management Council
FMP	Fishery Management Plan
FSC	Federal Species of Concern
FT	flow transmitter

FWKO	Free Water Knock-Out
FWPCA	Federal Water Pollution Control Act
GHG	greenhouse gases
Gpd	Gallons per day
H_2S	hydrogen sulfide
HAP	Hazardous Air Pollutants
HS&P	Heating, Separation and Pumping [Facility]
hp	horse power
IC	Incident Commander
IRI	Industrial Risk Insurers
JRP	Joint Review Panel
kV	kilovolt
LCP	local coastal programs
LOGP	Lompoc Oil and Gas Plant
LOS	Level of Service
LPG	Liquefied petroleum gas
LTS	low temperature separation
m	meters
MAOP	maximum allowable operating pressure
mbd	thousand barrels per day
MCE	Maximum Credible Earthquakes
MGD	million gallons per day
mg/kg	milligrams per kilogram
MLLW	mean lower low water
mm	millimeters
MMPA	Marine Mammals Protection Act
MMS	Minerals Management Service
mmscfd	million standard cubic feet per day
MMTCE	million metric tons of carbon equivalent
MOV	motor actuated valve
mph	miles per hour
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
N_2O	nitrous oxide
NAAQS	National Air Quality Standards
NACE	National Association of Corrosion Engineers
NAROC	Non-Alkaline Reactive Organic Compounds
NDBC	NOAA Data Buoy Center
NEC	National Electric Code
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NGL	natural gas liquids

NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO	nitric oxide
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOP	Notice of preparation
NO_x	oxides of nitrogen
NPDES	National Polluting Discharge Elimination System
NRHP	National Register of Historic Places
NS&T	National Status and Trends
O_3	ozone
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OD	outer diameter
OPA	Oil Pollution Act
OPS	Office of Pipeline Safety
OPUS	Organization of Persistent Upwelling Structures
OSCP	Oil Spill Contingency Plan
OSMB	Offshore Santa Maria Basin
OSPR	Oil Spill Prevention and Response
OSRA	Oil Spill Risk Analysis
OSRP	Oil Spill Response Plan
PAH	poly-aromatic hydrocarbons
PANGL	Point Arguello Natural Gas Pipeline
PAPCO	Point Arguello Pipeline Company
PEL	probable effects level
PLC	Programmable Logic Controller
PM	particulate matter
POPCO	Pacific Offshore Pipeline Company
ppb	parts per billion
ppm	parts per million
psia	pounds per square inch
psig	pounds per square inch
PT	pressure transmitter
PTO	permit to operate
ROC	reactive organic compounds
ROG	reactive organic gases (see ROC)
ROP	Rate of Progress Plan
ROW	right of way
RTU	Remote Terminal Unit

RVP	Reid vapor pressure
RWQCB	Regional Water Quality Control Board
SBCAPCD	Santa Barbara County Air Pollution Control District
SBC	Santa Barbara County
SBCh	Santa Barbara Channel
SBCFD	Santa Barbara County Fire Department
SBCP&D	Santa Barbara County Planning & Development Department
SCADA	supervisory control and data acquisition system
SCCAB	South Central Coast Air Basin
SCCPA	South Coast Consolidation Planning Area
SCGC	Southern California Gas Company
SDV	shutdown valve
SEIR	Subsequent Environmental Impact Report
SFA	Sustainable Fisheries Act
SFSCC	Santa Fe Springs Control Center
SIMQAP	Safety Inspection, Maintenance and Quality Assurance Program
SLC	California State Lands Commission
SLOB	San Luis Obispo Bay
SMB	Santa Maria Basin
SMW	State Mussel Watch
SO_2	sulfur dioxide
SOO	Suspension of Operation
SOP	Suspension of Production
SO_x	oxides of sulfur
SPCC	Spill Prevention Control and Countermeasures
SPCP	Spill Prevention and Cleanup Plan
SSLO	South San Luis Obispo
SSRRC	System Safety and Reliability Review Committee
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resource Control Board
TAC	Toxic Air Contaminants
TDS	total dissolved solids
TEL	threshold effects level
TOC	total oxygen content
UCSB	University of California – Santa Barbara
UFC	Uniform Fire Code
UNOCAP	Unocal California Pipeline Company
USDOI	U.S. Department of Interior
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USMR	Unocal Santa Maria Refinery

VAFB	Vandenberg Air Force Base
VCE	vapor cloud explosion
WDP	Waste Discharge Permit
WIS	Wave Information Study
YOY	young of the year

1.0 Introduction

This Environmental Evaluation is a supporting document to the Plains Exploration and Production, Inc. (PXP) proposed revisions to the Point Pedernales Field Development and Production Plan (DPP). The proposed revisions to the DPP address the development and production of oil and gas from the Tranquillon Ridge Field using existing Point Pedernales facilities. The DPP supporting information, including this Environmental Evaluation, has been developed as required by 30 CFR250.204(b). This document also incorporates by reference the Tranquillon Ridge Oil and Gas Development Project Draft Environmental Impact Report dated October 2006 (SCH #2006021055).

Pursuant to a Lease Line Well Agreement between the MMS and the California State Lands Commission dated February 13, 1997, Torch, as Operator for Nuevo and Bellwether, drilled Well A-28 on Federal OCS Lease OCS-P 0441 from Platform Irene to a bottomhole location approximately 50 feet from the seaward boundary of the State of California. Production from this well resulted in the discovery of a hydrocarbon-bearing structure, which has been named the Tranquillon Ridge Field. The majority of the Tranquillon Ridge Field is in State Tidelands.

The proposed Tranquillon Ridge Project would involve the development of oil and gas wells from Platform Irene into the Tranquillon Ridge Field. This platform is currently used to develop and produce the Point Pedernales Field, existing within federal waters. Under the proposed Project, the produced oil and gas from the Tranquillon Ridge Field would be commingled with the Point Pedernales oil and gas and sent ashore via pipelines from Platform Irene to PXP's onshore processing facility, the Lompoc Oil and Gas Plant (LOGP). The proposed Project is expected to have a total life of 30 years once the first well is drilled.

Section 2.0, Project Description, provides a description of the existing Point Pedernales Facilities and a description of the proposed Tranquillon Ridge Project. The Tranquillon Ridge Project Description includes how the wells would be developed and produced, the needed modifications to Platform Irene, the Lompoc Oil and Gas Plant Modifications and the existing pipeline proposed modifications. This section also includes information on the project schedule, equipment, and personnel requirements. A discussion of how the project would extend the life of the Point Pedernales facilities is also included.

Section 3.0, Proposed Project Environmental Evaluation, discusses the environmental baseline and the potential environmental impacts associated with the project. This section also identifies mitigation measures that would reduce the impacts. The analysis in this section is presented by issue area.

Technical attachments are also included with the supporting information volume.

2.0 Project Description

PXP, as Operator of the Point Pedernales Project, (referred hereafter as "Applicant"), is requesting revisions to the DPP for the Point Pedernales Field to develop (drilling and production operations) a California State Lease (Tranquillon Ridge Field). The proposed development of the Tranquillon Ridge Field will introduce Tranquillon Ridge production into the existing Point Pedernales facilities and production operations with minimal modifications to existing facility equipment. The following sections provide a description of the existing Point Pedernales Facilities and a description of all the aspects of the proposed Tranquillon Ridge Project.

2.1 Existing Point Pedernales Facilities

The original Point Pedernales Project (94-DP-027), including Platform Irene and the Lompoc Oil and Gas Plant (LOGP) facility located north of the City of Lompoc, was assessed in the 1985 Union Oil Project/Exxon Project Shamrock and Central Santa Maria Basin Study EIS/EIR (Point Pedernales EIS/EIR) (ADL 1985) and approved by the Santa Barbara County (SBC) Board of Supervisors in 1986. The Minerals Management Service (MMS) approved the federal portion of the project and the California Coastal Commission (CCC) concurred in a consistency certification in 1985/1986. The facility has operated since 1987. Gas treatment facilities were installed in 1997 that allowed for the production of sales quality natural gas at the LOGP. The Point Pedernales Project facilities include the following:

- An oil and gas drilling and production platform, Platform Irene, located on outer continental shelf (OCS) Lease P-0441;
- An oil dehydration and gas processing facility, LOGP, located 3 miles north of the City of Lompoc;
- Three pipelines, in one corridor, connecting Platform Irene with the LOGP: a 20-inch wet oil line, an 8-inch gas line, and an 8-inch produced water return line for discharge at the platform. The pipelines reach landfall just north of the Santa Ynez River and cross Vandenberg Air Force Base (VAFB) and PXP fee property;
- A power supply system consisting of an electrical substation located on Southern Pacific Railroad property at Surf, a subsea power cable from the substation to Platform Irene, and an upgraded transmission line from the Pacific Gas and Electric power line north of Lompoc to the substation;
- A 12-inch sales gas pipeline from LOGP to Righetti Valve Box and a 6-inch sales gas pipeline from Righetti Valve Box to The Gas Company gas transmission line #1010; and
- Three onshore produced water disposal lines, one 10-inch and two 12-inch lines, used to transport wastewater from the LOGP to the Lompoc Oil Field for injection.

The proposed Tranquillon Ridge development project will utilize the above existing facilities. Tranquillon Ridge development can fit within the existing framework of facility infrastructure at Platform Irene and the LOGP. Figure 2-1 shows the location of the Tranquillon Ridge Field, the

Point Pedernales Facilities, and other facilities that are associated with the movement of the Point Pedernales oil and gas from the LOGP.

Historical production levels from the Point Pedernales Project peaked at close to 25,000 barrels per day (bpd) of dry oil in 1987 and 1989, and close to 9 million standard cubic feet per day (mmscfd) of gas production in 1995. Production levels in 2005 averaged approximately 7,000 bpd of dry oil, 50,000 bpd of water and a total of 2.6 mmscfd of gas production. The peak monthly production in 2005 was approximately 8,600 bpd of dry oil and 3.3 mmscfd of gas.

Gas produced from Point Pedernales currently has an average hydrogen sulfide (H_2S) concentration of 3,400 parts per million (ppm). The crude oil has a Reid vapor pressure (RVP) of 4.1 pounds per square inch absolute (psia). Crude oil is transported from the LOGP to the ConocoPhillips Santa Maria Refinery via an existing ConocoPhillips pipeline network.

Currently, the Point Pedernales Project is permitted to operate under the following Santa Barbara County (SBC) Final Development Plan (FDP) production/processing capacities:

- 36,000 barrels per day of dry oil;
- 15 mmscfd of natural gas with a maximum H_2S concentration level of 8,000 ppm;
- 9.205 mmscfd of onshore gas reinjection (only during upset conditions); and
- Monthly average of 2.3 LPG/NGL truck trips per day.

Current Point Pedernales operations include drilling and production at Platform Irene, transportation of production via pipeline from offshore to onshore, oil dehydration and gas processing at the LOGP, and shipment of product for sale or further processing by pipeline or LPG trucks.

Platform Irene

Platform Irene sits in 242 feet of water on Lease OCS-P 0441 approximately six miles west of Point Pedernales, California. Platform Irene was set in April 1986, and development drilling started in April 1987. The platform has a total of 72 well slots. Oil and gas are produced from the Point Pedernales Field. Twenty-eight wells have been drilled to date with a maximum of 14 wells producing in a given month. As of July 2006, there were 12 producing wells in service. The platform is equipped with an electric top-drive drilling rig used for well workovers and maintenance which averages 10 weeks per year. Power is supplied to the platform via a subsea power cable from an electrical substation located in Union Pacific Railroad property at Surf beach. The platform safety systems are monitored using the August System Programmable Logic Controller (PLC) leak detection system. In 2005 the rig worked 29 weeks and to date in 2006 the rig has worked 30 weeks.

The produced liquid from Platform Irene is a combination of crude oil, gas, and water. The gas exists as free gas or is in solution in the oil, and the water exists both as free water and emulsion in the oil. The liquid stream is transferred to the LOGP through the 20-inch emulsion pipeline, which has a capacity of approximately 108,000 bpd of emulsion. Current design limit of Platform Irene is approximately 100,000 barrels of total fluids per day (as stated in the 1985 Point Pedernales Facilities EIR/EIS).

A portion of the produced gas from Platform Irene, which is not in solution in the liquid stream, is separated from the liquid at Irene and dehydrated offshore using a glycol system. The dehydrated gas is then transported to the inlet of the LOGP gas sweetening and processing equipment through an 8-inch pipeline. At the LOGP the gas is sweetened and processed to produce sales quality natural gas.

Produced water is separated from the crude oil at the LOGP. A portion of the produced water is sent back to Platform Irene (the 2005 annual average was 20,000 bpd out of approximately 50,000 bpd of water) through an 8-inch pipeline and is currently injected into the Point Pedernales Field through wells A-10 and A-11 with MMS authorization (injection in other wells would be subject to MMS authorization). The pressure from the pumps onshore (at the LOGP) provides the injection pressure needed to re-inject water into these wells. Currently there is no ocean outfall disposal of produced water. However, PXP is permitted for such disposal pursuant to the General NPDES permit that became effective December 1, 2004 (General Permit CAG 280000). The remainder of the produced water is injected onshore into wells at the Lompoc oil field.

Platform Irene is owned and operated by PXP. Employees (including contract employees) are housed on the platform and transported by helicopter. During normal operations, the platform has a workforce of approximately 12 employees per each 12-hour day shift, and two to three employees per each 12-hour night shift: a total of approximately 14 to 15 employees per crew. Each crew works a rotation of 7 days on and 7 days off. During drilling there can be as many as 70 personnel at the platform. Equipment and other supplies are brought to the platform by supply boat. An average of six helicopter one-way trips per day and two supply boat one-way trips per three days is permitted. In 2005, there was an annual average of 13 one-way helicopter flights per week with a maximum of six one-way trips every Thursday (shift change). In 2005, supply boat trips averaged one one-way trip every 3 to 4 days. Manpower requirements and boat schedules can vary depending on the workload. Helicopter flights originate from the Santa Maria or Lompoc airports, and supply boat trips originate from Port Hueneme.

Pipelines and Other Facilities

The Point Pedernales facilities include three subsea and buried pipelines between Platform Irene and the LOGP. The total pipeline route is 22.2 miles long with approximately 12.1 miles located onshore. The pipelines include one 20-inch diameter wet crude oil line, one 8-inch produced water return line, and one 8-inch produced gas line.

There are ten valve sites located on the oil pipeline, and four valve sites located on the water return and gas pipelines. Valves are used to close off segments of the pipelines in the event of a leak, rupture or repair and maintenance. Nine of the valve sites are located in underground vaults. Valve Site #2 is an aboveground facility located on Vandenberg Air Force Base (VAFB) and is approximately 100 feet by 100 feet and fenced. Valve Site #2 has two block valves on each of the three pipelines.

Current pipeline operations include performing ongoing routine internal and external pipeline surveys. Pipeline surveys include, but are not limited to, smart pigging, corrosion checks, pressure tests, air and ground patrols, visual surveys using a video camera, and cathodic protection surveys.

These periodic internal and external pipeline inspections are performed on a schedule specified by MMS, SBC, and Santa Barbara County Air Pollution Control District (SBCAPCD) permits. These inspections also satisfy the requirements of the Department of Transportation (DOT) and the California State Fire Marshal for the onshore portions of the pipelines.

Oil Emulsion Pipeline

The oil emulsion pipeline, or the wet crude pipeline, between Platform Irene and the LOGP has a 20-inch outer diameter (OD) with a Maximum Allowable Operating Pressure (MAOP) of 1,194 pounds per square inch gauge (psig). However, the pipeline current average operating pressure is 400 to 500 psig. MAOP is a function of pipeline design and integrity. Operating pressure is a factor monitored during leak detection (e.g., loss of pressure could indicate a pipeline leak or rupture). Another factor monitored as part of leak detection is throughput at the Platform Irene entry location versus the LOGP exit location. A change in throughput (entry versus exit) could be an indication of pipeline leak or rupture.

Wall thickness of the pipeline is 0.625 inches onshore, 0.688 inches offshore. The steel grade is API 5L-X52 electric resistance welded (ERW) onshore and API 5L-X46 ERW offshore. The entire length of the pipeline is coated with PRITEC 70/15 (70 millimeters polyethylene, 15 millimeters butyl adhesive). The average age of the pipeline is approximately 20 years, which includes sections replaced due to corrosion. The pipeline currently operates at a temperature of 175°F starting at Platform Irene and decreasing to 135°F at LOGP.

Approximately once every week, the 20-inch oil pipeline is batch-pigged with approximately 400 gallons of corrosion inhibitor and approximately 400 gallons of diesel in order to clean the line and control corrosion. Corrosion inhibitor chemical is also injected continuously. Fluid samples are frequently analyzed for metal deposits and chemical residuals. Corrosion coupons are pulled every six months at the LOGP and Platform Irene. There is a flush mounted coupon probe at Valve Site #2 for continuous corrosion monitoring of the oil pipeline, and, Beta foil which indicates corrosion potential on the pipeline. Section 3.2 provides a detailed description of the current PXP corrosion monitoring program.

In 1997, a failure of the pipe occurred at a flange weld approximately midway between Platform Irene and the shoreline. A crack developed in the weld connecting a flange to the pipe. The metal in this area was determined to be brittle due to the weld construction techniques where the metals were not properly pre-heated, thereby increasing the metal brittleness, and due to the high carbon content. The shutdown system on Platform Irene operated correctly, quickly detecting the low pressure and initiating a low pressure alarm and shutdown of the pumps and valves. At this point, the operator attempted to restart the system, bypassing the low pressure alarm and the pump shutdowns. The valve was re-opened and remained open for almost 80 minutes until the operator determined that there was an imbalance between Platform Irene shipping and the LOGP receiving. The pumps operated approximately 25 minutes during this 80-minute period. Approximately 163 to 1,242 bbls of crude oil[8] were released into the marine environment, causing oil to soil beach areas along Surf Beach and south of the Santa Ynez River.

The 20-inch crude pipeline is equipped with alarms and controls that allow operation of the equipment and protection during upset conditions. The pipeline is equipped with a shutdown valve at both the inlet and outlet. The inlet shutdown valve (SDV), SDV-171, is located at the outlet of the shipping tank prior to the pig launcher on Platform Irene. SDV-171 is actuated by the platform emergency shutdown switch, as well as interlocks on the pressure transmitter (PT), PT-171, located directly downstream of the SDV-171.

Inlet shutdown valve, SDV-40, provides automatic protection and isolation at the pipeline inlet to the LOGP facility upstream of the gas-oil separation vessel. SDV-40 is actuated manually by the "Oil Process Stop" button, and automatically by the LOGP facility emergency shutdown switch as well as by a number of pressure and level transmitters. The onshore portions of the pipelines are protected from external corrosion by a rectifier and deep-well anode bed that is installed adjacent to Valve Site #8. Test stations are installed at one-mile intervals to monitor the performance of the system.

The pipeline is equipped with a leak detection system used to detect leaks when the pipeline is in operation. The major component of the leak detection system is the August System PLC, which is used to monitor various operating parameters of the pipeline such as flowrates and pressures. The August System PLC collects and processes the data, and activates the system alarms and shutdowns when specific thresholds are reached.

The oil/water emulsion is metered at Platform Irene prior to shipment via the 20-inch pipeline and again when the emulsion reaches the LOGP facility. Flow meters are located adjacent to the shut-down valves. The signal from the LOGP flow meter is transmitted to the control room where it is compared with the flow meter reading from the platform. Should the total fluid production fall outside the following limits, an alarm will sound at Platform Irene indicating a potential pipeline leak:

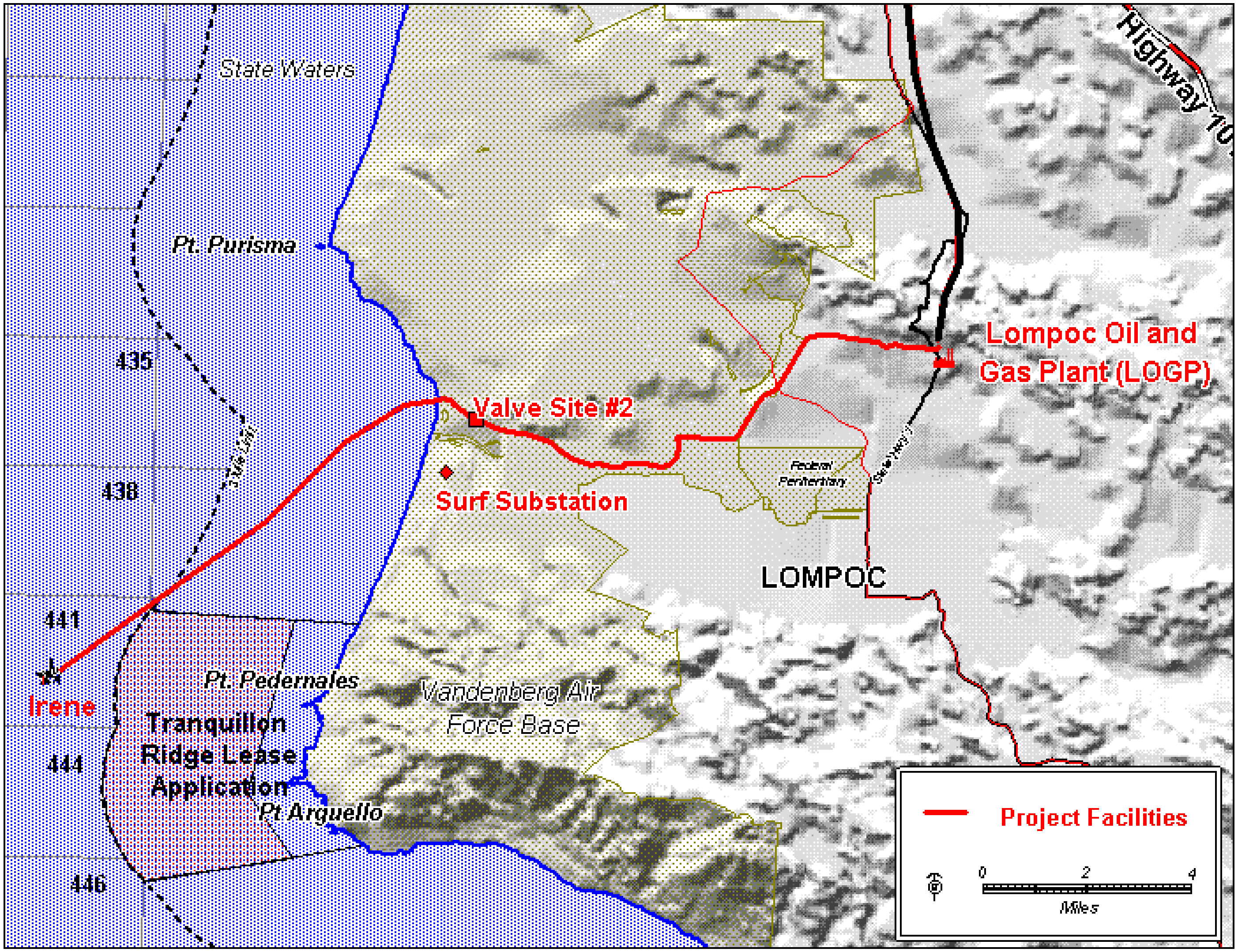
- 6 percent - more than 12 minutes or 63 barrels (based on 100,000 bpd)
- 15 percent – more than 20 minutes or 208 barrels (based on 100,000 bpd)

For example, if the flow meter detects a discrepancy in flow of 63 barrels (or 6% of volume based on 100,000 bpd) at a 12 minute interval, an alarm would sound. In the event of a large release from the oil pipeline, motor operated valves (MOVs) would close along the pipeline within two minutes after the operator initiates the appropriate shutdown command. For a large release, the Oil Spill Response Plan assumes that the operator has nine minutes to confirm the release and two minutes for MOV shutdown. The location of MOVs is described in the following sections.

Smaller leaks would also be detected but would take a longer time depending on the size of the leak. To aid prompt leak detection, PXP conducts one pipeline overflight and one right-of-way inspection per week. Past internal surveys of the oil pipeline identified a number of anomalies. As part of the overall pipeline maintenance and monitoring plan, some sections of the old pipe with significant anomalies were removed and replaced with new pipe. The oil line will continue to be monitored and inspected, and sections replaced as appropriate.

In August and September of 1999, Nuevo (operator at that time) conducted inspection of the flanges on the offshore oil pipeline. The inspections found defects at a flange on the bottom spool on the riser located on the offshore pipeline. As a result of this defect, the bottom spool was removed and replaced with a Big Inch flange spool similar to 1997 repair. During repairs the Point Pedernales facilities were shutdown, and the pipeline was flushed with water.

Figure 2-1 Location of the Tranquillon Ridge Field and Associated Point Pedernales Facilities



In September 2001, during flange inspections, Nuevo found cracks on a number of offshore flanges. As a result, Nuevo undertook a program to remove and replace all existing flanges on the offshore pipeline with the exception of the first flange (Flange #1-1). These flanges have been removed and replaced. Nuevo applied for, and received, permits from SBC, CCC, MMS, and CSLC for the repair work. In 2005, PXP completely encapsulated Flange #1-1.

Produced Water Pipeline

The MAOP of the water return pipeline is 1,311 psig. The produced water pipeline inlet pressure at the LOGP is approximately 500 psig and the outlet pressure at Platform Irene is approximately 500 psig. Repairs on the 8-inch produced water pipeline were conducted in the fall of 2001 to address corrosion discovered during annual surveys. The water pipeline is designed to automatically close valves at Valve Sites #1, 2, 8, and 10 when the pressure is low.

The produced water pipeline is 8.625-inch OD with a wall thickness of 0.312 inch onshore and 0.438 inch offshore. The pipe is made of steel grade API 5L-X42 ERW onshore and API 5LGrade B ERW offshore. The entire length of the water pipeline is also coated with PRITEC 70/15 (70 millimeters [mm] polyethylene, 15 mm butyl adhesive). The age of the pipe is approximately 20 years. The water pipeline operates at 130°F.

The 2000 Smart Pig Survey showed evidence of corrosion. As a result, a section of pipe was repaired and a confirmation dig was conducted along another section of pipeline.

The 8-inch produced water pipeline has four MOVs at Valve Sites #1, 2, 8, and 10, which can be operated locally or remotely from the LOGP. Position indication of the valves is transmitted to the control room operator at the LOGP facility.

The 8-inch produced water pipeline is equipped with a shutdown valve (SDV) at both the inlet and outlet. Inlet shutdown valve SDV-400 is located at the outlet of the clean water tank at the LOGP facility before the shipping pumps. SDV-400 responds solely to level controls on the clean water tank and the LOGP facility emergency shutdown switch. The valve position is displayed in the control room at the LOGP facility.

Inlet shutdown valve SDV-242 provides automatic protection and isolation on the pipeline on Platform Irene. SDV-242 is actuated by the Platform Irene emergency shutdown switch. MOV-612 also provides automatic protection, actuated from the high/low pressure (PSHL) switch, PSHL-612, located downstream of the SDV. The pressure, SDV position and shutdown signals are displayed in the control room on the platform.

Sour Gas Pipeline

The gas separated from emulsion and dehydrated at Platform Irene is shipped to LOGP via an 8-inch pipeline. The internal corrosion survey conducted in 2005 using a high resolution pig showed that the majority (greater than 99 percent) of anomalies were between 10 and 29 percent of wall thickness. Only three anomalies were between 30 to 49 percent of wall thickness.

The gas pipeline is an 8.625-inch OD pipe with a wall thickness of 0.312 inch onshore and 0.438 inch offshore. The pipe is made of steel grade API 5L-X42 ERW onshore and API 5L-Grade B ERW offshore. The entire length of the gas pipeline is also coated with PRITEC 70/15 (70 mm polyethylene, 15mm butyl adhesive). The age is approximately 20 years. The gas pipeline operates at 90°F and with a MAOP of 1,516 psig.

Four valve sites are located along the onshore portion. MOVs are located at Valve Sites #1, 2, 8, and 10 (see Appendix A). These valves can be operated manually or remotely from the LOGP. The gas pipeline is equipped with an SDV at the inlet (Platform Irene, SDV-401) and outlet (LOGP, SDV-100). The inlet SDV is actuated by the Platform Irene emergency shutdown switch, as well as interlocks on PT-401, located on the platform downstream of SDV-401. The pipeline pressure, valve positions, and shutdown signals are displayed in the control room on the platform. The pipeline is also equipped with a dew point analyzer.

The LOGP isolation valve (SDV-100) is actuated manually by the "Gas Stop" button as well as by the LOGP ESD procedure. SDV-100 automatically closes based on signals from a number of pressure transmitters located throughout the plant.

Co-located H2S sensors have been installed along the gas pipeline in the following locations: (a) at the pipeline's crossing of Highway 1, (b) upwind of Cabrillo High School, and (c) upwind of the north/northeast boundaries of Vandenberg Village. When any pair of the co-located sensors detects 40 ppm of H2S, the pipeline would be shutdown at the inlet (Platform Irene) and the situation investigated.

Valve Sites

The onshore portion of the pipelines incorporates ten valve sites between the shoreline and the LOGP. These valve sites consist of valves, either check or block[9], and Remote Terminal Unit (RTU) electronic equipment. The valves are contained in below-grade prefabricated vaults, with the exception of Valve Site #2, which is above grade.

The valve vaults and the area around the valves at Valve Site #2 are classified as Class 1,

Division 1, Group D areas, as per the National Electrical Code[10], which determines types of electrical equipment and installations considered safe in locations with hazardous classifications. The vaults are locked and designed such that a special tool is required to open them prior to entering. These areas must be checked for the oxygen concentration and presence of combustible and/or hazardous gases (H_2S) using hand-held gas detectors prior to entering these locations.

The RTU electronic equipment provided at each valve site is contained in either below-grade prefabricated vaults or in an above-grade prefabricated metal building. Valve Site #10 is not provided with RTU equipment. Valve Site #10 communicates directly with the August Systems' PLC.

Valve Sites #1, 2, 8 and 10 on all three pipelines are provided with an isolation valve that can be actuated locally at the station or remotely from the Pipeline Control Station at the LOGP. At Valve Sites #4 and 7 only the oil/water emulsion pipeline is provided with an isolation valve that can be actuated locally at the station or remotely from LOGP. Valve Sites #3, 5, 6 and 9 each contain a check valve in the crude oil pipeline only. Valve Site #2 is an aboveground installation with two isolation valves in each pipeline and a 60-foot dropout spool between the valves for installation of future launchers, receivers, and pumps.

The communication link between the valve site and the LOGP is accomplished by the RTU system. The RTU system and associated equipment are contained in a below-grade, prefabricated vault installed adjacent to the valve vault. The exception is Valve Site #2, in which the RTU equipment is installed above-grade in a prefabricated metal control building. The RTU vaults are covered with a weather-tight lid. The lid includes two spring-loaded doors that serve as an entrance into the vault. A ladder is also provided to facilitate entrance into the RTU vaults.

The RTU system receives all the status signals from the valve site and transmits these signals to the controller at the LOGP. The RTU system also receives remote valve open/close commands from the controller and sends these commands to the respective valves. Valve Site #10 communicates directly with the August Systems' PLC for exchange of this information.

Pipeline Catchment Basins

The pipeline route is constructed with 12 secondary containment catchment basins located at strategic locations along the route (see Appendix A). These basins are designed to catch oil if a pipeline leak or rupture were to occur. They were originally designed with a 10 percent excess capacity of a 100,000 bpd total fluids transportation rate to account for loss of volume due to erosion (Point Pedernales Facilities EIR, 1985). Current conditions and spill volumes are estimated in the Risk of Upset section. The basins contain concrete weirs that allow for water to flow out from the basin while retaining oil. The basins primarily protect the areas near the Santa Ynez River.

Surf Substation

Surf substation is located on Union Pacific Railroad property at Surf Beach. It supplies power to Platform Irene via a subsea power cable. The substation is connected to the PG&E power line north of Lompoc, approximately 700 feet north of the Surf railroad station on the ocean side of Ocean Avenue. The substation is approximately 60 by 70 feet and is enclosed inside a chain link fence. The substation contains meters, transformers and protective devices. Operation of the station does not require full time employees; however it is checked on a regular basis. The station does not generate any emissions, or any solid or liquid waste.

PXP Sales Gas Pipeline

Sales gas is shipped from the LOGP through a 12-inch sales gas pipeline to the Righetti valve site. The length of this line is approximately 6.5 miles with operating pressure ranges from 700 to 1,000 psig. The 12-inch sales gas line is API 5L-Grade B ERW pipe with 0.375-inch wall thickness. From the Righetti valve site, sales gas is then shipped through a 6-inch sales gas pipeline, The Gas Company gas transmission line # 1010. The Righetti valve site is located in the Lompoc Oil Field approximately 1.3 miles northeast of the intersection of Highway 1 and Highway 135.

Lompoc Oil and Gas Plant (LOGP)

Platform Irene ships all of its produced product to the LOGP. Throughput, pressure, and temperature at the LOGP are monitored using the August System Process Logic Controller (PLC). The control system is operated from the control room, which is manned 24 hours per day. The operator monitors operating pressures, levels, temperatures, flows, and other operating conditions. The LOGP is equipped with emergency alarms and equipment including hydrocarbon gas and hydrogen sulfide detectors, ultraviolet/infrared (UV/IR) fire detectors, fire hydrants, fire water line, fire monitors, foam capabilities, and other safety equipment. PXP maintains offshore and onshore spill response plans (the Core Oil Spill Response Plan for Operations in the Point Arguello and Point Pedernales Fields, Onshore Facilities and Associated Pipelines, Vol. 1, OSPR Supplement to the Core Oil Spill Response Plan (Vol. 2), DOT Supplement to the Core Oil Spill Response Plan (Vol. 2), MMS Supplement to the Core Oil Spill Response Plan (Vol. 2) and the Santa Barbara County Supplement to the Core Oil Spill Response Plan for Operation of the Point Pedernales Onshore 20-Inch Wet Oil Pipeline (Vol. 2), as well as the Emergency Response Plan for Operations on Point Pedernales Onshore Facilities). The oil dehydration facility has operated since 1987, and the gas plant began operation in September 1997. The LOGP currently employs 22 PXP workers and various contractors.

The LOGP receives oil/water emulsion and sour gas from Platform Irene, and sour gas from the onshore Lompoc Oil Field. Process operations at the LOGP include oil dehydration, produced water treatment, produced water injection offshore and onshore into the Lompoc Oil Field, oil reclamation, oil storage, oil shipment, gas compression, gas reinjection, gas sweetening, gas dehydration, LPG/NGL stabilization and storage, LPG/NGL truck loading, and NGL/crude oil blending.

The oil dehydration system dehydrates 57,000 bpd of oil/water emulsion (2005 annual average). The produced oil is characterized as heavy oil (16 degree American Petroleum Institute (API) gravity). At the LOGP, water removed from the oil/water emulsion is treated with emulsion breaking chemicals to separate the trace oil contained in the water. This oil is skimmed off the water in the water treatment tanks and sent back through the process. The existing oil processing and storage equipment at the LOGP includes heat exchangers, separators, free water knockout vessel, three heater treaters, flare system, flare sulfur dioxide (SO2) minimization scrubber, pressurized shipping vessel, wash tank, reject tanks, reclaimed oil storage tank, surge tank, vapor recovery system, gas compressors, and other miscellaneous pumps and equipment. Once dehydrated, the oil is sold to ConocoPhillips and shipped by pipeline from the LOGP to the Orcutt Pump Station, and then to the Santa Maria Refinery in San Luis Obispo County.

The majority of the produced gas is separated from oil/water emulsion at Platform Irene and is shipped to LOGP via an 8-inch pipeline. The LOGP also receives produced gas from the onshore Lompoc Field; this gas is shipped from the field via a separate 4-6-inch gas pipeline. At the LOGP, gas that remained dissolved in the oil/water emulsion is further separated from the emulsion. The vapor recovery system collects vapors from all the tanks, including the heater treaters and other miscellaneous vessels. Gas collected by the vapor recovery system, and the solution gas separated from the emulsion are combined and compressed to the inlet of the gas sweetening and processing equipment along with the gas delivered by the two gas pipelines.

The existing gas sweetening and processing equipment at the LOGP consists of an amine gas sweetening skid with an associated acid gas handling (Sulferox) system, gas dehydration, a low temperature separation (LTS) skid, LPG/NGL stabilization skid and storage, LPG/NGL truck loading, and NGL/crude oil blending.

The H2S removed from the combined inlet gas streams is reduced to elemental sulfur in the associated Sulferox unit. The tail gas from the Sulferox unit is sent to the thermal oxidizer for oxidation of residual hydrocarbon vapors to carbon dioxide and water. The sweetened gas then flows into the LTS skid where it is dehydrated. The raw NGL formed during this process then flows to the LPG/NGL stabilization skid. LPG gas (called “bute-mix”) comes off the top of the stabilizer column and is condensed and stored for sale and transported via trucks to other facilities for further fractionation. Currently, the monthly average is 2.7 LPG/NGL truck roundtrips per week (139 in the year 2005) based on the year 2005 annual average. Total LPG/NGL transported in the year 2005 was a monthly average of 105,000 gallons, with approximately 9,000 gallons per truck load. The stabilized NGL liquids flow to the NGL surge tank for blending into the dry crude oil to the maximum extent feasible. The processed sweet natural gas is sold and shipped by pipeline and/or used as fuel at the LOGP.

There are also truck trips due to sulfur removal (annual average of 12 trucks in 2005), amine makeup (annual average of 1 truck in 2005), and miscellaneous vacuum trucks (estimated at two trucks per week).

The existing water treatment equipment at the LOGP consists of the Wemco flotation cell (currently out of service), wash tank, clean water tanks, and injection pumps. After the water is treated to recover the hydrocarbon liquids, the treated water is either shipped via onshore produced water disposal lines (one 10-inch, one 12-inch and one 8-inch lines) to the Lompoc Oil Field for onshore injection or shipped via the 8-inch produced water return line to Platform Irene for offshore injection.

2.2 Proposed Tranquillon Ridge Project

The Tranquillon Ridge Project will mostly affect the Point Pedernales Project facilities and pipelines that are connected to these facilities. The original Point Pedernales Project (94-DP-027), including Platform Irene and the LOGP facility located north of the City of Lompoc, was approved by the SBC Board of Supervisors in 1986. The MMS approved the federal portion of the project and the CCC concurred in a consistency certification in 1985/1986. The facility has operated since 1987. Gas treatment facilities were installed in 1997 that allowed for the production of sales quality natural gas at the LOGP. The following sections provide background information, proposed well development and production information, proposed modifications to Platform Irene, proposed modifications to the pipeline system and proposed modifications to the Lompoc Oil and Gas Plant (LOGP).

2.2.1 Background Information

Pursuant to a Lease Line Well Agreement between the MMS and the California State Lands Commission (CSLC) dated February 13, 1997, Torch Operating Company, the previous Operator for Nuevo Energy Company and Bellwether Exploration Company, drilled Well A-28 on federal Lease OCS P-0441 from Platform Irene to a bottomhole location approximately fifty (50) feet from the seaward boundary of the State of California. This well drilling resulted in the discovery of a hydrocarbon-bearing structure. Recent 3-D seismic data and existing historic 2-D seismic data, along with a geologic interpretation developed by using the Point Pedernales Field as an analog, indicate that the majority of the Tranquillon Ridge structure is in State Tidelands. The MMS and the CSLC subsequently entered into a Lease Line Well Royalty Sharing Agreement relating to production from Well A-28. The Well A-28 production is combined at Platform Irene with production from other federal leases and transported to the LOGP.

Well A-28 is currently draining oil and gas from lands owned by the State of California. Several additional wells can be drilled on Lease OCS P-0441 from Platform Irene to bottom hole locations near the seaward boundary of the State of California. These wells will also drain significant quantities of oil and gas from lands owned by the State of California, substantially in excess of that currently being drained. This method of developing the reservoir (i.e., utilizing bottomhole locations on federal lands to drain reserves from lands owned by the State of California) will be inefficient, will require a longer production period than producing from wells within State lands, and will not allow for the full development of the Tranquillon Ridge Field.

In January 2000, Torch Operating Company, as Operator of the Point Pedernales Project, submitted an application to Santa Barbara County for development of the Tranquillon Ridge Field. The County prepared an Environmental Impact Report (EIR) for the project. The Final EIR was issued in June 2002 (SBC 2002). In August of 2002 the project was denied by the Santa Barbara County Board of Supervisors.

In March of 2000, Torch Operating Company submitted to the MMS a Revised Plan of Development and Production (DPP) for the Point Pedernales Field to Include the Tranquillon Ridge Development. At that time, the MMS determined that revisions to the DPP were not ripe for consideration because the State lease for the proposed development did not exist, and the development would be in State Waters with no development or production activities in the submerged lands of the Federal OCS. Subsequently, the MMS determined that a revised DPP would be necessary.

In the first quarter of 2004, Nuevo Energy Company merged with PXP; PXP is now Operator of the Point Pedernales Project. In September 2004, PXP submitted a revised application to Santa Barbara County and the CSLC for permits to develop and produce the Tranquillon Ridge Field. The County released the Draft EIR for the proposed project in October, 2006.

In May 2005, PXP submitted to the MMS Revisions to the Point Pedernales Field DPP to Include Development of the Tranquillon Ridge Field. The MMS determined that additional information was needed before the submittal could be considered complete. This Environmental Evaluation was developed to respond to MMS comments in order to finalize the submittal. The data and the analyses developed for the 1985 Point Pedernales EIS/EIR and the 2006 Tranquillon Ridge DEIR have been utilized in this document, as appropriate (ADL 1985; SBC 2006).

2.2.2 Tranquillon Ridge Field Development Summary

Present plans for development of the Lease proposes drilling a maximum of seventeen (17) wells, including 14 new production wells and potentially 3 utility wells from Platform Irene into California State Lands, utilizing extended reach drilling technology. Access to State Lands will be accomplished solely through extended reach drilling, several thousand feet below the ocean floor. The horizontal distances of the wells are well within the capability of existing drilling technology. Drilling plans were developed by using Point Pedernales Field drilling experience as an analog. Actual drilling results may indicate that fewer than seventeen (17) wells will be needed to develop the proposed State Lease.

PXP has preliminarily determined the bottomhole locations of the fourteen (14) new production wells to be drilled. Bottom hole locations for additional wells, if needed, will be determined as additional information is obtained from drilling. Figure 2-2 shows the proposed location of the 14 new Tranquillon Ridge wells. The remaining three (3) wells could be used for redrills or for utility purposes such as water injection.PXP has not identified which wells will be used for redrills or utility purposes. This cannot be determined until the field is in development and PXP can determine how the reservoir is performing. Specific drilling programs and bottomhole locations for each well would be submitted for approval to the California State Lands Commission (CSLC), California Division of Oil, Gas and Geothermal Resources (DOGGR), and Mineral Management Service (MMS) prior to drilling.

Recompletion in a well, if needed, will likely commence eight (8) to ten (10) years after the initial completion date of a well. Recompletion involves the re-work/drilling of a well to ensure full production levels are achievable. Wells currently proposed to be drilled are shown in Table 2.1. (The well numbers correspond to the bottomhole locations shown in Figure 2-2).

Total well drilling and completion times are anticipated to range between 60 and 120 days per well. These times are consistent with drilling and completion times of similar length development wells drilled from Platform Irene in the Point Pedernales Field. However, actual drilling times for wells of similar length may vary due to dynamic dependencies on equipment, total well length, angle, completion techniques, and weather.

The 14-well development plan that is being proposed for the Tranquillon Ridge Field is designed to provide 80-acre well spacing (each well would be approximately centered on an 80-acre area) in all of the four commercial Monterey zones. Each well will be directionally drilled using extended-reach technology from unused well slot locations currently available on Platform Irene. Total measured well lengths will come close in some instances to twenty-five thousand feet (25,000 feet), with overall vertical depths below the ocean surface averaging between three and five thousand feet (3,000–5,000 feet). These well lengths and depths can be accomplished utilizing existing extended-reach drilling development technology. To fit within the existing framework of the facility infrastructure at Platform Irene and the LOGP, and the existing permits, the proposed 14 production well development program would be drilled over a 5 year period.

Table 2.1 Proposed Well Locations and Distances

Approximate Drilling Order	Approximate Measured Length, feet	Estimated Drilling Days	Horizontal Distance from Irene, feet
B-1	15,000	60	13,250
B-2	15,000	60	13,250
B-3	17,300	90	15,600
B-4	16,200	90	14,600
B-5	18,100	90	16,600
B-6	21,540	120	20,000
B-7	16,860	90	15,300
B-8	23,390	120	22050
B-9	24,900	120	23400
B-10	15,000	60	13,250
B-11	17,370	90	15,800
B-12	19,800	120	18,400
B-13	23,750	120	22,300
B-14	24,700	120	23,300

Note: the wells may not be drilled in numerical order.

Due to the geotechnical constraints associated with developing a coastal California Monterey oil-bearing structure, production estimates can only be made from studying similar reservoirs. Fortunately, Tranquillon Ridge is similar in structure and chemical makeup to and is adjacent to the Point Pedernales Field, so analogies between the two fields can be made. PXP has used analogies with Point Pedernales production data to provide a statistical background for building the Tranquillon Ridge well drilling schedules and production forecasts. Figures 2-3 and 2-4 provide estimates of the oil and gas production for the proposed Tranquillon Ridge Project, respectively. The figures show the estimated oil and gas production from the Tranquillon Ridge Field, the Point Pedernales Field, as well as total estimated production from Platform Irene.

Production from the Tranquillon Ridge Field is estimated to peak at around 30,000 bbls/day of oil and 7 mmscfd of gas. With the proposed Tranquillon Ridge Project, production from Platform Irene will peak at around 35,000 bbls/day of oil and 10 mmscfd of gas. Based upon PXP's estimates, the ultimate recovery for the Tranquillon Ridge Field is estimated to be approximately 103 million barrels of oil and 40 to 50 billion standard cubic feet of gas (or approximately 18,840 bpd average of oil and 4.7 mmscfd average of gas.).

The oil and gas production estimates for Tranquillon Ridge and Platform Irene are based on limited data, and may not represent the actual production achieved once the wells are drilled. The actual production will depend on the number of wells that are drilled, the rate at which the wells are drilled, and the performance of each development well. It should not assume that the estimated production curves are what will actually occur with the development of the Tranquillon Ridge Field. It can only be used to provide information on the expected trends that will be associated with development of the Tranquillon Ridge Field. Gas H_2S concentrations are estimated to remain between 4,000 and 8,000 ppm with addition of Tranquillon Ridge gas production to the Point Pedernales produced gas. If Tranquillon Ridge production is similar to Point Pedernales production, then the H_2S concentration in the gas stream is expected to be lower during the initial period of production.

2.2.3 Platform Irene Modifications

The following discussion details the upgrades and minor modifications that are required on Platform Irene in order to integrate the proposed Tranquillon Ridge Project with the current operation of the Point Pedernales Project.

The proposed Tranquillon Ridge Project will require installing new pumps on Platform Irene. The Applicant proposes to replace three 600-horsepower electrical shipping pumps with three 1,250-horsepower electrical shipping pumps. In addition, approximately 15 of the new Tranquillon Ridge wells will utilize new 500-horsepower electrical submersible pumps. The other production wells will utilize gas-lift technology. The Applicant will continue ongoing maintenance and upgrades of the electrical transformers and switchgear on the platform for these additional pump loads.

During the Tranquillon Ridge drilling operations on Platform Irene, PXP proposes to batch discharge the muds and cuttings into the ocean in accordance with the National Pollutant Discharge Elimination System (NPDES) General Permit No. CA280000.

Bottomhole Locations

Pursuant to the Freedom of Information Act (5 U.S.C. 552) and its implementing regulations (43 CFR Part 2) and as provided in 30 CFR 550.199(b), the information contained in this section is deleted from the public information copy of this submission.

Proprietary

Not for Public Release

Forecast Data

Pursuant to the Freedom of Information Act (5 U.S.C. 552) and its implementing regulations (43 CFR Part 2) and as provided in 30 CFR 550.199(b), the information contained in this section is deleted from the public information copy of this submission.

Proprietary

Not for Public Release

The temperature of the discharged muds depends on the true vertical depth of the hole being drilled. In general, temperature of subsurface strata increases with depth. Based on data gathered in exploratory drilling on OCS P-0441, the maximum mud temperature at the mud shaker will be 117°F, assuming a depth of 5,000 feet total vertical distance. From the shaker area, the mud for discharge is continuously sent to a cuttings washing system, where it is diluted with seawater. Assuming a mud discharge rate of 3.5 gallons per minute diluted with wash water (seawater) at 100 gallons per minute rate, the resulting effluent temperature will be 63.3°F. As proposed, this effluent would be discharged at a point approximately 150 feet below mean lower low water (MLLW) into an ocean environment with the ambient temperature of 60 to 61°F. Any cuttings or muds that do not meet the NPDES permit requirements would be stored in bins and hauled to a permitted disposal site onshore or injected, if feasible. For example, if oil-based mud is used, the cuttings and excess muds would be stored in bins and transported to a permitted disposal site onshore, or injected offshore at the platform.

Drilling activities and equipment will be similar to those of ongoing drilling programs, but with different frequency and duration. The existing drilling rig on Platform Irene will be used to drill the Tranquillon Ridge wells. The only additional equipment for drilling will be two new 1,600-horsepower electric pumps for muds handling, as well as some refurbishing of the existing mud system. PXP has no plans to use diesel powered pumps for mud handling.

The existing 8-inch produced water return pipeline is currently used to return part of the Point Pedernales produced water from the LOGP to Platform Irene for offshore water injection (a part is injected onshore into the Lompoc Oil Field). For the proposed Tranquillon Ridge Project, a part of the produced water will continue to be transported offshore. This water will either be discharged to the ocean under the NPDES permit or injected offshore in accordance with the MMS authorization. Approximately 40,000 bpd of water produced from Point Pedernales and Tranquillon Ridge combined will be shipped from the LOGP to Platform Irene for discharge. The Applicant is authorized to discharge to the ocean from the platform up to 55,845,000 barrels of water per year in accordance with the general NPDES Permit. A part of the produced water that will be shipped to Platform Irene may still be reinjected into Point Pedernales reservoir wells, as is currently the operation to enhance current Point Pedernales production. Offshore water reinjection will be conducted as authorized by the MMS. The Platform Irene operations changes with the proposed project are summarized in Table 2.2.

Table 2.2 Summary of Changes to the Platform Irene with Proposed Project

Parameter (Permitted Level[a])	Platform Irene with Addition of Tranquillon Ridge Project	
	During Normal Operations	During Drilling of New Wells
Total Employees	No additional personnel [b] (Currently there are 14-15 personnel).	Currently during drilling there are up to 70 personnel = 15 [normal operations] + 55 [drilling]).
Total Boat Trips (1 one-way trip every 3 days)	No increase (Currently [c] – 1 one-way trip every 3 to 4 days annual average or 107 trips per year).	Increase to a total of 1 one-way trip every 3 days or 120 trips per year (at the permitted limit).[d]
Total Helicopter Trips (3 round trips per day)	Increase of 1 one-way trips per week or 26 round trips per year (Currently [c] – 13 round trips per week annual average, or 654 round trips in 2005)	Increase to a total of 3 round trips per day annual average.
Equipment	1) Replacement of three 600 hp pumps with	Installation and operation of two 1,600 hp

Table 2.2 Summary of Changes to the Platform Irene with Proposed Project

Parameter	Platform Irene with Addition of Tranquillon Ridge Project	
Additions, Upgrades OR Replacements	three 1,250 hp pumps. 2) Installation of 500 hp submersible pumps on 15 new wells. 3) Ongoing transformer and switchgear upgrades.	pump.
Additional Maintenance and Service of Wells	With addition of new wells could be up to 50% increase in maintenance and service.	None
Additional Electrical Power Requirement	104%[e]	116.9%[e]
Muds and Cuttings Disposal	N/A	Disposal into ocean outfall per the current NPDES permit or offshore injection if feasible.[f]
Water Disposal	Addition of 20,000 bpd for discharge offshore with a total of 40,000 bpd for injection or discharge to ocean. (Currently up to 20,000 bpd is injected offshore.)	N/A Produced

N/A – not applicable; hp – horsepower.

a. The permitted level is listed only where it is applicable.

b. Normal current operations include periodic well workover drilling, which takes 8 weeks per year and requires up to 55 personnel to operate the drilling rig and perform other work during the well workovers.

c. Maximum permitted helicopter trips and boat trips are occasionally utilized (e.g. during the platform shift change)
d. Assuming that drilling muds will be discharged into the ocean or reinjected (no onshore disposal).
e. Data is annualized data and does not distinguish between normal operation and operation during drilling.
f. Through 2008 to 2010, PXP estimates that their average annual muds and cuttings disposal will be approximately 48,700 bbls and 5,700 bbls, respectively. The current general NPDES permit limits muds and cuttings discharge to 105,000 bbls/yr and 30,000 bbls/yr, respectively.

2.2.4 Lompoc Oil and Gas Plant (LOGP) Modifications

The following minor modifications at the LOGP will be required in order to handle production from the proposed Tranquillon Ridge Project. PXP proposes to return to service two existing plate and frame heat exchangers, and install piping for the heat medium with the existing heater treater water outlets, to allow additional oil emulsion processing capacity. It would be necessary to heat the water and oil emulsion to aid in separation. In addition, PXP would install a new duplex feed strainer on the 20-inch pipeline inlet between the first and second plate and frame heat exchangers. One of the reasons the existing plate and frame heat exchangers are currently out of service is fouling from solid material in the emulsion stream. The installation of a feed strainer would facilitate the removal of solids, extend the time between cleaning, and maintain the efficiency of the exchangers. The duplex design would allow cleaning of one strainer while the other is online.

Other modifications include upgrades to the existing free-water knockout vessel, including installation of baffles and insulation of its exterior. In addition, upgrades and installation of baffles would be required for the three existing heater treaters. Installing baffles in the existing free water knockout and heater treaters would expand their emulsion breaking capacity. They would also aid in the water clarification process. Insulating the free water knockout would aid in heat retention and reduce the fuel consumption in the heater treaters.

Due to the increased use of the heater treaters for heating of the crude oil natural gas, fuel consumption could increase by 100 percent. Electricity consumption at the LOGP could increase by approximately 30 percent due to the increased operations of the existing equipment. Increases in maintenance and service of the new equipment would not require additional new employees.

Currently there are 2.7 liquid petroleum gas/natural gas liquid (LPG/NGL) truck trips per week (year 2005 annual average). It is expected that the Tranquillon Ridge Project would generate up to two additional trips per week.

Table 2.3 Summary of Changes to the LOGP with Tranquillon Ridge Project

Changes with Project	During Normal Operations
Additional Employees	None
Additional LPG/NGL Truck trips	Approximately 2 per week (to a total of 5 per week[a])
Additional Sulfur Truck Trips	Approximately 1 per week
Additional Equipment Or Equipment Modifications	1) Return to service of two heat exchangers. 2) Addition of duplex feed strainer. 3) Addition of internal coalescing assemblies inside the existing free-water knockout vessel and insulation of its exterior. 4) Addition of internal coalescing assemblies and four (4) externally adjustable baffles on the three existing heater treaters.
Additional Maintenance	To be handled by the current employees.
Additional Electrical Power Requirement	30%[b]
Water Disposal Onshore	No increase

hp – horse power.
a. Based on the ratio of oil that could be generated to currently being produced.
b. The increase is due to increased operations due to production from Tranquillon Ridge.

All LOGP upgrades and modifications would occur within the existing boundaries of the facility. No new grading or lighting would be required at the LOGP. Table 2.3 summarizes all the changes to the LOGP facility that will occur with the introduction of the Tranquillon Ridge Project

2.2.5 Existing Pipeline Modifications

This section addresses the modifications to the existing Point Pedernales Project onshore pipelines and ConocoPhillips dry oil pipeline system. The ConocoPhillips pipeline system is an existing common carrier dry oil pipeline system. The Point Pedernales Project was approved in 1986, at which time the ConocoPhillips pipeline system was owned and operated by Unocal Oil Company**.** As a result, the subject dry oil lines were included in the original permitting for the Point Pedernales Project. The subject dry oil pipelines have been under different ownership for many years; including Tosco and now ConocoPhillips. PXP does not have any ownership interests in ConocoPhillips and has not included any modifications to the ConocoPhillips system in the PXP application for the proposed project. If modifications are required, ConocoPhillips would need to address these changes under their existing permits with the County. Information about the ConocoPhillips pipeline system is provided herein for context and reference only.

Point Pedernales Project Onshore Pipelines

The Applicant is proposing the option to install crude oil booster pumps at Valve Site #2. No other modifications are proposed for the Platform Irene to LOGP pipelines. Monitoring of the pipelines will continue, and sections of existing pipe will be replaced with new pipe, as required, to maintain a sufficient maximum allowable operating pressure (MAOP) in order to continue operation of the Point Pedernales Project with the Tranquillon Ridge Project.

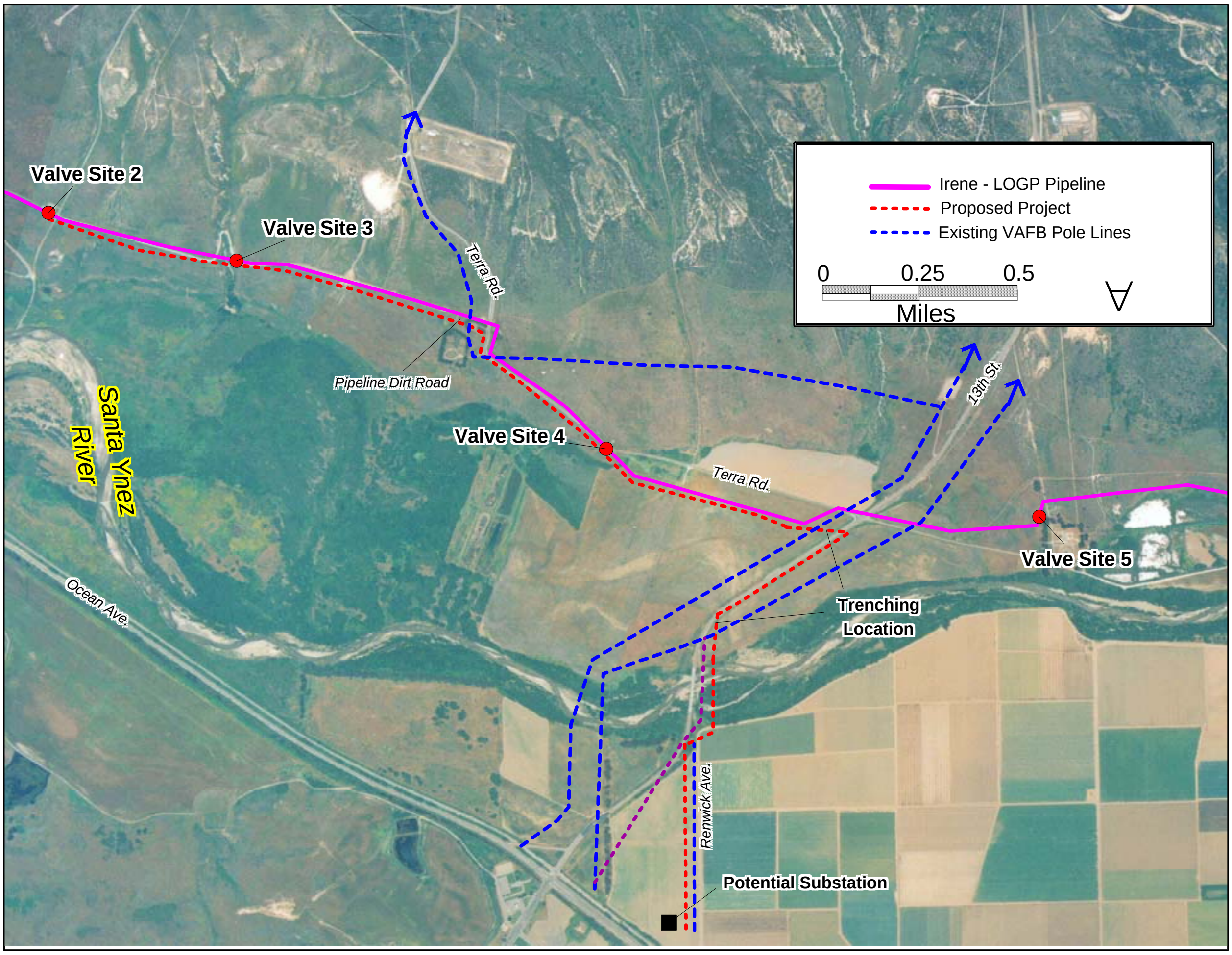
The expected volume of oil/water emulsion produced by Point Pedernales and Tranquillon Ridge combined is 90,000 bpd. Currently, the pressure rating on the 20-inch emulsion pipeline from Platform Irene to the LOGP is sufficient for the expected operation. However, during the course of Tranquillon Ridge project, if the MAOP of the 20-inch pipeline needs to be lowered (i.e., the pipeline derated to less than 1,000 psig), then operation at the pressures needed to transport 90,000 bpd of emulsion would not be possible. In this case, the Applicant proposes to install three new 1,250-horsepower, electric booster pumps at Valve Site #2 in order to minimize the operating pressure of the offshore pipeline segment of the 20-inch oil pipeline. Two pumps will be operated simultaneously with the third pump on standby. Apart from the power lines, all equipment modifications will be accommodated within the existing footprint of Valve Site #2, and will be integrated into the existing safety systems at the LOGP.

Electrical System Upgrade

The existing electrical system will be upgraded at Valve Site #2. Upgrading the system will consist of installing a new power line. Power is proposed to be supplied from one of two locations. The first choice is to supply power from the 115 kilovolt (kV) line which, exists along Renwick Avenue in Lompoc. In this case, a substation will need to be constructed to step power down from 115 kV to 34.5 kV. The substation will be placed in the farm field on the northwest corner of Renwick and Ocean Avenues. The new power line poles will be installed along Renwick Avenue in the northerly direction. The second choice is to supply power from the existing 12 kV power line. There will be no need for the substation, and the power line could be placed on the existing poles along Renwick Avenue. The selection of the power grid tie-in point will be contingent upon property availability and cost evaluation for power line installation and operation. Figure 2-5 shows the route of the proposed powerline to Valve Site #2.

At the northern end of Renwick Avenue the line will need to cross Santa Ynez River. PXP proposes that the power line cross the Santa Ynez River on a new set of poles, which will be installed on both sides of the river. After crossing the river and crossing under the VAFB power line via trenching, the new power line will run along 13th Street on the east side, until the intersection with Terra Road. Once at Terra Road, the new power line will be run under 13th Street, and under another VAFB power pole line that follows 13th Street in this location. This crossing will be done via trenching. After the power line emerges on the west side of 13th Street, it will follow Terra Road and the right-of-way of the Platform Irene to the LOGP pipeline route, until it reaches the Valve Site #2.

Figure 2-5 Proposed Powerline Route to Valve Site #2



For the portion of the route along Terra Road, the power line will be placed on new poles. The average height of power poles will be 60 feet, and the average span between the poles will be 350 to 400 feet, depending on the terrain. Installation of the power poles will require minimal grading and clearing around each installed pole, as required by the fire department. Table 2.4 summarizes the changes to the Point Pedernales pipelines and associated facilities.

Table 2.4 Summary of Changes to Valve Site #2 with Proposed Project[a]

Changes with Tranquillon Project	During Normal Operations
Additional Equipment	1) Three 1,250 hp electrical booster pumps on 20-inch oil pipeline with an additional transformer and required switchgear. 2) New power-lines with power poles[b], and possibly a new substation.
Additional Maintenance	One personnel month per year for maintenance to pump station equipment.

These changes will only be necessary if the 20-inch emulsion pipeline MAOP is derated.
The alternative to this is underground installation of the power line.

ConocoPhillips Pipeline System

The ConocoPhillips Orcutt Pump Station modifications would be limited to placing a second electrically driven shipping pump, driven by 175 to 350-horsepower variable speed electric motor, back into service, or replacing it with a new pump. This would allow the system at the Orcutt Pump Station to be able to pump at the flow rate of up to 36,000 bpd. The pump is already permitted under the UNOCAP Point Pedernales Project permit No.94-DP-028 and SBCAPCD PTO 7511; however, the PTO would require an amendment. Replacement of the permitted pump on as-needed basis is a part of normal operations at the pump station and does not represent new equipment installation.

The pipelines connecting the LOGP to the Summit Pump Station include the 12-inch pipeline form LOGP to Orcutt Pump Station, the 8-inch pipeline from Orcutt Pump Station to Summit through Suey Junction; and the 10/12-inch pipeline from Suey Junction to the Summit Station (see Figure 2-4). Only the 12-inch pipeline between the LOGP and Orcutt Pump Station and the 8-inch pipeline between Orcutt Pump Station and Suey Junction are expected to have increased oil throughput once Tranquillon Ridge production begins, since more oil would be shipped from the LOGP to the ConocoPhillips Santa Maria Refinery. Nonetheless, no modifications to the pipelines are expected. Some adjustments to the leak control and the overall pipeline operation control parameters could be necessary. Adjustment of these parameters is a usual operation matter that is handled by control operators on a regular basis. The proposed Tranquillon Ridge Project is not expected to result in a net increase in crude oil throughput for the other portions of the ConocoPhillips pipeline system. This is because the additional oil from Tranquillon Ridge is anticipated to displace crude oil delivered into the ConocoPhillips pipelines system from other sources, primarily outer continental shelf crude entering the system at Sisquoc (see Figure 2-4).

2.3 Project Schedule, Equipment and Personnel Requirements

Schedule

The addition of shipping pumps at Platform Irene and modifications at the LOGP are estimated to take approximately 9 months. The addition of booster pumps and associated equipment including the power pole installation to Valve Site #2 is estimated to take 14 weeks. Installing the transformer/substation is estimated to take 4 weeks. Electrical upgrades at Platform Irene will be conducted as needed throughout development of Tranquillon Ridge.

Based on PXP's data, the Tranquillon Ridge Project would have a total life of 30 years from the time the first well is drilled. Drilling of all new wells is expected to take 15 years to complete. Figure 2-7 shows the proposed schedule for drilling of the Tranquillon Ridge wells.

Personnel and Equipment

Tables 2.5 and 2.6 provide an estimate of personnel and equipment, which will be utilized to complete the onshore facilities upgrades and modifications at the LOGP and Valve Site #2.

Figure 2-6 Platform Irene to LOGP 20-inch Oil Emulsion Pipeline Elevation Profile

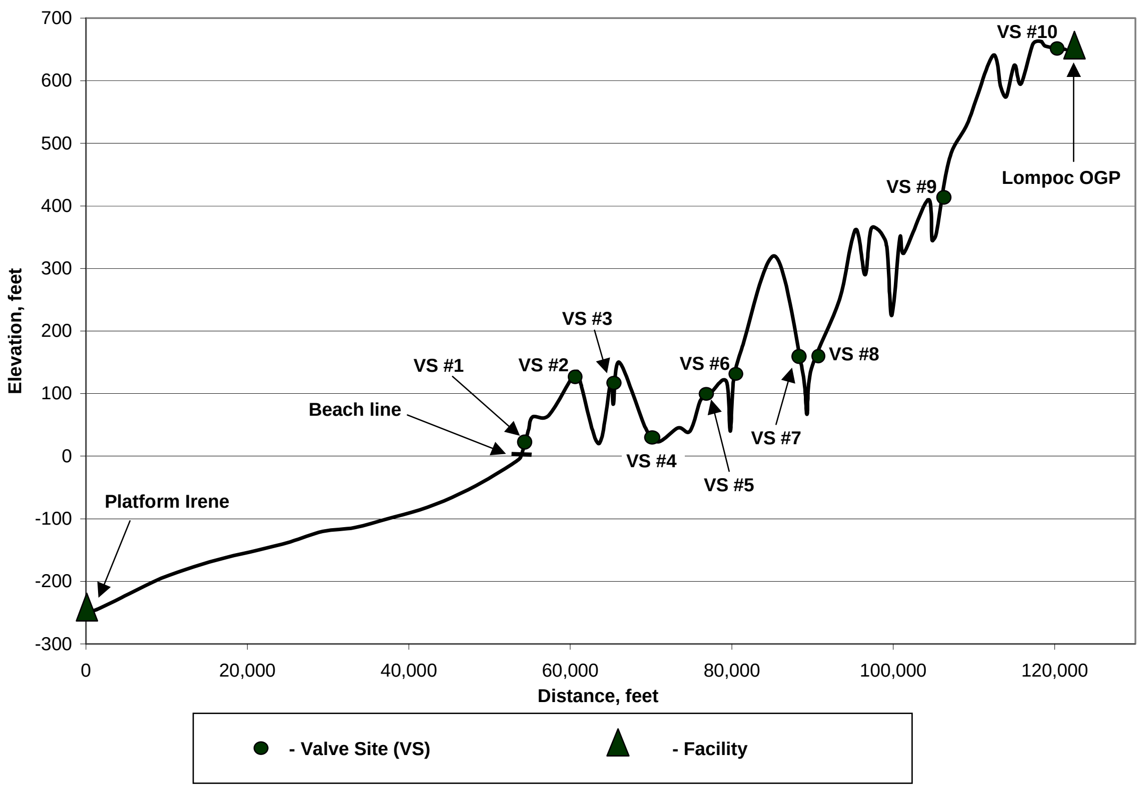


Table 2.5 Personnel Requirements for Modifications at LOGP and Valve Site #2

Position	Number of Personnel
Project Supervisor	2
Contract Crew Foreman	2
Electricians	6
Welders	6
Roustabouts	10
Equipment Operators	14
Total	**40**

Note: Includes Transformer and Power Lines modifications

Table 2.6 Equipment Requirements for Modifications at LOGP and Valve Site #2

Equipment	Number of Equipment
Medium Duty Crane	2
Backhoe	2
Welding Machines/Track Mounted	4
Concrete Trucks	2
A-Frame Trucks	3
Delivery Trucks	2
Total	**15**

Note: Includes Transformer and Power Lines modifications

The Tranquillon Ridge Project is expected to have a total life of 30 years from the time the first well is drilled. Drilling of the wells is expected to take 15 years to complete. Figure 2-7 shows the proposed schedule for drilling of the Tranquillon Ridge wells.

2.4 Extension of Life of Point Pedernales Facilities

Due to the geotechnical constraints associated with developing a coastal California Monterey oilbearing structure, estimating project life as well as ultimate recoveries is difficult without extensive production data from a number of wells. This type of data is typically not available during the permitting phase of a project. As such, the production and project life estimates made during the permitting phase are rough estimates and typically change over the course of the project's development. Other factors that affect total recoverable reserves and project life are changes in technology (e.g., enhanced oil recovery techniques), new well development technologies (e.g., directional and horizontal drilling), and the price of crude oil.

The Tranquillon Ridge Project is expected to have a total life of 15 years from the time the first well is drilled; assuming that development of the Tranquillon Ridge Field is successful. It is possible that the initial wells drilled into the Tranquillon Ridge Field may not be commercially viable. Under this scenario, the full development of the Tranquillon Ridge Field would not occur. However, for the purposes of this submittal, it has been assumed that full development of the Tranquillon Ridge Field will occur.

Based on a 15-year life for the Tranquillon Ridge Project, the Point Pedernales facilities (Platform Irene, the associated pipelines, and the LOGP) would have a total projected life of approximately 35 years (based on startup of Point Pedernales Field operations in 1987). This assumes that the first well for Tranquillon Ridge is drilled in the rhird quarter of 2008.

The 1985 Point Pedernales EIR/EIS assumed a 20-year life expectancy for Platform Irene, and a 30- to 35-year life expectancy for the pipelines and the Lompoc Oil and Gas Plant (formerly the HS&P). However, the 35 year timeframe referenced in the EIR was predicated on the use of the Point Pedernales facilities to process reserves from five additional offshore platforms located in the Central Santa Maria Basin, which were part of the document's Area Study. Two of these platforms were in the Point Pedernales Unit, one was in the Santa Maria Unit, one was in the Purisima Point Unit, and one was in the Bonito Unit. Based on improvements in drilling technology, the two additional platforms in the Point Pedernales Unit will not be needed. Full development of this unit is occurring from Platform Irene. To date, no development has occurred at the other three units. Although Exploration Plans for these three units were approved in the early 1980s, the units are under directed suspensions due to litigation.

The 20-year life expectancy of Platform Irene, assumed in the 1985 Point Pedernales EIR/EIS was based on an estimated production curve submitted by the applicant as part of its DPP submitted to the MMS in 1984. With startup in 1987 and an estimated life of 20 years, the estimate was that production would continue until 2007. Current production forecasts for the Point Pedernales Field now project that the production would continue until 2012 to 2022, which would represent a 25 to 35-year life. MMS has projected that operations for Point Pedernales Field could end sometime between 2010 and 2015 (MMS, 2004). These estimates are based on a number of assumptions that could change over time. CSLC (2001) has estimated that operations for the Point Pedernales Field would end around 2018-2022. This represents a life expectancy that is 9 to 15 years greater than what was assumed in the 1985 Point Pedernales EIR/EIS. For this submittal, Platform Irene was assumed to have a remaining life until 2017 and would produce 2000 bpd of oil over that period, with 2017 representing the mid-point of the Point Pedernales Field production forecasts by PXP (2012 to 2022) and approximate mid-point of the combined MMS and CSLC operation projections (2010 to 2022).

The 1993 Point Pedernales Supplemental EIR (SEIR), which evaluated the relocation of gas processing facilities from the Battles Gas Plant in Santa Maria to the Lompoc HS&P, assumed a life expectancy of 10 to 25 years for the new gas plant. Original estimates of Point Pedernales project life, as well as the estimated life of the Point Pedernales facilities with Tranquillon Ridge field development, are summarized in Table 2.7.

If development of the Tranquillon Ridge Project is successful, the expected life of the Point Pedernales Facilities will be extended beyond what was projected for the current Point Pedernales Field operations. However, it is uncertain how long the proposed Tranquillon Ridge Project will extend the life of these facilities. Based on the current projections for the Tranquillon Ridge Project (15-year life), the life expectancy of the Point Pedernales Facilities will be extended approximately 0 to 13 years beyond what the MMS and CSLC have projected for the Point Pedernales Field..

If the life expectancy assumed in the Point Pedernales 1985 EIR/EIS and 1993 SEIR, and the estimated project life expectancy of the Tranquillon Ridge Project are used as the basis for estimating extension of life, then the Tranquillon Ridge project will be expected to extend the life of Platform Irene by approximately 15 years, and the LOGP by zero years.

Figure 2-7 Proposed Tranquillon Ridge Field Drilling Schedule

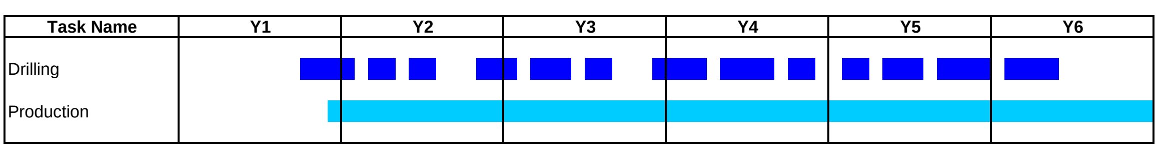


Table 2.7 Summary of Extension of Life Estimates from Environmental Documents

Existing Point Pedernales Facilities			
Project Component	**Original Estimated Life (Years)**	**Estimated Time Frame[a]**	**Source of Estimate**
Platform Irene	20	1987-2007	1985 Pt. Pedernales EIR/EIS
LOGP (HS&P) Gas Plant	30-35[b] 10-25	1987-2022 1997-2022	1985 Pt. Pedernales EIR/EIS 1993 Supplemental EIR
Tranquillon Ridge	30	2007-2037	Project Application
Estimated Increase in Life with Tranquillon Ridge			
Project Component	**Estimated Total Life (Years)**	**Estimated Total Time Frame**	**Net Increase in Life (Years)**
Platform Irene	35	1987-2022	15[c]
LOGP (HS&P)	35	1987-2022	0[d]

a Current production forecasts (MMS 2004 and CSLC 2001) show a current estimated Point Pedernales project life extending to between 2010 to 2022. Thus, the original project life for Platform Irene may have been underestimated by approximately 3 to 15 years.
b This estimate goes beyond permitted development levels, and was predicated on the development of up to six offshore platforms located in the Central Santa Maria Basin.
c. Assuming the estimated life of Platform Irene was through 2007, the Tranquillon Ridge Project would extend the life of the platform by 15 years.
d. Assuming the estimated life of the LOGP was through 2022, the Tranquillon Ridge Project would not extend the life of the LOGP.

2.5 References

Arthur D. Little, Inc. (ADL). 1985. Final Environmental Impact Statement/ Environmental Impact Report Union Oil Project/Exxon Project Shamrock and Central Santa Maria Basin Area Study. Prepared for the County of Santa Barbara, U.S. Minerals Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development. SCH #84062703, SBC #84-EIR-7, OCS Study MMS #85-0020, and SLC-EIR #379. June.

Santa Barbara County (SBC). 2002. Final Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project, LOGP Produced Water Treatment System Project, and Sisquoc Pipeline Bi-Directional Flow Project. Prepared by Arthur D. Little, Inc., Marine Research Specialists, and Science Applications International Corporation. SCH #2000071130, EIR #01-EIR-04. June.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

3.0 Proposed Project Environmental Evaluation

This section of the document presents the environmental baseline and project-specific impacts for the issue areas that were identified as having the potential for new environmental impacts. For each issue area the potential impacts are discussed along with mitigation measures. Each impact analysis discussion also includes a table comparing the impacts associated with the proposed project to the impacts identified in the 1985 Union Oil Project/Exxon Project Shamrock and Central Santa Maria Basin Study EIS/EIR (Point Pedernales EIS/EIR).

3.1 Oceanography

This section describes the physical oceanography and regional meteorology in the southern Santa Maria Basin (SMB) where the offshore activities of the proposed project would take place. These processes largely determine the proposed project's marine impacts. The physical oceanography and meteorology of the region have previously been described by the Minerals Management Service (MMS 2001, 2003, 2005ab). The additional directional drilling and production from Platform Irene are not expected to materially affect the oceanic flow field or meteorological conditions in the project area. However, periods of extreme wind or sea conditions could limit or delay cleanup of an offshore oil spill. Also, surface currents and winds dictate the trajectory of oil accidentally spilled in the marine environment as a result of the proposed project. Subsurface flow disperses drilling muds, cuttings, and produced water discharged from Platform Irene. Subsurface flow also affects the initial dispersal of oil spilled on or near the seafloor, such as would occur during a pipeline break. The oceanic flow field also establishes the baseline physical and chemical properties of the receiving waters.

3.1.1 Environmental Setting

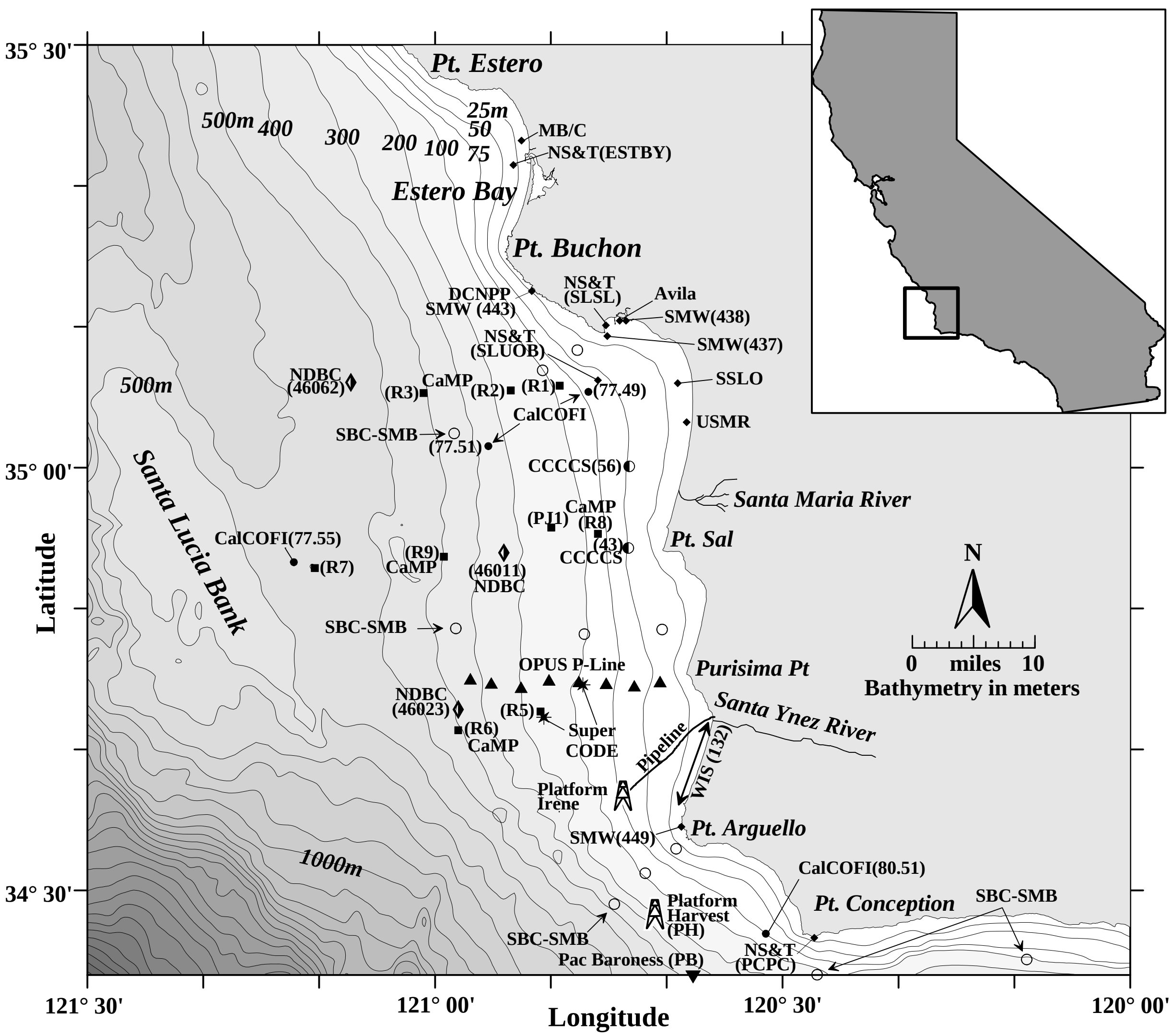
Platform Irene lies 4.7 miles from shore, and approximately 6 miles west of Point Pedernales in an oceanographically complex region. Flow around the platform constantly changes in response to competing geophysical forces. The proposed project's 15 years of drilling would encompass a broad range of meteorological and oceanographic conditions including major El Niño events that significantly alter the ocean environment over year-long periods. During drilling, muds and cuttings would be discharged into the ocean environment surrounding Platform Irene. An additional 15 years of production would bring the field to its economic limit. During that time, the discharge of large volumes of produced water is proposed.

Extending the ongoing offshore operations of Platform Irene by an additional 10 to 30 years also increases the risk of a project-related oil spill in marine waters. Meteorologic and oceanographic conditions determine the trajectory of these oil spills and their effects on specific biological communities. Resources within marine waters that would be affected by an oil spill are specified in the Central Coast Basin Plan (RWQCB 1994) and are discussed in more detail in Section 3.4, Water Quality, and Section 3.5, Biological Resources.

3.1.1.1 Sources of Data

A large number of oceanographic studies have been conducted on the continental shelf adjacent to Platform Irene. Figure 3.1-1 shows the location of measurements collected during the field studies listed in Table 3.1.1. Taken as a whole, these studies adequately characterize regional oceanographic processes and water-quality properties in the region. However, individual studies are not sufficiently comprehensive for a complete environmental assessment and some of their limitations are outlined below. Technical results from these individual studies are assimilated in the subsections that follow.

Figure 3.1-1 Location of Oceanographic Studies Conducted Near Platform Irene



Acronyms for the studies shown in this Figure are defined in Table 3.1.1

Table 3.1.1 Oceanographic Data Collected in the Studies Identified in Figure 3.1-1

Acronym	Study Title	Benthic Biology	Current Flow	Winds & Climatology	Waves	Sediment Chemistry	Water Quality	Tissue Body Burden	Coliform
Avila	Avila Beach County Water District								X
CalCOFI	California Cooperative Oceanic Fisheries Investigations[1]						X		
CaMP	California Monitoring Program[2]	X	X	X	X	X	X		
CCCCS	Central California Coastal Circulation Study[3]		X	X			X		
DCNPP	Diablo Canyon Nuclear Power Plant	X	X			X	X		
MB/C	Morro Bay/Cayucos Offshore Monitoring[4]	X	X			X	X		X
NDBC	NOAA Data Buoy Center[5]			X	X				
NS&T	NOAA National Status & Trends (Mussel Watch)[6]					X		X	
OPUS	Organization of Persistent Upwelling Structures[7]		X	X			X		
PB	Pac Baroness Survey[8]	X				X		X	
PH	Platform Harvest[9]			X	X				
SCODE	SuperCODE[10]		X	X					
SBCh-SMB	Santa Barbara Channel – Santa Maria Basin Coastal Circulation Study[11]		X	X					
SMW	State Mussel Watch[12]							X	
SSLO	South San Luis Obispo County Sanitation District[13]	X				X			
USMR	Unocal Santa Maria Refinery[14]	X	X						
WIS	Wave Information Study[15]				X				

[1] *SIO 2000, 2006.*
[2] *Hyland et al, 1990; Coats et al. 1991; Savoie et al. 1991; Steinhauer et al. 1994*
[3] *Chelton et al, 1987; Chelton et al. 1988.*
[4] *MRS 1996; 2006.*
[5] *NODC 1992.*
[6] *BOS 1991a.*
[7] *Atkinson et al. 1986.*
[8] *Hyland et al. 1989.*
[9] *Seymour 1996.*
[10] *Denbo et al. 1984.*
[11] *Hendershott and Winant 1996.*
[12] *SWRCB 1988.*
[13] *ABC 1995.*
[14] *KLI 1996.*
[15] *Jensen et al. 1989.*

Santa Barbara Channel – Santa Maria Basin Coastal Circulation Study (SBCh-SMB)

This multi-year observational study ending in 2005 was conducted by Scripps Institution of Oceanography under the auspices of the MMS (SIO 2006). Measurements, which included current-meter moorings, surface drifters, and hydrographic transects, emphasize a description of the surface circulation within the Santa Barbara Channel (SBCh). Interim results from the study have been summarized by Dever et al. (1998), Harms and Winant (1998), Hendershott and Winant (1996), and Winant et al. (1999). Results from these measurements have been incorporated in the MMS Oil Spill Risk Analysis (OSRA) numerical model used to compute oil-spill trajectories and risk of impingement on coastlines. As described in the following sections, there are discrepancies between the model results and drifter data.

The MMS sponsored a related modeling investigation of the flow regime within the SBCh (Gunn et al. 1987). Although flow-field results do not encompass the SMB where Platform Irene lies, oil spills associated with the proposed project could be transported into the SBCh. Also, potential spills from the existing offshore oil facilities within the SBCh could have a cumulative effect on the marine environment along the shorelines surrounding the proposed project. Fifteen current-meter moorings were deployed in the SBCh during 1984 to initialize the circulation model. These data were augmented by five hydrographic surveys and three surface-drifter studies.

Wave Information Study (WIS)

In late 1976, the U.S. Army Corps of Engineer's Waterways Experiment Station embarked upon a Wave Information Study (WIS) to establish the wave climatology for U.S. coastal waters. In March 1989, the seventeenth in a series of reports was published which presented hindcast shallow-water wave data for 134 shoreline segments north of Point Conception (Jensen et al. 1989). Coastline Section Number 132 extends between Point Arguello and Purisima Point and encompasses the shoreline adjacent to Platform Irene and the landing site for the offshore pipeline that transports crude oil to the LOGP. Wave statistics were computed at a depth of 10 m from atmospheric pressure and wind velocity data collected over a 20-year period. These near-shore wave statistics were derived from offshore wave climatology that excluded waves generated by distant tropical storms and southern-hemisphere swell. A new Pacific basin hindcast for 1995-2004 has been done. Wave models based on wave buoy data recently were assessed using satellite altimeter data (Baird and Associates, 2005).

Platform Harvest

A directional wave gauge array was installed on Platform Harvest in 1992. Although the wave record is limited compared to the WIS, it measures all incident waves regardless of origin, including those from tropical and southern-hemisphere storms. Also, the array is capable of high directional resolution on the order of 1 degree (°). Seymour (1996) provided a deep-water summary of wave climatology based on data from this and other wave gauges.

NOAA Data Buoy Center (NDBC)

Two NDBC ocean buoys have collected meteorological and oceanographic over a long period near the project area. NDBC Buoy 46023 lies northwest of Point Arguello and is the closest buoy to Platform Irene. A smaller NDBC buoy (46011) lies directly offshore of Point Sal in shallower water. Finally, Buoy 46062 lies southwest of Point Buchon. Wind climatology from these and other NDBC buoys has been summarized by Caldwell et al. (1986), Miller et al. (1991), Dorman and Winant (1995), and Winant and Dorman (1997), and Cudaback et al (2005). Data from buoy 46011 also was summarized recently by Goericke et al. (2004, 2005).

California Cooperative Oceanic Fisheries Investigations Program (CalCOFI)

The California Cooperative Oceanic Fisheries Investigations (CalCOFI) program was organized in the late 1940s and constitutes one of the most extensive long-term hydrographic data sets in existence. CalCOFI Line 80 is a cross-shelf transect that extends offshore from Point Conception. Line 77 lies to the north and extends offshore Point Buchon. Data on salinity, temperature, oxygen, nutrients (silicate, phosphate, nitrate, and nitrite), and primary productivity have been collected for decades along these CalCOFI lines (SIO 2000). Between 1955 and 1971, drift bottles were released in this area and those data are summarized by Crowe and Schwartzlose (1972), Schwartzlose and Reid (1972), and Reid (1965). More recently, the CalCOFI hydrographic data has been used to describe the central-coast flow regime by Chelton (1984) and Hickey (1979). The state of the California Current using data that includes data collected along Line 77 and Line 80 is summarized yearly in CalCOFI Reports. Recent summaries include Goerkicke et al. 2004, 2005; Venrick et al. 2003; and Schwing et al. 2002.

Organization of Persistent Upwelling Structures Program (OPUS)

The Organization of Persistent Upwelling Structures (OPUS) program was designed to synoptically sample the physical and biological processes associated with a localized persistent upwelling system near Point Arguello (Atkinson et al. 1986). Current meter moorings were deployed offshore of Purisima Point and hydrographic observations and current-velocity profiles were collected in the winter of 1983 when anomalous oceanographic conditions associated with an El Niño were extant (Brink and Muench 1986; Barth and Brink 1987; Dugdale and Wilkerson 1989).

California Monitoring Program (CaMP)

The MMS and the National Biological Service performed long-term oceanographic studies in the southern SMB between 1983 and 1995. This California Monitoring Program (CaMP) investigated the fate and effects of petroleum development activities in the region between Point Arguello and Point Conception (Hyland et al. 1990). Long-term current-meter moorings were deployed to augment water quality, sediment chemistry, and marine biological measurements. The influence of wind forcing and transient eddies on the local flow regime and upwelling was examined by SAIC (1995), Savoie et al. (1991), Bernstein et al. (1991), and Coats et al. (1991).

Central California Coastal Circulation Study (CCCCS)

The MMS-sponsored Central California Coastal Circulation Study (CCCCS; Chelton et al. 1987) was conducted along the central California continental shelf and slope between Point Conception and San Francisco Bay. Extensive hydrographic (water property) surveys were conducted over 18 months in 1984 and 1985 in conjunction with moored current meter and surface drifter deployments along the south central coast. Results from the CCCCS were presented by Chelton et al. (1988) and drifter data was presented by Chelton (1987).

State Mussel Watch Program (SMWP)

The State Mussel Watch Program is a long-term marine water quality monitoring program administered by the State Water Resources Control Board (SWRCB) and conducted by the California Department of Fish and Game (CDFG). The SMWP was organized to provide a uniform statewide approach to the detection and evaluation of the occurrence of toxic substances in the waters of California's bays, harbors, and estuaries through the analysis of mussels and clams. Pollutant concentrations in marine organisms have been measured at a number of sites since 1977. Figure 3.1-1 shows that sampling Station 449 at Point Arguello is closest to Platform Irene and is within the Tranquillon Ridge Field (SWRCB 1988, 2001). In more recent years, the SMW focused on sampling polluted areas. Station 449 has not been sampled since 1978. Station 450 at Point Conception was sampled most recently in 1991 (SWRCB, 1995).

National Status and Trends (NS&T)

The goal of the National Status and Trends (NS&T) Program is to quantify the current status of environmental quality of U.S. coastal waters. The Mussel Watch component of the NS&T Program analyzes contaminants both in the California mussel (*Mytilus californianus*) collected at 29 sites along the west coast of North America, and in the edible blue mussel (*Mytilus edulis*) collected at 31 sites. California mussels were collected in 1990 within the Tranquillon Ridge Lease Area at Station PCPC off Point Conception (Figure 3.1-1; BOS 1991). Another component of the NS&T Program is the Benthic Surveillance Project which collected and analyzed surficial sediment chemistry at a number of sites along the California coast, including site SLUOB within San Luis Obispo Bay located north of the project area (Figure 3.1-1). Benthic Surveillance data was collected at most sites between 1984 and 1988. Sediments at Site SLUOB were collected in 1988. Since that time, sediment collection ceased at sites where sediment had been sampled in a prior year. NOAA continues to sponsor the collection and analysis of mussel tissue nationwide. Site SLUOB has not been sampled since 1988.

Monitoring of Coastal contaminants using Sand Crabs

Recently the Central Coast Regional Water Quality Control Board has investigated the use of sampling the contaminant levels in the sand crab, *Emerita analoga*, as a way of monitoring for pollutants (Dugan et al., 2005). The pilot studies included samples of sand crabs at Surf Beach and Jalama in the general vicinity of the Tranquillon Ridge Project.

NPDES Monitoring Programs (Avila, DCNPP, MB/C, SSLO, SMR)

A number of point source discharges are located along the south central coast of California. These discharges provide a valuable long-term source of data on sediment and water quality near the study area because water quality monitoring is usually required when wastewater is discharged into the ocean through an outfall. However, because the monitoring for these discharges is conducted around a point source, results are limited spatially.

The South San Luis Obispo County Sanitation District (SSLO) discharges wastewater through an outfall in 60 feet of water offshore of Oceano. They conduct benthic surveys that include biological assessments and physicochemical analyses of sediments around the outfall on a triennial basis (ABC 1995).

The Santa Maria Refinery Ocean Monitoring Program (SMR) is conducted near an ocean outfall extending 2,000 feet offshore of Oso Flaco Lake south of Oceano. The outfall was completed in 1954 and benthic monitoring has been conducted since the initial discharge (Rechnitzer and Limbaugh 1956, 1959). Early studies included current measurements and fluorescent dye studies in addition to marine biological surveys. Recent NPDES monitoring focused only on benthic measurements (KLI 1996).

Other NPDES water-quality monitoring programs are conducted by the City of Morro Bay and Cayucos Sanitary District (MB/C) and Avila Beach dischargers (MRS 2006). The Diablo Canyon Nuclear Power Plant also conducts an extensive monitoring program around its thermal discharge although distribution of monitoring reports is limited.

Platform Discharges Monitoring Programs
In 1989, MMS, Pacific OCS Region and EPA Region 9 signed a Memorandum of Agreement (MOA) detailing the role each agency would play in conducting NPDES inspections and sampling at the offshore oil and gas platforms (MMS 2005). A workplan is created annually by EPA and MMS that gives the details of the inspection and sampling efforts and includes the number, location, and type of samples to be taken. Inspections and sampling are unannounced.

3.1.1.2 Oceanographic Setting

An abrupt change in coastline orientation occurs between Point Arguello and Point Conception (Figure 3.1-1). This large-scale change in coastal configuration induces much of the complexity in wind, wave, and oceanic flow fields near the Platform Irene. Coastal isobaths are aligned along a north-south axis in the southern SMB and Platform Irene lies at the southernmost reaches of the basin. To the southeast, the coastline of the Santa Barbara Channel (SBCh) is oriented along an east-west axis. The Tranquillon Ridge Field lies within the transition zone between the SMB and SBCh. Within this area isobaths are aligned along a northwest-southeast axis.

This coastal transition zone is influenced by markedly different physical processes than those that dominate within the two adjacent regions. Along the central California coast to the north, physical processes are strongly influenced by seasonally varying winds that blow uniformly to the south over a wide geographic area. The large-scale oceanic flow field beyond the continental slope is dominated by the southward-directed California Current. Waves generated over a large fetch impinge on the coastline from directions that encompass an azimuth of effectively 180 degrees. In contrast, the SBCh is sheltered from waves generated by distant storms to the north and the Channel Islands limit wave propagation from the south. Similarly, the east-west coastal configuration blocks the large-scale southward-directed winds that prevail outside the SBCh. Finally, the California Current separates from the coast near Point Arguello leaving other processes to control the flow within the Channel.

Despite their complexity, it is important to quantify physical processes within the project area. Surface flow fields determine the transport of spilled oil and the likelihood of impingement on adjacent coastlines. Subsurface flows dictate the transport and dispersion of additional drilling fluids that would be discharged from Platform Irene during the proposed drilling. They also determine the fate and effects of additional produced waters discharged from the platform during the production phase. Finally, the sea state, as determined by prevailing winds and waves, affects the efficacy of oil-spill contingency plans that rely on chemical dispersants or containment for cleanup.

Ocean Circulation
The flow field near the project area is influenced by a number of competing physical processes. Processes operating on the open-ocean flow field at distant locations exert their influence locally through major ocean currents that traverse the North Pacific Ocean. Beyond the continental slope (>100 km) to a distance of ~1000 km, the diffuse southward-flowing California Current represents the eastern limb of the clockwise-flowing gyre that covers much of the North Pacific Basin. Before turning south to form the California Current, subarctic water is carried along at high latitudes and is exposed to precipitation, atmospheric cooling, and nutrient regeneration. As a result, waters of the California Current are characterized by a seasonably-stable low salinity (32 to 34%), low temperature (13°C to 20°C), and high nutrient concentrations. They undergo less

seasonal variation than surface waters at similar latitudes on the eastern seaboard. The California Current exhibits the strongest speeds near the surface and extends to at least 500 m depth.

Immediately shoreward of the California Current, along the central California continental slope and shelf, a narrow, weaker surface northward flow persists. This current is known as the California Countercurrent south of Pt. Conception, and the Davidson Current north of Pt. Conception. The northward flowing Davidson Current carries water out of the western end of the SBCh. The southern origin of the waters of the Davidson Current makes them warmer, more saline and less oxygenated than the offshore waters of the California Current. The northward-flowing Davidson countercurrent exhibits strong seasonal variability in intensity but maintains a sustained northward flow at depth in the SMB despite reversals observed elsewhere along the California coast (Chelton et al. 1988; Coats et al. 1991; Hendershott 2001).

Another narrow northward flow, the California Undercurrent, extends the length of the coast along the continental slope. Seasonal maxima in current speeds are usually in summer to early fall for the California Current and California Undercurrent, and in winter for the California Countercurrent/Davidson Current.

There are three major current flow regimes that occur in the SBCh-SMB area: the upwelling flow regime, cyclonic flow regime, and the relaxation flow regime. These regimes are driven by the alternately weakening and strengthening of the northwest wind along the California coast and the opposing northward, alongshore pressure gradient (MMS 2003). The alongshore pressure gradient is due primarily to density differences between warm, saline Southern California Bight waters in the Davidson Current and cold, fresher waters of the central California coast. Although all three flow regimes occur throughout the year, they tend to dominate on a seasonal basis.

In spring, from late February to early June, when the prevailing northwest winds are strongest, the upwelling flow regime dominates. During upwelling, surface water near the coast is transported offshore and is replaced by cool, nutrient-rich water from deep offshore. At this time, the Davidson Current weakens and can even turn southward near the sea surface. Consequently, a strong southerly current and wind flow exists in the SMB and a southeasterly wind and current flow exists in the SBCh. During an upwelling flow regime the surface current flows are typically to the south and southeast in the project area and a weak western flow typically persists along the SBCh mainland. On average, winds are directed toward the south, parallel to the coast (Dorman and Winant 1995).

Similarly, during the summer and early fall, opposing northwest winds and alongshore pressure gradients are equally strong, and the cyclonic flow regime dominates. A strong counter-clockwise gyre is generated in the western half of the SBCh and a strong southerly current flow persists in the project area.

In contrast, during late fall and winter, between December and February, the alongshore pressure gradient is strong and the winds off the central California coast are weak, and at times, variable. This results in domination by the relaxation flow regime. The northward-flowing Davidson Current is strongest when these southward winds relax. Surface currents are strongly to the west along the SBCh mainland, turning northwest at Pt. Aruguello and proceeding north along the central California coast. Currents along the northern shores of the Channel Islands continue to flow eastward, but are relatively weak. In the project area, surface currents are generally to the west and northwest, and surface winds are weak and variable (MMS 2003).

Significant interannual (year-to-year) variations in oceanographic properties and marine zoogeography also occur within the SMB. These large amplitude variations are associated with the El Niño - Southern Oscillation, which cycles at a period of 3 to 5 years (Graham and White 1988). During El Niño periods, such as between 1997 and 1998, basin-wide changes in the dynamic balance of wind-driven currents results in modified flow patterns along the coastline of western North and South America (Chelton et al. 1982; Dever 2001a). Changes within the SMB include an anomalous strengthening of Davidson Current outflow from the SBCh. This increased outflow carries warm, saline sub-tropical waters northward into the SMB and coincides with increased winter storm activity, reductions in zooplankton biomass, and the introduction of tropical marine organisms typically found much farther south.

Superimposed on these large-scale oceanic flows are a variety of transient phenomena including intense eddies, swirls, filaments, meanders, and narrow jets of flow. These mesoscale (medium-sized) turbulent features are often observed in satellite imagery and are capable of transporting significant quantities of heat, nutrients, and pollutants to offshore waters (Savoie et al. 1991). Winds, tides, and waves also mix and transport nearshore waters within the surfzone. Tidal currents mix ocean waters near the coast, although they are not responsible for significant net transport. At shorter periods, shoaling internal and surface gravity waves mix coastal seawater in both the horizontal and vertical directions. Because of the semi-arid climate, substantial drainage from onshore is rare and regional water properties are largely determined by oceanographic processes. Nevertheless, river runoff during intense winter storms can significantly impact marine waters within localized areas of the California coast, including the southern SMB (Hickey 2000).

Long-term current monitoring near Point Arguello has yielded a consistent picture of the flow near the project area (SAIC 1995; Savoie et al. 1991; Bernstein et al. 1991; Coats et al. 1991). While subsurface currents are directed toward the northwest throughout the year, monthly-averaged surface currents reverse during spring upwelling when southward directed winds intensify. Between approximately April and June, isolated two-to-five-day events of intense southward winds are followed, after approximately 17 hours, by southward current flow that has an offshore component (Savoie et al. 1991). The intensification of southward winds also causes upwelling that can be seen in satellite imagery as a cold-water plume extending offshore near Point Conception (Svejkovsky 1988; Sheres and Kenyon 1989). These distinct upwelling events increase the rate of new biological production (Dugdale and Wilkerson 1989) and affect the distribution of water-mass properties (Reid 1965).

The flow regime within the transition zone immediately south of the SMB differs from the rest of the California coast. To the north, surface flows are predominantly southward throughout the year (Strub et al. 1987ab; Hendershott 2001). However, distant forcing, in the form of sea-level differences, contributes significantly to the flow dynamics within the southern SMB and SBCh. Because the SBCh is relatively sheltered from the strong southeastward-directed prevailing winds, the influence of the sea-level differences is revealed in the predominantly counterclockwise flow pattern (Caldwell et al. 1986; Brink and Muench 1986; Harms and Winant 1994, 1998). The influence of sea-level differences are particularly evident within the southern SMB and SBCh when southward-directed upwelling winds along the central coast relax (Hendershott 2001).

Surface Transport

The fate and effects of accidental oil spills that could be caused by the proposed project are largely dictated by transport along the ocean surface. Even seafloor releases from the 20-inch crude-oil pipeline that extends onshore from Platform Irene would rapidly rise to the sea surface. Precisely such a spill occurred along this pipeline in 1997 when somewhere between 163 and 1,242+ barrels of crude flowed from a break located midway along the line. Most of the crude remained offshore but some of the spilled crude washed ashore along a 15-mile stretch of beach near the mouth of the Santa Ynez River where the pipeline reaches landfall (See Figure 3.1-1).

The trajectories of drifters released near the project area generally reflect the surface flow patterns measured by long-term current-meter moorings (Crowe and Schwarzlose 1972; Schwartzlose and Reid 1972; Chelton 1987; Winant et al. 1999). Namely, northwestward transport is observed throughout much of the year except during strong upwelling events that are most prevalent between April and June. Prevailing winds near Point Arguello are directed to the southeast except during brief, 3- to 4-day periods when winter storms disrupt the normal pattern as they pass through the region. More extended periods of northward- or eastward-directed winds also occur but on the whole, these wind conditions occur only approximately 10% of the time. Surface currents near the project area are generally directed to the northwest, in opposition to, and uncoupled with the prevailing southeastward winds (Savoie et al. 1991; SAIC 1995). During the spring and early summer, brief episodes of intensified southward-directed winds result in a reversal of surface currents. For periods of up to a week, near-surface flows turn toward the southeast in opposition to the northwestward current direction that is maintained throughout most of the water column.

The opposing directions of the wind and surface currents near Point Arguello are evident in drifter studies. CalCOFI drifter bottles released north of the SBCh in December 1969 migrated northward at speeds exceeding 15 cm/s. However at other times of the year, drift bottles released near Point Conception were recovered both to the north and to the south near San Diego. For release points near Point Arguello in 1984, many of the CCCCS surface drifters traveled south in response to strong southward directed winds (Chelton 1987). It was only during a brief period when southward winds weakened in July that the majority of drifters moved northward. However, the CCCCS drifter design is susceptible to a downwind motion of approximately 0.5% of the wind speed and thus may not accurately represent surface currents alone.

The drifters used in the SBCh-SMB coastal circulation study were designed to minimize the influence of wind and wave drift in favor of tracking surface currents over a depth of approximately 1 m (Davis et al. 1982). As a result, flow statistics derived from the drifters compared well with that of the moored current meters (Dever et al. 1998). Discrepancies in mean flow direction have been ascribed to sampling bias (Dever 2001b). Beginning in January 1995, many of these drifters were deployed within the SMB, including locations near the Tranquillon Ridge Field. Few of the drifters released near the Point Arguello – Point Conception region beached before exiting the region (Dever et al. 2000; Winant et al. 1999). In a manner consistent with the long-term current meter data collected as part of CaMP, initial offshore movement was followed by northward movement into the SMB in fall and winter. Spring and summer deployments were more likely to show southward flow toward San Miguel Island. Few drifters moved eastward into the SBCh.

The complex interaction between winds and surface currents near Point Conception makes predictions of oil spill trajectories difficult. During much of the year, but especially in the fall and winter, the northwestward surface flow is in direct opposition to the prevailing winds. Certainly these surface currents, as determined by current meters and drifters, have a direct bearing on the fate and effects of potential oil spills resulting from the proposed project. However, winds also influence the spread and trajectory of oil slicks on the sea surface. Empirical data from the open ocean suggests that leading edge of an oil slick would drift at approximately 3% of the wind speed and oil-following drifters have been evaluated based on their ability to match this "3% rule" (Reed et al. 1988). However, there is no rigorously defensible theoretical basis or empirical data to support the application of this rule in coastal flow regimes. In the literature, estimates of the influence of wind on surface oil slicks vary from 1% to 6%. Part of the difficulty in estimating wind influence is that winds also drive ocean currents that move oil slicks and the two effects cannot always be easily separated.

An oil-spill risk analysis was performed using the MMS numerical (OSRA) model for the SBCh area (Arguello Inc. 2000). It calculated probabilities of shoreline impact after applying a drift equivalent to 3.5% of the prevailing wind velocity in its trajectory computations. Because of the heavy influence of southward-directed winds near Point Conception, the model results indicated that the probability of shoreline impacts along the Channel Islands to the south was far higher than at sites along the central coast to the north. The influence of southward directed winds in the model effectively overcame the northwestward surface currents observed throughout much of the year in the field programs (Browne 2001). In addition, current averaging weakened the influence of northward-directed currents in the model. This contrasts with drifters deployed during the SBCh-SMB coastal circulation study, which tended to travel toward the south only approximately 31% of the time and only approximately 15% of these intersected the shoreline.

Clearly, the complexity of opposing winds and currents near the project area makes the reconciliation between OSRA model results and observations difficult. Because the applicability of the "3% wind rule" in complex coastal flow regimes has not been rigorously quantified, this environmental assessment should entertain the possibility for spilled oil to travel from the project area toward the north. In particular, if the spill occurs during a period when southward-directed winds weaken or clock around to the north, oil transport will be dominated by the prevailing northward surface current flow.

Similarly, the environmental assessment for the proposed project should not rely solely on shoreline impact probabilities determined exclusively from available drifter trajectories. Drifters, with their measurable mass and finite vertical profile below the sea surface, cannot capture the behavior of an oil slick that is typically only a few millimeters thick (Reed et al. 1988).

Furthermore, dispersion and weathering affect the spread of oil on the sea surface, and buoys cannot capture the changing slick dynamics across a wide range of winds, waves, and currents. Goodman et al. (1995) and Simecek-Beatty (1994) tested the oil-tracking ability of several drifter designs, including the Davis et al. (1982) design used in the SBCh-SMB coastal circulation study. They found that Davis-type drifters lagged behind simulated oil slicks presumably because they are optimized to track surface currents with minimal influence by winds and waves. In cases where winds opposed surface currents, the Davis-type drifters moved into the prevailing wind and in a direction opposite of the simulated oil slicks made from wood chips. This is similar to the case in the southern SMB where the northward-flowing Davidson current often opposes the prevailing southward-directed winds.

Subsurface Transport

Subsurface currents are more important in determining the fate of drill muds and produced water discharged from Platform Irene. As described in Appendix D of the FEIR (SBC 2006), drill-muds depositional patterns are less influenced by surface flow direction or the opposing winds. Consequently, drill-muds transport estimates are not subject to the same discrepancies between observations and modeling as are oil-spill trajectories. The subsurface flow in the project area is predominantly upcoast, regardless of the intensity of the southward-directed upwelling winds (Savoie et al. 1991; Hendershott 2001). Drilling muds discharged at depth from the Platform Irene would be preferentially transported to the north. This finding has been independently confirmed through a comparison of muds-trajectory modeling and drill-muds accumulations within seafloor sediment traps near platforms to the south of the project area (Coats 1991) and for Platform Irene itself (Appendix D of SBC 2006). On Platform Irene, drill muds would be discharged at a depth of 46 m (150 feet) below the sea surface. The modeling results in Appendix D (SBC 2006) predicted that about half of the drilling mud would be deposited over a 9-km^2 area within about 1.7 km of the platform. Over 80 percent of the mud would be deposited within a 40-km^2 area within about 3.6 km of the platform. Less than 0.4 percent of the mud would travel farther than 10 km before being deposited on the seafloor. If produced water is discharged from the platform, the discharge point is at a depth of 55 m (180 feet) where it would remain nearly neutrally buoyant (Brandsma 2001).

Mesoscale Flow Variability

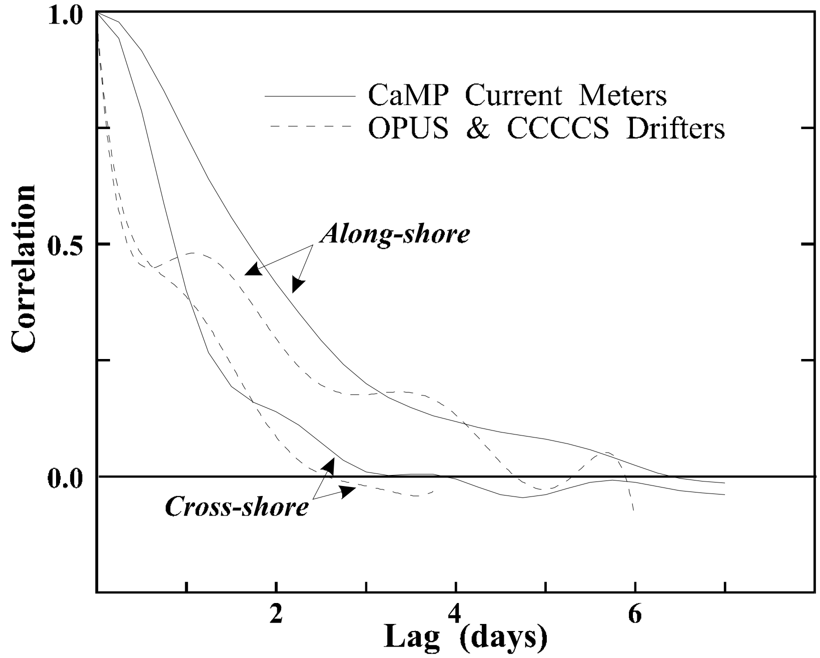
Energetic fluctuations are superimposed on the mean flow fields described above. These fluctuations arise from transient eddies that propagate along the central coast and cause periodic reversals in flow direction (Savoie et al. 1991). Short-duration contaminant discharges are likely to be entrained within a single eddy as it propagates along the coastline while longer-duration discharges are likely to impact a wide number of mesoscale flow features, and therefore larger areas of the ocean.

The persistence of these central-coast flow features can be determined from the time-lagged correlations shown in Figure 3.1-2. Over periods of less than two days, flow velocities remain somewhat coherent as a relatively slow-moving eddy or jet propagates along the coast. Between two and six days, the velocity fields de-correlate under the influence of multiple mesoscale features. This indicates that contaminants discharged over periods longer than two days would influence wider regions of the coastal flow field and would be carried within a greater number of independent flow cells.

Wave Climatology

The ambient sea state at the time of an oil spill determines the effectiveness of dispersants and booms deployed to contain the oil offshore (Lunel 1995). Upon reaching the coastline, high surf determines the intertidal distribution of oil and the ability of cleanup crews to reach the affected area.

Figure 3.1-2 Time-Lagged Correlation of Velocity from Near-Surface Moored Current Meters (Solid) and from Surface Drifters (Dashed) Along the Central Coast (Adapted from Coats 1994)



As with the flow field, wave climatology in the southern SMB reflects a transition from the sheltered environment of the SBCh and the exposed coastal region of the central California coast. Maximum design wave heights for 100-year return periods along the central California coast are 60 feet compared to 45 feet in the SBCh. Offshore platforms built within the SBCh do not have to withstand the same level of wave forces because of the sheltering effects from the Channel Islands and the orientation of the coastline (API 1987). Without the benefit of island sheltering, Platform Irene experiences comparatively high structural loading from waves. Along the adjacent shoreline, energetic wave action forms a harsh intertidal environment for benthic organisms although the influence of waves generated by intense winter storms traversing far to the north is limited by the orientation of the coastline. Nevertheless, as a result of the comparatively high energy flux in the surf zone, intertidal organisms along sand beaches tend to be burrowers adapted to high turbidity and mechanical disturbance. The high wave-energy flux has enhanced erosion along this section of the California coast and much of the shoreline consists of rocky bluffs rather than the sand beaches that are prevalent in the SBCh.

Four primary meteorological sources generate waves in the SMB: extratropical winter cyclones in the northern hemisphere, northwesterly winds during the spring transition and summer, tropical disturbances offshore Mexico, and extratropical storm swell generated in the southern hemisphere during summer. The first two are the primary sources for the wave climate along the central California coast although the last two occasionally generate significant swell from the south.

Winter Storm Waves: These waves are generated by extratropical winter cyclones and are often accompanied by local rainfall along the coast. Extratropical storms are associated with low-pressure systems that develop along the polar front in the Pacific Ocean and propagate westward toward the central coast. Thus, major wave events often coincide with an increased marine discharge of terrestrial sediments eroded by heavy rainfall. These storms occur predominantly in winter (December through March; Noble Consultants 1995).

Northwesterly Winds: With the exception of major winter storm events, the principal mechanism for generating waves over the central California continental shelf is prevailing northwesterly winds. These winds dominate during the spring and summer when a high-pressure system is established over the eastern North Pacific Ocean. The winds are highly coherent along the central coast and generate wind waves over a large fetch (Chelton et al. 1987). These locally generated waves tend to be of shorter period and smaller significant wave height than those generated by major winter storms.

Southerly Swell: Large swell generated to the south can occur on occasion during summer months. One large event occurred in late July 1996 from a storm 400 miles south of Tahiti. The Harvest Platform wave gauge recorded significant wave heights of over 2 m. These long period waves (20-s significant period) arrived from directions ranging between 200°T (degrees from True north) and 230°T. Nevertheless, major wave events arriving from south are rare, so deepwater wave climatology is directionally bimodal with the majority of events arriving directly from the west (270°T) or from the northwest (300°T) (Seymour 1996).

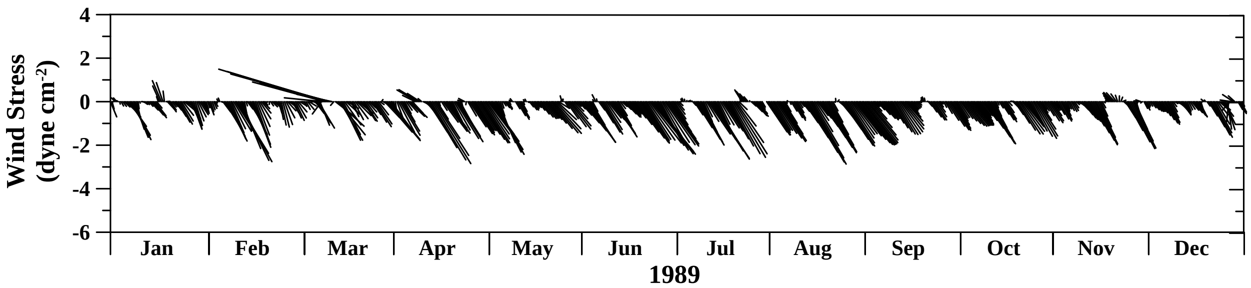
Deepwater waves arriving from certain directions never reach some coastal locations because of their coastline orientation and the presence of major coastal promontories such as Point Arguello and Purisima Point (see Figure 3.1-1). Coastal WIS Station 132 (Purisima Point) is adjacent to the project area and has a nearly north-south orientation (183°T; Jensen et al. 1989). Blocking by major promontories to the north limits the wave window to 183 - 343°T. At the pipeline landfall near the Santa Ynez River mouth, some of the deepwater wave energy generated to the north is blocked by the coastline so that almost all (~89%) waves of significant amplitude arrive directly from west (approximately 270°T). Most of the remaining waves arrive from the northwest (300 to 343°T). These waves impinge on the coastline at an oblique angle and drive much of the longshore circulation within the littoral zone.

Along this section of coastline, approximately 19% of the waves in 30-foot water depths have significant heights that exceed 10 feet. These waves have a dominant period of approximately 13 seconds. For return periods between 5 and 20 years, maximum significant wave heights are close to 18 feet. Offshore oil-spill cleanup operations involving a boom and skimmer have been hampered in seas exceeding 10 feet (McDonald 1995). This suggests that offshore cleanup operations could be limited approximately 18% of the time and on occasion, offshore cleanup would be untenable.

Winds

Figure 3.1-3 typifies the annual trend in the wind regime near Platform Irene (Savoie et al. 1991). The 1989 record for NDBC Buoy 23 shows that winds were largely directed toward the southeast along a principle axis of 143°T. Between January and March, the passage of occasional winter storms induces brief and occasionally very intense northwesterly winds. Beginning in April, and throughout the summer, southeastward winds intensify in response to the spring transition after a high-pressure cell forms over the eastern North Pacific Ocean.

Figure 3.1-3 Wind Stress Recorded at Buoy 46023 near Platform Irene



Local sea level pressure variations match the wind fluctuations. The largest pressure variations occur in the winter and are caused by the passage of low pressure systems associated with storms (Dorman 2001). The strongest winter winds are associated with the lowest pressures. In contrast, pressure variations are reduced and the mean pressure is higher in the summer.

Water Level

The shoreline near the pipeline landfall north of the Santa Ynez River mouth experiences astronomical tides of diurnal inequality wherein two daily sets of tidal extrema have unequal amplitude. Tidal amplitudes for this section of the central California coast are listed in Table 3.1.2 as estimated from the closest benchmark tide station at Port San Luis near Avila Beach. Storm surge along this section of open coastline is small (less than 1 foot) compared to the 7-foot variation in astronomical tides. An analysis of coastal sea level data from Port San Luis (Savoie et al. 1991) revealed that sea level rose by only approximately 0.7 foot during the severe storm of 18 January 1988. This storm produced one of the lowest barometric pressures ever recorded at NDBC Buoy 46023, and generated the largest significant wave heights of any storm between 1900 and 1995 (Seymour 1996).

Table 3.1.2 Estimated Tidal Amplitudes at the Port San Luis Tidal Benchmark

Datum	Amplitude, feet	Amplitude, meters
Extreme High (observed 18 January 1973)	7.80	2.37
Mean Higher High Water (MHHW)	5.39	1.64
Mean High Water (MHW)	4.68	1.43
Mean Tide Level (MTL)	2.86	0.87
Mean Sea Level (MSL)	2.83	0.86
Mean Low Water (MLW)	1.04	0.32
Mean Lower Low Water (MLLW)	0.00	0.06
Extreme Low (observed 8 January 1988)	-2.20	-0.67

Onshore Runoff

The major source of freshwater input to coastal waters within the southern SMB is the Santa Ynez River, although the more distant Santa Maria River also provides significant input (see Figure 3.1-1). During times of high discharge, the River brings increased sediment loads as well as contaminants from agricultural and urban runoff to the coastal environment. The Santa Ynez River

Basin has a Mediterranean climate, so runoff is episodic and streamflow within the Santa Ynez watershed rapidly rises and falls in response to precipitation (SYRTAC 1999). Most of the rainfall occurs in winter and the majority of runoff occurs in the winter and spring months. Low or no flow occurs in the summer. River discharge data demonstrate that major floods occur every few years during El Niño conditions.

The river discharge results in temporary localized salinity reductions and increased particulate loads within the coastal waters of the southern SMB. Plumes from individual rainfall events persist for approximately two to five days. Because deposition rapidly removes suspended sediment from the water column, the depth and area influenced by river turbidity is smaller than the footprint of reduced salinity associated with freshwater discharge. The Santa Ynez River plume also substantially affects coastal circulation patterns within the upper 5 m of the water column (Hickey 2000). Upon discharge into the coastal ocean, the plume forms a buoyant water mass that is particularly sensitive to changes in local wind conditions. During winter, when the principal river discharge events occur, winds with a northward component are generally associated with storms, increased rainfall, and northward (upcoast) surface flow in the southern SMB. In contrast, river discharge resulting from late-season rainfall can be carried southward and upwelling-favorable wind conditions tend to spread plumes farther offshore. In high-discharge El Niño years such as 1998, the Santa Ynez River discharge plume can even impact the western Channel Islands well to the south (Hickey 2000).

3.1.2 References

ABC Labs. 1995. South San Luis Obispo County sanitation district receiving water monitoring report. September, 1995. 38 pp.

American Petroleum Institute (API). 1987. Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms. API Recommended Practice 2A, Seventeenth Edition.

Amstutz, R.W. 1980. Deep Well Disposal: A Valuable Natural Resource. Chapter 17, pp 281-189. In: R.B. Pojasek, Editor, Toxic and Hazardous Waste Disposal. Volume 4, New and Promising Ultimate Disposal Options. Annharbor Science, Annharbor Michigan.

Arguello Inc. 2000. Rocky Point Unit Development Environmental Report. Submitted to: The Minerals Management Service, Pacific OCS Region. November 30, 2000.

Arthur D. Little, Inc. 1998a. Guadalupe Oil Field Remediation and Abandonment Project: Final Environmental Impact Report. Prepared for County of San Luis Obispo. March 1998.

—. 1998b. Unocal Avila Beach Cleanup Project, Environmental Impact Report/Statement, Final Report. Prepared for County of San Luis Obispo. SCH #95071094 February 1998.

Atkinson, L.P., K.H. Brink, R.E. Davis, B.H. Jones, T. Paluszkiewicz, and D.W. Stuart. 1986. Mesoscale hydrographic variability in the vicinity of Points Conception and Arguello during April to May 1983: the OPUS 1983 experiment. Journal of Geophysical Research. 91(C11): 12899-12918.

Barth, J.A. and K.H. Brink. 1987. Shipboard acoustic doppler profiler velocity observations near Point Conception: Spring 1983. Journal of Geophysical Research, 92(C4):3925–3943.

Battelle Ocean Sciences (BOS). 1991. Phase 5 Final Report on National Status and Trends Mussel Watch Project: Collection of Bivalves and Surficial Sediments from Coastal U.S. Atlantic and Pacific Locations and Analyses for Organic Chemicals and Trace Elements. Contract Number 50-DGNC-0-00048. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Ocean Assessments Division, Rockville, Maryland. April 1, 1991. 127pp+appendices.

Bernstein, R.L., G.S. Lagerloef, M.A. Savoie. 1991. Analysis of a four-year satellite sea surface temperature imaging sequence near Point Conception, California. In: Minerals Management Service . 1991. California OCS Phase II Monitoring Program Final Report. U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, California. OCS Study MMS 91-0083. 22pp.

Brandsma, M.G. 2001. Near-Field Produced Water Plume, Platform Irene. Prepared for: Arthur. D. Little, Inc. 3916 State Street #2A, Santa Barbara, CA 93105. A. D. Little Purchase Order: 21944700S. Prepared 18 July 2001. BRANDSMA ENGINEERING, 102 E. Eighth Street, Suite 203, Durango, Colorado 81301.

Brink, K.H. and R.D. Muench. 1986. Circulation in the Point Conception – Santa Barbara Channel Region. Journal of Geophysical Research. 91(C1): 877-895.

Browne, D.R. 2001. Comparing Drifter Observations with MMS OSRA Results. In: Quality Review Board Minutes Of Meeting No. 7, 7-9 March 2000. Analysis and Acquisition of Observations of the Circulation on the California Continental Shelf. University of California, San Diego; Scripps Institution of Oceanography; Center for Coastal Studies, 0209; 9500 Gilman Drive; La Jolla, California 92093-0209. Technical Report Reference No. 01-1 (Published 1 February 2001). Cooperative Agreement No. 14-35-0001-30571. pp 417-419.

Caldwell, P. C., D. W. Stuart, and K. H. Brink. 1986. Mesoscale wind variability near Point Conception, California, during spring 1983. Journal of Climate and Applied Meteorology 25:1241-1254.

Chelton, D.B. 1984. Seasonal variability of alongshore geostrophic velocity off central California. Journal of Geophysical Research, 89(C3):3473–3486.

—. 1987. Central California Coastal Circulation Study Drifter Observations February, July, October 1984 and January 1985. Data Report 130, Referenct 87-06, January 1987. Minerals Management Service, U.S. Department of the Interior Contract NO. 14-12-0001-30020. Raytheon Service Company Subcontract No. 93330936556. College of Ocenaography, Oregon State University.

Chelton, D.B., P.A. Bernal, and J.A. McGowan. 1982. Large-scale interannual physical and biological interaction in the California Current. J. Mar. Res. 40:1095-1125.

Chelton, D.B., R.L. Bernstein, A. Bratkovich, and P.M. Kosro. 1987. The central California coastal circulation study. *EOS Trans. AGU*. 68(1):12-13.

—. 1988. Poleward flow off central California during the spring and summer of 1981 and 1984. *J. Geophys. Res*. 93(C9):10605.

Coats, D. 1994. Deposition of drilling particulates off Point Conception, CA. Mar. Env. Rev. 37:95-127.

Coats, D.A., M.A. Savoie, and D.D. Hardin. 1991. Poleward flow on the Point Conception Continental Shelf and its relation to the distribution of oil-drilling particulates and biological impacts, *EOS Trans. AGU* 72(44):254.

County of Santa Barbara (SBC). 1997. Torch Oil Spill – The Response and Cleanup Effort. In: Offshore Oil and Gas Status Report. County of Santa Barbara Planning & Development, Energy Division. November, 1997.

—. 2001. Torch Point Pedernales Project Final Development Plan 94-DP-027. 1998-2000 Condition Effectiveness Review Revised Final Analysis. Prepared by Santa Barbara County Planning & Development Department, Energy Division. January 11 2001.

Crowe, F.J. and R.A. Schwarzlose. 1972. Release and recovery records of drift bottles in the California Current region, 1955 through 1971. California Cooperative Oceanic Fisheries Atlas #16, Marine Fisheries Committee, State of California.

Cudaback, C. N., L. Washburn, and E. Dever. 2005. Subtidal inner-shelf circulation near Point Conception, California, J. Geophys. Res., 110, C10007, doi:10.1029/2004JC002608.

Davis, R.E. 1985. Drifter observations of coastal surface currents during CODE: The statistical and dynamical views. J. Geophys. Res., 90(C3), 4756-4772.

Davis, R.E., J.E. Dufour, G.J. Parks, and M.R. Perkins. 1982. Two Inexpensive Current-Following Drifters. Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California. SIO Reference No. 82-28. December 1982.

Denbo, D., K. Polzin, J. Allen, A. Huyer, R. Smith. 1984. Current Meter Observations Over the Continental Shelf Off Oregon and California: February 1981 - January 1984. Data Report 112, Reference 84-12. Oregon State University College of Oceanography, Corvallis, Oregon.

Dever, E.P. 2001a. The ’97-’98 El Niño. In: Quality Review Board Minutes Of Meeting No. 7, 7-9 March 2000. Analysis and Acquisition of Observations of the Circulation on the California Continental Shelf. University of California, San Diego; Scripps Institution of Oceanography; Center for Coastal Studies, 0209; 9500 Gilman Drive; La Jolla, California 92093-0209. Technical Report Reference No. 01-1 (Published 1 February 2001). Cooperative Agreement No. 14-35-0001-30571. pp 163-194.

—. 2001b. Drifter Observations in the Santa Maria Basin. In: Quality Review Board Minutes Of Meeting No. 7, 7-9 March 2000. Analysis and Acquisition of Observations of the Circulation on the California Continental Shelf. University of California, San Diego; Scripps Institution of Oceanography; Center for Coastal Studies, 0209; 9500 Gilman Drive; La Jolla, California 92093-0209. Technical Report Reference No. 01-1 (Published 1 February 2001). Cooperative Agreement No. 14-35-0001-30571. pp 237-262.

Dever, E.P., M.C. Hendershott, and C.D. Winant. 1998. Statistical aspects of surface drifter observations of circulation in the Santa Barbara Channel. Journal of Geophysical Research 103(C11):24,781-24,797.

—. 2000. Near-surface drifter trajectories in the Point Conception area. Proceedings of the Fifth California Islands Symposium. Sponsored by the Minerals Management Service at the Santa Barbara Museum of Natural History. OCS Study MMS 99-0038.

Dorman, C.E. 2001. Meteorology of Santa Maria Basin. In: Quality Review Board Minutes Of Meeting No. 7, 7-9 March 2000. Analysis and Acquisition of Observations of the Circulation on the California Continental Shelf. University of California, San Diego; Scripps Institution of Oceanography; Center for Coastal Studies, 0209; 9500 Gilman Drive; La Jolla, California 92093-0209. Technical Report Reference No. 01-1 (Published 1 February 2001). Cooperative Agreement No. 14-35-0001-30571. pp 93-120.

Dorman, C.E. and C.D. Winant. 1995. Buoy observations of the atmosphere along the west coast of the United States, 1981-1990. Journal of Geophysical Research 100(C8):16029-16044.

Dugdale, R.C., and F.P. Wilkerson. 1989. New production in the upwelling center at Point Conception, California: temporal and spatial patterns. Deep–Sea Research, 36(7):985–1007.

Environmental Protection Agency (EPA). 2000a. Fact Sheet: Proposed National Pollutant Discharge Elimination System ("NPDES") General Permit No. CAG280000 for Offshore Oil and Gas Exploration, Development and Production Operations off Southern California. July 18, 2000.

—. 2000b. General NPDES Permit Number CAG280000. Authorization to Discharge under the National Pollutant Discharge Elimination System For Oil And Gas Exploration, Development, And Production Facilities. December 2000.

Goodman, R.H., D. Simecek-Beatty, and D. Hodgins. 1995. Tracking Buoys for Oil Spills. In: Proceedings 1995 International Oil Spill Conference (Achieving and Maintaining Preparedness). February 27 – March 2, 1995, Long Beach, California. American Petroleum Institute publication No. 4620. pp3-8.

Graham, N.E. and W.B. White. 1988. The El Niño cycle: a natural oscillator of the Pacific Ocean atmosphere system. Science 240:1293-1302.

Gunn, J.T., P. Hamilton, H.J. Herring, L.H.Kantha, G.S.E. Lagerloef, G.L. Mellor, R.D. Muench, and G.R. Stegen. 1987. Santa Barbara Channel Circulation Model and Field Study. Volumes 1 and 2. Prepared for the U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region under Contract Number 14-12-0001-29123. September 1987.

Harms, S. and C. D. Winant. 1994. Synthetic subsurface pressure derived from bottom pressure and tide gauge observations. Journal of Oceanic and Atmospheric Technology 11(6):1625-1637.

—. 1998. Characteristic patterns of the circulation in the Santa Barbara Channel. Journal of Geophysical Research 103(C2):3041-3065.

Hendershott, M.C. 2001. Observations of Circulation in the Santa Maria Basin. In: Quality Review Board Minutes Of Meeting No. 7, 7-9 March 2000. Analysis and Acquisition of Observations of the Circulation on the California Continental Shelf. University of California, San Diego; Scripps Institution of Oceanography; Center for Coastal Studies, 0209; 9500 Gilman Drive; La Jolla, California 92093-0209. Technical Report Reference No. 01-1 (Published 1 February 2001). Cooperative Agreement No. 14-35-0001-30571. pp 93-120.

Hendershott, M.C. and C. D. Winant. 1996. Surface Circulation in the Santa Barbara Channel. Oceanography 9(2):14-121.

Hickey, B.M. 1979. The California Current System – Hypotheses and Facts. Progr. Oceangr., 8:191-279.

—. 2000. River Discharge Plumes In The Santa Barbara Channel. Proceedings of the Fifth California Islands Symposium. Sponsored by the Minerals Management Service at the Santa Barbara Museum of Natural History. OCS Study MMS 99-0038.

Hyland, J.L., J. Kennedy, J. Campbell, S. Williams, P. Boehm, A. Uhler, and W. Steinhauer. 1989. Environmental effects of the *Pac Baroness* oil and copper spill. In: Proceedings of the 1989 Oil Spill Conference, San Antonio, Texas; API, EPA, and USCG. pp. 413-419.

Hyland, J., D. Hardin, E. Crecelius, D. Drake, P. Montagna and M. Steinhauer. 1990. Monitoring long-term effects of offshore oil and gas development along the southern California outer continental shelf and slope: background environmental conditions in the Santa Maria Basin. Oil and Chem. Pollut. 6:195-240.

Hyland, J., D. Hardin, M. Steinhauer, D. Coats, R. Green, and J. Neff, 1994. Environmental Impact of Offshore Oil Development on the Outer Continental Shelf and Slope off Point Arguello, California, Marine Environmental Research. Vol. 37(1994): 195-229.

Jensen, R.E., J.M. Hubertz, and J.B. Payne. 1989. Pacific Coast Hindcast Phase III North Wave Information, Wave Information Studies of U.S. Coastlines. March 1989, Final Report. WIS Report 17, Coastal Engineering Research Center, Department of the Army, Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi. 600pp.

Kinnetic Laboratories, Inc. (KLI). 1996. Unocal Santa Maria Refinery NPDES Receiving Water Ocean Monitoring Program, 1995. Prepared for Unocal Corporation, Arroyo Grande, California. 31pp+appendices.

Lunel, T. 1995. Dispersant Effectiveness at Sea. In: Proceedings 1995 International Oil Spill Conference (Achieving and Maintaining Preparedness). February 27 – March 2, 1995, Long Beach, California. American Petroleum Institute publication No. 4620. pp147-155.

Marine Research Specialists (MRS). 1996. City of Morro Bay and Cayucos Sanitary District, Offshore Monitoring and Reporting Program, 1995 Annual Report. Prepared for the City of Morro Bay, Morro Bay, California. February, 1996. 173 pp.

—. 2006. City of Morro Bay and Cayucos Sanitary District, Offshore Monitoring and Reporting Program, 2005 Annual Report. Prepared for the City of Morro Bay, Morro Bay, California. February 2006. 867 pp.

McDonald, J.L. 1995. The Morris J. Berman spill – MSRC's offshore operations. In: Proceedings 1995 International Oil Spill Conference (Achieving and Maintaining Preparedness). February 27 – March 2, 1995, Long Beach, California. American Petroleum Institute publication No. 4620. pp701-706.

Miller, C.D., S.R. Signorini, L.E. Borgman, D.W. Denbo, and C.E. Dorman. 1991. An initial statistical characterization of the variability of coastal winds and currents. Prepared for: U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region. OCS Study MMS 91-0091.

Minerals Management Service (MMS). 2001. Delineation drilling activities in Federal Waters offshore Santa Barbara, CA, draft environmental impact statement. OCS EIS/EA MMS 2001-046. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

—. 2003. OCS Environmental Assessment (EA) Revisions to the Point Arguello Field Development and Production Plans to Include Development of the Eastern Half of Lease OCS-P 0451. Arguello Inc. June 19, 2003.

—. 2005a. Environmental Information Document for Post-Suspension Activities on the Nine Federal Undeveloped Units and Lease OCS-P 0409 Offshore Santa Barbara, Ventura, and San Luis Obispo Counties. Prepared for U.S. Department of Interior, Minerals Management Service, Pacific Outer Continental Shelf Region. Prepared by Aspen Environmental Group, January 2005.

—. 2005b. Environmental Assessment (Final) Minerals Management Service to Grant Suspensions of Production for Aera Energy LLC's, Lion Rock Unit, Purisima Point Unit, Point Sal Unit, and Santa Maria Unit. February 11, 2005. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

Morro Group, Inc. 2000. MFS Globenet Corp./WorldCom Network Services Fiber Optic Cable Project Final Environmental Impact Report. SCH No. 98091053. Volume I. Submitted to: County of San Luis Obispo Department of Planning and Building. Prepared in association with Arthur D. Little, Inc. and Marine Research Specialists. January 2000.

National Oceanographic Data Center (NODC). 1992. Key to Oceanographic Records Documentation No. 14. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Second Edition. March 1992.

Noble Consultants. 1995. Nearshore Hydrodynamic Factors and Wave Study of the Orange County Coast, Draft Report. Prepared for the U.S. Army Corps of Engineers, Los Angeles District.

Reed, M., C. Turner, M. Spaulding, K. Jayko, D. Dorson, and Ø. Johansen. 1988. Evaluation of satellite-tracked surface drifting buoys for simulating the movement of spilled oil in the marine environment. Prepared for the U.S. Department of Interior, Minerals Management Service, Reston, Virginia. OCS Study MMS 87-0071.

Reid, J.L. 1965. Physical oceanography of the region near Point Arguello. Technical report, Institute of Marine Resources, University of California, La Jolla, IMR Ref. 75–19, 30pp.

Rechnitzer, A.B. and C. Limbaugh. 1956. An Oceanographic and Ecological Investigation of the Area Surrounding the Union Oil Company, Santa Maria Refinery Outfall, Oso Flaco, California. September 24, 1956. Prepared for the State Water Pollution Control Board, Standard Service Agreement No. 12D-15; prepared by the University of California Institute of Marine Resources, La Jolla, California. IMR Reference 56-5. 46pp+figures.

—. 1959. An Oceanographic and Ecological Investigation of the Area surrounding the Union Oil Company, Santa Maria Refinery Outfall, Oso Flaco, California (Revised). October 20, 1959. Prepared for the State Water Pollution Control Board, Standard Service Agreement No. 12D-15; prepared by the University of California Institute of Marine Resources, La Jolla, California. IMR Reference 59-13. 67pp.

Regional Water Quality Control Board (RWQCB) - Central Coast Region. 1994. Water Quality Control Plan (Basin Plan) Central Coast Region. Available from the RWQCB at 81 Higuera Street, Suite 200, San Luis Obispo, California. 148pp+appendicies. Also available online at: http://www.swrcb.ca.gov/rwqcb3/BasinPlan/Index.htm

Santa Barbara County (SBC). 2002. Final Environmental Impact Report - Tranquillon Ridge Oil and Gas Development Project LOGP Produced Water Treatment System Project Siquoc Pipeline Bi-Directional Flow Project. Prepared by Arthur D. Little, Inc., Marine Research Specialists, and SAIC. June 2002.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon

Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

Santa Ynez River Technical Advisory Committee (SYRTAC). 1999. Lower Santa Ynez River Fish Management Plan. Prepared for the Santa Ynez River Consensus Committee. Public Review Draft. April 10, 1999.

Savoie, M.A., D.A. Coats, P. Wilde, and P. Kinney. 1991. *Low-Frequency Flow Variability on the Continental Shelf Offshore Point Conception.* In: Minerals Management Service . 1991. California OCS Phase II Monitoring Program Final Report. U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, California. OCS Study MMS 91-0083. 41pp.

Science Applications International Corporation (SAIC). 1995. *Appendix A: Physical Oceanography (Currents, Waves, Tides, Winds, Satellite Imagery, Physical Measurements Arrays, and Particle Transport Modeling)*. In: Minerals Management Service . 1995. Monitoring Assessment of Long-Term Changes in Biological Communities in the Santa Maria Basin: Phase III, Final Report. Report submitted to the U.S. Department of the Interior, Minerals Management Service/National Biological Service, Under Contract No. 14-35-0001-30584. OCS Study MMS 95-0049.

Schwartzlose, R.A. and J.L. Reid. 1972. Near-shore circulation in the California Current. CalCOFI Report 16:57-65.

Scripps Institution of Oceanography (SIO). 2000. CalCOFI Data Report, Physical, Chemical and Biological Data: CalCOFI Cruise 0001 (7 – 27 January 2000) and CalCOFI Cruise 0004 (7 – 29 April 2000). SIO Reference 00-16. 21 October 2000. 101 pp.

—. 2006. Final Report: Santa Barbara Channel – Santa Maria Basin Circulation Study, In conjunction with the Minerals Management Service under Cooperative Agreement No. 14-35-0001-30571. February 6, 2006. 27 pp.

Seymour, Richard. 1996. Wave climate variability in Southern California. *Jour. Waterway, Port, Coastal, and Ocean Engineering*, *ASCE* 122(4):182-186; July-August.

Sheres, D., and K.E. Kenyon. 1989. A double vortex along the California coast. Journal of Geophysical Research, 94(C4):4989–4997.

Strub, P.T., J.S. Allen, A. Huyer, and R.L. Smith. 1987a. Seasonal cycles of currents, temperatures, winds, and sea level over the northeast Pacific continental shelf: 35°N to 48°N. Journal of Geophysical Research, 92(C2):1507-1526.

—. 1987b. Large-scale structure of the spring transition in the coastal ocean off western North America. Journal of Geophysical Research, 92(C2):1527-1544.

Simecek-Beatty, D. 1994. Tracking of oil spills by ARGOS-satellite drifters: A comparison. In: Proceedings of the Second Thematic Conference on Remote Sensing for Marine and Coastal Environments. pp423-434.

State Water Resources Control Board (SWRCB). 1988. California State Mussel Watch Ten Year Data Summary 1977 - 1987. May 1988. Water Quality Monitoring Report No. 87-3, Division of Water Quality. 313pp+appendices.

—. 1997. California State Mussel Watch Sampling Data – Central Coast. June 2, 1997..

—. 2001. Water Quality Control Plan, Ocean Waters of California, California Ocean Plan. California Environmental Protection Agency. Effective December 3, 2001.

Steinhauer, M., E. Crecelius, and W. Steinhauer. 1994. Temporal and spatial changes in the concentrations of hydrocarbons and trace metals in the vicinity of an offshore production platform. *Mar. Environ. Res.* 37:129-163.

Svejkovsky, J. 1988. Sea surface flow estimation from advanced very high resolution radiometer and coastal zone color scanner satellite imagery: a verification study. Journal of Geophysical Research, 93:6735–6743.

Torch Operating Company. 2000. Oil Spill Response Plan for Operations on Torch Platform Irene and Point Pedernales 20-inch Wet Oil Pipeline. Owner: Nuevo Energy Company, 1800 30th Street, Suite 200, Bakersfield, California 93301. October 2000.

United States Army Corps of Engineers (USACOE). 1984. Shore Protection Manual. Volume 1. Coastal Engineering Research Center, U.S. Department of the Army, Waterways Experiment Station, Corps of Engineers (COE), Vicksburg, Mississippi.

Winant, C.D., and C.E. Dorman. 1997. Seasonal patterns of surface wind stress and heat flux over the Southern California Bight. Journal of Geophysical Research 102(C3): 5641-5653.

Winant, C. D., D. J. Alden, E. P. Dever, K. A. Edwards and M. C. Hendershott. 1999. Near-surface trajectories off central and southern California. Journal of Geophysical Research, 104(C7): 15713-15726.

3.2 Oil Spill/Risk Analysis

This section addresses public safety issues associated with the proposed project. It describes the process used to evaluate hazards and risks related to the Project. It identifies the agencies, laws, and regulations that would regulate the safety of the proposed project; lists the main design criteria that would be used for the proposed project; and evaluates the potential effects of a release of produced oil and gas to the environment. Information presented below also outlines potential upset scenarios that lead to a release of hazardous materials, the levels of risk associated with these scenarios, and the significance of the upset scenarios. Hazardous materials release analysis includes those scenarios that could adversely affect public health as well as those scenarios that could affect the environment, in particular – water quality, marine and biological resources.

3.2.1 Affected Environment

For the proposed project, the affected environment would include the location and conditions associated with the existing project facilities, and pipeline system. The existing safety and risk of upset conditions have to be identified, in order to determine if there is an increased level of risk associated with the proposed project, and if the proposed change in the system introduces an increase in the risk of upset or an increase in the severity of an already significant impact.

3.2.1.1 Regional Overview

Santa Barbara and San Luis Obispo Counties have a number of oil and gas fields located onshore and offshore. Development and exploitation of these natural resources have occurred in these counties for approximately a century. As a result, there are many different oil and gas facilities of different ages and functions scattered throughout the region and connected by various pipelines.

Although oil and gas pipelines and processing facilities in the region are engineered to current safety standards at the time of construction and undergo rigorous safety studies and environmental reviews during county approval and prior to construction, the nature of the materials handled by these pipelines and facilities still poses risks to people and the environment in the vicinity. Upsets in normal operation of the oil and gas pipelines and facilities in the area pose a risk of exposing the population to accidental releases of materials, which can subsequently lead to biological or water quality damage, exposure to toxic materials, fires and explosions.

3.2.1.2 Study Area and Scope

For the safety analysis the study area includes the existing facilities and pipelines associated with the proposed project, and the areas in the immediate vicinity of the proposed project that could be affected by an upset at the facilities. The facilities where the safety and risk of upset are potentially changed due to the proposed project include:

- Platform Irene;
- Offshore pipeline route;
- Onshore pipeline route from landfall to the LOGP; and

- LOGP Facility.

An upset condition at the listed facilities could have an adverse impact to the public or environmental resources in the study area. Impacts to water and biological resources are discussed in the appropriate sections of this document. The study area that would be affected in terms of public safety by an upset condition is the population near the City of Lompoc and the land and any population along the pipeline route between landfall and the LOGP. Impacts to water, biological or marine resources near Platform Irene and the Irene/LOGP pipeline due to a release from these facilities are also examined by assessing the potential spill sizes and marine trajectories. Public safety related impacts to boats and populations in the vicinity of Platform Irene are assumed to be minimal and are therefore not quantified (as per the original Point Pedernales EIR, 1985 and previous studies for other offshore facilities including the Venoco Ellwood Quantitative Risk Assessment, 2000).

Oil spill volumes that could be released in the event of a pipeline spill are identified, with the assumption that the SCADA (Supervisor Control and Data Acquisition) system responds appropriately and activates isolation valves. Closing of the automatic isolation valves within the appropriate response time would considerably reduce spill volumes from the pipeline segment. Evaluation of spill volumes for the worst-case scenario when the SCADA system malfunctions, or is overridden by an operator, is also addressed.

3.2.1.3 Characteristics of Crude Oil and Produced Gas

This section discusses the properties of crude oil and produced gas as they relate to safety impacts, such as oil spills, toxic exposure and fires.

A spill of crude oil from the pipeline could damage the environment if oil spilled on land, or in rivers, creeks, or the ocean, and could produce public safety concerns from fires that may arise if the oil ignites. Flammable vapors (propane, butane, and pentane) may also emanate from the crude oil, and there may be safety hazards arising from toxic vapors in the crude oil (primarily benzene and hydrogen sulfide).

Crude oil, as it emerges from the wellhead, is a heterogeneous mixture of solids, liquids and gases. This mixture includes sediments, water, salts and acid gases including hydrogen sulfide and carbon dioxide. The major hydrocarbons constituents include:

- Alkanes (paraffins) – straight-chain normal alkanes and branched iso-alkanes with the general formula CnH2n+2. The major paraffinic components of most crude oils are in the C1 to C35 range.
- Cycloalkanes (naphthenes) – saturated hydrocarbons containing structures with carbon atoms linked in a ring. The cycloalkane composition in crude oil worldwide typically varies from 30 to 60%.
- Aromatic Hydrocarbons – most commonly benzene, benzene derivatives, and fused benzene ring compounds. The concentration of benzene in crude oil ranges between 0.01% and 1%.

Sulfur occurs as hydrogen sulfide in the crude oil. Total sulfur ranges from approximately 1 to 5% or higher by weight in crude oils, and hydrogen sulfide concentrations can reach 100 ppm in "sour" crudes. Other constituents of crude oil include nitrogen and oxygen compounds, and water- and metal-containing compounds such as vanadium and nickel compounds.

Physical properties of crude oil are needed to assess the effects of a potential spill from the pipeline. It is assumed that the oil potentially extracted from the Tranquillon Ridge reservoir would be close in properties to the LOGP oil produced from Point Pedernales. Oil properties for the LOGP crude oil are summarized in Table 3.2.1.

Table 3.2.1 Crude Oil Properties

Property	LOGP
API Gravity	16-18
Viscosity, centistokes (at ºF)	213 (122)
Sulfur Content, % wt [a]	2

Source: California Division of Oil and Gas.
a. Not the same as hydrogen sulfide.

However, as the emulsion mixture between Platform Irene and the LOGP does and would have a large percentage of water (currently close to 90% water, with the Tranquillon Ridge Project decreasing this to close to 60% water) impacts would be limited to marine, biological and hydrological as opposed to safety impacts to populations. The large volume of produced water that is transported from Platform Irene to the LOGP inhibits the release of flammable vapor in the event of an oil spill, thus minimizing potential fire and explosion hazards. Therefore, the safety analysis is primarily focused on gas transportation and processing. Crude oil spills and frequencies are presented in order to understand the impacts to marine resources, biology and water quality.

Produced gas transported from Platform Irene to the LOGP presents hazards in the form of (1) toxicity, due to the presence of hydrogen sulfide (H_2S) gas; (2) flammability in the form of vapor cloud fires and explosions; and (3) thermal radiation impacts due to flame jet fires emanating from a gas pipeline leak or rupture. Historic concentrations of H_2S in the gas have ranged from 800 ppm in 1993, when the Point Pedernales Project SEIR was completed, to 3,700 ppm in the year 2000. Currently, the maximum allowable H_2S content is 8,000 ppm. Current pipeline operating pressures range up to 570 psig. The Point Pedernales Project gas pipeline is currently permitted to transport gas with a maximum hydrogen sulfide concentration of 8000 ppm.

Hydrogen sulfide is a toxic gas often present in the fluids extracted from wells. In the gas phase, it produces odors at levels down to 0.007 ppm (SBCFD 2000) and according to the Emergency Response Planning Guidelines (ERPG) can produce injuries at levels equal to 30 ppm (ERPG-2) and fatalities as low as 100 ppm (ERPG-3) if exposed to for long enough periods (>60 minutes). It has a characteristic "rotten egg" smell. A complicating factor that increases its hazards is that it also produces olfactory paralysis at levels as low as 50 ppm, or below those at which it could produce injuries or fatalities.

3.2.1.4 Existing Facility Risks

The potential impacts for the currently operating Platform Irene to LOGP pipeline system and the LOGP facility were addressed in the Point Pedernales EIR in 1985, the Unocal Point

Pedernales Project SEIR in 1993, the Torch Gas Plant Project Addendum in 1996, and the 2006 Tranquillon Ridge Oil and Gas Development DEIR. These risks include:

- Potential spills both offshore and onshore to the LOGP of oil/water emulsion and produced water returned to Platform Irene;
- Potential spills of crude oil from the LOGP to Summit pipeline;
- Potential releases between Platform Irene and the LOGP of produced gas containing up to 5,000 ppm of hydrogen sulfide;
- Potential releases of oil or natural gas from the processing equipment at the LOGP;
- Potential releases of sales gas from the LOGP to the Gas Company; and
- Potential releases of liquefied petroleum gas due to truck shipments from the LOGP to local customers.

The Point Pedernales EIR did not classify risk into the Santa Barbara County (SBC) California Environmental Quality Act (CEQA) significance criteria (e.g., Class I, II, and III). However, risks to the public health were calculated and FN (frequency versus number of fatalities/injuries) curves were developed and can be assessed based on the current SBC criteria. These criteria would indicate that a significant risk to public safety would exist primarily for gas liquids transportation, where it was calculated that a severe consequence (one or more fatalities) could occur over the project lifetime. However, subsequent to the Point Pedernales 1985 EIR, the 1993 SEIR and 1996 Addendum developed additional release scenarios. Due to increased gas processing, previous release scenarios were reassessed and transportation of gas liquids has subsequently changed.

Calculations related to discharge volumes, frequencies and probabilities are based on the 1985 Point Pedernales EIR, the 2006 Tranquillon Ridge Oil and Gas Development EIR, the PXP Core Oil Spill Response Plan (November 2004) and Supplement (July 2005), and various failure rate and spill rate sources such as the MMS and the Office of Pipeline Safety. A number of different frequency sources and calculations have been included in order to give a range of frequency numbers and thereby address the potential uncertainties associated with estimating future events.

3.2.1.5 Oil Spill Assessment Methodology

The safety and risk assessment evaluates baseline failure rates, spill volumes, impacts, and associated risks, as per the SBC safety criteria, that exist at the facilities as currently configured. Previous documents covering the Point Pedernales Field Development (1985 EIR, 1993 SEIR, 1996 Addendum, 2002 EIR, and 2006 DEIR) were used to formulate the scenarios, the failure frequencies, and the hazard zones for current operations. Additionally, recent studies from the MMS and failure frequency databases were used to update the information. Current population information was utilized to estimate the population that could be affected by an accidental spill or release. The frequencies and consequences were then used to prepare an FN curve, as per the SBC safety criteria.

For oil spills into the marine or onshore environment, estimated frequencies (events per year) are used to develop the probability (in percent) of an oil spill over the project lifetime utilizing the MMS probability approach. Spill volumes are also estimated. Spill volumes are generally divided into leaks (or small spills), and ruptures (or large spills) with small spills being less than

100 barrels (bbls) and larger spills being more than 100 bbls. As the criteria for risk impacts only addresses public safety, spill volumes and probabilities are used to compare the baseline with the proposed project and as a guide for the biology, water quality and marine resources sections.

A range of scenarios were developed and analyzed in the original EIR, SEIR and Addendum, 2002 EIR and 2006 DEIR. Each of these scenarios is discussed below.

Crude or Emulsion Pipeline Scenarios

The oil emulsion pipeline, or the wet crude pipeline, between Platform Irene and the LOGP has a 20-inch outer diameter (OD) with a Maximum Allowable Operating Pressure (MAOP) of 1,194psig.

Historical production levels from the Point Pedernales Project peaked at close to 25,000 barrels per day (bpd) of dry oil in 1987 and 1989. Production levels in 2005 averaged approximately 7,000 bpd of dry oil and 50,000 bpd of water. The peak monthly production in 2005 was approximately 8,600 bpd of dry oil.

These scenarios involve a rupture (spill greater than 100 bbls) or a leak (spills less than 100 bbls) of the crude or emulsion pipeline. In the event of a pipeline rupture, the leak detection system should be capable of detecting and isolating the spill within five minutes. Once the pipeline is shutdown, the oil would continue to spill until the oil was drained from the associated segments of the pipeline. The maximum spill volumes from the pipeline are a function of the location of the pipeline rupture in relationship to the automatic isolation valves, check valves, and the pipeline elevation profile, and the duration of the pumping that occurs before the leak or rupture is detected. If the SCADA system is not operational or is overridden by an operator, it is assumed that the pumping would continue for 30 minutes before rupture would be detected and response initiated.

How an operator responds to SCADA system alarms and automatic shutdowns have an impact on the size of the oil spill in the event of a leak. The 1997 release from the project oil pipeline was exacerbated by an operator restarting the shipping pumps, thereby increasing the release volume. The frequency of a release (leak or rupture) is primarily a function of the construction of the pipeline, the maintenance and operational practices, as well as third party damage. The volume of the subsequent release is a function of the training of the operators as well as the design, construction and maintenance of the leak detection system.

Crude or emulsion pipeline leaks are similar to ruptures described above, except that they address smaller sized releases from the pipeline. This distinction has been made between leaks and ruptures to account for the different failure frequencies that exist between ruptures and leaks. Pipeline leaks are most commonly a result of corrosion, erosion, or third party damage to the pipeline. The project's pipeline leak detection system uses a volume based monitoring system to assist in the detection of small leaks. Typically, a small corrosion induced leak would have a leak rate of 1 to 2 barrels per hour, which might require approximately 10 to 12 hours to detect. Typically pipeline ruptures have much greater spill volumes than do pipeline leaks.

With any spill of crude oil, there is the potential for a fire associated with a spill at either the LOGP or along any of the pipelines. If the crude oil spill were to catch fire, there could be a subsequent threat to public safety through thermal radiation effects. Given the properties of the crude oil, the likelihood of an explosion is virtually non-existent, and therefore explosions have not been addressed further in this document. In addition, due to the high water content in the crude oil transported to the LOGP from Platform Irene, a fire and subsequent safety impacts are assumed to be non-existent for the Platform Irene to LOGP pipeline (as per the 1985 Point Pedernales EIR). However, impacts to other resources (e.g., biology, water quality, agriculture) for that pipeline segment would remain.

Offshore marine impacts would be associated with spills of the oil/water emulsion into the marine environment, which could cause impacts to marine resources. The frequencies and spill volumes are examined utilizing MMS's and other standard approaches.

Gas Pipeline Scenarios

Gas pipeline leaks and ruptures have also been included as per analysis in the Point Pedernales 1985 EIR, 1993 SEIR, 1996 Addendum, 2002 EIR, and 2006 DEIR. Impacts due to high pressure gas releases are complex because the gas transported from Platform Irene is not processed and therefore contains some gas liquids in vapor form and contains some hydrogen sulfide. Consequences are based on hydrogen sulfide exposure or flammable vapor cloud/explosion exposure to nearby populations. The previous environmental documents addressed a range of pipeline operating conditions. These included throughput ranges up to 6 mmscfd and 600 psig operating pressures. The Point Pedernales 2005 year average production was 2.6 mmscfd, with operating pressures in the 425 to 570 psig range. Peak annual average (running 12-month average) levels have ranged from 2.2 mmscfd in 1994 up to almost 9 mmscfd in 1995 with operating pressures in the 400 to 500 psig range. As the operating pressure of the pipeline is the dominant factor in determining the size of impact zones, the 600 psig scenario used in the SEIR has been used as the worst-case operating scenario in this analysis.

A gas pipeline release could also have an impact on biological resources along the onshore pipeline route. These might include fatalities of animals or wildlife or impacts to sensitive species due to fires.

Gas pipeline releases offshore are assumed to present insignificant risks to the public due to the remote location and low density of public receptors.

LOGP Scenarios

Failures at the LOGP could range from process vessel ruptures to pipe ruptures or leaks. Failures would also include gas liquids vessel storage and handling operations. Consequences could include an oil spill with subsequent fire, a gas release with subsequent toxic H_2S exposure, flammable gas vapor cloud explosions, or thermal radiation effects.

Platform Irene Scenarios

Scenarios are developed for potential emulsion fluid releases from Platform Irene into the marine environment. These releases take into account the platform drain system, which is currently designed to capture leaks and redirect them back into the process stream. Scenarios related to gas releases or impacts to the public were not considered due to the remote location of the facility.

Transportation Scenarios
Transportation risks were limited to examining the risks associated with the transportation of gas liquids. Risks due to gas liquids transportation include a spill with a subsequent fire or explosion affecting persons along the transportation corridor. Transportation impacts were assessed in the 1985 Point Pedernales EIR. This assessment is scaled to reflect the current operating conditions.

Biology, Water Quality and Marine Resources
These areas are addressed in Section 3.1, Oceanography, Section 3.4, Water Quality, Section 3.5, Biology, and Section 3.6, Commercial and Recreational Fishing of this report. However, spill volumes and frequencies used in those sections are documented below, in the current section. The spill volumes and spill frequencies and probabilities over the project lifetime are developed as part of this analysis.

3.2.1.6 Existing Onshore Facilities

Onshore facilities included in this analysis are the onshore portion of the Platform Irene to LOGP pipelines (gas, emulsion and produced water return), and the LOGP Facility.

Existing Onshore Emulsion Pipeline Spill Frequencies and Probabilities
While pipelines have historically had one of the lowest spill rates of any mode of transportation, there still is some level of risk that a pipeline could leak or rupture. In order to estimate the frequency of such an event and the probability of the event occurring over the project lifetime, historic data for other operating liquid pipelines has been used to estimate the probability of a leak or rupture for the existing pipeline and the pipeline with the modifications that have been proposed.

Historically, spills from pipelines have been attributed to a number of different causes, including corrosion, defects in material or welding, damage from third-party interference, natural hazards such as earthquakes or landslides, and operational errors.

Information on the number and causes of pipeline spills in the United States greater than 50 barrels in size is available from the DOT OPS. These data were obtained for spills from 1968 to 2000 (information from pre-1985 is less reliable in the OPS database). Information is available from the OPS for crude-oil pipelines only, as well as for all liquid pipelines (OPS 1990). In the years since 1985, crude oil has comprised 42 to 51% of the liquid spilled from pipelines, and petroleum products have made up 47 to 55% of the total volume spilled. Spills due to corrosion rank as the most frequent cause with an estimated 39% of all failures (since 1985). The number of spills due to corrosion ranges from a high of 36 and 35 spills in 1987 and 1996, respectively, down to 8 spills in 2000. The number of spills due to third-party impact ranks next with 30% of the spills. The overall spill rate of crude oil pipelines was estimated by the OPS database to be 8.9×10^{-4} spills (with spill volumes greater than 50 barrels) per mile year.

The California State Fire Marshal (CSFM) publication, Hazardous Liquid Pipeline Risk Assessment (CSFM 1993), analyzes leak information for the 7,800 miles of liquid pipelines within California for the years 1981 through 1990. This study enables pipeline spill rates to be adjusted based on variables such as pipeline age, diameter, operating temperature, etc., as well as spill cause. The study found that external corrosion was the major cause of pipeline leaks, causing approximately 59% of spills, followed by third party damage at 20%. Older pipelines and those that operate at higher temperatures had significantly higher spill rates. The CSFM base rate for pipeline crude oil spills was calculated to be 9.89×10^{-3} incidents (of any size) per mile year. Note that this is for crude oil only. Crude oil had the highest spill rate primarily due to the fact that crude oil is often transported at elevated temperatures, which increases the rate of external corrosion. This is because faster corrosion rates occur at elevated temperatures when metal comes in contact with soil moisture.

Spill frequencies were estimated using the latest information on crude oil pipeline spill rates available from the CSFM report. This approach was considered to be the most conservative. As discussed above, the Federal OPS predicted spill rates lower than the CSFM report. The CFSM study involved surveying of pipeline operators. Reporting requirements had changed during the 10-year study period thereby possibly affecting the accuracy of the data. However, the report indicated that most operators kept records on all leaks, regardless of reporting requirements. Some discrepancies in the data were due to leaks reported on pipeline segments that were subsequently replaced or leaks on pipeline segments that had been shut down. Both of these issues, however, would add conservatism to the estimated leak rates. The CSFM leak rates are therefore considered to be quite conservative and to overestimate the existing risks.

The CSFM report presented a set of hazardous liquid pipeline incident rates for all pipelines and uses. A review of the CSFM report shows that the following pipeline design and operation parameters can have a significant effect on pipeline spill rates:

- Pipeline age;
- Pipeline diameter;
- Pipe specification;
- Pipe type;
- Normal operating temperature;
- SCADA System;
- Cathodic protection system;
- Coating type; and
- Internal inspection.

Based on the CSFM data, pipeline-specific spill rates can be estimated for a pipeline based on the above-listed criteria. Using the CSFM data, the following pipeline characteristics and assumptions for the emulsion pipeline (Platform Irene to LOGP) were used for baseline operating conditions. The correction factor is a multiplier by which the CSFM base rate (9.89×10^{-3} for crude oil pipelines) would be multiplied to develop the character specific failure rate.

- Pipeline diameter of 20 inches (0.49 correction factor);
- Pipeline specification is average (1.0 correction factor);
- Pipeline type is API 5L X46 grade, electric resistance welded (0.71 correction factor);
- Operating temperature of 180°F (2.14 correction factor);
- SCADA system is present (0.9 correction factor);
- Cathodic protection system is present (0.98 correction factor);
- Pipeline coating is polyethylene butyl adhesive (0.09 correction factor); and

- Pipeline is internally inspected (0.63 correction factor).

Based on the above pipeline specifications, a pipeline-specific spill rate was calculated from the CSFM base data with the correction factors, which is lower than the DOT OPS spill rate due to the relative design of the pipeline versus those that comprise the DOT OPS database. The CSFM report also estimated that larger spills (greater than 100 barrels) comprise approximately 18% of the total number of spills. These larger spills are assumed to equate to a rupture of the pipeline, whereas spills less than 100 barrels would equate to a leak.

Frequencies and probabilities of pipeline spills for ruptures and leaks are shown in Table 3.2.2 below.

Table 3.2.2 Current Operations Onshore Emulsion Pipeline Spill Frequencies and Probabilities, CSFM

Scenario	Spill Frequency per year	Lifetime Spill Probability, %
Onshore Emulsion Pipeline ruptures	8.59×10^{-4}	0.9
Onshore Emulsion Pipeline leaks	3.68×10^{-3}	3.6

For a project lifetime until 2017 (ten year remaining life).
Spill rate based on the base rate of 9.89×10^{-3} incidents/mile-year with the correction factors, which total 3.68×10^{-4} incidents/mile-year, multiplying by the pipeline distance of 12.2 miles and adding in the seismic frequency for ruptures of 5×10^{-5} per year for this pipeline.

Emulsion Pipeline Spill Frequencies for Seismic Activity

Based on the information in the CSFM report, three of the 507 pipeline spills reported during the 1981 to 1990 study period were related to seismic activity. Based on the total length of pipelines in the state (72,303 mile-years), and the number of spills observed during this ten-year period (3), one could assume that the base rate for seismically-induced spills could be 4.15×10^{-6} spills per mile-year. This number has been included in the rupture rates in the above table.

Emulsion Pipeline SCADA System Failure Rates

The Point Pedernales facilities have a computerized leak detection system (SCADA) that is used to monitor and detect leaks in the Platform Irene emulsion pipeline between the platform and the LOGP. The computer-based system is a triply redundant August System Process Logic Controller (PLC) that monitors the pipeline's flow rates and pressure. Crude oil is metered at Platform Irene and the LOGP. The signal from the LOGP meter is transmitted to the LOGP control room August System PLC where it is compared with the flow meter from Platform Irene. Should the totalized fluid productions differ by more than the following limits, an alarm is sounded indicating a potential pipeline leak:

- 6 percent deviation over 12 minutes; or a
- 15 percent deviation over 20 minutes.

Pressures are monitored at Platform Irene and the LOGP. If pressure crosses high or low shutdown set points as specified in the operating manual, then Shut Down Valves (SDVs) at the Platform and the LOGP will activate automatically. The August System PLC is monitored by the operator at the LOGP. If a low pressure pipeline shutdown occurs at the LOGP, the Operator is required by procedure to close the entire pipeline MOVs; thereby, initiating isolation of each segment of the line.

The time it would take the pipeline monitoring system to detect a release is a function of the size of the release. A large leak or rupture would most likely be detected in 30 seconds or less. Smaller leaks could take longer to detect. Once a leak has been detected, the valves can then be closed remotely and production shut down on Platform Irene using the Emergency Shutdown Switch (ESD). Automatic ESD-initiated valves can shut-in the oil pipeline in less than two minutes. Closure of the MOVs would be initiated by the operator and would take from 30 seconds to two minutes depending on the MOV.

Failure of the SCADA system to detect a leak or rupture of the pipeline would prolong the time that the pumps continue to operate and would delay emergency response actions. Failure of the SCADA system could be caused by faulty sensors, failure of the actuated valves to close or the pumps to shutdown, a communications failure, or operator error. In the event of a communication failure in parts of the SCADA system, alternative methods for detecting leaks are available as described in Appendix I of the PXP Core Oil Spill Response Plan. For example, the SCADA system is based on redundant microwave transmitters and receivers at the platforms and pipeline landfall and a hard-wired system along the onshore pipeline right-of-way. The platform and landfall systems are separate from the right-of-way system, so it is unlikely both would fail simultaneously. If the onshore right-of-way system failed (e.g., by being severed or washed out), the platform, landfall, and plant receiving systems would continue to function permitting the operator to monitor flow rates and detect a potential leak.

Flow rates are continuously monitored at the platform and onshore. If one or more of the redundant SCADA communications systems fail, pipeline flow rates would be manually monitored closely to detect potential leaks. In the event of complete SCADA system failure, the pipeline is shut down.

Emulsion Pipeline Historical Activities and Releases

Historical incidents along the pipeline include a rupture of the sub-sea portion of the pipeline in September 1997. According to reports from the SBC, the MMS, the CSFM, and various consultants and other groups, the release and contributing events occurred between approximately 10 and 11 p.m. on September, 28, 1997 in 120 feet of water. Approximately 163 to 1,242 barrels of crude oil were released into the marine environment (SBC P&D 2001), causing oil to soil beach areas along Surf Beach and south of the Santa Ynez River. Approximately 635 to 815 birds were reported impacted by the spill (OSPR 1998).

The 1997 failure of the pipe occurred at a flange weld approximately midway between Platform Irene and the shoreline. A crack developed in the weld connecting a flange to the pipe. The metal in this area was determined to be brittle due to the weld construction techniques where the metals were not properly pre-heated, thereby increasing the metal brittleness, and due to the high carbon content.

The shutdown system on Platform Irene operated correctly, quickly detecting the low pressure and initiating a low pressure alarm and shutdown from pressure transmitter (PT)-171. This pressure transmitter is the emulsion line pressure transmitter located at Platform Irene just before the pipeline leaves the platform. This alarm initiated a shutdown of Platform Irene. The level 2 shutdown involved shutting the MOV-224 located downstream of PT-171, which isolated the pipeline from Platform Irene. This shutdown occurred within ten seconds of the PT-171 low pressure alarm. At this point, the operator attempted to restart the system, bypassing PT-171 and the pump shutdowns. The MOV-224 was re-opened within eight minutes of the initial PT-171 alarm. MOV-224 remained open for almost 80 minutes until the operator determined that there was an imbalance between Platform Irene shipping and the LOGP receiving. The pumps operated for a period of approximately 25 minutes during this 80-minute period.

On August 8, 2001, a release occurred at the Bradley Valve box on Tosco's (now owned by ConocoPhillips) Line 300 system (approximately 2 miles south of Suey Junction between Orcutt and Suey). The release filled the valve box and spilled into the neighboring parking lot.

Approximately 182 bbls of crude oil were released. The cause was determined to be a valve failure related to corrosion. The valve had been installed in approximately 1976 and was manufactured in the 1950s. The SCADA system performed as expected, indicating an imbalance. However, the SCADA system operator reviewing available data (volume balance alarms and pressure data), incorrectly determined that a release had not occurred and allowed the system to continue to operate. Visual observations by a third-party initiated the shut down.

Emulsion Pipeline Smart Pigging Results

Smart pig internal pipeline inspections are conducted on the emulsion pipeline on an annual basis. PXP utilizes a high-resolution smart pig that detects metal losses and pipe thickness along the pipeline. A smart pig survey conducted in 1995 and 1996 (with a lower-resolution smart pig than is currently being used) indicated significant corrosion on segments of the pipeline, mostly on the bottom. A more aggressive corrosion prevention program was initiated which has reduced the rate of corrosion since that time. This program included increased corrosion inhibitor injection, the use of brushing pigs, and a survey of the adequacy of the cathodic protection. The cathodic protection survey indicated that the cathodic protection is provided per the National Association of Corrosion Engineers (NACE) standards, except that rapid depletion of the anodes near the platform was anticipated because the galvanic potential is influenced by the platform.

More recent smart pig data using high resolution tools (October, 2005) found that 27,995 wall anomalies (most of these minor and not a safety issue) exist in the emulsion pipeline with the deepest being 50 percent of the wall thickness (PXP EIR Update Meeting Presentation, August 1, 2006). Most of these are on the bottom of the pipe and are internal to the pipe, characteristic of internal corrosion. All of the most significant anomalies (ranging in depth from 40 to 59 percent) are located in the onshore portion of the pipeline with the deepest anomaly being located immediately before Valve Site #6. Most (16) of the more serious anomalies are located between Valve Sites #6 and 7. The pipeline maximum allowable operating pressure has been reduced (derated) due to the presence of anomalies detected in 1995, 1996 and 1997. No de-ratings have occurred since 1997.

A report generated in July 1996 correlated corrosion levels with pipeline location in an attempt to identify areas that could, in the future, experience corrosion related failures or require replacement type maintenance. Segments that indicated high levels of corrosion were between Valve Sites #1 and #2, between Valve Sites #3 and #4, and between Valve Sites #7 and #8.

As a result of the increased corrosion observed in the 1995 smart pig results, additional analysis and precautions have been implemented including increasing the corrosion inhibitor injection rates to achieve 200 ppm, conducting additional laboratory testing of fluid corrosivity, and installation of additional corrosion monitoring devices. Corrosive rates have slowed since the program has been undertaken, and smart pig results taken in the last 3 years have indicated a reduced rate of corrosion in the pipeline, that are in line with the pipeline's design parameters.

The emulsion pipeline has had a history of internal corrosion in the onshore section. In addition, as a result of the 1997 offshore failure, the emulsion pipeline would have been considered a "high-risk" pipeline by the CSFM. Since the 1997 release, smart pig survey results have indicated that the internal corrosion program has been effective at substantially reducing the rate of corrosion in the onshore portion of the pipeline. In addition, smart pig survey results indicate that external corrosion, the primary cause of the difference between "high risk" and "non-high risk" pipelines in the CSFM report, is non-existent for the emulsion pipeline.

Although internal corrosion has been experienced on the existing emulsion pipeline, adhering to DOT de-rating requirements reduces the failure rates associated with internal corrosion to levels similar to pipelines that do not exhibit internal corrosion problems. This is due primarily to the failure modes of corrosion failures. Corrosion-related failures are generally experienced when the corrosion on the pipeline reaches the point where the reduction in metal increases the stresses in the metal pipe wall, due to the operating pressure, and these stresses exceed the metal capabilities. Metals generally do not fail as long as the stresses are below a given threshold level, or minimum yield strength. However, if the stresses exceed this threshold, failure occurs quite rapidly. This is why de-ratings are conducted; to ensure that the stresses in the pipe walls are below the minimum yield strength of the pipe material. If the stresses are below the minimum yield strength of the pipe, then the pipe effectively operates like a new pipe would. This is supported by the fact that the CSFM report indicates that there is not a statistical correlation between failure rates and operating pressure, or pipe stresses.

It is important to note that the primary difference in rates between pipelines built since 1950 and pipelines built before 1950 is due to external corrosion. External corrosion is not an issue with the current pipeline system.

Smart pig runs are done on an annual basis as required by the SIMQAP. Tests also indicate that the cathodic protection system is effective. By removing the external corrosion influence, a high risk pipeline would be expected to have a similar spill frequency as a "non-high risk" pipeline, as per the CSFM report. Therefore, the onshore portion of the emulsion pipeline would be expected to have a spill frequency comparable with other "non-high risk" pipelines.

In August and September of 1999, then-operator Nuevo conducted inspections of the flanges on the offshore oil pipeline. The inspections found defects at the sweep spool or "J Tube" flange located at the bottom of the offshore pipeline riser. As a result of this defect, the "J Tube" spool was removed and replaced with a Big Inch flange spool similar to the 1997 repair. During repairs, the Point Pedernales facilities were shutdown and the pipeline was flushed with water. In September 2001, during flange inspections, Nuevo found cracks on a number of offshore flanges. As a result, Nuevo undertook a program to remove and replace all existing flanges on the offshore oil pipeline, with the exception of the riser flange (Flange #1-1). These flanges have been removed and replaced. Nuevo applied for and received permits from SBC, California Coastal Commission (CCC), MMS, and California State Lands Commission (CSLC) for the repair work. Additional information on this project can be found in the Nuevo Energy Company Irene to Shore Oil Pipeline Repair Project Execution Plan (October 19, 2001). In 2005, PXP took steps to upgrade the integrity of the riser flange #1-1, which had not been replaced by Nuevo. Due to the location of the flange at the bottom of a long (greater than 250 foot) vertical leg of pipe, the flange was totally encapsulated using a specially designed clamping fixture instead of removing the flange and inserting a spool. All offshore flanges that were susceptible to failure due to micro cracks in the heat-affected zone have been replaced or encapsulated.

Existing Onshore Emulsion Pipeline Spill Volumes

The Platform Irene to LOGP pipeline volume is close to 1.9 million gallons (or 46,000 barrels). However, much of this volume would not be released in the event of a rupture or leak of the pipeline. This is due primarily to the onshore terrain of the pipeline, which would trap some oil in the pipeline “low points”, or valleys. The presence of check valves would also prevent the oil from draining backwards down the pipe towards a break. The presence of MOVs would also allow the isolation of sections, thereby reducing a spill volume further. In addition, as oil is released, air must enter the pipeline to occupy the displaced volume. This can slow draining and prevent the maximum pipeline release volume from occurring. The CSFM report indicates that only 6% of incidents generated release volumes close to the theoretical maximum (greater than 50% of the pipeline volume between block valves). Much of this was due to terrain. For the purposes of this evaluation, the maximum theoretical spill volume, including a terrain adjustment, was used.

Pipeline spill volumes for the onshore Platform Irene to LOGP pipeline are presented in Table 3.2.3. Spill volumes are shown for two scenarios: SCADA operational and SCADA not operational. If the SCADA system were to fail, thereby not closing the automatic valves, spill volumes would be increased on segments of the pipeline where spill volumes are controlled by the valves, not by terrain. Spill volumes are a function of both the line drainage and the pumping rate. If a leak or rupture occurs in the pipeline, crude oil will flow out of the pipeline due to gravity draining the pipeline and to crude oil being forced through the pipeline from the shipping pumps. The length of pipeline that would drain is a function of the terrain and elevation profile of the pipeline and the characteristics of the crude oil. Higher viscosity crude oil would drain slower. In addition, relatively level terrain would contribute to slower draining. Also, remotely operated valves that are closed via the SCADA system or the presence of check valves would limit the length of pipeline that would drain.

How an operator responds to SCADA system alarms and automatic shutdowns have an impact on the size of the oil spill in the event of a leak. The 1997 release from the emulsion pipeline was exacerbated by an operator restarting the shipping pumps, thereby increasing the release volume. Following the release, the operator (Nuevo) developed a response procedure for unintended shutdown of the emulsion pipeline.

Table 3.2.3 Current Operations Onshore Emulsion Pipeline Spill Volumes (barrels)

Location Description	Normal Operation: SCADA Operational		Worst-case: SCADA Not Operational		Notes
	Drain-down Spill Volume	Total, with Pumping Loss	Drain-down Spill Volume	Total, with Pumping Loss	
On Beach	386	584	2738	3,926	Loss of contents between beach and VS1 (1,000'). Worst-case loss of contents between beach and high point before VS2 (7,000'). Check valve at VS3 prevents backflow.
At Valve Site #2	179	376	179	1,366	Loss of contents from pipeline uphill from VS2 (500'). Worst-case same as VS3 check valve prevents backflow.
Canyon and Terra Road Crossing	952	1,150	952	2,140	Loss of contents between VS2 and VS3 (2,500'). Worst-case same as VS3 check valve prevents backflow
Valve Site #3	714	912	714	1,902	Break just downstream of VS3 (after CV). Loss of contents between VS3 and high point after VS3 (1,800'). Worst-case the same as check valve at VS5 prevents backflow.
Valve Site #4	952	1,150	952	2,140	Loss of contents between hill before VS4 and VS4 (2,500'). Worst-case the same as VS5 check valve would prevent backflow.
After Valve Site #4	1,500	1,698	2,452	3,640	Break located after VS4 and Terra Road Crossing in small drainage. Loss of contents between VS4 and VS5 (3,900'). Worst-case loss of contents between hill after VS3 and VS5 (6,300').
Valve Site #5	571	769	571	1,759	Loss of contents from pipeline located upstream and downstream of VS5 not including valleys (1,500'). Worst-case would be the same as the check valve at VS6 would prevent backflow.
Drainage Area Before Valve Site #6	417	615	417	1,604	Limited by elevation profile and VS6 check valve (1,100'). Worst-case would be the same as the VS6 check valve would prevent backflow.
Valve Site #6	1,405	1,603	2,571	3,759	Loss of contents located above VS6 including valleys between VS6 and VS7 (3,600'). Worst-case would include all areas above VS6 between VS6 and the VS9 check valve excluding valleys (6,600').
Valve Site #7	1,143	1,341	3,083	4,271	Loss of contents between hill upstream of VS7 and VS7 (2,900'). Worst-case due to all segments of pipeline downstream of VS7 before the VS9 check valve excluding valleys (7,900').
Between Valve Sites #7 and #8	786	984	5,131	6,318	Loss of contents between VS7 and VS8 (2,000'). Worst-case release due to pipeline above drainage bottom before the VS9 check valve excluding valleys (13,200').
Valve Site #8	2,619	2,817	4,048	5,235	Loss of contents from areas downstream of VS8 between VS8 and VS9 excluding valleys (6,700'). Worst-case would include upstream volume between hill before VS7 and VS8, which is above VS8 (10,400').
Drainage Area Before Valve Site #9	2,943	3,141	2,943	4,130	Loss of contents from pipeline located above drainage area between highway S-20 and VS9 (7,600'). Worst-case would be the same because of the check valve at

Table 3.2.3 Current Operations Onshore Emulsion Pipeline Spill Volumes (barrels)

Location Description	Normal Operation: SCADA Operational		Worst-case: SCADA Not Operational		Notes
	Drain-down Spill Volume	Total, with Pumping Loss	Drain-down Spill Volume	Total, with Pumping Loss	
					VS9.
Valve Site #9	2,755	2,953	2,755	3,942	Loss of contents from pipeline located downstream of VS9 excluding valleys (7,100'). Worst-case would be the same.
Valve Site #10	167	365	167	1,354	Release from last section of pipeline above VS10 (400').
Largest Spill Volume		**3,141**		**6,318**	**Largest Spill Volumes from all segments.**

Pumping rate calculated at 57,000 bpd. VS – valve site.

The MMS Supplement to the Core Oil Spill Response Plan (Volume 2) states the shutdown time for the shipping pumps in the event of a release is estimated to be 11 minutes; 9 minutes to discover and confirm the leak and 2 minutes to close the shutdown valves. The frequency of a release (leak or rupture) is primarily a function of the construction of the pipeline, the maintenance and operational practices, as well as third party damage. The volume of the subsequent release is a function of the training of the operators as well as the design, construction and maintenance of the leak detection system.

The spill volumes are for total pipeline fluids. Spill volumes of just oil would be 10% of the above listed numbers (current operation is with 90% produced water, 10% oil). Produced water also may contain potentially hazardous materials and may not comply with NPDES discharge requirements. Worst-case scenarios would assume that the SCADA system is not operational and that pumping continues for 30 minutes. Normal operations assume pumps continue to run for 5 minutes.

Along selected portions, the pipeline route is equipped with catchment basins that are designed to catch spilled oil resulting from a pipeline leak or rupture. The 1985 Point Pedernales EIR detailed these catchment basins and their associated potential storage volumes. Also, see Section 3.4, Water Resources, for a discussion of the catchment basins and associated mitigation.

Existing Onshore Gas Pipelines: Frequencies, Probabilities and Release Impacts

Operation of the gas pipeline from Platform Irene to LOGP presents a hazard to the public in the form of toxic and flammable vapor exposure. Scenarios for releases and subsequent consequence events were developed as part of the Point Pedernales 1985 EIR, 1993 SEIR and 1996 Addendum. All scenarios were included as any release from the pipeline has the potential to impact populations.

Both pipeline ruptures and pipeline leaks were included. Each of these has the potential to produce toxic effects, flammable vapor cloud effects, thermal effects due to flame jets and flammable vapor explosions and vapor cloud fires/explosions (VCE) due to the ignition of flammable vapors.

The operating pressures were assumed to be the worst-case addressed in the 1993 Point Pedernales SEIR as historic operations have been up to this level. Operation of the pipeline at 600 psig was assumed. Impact distances utilized those developed as part of the 1993 SEIR and are listed in Table 3.2.4 along with levels of concern criteria for fatality and injury. Toxic impacts distances were modeled in the 1993 SEIR at 4,000 ppm H_2S. Recently, the permit levels have been approved by the SBC at 8,000 ppm. Therefore, the 1993 SEIR toxic impact numbers have been updated to reflect the higher H_2S concentration. Because of this change, impact distances have increased almost by a factor of 2.5 (for the stable wind condition scenarios).

Table 3.2.4 Current Operations Gas Pipeline Release Scenario Impacts

Type	Stability Class/Wind Speed	Fatality Distance, ft	Injury Distance, ft	Criteria
Leak – Explosion	-	49	289	Fatality-3 psi, Injury-0.5 psi
Leak – Thermal	-	75	92	Fatality–10 kw/m2, Injury–5 kw/m^2
Leak – Toxic*	F-2 m/s	172	461	Fatality–ERPG-3, Injury–ERPG-2
Leak – Toxic*	D-4 m/s	112	246	Fatality–ERPG-3, Injury–ERPG-2
Leak – VCE	F-2 m/s	400	1,060	Fatality – LFL, Injury – ½ LFL
Leak – VCE	D-4 m/s	89	135	Fatality – LFL, Injury – ½ LFL
Rupture – Explosion	-	125	751	Fatality-3 psi, Injury-0.5 psi
Rupture – Thermal	-	217	259	Fatality–10 kw/m2, Injury–5 kw/m^2
Rupture – Toxic*	F-2 m/s	780	2,033	Fatality–ERPG-3, Injury–ERPG-2
Rupture – Toxic*	D-4 m/s	448	974	Fatality–ERPG-3, Injury–ERPG-2
Rupture – VCE	F-2 m/s	1,066	2,477	Fatality – LFL, Injury – ½ LFL
Rupture – VCE	D-4 m/s	262	407	Fatality – LFL, Injury – ½ LFL

* Toxic impact distances have been updated to reflect the maximum H_2S concentration of 8,000 ppm.
VCE – vapor cloud fires/explosions.

For toxic exposure, levels of concern conservatively utilized the ERPG as established by the American Industrial Hygiene Association. ERPG-3 (100 ppm for 60 minutes), defined as the dose at which persons could be exposed for up to one hour without developing life threatening effects, was chosen as the level at which 10% of persons exposed would experience fatalities. ERPG-2 (30 ppm for 60 minutes), defined as the dose at which persons could be exposed for up to one hour without developing serious injury effects, was chosen as the level at which 10% of persons exposed would experience injuries. These compare to the 100 ppm for 30 minutes IDLH value (Immediately Dangerous to Life and Health) which is defined as the level at which no life threatening health effects would occur.

Effects of acute exposures to H_2S include eye irritation, respiratory tract irritation, headache, dizziness, excitement, staggering gait, and gastroenteric disorders. Exposure to concentrations of 1,000 to 2,000 ppm causes respiratory paralysis after a breath or two, due to inhibition of the respiratory center of the brain. Olfactory paralysis is estimated to occur between 50 and 200 ppm (SBCFD 2000). The ERPG-2 and ERPG-3 values for injuries and fatalities, respectively, are based on past workshops and studies (SBCFD 2000) as well as a level of conservativeness related to impacts on elderly and child populations. Note that the Bercha Study (Bercha Group 1998) conducted on the same facilities utilized ERPG-3 as the 10% level for injuries.

For explosions, the fatality level was estimated to be 3 pounds per square inch (psi) above normal atmospheric pressure and the injury level was estimated to be 0.5 psi. These are based on impacts to buildings where, according to the Center for Chemical Process Safety (CCPS), occupants would most likely suffer fatalities or injuries at these levels due to collapsing walls or shattered windows.

For thermal exposure to fires or flames, the fatality exposure level was estimated to be 10 kw/m^2 and the injury level to be 5 kw/m^2. These levels are based on the time it takes to develop second degree burns. For vapor cloud explosions, the fatality level was estimated to be within the lower flammability limit (LFL) and the injury level as estimated to be within the ½ LFL.

Gas pipeline failure frequencies utilized the DOT failure rates for gas pipelines (based on the 1993 Point Pedernales SEIR for the LOGP). These rates are to $4.34x10^{-4}$ and $2.13x10^{-4}$ per mile-year for leaks and ruptures. The pipeline specific failure frequencies and probabilities shown below in Table 3.2.5 are for ruptures and leaks and were developed as part of the 1993 SEIR.

Table 3.2.5 Current Operations Onshore Produced Gas Pipeline Failure Frequencies and Probabilities

	Failure Frequency, per year	Lifetime Release Probability, %
Leak rate	$5.29x10^{-3}$	5.2
Rupture rate	$2.60x10^{-3}$	2.6

For a project lifetime of ten years until 2017. Pipeline length of 12.2 miles.
Frequencies based on the 1993 Point Pedernales SEIR.

Existing Onshore Water Return Pipeline: Frequencies, Probabilities and Spill Volumes

Although the water return line does not currently transport crude oil or gas, and therefore would present minimal, if any, public safety hazard, the water carried does not meet the California Ocean Plan nor the Federal requirements (NPDES) for discharge of the water into the environment. Therefore, a failure of the pipeline could produce a spill that could degrade the existing environment.

The methodology for determining pipeline spill frequencies was the same used for determining crude oil pipeline spill rates. Based on the CSFM data, pipeline-specific spill rates can be estimated for a pipeline based on the specific criteria. Using the CSFM data, the following pipeline characteristics and assumptions for the water return pipeline were used for baseline and operating conditions:

- Pipeline diameter of 8 inches (1.04 correction factor);
- Pipeline specification is API 5L X46 grade, electric resistance welded (0.71 correction factor);
- Pipeline type is average (1.0 correction factor);
- Operating temperature of 125°F (1.59 correction factor);
- SCADA system is not present (1.57 correction factor);
- Cathodic protection system is present (0.98 correction factor);
- Pipeline is internally inspected (0.63 correction factor); and

- Pipeline coating is polyethylene butyl adhesive (0.09 correction factor).

Based on the above pipeline specifications, a pipeline spill rate was calculated. This spill rate is slightly higher than the crude oil pipeline, mainly due to the pipeline diameter and absence of a SCADA system. The CSFM report also estimated that larger spills (greater than 100 barrels) comprise approximately 18% of the total number of spills. These larger spills are assumed to equate to a rupture of the pipeline, whereas spills less than 100 barrels would equate to a leak. These equate to the following pipeline specific spill frequencies and probabilities.

Table 3.2.6 Current Operations Onshore Water Return Pipeline Spill Frequencies and Probabilities

Scenario	Spill Frequency per year	Lifetime Spill Probability, %
Onshore Water Pipeline ruptures	1.65×10^{-3}	1.6
Onshore Water Pipeline leaks	7.27×10^{-3}	7.0

For a project lifetime of ten years until 2017.
Spill rate based on the base rate of 7.1×10^{-3} incidents/mile-year (for all pipelines) with the correction factors and multiplying by the pipeline distance of 12.2 miles and adding in the seismic frequency for ruptures of 5×10^{-5}/year for this pipeline.

The produced water pipeline has not experienced any leaks or failures to date. There are no anticipated changes to the corrosion control program; however, the frequency of the maintenance pigging may increase or decrease based on pipeline parameters. If for example, the pipeline smart pigging demonstrates increased corrosion rates, then pigging would occur more frequently. A recent Smart Pig Survey (2005) showed evidence of corrosion and a section of pipe was repaired. As a result of a confirmation dig for the identified anomalies, a monolithic isolation flange and pipe spool were replaced at Valve Site #1. The internal corrosion survey conducted in 2005 using a high resolution pig showed that the majority (greater than 99 percent) of anomalies were between 10 and 29 percent of wall thickness. There were 23 anomalies between 30 to 79 percent.

The total produced water return line volume is calculated to be approximately 307,000 gallons. However, as with the crude oil pipeline, terrain greatly affects the release volumes. As the produced water return pipeline follows the same route as the crude oil/emulsion pipeline, the elevation profile would be identical. However, the produced water return line has fewer automatic valves and no check valves. Therefore, greater lengths of the pipeline would drain and affect the release volumes; hence the release volumes would be greater than for the crude oil/emulsion pipeline.

Pipeline spill volumes for the onshore pipeline between Platform Irene and the LOGP are presented in Table 3.2.7. Because the produced water return line is not equipped with a SCADA system, time to respond to a rupture or leak would be longer than for the emulsion line. Time to respond is estimated to be 30 minutes. Detection most likely would be through loss of flow rate and an associated pressure drop in the water pipeline. These would be noticed at theMOV-612 located at Platform Irene, which would close on detection of high or low pressure on Pressure Switch High-Low (PSHL) #612 which is located downstream of the platform SDV. The leak would also be noticed at the Platform Irene flow transmitter (FT) and located immediately downstream of the water pipeline pig catchers (FT-612). The water pipeline is designed to close at Valve Sites #1, 2, 8 and 10 when the pressure is low.

Table 3.2.7 Current Operations Onshore Water Return Line Estimated Spill Volumes (bbls)

Location Description	Normal Operation: Automatic Valves Operational		Worst-case: Automatic Valves Not Operational		Notes
	Drain-down Spill Volume	Total, With Pumping Loss	Drain-down Spill Volume	Total, With Pumping Loss	
On Beach	62	478	1,146	1,563	Loss of contents to Valve Site #2 (1,000'). Worst-case: downstream pipeline minus the valleys (18,400').
At Valve Site #2	255	672	708	1,124	Loss of contents to Valve Site #8 (4,100'). Worst-case: downstream pipeline minus the valleys (11,400').
Canyon and Terra Road Crossing	533	950	986	1,403	Loss of contents upstream to Valve Site #2 and downstream to Valve Site #8 excluding the valleys (8,600'). Worst-case: upstream and downstream pipeline minus the valleys (15,900').
After Valve Site #4	659	1,076	1,112	1,528	Loss of contents towards Valve Site #4 and downstream to Valve Site #8 excluding valleys (10,600'), Worst-case towards VS4 and downstream to LOGP minus valleys (17,900').
Drainage area before Valve Site #6	343	760	795	1,212	Drainage primarily from downstream pipeline to Valve Site #8 (5,500'). Worst-case past Valve Site #8 (12,800').
Between Valve Sites #7 and #8	312	729	986	1,403	Drainage primarily from upstream portion (5,000'). Worst-case from downstream (towards LOGP) as well (15,900').
Drainage area before Valve Site #9	437	854	437	854	Drainage primarily from downstream portion minus valleys (7000). Worst-case the same.
Valve Site #10	27	443	27	443	Release due to last section of pipeline above Valve Site #10 (400'). Worst-case the same.
Largest Spill Volume		1,076		1,563	**Largest Spill Volumes from all segments**

Pumping rate calculated at 20,000 bpd.

Existing LOGP Facility and Sales Gas Pipeline: Scenarios and Failure Rates

Operation of the LOGP has the potential to cause impacts to the public through releases of flammable and toxic materials. Modeling conducted as part of the Point Pedernales 1985 EIR, 1993 SEIR and 1996 Addendum was utilized in this study. Only scenarios which produced a fatality or injury impact distance equal to or greater than the LOGP facility boundary (700 feet) were selected for analysis. All other scenarios, even though they could produce secondary effects such as fires or traffic hazards, were not addressed. Secondary effects were assumed to be effectively mitigated through existing emergency response actions and community preparedness and are considered to be outside the scope of this analysis. The scenarios included in this study are listed below in Table 3.2.8.

Only flammable releases from the LOGP facility were determined to produce impacts offsite. Toxic releases were contained within the facility boundaries.

Table 3.2.8 Current Operations LOGP Release Scenarios Impacting Offsite and Base Frequencies

Scenario	Type	Stability Class/Wind Speed	Fatality Distance ft	Injury Distance ft	Base Frequency per yr	Source
Crude tank fire	Thermal		650	885	$4.00x10^{-5}$	1985 EIR
Gas/oil separator vessel rupture	VCE	D-5 m/s	318	740	$2.00x10^{-5}$	1985 EIR
Gas/oil separator vessel rupture	VCE	F-2 m/s	705	1,640	$2.00x10^{-5}$	1985 EIR
LPG/NGL vessel BLEVE	Thermal		1,635	2,240	$8.00x10^{-7}$	1993 and 1996 SEIR and Addendum
LPG/NGL vessel Explosion	Explosion		470	1,880	$8.00x10^{-7}$	1993 and 1996 SEIR and Addendum
LPG/NGL tank rupture/release	VCE	D-5 m/s	1,032	2,400	$2.00x10^{-5}$	1985 EIR
LPG/NGL tank rupture/release	VCE	F-2 m/s	1,075	2,500	$2.00x10^{-5}$	1985 EIR
LPG/NGL tank truck rupture	Explosion		460	1,800	$4.04x10^{-7}$	1985 EIR
LPG/NGL tank truck rupture	VCE	D-5 m/s	593	1,380	$4.04x10^{-7}$	1985 EIR
LPG/NGL tank truck rupture	VCE	F-2 m/s	538	1,250	$4.04x10^{-7}$	1985 EIR
LPG/NGL tank truck rupture	VCE	F-2 m/s	538	1,250	$4.04x10^{-7}$	1985 EIR
Sales Gas Pipeline	Thermal		126	138	1.51E-04	PANGL, 1999*
Sales Gas Pipeline	VCE	D-5 m/s	335	600	1.51E-04	PANGL, 1999*
Sales Gas Pipeline	VCE	F-2 m/s	167	259	1.51E-04	PANGL, 1999*
Sales Gas Pipeline	Thermal		771	791	7.43E-05	PANGL, 1999*
Sales Gas Pipeline	VCE	D-5 m/s	1,761	3,050	7.43E-05	PANGL, 1999*
Sales Gas Pipeline	VCE	F-2 m/s	928	1,450	7.43E-05	PANGL, 1999*

Lifetime Probabilities would be less than 0.1% for all scenarios. Cumulative total lifetime probability is 0.15%.
VCE = Vapor Cloud Fire/Explosion.

The sales gas pipeline connects the LOGP to The Gas Company transmission line located approximately 6.5 miles to the north of the LOGP of the LOGP. Failure rates for gas transmission and gathering pipelines are estimated by the DOT to be approximately $2.25x10^{-4}$ incidents (a leak or a rupture) per mile-year. This number is lower than the produced gas pipelines due to the presence of hydrogen sulfide in the produced gas. The sales gas pipeline hazards would be limited to flammable hazards (VCE or thermal) due to the lack of hydrogen sulfide in the sales gas stream. Impact distances are somewhat greater than those for the LOGP scenarios due to the larger pipeline size and higher operating pressures.

Existing Transportation: Scenarios and Failure Rates

Transportation of flammable gas liquids (propane and butane) to markets both locally and regionally presents a risk to populations along the transportation corridors. Transportation impacts were examined as part of the 1985 EIR. Risks to populations were generated by utilizing historical accident rates for trucks along with spill probabilities for small, medium and large spills and subsequent ignition. Population densities (urban or rural) were assigned to designated routes and the release impact distances were utilized to generate the number of persons that could be affected.

Scenarios associated with gas liquids transport include a truck accident with a subsequent spill of the truck vessel contents. The material would vaporize rapidly and produce a flammable cloud that, upon ignition, could impact public safety.

Table 3.2.9 shows inputs to the transportation risk model developed as part of the 1985 Point Pedernales EIR.

Table 3.2.9 Current Operations Transportation Risk Inputs, 1985 Point Pedernales EIR

Input	Number
Base accident frequency, per vehicle-mile	1.5×10^{-6}
Spill probability given an accident occurs	0.5
Fraction of spills that are less than 100 gallons (minor spills)	0.5
Fraction of spills that are less than 900 gallons (major spills)	0.30
Fraction of spills that are catastrophic	0.20
Major spills ignition probability	0.25
Catastrophic spills ignition probability	0.75
Percent of trucks traveling to Los Angeles	40
Percent of trucks traveling to Bakersfield	10
Percent of trucks traveling to local destinations	50

The SBC Board of Supervisors' Resolution 93-480 (adopted in 1993, amended resolution 85-334) requires the implementation of safety measures to minimize the hazards associated with the transportation of natural gas liquids on roads within the County and region. These measures include the blending of gas liquids with crude oil for pipeline shipment to the maximum extent feasible; the use of DOT LPG rated trucks (MC-331); the development of a risk management program that includes carrier audits, vehicle speed monitoring and operating procedures; and the use of only "lower-risk" routes. In the PXP Point Pedernales permit, this resolution is incorporated into conditions P-2 and P-23. Since December, 2001, SBC has determined that Torch (now PXP) has demonstrated that the existing operation is in compliance with Resolution 93-480.

3.2.1.7 Existing Offshore Facilities

Offshore facilities include Platform Irene and the offshore portions of the emulsion, gas and water return pipelines.

Existing Offshore Facilities Spill Frequencies, Probabilities and Spill Volumes

Offshore oil spills probabilities have been generated from a number of different sources and approaches. The MMS has developed an approach for estimating the oil spill occurrence, normalized as a function of total oil handled (Anderson et al. 1994). The 1985 Point Pedernales EIR addressed oil spill probabilities based on past studies and an equipment specific analysis of the proposed project. Additional information from the DOT is also presented.

Offshore MMS Spill Probabilities

The MMS approach is presented in order to provide a comparison to more equipment specific and operations-derived calculations of spill frequency. The MMS has developed this approach in order to calculate spill probabilities of future development scenarios. This analysis is based on the actual spills that have occurred for offshore platforms and pipelines for the period 1964 to 1992. Table 3.2.10 provides the OCS platform and pipeline spill rates for the period 1964 to 1992. For the Pacific region, spills range in size from 1 to 163 bbls (recorded in 1997). This excludes the 80,900 bbl spill that occurred in 1969. Since 1969 there have been only six other spills above 50 bbls (of sizes 900, 100, 50, 50, 150 and 163 bbls). According to MMS "a number of preventative measures have been initiated since that time. These measures make reoccurrence a highly unlikely event" (MMS, 2001). Therefore, in order to avoid skewing the results, the 1969 spill is excluded.

Table 3.2.10 MMS OCS Platform and Pipeline Spill Rates

US OCS Spills	Number of Spills	Median Spill Size (bbls)	Spill Rate (spills per 10^9 bbls produced)
Spills less than 50 bbls (Small or Leaks)			
Platforms	154	25	11.1
Pipelines	457	25	33.2
Spills greater than 50 bbls (Large or Ruptures)			
Platforms	27	159	1.9
Pipelines	80	159	5.8

Source: Comparative Occurrence Rate for Offshore Oil Spills, Anderson and La Belle, MMS. Also, MMS, 2001, and Attachment F in this document. Values for breakdown of spills between platforms and pipelines have been estimated based on ratios associated with larger spills (for which better data is available).

Using the data provided above, estimated oil spill probabilities were generated for Platform Irene and the associated pipeline These spill probability estimates are shown in Table 3.2.11 and are based upon the remaining life of Platform Irene as determined from the CSLC production estimates (to approximately the year 2017). The Point Pedernales Field is expected to continue production until this time.

Existing Offshore Equipment Specific Failure Frequencies and Probabilities

The MMS oil spill probability estimates are based on historic data of oil spills from OCS facilities and the total production from these facilities. These data are combined to generate a spill rate as a function of total oil production. This method of estimating spill rates is useful in evaluating the likelihood of an oil spill, in general, from OCS facilities. However, when looking at a specific project, spill probabilities are typically generated based upon equipment failure rate, which allow one to account for variations in project-specific designs. For example, projects that have a large number of oil handling vessels on a platform would have a higher probability of an oil spill since there is more equipment that could fail. Also, platforms that have a closed drain system would have fewer spills to the ocean than a platform without a closed drain system.

Table 3.2.11 Current Operations Oil Spill Probability Estimates for the Point Pedernales Field (2007-2017)

Location	Total Oil Production, 10^9 bbls	Duration of Total Oil Production, years	Estimated Number of Spills During the Duration	Probability of Zero Spills Occurring (P)	Probability of One or More Spills Occurring
Spills between 1 and 50 bbls (Small or Leaks)					
Platform Irene	0.0073	10	0.0808	92.2%	7.8%
Irene Pipeline	0.0073	10	0.2425	78.5%	21.5%
Total			0.3233	72.4%	27.6%
Spills > 50 bbls (Large or Ruptures)					
Platform Irene	0.0073	10	0.0283	98.6%	1.4%
Irene Pipeline	0.0073	10	0.0849	95.8%	4.2%
Total			0.1132	94.5%	5.5%

Estimated average rate of oil production over remaining life is 2,000 bpd.
Duration of production is from the beginning of 2007 through the end of 2017.
Estimated number of spills during the duration = (spill rate) x (total oil production).
Probability (P) = e^ (-number of spills during duration).
The probability of one or more spills = 1-P. Please see Attachment F for more details.

The 1985 Point Pedernales EIR developed project-specific estimates of the frequency of an oil spill release from Platform Irene. The areas examined included the following:

Wellhead drilling and production: Currently, all wells on Platform Irene are utilizing submerged pumps or gas lift. The risk of a blowout is therefore minimized due to the relatively low pressures of these systems and the ability of the platform systems to control the pressure. However, the wells could produce releases addressed in the wellhead systems. Well workovers could produce blowouts. The Hydrocarbon Leak and Ignition Database (HLID 1992) estimates well workovers are performed every seven years. In addition, some of the blowouts occur subsea, below the platform deck areas. These blowouts would not be trapped by the platform drain system and would therefore release directly to the ocean. Blowouts that occur at the wellhead or the drilling deck could be captured by the platform deck system, if small enough. Larger blowouts, given a conditional probability in the HLID report, could directly affect the ocean.

Wellhead Systems: Wellhead failures would be due to a failure in the piping or fittings with a subsequent failure to close the safety valves. For medium to small leaks, a failure of the platform drainage system would also have to occur for a release to impact the ocean.

Oil and Gas Separation: Releases from separation vessels on the platform could occur due to piping or connection failures or vessel leaks and ruptures. For medium to small leaks, a failure of the platform drainage system would also have to occur for a release to impact the ocean. Larger spills could exceed the capacity of the drain system and cause a release to the ocean (1985 Point Pedernales EIR).

Crude Oil Pumping/Shipping: Releases from these areas would be due to pump failures, piping valve, or fitting failures or the pump surge vessel failure. Shipping failures could be due to pig-launching equipment or operator errors during the pig-launching activity. All small and medium leaks would be captured by the platform drain system and a failure of the drain system would be required to impact the ocean. Only the catastrophic rupture of the surge vessel could produce a spill large enough to directly affect the ocean.

Gas Dehydration: Although releases from the gas equipment could impact personnel at the platform, impacts to the public or to the ocean are considered remote.

Utilities: Impacts from utilities are primarily due to diesel fuel loading to operate the two cranes and the emergency power generators. Loading failures that could cause a small to medium sized release to the ocean would include a hose failure with subsequent failure of the check valve.

Platform Drain System: The Platform, as most offshore platforms, has a drain system which captures all liquids (e.g., leaks, rainwater, washdowns) released to the platform decks and directs these to a system which pumps the liquids into the oil emulsion pipeline and takes the liquids to the onshore LOGP. This system is limited both by the deck capacity to hold liquids (each deck is enclosed by a 6-inch welded “lip”), the drain capacity and the ability of the deck drain system to move liquids away from the decks, and the system pumps which pump the liquids into the emulsion pipeline (pump capacity is 40 gallons per minute for sump pumps which drain sumps and 200 gpm for transfer pumps which drain the decks). Spill histories offshore have indicated that spills can occur if it is windy or if a release has sufficient velocity to “ride over” the deck lip. Also, if a failure of any of the drain system were to occur, such as drain pluggage, pump failures, valve failures, etc., the spill could be released to the ocean.

Gas Lift and Reinjection would not involve releases of crude oil, and pipelines are discussed in other sections.

Table 3.2.12 lists the failure rates for the above listed equipment categories. The failure frequencies are derived from the 1985 Point Pedernales EIR and from other sources. The CCPS details uncertainties associated with equipment specific failure rates. As per the CCPS analysis, confidence intervals span approximately 2 orders of magnitude with the mean valve used in this analysis.

Table 3.2.12 Current Operations Platform Irene Spills to Ocean (Frequency and Probabilities)

Scenario	Frequency, per year	Lifetime Probability of Spill, % [a]
Small Spills or Leaks		
Irene - Wellhead Area Spill to Ocean – small	1.47×10^{-8}	0.0
Irene - Separator Failure Spill to Ocean – small	3.74×10^{-6}	0.0
Irene - Pumping and Shipping Spill to Ocean – small	2.38E$\times 10^{-4}$	0.2
Irene - Diesel Fuel Loading – Small spill to Ocean	2.90×10^{-4}	0.3
Cumulative Small Spills	5.33×10^{-4}	0.5
Large Spills or Ruptures		
Irene – Blowouts	NA	NA
Irene - Wellhead Area Spill to Ocean – large	1.25×10^{-8}	0.0
Irene - Separator Failure Spill to Ocean – large	9.60×10^{-5}	0.1
Irene - Pumping and Shipping Spill to Ocean – large	2.80×10^{-5}	0.0
Irene - External Impact	1.00×10^{-5}	0.0
Cumulative Large Spills	1.34×10^{-4}	0.1

Table 3.2.12 Current Operations Platform Irene Spills to Ocean (Frequency and Probabilities)

Scenario	Frequency, per year	Lifetime Probability of Spill, % [a]
Cumulative All Spills	**6.67 x10^{-4}**	***0.7***
MMS Throughput method, 1 – 50 bbls spills, small spills	8.1x10^{-3}	7.8
MMS Throughput method, > 50 bbls spills, large spills	1.4x10^{-3}	1.4

a. Zero indicates less than 0.1%. Lifetime assumes until the year 2017.

For Platform Irene, the MMS method estimates the probability of a spill to be higher in relation to the equipment-specific method.

Pipeline failures would be caused primarily by corrosion of the pipeline or outside force damage. The OPS compiles data on spills from pipelines, both onshore and offshore, that release greater than 50 barrels of material. For crude oil pipelines only, between the years 1985 and 2000, the majority of releases from offshore pipelines were due to outside force damage followed by corrosion. This is different from the onshore pipelines, which were due primarily to corrosion (38%) followed by outside force damage (29%). This is because offshore pipelines are more susceptible to outside impacts because they are generally not buried.

Pipeline spills rates are shown in Table 3.2.13 from a number of sources giving a range of the frequency of pipeline spills. These rates are for the emulsion pipeline only. The water return pipeline is discussed below. The gas pipeline rates are examined for the onshore portion only.

Table 3.2.13 Summary of Current Operations Emulsion Pipeline Spills to Ocean (Frequency and Probabilities)

Source	Frequency, per year	Lifetime Probability of Spill, % [a]
Leaks		
1985 Point Pedernales EIR Table 2-2, leaks	4.41x10^{-3}	4.3
CSFM for this pipeline, leak	1.77x10^{-3}	3.1
MMS pipeline throughput method, 1 – 50 bbls spill	2.42x10^{-2}	21.5
Rupture/Larger Spills		
1985 EIR Table 2-2, ruptures	4.90x10^{-4}	0.5
CSFM for this pipeline, rupture	6.82x10^{-4}	0.7
OPS all crude lines, spills > 50 bbl	9.17x10^{-3}	8.8
MMS pipeline throughput method, spills > 50 bbl	4.24x10^{-3}	4.2

a. For a project life until year 2017.

The CSFM pipeline database shows the lowest frequency for spills. The MMS gives estimates in the middle to high end of the range, with larger spills being more frequent than the 1985 Point Pedernales EIR or the CSFM estimates and small spills being significantly more frequent.

Total spill frequencies for the offshore emulsion pipeline and Platform Irene are shown in Table 3.2.14. These numbers utilize the 1985 Point Pedernales EIR pipeline leak rate for leaks and for pipeline ruptures.

Table 3.2.14 Offshore Current Operations Combined Platform Irene and Emulsion Pipeline Spills to Ocean (Frequency and Probabilities)

Scenario	Frequency, per year	Lifetime Probability of Spill, %
Leaks and Small Spills	$4.94x10^{-3}$	4.8
Ruptures and Large Spills	$6.24x10^{-4}$	0.6
Any Spill Size	$5.57x10^{-3}$	5.4

Numbers may not add due to rounding.
Utilizing 1985 Point Pedernales EIR numbers.

Spills from the pipeline dominate the spill frequency. This is primarily due to the drain system on the platform, which prevents most small and medium sized leaks from entering the ocean.

The offshore portion of the emulsion pipeline experienced a mechanical failure and subsequent spill in 1997. The spill was caused by a failure in a welded and flanged connection. As a result of the 1997 offshore failure, the emulsion pipeline would have been considered a "high-risk" pipeline by the CSFM. After the 1997 spill the SBC required inspections of the remaining welded and flanged connections every six-months. As a result of these inspections, a number of cracks were found in other welded and flanged connections. In 2001, the Applicant chose to replace all but one of the remaining welded and flanged connections on the offshore portion of the emulsion pipeline. The welded and flanged connection at the Platform was not replaced. The flanges were removed and replaced with Flexiforge® flanges (BIMS, 1999), which do not require welding to make a joint connection. The welded and flanged connection (Flange #1-1) at the Platform was subsequently encapsulated in the fall of 2005 (DIVECON, 2005). Therefore, flanges that were susceptible to failure due to microcracks in the heat-affected zone have been eliminated or encapsulated.

The offshore pipeline is smart-pigged every year as required by the SIMQAP. The 2005 smart-pig survey results indicate that both internal and external corrosion is negligible for the offshore portion of the emulsion pipeline. External corrosion is the primary cause of the difference between "high risk" and "non-high risk" pipelines in the CSFM report.

With the replacement or encapsulation of all the offshore welded and flanged connections, the annual smart-pig inspection, and the lack of internal and external corrosion, a "high risk" pipeline would be expected to have a similar spill frequency as a "non-high risk" pipeline, as per the CSFM report. Therefore, the offshore portion of the emulsion pipeline would be expected to have a spill frequency comparable to other "non-high risk" offshore pipelines.

Existing Offshore Water Return Pipeline Spills to Ocean Frequency and Probabilities

The produced water return pipeline carries water for injection into the Point Pedernales formation. As this water does not currently meet NPDES standards for discharge to the marine environment, a leak or rupture of the water return pipeline could have impacts to the marine environment. Release frequencies are shown in Table 3.2.15 for the 8-inch water return pipeline.

Table 3.2.15 Current Operations Water Return Pipeline Spills to Ocean (Frequency and Probabilities)

Source	Frequency, per year	Lifetime Probability of Spill, %
Leaks		
1985 Point Pedernales EIR, Table 2-2, leaks	$3.60x10^{-3}$	3.5
CSFM for this pipeline, leak	$6.14x10^{-3}$	6.0
Rupture/Larger Spills		
1985 EIR, Table 2-2, ruptures	$4.00x10^{-4}$	0.4
CSFM for this pipeline, rupture	$1.35x10^{-3}$	1.3
OPS all crude lines, spills > 50 bbl	$9.17x10^{-3}$	8.8

For a project life of 10 years, CSFM assumes rate for all product types, 1985 EIR assumes rate from 10-inch Platform Irene pipeline.

Smart-pig results using a high resolution tool conducted by PXP on September 26, 2005 show moderate corrosion. There were a total of 162,025 metal loss anomalies, the majority of them (161,599) of internal corrosion. Out of 162,025 anomalies, 160,309 anomalies are less than 20 percent (<20 percent), 1,711 anomalies are between 20 percent and less than 40 percent (20 percent to <40 percent). There are total of 4 anomalies greater than 40 percent metal loss (>40 percent), one of which is equal to 79 percent metal loss at 60,224.8 feet from Platform Irene (onshore downstream of Valve site #1). Upon further inspection, this anomaly was found to be a corroded monolithic fitting. The fitting was replaced and relocated to a better monitoring location. Currently, this produced water pipeline is on an annual smart pig schedule.

Existing Offshore Oil Spill Volumes

Offshore spill volumes are based on the 1985 Point Pedernales EIR and the October 2000 Torch OSRP; adjustments to each of these based on a worst-case analysis. The 1985 EIR estimated spill volumes are shown in Table 3.2.16. Spill volumes are listed for total pipeline and platform fluids. Current production levels have been approximately 88% water, 12% crude oil (2005 average).

As part of the 30 CFR 254 requirements, then operator Torch compiled its October 2000 OSRP for the Point Pedernales facilities. Section 30 CFR 254.47 details requirements for determining the worst-case spill volume from the platform and from the pipeline. As per this procedure, for an oil production platform facility, 30 CFR 254.47 specifies that the size of the worst-case discharge scenario is the sum of the following:

1. The maximum capacity of all oil storage tanks and flow lines on the facility;
2. The volume of oil calculated to leak from a break in any pipelines connected to the facility considering shutdown time, the effect of hydrostatic pressure, gravity, frictional wall forces and other factors; and
3. The daily production volume from an uncontrolled blowout of the highest capacity well associated with the facility.

Table 3.2.16 Offshore Spill Volume Estimates: 1985 Point Pedernales EIR

Scenario	Area	Total Fluids Spill Volume, bbls	Crude Oil Spill Volume, bbls [a]
Irene-Blowouts	Well area or subsea	NA	NA
Irene-Wellhead Area	5 minute spill	20	2
Irene-Separator Failure	Separators	120	14
Irene-Pumping and Shipping	Surge Tanks/Pig Launchers	200/70	24/8
Irene-Diesel Fuel Loading	Diesel transfers	10	10
Irene-External Impact	Complete Platform Loss	2,500	300
Emulsion Pipeline Rupture	Near-shore	18,000	2,160
Emulsion Pipeline Rupture	Near Irene	650	78
Emulsion Pipeline Leak	Near-shore	1- 2,000	1 - 240
Emulsion Pipeline Leak	Near Irene	1 - 650	1 - 78

a. Current operation is with 88% water, 12% crude oil in the pipeline (as of year 2005).
Source: 1985 Point Pedernales Facilities EIS/EIR, 84-EIR-17.

In addition, for exploratory or development drilling operations, the size of the worst-case discharge scenario is the daily volume possible from an uncontrolled blowout.

For a pipeline facility, the size of the worst-case discharge scenario is the volume possible from a pipeline break. This is calculated as specified in 30 CFR 254.47:

1. Add the pipeline system leak detection time to the shutdown response time.
2. Multiply the time calculated above by the highest measured oil flow rate over the preceding 12-month period. These are the pumping losses.
3. Estimate the total volume of oil that would leak from the pipeline after it is shut in. These are the line losses. Line losses are the sum of the losses due to decreased oil density and pipeline diameter due to the reduced pressure and the effects of hydrostatic pressure and buoyancy on the oil remaining on the pipeline.
4. Add together the pumping losses and the line losses to equal the total line losses.

Torch estimated in its OSRP the following capacities and release volumes. These estimates are for oil, as the water percentage has already been removed from these numbers.

Table 3.2.17 Offshore Spill Volumes: Torch OSRP

Area	Oil Only Release Volume, bbls
Platform Irene oil tanks and piping, total of all volumes	188
Diesel Storage	238
Pipeline – pumping losses	382
Pipeline – line losses	2,531
Pipeline – total release volume	2,913
Worst-Case Discharge	3,339

The largest single tank was the T-530/540 wastewater tank at 84 bbls of oil.
The Torch OSCP assumed 20% oil cut as opposed to current operations of close to 12%. These numbers reflect the current operations at 12%.
The Torch OSCP assumed only 5% of emulsion pipeline volume released. These numbers represent the same calculations but with 100% of oil volume being released.

In addition, the wells currently producing operate with submersible pumps, meaning that the wells are not free-flowing (not under pressure) and there is very low probability of a well blowout.

The volume of oil which will leave the offshore emulsion pipeline in the event of a pipeline leak or rupture is due to density differences between the oil and sea water, which will vary dramatically depending on location of the leak relative to water depth, shape of the exit hole, and position of exit hole on the pipeline. The rate at which this oil will be displaced is not difficult to calculate due to the fact the oil exits the line intermittently rather than with a steady flow. A hole at the bottom of the platform riser will release no oil as the oil is lighter than the seawater and will therefore stay in the pipeline. A hole at the surfline would, in theory, be able to completely empty the pipeline if the pipe were uniformly straight (i.e., no hills and valleys in the lay of the line), assuming no intervention to stop the leak and an unlimited time allowed for the displacement. The 2000 Torch OSRP estimated that, for offshore pipeline releases, only a small portion (5%) of the oil would actually be released due to hydrostatic pressure and buoyancy effects. However, as a worst-case analysis, the Torch OSRP analysis was recalculated assuming that 100% of the emulsion pipeline volume was released to the marine environment. This analysis increased the estimated pipeline total release volume (for details of the analysis, see the Torch OSRP, October, 2000).

The worst-case oil spill volumes used in this analysis are shown in the Table 3.2.18.

Table 3.2.18 Worst Case Offshore Spill Volumes

Area	Oil Only Release Volume, bbls
Platform Irene – Total Platform Loss	426
Offshore Emulsion Pipeline – Pipeline Midpoint Failure	1,754
Offshore Emulsion Pipeline – Shoreline Failure	2,913

Existing Offshore Water Return Pipeline Spill Volumes

A release from the offshore portion of the water return pipeline would release water in equal amounts to the hydrostatic head above the ocean level on the land-side of the pipeline route plus the pumping rate of 13.9 barrels per minute, or 417 barrels over 30 minutes. It is estimated it would take 30 minutes to shutdown the water return pipeline. For line losses, produced water in the offshore section of the pipeline would only be minimally released due to decompression and pipe diameter reductions (estimated to release approximately 150 gallons, or 4 barrels) as it is the same density as the surrounding ocean water. Releases to the ocean due to hydrostatic head would include the entire onshore portion of the pipeline not trapped by terrain “valleys” and it is assumed that this volume would drain in the time that it would take to isolate the pipeline (i.e., close the automatic valves). The hydrostatic head is estimated to be close to 50,000 gallons, or approximately 1,100 barrels of produced water.

Oil Spill Trajectories

The fate of oil spilled into the marine environment is a function of a number of different variables, primarily wind speed and direction, ocean currents, ocean conditions, and oil characteristics. Models to estimate the fate of oil spills have been developed by a number of different sources, including the MMS and National Oceanic and Atmospheric Administration

(NOAA). Modeling was conducted using two different models: the MMS Oil Spill Risk Analysis model (OSRA) and the NOAA model GNOME. Modeling results for the OSRA analysis are shown in Figure 3.2-1 and presented in detail in the 2002 EIR Appendix G, Oil Spill Trajectory Modeling and reiterated in the 2006 DEIR (SBC 2002b, 2006) (Attachment E of this document). In summary, spills from Platform Irene or the offshore pipeline could impact the coast and beaches, depending on conditions, as far north as Piedras Blancas, north of Morro Bay, to as far south as Catalina Island. The highest probabilities of impact are Point Arguello and Point Conception as well as Surf Beach and the San Miguel and Santa Rosa Islands. It is noted that the chances of a spill hitting the more distant portions of coastline are dependent upon the volume of oil spilled; a small one barrel spill is not likely to reach the more distant locations.

3.2.1.8 Existing Facilities Risk Analysis

Conducting the risk analysis involves combining the scenario frequencies and impact distances with the conditional probabilities of events, meteorological conditions and the respective populations that could be exposed to each event. Each of these is discussed below.

Conditional Probabilities

Event trees are used to determine the fate of a released material after the release has occurred. A release of a flammable material, for example, could experience instantaneous ignition leading to a flame jet. It could also disperse downwind and encounter an ignition source and burn or explode, or it could disperse safely. The probability of each of these events occurring is shown in Table 3.2.19 for major and minor events. These numbers are based on CCPS' Chemical Process Quantitative Risk Analysis, as well as other literature.

Table 3.2.19 Event Tree Probabilities

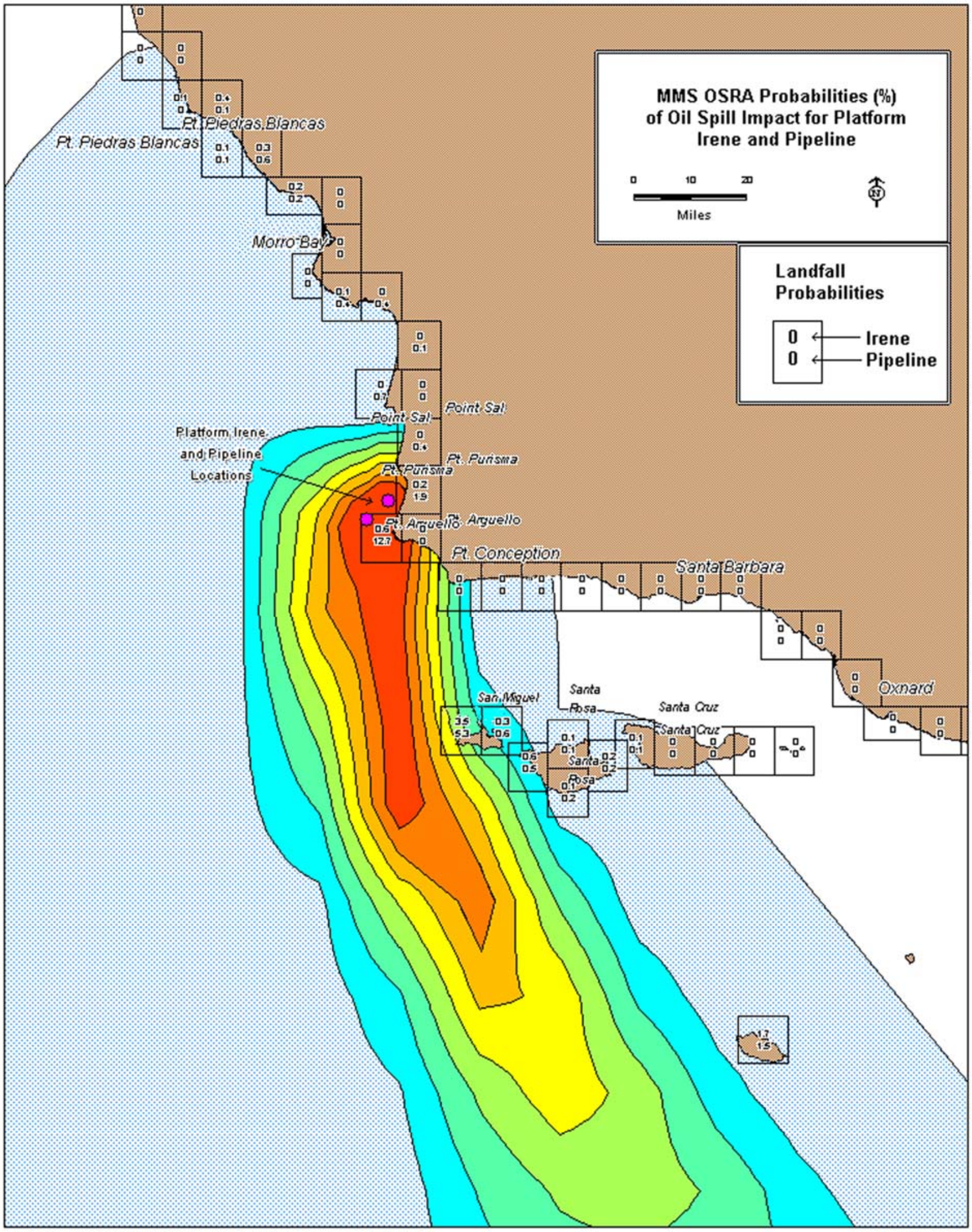
Event	Probability
Immediate Ignition	0.25
Vapor Cloud with Explosion	0.25
Vapor Cloud with Flash Fire	0.50
Toxic Dispersion	0.75 [a]

a. If the release is not immediately ignited, it can produce a toxic cloud (assuming H_2S is present in the gas at dangerous levels) until it is ignited or remains unignited. After ignition, it is assumed that the plume rises and any residual H_2S or combustion byproducts (SO_x) would rise due to thermal effects and not present a hazard.

Sensitive Populations

Populations that could be exposed to the resulting material releases include Vandenberg Village, the northern areas of the Lompoc Federal Penitentiary and sparsely populated rural and farmland areas. See Attachment A for maps of the pipeline route and the sensitive receptors. Distances from the facilities to locations along the route are listed in Table 3.2.20.

Figure 3.2-1 Oil Spill Trajectory



Based on MMS OSPRA analysis, year 2000, annual average 30-day timeframe. Conditional probabilities demote a point travel (trajectory) in 30 days and do not indicate spill area or spill volumes.

Table 3.2.20 Sensitive Population Areas and Distances from Facilities

Location	Distance, feet
From LOGP to:	
Vandenberg Village	4,600
Mission Village	8,000
From Pipeline ROW to:	
Vandenberg Village	1,800
Penitentiary	2,600
Ocean Beach Park	4,300

Population concentrations at Vandenberg Village are based on the 2000 Census (Block groups 1-5, group 28.08) and are estimated to be 7,000 persons per square mile. Rural populations, including the Burton Mesa Natural Reserve, farmland and unpopulated areas are assigned a population density of one person per square mile. This rural population number equates to an average of three persons being located in the hills around the LOGP for a distance equal to the distance between the LOGP and Vandenberg Village for 24 hours per day, 365 days a year. Automobile and other vehicle traffic along area roadways were addressed through the use of traffic counts available from the SBC. Harris Grade Road average daily traffic produces a vehicle density of 1.76 cars per mile. Assuming two persons per car, this equates to less than four persons per mile. Releases from the LOGP towards Harris Grade Road were assigned a different population density factor due to the presence of these vehicles.

Toxic and vapor clouds generally produce an impact in the form of an elliptical shaped cloud that travels downwind until dispersion reduces the concentration of material to below the toxic injury levels or below the flammability levels or, for a flammable cloud, ignition occurs. A release at the pipeline or the LOGP could create an elliptically shaped cloud that covers rural low density areas and urban, higher density areas near the end of the ellipse (if the release reaches urban areas). Geometric calculations were used to estimate the percent of the cloud over rural and urban areas, and that percent of the cloud that is located within the LOGP facility and therefore would not affect the public. For releases that produce impact distances less than the distances to sensitive receptors, all of the cloud would be located over rural areas or within the facility.

Meteorological conditions affect characteristics of releases that generate cloud effects such as toxic and vapor cloud events. Overpressure, and to a lesser extent, thermal effects, are wind independent. Therefore, for wind-dependant events, the frequency of experiencing a release at a given receptor is dependent on the wind blowing in the direction of that receptor from the release location. Wind rose data were utilized from the 1993 Point Pedernales SEIR to estimate the fraction of time that wind blows towards Vandenberg Village from the LOGP or from the pipeline ROW. These estimates are shown below for the LOGP and the pipeline segments.

Table 3.2.21 Wind Directions Towards Sensitive Population Areas

Direction	D Stability Percent of Time, %	F Stability Percent of Time, %
From LOGP towards Vandenberg Village	1.8	4.7
Platform Irene to LOGP Pipeline Segment: Between Valve Site #9 and LOGP toward Vandenberg Village	7.2	11.2
Platform Irene to LOGP Pipeline Segment: Between Valve Sites #8 and #9 toward Vandenberg Village	32.9	5.0
Platform Irene to LOGP Pipeline Segment: Near Valve Sites #7 and #8 toward Penitentiary	7.2	11.2

Meteorologists have defined six atmospheric stability classes, each representing a different degree of turbulence in the atmosphere. When moderate to strong incoming solar radiation heats air near the ground, causing it to rise and generating large eddies, the atmosphere is considered "unstable," or relatively turbulent. Unstable conditions are associated with atmospheric stability classes A and B. When solar radiation is relatively weak, air near the surface has less of a tendency to rise and less turbulence develops. In this case, the atmosphere is considered "stable," or less turbulent, the wind is weak, and the stability class would be E or F. Stability classes D and C represent conditions of more neutral stability, or moderate turbulence. Neutral conditions are associated with relatively strong wind speeds and moderate solar radiation.

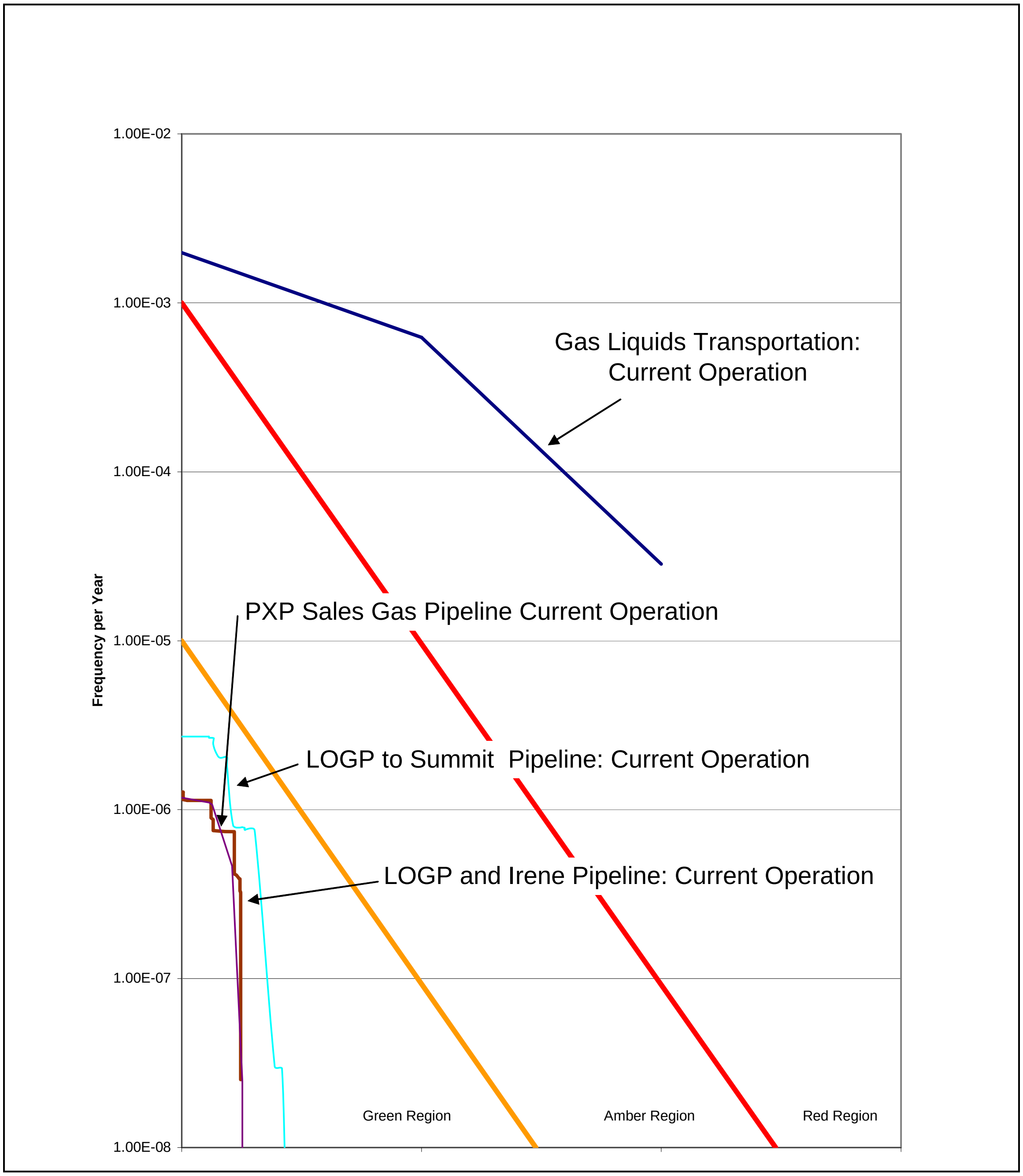
FN Curves

FN curves depict the frequency (F) of events that could produce a given number (N) of fatalities or injuries. Each scenario identified in the previous sections has a number of potential consequences based on what happens to the released material, i.e., the material could encounter an ignition source and ignite; explode; be toxic or disperse without effects (for non-toxic releases that do not encounter an ignition source). The direction and area that the releases affect are also a function of the wind direction and conditions. This situation produces a large number of possible release outcomes, a different number of persons affected for each one. A plot of each of these results cumulatively adding the frequency of affecting a given number of persons produces the FN curves. FN curves show “societal risk”, which is the likelihood that any person or persons would be injured or suffer a fatality.

SBC has established Public Safety Thresholds for CEQA documents (SBC 2002) that establish the areas on an FN curve that are considered acceptable (or not significant) and those areas which are unacceptable (or significant). See the significance criteria discussion below (see also Section 3.2.3).

For fatalities, FN curves are shown in Figure 3.2-2. The baseline risk for fatalities is considered significant, or in the “red” or “significant” region as labeled by the guidelines, for the transportation of gas liquids. These FN curves are taken from the 1985 Point Pedernales EIR and are scaled to the actual number of annual gas liquid truck trips that have been recorded by PXP and reported to SBC.

Figure 3.2-2 Fatality FN Curves: Current Conditions



Transportation FN curves are taken from the 1985 Point Pedernales EIR and are scaled to the annual average number of gas liquid truck trips that have been recorded.

The fatality FN curve for the combined LOGP and Platform Irene to LOGP pipeline shows insignificant risk, or within the “green” region. This conclusion agrees with the Bercha study (Bercha Group 1998) that was prepared to quantify the risks associated with the produced gas pipeline operations.

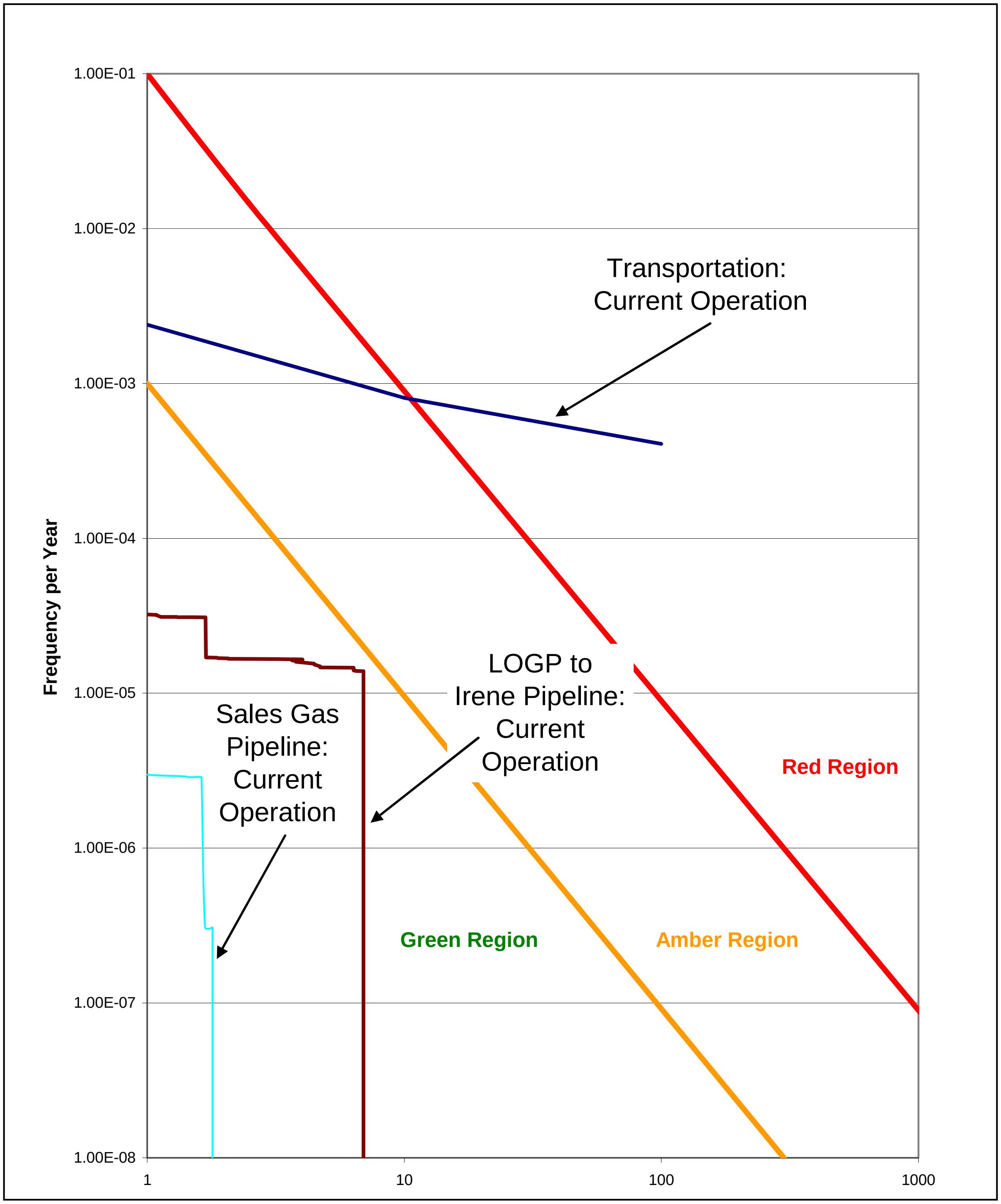
For injuries, FN curves are shown in Figure 3.2-3. The baseline risk of injuries is considered significant, or in the red region, for the transportation of gas liquids. These FN curves are taken from the 1985 Point Pedernales EIR and are scaled to the actual number of annual gas liquid truck trips that have been recorded. The injury FN curve for the combined LOGP and Platform Irene to LOGP gas pipeline shows a potential exceedance of the significance risk level, which is characterized by the “amber” region. This is due primarily to the scenario of a pipeline rupture between Valve Site #9 and the LOGP with potential impacts to Vandenberg Village. A large percentage of the vapor cloud could be located within Vandenberg Village under certain meteorological conditions, thereby producing injuries. Note that the levels that could produce fatalities from this same scenario do not reach Vandenberg Village. The reason why the risk level, as represented by the FN curve, is in the acceptable “green” zone is that in order for residents in Vandenberg Village to be potentially impacted, a number of events would have to occur simultaneously. The Irene to LOGP produced sour gas pipeline would have to rupture somewhere between Valve Station 9 and the LOGP, the wind would have to be blowing toward Vandenberg Village and the atmospheric stability class would have to be F. These atmospheric conditions only occur on average 4.7% of the time. Also, the cloud would have to disperse to its maximum flammable extent (1/2 FL) before it could ignite. Therefore, when all of these factors are combined with the number of individuals that could potentially be impacted, the probability is low enough to be considered acceptable.

The Bercha study, 1998 and the subsequent SBC P&D, 1999 Quantitative Risk Analysis (a summary and discussion about the Bercha study) investigated the risks associated with the sour gas pipeline in a manner similar to this study. However, levels of concern selected were less conservative. These include, primarily, the use of ERPG-3 as the level at which an estimated 10% of the population would experience injuries.

Due to past studies conducted by Arthur D. Little (SBCFD 2000) and public workshops conducted as part of these studies, combined with the definitions associated with the ERPG levels and the uncertainty of injury levels particularly related to injury impacts on elderly and young populations, a level of concern for injuries of ERPG-2 (with 10% of the population experiencing injuries) was selected for this study. This lower level of concern produced larger injury impact zones which caused the injury impacts to reach Vandenberg Village (again, fatality zones do not reach Vandenberg Village).

In addition, modeling conducted as part of this analysis was more conservative than the Bercha study, thereby also producing larger impact zones. This modeling assumed a degree of cratering associated with a pipeline rupture. As the pipeline is buried approximately 6 feet deep, it is assumed that a rupture would release into an earthen crater or hole, thereby reducing the jet effects of the release due to impingement on the walls of the crater.

Figure 3.2-3 Injury FN Curves: Current Conditions



Transportation FN curves are taken from the 1985 Point Pedernales EIR and are scaled to the annual average number of gas liquid truck trips that have been recorded.

This loss in exit velocity substantially reduces mixing due to the jet effects and the level of near-field dilution by air of the released material. The dispersion then approaches a gaussian dispersion as opposed to being dominated by a jet release, as might be experienced with a release from exposed piping. This effect allows the released material to travel farther with less dilution by air and to therefore produce larger impact zones.

In summary, buried pipelines, or pipelines that could release into an enclosed area, would most likely have impact zones that are larger than those of pipelines that release directly into the atmosphere.

The Bercha study (Bercha Group 1998) concluded that the impacts from injury would be insignificant. This study concluded that the risks would be greater than described in the Bercha study, but still not significant.

3.2.2 Regulatory Setting

Many regulations and standards exist to assure the safe operation of pipelines carrying hazardous liquids such as crude oil and facilities associated with these pipelines. This section gives an overview of the federal and state regulations.

3.2.2.1 Federal Laws and Regulations

Hazardous liquid pipelines are under the jurisdiction of the DOT and must follow the regulations in 49 CFR Part 195, Transportation of Hazardous Liquids by Pipeline, as authorized by the Hazardous Liquid Pipeline Safety Act of 1979 (49 U.S.C. 2004). Other important federal requirements are contained in 40 CFR Parts 109, 110, 112, 113, and 114, which pertains to the need for Oil Spill Prevention Control & Countermeasures (SPCC) Plans and 40 CFR Parts 109-114 promulgated in response to the Oil Pollution Act of 1990, as well as the Outer Continental Shelf Lands Act.

Overview of the 49 CFR 195 Requirements

Part 195.30 incorporates many of the applicable national safety standards of the:

- American Petroleum Institute (API);
- American Society of Mechanical Engineers (ASME);
- American National Standards Institute (ANSI); and
- American Society for Testing and Materials (ASTM).

Part 195.49 Annual Report. Beginning no later than June 15, 2005, each operator must annually complete and submit DOT form RSPA F 7000–1.1 for each type of hazardous liquid pipeline facility operated at the end of the previous year. A separate report is required for crude oil, HVL(including anhydrous ammonia), petroleum products, and carbon dioxide pipelines. Operators are encouraged, but not required, to file an annual report by June 15, 2004, for calendar year 2003.

Part 195.50 (amended 1/8/2002) requires reporting of accidents by telephone and in writing for:

- Explosion or fire;
- Spills of greater than 5 gallons of a hazardous liquid, or 5 barrels if associated with a maintenance activity;
- Death or serious injury of a person; or
- Damage to property of operator or others, greater than $50,000.

The Part 195.100 series includes design requirements for the temperature environment, variations in pressure, internal design pressure for pipe specifications, external pressure and external loads, new and used pipe, valves, fittings, and flanges.

The Part 195.200 series provides construction requirements for standards such as compliance, inspections, welding, siting and routing, bending, welding and welders, inspection and nondestructive testing of welds, external corrosion protection and cathodic protection, installing in ditch and covering, clearances and crossings, valves, pumping, breakout tanks, and construction records.

The Part 195.300 series prescribes minimum requirements for hydrostatic testing, compliance dates, test pressures and duration, test medium, and records.

The Part 195.400 series specifies minimum requirements for operating and maintaining steel pipeline systems, including:

- Correction of unsafe conditions within a reasonable time;
- Procedural manual for operations, maintenance, and emergencies;
- Training;
- Maps;
- Maximum operating pressure;
- Communication system;
- Cathodic protection system;
- External and internal corrosion control;
- Valve maintenance;
- Pipeline repairs;
- Overpressure safety devices;
- Firefighting equipment; and
- Public education program for hazardous liquid pipeline emergencies and reporting.

The Part 195.500 series covers qualification of pipeline personnel and corrosion control.

The DOT OPS has issued a Direct Final Rule concerning new Operator Qualification program requirements for personnel training, notice of program changes, government review and verification of programs, and use of on-the-job performance as a qualification method. The affected rule sections are given below and are identical for both the gas and liquid pipeline regulations.

Overview of 40 CFR Parts 109, 110, 112, 113, and 114

The SPCC covered in these regulation programs apply to oil storage and transportation facilities and terminals, tank farms, bulk plants, oil refineries, and production facilities, as well as bulk oil consumers such as apartment houses, office buildings, schools, hospitals, farms, and State and Federal facilities.

Part 109 establishes the minimum criteria for developing oil removal contingency plans for certain inland navigable water by State, local, and regional agencies in consultation with the regulated community (oil facilities).

Part 110 prohibits discharge of oil such that applicable water quality standards would be violated, or that would cause a film or sheen upon or in the water. These regulations were updated in 1987 to adequately reflect the intent of Congress in Section 311(b) (3) and (4) of the Clean Water Act.

Part 112 deals with oil spill prevention and preparation of SPCC Plans. These regulations establish procedures, methods, and equipment requirements to prevent the discharge of oil from onshore and offshore facilities into or upon the navigable waters of the United States. Current wording applies these regulations to facilities that are non-transportation-related. However, proposed rules would make the spill emergency planning of these rules applicable to all oil facilities. These rules should be used by pipeline operators as additional guidelines for the development of oil spill prevention, control and emergency response plans.

Part 113 establishes financial liability limits; however these limits have now been preempted by the Oil Pollution Act (OPA) of 1990.

Part 114 provides civil penalties for violations of the oil spill regulations.

Following a major release of diesel oil at an Ashland Oil Terminal in Floreffe, Pennsylvania on January 3, 1988, the SPCC Program Task Force convened to study the need for enhanced SPCC regulations. More stringent rules have been proposed. The Task Force study provided recommendations that are useful for all oil-related facilities in preventing spills. The Ashland oil spill was very similar to many oil pipeline ruptures and spills, so the recommendations are appropriate for the pipeline industry.

Oil Pollution Act of 1990 OPA. Public Law 101-380 (H.R.): August 18, 1990

The Oil Pollution Act of 1990, together with the Oil Pollution Liability and Compensation Act of 1989, builds upon Section 311 of the Clean Water Act (CWA) to create a single Federal law providing cleanup authority, penalties, and liability for oil pollution. The bill creates a single fund to pay for removal of and damages from oil pollution. This new fund replaces those created under the Trans-Alaska Pipeline Act, Deep Water Port Act of 1974, and Outer Continental Shelf Lands Act, and supersedes the contingency fund established under Section 311 of CWA.

The Oil Spill Compensation Fund will be available, up to a limit of $1 billion per incident, for all removal costs and compensatory damages. The act provides for liability and availability of the fund to pay removal costs and compensation in case of discharges of oil. It adopts the standard of liability under Section 311 for liability of dischargers for cleanup costs - strict, several and joint liability. The law establishes financial liability for all oil facility operators including pipelines.

The OPA affirms the rights of states to protect their own air, water, and land resources by permitting them to establish State standards which are more restrictive than Federal standards. More stringent State laws are specifically preserved. Section 106 explicitly preserves authority of any state to impose its own requirements or standards with respect to discharges of oil within each state.

3.2.2.2 California Laws and Regulations

California Pipeline Safety Act of 1981
This act gives regulatory jurisdiction to the State Fire Marshal for the safety of all intrastate hazardous liquid pipelines and all interstate pipelines used for the transportation of hazardous or highly volatile liquid substances. The law establishes the governing rules for interstate pipelines to be the Federal Hazardous Liquid Pipeline Safety Act and Federal pipeline safety regulations.

Overview of California Pipeline Safety Regulations
State of California regulations Part 51010 through 51018 of the Government Code provide specific safety requirements that are more stringent than the Federal rules. These include:

- Periodic hydrostatic testing of pipelines, with specific accuracy requirements on leak rate determination;
- Hydrostatic testing by state-certified independent pipeline testing firms;
- Pipeline leak detection; and
- Reporting of all leaks.

Recent amendments require pipelines to include means of leak prevention and cathodic protection, with acceptability to be determined by the State Fire Marshal. All new pipelines must also be designed to accommodate passage of instrumented inspection devices (smart pigs) through the pipeline.

Oil Pipeline Environmental Responsibility Act (AB 1868)
This bill requires each pipeline corporation qualifying as a public utility that transports crude oil in a public utility oil pipeline system, to be strictly liable for any damages incurred by “any injured party which arise out of, or caused by, the discharge or leaking of crude oil or any fraction thereof...” The law only applies to public utility pipelines for which construction would be completed after January 1, 1996, or that part of an existing utility pipeline that is being relocated after the above date and is more than three miles in length. The major features signed into law by the Governor of California in October 1995 include:

- Each pipeline corporation that qualifies as a public utility that transports any crude oil in a public utility oil pipeline system shall be absolutely liable without regard to fault for any damages incurred by any injured party that arise out of, or are caused by, the discharge or leaking of crude oil;

- Damages for which a pipeline corporation is liable under this law are:

  - All costs of response, containment, cleanup, removal, and treatment including monitoring and administration cost.
  - Injury or economic losses resulting from destruction of or injury to, real or personal property.
  - Injury to, destruction of, or loss of, natural resources, including but not limited to, the reasonable cost of rehabilitating wildlife habitat, and other resources and the reasonable cost of assessing that injury, destruction, or loss, in any action brought by the state, county, city, or district.
  - Loss of taxes, royalties, rents, use, or profit shares caused by the injury, destruction, loss, or impairment of use of real property, personal property, or natural resources.
  - Loss of use and enjoyment of natural resources and other public resources or facilities in any action brought by the state, county, city, or district.
- A pipeline corporation shall immediately cleanup all crude oil that leaks or is discharged from a pipeline;
- No pipeline system subject to this law shall be permitted to operate unless the State Fire Marshal certifies that the pipeline corporation demonstrates sufficient financial responsibility to respond to the liability imposed by this section. The minimum financial responsibility required by the State Fire Marshal shall be seven hundred fifty dollars ($750) times the maximum capacity of the pipeline in the number of barrels per day up to a maximum of one hundred million dollars ($100,000,000) per pipeline system, or a maximum of two hundred million dollars ($200,000,000) per multiple pipeline systems. For the Pacific Pipeline, the Bill specifically requires ($100,000,000 for the financial responsibility (Section l.h.(l));
- Financial responsibility shall be demonstrated by evidence that is substantially equivalent to that required by regulations issued under Section 8670.37.54 of the Government Code, including insurance, surety bond, letter of credit, guaranty, qualification as a self-insurer, or combination thereof or any other evidence of financial responsibility. The State Fire Marshal shall require the documentation evidencing financial responsibility to be placed on file with that office; and
- The State Fire Marshal shall require evidence of financial responsibility to fund postclosure cleanup spots. The evidence of financial responsibility shall be 15% of the amount of financial responsibility stated above.

Lempert-Keene-Seastrand Oil Spill Prevention and Response Act, (OSPRA, 8670 Gov. Code Chapter 7.4)

This act requires a State oil spill contingency plan to protect marine waters, and empowers a deputy director of the Department of Fish and Game to take steps to prevent, remove, abate, respond, contain and clean up oil spills. Notification of all oil spills in the marine environment, regardless of size, is required to the Office of Emergency Services, who in turn notifies the response agencies Oil Spill Contingency Plans must be prepared and implemented. The Act creates the Oil Spill Prevention and Administration Fund and the Oil Spill Response Trust Fund. Pipeline operators will pay fees into the first of these funds for pipelines transporting oil into the state across, under, or through marine waters. The Lempert-Keene Act also directs some authority to the California Coastal Commission.

California Coastal Commission

The California Coastal Act of 1976 (Public Resources Code, Division 20) created the CCC and six area offices which are charged with the responsibility of granting development permits for coastal projects and for determining consistency between Federal and State coastal management programs Section 30232 of the Coastal Act addresses hazardous materials spills and states that "Protection against the spillage of crude oil, gas, petroleum products, or hazardous substances shall be provided in relation to any development or transportation of such materials. Effective containment and cleanup facilities and procedures shall be provided for accidental spills that do occur".

Sections 30260, 30262 and 30265 require that adverse environmental effects to be mitigated to the maximum extent feasible, that new and expanded oil and gas facilities be consolidated and that platforms not be sited where a substantial hazard to vessel traffic might result from the facility or related operations. Section 30265 finds that pipeline transport of oil is generally both economically feasible and environmentally preferable to other forms of crude oil transport.

Also in 1976, the state legislature created the California State Coastal Conservancy to take steps to preserve, enhance, and restore coastal resources and to address issues that regulation alone cannot resolve.

California State Lands Commission (CCR Title 2, Division 3, Chapter 1)

The CSLC was established in 1938 with authority detailed in Division 6 of the California Public Resources Code. Title 2, Division 3, Chapter 1 (Articles 1 through 14) address the requirements related to leasing and permits, oil and gas operations, mineral resource regulations, and marine terminal regulations. Article 3.4 specifically addresses pollution control, disposal of drilling muds and cuttings and the oil spill contingency plan. Article 3.4 specifically requires the development of an operating manual. Article 3 specifically addresses the operating requirements, such as tankage, laboratory testing, drilling operations and offshore operations. Article 3.2 and 3.3 address specifics related to drilling and production activities.

3.2.2.3 Santa Barbara County Regulations

Oil Transportation Plan

The Oil Transportation Plan has determined that pipelines are preferable to marine tankering in terms of air quality, socioeconomics and risk of an oil spill.

Safety Thresholds and Safety Element

The SBC adopted Public Safety Thresholds in August, 1999. The thresholds provide three zones – green, amber, and red – for guiding the determination of significance or insignificance based on the estimated probability and consequence of an accident. In addition, a Safety Element Supplement was adopted in February 2000 (Board of Supervisors Resolution 00-56) covering hazardous materials. The objective of the Safety Element is to define unacceptable risk in a manner that guides consistent and sound land-use decisions involving hazardous facilities. As part of this objective, the SBC has defined unacceptable risk as involving new development as well as modifications to existing development if those modifications increase risk.

Other Recognized National Codes and Standards

Safety and Corrosion Prevention Requirements - ASME, NACE, ANSI:
- ASME & ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings;
- ASME & ANSI B16.9, Factory-Made Wrought Steel Butt Welding Fittings;
- ASME & ANSI B31.1a, Power Piping;
- ASME & ANSI B31.4a 1998 and 2001 addenda, "Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids";
- NACE Standard RP0190-95, Item No. 53071. Standard Recommended Practice External Protective Coatings for Joints, Fittings, and Valves on Metallic Underground or Submerged Pipelines and Piping Systems; and
- NACE Standard RP0169-96, Item No. 53002. Standard Recommended Practice Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

Fire and Explosion Prevention and Control, NFPA Standards:
- NFPA 30 Flammable and Combustible Liquids Code and Handbook;
- NFPA 11 Foam Extinguishing Systems;
- NFPA 12 A&B Halogenated Extinguishing Agent Systems;
- NFPA 15 Water Spray Fixed Systems;
- NFPA 20 Centrifugal Fire Pumps; and
- NFPA 70 National Electrical Code.

3.2.3 Significance Criteria

As defined in CEQA Appendix G (v) (the Environmental Checklist Form), a significant safety effect is one in which the project "create[s] a potential health hazard or involve[s] the use, production or disposal of materials which pose a hazard to people, animal or plant populations in the area affected".

The SBC Safety Thresholds (SBC 2002a) are used to determine significance. The thresholds utilize FN curves to define the significance level of a proposed project or modification. The guidelines indicate that significant impacts would be avoided if the frequency of a single fatality is shown to be less than 1 in 1,000,000 years (the individual specific risk). If the risk of a single fatality is greater than 1 in 1,000,000 years, then a detailed quantitative risk analysis must be completed to indicate that the risks are below those defined by the FN curves. The project related FN curves would need to be in the green region to be defined as not significant.

3.2.4 Impact Analysis for the Proposed Projects

This section has been broken down into two major parts. The first part provides a discussion of the safety and risk of upset issues that affect each of the major project components. The second part presents the project-specific impacts.

3.2.4.1 Proposed Projects Risk of Upset Issues

The proposed project would involve increased oil transportation from Platform Irene to LOGP and extension of life of Platform Irene, the Platform Irene to LOGP pipelines, and the LOGP. In addition, increased drilling would occur on Platform Irene. Increased truck trips of gas liquids could occur from the LOGP due to increased crude oil production.

Onshore Emulsion Pipeline

The onshore emulsion pipeline would have spill frequency rates similar to those of the current operations as none of the operating parameters that affect spill frequency rates (e.g., temperature) would change (but throughput would increase). As the proposed project would extend the life of the Irene-LOGP emulsion pipeline, this would increase the frequency of spills (ruptures and leaks) due to the increased average age of the pipeline. The CSFM report concluded that spill rates are a function of pipeline age. However, only pipelines built before about 1950 exhibited significantly higher spill rates. Most failures of older pipelines were due to external corrosion effects due to failed external coatings and the use of older technologies prior to 1950. As pipelines built in 1955 and those built in 1975 exhibited almost identical failure rates, an increase in the average age of a pipeline built since 1950 would have minimal effect on the pipeline spill rates. Spill rates for pipelines built in the 1950s averaged 4.17×10^{-3} spills per mile-year verses a rate of 3.72×10^{-3} spills per mile-year for pipelines built in the 1970s, a difference of 10%. Although this rate difference is true for past pipelines, it is difficult to extrapolate this data to future average spill rates due to the differences in pipeline construction techniques. Prior to the 1950s, pipelines were not built to the same standards as they are today with advanced pipeline coatings, cathodic protection and smart-pigging. These better standards will most likely decrease spill rates for pipelines built since 1980 when they are 20 – 50 years old over the pre1950 pipeline rates. A pipeline built today would most likely not exhibit the same high failure rates as pre-1950 pipelines in 40 years.

The addition of a pump station to the emulsion pipeline at Valve Site #2 would increase the frequency of a spill at that location. Spills at pump stations are more common than along a pipeline due to the potential failure of the pumps. The OPS data indicates that there have been 205 spills (>50 bbls) at pump stations since 1985 producing a single fatality and four injuries. Spills from pumps are estimated by a number of different sources ranging from 0.31 spills per year (HLID 1992, reciprocating) to 0.07 spills per year (HLID 1992, centrifugal). Spill frequencies for the pipeline and the pump station are shown below. Due to the high leak rate of the pumps at the pump station, the spill probability has increased substantially over the current operations (1.0 lifetime spill probability currently for ruptures and 4.1 currently for leaks, see Table 3.2.2). This is addressed as a significant impact in the Water Quality Section (OWR.2) and Biological Resources Section (TB.6 and TB.7).

Table 3.2.22 summarizes the spill frequencies and probabilities with the proposed project. The pipeline ruptures and leaks are based on the current operations (see Table 3.2.2).

Table 3.2.22 Onshore Emulsion Pipeline Spill Frequencies and Probabilities, with Pump Station

	Spill Frequency per year	Proposed Project Lifetime Spill Probability, %	Current Operations Lifetime Spill Probability, %
Onshore Emulsion Pipeline ruptures	8.59×10^{-4}	1.3	0.9
Onshore Emulsion Pipeline leaks	3.68×10^{-3}	5.4	3.6
Valve Site #2 ruptures	3.10×10^{-3}	4.5	-
Valve Site #2 leaks	0.31	99.0	-

Table 3.2.22 Onshore Emulsion Pipeline Spill Frequencies and Probabilities, with Pump Station

	Spill Frequency per year	Proposed Project Lifetime Spill Probability, %	Current Operations Lifetime Spill Probability, %
Emulsion Pipeline with Valve Site, ruptures	$3.6x10^{-3}$	5.3	0.9
Emulsion Pipeline with Valve Site, leaks	$3.14x10^{-1}$	99.1	3.6

Failure rates for Valve Site #2 pumps: Hydrocarbon Leak and Ignition Database, 1992. Assumes 30 year project life.

Table 3.2.23 provides the onshore emulsion spill volumes with the Tranquillon Ridge Project. Emulsion spill volumes would increase as the total fluids transported would be increased over the current operations. In addition, the fraction of oil in the pipeline would increase. Oil fraction for the proposed project is estimated by PXP to be 40% oil and 60% water.

Table 3.2.23 Onshore Emulsion Pipeline Spill Volumes (barrels)

Location Description	Normal Operation: SCADA Operational		Worst-case: SCADA Not Operational		Notes
	Drain down Spill Volume	Total, With Pumping Loss	Drain down Spill Volume	Total, With Pumping Loss	
On Beach	386	698	2,738	4,613	Loss of contents between beach and VS1 (1,000’). Worst-case loss of contents between beach and high point before VS2 (7,000’). Check valve at VS3 prevents backflow.
At Valve Site #2	179	491	179	2,054	Loss of contents from pipeline uphill from VS2 (500’). Worst-case same as VS3 check valve prevents backflow.
Canyon and Terra Road Crossing	952	1,265	952	2,827	Loss of contents between VS2 and VS3 (2,500’). Worst-case same as VS3 check valve prevents backflow.
Valve Site #3	714	1,027	714	2,589	Break just downstream of VS3 (after CV). Loss of contents between VS3 and high point after VS3 (1,800’). Worst-case the same as check valve at VS5 prevents backflow.
Valve Site #4	952	1,265	952	2,827	Loss of contents between hill before VS4 and VS4 (2,500). Worst-case the same as VS5 check valve would prevent backflow.
After Valve Site #4	1,500	1,813	2,452	4,327	Break located after VS4 and Terra Road Crossing in small drainage. Loss of contents between VS4 and VS5 (3,900’). Worst-case loss of contents between hill after VS3 and VS5 (6,300’).
Valve Site #5	571	884	571	2,446	Loss of contents from pipeline located upstream and downstream of VS5 not including valleys (1,500’). Worst-case would be the same as the check valve at VS6 would prevent backflow.
Drainage area before Valve Site #6	417	729	417	2,292	Limited by elevation profile and VS6 check valve (1,100’). Worst-case would be the same as the VS6 check valve would prevent backflow.
Valve Site #6	1,405	1,717	2,571	4,446	Loss of contents located above VS not including valleys between VS6 and VS7 (3,600’). Worst-case would include all areas above VS6 between VS6 and the VS9 check valve excluding valleys (6,600’).

Table 3.2.23 Onshore Emulsion Pipeline Spill Volumes (barrels)

Location Description	Normal Operation: SCADA Operational		Worst-case: SCADA Not Operational		Notes
	Drain down Spill Volume	Total, With Pumping Loss	Drain down Spill Volume	Total, With Pumping Loss	
Valve Site #7	1,143	1,455	3,083	4,958	Loss of contents between hill upstream of VS7 and VS7 (2,900’). Worst-case due to all segments of pipeline downstream of VS7 before the VS9 check valve excluding valleys (7,900’).
Between Valve Sites #7 and #8	786	1,098	5,131	7,006	Loss of contents between VS7 and VS8 (2,000’). Worst-case release due to pipeline above drainage bottom before the VS9 check valve excluding valleys (13,200’).
Valve Site #8	2,619	2,932	4,048	5,923	Loss of contents from areas downsteam of VS8 between VS8 and VS9 excluding valleys (6,700‘). Worst-case would include upstrean volume between hill before VS7 and VS8 which is above VS8 (10,400’).
Drainage area before Valve Site #9	2,943	3,255	2,943	4,818	Loss of contents from pipeline located above drainage area between highway S-20 and VS9 (7,600’). Worst-case would be the same because of the check valve at VS9.
Valve Site #9	2,755	3,067	2,755	4,630	Loss of contents from pipeline located downstream of VS9 excluding valleys (7,100’). Worst-case would be the same.
Valve Site #10	167	479	167	2,042	Release from last section of pipeline above VS10 (400’).
Proposed Operations Largest Spill Volume		**3,255**		**7,006**	**Largest Spill Volumes from all segments: Proposed Project**
Current Operations Largest Spill Volume		**3,141**		**6,318**	**Largest Spill Volumes from all segments: Current Operations**
Spill Volume Increase		**114**		**688**	**Spill Volume Increase due to proposed project**

Pumping rate calculated at 90,000 bpd emulsion. Assumes 30 year project life.
VS – Valve Station.

Onshore Gas Pipeline

Because the gas pipeline operating pressure for the proposed project would be the same as the current operations, there are no additional impacts associated with the proposed project gas pipeline. Impact distances would be the same as the baseline. However, the probability of having a release over the lifetime of the project would increase as the project life would be extended.

Onshore Water Return Pipeline

The onshore water return pipeline would have a similar spill rate as the current operation because the parameters that affect spill rates would not change except for the average age of the pipeline. The CSFM indicates that there would be minimal increases in spill rates for an average age difference of 10 to 25 years. However, as the pipeline has exhibited significant levels of corrosion in the most recent testing, proper maintenance and rating as well as frequent surveys of the pipeline integrity would be required in order to maintain an acceptable risk level to the environment. Mitigation has been proposed for this in the Water Quality Section.

A proposed increase in water transported would increase the spill volumes due to an increase in the pumping rate. However, the water would be treated to a level required under the NPDES permit. Increased spill volumes for the water return pipeline are shown in Table 3.2.24.

Table 3.2.24 Proposed Project Onshore Water Return Line Estimated Spill Volumes, barrels

Location Description	Normal Operation: Automatic Valves Operational		Worst-case: Automatic Valves Not Operational		Notes
	Drain down Spill Volume	Total, With Pumping Loss	Drain down Spill Volume	Total, With Pumping Loss	
On Beach	62	895	1,146	1,979	Loss of contents to Valve Site #2 (1,000'). Worst-case: downstream pipeline minus the valleys (18,400').
At Valve Site #2	255	1,089	708	1,541	Loss of contents to Valve Site #8 (4,100'). Worst-case: downstream pipeline minus the valleys (11,400').
Canyon and Terra Road Crossing	533	1,367	986	1,819	Loss of contents upstream to Valve Site #2 and downstream to Valve Site #8 excluding the valleys (8,600'). Worst-case: upstream and downstream pipeline minus the valleys (15,900').
After Valve Site #4	659	1,492	1,112	1,945	Loss of contents towards Valve Site #4 and downstream to Valve Site #8 excluding valleys (10,600'), Worst-case towards VS4 and downstream to LOGP minus valleys (17,900').
Drainage area before Valve Site #6	343	1,176	795	1,629	Drainage primarily from downstream pipeline to Valve Site #8 (5,500'). Worst-case past Valve Site #8 (12,800').
Between Valve Sites #7 and #8	312	1,146	986	1,819	Drainage primarily from upstream portion (5,000'). Worst-case from downstream (towards LOGP) as well (15,900').
Drainage area before Valve Site #9	437	1,271	437	1,271	Drainage primarily from downstream portion minus valleys (7,000). Worst-case the same.
Valve Site #10	27	860	27	860	Release due to last section of pipeline above Valve Site #10 (400'). Worst-case the same.
Proposed Project Largest Spill Volume		**1,492**		**1,979**	**Largest Spill Volumes from all segments: Proposed Project**
Current Operations Largest Spill Volume		**1076**		**1,563**	**Largest Spill Volumes from all segments: Current operations**
Spill Volume Increase		**416**		**416**	**Spill Volume Increase due to proposed project.**

Pumping rate calculated at 40,000 bpd.

LOGP Facility

Under the proposed project changes, the LOGP facility would operate similarly to the current operations scenario except that the number of gas liquids truck trips would increase to an average of five per week (260 per year) from 2.7 per week (139 per year, 2005 actual). This would move the FN curve for transportation further into the red region (as per the SBC Safety Element the red region is classified as a significant impact) and exacerbate an already significant impact. Operation of additional trucks would also impact the risks associated with the LOGP facility as there would be trucks at the facility more often. Increased truck loading operations at the LOGP facility would very slightly increase the risk levels above the current operations. The operation of the sales gas pipeline connection would remain the same as current operations because operating pressure would not increase. The FN curves attributable to the LOGP operations (without gas liquids transportation) would remain unchanged because most of the risks to the public are associated with the produced gas pipeline and the associated potential impacts to Vandenberg Village. Figures 3.2-4 and 3.2-5 show the FN curves for fatalities and injuries.

For the pipeline and LOGP operations, the FN curves are essentially identical. For transportation, the FN curves have shifted upwards due to the increase of gas liquids transportation from 2.7 to 5 truck trips per week.

Offshore Facilities

Increased activities offshore would increase the frequency of spills. Also, an increase in the oil percentages in the pipeline would increase the amount of oil that could be spilled into the marine environment if a spill occurs. In addition, the longer life associated with Platform Irene and the Platform Irene to LOGP pipeline would increase the probabilities of a spill over the facility lifetime. Spill frequencies and lifetime probabilities are shown in Table 3.2.25.

Table 3.2.25 Proposed Project Platform Irene and Offshore Emulsion Pipeline Spills to Ocean Frequency and Probabilities

Scenario	Frequency, per year	Lifetime Probability of Spill, % [a]
PLATFORM IRENE		
Small Spills		
Irene – Wellhead Area Spill to Ocean – small	$1.47x10^{-8}$	0.0
Irene – Separator Failure Spill to Ocean – small	$3.74x10^{-6}$	0.0
Irene – Pumping and Shipping Spill to Ocean – small	$2.38x10^{-4}$	0.4
Irene – Diesel Fuel Loading - Small Spill to Ocean	$2.90x10^{-4}$	0.4
Cumulative Small Spills	$5.33x10^{-4}$	0.8
Large Spills		
Irene – Blowouts	$2.78x10^{-3}$	4.1
Irene – Wellhead Area Spill to Ocean – large	$1.25x10^{-8}$	0.0
Irene – Separator Failure Spill to Ocean – large	$9.60x10^{-5}$	0.1
Irene – Pumping and Shipping Spill to Ocean – large	$2.80x10^{-5}$	0.0
Irene – External Impact	$1.00x10^{-5}$	0.0
Cumulative Large Spills	$2.91x10^{-3}$	4.3
Cumulative All Spills	**$3.4 x10^{-3}$**	**5.0**
MMS Throughput Approach, < 50 bbls, small spill	**$7.60x10^{-2}$**	**68.0**
MMS Throughput Approach, > 50 bbls, large spill	**$1.33x10^{-2}$**	**18.1**
EMULSION PIPELINE		
Leaks		
1985 Point Pedernales EIR Table 2-2, leaks	$4.41x10^{-3}$	6.4
CSFM for this Pipeline, leak	$3.11x10^{-3}$	4.6
MMS Throughput method, between 1 and 50 bbls, leak	**0.228**	**96.7**
Ruptures		
1985 EIR Table 2-2, ruptures	$4.90x10^{-4}$	0.7
CSFM for this Pipeline, rupture	$6.82x10^{-4}$	1.0
OPS all Crude Lines, spills > 50 bbl	$9.17x10^{-3}$	12.8
MMS Pipeline Throughput Method, > 50 bbls, rupture	$3.99x10^{-2}$	45.0

a. Zero indicates less than 0.1%. Lifetime assumes 30 years.

Figure 3.2-4 Fatality FN Curves: Proposed Conditions

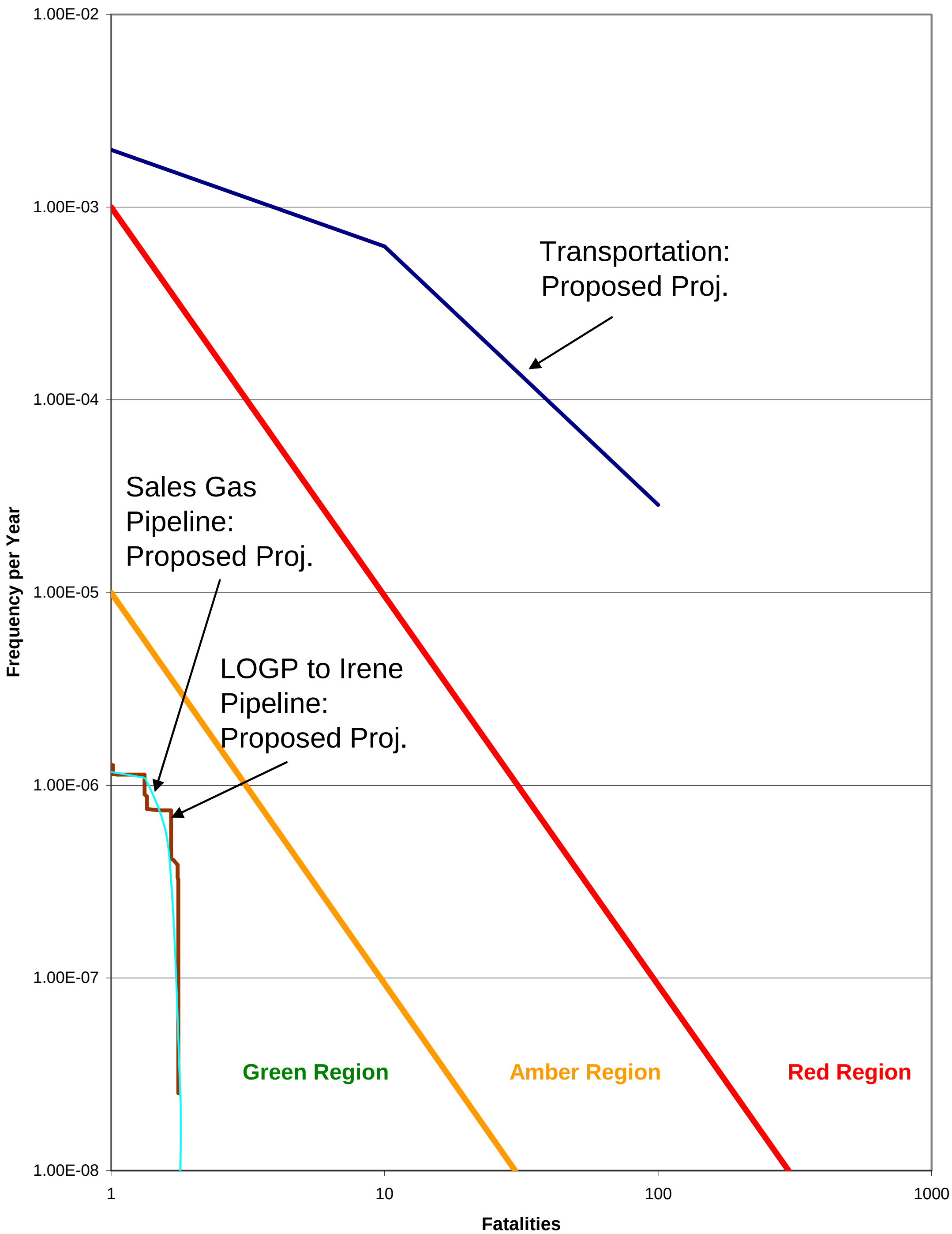
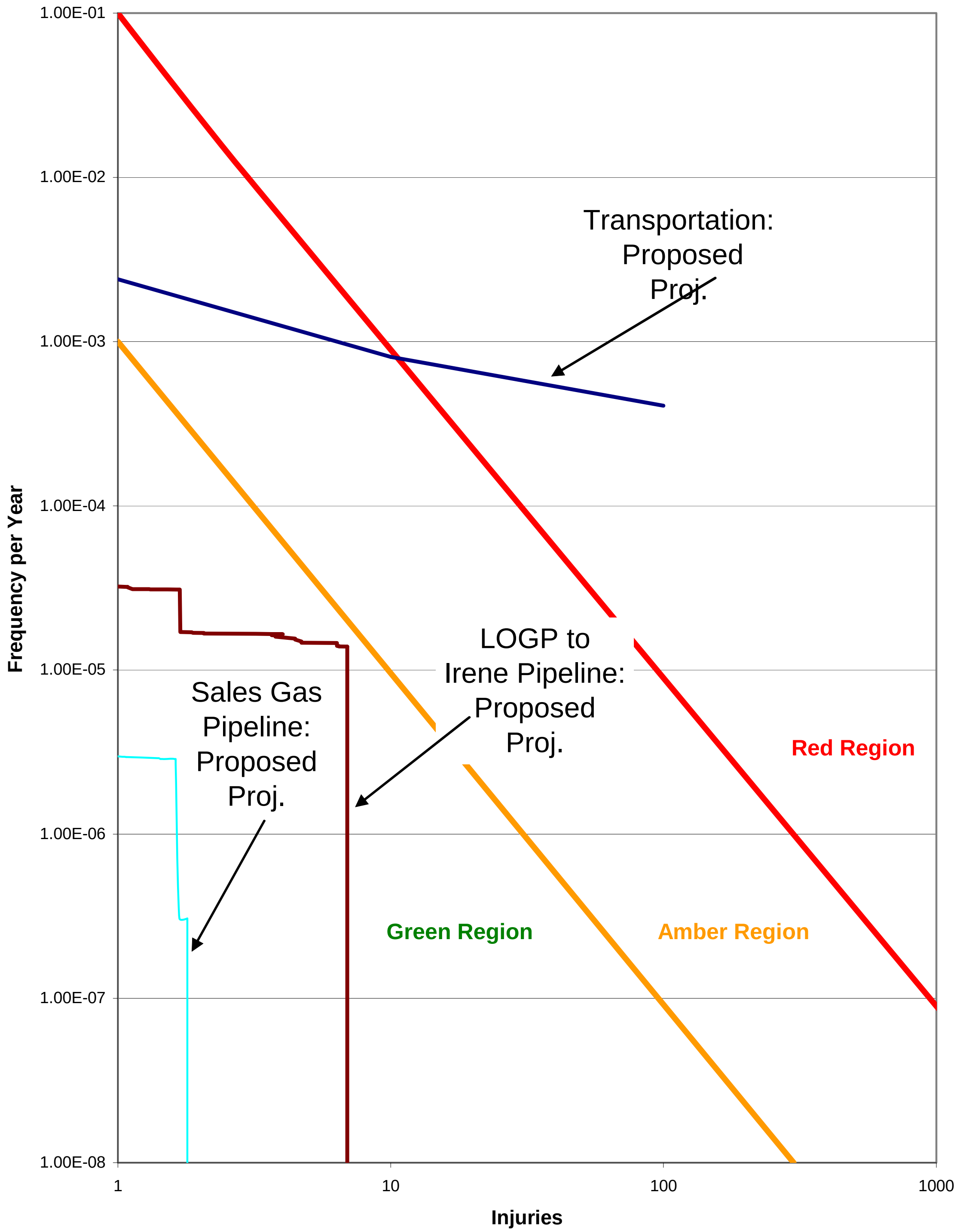


Figure 3.2-5 Injury FN Curves: Proposed Conditions



The increase in the average age of the emulsion pipeline due to the increased project life of 5 years (from 10 years to 15 years) would not appreciably increase the rate of spills from the pipeline. Other parameters that affect spill rates, such as temperature, would remain the same for the proposed project as the current operations. Spill rates for Platform Irene and Platform Irene to LOGP pipeline combined, as shown in Table 3.2.26, utilize the equipment specific approach and the 1985 Point Pedernales EIR failure rates for pipelines.

Table 3.2.26 Proposed Project Combined Platform Irene and Offshore Emulsion Pipeline Spills to Ocean Frequency and Probabilities

Scenario	Frequency, per year	Proposed Project Lifetime[a] Probability of Spill, %	Current Operations Lifetime[a] Probability of Spill, %
Leaks and Small Spills	$4.94x10^{-3}$	7.1	4.8
Ruptures and Large Spills	$3.40x10^{-3}$	5.0	0.6
Any Spill Size	$8.34x10^{-3}$	11.8	5.4

a. Lifetime assumes 15 years, numbers may not add due to rounding.
Utilizing number from the 1985 Point Pedernales Facilities EIR/EIS.

Spill volumes of emulsion associated with the offshore Platform Irene to LOGP emulsion pipeline would be similar to those for the current operation with some increase due to the increased pumping rate (approximately 100 bbls). However, as the oil percentage would increase, the amount of oil discharged would also increase. In addition, the wells currently producing operate with submersible pumps, meaning that the wells are not free-flowing and there is virtually no possibility of a well blowout. However, as new wells would be drilled with the Tranquillon Ridge project, these new wells could exhibit higher reservoir pressures that may increase the potential for a well blowout. Frequencies of well blowouts are based on the Hydrocarbon Leak and Ignition Database (HLID 1992) based on actual blowout experiences. See Attachment F for more details.

Table 3.2.27 gives a summary of the proposed project offshore release volumes and includes the release volumes associated with the current operations and with well blowouts.

Table 3.2.27 Proposed Project Offshore Spill Volumes

Area	Current Operations Oil Only Release Volume, bbls	Proposed Project Oil Only Release Volume, bbls	Increase in Spill Volumes due to the proposed Project, bbls
Platform Irene – Total Platform Loss	426 0 blowout	551 4,500 blowout	+125 +4,500
Offshore Emulsion Pipeline – Pipeline Midpoint Failure	1,754	4,244	+2,490
Offshore Emulsion Pipeline – Shoreline Failure	2,913	7,929	+5,016

Proposed operation is with 60% water, 40% crude oil in the pipeline. Current operations are with submersible pumps, which do not have a blowout potential. Tranquillon Ridge is expected to have free-flowing wells for about 5 years, thereby introducing the potential for well blowouts. See Attachment F.

Spills of crude oil only (just the crude portion of the pipeline stream) would increase by a substantial margin primarily due to the increase in oil composition of the emulsion. Increased pumping rates would account for less than 2% of the spill size increase.

The offshore portion of the water return pipeline would have a similar spill frequency rate as the current operation as the increase in average age has a minimal impact on spill frequency rates. Spill volumes would increase as the amount of water transported is proposed to increase. Spills due to pumping would total 27.8 barrels per minute, or 833 barrels over the 30 minutes it is estimated it would take to shutdown the water return pipeline. Spills due to hydrostatic head would be the same as for the current operations.

3.2.4.2 Impact Analysis for the Proposed Project

Impact #		Project Phase
SS.1	The proposed project could generate risks to public safety by exposing the public to crude oil spills and subsequent fires.	Increased Throughput Extension of Life

Increased throughput of crude oil between Platform Irene and the LOGP is not expected to generate increased public risks due to the relatively high level of water located within the process stream (upwards of 60%). Therefore, the proposed project is considered to have adverse but not significant public safety impacts due to crude oil spills associated with upset conditions along the crude oil pipelines.

Mitigation Measures

SS-1 *The Applicant shall install an upgraded SCADA system on the existing emulsion line and a new system on the produced sour gas pipeline. The new system shall have improved sensitivity to detect leaks, similar to the upgrades installed on PXP's Point Arguello facility. The new SCADA system should be able to detect 0.08 percent of flow leaks in less than 48 minutes and be able to detect leaks as small as 1/16 inch in diameter in less than two minutes.*

Impact #		Project Phase
SS.2	The proposed project could generate risks to public safety by exposing the public to produced gas releases from the sour gas pipeline from Platform Irene to the LOGP.	Extension of Life

The proposed project does not propose to increase the operating pressure of the produced sour gas pipeline between Platform Irene and LOGP nor the maximum hydrogen sulfide levels (maximum levels were examined in this analysis). Because impact zones, and therefore risks to the public, are a function of the operating pressure and the hydrogen sulfide content, not the throughput, the risks to the public are considered to be the same as the current operations. According to the significance criteria defined in the SBC Safety Element, these risks were found to be not significant. This conclusion assumes that the pipeline would neither operate above 600 psig operating pressure nor above 8,000 ppm hydrogen sulfide concentration. See Section 3.2.1.4 for a more detailed discussion of the public safety risks associated with the sour gas pipeline.

The sales gas pipeline connection between the LOGP and the Gas Company transmission pipeline also has the potential for failure. However, as it is located along a more sparsely populated area and farther away from large populations like the produced gas pipeline (Irene to LOGP) it has risk levels in the green region of the FN curve.

Mitigation Measures

Impact Risk.2 remains in the green region of the FN curve only when operation of the pipeline is below 600 psig. Therefore, the following mitigation measure is recommended to ensure the proposed operating parameter is applicable throughout the life of the project. In addition, Mitigation Measure SS-1 would apply to mitigate this impact to the maximum extent feasible.

Since the proposed project would have an adverse impact due to potential for produced sour gas releases, an upgrade to the SCADA system would improve safety by allowing smaller leaks to be detected. Therefore the following mitigation is recommended to ensure the upgraded SCADA system is implemented and maintained throughout the life of the project.

SS-2 The Applicant shall ensure that pipeline operation does not exceed 600 psig pressure and 8,000 ppm hydrogen sulfide concentration.

The impacts remain in the green region when operation of the pipeline is below 600 psig and 8,000 ppm hydrogen sulfide.

Impact #		Project Phase
SS.3	The proposed project could generate risks to public safety by exposing the public to transportation hazards.	Increased Throughput Extension of Life

The project would increase the transportation of gas liquids along roadways over the current operations. This was identified as a significant impact in the 1985 Point Pedernales EIR and in this document with the current number of truck trips. By increasing the number of trips, and therefore the risks to the public, this existing significant impact is exacerbated (more truck trips and a longer period over which truck trips would occur). Therefore, impacts could be considered significant, for public risks due to gas liquids transportation.

Mitigation Measures

SS-3 The Applicant shall implement all of the measures identified in the SBC's policies regarding the transportation of gas liquids that were developed as part of the LPG/NGL Transportation Risk Assessment including the blending of gas liquids into the crude oil to the maximum extent feasible. (The policies are included in the Point Pedernales FDP permit conditions P-2 and P-23).

3.2.4.3 Biology, Water Quality and Marine Resources Impacts

Because the calculations in the Oil Spill Analysis Section are used in other parts of the report, this section briefly discusses the pertinent issues. Implementation of the proposed projects would increase the probability of a pipeline oil spill over the life of the projects, both onshore and offshore, due to the extended life of the proposed project over the current operations. In addition, the increased amount of crude oil transported would increase the size of the oil spill, particularly into the marine environment. This is due to an increase in fluids transported and an increase in the oil percent over the current operations.

Increased drilling operations on Platform Irene would contribute to an increase in the frequency of an oil spill. This, combined with the extended life of Platform Irene due to the proposed projects, would increase the probability of an oil spill from the platform over the life of the projects by a significant margin. Oil spill volumes from Platform Irene are not expected to increase.

Spill volumes for the water return pipeline are expected to increase due to the increase in the amount of water transported. In addition, the probability of a water spill over the lifetime of the project would increase over the current operations due to the extended life. However, if the water was treated to the NPDES permit requirements, this would be considered a beneficial impact over the current non-treated operations. This issue is discussed more fully in Section 3.5, Biological Resources.

3.2.5 Comparison of Impacts Between Proposed Project and 1985 Point Pedernales EIS/EIR

Impact No.	Project Phase	Tranquillon Ridge Project Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
SS.1	Increased Throughput Extension of Life	The proposed project could generate risks to public safety by exposing the public to crude oil spills and subsequent fires.	Risk to residential areas from pipeline route to dehydration facility.	1985 impact listed in socioeconomic section.
SS.2	Extension of Life	The proposed project could generate risks to public safety by exposing the public to produced gas releases from the sour gas pipeline from Platform Irene to the LOGP.	Risk to residential areas from pipeline route to dehydration facility.	1985 impact listed in socioeconomic section.
SS.3	Increased Throughput Extension of Life	The proposed project could generate risks to public safety by exposing the public to transportation hazards.	This Impact was not addressed	

3.2.6 References

Anderson, C. M., LaBelle, R. P. December 1994. Comparative Occurrence Rates for Offshore Oil Spills. *Spill Science & Technology Bulletin, Vol I., No. 2*. Pp 131-141.

Arthur D. Little (ADL). 1985. Union Oil Project/Exxon Project Shamrock and Central Santa Maria Basin Area Study EIS/EIR, 84-EIR-17.

___. 1990. Risk Assessment For Gas Liquids Transportation from Santa Barbara County. Prepared for Santa Barbara County.

___. 1991. SuperChems™ Reference and User's Manual. Arthur D. Little, Cambridge, MA.

___. 1995. SuperChems™ Reference and User's Manual. Arthur D. Little, Cambridge, MA.

___. 2001. Tranquillon Ridge Oil and Gas Development and Sisquoc Pipeline, Bi-directional Flow Projects Final EIR. Prepared for County of Santa Barbara, May.

Aspen Environmental Group. 1993. Pacific Pipeline Project Final Environmental Impact Report, California Public Utilities Commissions, SCH:92013018.

Bercha Group. 1998. Torch Point Pedernales Gas Pipeline Quantitative Risk Assessment, Volume 1 – Final Report and Volume 2 – Appendices. October.

California State Fire Marshal (CSFM). 1993. Hazardous Liquid Pipeline Risk Assessment.

California Department of Transportation (CalTrans), Department of Traffic Operations, Internet database information, *http://www.dot.ca.gov/hq/traffops/*

Center for Chemical Process Safety. 1989a. Guidelines For Process Equipment Reliability Data. Center for Chemical Process Safety of the American Institute of Chemical Engineers. Prepared by Science Applications International Corporation (SAIC) for the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE). NY: American Institute of Chemical Engineers.

___. 1989b. Guidelines For Chemical Process Quantitative Risk Analysis. NY: American Institute of Chemical Engineers.

___. 1996 Evaluating Process Plant buildings for External Explosions and Fires. *Provides data on process systems and equipment*.

___. 1997. Guidelines For Post-Release Mitigation Technology In the Chemical Process Industry. Prepared by Arthur D. Little, Inc. for the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE). NY: American Institute of Chemical Engineers.

Code of Federal Regulations, 49 Part 195, 40 Part 109-114.

Environ Corporation. 1995. Health and Ecological Risk Assessment. Prepared for Unocal Corporation.

Hydrocarbon Leak and Ignition Database. May 1992. Report N0. 11.4/180, E&P Forum

Lees, F.P. 1996 Loss Prevention In The Process Industries, Volumes 1 - 3. *Butterworths*: London.

Minerals Management Service (MMS). August 2000. Oil Spill Risk Analysis – Pacific Outer Continental Shelf Program, MMS 2000-057, *http://www.mms.gov/eppd/sciences/esp/ programs/osra.htm.*

___.2001. Delineation Drilling Activities in Federal Waters Offshore Santa Barbara County, California, Draft Environmental Impact Statement, MMS 2001-046.

Nalco/Exxon Energy Chemicals. July 19, 1996. Letter from Bill Hedges.

___. July 1, 1996. Torch Operating Company Correlation of Corrosion with Topography in 20-Inch Oil Pipeline.

Office of Pipeline Safety, Department of Transportation. Hazardous Liquid Pipeline Accident Data, 1986 to present and pre-1986. Available on the Internet: http://ops.dot.gov/.

___. Hazardous Liquid Pipeline Accident Data. 2001-2005. Available on the Internet: http://ops.dot.gov/stats/IA98.htm.

OREDA. 1992. Offshore Reliability Data Handbook, 2nd Edition. *OREDA Participants*: Norway. Detailed information on equipment found on offshore platforms. (commonly referred to as OREDA).

Pipeline Integrity International. August 1999. Platform Irene to HS&P Torch Operating Company 8-Inch Natural Gas Pipeline and 20-Inch Emulsion Pipeline Smartpig Results.

Plains Exploration & Production Company. 2006. EIR Update Meeting Presentation, August 1.

____. 2004. CORE Oil Spill Response Plan Pt. Arguello and Pt. Pedernales Fields. November.

____. 2004. Letter to MMS. Additional Clarification to Bonito Suspension Request. December 28.

____. 2005. Pipeline Integrity Review Manual, 20" Oil & 8" Water Pipeline

Rijnmond Public Authority. 1982. Risk Analysis of Six Potentially Hazardous Industrial Objects In The Rijnmond Area, A Pilot Study. A report presented by COVO Steering Committee. *D. Reidel Publishing Co.*: Dordrecht, Holland. (commonly referred to as Rijnmond).

Santa Barbara County (SBC). 1993. UNOCAL Point Pedernales Final SEIR, 92-EIR-13.

___. 1996. Torch Gas Plant Project: Addendum, 94-DP-027.

___. February 1, 2000b. Safety Element Supplement.

___. 2002a. Environmental Thresholds and Guidelines Manual. Santa Barbara Resource Management Department Division of Environmental Review and Compliance, Santa Barbara, California. October.

___. 2002b. Final Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project, LOGP Produced Water Treatment System Project, and Sisquoc Pipeline Bi-Directional Flow Project. Prepared by Arthur D. Little, Inc., Marine Research Specialists, and Science Applications International Corporation. SCH #2000071130, EIR #01-EIR-04. June.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon

Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

Santa Barbara County Fire Department (SBCFD). 2000. Quantitative Risk Assessment for Venoco's Platform Holly and Elwood Facility. June 9.

Santa Barbara County Planning and Development Department Energy Division. February 8, 1999. Torch Operating Company Point Pedernales Project H_2S Concentration Increase Project Addendum to 92-EIR-13, Case No. 94-DP-027 AM02.

___. 2001. Torch Point Pedernales Project Final Development Plan 94-DP-027 1998-2000 Condition Effectiveness Review Revised Final Analysis. January 11.

Sax, N.I. and R.J. Lewis. 1989. Dangerous Properties Of Industrial Materials. *Van Nostrand Reinhold Company*: New York.

State of California Government Code Regulations Part 51010 through 51018.

Torch Operating Company. 2000a. Oil Spill Response Plan for Operations on Torch Platform Irene and Point Pedernales 20-Inch Wet Oil Pipeline. October.

___. 2000b. Emergency Response Plan for Operations on Point Pedernales Onshore Facilities. Platform Irene Production Pipeline from Beach to Lompoc Oil and Gas Plant and Lompoc Oil and Gas Plant. September.

U.S. Census Bureau. 1990. Census Data STF1A from 1990 Census (http://www.census.gov).

3.3 Air Quality

This section describes environmental and regulatory settings related to air quality in the project area, specifies significance criteria against which the impacts would be identified, air quality impacts of the proposed project and lists potential mitigation measures.

3.3.1 Environmental Setting

3.3.1.1 Regional Overview

The proposed project would be located within the South Central Coast Air Basin (SCCAB) in northwestern Santa Barbara County. Santa Barbara County has a Mediterranean climate characterized by mild winters, when most rainfall occurs, and warm and dry summers. The influence of the Pacific Ocean causes mild temperatures year-round along the coast, while inland areas experience a wider range of temperatures. The mean maximum temperatures at the VAFB Weather Station varies from 60°F to 68°F; the mean minimum temperature varies from 45° to 55°F; and the annual mean temperature is 61.5 to 62°F. Precipitation is confined primarily to the winter months. Occasionally, tropical air masses result in rainfall during summer months. At the VAFB Weather Station mean precipitation ranges from 0.02 inches in July to 14 inches in December.

The regional climate is dominated by a strong and persistent high-pressure system, which frequently lies off the Pacific Coast (generally referred to as the East Pacific Subtropical High-Pressure Zone or Pacific High). The Pacific High shifts northward or southward in response to seasonal changes or the presence of cyclonic storms. In its usual position to the west, the high produces an elevated temperature inversion. An inversion is characterized by a layer of warmer air aloft and cooler air near the ground surface. Normally, air temperature decreases with altitude. In an inversion, the temperature of a layer of air increases with altitude. The inversion acts like a lid on the cooler air mass near the ground, preventing pollutants in the lower air mass from dispersing upward beyond the inversion "lid." This phenomenon results in higher concentrations of pollutants trapped below the inversion.

Atmospheric stability is a primary factor, which that affects air quality in the study region. Atmospheric stability regulates the amount of air exchange (referred to as turbulent mixing) both horizontally and vertically. Restricted atmospheric turbulence, that is, a high degree of stability, and low wind speeds, are generally associated with higher pollutant concentrations. These conditions are typically related to temperature inversions that cap the pollutants emitted below or within them.

Airflow plays an important role in the movement of pollutants. Regional winds are normally controlled by the location of the Pacific High. Wind speeds typical of the region are generally light, another factor that contributes to higher levels of pollution, since low wind speeds minimize dispersion of pollutants. The sea breeze is typically northwesterly throughout the year; however, local topography causes variations. During summer months, these northwesterly winds are stronger and persist later into the night. When the Pacific High weakens, a Santa Ana condition can develop, with air traveling westward into the county from the east. Stagnant air often occurs at the end of a Santa Ana condition, causing a buildup of pollutants offshore.

Prevailing wind speeds on the coast range from 9 to 11.5 miles per hour (mph) (14.5 to 18.5 kilometers per hour [km/h]), with maximum gusts up to 70 to 80 mph (113 to 129 km/h).

Several types of inversions are common to the area. In winter, weak surface inversions occur, caused by radiation cooling of air in contact with the cold surface of the earth. During spring and summer, marine inversions occur when cool air from over the ocean intrudes under the warmer air that lies over the land. During the summer, the Pacific High can cause the air mass to sink, creating a subsidence inversion.

Topography plays a significant role in affecting the direction and speed of winds. During the months of May to October, inversions commonly form in the project area. Year round, light onshore winds hamper the dispersion of primary pollutants, and the orientation of the inland mountain ranges interrupt air circulation patterns. Pollutants become trapped, creating ideal conditions for the production of secondary pollutants in the coastal zones.

3.3.1.2 Air Quality

Air quality is determined by measuring ambient concentrations of air pollutants that are known to have adverse health effects. For regulatory purposes, standards have been set for some of these air pollutants, and they are referred to as “criteria pollutants.” For most criteria pollutants, regulations and standards have been in effect, in varying degrees, for more than 25 years, and control strategies are designed to ensure that the ambient concentrations do not exceed certain thresholds. Another class of air pollutants that are subject to regulatory requirements is called hazardous air pollutants (HAPs) or air toxics. Substances that are especially harmful to health, such as those considered under the U.S. Environmental Protection Agency’s (EPA) hazardous air pollutant program or California’s AB 1807 and/or AB 2588 air toxics programs, are considered to be air toxics. Regulatory air quality standards are based on scientific and medical research. These standards establish minimum concentrations of an air pollutant in the ambient air that could initiate adverse health effects.

For air toxics emissions, however, the regulatory process usually assesses the potential impacts to public health in terms of “risk,” such as the Air Toxics “Hot Spots” Program in California, or the emissions may be controlled by prescribed technologies, as in the new Federal approach for controlling hazardous air pollutants.

The degree of air quality degradation for criteria pollutants is determined by comparing the ambient pollutant concentrations to health-based standards developed by government agencies. The current National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards (CAAQS) for “criteria pollutants” are listed in Table 3.3.1. Ambient air quality monitoring for criteria pollutants is conducted at numerous sites throughout California. Table 3.3.2 presents relevant data from several monitoring stations located in the project area. A summary of the attainment status for Santa Barbara County is provided in Table 3.3.3. Ambient air quality in the County is generally good, i.e., within applicable ambient air quality standards, with the exception of particulate matter with an aerodynamic diameter of ten microns or less (PM_{10}), and ozone (O_3).

Criteria pollutants are also categorized as inert or photochemically reactive, depending on their subsequent behavior in the atmosphere. By definition, inert pollutants are relatively stable, and their chemical composition remains stable as they move and diffuse through the atmosphere. The photochemical pollutants may react to form secondary pollutants. For these pollutants, adverse health effects may be caused directly by the emitted pollutant or by the secondary pollutants.

Inert Pollutants

Criteria pollutants that are considered to be inert include carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), PM, lead, sulfates, and hydrogen sulfide (H_2S).

Carbon monoxide is formed primarily by the incomplete combustion of organic fuels. Santa Barbara County is in attainment of the California and national one-hour and eight-hour CO standards. High values are generally measured during winter, when dispersion is limited by morning surface inversions. Seasonal and diurnal variations in meteorological conditions lead to lower values in summer and in the afternoon.

Nitric oxide (NO) is a colorless gas formed during combustion processes that rapidly oxidizes to form nitrogen dioxide (NO_2), a brownish gas. Santa Barbara County is in attainment for the California and national nitrogen dioxide standards. The highest nitrogen dioxide values are generally measured in urbanized areas with heavy traffic.

Sulfur dioxide (SO_2) is a gas produced primarily from combustion of sulfurous fuels by stationary and mobile sources. Santa Barbara County has been in attainment of the California and national sulfur dioxide standards for the last ten years.

The largest PM_{10} emissions appear to originate from soils via roads, construction, agriculture, and natural, windblown dust. Other sources of PM_{10} include sea salt, particulate matter released during combustion processes, such as those in gasoline and diesel vehicles, and wood burning. Also, nitrogen oxides (NOx) and sulfur oxides (SOx) are precursors in the formation of secondary PM_{10}. Santa Barbara County is in exceedance of the California 24-hour PM_{10} standard (see Table 3.3.3). Santa Barbara County is Unclassified for the recently added State $PM_{2.5}$ Standard.

Lead is a heavy metal that in ambient air occurs as a lead oxide aerosol or dust. Since lead is no longer added to gasoline or to paint products, lead emissions have been reduced significantly in recent years. The County is in attainment with the NAAQS and the CAAQS for lead.

Sulfates are aerosols, i.e., wet particulate, that are formed by sulfur oxides in moist environments. They exist in the atmosphere as sulfuric acid and sulfate salts. The primary source of sulfate is from the combustion of sulfurous fuels. The County is in attainment for the California sulfate standard, and there has been a steady decrease in ambient concentrations in the recent decade.

Table 3.3.1 National and California Ambient Air Quality Standards for Criteria Pollutants

Pollutant	Averaging Time	California Standards [a,c]	National Standards [b]	
			Primary[d]	Secondary [c,e]
O_3	1-hour [2] 8-hour [1]	0.09ppm (180µg/m^3) 0.07ppm (137µg/m^3)	0.12ppm (235µg/m^3) 0.08ppm (157µg/m^3)	0.12ppm (235µg/m^3) 0.08ppm (157µg/m^3)
CO	8-hour 1-hour	9.0ppm (10mg/m^3) 20.0ppm (23mg/m^3)	9.0ppm (10mg/m^3) 35ppm (40mg/m^3)	NS NS
NO_2	Annual Avg. 1-hour	NS 0.25ppm (470µg/m^3)	0.053ppm (100µg/m^3) NS	0.053ppm (100µg/m^3) NS
Sulfur Dioxide, SO_2	Annual Avg. 24-hour 3-hour 1-hour	NS 0.04ppm (105µg/m^3) NS 0.25 ppm (655µg/m^3)	0.03ppm (80µg/m^3) 0.14ppm (365µg/m^3) NS NS	NS NS 0.5ppm (1,300µg/m^3) NS
PM_{10}	Ann.Arith.Mean 24-hour	20µg/m^3 50µg/m^3	50µg/m^3 150µg/m^3	50µg/m^3 150µg/m^3
PM2.5	Ann.Arith.Mean 24-hour	12µg/m3 NS	15µg/m3 65µg/m3	15µg/m3 65µg/m3
Sulfates (SO_4^{-2})	24-hour	25µg/m^3	NS	NS
Lead (Pb) [f]	30-day Avg. Calendar Qtr.	1.5µg/m^3 NS	NS 1.5µg/m^3	NS 1.5µg/m^3
H_2S	1-hour	0.03ppm (42µg/m^3)	NS	NS
Vinyl Chloride [f]	24-hour	0.010ppm (26µg/m^3)	NS	NS
Visibility Reducing Particles	1 Observation	Insufficient amount to reduce the prevailing visibility [g] to less than 10 miles when the relative humidity is less than 70 percent (CA only).		

Notes: ppm = parts per million by volume (micromoles of pollutant per mole of gas) µg/m^3 = microgram/cubic meter; mm = millimeter; NS = No Standard; Avg. = Average; Ann. Arith. Mean = Annual Arithmetic Mean.

a. California standards for O_3, CO, SO_2 (1-hour), NO_2, $PM_{2.5}$ and PM_{10} are values that are not to be exceeded. SO_4^{-2}, Pb, H_2S, Vinyl Chloride, and visibility-reducing particles standards are not to be equaled or exceeded. Sulfates are pollutants that include SO_4^{-2} ion in their molecule. CA 8-hr O_3 standard was approved by CARB on April 28, 2005 and is effective as of May 17, 2006.

b. National Standards, other than O_3 and those based on annual averages or annual arithmetic means, are not to be exceeded more than once a year. The O_3 Standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one. National 1-hour O_3 standard was revoked on June 30, 2005.

c. Concentration expressed first in units in which it was promulgated. Equivalent units in parentheses are based upon reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibar). All measurements of air quality are to be corrected to these reference conditions.

d. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the EPA.

e. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the EPA.

f. The California Air Resources Board (CARB) has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

g. Prevailing visibility is defined as the greatest visibility, which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

Source: CARB 2005.

Table 3.3.2 Ambient Air Quality Summary for Project Area – 2003 to 2005

Pollutant	Year	Maximum Observed Concentration (Number of Standard Exceedances) [a]			
		Lompoc HS and P	Lompoc S H Street	VAFB STS Power	Santa Maria – Broadway
Ozone, ppm					
1-hour 8-hour	2003	0.107 (1 day) 0.080 (0)	0.071 (0) 0.060 (0)	0.089 (0) 0.077 (0)	0.065 (0) 0.060 (0)
1-hour 8-hour	2004	0.089 (2 days) 0.097 (1 day)	0.084 (0) 0.075 (0)	0.090 (0) 0.083 (0)	0.074 (0) 0.064 (0)
1-hour 8-hour	2005	0.072 (0) 0.069 (0)	0.064 (0) 0.052 (0)	0.072 (0) 0.066 (0)	0.063 (0) 0.061 (0)
CO, ppm					
8-hour	2003	NA	1.71 (0)	0.36 (0)	1.13 (0)
8-hour	2004	NA	1.26 (0)	0.36 (0)	0.95 (0)
8-hour	2005	NA	1.07 (0)	0.70 (0)	0.94 (0)
NO_2, ppm					
1-hour Annual Avg.	2003	0.024 (0) 0.002	0.051 (0) 0.006	0.023 (0) 0.001	0.056 (0) 0.011
1-hour Annual Avg.	2004	0.022 (0) 0.002	0.036 (0) 0.006	0.023 (0) 0.001	0.050 (0) 0.010
1-hour Annual Avg.	2005	0.012 (0) 0.002	0.035(0) 0.006	0.019 (0) 0.001	0.048 (0) 0.010
SO_2, ppm					
24-hour Annual Avg.	2003	0.002 (0) NA	0.003 (0) 0.001	0.001 (0) NA	NA NA
24-hour Annual Avg.	2004	0.002 (0) NA	0.002 (0) NA	0.002 (0) NA	NA NA
24-hour Annual Avg.	2005	0.001 (0) NA	0.003 (0) NA	0.001 (0) NA	NA NA
PM_{10}, µg/m^3					
24-hour State/ Federal	2003	NA NA/ NA	57.1 (1 day) 22.1	97.8 (1 day) 13.6	58.0 (1 day) 25.2/ 24.4
24-hour State/ Federal	2004	NA NA/ NA	52.3 (1 day) 20.1	38.1 (0) 18.0	52.0 (1 day) 24.7/ 24.1
24-hour State/ Federal	2005	NA NA/ NA	86.6 (1 day) 17.5	41.8 (0) 15.3	43.0 (0) 25 [b]/ NA
$PM_{2.5}$, µg/m^3					
24-hour State/ Federal	2003	NA NA/ NA	NA NA/ NA	NA NA/ NA	20.5 (0) 8.6/ 8.6
24-hour State/ Federal	2004	NA NA/ NA	NA NA/ NA	NA NA/ NA	16.6 (0) 7.5/ 7.6
24-hour State/ Federal	2005	NA NA/ NA	NA NA/ NA	NA NA/ NA	29.8 (0) 9 [b]/ NA

Sources: Air Resources Board Air Quality Data Annual Summaries 2003 – 2005 from the Internet web site - www.arb.ca.gov.
Notes: NA – No data available, State – State Annual Average, National – National Annual Average.

Table 3.3.3 Attainment Status of Santa Barbara County

1-hour O_3 [a]		CO		NO_2		SO_2		PM_{10} / PM_{25}	
CA	Fed	CA	Fed	CA	Fed	CA	Fed	CA	Fed
N	A	A	A	A	U/A	A	U/A	N/U /A	U/A

Notes: CA = California State Standards; A = Attainment of Standards; N = Nonattainment; U = Unclassified; U/A = Unclassified/Attainment.
Source: *1. U.S. EPA, http://www.epa.gov/region09/air/maps/maps_top.html, page updated August 15, 2006 .*
2. ARB, http://www.arb.ca.gov/desig/adm/adm.htm , page last updated February 3, 2006.

Hydrogen sulfide (H2S) is an odorous, toxic, gaseous compound that can be smelled by humans at very low concentrations. Concentrations detectable by smell (this can vary from 0.5 parts per billion [ppb] detected by 2 % of the population to 40 ppb, qualified as annoying by 50 % of the population) are significantly lower than concentrations that could affect human health (2 ppm [2,000 ppb] can cause headaches and increased airway resistance in asthmatics; inhalation of 600 ppm is lethal). The gas is produced during the decay of organic material and is also found naturally in petroleum and natural gas. The County is in attainment of the H2S standard.

Photochemical Pollutants

Ozone is formed in the atmosphere through a series of complex photochemical reactions involving oxides of nitrogen (NOx), reactive organic compounds (ROC), and sunlight, occurring over a period of several hours. Since ozone is not emitted directly into the atmosphere, but is formed as a result of photochemical reactions, it is classified as a secondary or regional pollutant. Because these ozone-forming reactions take time, peak ozone levels are often found downwind of major source areas.

Santa Barbara County is not in attainment for the State 1-hour ozone standard. Santa Barbara County is in attainment for the Federal 8-hour ozone standard.

Toxic Air Contaminants

Toxic Air Contaminants (TACs) are hazardous air pollutants that are known or suspected to cause cancer, genetic mutations, birth defects, or other serious illnesses to people. TACs may be emitted from three main source categories: (1) industrial facilities; (2) internal combustion engines (stationary and mobile); and (3) small "area sources," such as solvent use. The California Air Resources Board (CARB) publishes lists of Volatile Organic Compound (VOC) species profiles for many industrial applications and substances.

Generally, TACs behave in the atmosphere in the same general way as inert pollutants, i.e., those that do not react chemically, but preserve the same chemical composition from point of emission to point of impact. The concentrations of toxic pollutants are, therefore, determined by the quantity and concentration emitted at the source and the meteorological conditions encountered as the pollutants are transported away from the source. Thus, impacts from toxic-pollutant emissions tend to be site-specific, and their intensity is a function of constantly changing meteorological conditions. The worst meteorological conditions that affect short-term impacts (low wind speeds, highly stable air mass, and constant wind direction) occur relatively infrequently.

Greenhouse Gases

Greenhouse gases (GHGs) are defined as any gas that absorbs infrared radiation in the atmosphere. Greenhouse gasses include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These greenhouse gases lead to the trapping and buildup of heat in the atmosphere near the earth's surface, commonly known as the Greenhouse Effect. There is increasing evidence that the Greenhouse Effect is leading to global warming and climate change (EPA 2000).

The primary source of GHG in the United States is energy-use related activities, which include fuel combustion, as well as energy production, transmission, storage and distribution. These energy related activities generated 85 percent of the total U.S. emissions on a carbon equivalent basis in 1998 and 86 percent in 2004. Fossil fuel combustion represents the vast majority of the energy related GHG emissions, with CO_2 being the primary GHG. The total U.S. GHG emissions associated with energy related activities was 5,752.3 teragrams (Tg) of carbon equivalent (Tg CO_2 Eq) in 1998, of which 5,448.3 Tg was CO_2 emissions (Inventory of U.S. Greenhouse Gases Emissions and Sinks: 1990-2004, EPA, April 2006). These emissions grew to 6,108.2 Tg CO_2 Eq for all energy related activities in 2004, of which 5,835.3 Tg was CO_2 emissions.

Eighty-six percent of the energy consumed in the U.S. in 2004 was from fossil fuels such as coal, natural gas and petroleum. The remaining 14 percent was supplied by nuclear electric power (8 percent) and renewable sources (6 percent) (U.S. EPA, 2006)

3.3.1.3 Regional Emissions

Emissions within the County are estimated annually by the Santa Barbara Air Pollution Control District (APCD). Table 3.3.4 lists the estimated emissions by source category.

In Santa Barbara County, the highest contributors to the ROC emissions are natural sources, primarily uncontrolled seeps of different oil and gas constituents. Carbon monoxide and NOx emissions mostly occur due to mobile sources, e.g., on-road vehicles. The majority of SOx emissions come from mineral processes, specifically from diatomaceous earth processing. PM_{10} emissions are mostly due to road dust (area-wide sources).

Table 3.3.4 Regional Emissions Inventory (Tons Per Year) for Santa Barbara County[a]

Emission Sources	ROC	CO	NO_x	SO_2	PM_{10}
Stationary Sources	2,838	1,551	2,159	552	554
Petroleum Activities	*1,112*	*104*	*1,143*	*9*	*14*
Petroleum Activities % of Total	*2.5*	*0.1*	*6.9*	*1.0*	*0.1*
Area-Wide Sources	3,420	9,433	2,653	8	10,584
Mobile Sources	8,907	82,532	12,878	305	572
Natural Sources	29,295	11,404	1,058	0.0	1,843
SBC Total	44,460	103,369	16,589	865	13,553

a. For Clean Air Plan (CAP) base year 1996.

3.3.1.4 Study Area Baseline Emissions

The current level of air emissions at the following facilities represents the baseline for the proposed project and modification of the associated facilities: Platform Irene, the LOGP, and the associated pipelines. Also, the baseline is characterized by current emissions from several mobile sources such as helicopters and supply-boats servicing Platform Irene, as well as emissions from mobile services including commuters, LPG/NGL, sulfur and miscellaneous trucks servicing the LOGP.

The stationary project emissions are comprised of the following categories of equipment emissions listed in Table 3.3.5.

Table 3.3.5 Equipment at the Project Facilities

Platform Irene	LOGP
Engines (Cranes)	Heater Treaters
Flare	Thermal Oxidizer (Heating Medium Heater)
Fugitive Components	Flare
Supply Boat	Fugitive Emissions (including pipelines)
Pigging Equipment	Pigging
Sumps/Tanks/Separators	Sumps
Solvent Usage	Solvent Usage

Table 3.3.6 summarizes the estimated current emissions of the operating equipment at the facilities that are covered under the appropriate APCD PTOs.

Table 3.3.6 Point Pedernales Current Emissions

Facility	NO_x, (tons/yr)	ROC, (tons/yr)	CO, (tons/yr)	SOx, (tons/yr)	PM_{10}, (tons/yr)
Platform Irene [a]	12.52	26.05	2.66	1.04	1.01
LOGP [b]	2.53	35.86	0.89	0.58	0.61

Sources: PXP Annual report to SBCAPCD for Platform Irene, 2006; PXP report to SBCAPCD for LOGP, 2006.

a. Includes emissions from supply boats.

b. Includes emissions from pipelines.

Emissions that comprise the project air quality baseline are within the permitted limits established by the SBCAPCD. Table 3.3.7 below summarizes the limits stated by SBCAPCD in the appropriate PTO.

Table 3.3.7 Point Pedernales Permitted Emissions Levels

Facility	NO_x, tons/yr (lbs/day)	ROC, tons/yr (lbs/day)	CO, tons/yr (lbs/day)	SO_2, tons/yr (lbs/day)	PM_{10}, tons/yr (lbs/day)
Platform Irene – PTO 9106[a]	45.64 (1187.40)	28.01 (231.40)	13.87 (165.70)	9.30 (66.40)	4.66 (80.10)
LOGP – PTO 6708[b]	8.25 (45.00)	43.66 (263.65)	5.89 (32.19)	3.48 (18.72)	2.17 (11.81)

Sources: SBC APCD, Permits to Operate #6708 and #9106

a. Includes emissions from supply boats.

b. Includes emissions from pipelines, emissions from trucks are exempt.

3.3.1.5 Emissions Reductions Requirements

Increases in emissions of any non-attainment pollutant or its precursor from a new or modified project that exceed the thresholds identified in the APCD Rule 801(E) are required to be mitigated. When the Point Pedernales Project was permitted, project emissions did not exceed the existing thresholds for emission reductions.

Mitigation was required in 1986 for the Point Pedernales Project pursuant to CEQA. In particular, an agreement between Torch and the SBCAPCD in 1986, Emission Reduction Agreement-Union Oil Point Pedernales Project, established these emission mitigations. Mitigations for emissions from Platform Irene were also included as part of the permitting of onshore sources. The 1986 agreement was amended in 1996 to give credit for the shutdown of the Battles Gas Plant. Under CEQA, reducing existing sources of emissions on a 1:1 basis mitigated total project emissions increases. Mitigation of project emissions was required to maintain consistency with the 1986 Air Quality Attainment Plan (AQAP).

Emission mitigations were originally obtained for the project through electrification of IC engines, installation of emission reduction technologies (such as Pre-Stratified Charge) on other engines and installation of vapor recovery systems. Since that time, Battles Gas Plant shutdown has provided a “swap” for the above listed mitigations along with electrification of compressors. Currently the emission mitigations exceed the project emission liabilities.

3.3.2 Regulatory Setting

Federal, state, and local agencies have established standards and regulations that will affect the proposed project. A summary of the regulatory setting for air quality is provided below.

3.3.2.1 Federal Regulations

The Federal Clean Air Act of 1970 directs the attainment and maintenance of the NAAQS. The 1990 Amendments to this Act included new provisions that address air emissions that affect local, regional and global air quality. The main elements of the 1990 Clean Air Act Amendments are summarized below:

- Title I Attainment and maintenance of NAAQS;
- Title II Motor vehicles and fuel reformulation;
- Title III Hazardous air pollutants;
- Title IV Acid deposition;
- Title V Facility operating permits;
- Title VI Stratospheric ozone protection; and
- Title VII Enforcement.

The U.S. EPA is responsible for implementing the Federal Clean Air Act and establishing the NAAQS for criteria pollutants. In 1997 EPA adopted revisions to the Ozone and Particulate Matter Standards contained in the Clean Air Act. These revisions included a new 8-hour ozone standard and a new particulate matter standard for particles below 2.5 micron in diameter. These standards were suspended, however, when in May 1999 the U.S. Court of Appeals for District of Columbia remanded the new ozone standard. In January 2001 EPA issued a Proposed Response to Remand, where it stated that the revised ozone standard should remain at 0.08 ppm. In February 2001 the U.S. Supreme Court upheld the constitutionality of the Clean Air Act as EPA had interpreted it in setting health-protective air quality standards for ground-level ozone and particulate matter.

3.3.2.2 State Regulations

California Air Resources Board (CARB).
The CARB established the CAAQS. Comparison of the criteria pollutant concentrations in ambient air to the CAAQS determines State attainment status for criteria pollutants. The CARB has jurisdiction over all air pollutant sources in the state; it has delegated to local air districts the responsibility for stationary sources and has retained authority for emissions from mobile sources. The CARB in partnership with the local air quality management districts within California has developed a pollutant monitoring network to aid attainment of CAAQS. The network consists of numerous monitoring stations located throughout the state, which monitor and report various pollutants concentrations in ambient air.

California Clean Air Act (CCAA) (California Health and Safety Code, Division 26).
This act went into effect on January 1, 1989, and was amended in 1992. The CCAA mandates achieving the health-based CAAQS at the earliest practical date.

Air Toxics "Hot Spots" Information and Assessment Act of 1987 (California Health & Safety Code, Division 26, Part 6). The Hot Spots Act requires an inventory of air toxics emissions from individual facilities, an assessment of health risk, and notification of potential significant health risk.

The Calderon Bill (SB 1889), (California Health & Safety Code Sections 25531-25543).
This bill, signed by Governor Pete Wilson in September 1996, sets forth changes in the following four areas: provides guidelines to identify a more realistic health risk; requires high risk facilities to submit an air toxic emission reduction plan; holds air pollution control districts accountable for ensuring that the plans will achieve their objectives; and requires high risk facilities to achieve their planned emissions reduction.

California Global Warming Solutions Act of 2006 (AB 32)
The Global Warming Solutions Act caps California's greenhouse gas emissions at 1990 levels by 2020. This legislation represents the first enforceable state-wide program in the U.S. to cap all GHG emissions from major industries that includes penalties for non-compliance. It requires the CARB to establish a program for statewide greenhouse gas emissions reporting and to monitor and enforce compliance with this program. The Act authorizes the CARB to adopt market-based compliance mechanisms including cap-and-trade, and allows a one-year extension of the targets under extraordinary circumstances.

3.3.2.3 County Rules and Regulations

Local APCDs in California have jurisdiction over stationary sources in their respective areas and must adopt plans and regulations necessary to demonstrate attainment of Federal and State air quality standards. As directed by the Federal and State Clean Air Acts, local air districts are required to prepare plans with strategies for attaining and maintaining state and federal ozone standards. The 1998 Clean Air Plan and subsequent updates, including the most recent 2004

Clean Air Plan adopted in December 2004, outline the steps to be taken to ensure that ozone levels attain the state standards. The 2004 CAP begins with county-wide emissions from a 2000 base year and uses projections of population growth and trends in energy and transportation\ demand to predict future emissions and determine the control strategies needed to eventually achieve attainment. The control strategies are then either codified into the SBCAPCD rules and regulations or otherwise set forth as formal recommendations form SBCAPCD to other agencies.

In the project area, air quality rules and regulations are promulgated by the SBCAPCD. In order to ultimately achieve the air quality standards, the rules and regulations limit emissions and permissible impacts from proposed project. Some rules also specify emission controls and control technologies for each type of emitting source. The regulations also include requirements for obtaining an Authority to Construct (ATC) permit and a PTO.

The SBCAPCD has jurisdiction over air quality attainment in the SBC portion of the SCCAB. All aspects of the proposed project and alternatives occurring in SBC must obtain a SBCAPCD permit, if applicable.

SBCAPCD also has jurisdiction over OCS sources located within 25 miles of the seaward boundaries of the State of California (Rule 903).

Increases in emissions of any non-attainment pollutant or its precursor from a new or modified project that exceed the thresholds identified in the APCD Rule 801(E) are required to be mitigated.

3.3.3 Significance Criteria

3.3.3.1 Significance Criteria for Construction

Emissions from construction are normally short-term. Currently, neither the County nor the SBCAPCD have daily or quarterly quantifiable emission thresholds established for short-term construction emissions. PM_{10} impacts from dust emissions should be discussed and mitigation measures proposed as per AQAP policies. However, should the construction emissions exceed 25 tons per year of any criteria pollutant, the owner of the stationary source would have to provide emission reductions per SBCAPCD Rules 202 and 804; and the SBCAPCD would find this to be significant.

3.3.3.2 Significance Criteria for Operation

Quantitative significance criteria have been developed for air quality impacts by the SBC P&D (Environmental Thresholds and Guidelines, 2006). According to the SBC guidelines, proposed project air quality impacts are considered significant if the project:

- Interferes with the progress toward attainment of the ozone standard by releasing emissions, which equal or exceed the established long-term quantitative thresholds for NOx and ROC. The quantitative threshold for NOx and ROC is 25 lbs/day of either contaminant from motor vehicle trips only;

- Equals or exceeds the daily trigger for offsets set in the SBCAPCD New Source Review Rule 802, for any pollutant from all project sources, mobile and stationary, which are 80 lbs/day PM10 or 55 lbs/day NOx and ROC; and
- Equals or exceeds the state or Federal ambient air quality standards for any criteria pollutant (as determined by modeling).

Criteria for triggering modeling have been established for CO. A project would have a significant air quality impact if it causes, by adding to the existing background CO levels, a CO“hot spot” where California one-hour standard of 20 ppm of CO is exceeded. Screening criteria for CO impacts are the following:

- If a project contributes less than 800 peak hour trips, then CO modeling is not required; and
- Projects contributing more than 800 peak hour trips to an existing congested intersection at level of service (LOS) D or below, or will cause an intersection to reach LOS of D or below, may be required to model for CO impacts

The following issues should be discussed only if they are applicable to the project:

- Emissions which may affect sensitive receptors (e.g., children, elderly or acutely ill);
- Toxic or hazardous air pollutants in amounts which may increase cancer risk for the affected population; or
- Odor or another air quality nuisance problem impacting a considerable number of people.

3.3.3.3 Significance Criteria for Health Risks

The SBCAPCD has established criteria for determining the significance of potential health risks associated with toxic emissions from a project. These criteria have been developed for both carcinogenic and non-carcinogenic compounds, as well as for acute and chronic exposure as follows:

Potential Health Risk	Criterion
Cancer Risk	10 in one million (1 x 10^{-5})
Health Hazard Index	1.0

A cancer risk of 10 in one million represents the number of potential excess cancer cases (10) per million individuals exposed. The health hazard index is the cumulative ratio of the estimated exposure level to a chemical-specific health threshold. The health hazard index is the sum of the ratios for all chemicals present. Therefore, potential health hazards can be significant even if the threshold for a single chemical is not exceeded, but the sum of the exposure ratios exceeds one.

3.3.4 Impact Analysis for the Proposed Project

The proposed project will have construction and operation air quality impacts. The remainder of this section is broken down into construction and operational impacts. Where the air quality impacts for each of the projects are similar, the impact discussion has been combined. Detailed calculations of the emissions are presented in Attachment C.

3.3.4.1 Construction Impacts

Impact #	Impact Description	Project Phase
AQ.1	Construction activities would generate air emissions.	Construction

Construction (short-term) emissions would occur during the following activities:

1. Modifications at Platform Irene:
   - equipment modifications;
   - additional helicopter and supply boat trips to support modification activities (offsite).
2. Modifications at Valve Site #2:
   - delivery and installation of the new pumps;
   - construction of the power lines and transformer.
3. Modifications at the LOGP.

The addition of shipping pumps at Platform Irene and modifications at the LOGP would take the longest time to accomplish – approximately nine months. The short-term construction air quality impacts are summarized in Table 3.3.8. See Attachment C for detailed calculations.

Table 3.3.8 Summary of the Proposed Project Emissions – Construction

Location and Construction Activity	Total (Annual) Emissions (tons/yr)				
	CO	ROC	NO_x	SO_2	PM_{10}
LOGP & Valve Station #2	8.02	1.39	19.37	2.00	1.52
LOGP & Valve Station #2 – Fugitive Dust	-	-	-	-	0.01
Platform Irene	0.08	0.03	0.20	0.02	0.03
Offsite – onshore and offshore	3.14	0.74	2.18	0.05	0.16
Construction Total Emissions	**11.26**	**2.16**	**21.75**	**2.07**	**1.71**
Significant?	**No**	**No**	**No**	**No**	**No**

Construction emissions are short-term and are within the significance criteria, therefore these impacts are considered to be adverse but not significant. However, the Santa Barbara County requires standard mitigation measures for dust control, these are detailed below.

Mitigation Measures

AQ-1 The Applicant shall implement dust reduction measures during construction. Coordination with the SBCAPCD on dust control measures shall be implemented. The following APCD Standard Dust Mitigation Measures shall be implemented:

1. Dust generated by the development activities shall be retained onsite and kept to a minimum by following the dust control measures listed below. Reclaimed water shall be used whenever possible.

a. During clearing, grading, earth moving or excavation, water trucks or sprinkler systems are to be used in sufficient quantities to prevent dust from leaving the site and to create a crust, after each day's activities cease.

b. After clearing, grading, earth moving or excavation is completed, the disturbed area must be treated by watering, or revegetating; or by spreading soil binders until the area is paved or otherwise developed so that dust generation would not occur.

c. During construction, water trucks or sprinkler systems shall be used to keep all areas of vehicle movement damp enough to prevent dust from leaving the site. At a minimum, this would include wetting down such areas in the late morning and after work is completed for the day. Increased watering frequency will be required whenever the wind speed exceeds 15 mph.

2. Importation, exportation and stockpiling of fill material:

a. Soil stockpiled for more than two days shall be covered, kept moist, or treated with soil binders to prevent dust generation.

b. Trucks transporting fill material to and from the site shall be tarped from the point of origin.

c. If the construction site is greater than five acres, gravel pads must be installed at all access points to minimize tracking of mud onto public roads.

3. Activation of increased dust control measures:

a. The contractor or builder shall designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust offsite. Their duties shall include holiday and weekend periods when work may not be in progress. The name and telephone number of such persons shall be provided to the APCD.

After implementation of the mitigation measures the proposed project construction air quality impacts would be adverse but not significant.

3.3.4.2 Operational Impacts

Operational air impacts are expected from emissions associated with the new well development, increased oil production and treatment. Fugitive hydrocarbon emissions from the piping at the facilities or the pipelines connecting them would not increase due to the throughput increase. The emissions sources would include the following:

1. Platform Irene:
   - emissions from diesel equipment for drilling of new wells (well logging unit, acidizing pump, cement pump);
   - exhaust vapors from mud-gas separator and mud degasser as muds are recycled;
   - emissions from additional (over the current levels) supply boat and helicopter trips related to increased drilling activities;
   - fugitive emissions from additional well-related equipment and piping.

2. Valve Site #2:
   - fugitive emissions from the new pumps.

3. The LOGP:
   - increased over the current heater treaters operation (all three heater treaters could be operating, compared to only one at a time during the current operations);
   - increased over the current level truck traffic (LPG/NGL, amine and sulfur, etc.)

Impact #	Impact Description	Project Phase
AQ.2	Increased oil processing and drilling of the new Tranquillon Ridge Unit wells at Platform Irene would result in an increase in operational air emissions.	Drilling Increased Throughput Extension of Life

Operational emissions associated with the project were estimated with the following assumptions:

Assumptions for Platform Irene

- peak daily emissions include emissions from the drilling equipment (i.e., well logging unit, acidizing pump, and cement pump);
- emissions from testing of emergency drill generator are already a part of the baseline and are not a part of the proposed project;
- peak daily emissions include emissions from drilling muds due to associated off gassing during muds recycling;
- peak daily emissions that include one supply boat trip and three helicopter trips would remain the same as current, and are not a part of the proposed project. Only annual number of helicopter and boat trips will increase over the current level due to the proposed project;
- fugitive emissions from additional well piping are estimated, emissions would be more accurately known when the wells are installed; and
- added fugitive emissions from additional well leaking components was estimated for 20 additional wells.

Assumptions for the LOGP and Valve Site #2

- all three heater treaters would be in operation at the same time (currently there is only one heater treater operating at one time);
- fugitive emissions at the LOGP (including pipelines), emissions from pigging, thermal oxidizer, flare, solvent usage and sumps would remain the same;
- addition of pumps and valving at Valve Site #2 would increase fugitive emissions as a function of the new leak paths counts; and
- LPG/NGL truck emissions would increase due to increase in trips to a total of five trips per week.

Due to the proposed project, the identified emissions of both criteria pollutants and GHGs would continue beyond the projected lifetime of the approved Point Pedernales Project; therefore the continued air emissions would be considered an extension of life impact to air quality.

Criteria Pollutants

The project would generate air emissions above the current emissions from the existing facilities that are significant because the peak day emissions of NO_x and ROC are estimated to be considerably higher than the significance trigger of 25 lbs/day. See Table 3.3.9 for the summary of the proposed project emissions.

Table 3.3.10 compares the current Point Pedernales Project emissions and the proposed project air emissions with the mitigations that are in place for the Point Pedernales Project. The SBC approved FDP requires that the permitted NO_x and ROC emissions from the FDP be mitigated at a ratio of at least 1:1.

Table 3.3.9 Summary of the Proposed Project Emissions – Operation

Location and Activity or Equipment	Peak Daily Emissions, lbs/day					Annual Emissions, tons/yr				
	CO	ROC	NO_x	SO_2	PM_{10}	CO	ROC	NO_x	SO_2	PM_{10}
LOGP and Valve Site #2 Additional Emissions			-							
Heater treaters (2 additional units in operation)	14.13	1.31	20.43	9.60	5.76	2.579	0.238	3.728	1.752	1.051
Additional truck trips	1.44	0.32	0.14	0.01	0.00	0.075	0.017	0.007	0.001	0.000
Additional fugitive emissions (Valve Site #2)	-	0.06	-	-	-	-	0.011	-	-	-
Platform Irene Additional Emissions										
Emissions from drilling muds	-	1.00	-	-	-	-	0.040	-	-	-
Drilling equipment emissions	32.06	12.06	88.89	- .22	10.58	1.144	0.430	3.170	0.079	0.377
Additional helicopter trips (do not contribute to peak day)[a]	-	-	-	-	-	3.844	1.355	0.019	0.010	0.013
Additional boat trips (do not contribute to peak day) *	-	-	-	-	-	1.238	0.305	0.305	0.412	0.483
Fugitive emissions (new wells)	-	39.00	-	-	-	-	7.118	-	-	-
Total Proposed Project Operational Emissions	**47.64**	**53.78**	**109.46**	**11.84**	**16.34**	**8.88**	**9.52**	**7.23**	**2.25**	**1.92**
SBC Significance Criteria	**n/a**	**55**	**55**	**n/a**	**80**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
Significant?		**No**	**Yes**		No					

a. Helicopter and supply boat maximum permitted daily trips already occur during current operations, and are, therefore, a part of the baseline.

Table 3.3.10 Comparison of Current Emissions and Project Emissions – Operation

Facility or Type of Emissions	Annual Emissions, tons/yr				
	CO	ROC	NO_x	SO_2	PM_{10}
Current LOGP - Permitted Equipment (reported to SBCAPCD in 2005)	0.89	35.86	2.53	0.58	0.61
Current LOGP - Exempt Equipment (estimate from PTO 6708)	0.83	0.42	3.31	0.22	0.22
Current Platform Irene – Permitted Equipment (reported to SBCAPCD in 2005)	2.66	26.05	12.52	1.04	1.01
Current Platform Irene – Exempt Equipment (estimate from PTO 9106)	4.10	4.27	11.24	0.70	0.68
Total Current Operational Emissions	8.48	66.60	29.60	2.54	2.52
Proposed Project Operational Emissions (Table 3.3-8)	8.88	9.52	7.23	2.25	1.92
Total Current + Proposed Project	**17.36**	**76.11**	**36.83**	**4.79**	**4.44**
Permitted Point Pedernales Emissions [a]	23.76	75.25	74.86	13.73	8.06
Previous Offset Credit [b]	**n/a**	**166.03**	**82.52**	**n/a**	**n/a**

a. Includes also permitted Orcutt Pump Station emissions, does not include PTO Exempt emissions

b. Source: PTO 6708,

Emission mitigations are in place at the required permitted emissions level. The current Point Pedernales Project emissions of NO_x and ROC that include the permitted and exempt emissions (including emissions from trucks, helicopters and PTO exempt equipment) are within the available emissions mitigations. In fact, at present there is an excess of NOx and ROC emission mitigations in place in comparison to the current Point Pedernales Project emissions. If the Tranquillon Ridge Project estimated emissions are added to the current Point Pedernales Project emissions, the resulting total emissions are still within the available emission mitigations provided for NO_x and ROC according to the FDP requirement. The proposed project emissions would also be within the allowable PTO emissions. The APCD would need to approve PTO changes for the equipment changes and higher oil and gas throughput associated with the proposed project.

Oil and gas production and processing facilities could produce emissions that have unpleasant odors and are a nuisance to the public. The changes in the equipment, the increased oil and gas production and the higher oil and gas throughput due to the project would not significantly increase the odorous emissions from the project facilities (fugitive emissions are only minimally increased over current fugitive emissions). Therefore, the proposed project would not increase existing odor or other air quality nuisance problems.

The project is expected to generate fewer vehicle trips than the trigger for CO modeling of 800 daily trips, thus modeling is not required.

The proposed project operational NO_x estimated emissions are higher than the significance trigger of 55 lbs/day. Emissions reductions would be required for NO_x to mitigate this impact. In addition, offsets would be required for ROC emissions by the SBCAPCD as part of the PTO.

Greenhouse Gases

The proposed Tranquillon Ridge Project would generate additional greenhouse gases above and beyond what occurs for current operations. GHG emissions from the Tranquillon Ridge operations were estimated using the emissions by the source categories approach discussed above. The following GHGs are produced and accounted for as a result of any of the energy activities associated with the proposed project:

- CO_2 emissions from fuel combustion due to transportation activities (e.g., supply boat, LPG/NGL/sulfur trucks, trucks for transport of project-generated wastes to a disposal facility) {NOTE: the transport of drill muds and cuttings is not proposed; a certified EIR, or CSLC-approved lease terms, specifying no discharge would need to occur first before we could state that with certainty};
- SO_2 emissions from fuel combustion due to transportation activities (same transportation activities as for CO_2 emissions); and
- NO_x emissions from fuel combustion due to transportation activities (same transportation activities as for CO_2 emissions).

During the peak year of the Tranquillon Ridge Project, which would include drilling and production, the increase in GHG would be approximately 15,000 tons of CO2, 29 tons of methane, 7 tons of NOx, and 2 tons of SO2. This compares with U.S. GHG emissions for all energy related activities in 2004 of 6,430 million tons (5,835 Tg) of CO2, 11.3 million tons (10.3

Tg) of methane, and 198 million tons (0.18 Tg) of N_2O. The Tranquillon Ridge project operations would add very little GHGs to the U.S. inventory (less than 0.0002 percent).

The proposed Tranquillon Ridge Project would result in the production of crude oil and natural gas. These products would be used to help meet the energy needs of California and the U.S. The crude oil would most likely be refined at the Tosco Santa Maria Refinery, but could be potentially transported to Bay Area facilities for additional refining and distribution. These refineries produce a number of petroleum products (such as gasoline, jet fuel, diesel fuel, asphalt, etc.), using crude oil as the primary feed stock. The use of the fossil fuel produced from the proposed Tranquillon Ridge Project would generate GHGs, but would not result in any overall change to the U.S. GHG inventory.

Mitigation Measures

AQ-2 PXP shall ensure that emission reductions are provided to fully mitigate increases in operational emissions associated with the proposed project consistent with SBCAPCD Rules and Regulations.

Emissions would be less than the SBC significance criteria with the application of mitigations. Therefore, the operational air quality impacts are considered to be significant but mitigable. As the emissions in the years beyond the previously expected life of the Point Pedernales Project would be below the significance criteria (after the application of mitigation), the impacts due to extension of life are also considered to be significant but mitigable.

Impact #	Impact Description	Project Phase
AQ.3	Increased health risks from the increased air emissions due to the expected increase in equipment operation and oil volumes processed.	Increased Throughput Extension of Life

A health risk assessment is not required for Platform Irene as per PTO 9106, Section 6.4. Health risk from hazardous air pollutants (HAPs) is evaluated based on the population that is continuously exposed to the emissions of HAPs. The platform is located offshore, therefore no permanent population would be continuously exposed to the HAPs.

For the LOGP facility a cancer risk of approximately 0.1 per million, occurring on the site's property boundary, was estimated by the SBCAPCD based on the 1992 HAPs inventory. This cancer risk is primarily due to emissions of benzene. In addition, chronic and acute non-carcinogenic risks, or hazard indices, were estimated to be 0.008 and 0.2, respectively.

The current LOGP estimated emissions of HAPs (based on the 1994 AB2588 Toxic Inventory) are given in Part 70 PTO 6708 (see Attachment C). These emissions were estimated based on the facility's total potential to emit. Emissions from the proposed project plus the current emissions are not expected to be higher than the permitted emissions or the total potential to emit (which are the same), see Table 3.3.10. Therefore, the HAPs emissions are not expected to be higher than the worst-case scenario accounted in the SBCAPCD health risk estimates. Therefore, the health risks would not be higher than the ones listed in Table 3.3.11 under Current Estimate. Due to the proposed project the identified emissions HAPs would continue beyond the projected lifetime of the approved Point Pedernales Project, therefore the continued health risks would be present and considered a project extension of life health impact. The current risks estimate are below the criteria of the SBCAPCD, and will continue to be below significance levels beyond the projected Point Pedernales Project lifetime, therefore the health risks from the proposed project are adverse but not significant.

Table 3.3.11 Health Risk Impacts Summary

Potential Health Risk	Criterion	1992 Inventory	Current Estimate [a]
Cancer Risk	10 in one million (1×10^{-5})	0.01×10^{-5}	0.3×10^{-5}
Chronic Health Hazard Index	1.0	0.008	0.013
Acute Health Hazard Index	1.0	0.2	0.3

a. Estimated using the worst-case emissions data from PTO 6708, Risk Assessment Procedures for Rules 1401 and 212 South Coast Air Quality Management District, Air Toxics “Hot Spots” Program Risk Assessment Guidelines, 1992.

Mitigation Measures

No mitigation measures have been identified.

3.3.5 Comparison of Impacts Between Proposed Project and 1985 Point Pedernales EIS/EIR

Impact No.	Project Phase	Tranquillon Ridge Project Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
AQ.1	Construction	Construction activities would generate air emissions.	Increased ambient air concentrations of SO_2, NO_2, CO, O_3 and TSP but below the standards and allowed PDS increments. Increased levels of odorous pollutants and smoke but below the detection.	
AQ.2	Drilling Increased Throughput Extension of Life	Increased oil processing and drilling of the new Tranquillon Ridge Unit wells at Platform Irene would result in an increase in operational air emissions.	Potential to exceed 1 hour state and federal ozone standards in Santa Ynez due to emissions from Area Study platforms and onshore processing facility in Lompoc.	
AQ.3	Increased Throughput Extension of Life	Increased health risks from the increased air emissions due to the expected increase in equipment operation and oil volumes processed.	Increased ambient air concentrations of SO_2, NO_2, CO, O_3 and TSP but below the standards and allowed PDS increments. Increased levels of odorous pollutants and smoke but below the detection.	

3.3.6 References

Arthur D. Little. 1985. Union Oil Project/Exxon Project Shamrock and Central Santa Maria Basin Area Study: Final EIS/EIR. Prepared for County of Santa Barbara, U.S. Mineral Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development. Technical Appendix B Volume 1 and 2.

California Air Resources Board (CARB) 2005. Air Emissions. Available on the Internet: http://www.arb.ca.gov/homepage.htm

Office of Environmental Health Hazard Assessment (OEHHA). 2002. California EPA, Air Toxics Hot Spot Program Risk Assessment Guidelines. December.

Santa Barbara County (SBC). 2002. Final Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project, LOGP Produced Water Treatment System Project, and Sisquoc Pipeline Bi-Directional Flow Project. Prepared by Arthur D. Little, Inc., Marine Research Specialists, and Science Applications International Corporation. SCH #2000071130, EIR #01-EIR-04. June.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

Santa Barbara County, Air Pollution Control District. 2003. Permit to Operate 6708 and Part 70 Operating Permit 6708. December.

___. 2003. Permit to Operate 9106. December.

___. 2006. Rules and Regulations.

Santa Barbara County, Planning and Development Department (SBC P&D). January 2000. North County Oil and Gas Facility Siting and Planning Analysis.

___. 2002a. Environmental Thresholds and Guidelines Manual. October.

___. 2002b. A Planner's Guide to Conditions of Approval and Mitigation Measures. (republished February 2005).

U.S. EPA 1995. Compilation of Air Pollution Emission Factors Volume I Stationary Point and Area Sources. Fifth Edition; Part 3 of 3. January 1995. #AP-42. U.S. Dept. of Commerce reproduction. Available from National Technical Information Service (NTIS), Springfield, Virginia.

___. 2005. Inventory of U.S. Greenhouse Gases Emissions and Sinks. April.

PXP. 2004a. Annual Emissions report to SBCAPCD for Platform Irene.

___. 2004b. Emissions Report to SBCAPCD for LOGP.

3.4 Water Quality

This section describes the marine water and sediment quality in the southern Santa Maria Basin (SMB) where the offshore activities of the proposed project would take place. The water quality resources in this region have been previously described by the Minerals Management Service (MMS 2001, 2003, 2005ab) and by the FEIR (SBC 2002). Water quality parameters such as temperature, salinity, and turbidity near Platform Irene would be impacted by the increased discharge of drilling fluids and produced water, as well as by an oil spill event. This section also addresses the onshore water resources—surface and groundwater—that may be affected by the project.

3.4.1 Affected Environment

3.4.1.1 Seawater Quality

Coastal seawater and sediment quality is determined by a number of factors, including oceanographic processes, contaminant discharge, and freshwater inflow. Petroleum development activities, commercial and recreational vessels, natural hydrocarbon seeps, river runoff, municipal wastewater outfalls and minor industrial outfalls all contribute to increased nutrients, trace metals, synthetic organic contaminants, and pathogens in offshore waters and sediments. However, compared to coastal waters of the Southern California Bight, anthropogenic (human-induced) inputs into the waters of the SMB are minor and its marine waters are considered relatively pristine.

Seawater Properties
Other than the presence of specific contaminants that are described below, marine water quality is largely determined by five seawater properties: temperature, salinity, turbidity, alkalinity, and dissolved oxygen. Ambient seawater properties in the southern SMB are governed by seasonal and interannual variations in large-scale circulation patterns, wind stress, wave climatology, and runoff from land.

The vertical density structure or stratification of coastal waters dictates the amount of vertical mixing within the water column (Fischer et al. 1979). Highly stratified waters inhibit vertical exchange of nutrients, and other water properties, and can reduce vertical spread of contaminants introduced by a point source. Density stratification is primarily determined by the temperature structure. During periods when the upper water column is well mixed with uniform thermal structure and weak stratification, enhanced vertical mixing is expected. In the fall and winter, convective cooling and mechanical wind stirring drive the main thermocline to great depth (50 m) leaving the nearshore water columns with little vertical stability. In spring, a shallow thermocline (<10 m) forms near the shore in response to deep onshore transport during upwelling. This shallow seasonal thermocline is maintained throughout the summer and may even reach the surface as upwelling continues to bring cold nutrient-rich water onshore at depth.

Upwelling is an important feature of this coastal region and is largely responsible for its productive fishery. The presence of nutrient-rich water near the sea surface significantly enhances primary productivity (phytoplanktonic blooms) that is otherwise limited by the lack of nutrients within the photic zone. Phytoplankton are the foundation of the marine food web and their increased abundance results in the greater diversity and biomass of marine organisms along the central California coast.

Typically, the coolest coastal sea-surface temperatures (near 11°C) occur in spring and early summer when upwelling is prevalent. Increased insolation throughout the summer and the decline in upwelling-favorable winds in the fall results in a seasonal temperature maximum in September and October of around 17°C.

The onshore movement of deep cool water during upwelling is also reflected in the salinity and density distribution. The dense near-bottom water mass is more saline, which attests to its origin in the Southern California Bight. The northward flowing Davidson Current brings this cool saline water into the southern SMB. During upwelling, coastal salinity exhibits a seasonal maximum as a result of onshore flow at depth.

In addition to nutrients, high dissolved oxygen levels are also necessary for a healthy marine ecosystem. Pollutants that are high in organic compounds can locally deplete oxygen levels and have a deleterious affect on marine organisms. In general however, surface waters are saturated with oxygen due to rapid exchange with the overlying atmosphere. The oxygen concentration at saturation is largely determined by sea surface temperature. Below this surface maximum, oxygen steadily decreases with depth due to losses from biotic respiration and decomposition. The rates of chemical and biological oxygen demand decrease exponentially with depth.

Coastal dissolved-oxygen concentrations vary seasonally and range from 6 to 8 milligrams per liter (mg/L) near the surface. Surface levels are lowest in the fall when surface temperatures are highest. This reflects the inverse relationship between oxygen saturation and temperature. Under the stratified conditions during upwelling, dissolved oxygen decreases strongly with depth and declines to 5 mg/L in as little as 45 m. These low oxygen concentrations are a consequence of the onshore movement of deeper oxygen-poor water. These deep waters have not been in contact with the atmosphere, and ongoing respiration and decomposition has resulted in under-saturated oxygen levels along with the enhanced nutrient levels.

The highest alkalinity (pH) levels also occur during spring upwelling when increased photosynthesis consumes CO_2 and produces oxygen near the surface. As the ratio of respiration to photosynthesis increases with depth, there is an increase in CO_2 and a decline in alkalinity. Alkalinity can also be affected by discharge of waste into the ocean but tends to have only a localized effect on open-ocean waters.

Turbidity decreases the clarity of seawater and is largely determined by the concentration of suspended particulate matter. Turbidity dictates the depth of the photic zone. Within the photic zone, ambient light intensity exceeds roughly 1% of surface illumination, which is the minimum necessary for phytoplankton growth. Turbidity is increased in coastal waters as a result of phytoplankton blooms, storm runoff, sediment re-suspension, and discharge of wastewater. Substantial sediment input from onshore occurs in the form of large isolated pulses rather than a steady discharge of material. Intense storm events occasionally punctuate the prevailing semi-arid climate and result in mass runoff with profound increases in coastal turbidity. Turbidity near the seafloor is also caused by wave-induced sediment re-suspension. Near the shoreline, this is apparent as a decrease in transmissivity near the seafloor during periods of high wave activity.

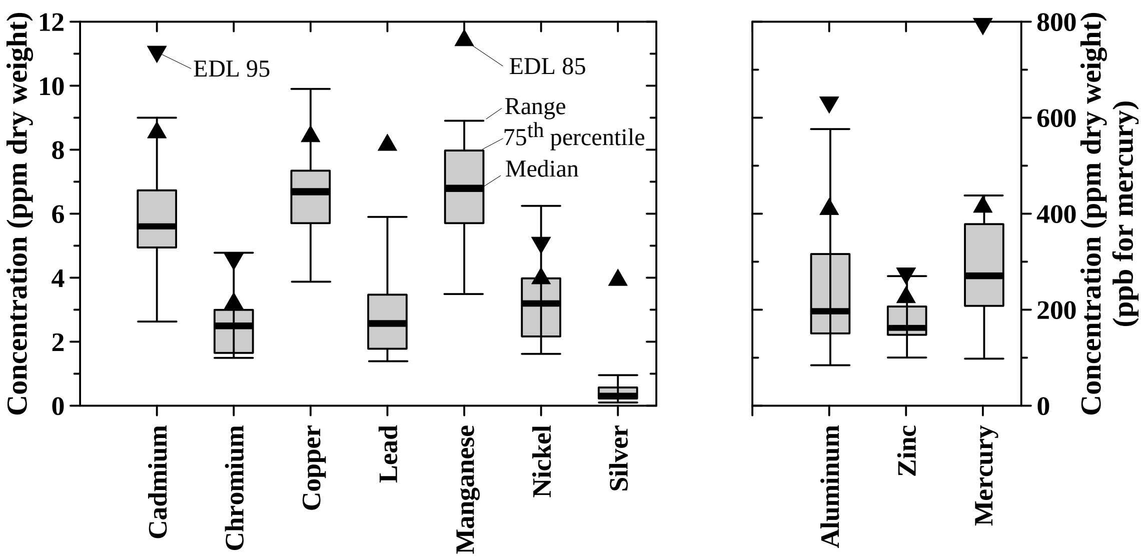
When this coincides with upwelling, turbidity is also higher near the sea surface which creates the mid-depth maximum in transmissivity commonly observed in vertical profiles.

Trace Metals

Ambient trace metal concentrations in the water column are generally below the detection limit of standard methods. Because these and other contaminants are difficult or impossible to measure directly in seawater, resident California mussels (*Mytilus californianus*) have been used as sentinel organisms to indirectly monitor water quality. Like most filter feeders, mussels are capable of concentrating contaminants in their tissues by factors of 10^2 to 10^5. Bivalves accumulate contaminants directly from seawater and from ingested food. They provide a time-integrated measure of the abundance of bioavailable contaminants in the water column.

Based on analysis of mussel tissue, trace-metal concentrations in the marine waters of the southern SMB are somewhat lower than many other regions offshore California. Trace metal data derived from the State Mussel Watch Program are summarized in Figure 3.4-1. The figure shows box plots of the distribution of the 19 to 27 samples collected between 1977 and 1987 at Stations 437, 438, and 449 (SWRCB 1988). For comparison, Elevated Data Levels (EDLs) are also shown. They reflect concentrations below which 85% (EDL 85) and 95% (EDL 95) of the 400 or so samples collected statewide were distributed.

Figure 3.4-1 Distribution of Trace Metal Concentrations in Mussels Collected in the Study Region Compared to Statewide Levels



Median concentrations in the southern SMB were well below the top 15% of samples collected statewide (EDL 85). The concentrations of these ten trace metals were frequently higher in bivalves and sediments found in other California coastal regions; especially those collected in urban areas. In the SMB, the maximum observed concentrations of cadmium, lead, manganese, silver, and mercury, were at or below the EDL 85. This reflects the south central coast's relative remoteness from industry. A few samples from the SMB had maximum concentrations in aluminum, chromium, copper, nickel, and zinc that exceeded the EDL 85, but these concentrations were generally not within the top 5% of statewide samples (EDL 95). Also, these elements occur naturally in sediments and are widely distributed in the mineralogy of the region. Their variability in bivalve tissue probably reflects the degree of sediment incorporation into the bivalves rather than bioavailability or the influence of anthropogenic sources.

Tissue samples collected in the NS&T program (BOS 1991) at the San Luis Obispo Bay site were comparable with those of the State Mussel Watch Program. Copper was an exception with elevated mean concentrations near 11.3 micrograms per gram dry weight (mg/g) or parts per billion (ppb). In addition, iron, total butyltin, and selenium were analyzed in NS&T samples but did not exhibit elevated concentrations compared to other west coast sites.

Waterborne Bacteria

Bacteria levels in the southern SMB vary widely and often increase after significant rainfall. This increase is due to the runoff of contaminants accumulated onshore. The extent to which bacterial pathogens survive after their introduction into the marine environment is currently the subject of investigation. Some studies have indicated that bacteria in seawater can remain infectious but undetectable by standard techniques used for microbiological monitoring (Grimes et al. 1986; Colwell et al 1985). Standard techniques report the most probable number of coliform organisms per 100 milliliters of water sample (MPN/100mL) and have detection limits near 2 MPN/100mL. The California Ocean Plan’s bacterial limits for water contact areas are 1000 total coliform organisms per 100mL and 200 MPN/mL for fecal coliform. While coliform densities in the water column are typically near the detection limit, surfzone samples adjacent to creeks and rivers often exceed bacterial standards during periods of high runoff (MRS 2006). Treated effluent discharged from wastewater point sources in the region is low in bacteria and has little tangible effect on marine water quality.

Excess nutrients in near-surface waters can lead to blooms of toxin-producing dinoflagellates in the form of red tides that result in deleterious impacts on water quality. Phytoplankton productivity is normally limited by the availability of the micronutrient nitrates, phosphates, and silicates in the upper water column. Upwelling is an important mechanism for adding nutrients to the euphotic zone. Nutrients are also added to coastal waters by wave-induced re-suspension of organic material contained within seafloor sediments. Onshore runoff and sewage discharge can also introduce unhealthy amounts of nitrogen, which is usually the most limiting nutrient for primary production.

Petroleum Hydrocarbons

- Petroleum hydrocarbons are an organic contaminant that can be of anthropogenic or natural origin. The principal sources of petroleum hydrocarbons in the southern SMB include:
- Urban runoff of road material, auto exhaust, lubricating oils, gasoline, diesel fuel, and tire particles;
- Atmospheric deposition from the combustion of fossil fuels;
- Vessel leaks, spills, and exhaust;
- Leaching of creosote from wooden pilings;
- Oil and grease contained in municipal sewage effluent; and
- Natural oil seeps.

Despite these diverse sources, hydrocarbon concentrations in tissue samples collected in the southern SMB were near background levels as compared to the elevated levels in samples collected within the Southern California Bight (BOS 1991). Also, oil and grease concentrations in wastewater discharged by ocean outfalls in the region are consistently small and do not contribute significantly to overall hydrocarbon levels in the water column (MRS 1996, 2006).

Petroleum hydrocarbons have also been introduced along this section of the central California coast by major oil spills. A spill of 163 to 1242+ barrels occurred in September 1997 when the pipeline that carries crude oil from Platform Irene ruptured at a flange (SBC 2001). Some of the oil was recovered offshore under relatively calm conditions. Another spill near the study region was associated with the sinking of the freighter Pac Baroness offshore Point Conception in 1987 (Hyland et al. 1989). An initial oil spill of 20,000 gallons (476 bbls) was accompanied by a partial release of the copper ore cargo. A similar potential exists for a future release of up to 3.1 million gallons (74,000 bbls) of crude oil from the oil tanker Montebello, which lies in 900 feet of water after being sunk during World War II offshore Cambria.

Two other onshore spills that have impacted near-shore waters along the central coast occurred at Avila Beach and the Guadalupe Dunes Oil Field just north of the Santa Maria River. Shallow groundwater at the Guadalupe Field was contaminated with approximately 6 million gallons of diluent at a number of beach sites. Prior to remediation, diluent was released into the marine environment on several occasions (ADL 1998a). Similarly, prior to cleanup, subsurface onshore hydrocarbon contamination at Avila Beach extended below the beach. There is some evidence that during periods of high wave erosion, the nearshore hydrocarbon plume daylighted and contaminated marine waters (ADL 1998b).

Perhaps the most significant long-term sources of hydrocarbons within the marine waters of SBCh and sediments of the SMB and SBCh are natural oil seeps (Hornafius et al 1999). The presence of naturally occurring petroleum products within the study region is suggested by the presence of numerous tar balls and tar mats commonly observed along the shoreline of the south-central California coast. The prevalence of oil seeps in the region is also suggested by the local place name Pismo Beach. “Pismo” derives from the Chumash word *pismu*, which describes the naturally-occurring asphaltum tar that Native Americans used to caulk plank canoes.

The offshore Santa Maria Basin contains two types of hydrocarbon seeps: active and passive. In the northern and central areas of the basin, passive and microseeps occur where the concentrations of migrated hydrocarbons are lower, and there are no visible geophysical anomalies (Saenz 2004). Passive seeps likely occur in areas where effective regional seals or deep-water depths limit vertical migration. In the northern and central areas of the SMB, the Hosgri Fault zone is associated with many active and passive or episodic gas vent craters. In contrast to passive seeps, active seeps (macroseeps) presumably occur where generation and migration of hydrocarbons from source rocks is ongoing and where migration pathways have developed along structural conduits through the overlying sediments. The southern area of the SMB, where tar seeps and mounds are present on the seafloor, is dominated by the North Channel Fault zone. These heavy oil-tar seeps are the result of a loss of volatiles and the biodegradation of the oil to tar along the seafloor outcrop of the Monterey Formation. Higher gravity crude oils exist in the southern portion of the area, and decreases northwestward across the offshore SMB (Saenz 2004).

The timing of tar accumulation on the beaches occurs mainly during the summer and fall months. Although natural oil seeps are still in the process of being cataloged for the waters north of Point Conception, it is likely that they exist in numbers large enough to be a principal source of background hydrocarbons in the marine waters and sediments (Steinhauer et al. 1994).

Hydrocarbon seeps provide evidence of the locations of underlying fractured formations and reservoirs. They also help in the characterization of these reservoirs. A 2004 study aimed at establishing baseline tar conditions on various Santa Barbara beaches used biochemical fingerprinting to divide tar balls collected from seeps, beaches, and platforms into nine groups (SBC 2004). The study determined that three main tar ball groups correspond to three main seepage areas; one likely located north of Casmalia Beach, one centered around Pt. Conception, and the third, a large area extending from about offshore Gaviota to offshore Coal Oil Point. The study also established that the biochemical signature for the tar balls found on beaches can, in many cases be distinguished from oil from distinct sources through biomarker analysis. Thus, beach tar believed to originate from natural seeps can be distinguished from oil produced at some platforms (e.g., Point Arguello platforms; Irene) (SBC 2004).

A large part of the elevated total hydrocarbon concentrations found in deep-water surficial sediments of the southern SMB derive from seep-related petroleum components. For that reason, elevated hydrocarbon concentrations arising from natural seeps need to be included in the determination of background concentrations for impact evaluations (Steinhauer et al. 1994).

3.4.1.2 Sediment Quality

Chemical analysis of seafloor sediments provides insight into the overall health of the marine environment. Over long periods of time, environmental contaminants tend to accumulate in the particulates that are deposited on the seafloor. However, for most elements, low levels of anthropogenic sediment contamination are difficult to detect because natural background concentrations vary with grain size, carbon content, and mineralogy.

To assess whether sediment contaminant levels are environmentally significant, they can be compared with sediment guidelines advanced by the National Oceanic and Atmospheric Administration (NOAA) (Long and Morgan 1991; Long et al. 1995) and by the Florida Coastal Management Program (MacDonald 1993). These guidelines are based on correlations between chemical concentrations and observed biological effects. Differences in the two sets of guidelines arise from the databases used and the assumptions applied in the analyses of the toxicity data. The NOAA guidelines identify Effects Range-Low (ERL) and Effects Range-Median (ERM) values. ERL guidelines reflect levels below which adverse effects are not expected to occur. ERM guidelines represent the concentration above which adverse effects are expected. The State of Florida (MacDonald 1993) developed sediment guidelines that are somewhat more conservative than those of NOAA. These guidelines describe a Threshold Effects Level (TEL) and the Probable Effects Level (PEL). The guidelines are compared with background concentrations measured in marine sediment samples collected within the southern SMB in Table 3.4.1.

For all but two contaminants, measured background concentrations were well below the lowest threshold limit (TEL). Chromium concentrations in deep (CaMP) sediments and within Estero

Bay (MB/C) slightly exceeded the TEL but were well below the ERL. Nickel was even more elevated and exceeded the ERL. These trace metals were also elevated in mussel tissue within the study area compared to other tissue samples collected statewide (Figure 3.4-1). As described above, elevated tissue levels probably reflect the incorporation of sediments into the bivalve's gut rather than dissolution in tissue.

Table 3.4.1 Comparison of background concentrations and sediment guidelines in milligrams per kilogram dry weight (mg/kg) or parts per million (ppm) unless otherwise indicated.

Constituent	Sediment Criteria				Background				
	TELa	ERLb	PELa	ERMb	SSLOc	SMRd	MB/Ce	CaMPf	SLUOBg
Grain Size (ϕ)					3.03	2.73	2.75	4.0	NA
TOC					2706	ND[h]	NA[i]	NA	NA
BOD					178	45	38	NA	NA
TKN					51	122	124	NA	NA
Ammonia					1.22	2.77	NA	NA	NA
Oil & Grease					NA	2.12	<36	NA	NA
Chromium	52	81	160	370	3.08	10.1	49	121	130
Cadmium	0.68	1.20	4.21	9.60	0.17	0.25	<0.17	0.56	0.39
Copper	19	34	108	270	0.9	7.2	4.0	16	7.5
Lead	30	47	112	218	1.5	4.1	2.3	14	4.9
Mercury	0.13	0.15	0.70	0.71	ND	ND	<0.07	0.072	0.075
Nickel	16	21	43	52	3.4	3.7	43	42	30
Silver	0.73	1.00	1.77	3.70	0.005	ND	<0.07	0.11	0.6
Zinc	124	150	271	410	9.93	22.6	16	72	43.6
p,p'-DDE (ppb)	2.1	2.2	374.2	27.0	NA	NA	ND	NA	1.0
Total DDT (ppb)	3.9	1.6	51.7	46.1	NA	NA	ND	NA	6.9
Total PCB (ppb)	21.6	22.7	188.8	180.0	NA	NA	ND	NA	5.6
Total PAH (ppb)	1684	4022	16771	44792	NA	NA	ND	0.08	NA

[a] *Threshold Effect Level (TEL) and the Probable Effects Level (PEL) of MacDonald (1993).*
[b] *Effects Range-Low (ERL) and Effects Range-Median (ERM) of Long et al. (1995).*
[c] *South San Luis Obispo County (SSLO) wastewater outfall at Oceano (ABC 1995).*
[d] *Unocal Santa Maria Refinery (SMR) receiving water monitoring program (KLI 1996).*
[e] *Morro Bay/Cayucos (MB/C) sanitary district offshore monitoring program (MRS 2006).*
[f] *California Monitoring Program (CaMP) surficial sediment chemistry (Steinhauer et al. 1994).*
[g] *Sediment data collected in 1988 at the National Status and Trends Benthic Surveillance Site (SLUOB) within San Luis Obispo Bay (BOS 1991).*
[h] *Not Detected (ND).*
[i] *Not Available (NA).*

The elevated chromium and nickel concentrations within the sediments of the southern SMB are increasing (MRS 2006). Onshore erosion around abandoned chromite mines within the San Luis Obispo County watershed has been identified as the probable source of the increase observed in regional marine sediments (RWQCB 1999; MRS 2000). Although there is no evidence that current levels are impacting marine organisms, projected increases are causing measured concentrations to rapidly approach the marine toxicological benchmarks listed in Table 3.4.1. At current accumulation rates, nickel could reach the ERM, where marine biological impacts are probable, in less than a year (by 2006). If chromium concentrations continue to increase at approximately 2 mg/Kg each year, contaminant levels could begin to affect marine organisms in as little as 10 years, or by the year 2010.

However, significant marine biological impacts from increasing chromium and nickel concentrations are unlikely because the minerals are not readily bioavailable and their threshold effects levels have a low degree of confidence. The incidence of effects in the toxicological studies used to establish the threshold levels for chromium was '*greatly influenced and exaggerated by data from multiple tests conducted in only two field surveys*' (Long et al. 1995). Similarly, nickel exhibits a very weak relationship between the incidence of effects and concentrations in the database used to establish the toxic-effect ranges. Because of these weak toxicological relationships, specification of nickel and chromium concentrations that induce adverse reactions in marine biota is highly uncertain. Much of this uncertainty arises from wide variability in nickel and chromium bioavailability. Nickel and chromium fines adhering to surface of sediment particles are much more likely to impact organisms that ingest or encounter the sediments. Conversely, nickel and chromium that are bound into the mineralogy of particles eroded onshore probably have little adverse effect on marine organisms.

It is not clear why nearshore sediment samples collected in 1995 at the San Luis Obispo County and SMR sites had low nickel and chromium concentrations (Table 3.4.1). By comparison, offshore chromium concentrations in samples collected at MB/C, CaMP, and SLUOB consistently exceeded 57 mg/Kg. This concentration is approximately three and a half times higher than average chromium concentrations within the Southern California Bight and was approximately twice the concentration (29 mg/Kg) that would be considered enriched in the Bight (Schiff and Gossett 1998). Nevertheless, measurements listed in Table 3.4.1 indicate that sediment chromium and nickel concentrations are spatially variable within the SMB decrease to the south toward the SBCh. Consequently, sediments below Platform Irene probably have lower concentrations of nickel and chromium because it is remote from the chromite mines near San Luis Obispo County.

3.4.1.3 Offshore Petroleum Production and Development

Offshore oil development and production activities can also affect the quality of seawater and marine sediments. The ongoing activities on Platform Irene and along the pipeline corridor are of particular interest for this environmental assessment.

Marine Oil Spills

The proposed project would extend the ongoing offshore operations of Platform Irene by an additional 10 to 25 years. These expanded operations would increase the risk of an accidental oil spill to marine waters. Three subsea pipelines currently transit the 10.5 miles (16.8 km) of seafloor between Platform Irene and the coast. The volume crude oil, produced water and gas transferred along these pipelines is likely to increase as a result of the proposed project. Currently, a spill from the 20-inch diameter crude oil line represents the greatest hazard to the marine environment. The offshore section of this pipeline can contain more than 18,000 bbls of oil emulsion at any one time. The two smaller pipelines transport lower volumes of produced water and gas and present less risk to the marine environment.

A marine spill that occurred along the 20-inch crude-oil transmission line in 1997 attests to the risk associated with operations on Platform Irene. On 28 September 1997, the seafloor pipeline ruptured approximately 2.5 miles from shore in a water depth of 120 feet (SBC 1997). Although the spill was initially limited by an automatic shutdown triggered by the abrupt pressure release, an operator on the Platform overrode the shutdown and reinitiated pumping from the platform into the ruptured pipeline. As a result, approximately 163 to 1,242+ barrels of crude oil spilled into the ocean. Mild oceanographic conditions facilitated the offshore recovery of some of the spilled oil but oil eventually washed ashore just south of Point Sal and onto the beaches south of Point Arguello. The sandy beaches at and south of the Santa Ynez River mouth were the most heavily oiled.

Generally, marine oil spills do not severely degrade open-ocean water quality except during and for a few weeks after the spill. Most of the components of crude oil are insoluble in seawater and because the spill floats on the sea surface, impacts to the water column are limited. Also, aromatic hydrocarbons, such as benzene and toluene, that are considered to be most toxic to marine life evaporate quickly as the spill weathers in the marine environment. Other weathering processes such as spreading, dissolution, dispersion, emulsification, photochemical oxidation, and microbial degradation decrease the volume of the oil slick and increase the viscosity and specific gravity of the spilled oil. Thus, mortality of marine organisms arising from the physical effects of smothering and coating is of greatest concern from weathered oil. However, toxicological effects from exposure to aromatic hydrocarbons can be significant if unweathered oil reaches the shoreline, particularly in areas with rocky shorelines, enclosed embayments, estuaries, and wetlands. The movement of spilled oil into the SBCh and its islands can be problematic in this regard.

Produced Water Discharges

Prior to 1991, produced water was discharged from Platform Irene. Currently, however, there is no marine discharge of produced water although NPDES General Permit CA 280000 for such disposal applies to Platform Irene. The existing LOGP treatment facilities are incapable of removing contaminants to the level specified in the NPDES discharge permit and the 25,000 Bpd of produced water that is presently piped to the platform, is reinjected downhole into the reservoir formation. The produced water treatment system at the LOGP currently is being upgraded and any produced water that is discharged from Platform Irene would be in compliance with the current NPDES general permit, which specifies allowable concentrations for specified contaminants. If ocean discharge resumes, the majority of this could be discharged through a 32-cm (12.75-inch) diameter ocean outfall oriented downward at a depth of 55 m below the Platform. However, a part of the produced water that would be shipped to Platform Irene may still be injected into Point Pedernales reservoir wells, as is currently the operation, to enhance current Point Pedernales production. The new pump system is expected to be capable of injecting 40,000 bbls/day.

On Pacific OCS platforms that discharge produced water, each platform operator conducts self-monitoring of these discharges pursuant to the requirements of the EPA's applicable NPDES permit. The MMS and EPA may also conduct compliance monitoring of the produced water discharges from offshore platforms in the Pacific OCS as part of a Memorandum of Agreement that has been in effect since 1989 (Panzer 2000). A work plan is agreed upon each year specifying the number of inspections and sampling. Constituents of concern include free and dissolved oil and grease, heavy metals, cyanide, organic compounds, added treatment chemicals, and radioactivity. A study of produced-water discharges from platforms in southern and central California found that concentrations of most trace metals and cyanide were below detection limits beyond the initial dilution zone (SCCWRP 1994). Cadmium was below detection limits in all samples. Nickel was detected in 50% of the samples, the most of any metal, and cyanide was detected in 25% of the samples. Zinc accounted for 60%, and nickel accounted for 30%, of the total mass of metals discharged. However, the mass emission of metals was negligible compared to the discharge from other point sources in the region.

All of the platforms discharging produced water had measurable concentrations of oil and grease, and 75% had measurable concentrations of phenols. Oil and grease and phenols were the dominant constituents in produced waters. Also, produced water has a lower dissolved-oxygen concentration than receiving ocean water. Produced water contains trace concentrations of naturally occurring radium but radioactivity in produced water from California platforms is much lower than for Gulf of Mexico platforms where excessive levels can make disposal problematic. Mean total radioactivity in produced water from two California platforms ranged from below the method detection limit to 154 pCi/L (Neff 1997). For comparison, drinking-water standards in California limit combined gross α and β radioactivity to 65 pCi/L. Radioactivity levels in coastal ocean waters are generally below 1 pCi/L.

Initial mixing and dispersion govern the fate of produced water discharged into the marine environment. Initial mixing occurs immediately after discharge. It is driven by the turbulence caused by the momentum of the discharge jet and instability of the buoyant effluent plume as it rises through the water column. Produced water discharged off the California coast is generally less saline and warmer than ambient seawater. This results in a buoyant discharge plume that aids in the initial mixing of the effluent. Modeling suggests that initial mixing occurs rapidly and results in dilutions of 30- to 100-fold within a few tens of meters from the outfall (Neff 1997). Slower-paced dispersion further reduces the concentration of contaminants as the oceanic flow field transports the produced-water plume. However, for Platform Irene, the produced water salinity and temperature are close to the ambient values, and the plume would be nearly neutrally buoyant at discharge depth. Consequently, it would not receive the additional benefit of buoyancy-induced mixing.

Discharge of Drilling Muds and Cuttings

Muds and cuttings would also be discharged offshore as part of the proposed project under the new NPDES General Permit (EPA 2000ab) covering discharges from oil and gas operations in Federal Waters offshore of the State of California. Materials that do not meet the discharge requirements would be transported to shore for disposal at a permitted site. There are a wide variety of generic drill muds available for use offshore California (CSA 1993). In the course of the drilling process, operators recycle drill muds until formulations change due to changing down-hole drilling conditions. Bulk discharges of 1,000 to 2,000 bbls of mud occur several times in the course of drilling a well, including a last time when the well is completed (EPA 2000a). Typical bulk discharge rates for platforms on the California OCS range from 75 to 700 bbls (3,150 to 29,400 gallons) per hour per platform (CSA 1985). In addition to these large bulk discharges, drill cuttings along with a small volume of mud that adheres to the cuttings are discharged continuously throughout drilling.

The most frequent additives to generic water-based drill muds are barite, clay, caustic soda, lignite, lignosulfonate, cellulose polymer, and soda ash or sodium bicarbonate. For special applications, other additives include de-foamers, emulsifiers, and detergents. At least 50 additives were found to be practically non-toxic or only slightly toxic to marine organisms based on 96-hour acute bioassay tests on Mysid shrimp (CSA 1993). In those tests, the lethal concentration at which 50% of the specimens died (LC50), was greater than 1,000 ppm for slightly toxic compounds and greater than 10,000 ppm for non-toxic compounds. A drill mud is less toxic as the concentration where 50% mortality (LC50) increases, because less dilution is required to prevent 50% mortality.

Tests for toxicity and free oil in discharged drilling muds are required as part of the NPDES discharge monitoring program. Toxicity is determined by conducting a 96-hour acute toxicity bioassay on muds collected after the wells have been drilled to at least 80% of their target depth (Panzer 2000). Most of the potentially toxic additives are added in these later stages of drilling. The General Permit (EPA 2000a) specifies a conservative minimum LC50 of 30,000 ppm for a suspended particulate phase test on muds.

Diesel and mineral oils are occasionally added to water-based drill muds to free stuck drill pipe, although this practice is uncommon along the California OCS. Diesel oil is not approved for discharge in ocean waters and diesel-contaminated muds must be transported to shore for recycling. In contrast, marine discharge of water-based muds with low concentrations of mineral oil is permitted under the General NPDES Permit (EPA 2000b) and the individual NPDES permit when the mineral oil is used as a carrier fluid (transporter fluid), lubricity additive, or pill. Mineral oil contains low concentrations of aromatic hydrocarbons and is much less toxic than diesel fuel. Free oil can be also introduced into drilling muds by drilling through an oil-bearing formation. If mineral oil or other hydrocarbons are discharged with drill muds, their concentrations must be less than approximately 2% based on a free-oil static sheen test. Excessive discharge of free oil is also monitored by examining the ocean surface for evidence of sheens near the discharge point (cuttings chute).

Analyses of drill muds and cuttings discharged in the southern SMB indicate that the volume of metal and hydrocarbon contaminants has been small relative to contributions from natural sources (Steinhauer et al. 1992). Barium, lead, and zinc had higher concentrations in discharged muds than in ambient marine sediments but total input was comparable to the flux from coastal rivers that drain into the southern SMB. Also, all three constituents are relatively insoluble in seawater and remain inert in marine sediments. Barium in the form of barite ($BaSO_4$) and bentonite clay were the major inorganic constituents of drill muds. They are used as the viscosifying and weighting agents in drill muds and are relatively benign. The excess lead and zinc that have been detected in drilling muds arose from the pipe dope used to lubricate the threads of drill pipe, not drilling mud additives (Steinhauer et al. 1994).

Other drilling muds constituents of concern include cement, mercury, and cadmium. Cement is used in cementing of well casings, well workovers, and completions. Because of its high alkalinity, cement can be harmful to the marine ecosystem. Other than mercury and cadmium, heavy metals are generally not monitored in drilling muds and cuttings (Panzer, 2000). The other metals present in drill muds include silver, arsenic, copper, nickel and vanadium but are typically present only at very low concentrations. These metals arise from trace impurities in the barite or in other minor additives used in the drilling process.

The NPDES General Permit prohibits the discharge of drill muds containing chrome lignosulfonate. Lignosulfonate is a thinning agent that controls the viscosity of water-based drill muds. Chrome-free lignosulfonate and other thinning products that have less potential to produce marine toxic effects are also available. In the past, lignosulfonate was added to muds in approximately 70% of the wells drilled offshore California and it accounted for approximately one percent of the total solids discharged (CSA 1985). Chrome-based thinning products accounted for approximately 32% of the lignosulfonate used. Chrome-based lignosulfonates are more effective than other thinning products in the high downhole temperatures experienced when drilling deep wells. Other common lignosulfonates are complexed with metals such as iron, manganese, and zirconium. The 2004 NPDES General Permit allows the use of eight generic mud types determined by the EPA to be of low toxicity.

The dispersion of drill muds and cuttings depends on the depth of the discharge (shunt depth), the prevailing flow field, and the physical characteristics of the drill muds and the receiving waters (see Appendix D of SBC 2002 or SBC 2006). On Platform Irene, spent drill muds and cuttings would be discharged 150 ft (46 m) below the sea surface. The temperature and density of drill muds generally increase with increasing drilling depth. Even after dilution with seawater at the shale shaker, the discharged material would be a few degrees warmer than ambient seawater temperatures. Because of the shunt depth, most of the heavier muds aggregates are deposited on the seafloor directly below and within 500 m of the discharge point. The heavier rock cuttings are not expected to be transported more than 200 m beyond the discharge point (de Margerie, 1989). Approximately 80% of the particulates are removed by these near-field depositional processes (CSA, 1985). Lightweight floccules formed from the remaining suspended particulates would be carried upward toward the sea surface by the buoyant plume of warm water associated with the discharge. They can be carried over four miles from the platform before being deposited on the seafloor (Coats 1994; Pickens 1992; Appendix D of SBC 2002 and SBC 2006).

Other Discharges

Offshore oil and gas development can also result in a variety of other discharges to the marine environment. In addition to the discharges described above, treated sewage and desalinization brines are the only discharges from offshore platforms that have a significant enough volume to potentially impact marine resources (SAIC 2000). Other discharges, such as deck drainage, blowout prevention fluid, fire-control system test water, and non-contact cooling water constitute relatively minor discharge volumes. Table 3.4.2 summarizes current discharges from Platform Irene and projected discharges under the proposed project. Seawater use is not expected to increase under the proposed project, but it may approach the upper end of the current range (12,000 bbls per day) during drilling and well workover. When drilling is not occurring, seawater use would be a the bottom end of the current range (6,000 bbls per day).

Table 3.4.2 Current and Proposed Discharges from Platform Irene

Discharge Stream	Current Volume/Frequency	Proposed Volume/Frequency
Sanitary Waste	100-200 bbls/day (max 600bbls/day in 2006	100-200 bbls/day (max about 600 bbls/day
Fire water/cooling	6,860 to 12,000 bbls/day	6,860 to 12,000 bbls/day
Drilling Muds	11,600 bbls (2006 through July)	Below permitted limit of 105,000 bbls/year
Drill Cuttings	1,800 bbls (2006 through July)	Below permitted limit of 30,000 bbls/year
Produced Water	None	Below permitted limit of 153,000 bbls/day

If each person generates 100 gallons per day (Gpd) of treated sewage, the total discharge from Platform Irene would be 2,400 Gpd. The effluent volume would increase to approximately 2,900 Gpd during drilling under the proposed project. Sanitary and domestic wastes are typically treated with chlorine prior to discharge. Enough chlorine must be added to kill coliform bacteria but not so much that it affects marine organisms. Chlorine levels are required to remain between 1 and 10 ppm (Panzer 2000). Some platforms discharge desalinization brines, which are generated from the desalinization process used to produce drinking water. Platform Irene does not discharge the desalinization brine, but rather sends it ashore with the produced water. Although the flow rates are highly variable, offshore platforms can discharge up to 200,000 Gpd of desalinization brine. These discharges are more saline than seawater, which would normally make them denser than receiving waters. However, their generally higher temperature results in a buoyant plume upon discharge. The ensuing momentum- and buoyancy-induced mixing rapidly dilutes the discharge to background levels within 100 m of the discharge (MMS 2001).

3.4.1.4 Onshore Water Resources

Surface Waters

The onshore portion of the oil emulsion pipeline and processing facility is located in the Lompoc Subarea of the Santa Ynez River Basin. The river and associated tributaries are the dominant surface water features within the three project areas. The river basin is situated between the east-west trending Santa Ynez Mountain and San Rafael Mountain ranges. The head of the basin occurs 60 miles east of the mouth of the Santa Ynez River within the Headwater Subarea of the river basin. Three dams in the upper reaches of the river are used for water supply for the South Coast of SBC.

The basin itself is a narrow, nearly flat, alluvial plain with a total area of approximately 800 square miles. Surface water drainages are limited to the distance between the crest of the mountain range and the shoreline. Therefore, most drainages are short, steep, and small. The major tributaries are Lompoc Canyon, La Salle Canyon, Sloans Canyon, San Miguelito Creek, and Salsipuedes Creek from the south, and Oak Canyon, Santa Lucia Canyon, Davis Creek, Purisima Canyon, and Cebada Canyon to the north. Throughout most of its length, the river is dry during most of the year, with large flows only in response to winter storms and spilling from upstream dams.

The Santa Ynez River basin is susceptible to severe flooding in response to heavy rainfall and water releases from upstream dams. Peak flows may reach 100,000 cubic feet per second (cfs). Flooding has potential for substantial soil erosion within the flood plain.

Within the project areas, rainfall typically occurs only during November through April, with high annual variability. The average rainfall at Lompoc is approximately 23 inches, with a range of approximately 6 to 30 inches per year. In response to seasonal rainfall, stream flow and the presence of surface waters are also highly variable throughout most of the basin. In contrast, perennial flow exists near the mouth of the Santa Ynez River and other areas subject to groundwater discharge, irrigation runoff, and effluent discharge from the Lompoc Regional Wastewater Treatment Plant. Flow volumes and water quality characteristics within the river basin are highly variable.

Surface water quality in the project areas is typical of surface waters in the river basin. No major industrial waste sources discharge directly to the Santa Ynez River. In accordance with an NPDES permit, the Lompoc Wastewater Treatment Plant discharges approximately 5 million gallons per day (MGD) of treated municipal wastewaters at a location approximately three miles from the river mouth. Water quality in the river has been characterized as "less serious problems-low vulnerability" (i.e., to stressors such as pollutant loadings above permitted discharge limits and urban runoff potential; EPA 1999). However, the Santa Ynez River is on the 1998 Section 303(d) list as an impaired water body. Nutrients, sedimentation/siltation, and salinity/ total dissolved solids (TDS)/chlorides are parameters of concern. Major ions include sodium, chloride, bicarbonate, and sulfate. Waters are suitable for most irrigation and agricultural uses but only marginally suitable for domestic uses because of high TDS levels.

The onshore portion of the pipeline is north of and generally parallel to the Santa Ynez River before turning north near Valve Site #6. From landfall to Route 1, the pipeline crosses 14 drainages, with drainage areas ranging from 18 to 9,100 acres. All but two are considered minor, with drainage areas less than 200 acres. Surface waters in these minor drainage areas are classified as ephemeral (i.e., seasonal), and natural runoff occurs only during the rainy season.

Surface waters in the western end of the land portion of the pipeline near the mouth of the Santa Ynez River are fed by groundwater, irrigation tail water, and effluent from the Lompoc Wastewater Treatment Plant. During portions of the year (e.g., summer) the presence of a sand bar at the mouth of the river prevents exchange between the river and ocean. Following winter storms, high river flows will breach and erode the sand bar, allowing the river to drain to the ocean. While the river mouth is open, exchanges with ocean waters result in increases in salinity within portions of the rivers affected by estuarine circulation (e.g., mixing of lower density river water and higher density seawater).

A small water body is also located immediately north of the mouth of the river, between the back dunes of the beach and the railroad tracks. This water body appears to be part of the estuarine system within the lower Santa Ynez River, although exchange between this water body and the river probably occurs episodically due to formation of a sand berm at the connection to the river mouth. Based on the species of vegetation present, waters within this feature are expected to be brackish. The onshore portion of the pipeline passes within 0.5 kilometers of this portion of the estuary.

Proceeding inland from the railroad tracks, the pipeline route between Basin 2 and Basin 8 is one kilometer or more from the Santa Ynez River. The direction of surface water flow in the area of the pipeline route, is generally southwestward, towards the river. The pipeline crosses a small drainage near Basin 4, where the pipeline daylights and is suspended at an elevation of approximately 50 feet over the floor of the canyon (see Figure 3.4-2).

Figure 3.4-2 Photograph of Pipeline (foreground) Route Crossing Small Drainage Feature Near Basin 4

According to the 1985 Point Pedernales EIR/EIS, this unnamed canyon drains an area of 213 acres, with an average flow of 15.4 acre-feet per year (AFY), although streamflow is classified as ephemeral (HDR 1984). Eight catchment basins, with varying capacities, have been constructed along the portion of the pipeline between Valve Site #1 (at the beach landing) and Valve Site #5 (Figure 3.4-3).

Between Catchment Basins 8 and 12, the pipeline route is within approximately 0.5 kilometers of the Santa Ynez River. The pipeline also crosses Oak Canyon near Basin 12 before turning north and away from the river. Oak Canyon and related tributaries drain an area of approximately 1800 acres with an average flow of 70 acre-feet per year (Arthur D. Little 1985). Streamflow in Oak Canyon is classified as ephemeral, and has been diverted into a diked channel along the eastern side of the valley floor (HDR 1984).

Near Valve Site #8, the pipeline route crosses Santa Lucia Canyon, which drains an area of approximately 9,000 acres and has an average flow of 373 acre-feet per year. The stream is classified as intermittent/perennial. Santa Lucia Canyon drains to the Santa Ynez River.

Figure 3.4-3 Example of a Catchment Basin (Basin 1) Adjacent to Onshore Portion of the Pipeline Route

A Weired Concrete Outlet is Shown Near the Upper Left Corner of the Photograph.

Approximately mid-way between Valve Sites #8 and 9, the pipeline route passes within one kilometer of a wetlands area classified as an ephemeral stream (HDR 1984) with a small (less than 30 acres) drainage area. From Valve Site #9 to the Lompoc Oil and Gas Plant, the pipeline crosses a number of small drainages with ephemeral flow, and Davis Creek, with a drainage area of 3,660 acres and intermittent/perennial flow from underground return flow of golf course irrigation water (HDR 1984). No catchment basins occur along this portion of the pipeline route.

No specific data are available to characterize water quality within these smaller drainage systems. Large portions of the Oak Canyon and Santa Lucia Canyon drainage areas are undeveloped without significant sources of industrial discharges or agricultural or urban runoff. Portions of the Davis Creek drainage area could be affected to a relatively greater extent by urban runoff and, therefore, surface water quality may reflect inputs of nutrients, bacteria, pesticides, and organophosphorus herbicides that are common in urbanized watersheds.

Groundwater

Portions of the proposed projects are located within the Lompoc Subarea of the Santa Ynez River basin. The geological units of the basin can be divided into two parts: underlying, non-water bearing, consolidated rocks, and an overlying, water bearing, unconsolidated deposit. The underlying consolidated rocks form an effective lower boundary for the usable aquifer.

The lower portion of the younger alluvium under the Lompoc Plain is up to 180 feet thick, comprises most of the water-bearing zone, and is the most utilized aquifer in the Lompoc area (Miller 1976). The upper portion of the alluvium has a lower permeability, but supplies a few domestic wells, whereas the river channel deposits are permeable but not tapped by wells in the Lompoc Plain. The lower terrace deposits that underlie alluvium deposits on the southern portion of the plain are up to several thousand feet thick, moderately permeable, and tapped by many wells with yields up to several hundred gallons per minute (Miller 1976).

The aquifer of the Santa Ynez River Basin is bounded below and laterally to the north, south, and east by largely impermeable consolidated formations, and on the west by the ocean. These conditions create a general flow direction from east to west, with unconsumed groundwater discharging to the ocean. Prior to reaching the ocean, the aquifers discharge to streams where the water level in the stream is lower than the adjacent water table. Aquifer recharge is from infiltration of rainwater, seepage from streams, and return flows from irrigation and wastewater discharges (Arthur D. Little 1985).

Depth to groundwater varies from zero near the ocean to over 400 feet in upland areas of the basin. For much of the Lompoc Plain, depth to groundwater ranges from 15 to 50 feet. Seepage from the Santa Ynez River to groundwater occurs consistently in portions of the river downstream from the city of Lompoc and intermittently in the rest of the river. Average annual recharge to groundwater in the Lompoc Plain from the Santa Ynez River, local tributaries, rain infiltration, and underflow is approximately 14,000 acre-feet, whereas removal is due to pumping, evapotransporation, streamflow, and underflow to the ocean. The net consumptive use from the Lompoc Basin was estimated to be 22,459 acre-feet in 2000 (SBC 2001).

Groundwater within the Lompoc Sub-area is used extensively for agriculture (an estimated 70%), as well as some municipal, industrial, and military requirements. In contrast, groundwaters generally are not suitable for drinking water due to high TDS, as well as sulfate, chloride, and iron concentrations. Previous studies had shown a progressive deterioration of groundwater quality within the Santa Ynez River Basin, associated with increasing chloride ion concentrations due to agricultural recycling (Evenson 1965). The effects of saltwater intrusion in the western portion of the basin are considered negligible.

The project area lies in the Lompoc Groundwater Basin, which consists of three hydrologically connected sub-basins: Lompoc Plain, Lompoc Terrace, and Lompoc Uplands. The water serving the LOGP originates in the Lompoc Uplands, a sub-basin that has been overdrawn at an average rate of 906 AFY between 1975 and 2000 (SBC 2001b). The Lompoc Plain sub-basin has been overdrawn at an average rate of 40 AFY over the same period 1975 to 2000). The Lompoc Terrace has experienced an average gain of 33 AFY between 1975 and 2000. Because these sub-basins are hydrologically connected, however, they are considered by SBC to be a single overdrafted unit with net extractions exceeding recharge by 913 acre-feet per year (SBC 2001a, 2001b).

3.4.2 Regulatory Setting

Several Federal and State laws pertain to water quality. This section describes the relevance of these statutes to the proposed project.

3.4.2.1 Federal Regulations

The Clean Water Act

The 1972 Federal Water Pollution Control Act and its amendments in 1977, collectively known as the Clean Water Act, established national water-quality goals. The Act also created a National

Pollutant Discharge Elimination System (NPDES) of permits that specified minimum standards for the quality of discharged waters. It required states to establish standards specific to water bodies and designated the types of pollutants to be regulated, including total suspended solids and oil. The Act authorized the U.S. Environmental Protection Agency (EPA) to issue the NPDES permits and Region 9 of the EPA has jurisdiction for permitting discharges associated with the proposed project.

Under NPDES, all point sources that discharge directly into waterways are required to obtain a permit regulating their discharge. Each NPDES permit specifies effluent limitations for particular pollutants, and monitoring and reporting requirements for the proposed discharge. Chapter 27 of the Clean Water Act deals with Ocean Dumping and Section 1412 describes the following criteria for evaluating permit applications:

- the need for the proposed dumping;
- the effect of such dumping on human health and welfare, including economic, esthetic, and recreational values;
- the effect of such dumping on fisheries resources, plankton, fish, shellfish, wildlife, shore lines and beaches;
- the persistence and permanence of the effects of the dumping;
- the effect of dumping particular volumes and concentrations of such materials;
- appropriate locations and methods of disposal or recycling, including land-based alternatives and the probable impact of requiring use of such alternate locations or methods upon considerations affecting the public interest;
- the effect on alternate uses of oceans, such as scientific study, fishing, and other living resource exploitation, and non-living resource exploitation;
- the effect of such dumping on marine ecosystems, particularly with respect to
    - the transfer, concentration, and dispersion of such material and its by products through biological, physical, and chemical processes;
    - potential changes in marine ecosystem diversity, productivity, and stability; and
    - species and community population dynamics.

Permit issuance, receipt of monitoring data submitted by permittees, compliance monitoring, and enforcement are the primary responsibility of States when the discharge occurs within the 3-mile territorial limit. The MMS and the EPA Region 9 coordinate the Federal government's monitoring of offshore oil and gas discharges in Federal Waters of the SMB. They signed a Memorandum of Agreement in 1989 that utilizes MMS's daily presence on the platforms as a vehicle to perform inspections, collect samples, and to provide transportation for EPA during those occasions when they conduct inspections (Panzer 2000). The Memorandum's work plan is updated annually.

Pacific OCS platforms are also required to periodically submit Discharge Monitoring Reports (DMRs) to Region 9 of the EPA. The reporting requirements depend on whether the NPDES discharge permit issued to the operator was a General Permit or an Individual Permit. The General Permit was issued in February 1982 and when it lapsed in June 1984, it was administratively extended until a new General Permit could be developed. In the interim, a series of Individual Permits were issued that were uniformly more strict and required monitoring of a greater number of produced water parameters. This two-tiered system of permits rapidly became unwieldy for EPA because each individual permit had to be reevaluated and reissued every five years. For this and other reasons, a new General Permit was developed (SAIC 2000). The new general permit became effective on December 1, 2004.

The Marine Plastic Pollution Research and Control Act

Originally enacted as the Act to Prevent Pollution from Ships, it prohibited any discharge of oil from a ship within 12 nautical miles of land, unless it did not exceed 15 ppm or the ship has oil-water separating equipment. The act was amended in 1987 to prohibit the discharge of plastic, garbage, and floating dunnage within three nautical miles of land. Beyond three miles, garbage must be ground to less than one inch but discharge of plastic and floating dunnage is still restricted. This Act requires manned offshore platforms, drilling rigs, and support vessels operating under a Federal oil and gas lease to develop waste management plans and to post placards reflecting discharge limitations and restrictions on plastics and other forms of solid wastes. These requirements are enforced by the U.S. Coast Guard.

The Oil Pollution Act

The Oil Pollution Act of 1990 established a system of liability and compensation for damages caused by oil spills in U.S. navigable waters. It also required removal of spilled oil and established a national system of planning for and responding to oil spill incidents. The Act included provisions to provide funding for natural resource damage assessments and to establish an oil pollution research and development program.

The Secretary of Interior is responsible for spill prevention, oil-spill contingency plans, oil-spill containment and clean-up equipment, financial responsibility certification, and civil penalties for offshore facilities and associated pipelines in all Federal and State Waters. The U.S. Department of Transportation (Coast Guard) was designated as the lead agency for offshore oil spill response, which includes responsibility for coordination of federal responses to marine emergencies. The U.S. Coast Guard is also responsible for enforcing vessel compliance with the Act.

3.4.2.2 State and Local Laws and Policies

Lempert-Keene-Seastrand Oil Spill Prevention and Response Act

Under the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act, the California Department of Fish and Game became the State lead agency in spill response and created the Office of Oil Spill Prevention and Response (OSPR). The Act requires that persons causing a spill begin immediate cleanup, follow approved contingency plans, and fully mitigate impacts to wildlife. Under an Interagency Agreement with OSPR, the California Coastal Commission (CCC) operates an oil spill program and maintains an oil spill staff. Before and after a spill, CCC staff are involved in review and comment to both State (e.g., OSPR) and Federal (e.g., U.S. Coast Guard) agencies on contingency plans and regulations related to marine vessels, marine facilities and marine vessel routing.

California Harbors and Navigation Code

Discharges from vessels within territorial waters are regulated by the California Harbors and Navigation Code. One of its purposes is to prevent vessel discharges from adversely affecting the marine environment. Section 151 regulates oil discharges and imposes civil penalties and liability for cleanup costs when oil is intentionally or negligently deposited on the waters of the State of California.

California Ocean Plan

Since 1973, the California State Water Resources Control Board (SWRCB) and its nine Regional Water Quality Control Boards (RWQCBs) have been delegated the responsibility for administering permitted discharge into the coastal marine waters of California. The Porter-Cologne Water Quality Act provided a comprehensive water quality management system for the protection of California waters and regulated the discharge of oil into navigable waters by imposing civil penalties and damages for negligent or intentional oil spills. The State board prepares and adopts the California Ocean Plan (SWRCB 2001), which incorporates the State water quality standards that apply to all NPDES permits (Table 3.4.3). In April 1991, the SWQRCB and other State environmental agencies were incorporated into the California Environmental Protection Agency.

The standards identified in the California Ocean Plan are consistent with the limitations specified in the NPDES General Permit. This determination was made when the CCC (2001) concurred with the EPA’s consistency certification that the proposed activities are consistent with the enforceable policies of California’s Coastal Management Program which incorporates the Ocean Plan.

Central Coast Basin Plan

The Central Coast Region of the RWQCB has established a Water Quality Control Plan (Basin Plan) for the coastal waters that include the Tranquillon Ridge Field (RWQCB 1994). The standards of the RWQCB incorporate the applicable portions of the ocean plan and are more specific to the beneficial uses of marine waters adjacent to the project site. These water quality objectives and toxic material limitations are designed to protect the beneficial uses of ocean waters within specific drainage basins. The Basin Plan identifies the following existing beneficial uses for the coastal waters contained within the project area (RWQCB 1994).

Water Contact Recreation (REC-1): Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing and fishing.

Non-Contact Water Recreation (REC-2): Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.

Table 3.4.3 California Ocean Plan Water Quality Standards

A. Bacterial Characteristics

1. Water-Contact Standards

Within a zone bounded by the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline and in areas outside this zone used for water contact sports, as determined by the Regional Board, but including all kelp beds, the following bacterial objectives shall be maintained throughout the water column:

a. Samples of water from each sampling station shall have a density of total coliform organisms less than 1,000 per 100 ml (10 per ml); provided that not more than 20 % of the samples at any sampling station, in any 30-day period, may exceed 1,000 per 100 ml (10 ml) and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 ml (100 ml).

b. The fecal coliform density based on a minimum of not less than five samples for any 30-day period, shall not exceed a geometric mean of 200 per 100 ml nor shall more than 10 % of the total samples during any 60-day period exceed 400 per ml.

The “Initial Dilution Zone” of wastewater outfalls shall be excluded from designation as “kelp beds” for purposes of bacterial standards and Regional Boards should recommend extension of such exclusion zone where warranted to the State Board (for consideration under Chapter VI.F.) Adventitious assemblages of kelp plants on waste discharge structures (e.g., outfall pipes and diffusers) do not constitute kelp beds for purposed of bacterial standards.

2. Shellfish Harvesting Standards

At all areas where shellfish may be harvested for human consumption, as determined by the Regional Board, the following bacterial objectives shall be maintained throughout the water column:

The median total coliform density shall not exceed 70 per 100 ml and not more than 10 % of the samples shall exceed 230 per 100 ml.

B. Bacterial Assessment and Remedial Action Requirements

Describes guidelines for monitoring enterococcus bacteria. (See Plan for full description).

C. Physical Characteristics

1. Floating particulates and grease and oil shall not be visible.
2. The discharge of the waste shall not cause aesthetically undesirable discoloration of the ocean surface.
3. Natural light shall not be significantly reduced at any point outside the initial dilution zone as a result of the discharge of waste.
4. The rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded.

D. Chemical Characteristics

1. The dissolved oxygen concentration shall not at any time be depressed more than 10 % from which occurs naturally, as a result of the discharge of oxygen demanding waste materials.
2. The pH shall not be changed at any time more than 0.2 units from that which occurs naturally.
3. The dissolved sulfide concentration of waters in and near sediments shall not be significantly increased above that present under natural conditions.
4. The concentration of substances set forth in Chapter IV, Table B in marine sediments shall not be increased to levels which would degrade indigenous biota.
5. The concentration of organic materials in marine sediments shall not be increased to levels which would degrade marine life.
6. Nutrient materials shall not cause objectionable aquatic growths or degrade indigenous biota.

E. Biological Characteristics

1. Marine communities, including vertebrate, invertebrate and plant species, shall not be degraded.
2. The natural taste, odor and color of fish, shellfish, or other marine resources used for human consumption shall not be altered.
3. The concentration of organic materials in fish, shellfish or other marine resources used for human consumption shall not be bioaccumulated to levels that are harmful to human health.

F. Radioactivity

1. Discharge of radioactive waste shall not degrade marine life.

Industrial Service Supply (IND): Uses of water for industrial activities that do not depend primarily on water quality including, mining cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

Navigation (NAV): Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels. The RWQCB interprets NAV as any natural body of water that has sufficient capacity to float watercraft for the purposes of commerce, trade, transportation, and pleasure.

Marine Habitat (MAR): Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife such as marine mammals and shorebirds.

Shellfish Harvesting (SHELL): Uses of water that support habitats suitable for the collection of filter-feeding shellfish such as clams, oysters, and mussels, for human consumption, commercial, or sport purposes. This includes waters that have in the past, or may in the future, contain significant shell fisheries.

Ocean Commercial and Sport Fishing (COMM): Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including uses involving organisms intended for human consumption or bait purposes.

Wildlife Habitat (WILD): Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

The Basin Plan states that, in addition to the provisions of the Ocean Plan, the following objectives shall also apply to all ocean waters:

- The mean annual dissolved oxygen concentration shall not be less than 7.0 mg/L, nor shall the minimum dissolved oxygen concentration be reduced below 5.0 mg/L at any time;
- The pH value shall not be depressed below 7.0, nor raised above 8.5; and
- Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life; or result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal, or aquatic life.

The State Water Resources Control Board sets statewide policies and develops regulations for the implementation of water quality control programs mandated by State and Federal water quality statutes and regulations. The RWQCB develop and implement Basin Plans that consider regional beneficial uses, water quality objectives, and water quality problems.

Activities which may result in the discharge of pollutants into waters of the nation require a Clean Water Act Section 401 Water Quality Certification from the RWQCB verifying that the activity complies with the states water quality standards. Discharges to surface waters from the project would have to be approved by the RWQCB. The proposed project does not involve any planned discharges to surface waters and, therefore, would not require a waste discharge permit. However, a stormwater pollution prevention plan (SWPPP) would be required by the RWQCB for any project-related construction activities with a development footprint equal to or greater than one acre. The LOGP is covered by an existing industrial SWPPP. Significant changes to LOGP facilities would require a new SWPPP.

The California Coastal Act also addresses several issues that relate to surface waters. Specific sections of the Act, addressing flood hazards and disturbances, maintenance of biological productivity, and possible impacts from runoff, are applicable to the proposed projects.

The proposed projects may also be subject to California Department of Fish and Game (DFG) Streambed Alteration Agreement(s) (Section 1601 of the DFG Code).

Onshore re-injection of produced waters requires approval from the Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) under provisions of the Public Resources Code and a permit reviewed by RWQCB.

Regulations covering oil spills are discussed in Section 3.2, Oil Spill Analysis.

3.4.3 Significance Criteria

3.4.3.1 Offshore

This section describes criteria for evaluating the significance of project-related activities or incidents that may result in impacts on marine water and sediment quality. A project activity would be deemed to have a significant impact if it leads to violation of water quality standards or waste discharge requirements. However, most marine water-quality standards apply to continuous point-source discharges, namely ocean outfalls. Because project-related marine water quality impacts are likely to differ from those of typical ocean discharges, evaluation of their significance must also consider their persistence, extent, and amplitude. Namely, significant marine impacts are:

- Persistent and not reversed by natural dispersive processes within a few days;
- Extend beyond the project area;
- Cause physicochemical changes that impact the marine ecosystem; or
- Are measurably different from ambient background conditions.

Impacts that are adverse but not significant, are limited to those that cause no more than short-term changes over small areas, or are indistinguishable from natural variation in the marine environment.

If the intentional release of produced water or drill muds does not conform to the requirements of an NPDES discharge permit or other common water-quality standards and guidelines, then it is assumed that it could have a significant water-quality impact. However, standards applied in a particular permit may be outdated and a discharge may be causing previously unrecognized water-quality impacts. Moreover, interpretation of unacceptable changes in seawater properties promulgated in existing guidelines, regulations, standards, and discharge requirements often requires some judgement. In these cases and in non-point-source cases, such as accidental spills, marine water quality impacts would be considered significant if they exceed either of the following threshold criteria.

1. Project-related activities cause significant impacts if they result in changes to marine water or sediment quality that exceed established standards beyond a region immediately adjacent to proposed project. The region of allowed impact is assumed to extend a lateral distance equal to the local water depth or within a defined zone of initial dilution for a particular discharge, such as the 100-m zone around Platform Irene.

2. Projected-related changes in water properties are also considered significant if they are large compared to natural background variability in the surrounding marine environment, last more than two days, or cause permanent deleterious effects in marine organisms.

Allowing the region of impact to extend to a lateral distance equal to the water depth derives from the concept of a “zone-of-initial dilution” that is applied to point-source discharges. Within this zone, turbulent mixing processes are thought to drive an initial rapid dispersion of contaminants. Within this mixing zone, exceptions to the water-quality limitations are allowed to occur while contaminants are being dispersed. “Large” project-related anomalies beyond this zone can be evaluated from a statistical hypothesis test that compares the amplitude of the water-property anomaly with 95% confidence levels about mean conditions measured within any given season. This approach has been successfully used to identify discharge-related anomalies along the central coast (MRS 2006) and the 95% confidence level is consistent with the Ocean Plan’s definition of “significant” differences (SWRCB 2001). The two-day criterion for significance was based on analyses of mesoscale flow variability where longer-term changes would influence multiple coastal-flow features and thus have wider-spread impacts. The last consideration is also the subject of Section 3.5, Biological Resources. Water-quality impacts that impinge on marine sanctuaries or sensitive habitats would also be considered significant.

Thresholds for significant aesthetic impacts on marine water quality are set by Ocean-Plan prohibitions on visual observations of oil sheens or floating debris on the sea surface (See Table 3.4.2). Also, the Ocean Plan relates significant marine-water-quality impacts to a degradation in the composition of resident marine communities; namely resulting from contamination levels leading to chronic or acute toxic effects. This is reflected in the water quality objective of maintaining all surface waters free of contaminants in concentrations toxic to aquatic life as stated in the Water Quality Control Plan (RWQCB 1994). Except for chromium and nickel, which are naturally elevated in ambient sediments, the toxicity of drill muds deposited on the seafloor can be evaluated by comparing contaminant concentrations with the effects levels listed in Table 3.4.1. Significant impacts would be expected if concentrations exceeded the ERM guideline for any compound that had well-established toxicity benchmarks.

3.4.3.2 Onshore

Significant impacts to onshore water resources would result from any of the following events or conditions:

- Violation of any water quality standards or waste discharge requirements;
- Substantial depletion of groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to

a level which would not support existing land uses or planned uses for which permits have been granted);

- Substantial alteration of the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water exceeding the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- Other substantial degradation of water quality;
- Location of facilities in flood-prone area or alterations to the course or flow of floodwater;
- Substantial flooding, erosion, or siltation; and/or
- Alteration of stream flow characteristics that result in erosion, sedimentation or flooding downstream.

3.4.4 Impact Discussion

3.4.4.1 Marine Water Quality Impacts

The primary impacts to marine water and sediment quality from the proposed Tranquillon Ridge Project arise from three sources. First, the Project would increase the potential for an accidental marine release of crude oil from the platform, the seafloor transmission line, or supply boats. Second, during directional drilling, the discharge of drilling fluid would increase particulate loads near Platform Irene. Finally, during production of the Tranquillon Ridge Field, produced water would be discharged into the marine environment near Platform Irene and accidental releases of produced water could occur along the transmission line as it transits the seafloor to the platform.

Impact #	Impact Description	Project/Phase
MWQ.1	Accidental discharge of petroleum hydrocarbons into marine waters would adversely affect marine water quality.	Increased Throughput Extension of Life

The proposed project would increase the likelihood of an accidental release of crude oil to the marine environment. From the analyses presented in Section 3.2, Oil Spill Analysis, the increased risk of an ocean oil spill arises because of an increase in the facility lifetime, an increase in crude-oil throughput, and an increase in the blowout potential if the new wells encounter a pressurized reservoir. The combined probability of oil leaks, ruptures, blowouts, and spills from Platform Irene and the offshore portion of the wet-oil transmission line would approximately double under the proposed project. In addition, the expanded new production would increase the concentration of crude in the oil emulsion transported to shore. Because of increased crude concentrations, offshore oil spills associated with a rupture of the transmission line would induce greater deleterious effects within marine waters. Finally, the frequency and duration of trips made by offshore support vessels would increase substantially under the proposed project. The increased vessel traffic would increase the risk of a vessel accident and an attendant spill although its volume would be limited compared to other oil-spill scenarios.

The proposed project would substantially increase the risk of an oil spill beyond current baseline conditions. In accordance with the significance criteria, impacts to marine water quality from a large crude-oil spill (>100 bbls) must be considered potentially significant. A large spill, such as the spill in 1997, would meet all of the threshold criteria for a significant water-quality impact. Namely, it introduced hydrocarbon contaminants that were persistent, extended well beyond the project area, impacted the marine ecosystem, and measurably departed from background concentrations. Spilled oil produces several impacts to marine water quality that are explicitly addressed in the California Ocean Plan (SWRCB 2001). Surface slicks limit equilibrium exchange of gases at the ocean-atmosphere interface. This reduces near-surface oxygen concentrations, particularly with the increased biochemical oxygen demand of crude-oil emulsions. As the seawater-oil emulsion mixes into the water column, turbidity would increase and toxic hydrocarbons would be released into the water column and seafloor sediments. Weathering can widely disperse tar balls, which may eventually be ingested by pelagic and benthic biota with adverse effects. Although a surface slick can disperse within a few hours of a spill in harsh sea states, lingering effects could persist for much longer periods. For example, it took approximately two years for mussel tissue burdens of aromatic hydrocarbons to return to background levels after the Exxon Valdez Oil Spill (Boehm et al. 1995). Although this spill was much larger than that projected for the Tranquillon Ridge Project, monitoring results indicate the potential for long-term effects. Because there is an increased likelihood of a large oil spill as a result of the proposed project, and because such a spill would result in tangible damage to marine water quality, in excess of levels identified in regulatory criteria, accidental discharges of petroleum hydrocarbons into marine waters are considered a significant adverse impact.

An oil-spill trajectory analysis for Platform Irene and its pipelines is presented in Section 3.2, Oil Spill Analysis. Ocean impact areas were found to be similar for spills from Platform Irene and from the oil-emulsion pipeline. Oil spills were far more likely to travel due south from the site of the spill. Spills could potentially extend substantial distances and impact ocean areas south of the Channel Islands. There is a tangible probability that they would impact the Channel Islands Marine Sanctuary. To the north, only open-ocean areas south of Point Sal were likely to be impacted by oil spills resulting from the proposed project. However, uncertainty concerning the influence of wind drift on spilled oil, limitations in the model, and the prevailing northward surface current flow, suggest that oil spilled within the project area could also impact coastlines to the north.

Mitigation Measures

Mitigation Measure MB-1 requires an update to the Oil Spill Response Plan and serves to ameliorate marine water quality impacts should a spill occur. The following mitigation would help reduce the likelihood of an oil spill similar to the one that occurred in 1997. This measure would also serve to mitigate oil spill impacts to marine biology and commercial and recreational fishing.

MWQ-1 Offshore inspections of the wet-oil pipeline shall continue to be conducted on a regular basis as determined by the County and/or other regulatory agency throughout the extended life of the project. Inspections shall use the best available technology to identify unsupported spans and deteriorating or inadequate welds. When structural anomalies or unsupported spans are identified that compromise the integrity of the pipeline as determined by the County and/or other regulatory agency, flow through the *pipeline shall cease until repairs can be effected, spans can be supported, or problematic pipeline components can be replaced. If the leak detection system causes an unexplained shutdown of flow through the offshore pipeline, flow shall remain shutdown until the entire length of pipe is inspected. The applicant shall submit annual inspection reports fro verification. These requirements shall be referenced in the project's Safety, Inspection, Maintenance, and Quality Assurance Program (SIMQAP).*

Marine water-quality impacts associated with accidental oil spills are categorized as significant because the proposed mitigation measures would not be completely effective in reducing the significant risk of a spill, nor would they adequately eliminate the significant effect of a spill on marine water quality. A large spill (>100 bbls) would violate many of the water quality standards. It would generate visible surface sheens, significant reductions in the penetration of natural light, reductions in dissolved oxygen, degradation of indigenous biota, and hydrocarbon contamination within the water column and marine sediments. The duration and area of the impact would be largely dictated by the size of the spill. Impacts would last from days to weeks and extend for tens of kilometers.

Mitigation of water-quality impacts from a major marine oil spill (> 100 bbls) is largely a function of the efficacy of the spill-response measures. The effectiveness of spill cleanup measures is dependent on the response time, availability and type of equipment, size of the spill, and the weather and sea state during the spill. Only some of these aspects are within the control of the spill-response team. In addition, many oil spill response measures have impacts of their own. Appendix E of the 2002 FEIR and 2006 DEIR provides additional information on the impacts associated with various oil spill response measures (SBC 2002, SBC 2006).

Under the regulatory-based significance criteria, even small oil spills could be considered potentially significant. Many regulations and guidelines establish limits based on the presence of a visible sheen on the ocean surface. This criterion is reflected in the static sheen test for free oil identified in the NPDES General Permit (EPA 2000b), USCG regulations, and the aesthetic criterion C.1 in the Ocean Plan Standards (See Table 3.4.2). Adverse aesthetic impacts from a visible sheen would occur upon discharge of a very small amount of free-phase hydrocarbons into calm marine waters. Because sheens are so thin, as little as 0.5 ounces of oil can form a rainbow sheen covering 500 ft^2 of calm ocean surface area (Taft et al. 1995).

Impact #	Impact Description	Project/Phase
MWQ.2	Reduced marine water and sediment quality would result from increased oceanic discharge of drilling fluids.	Drilling

Under the proposed project, drilling muds and cuttings would either be discharged to the ocean at Platform Irene or reinjected. The increased discharge of drilling muds, cuttings, and completion fluids would negatively impact seawater and sediment quality. Marine impacts arise because unmitigated discharge of used drilling fluids can harm marine organisms, reduce aesthetic benefits, and disrupt the benthic habitat. However, the magnitude and spatial extent of these impacts would be largely ameliorated in the proposed project through the NPDES Permit requirements.

For example, the toxicity of discharged muds is regulated by limiting muds additives to those predetermined to have low toxicities. Also, muds bioassays are periodically conducted prior to discharge as part of the NPDES monitoring program. Marine impacts are further limited by shunting the drilling fluids so that they discharge well below the sea surface. Platform Irene's muds-discharge pipe extends 150 feet below the sea surface.

Shunted discharge avoids large increases in near-surface turbidity that are caused by the introduction of suspended drilling particulates in the upper water column. Shallow turbidity increases impact primary productivity (phytoplankton growth), which depends on the penetration of ambient light within the photic zone. Because of this, avoiding reductions in ambient light is listed as Water-Quality Standard C.3 in the California Ocean Plan (see Table 3.4.2). Mitigating the occurrence of shallow turbidity plumes also conforms to aesthetic water-quality standards relating to floating particulates (Standard C.1) and visible discoloration (Standard C.2).

Deep discharge also limits the seafloor area impacted by the muds deposition. Avoiding degradation in the benthic community is designated as Water-Quality Standard C.4 in Table 3.4.2. The area of a depositional footprint is largely dictated by the amount of the time that drilling particulates remain suspended. Thus, rapid deposition from a discharge close to the seafloor may avoid impacts to sensitive benthic communities that reside on distant hard substrate features. However, discharges shunted too close to the seafloor would increase localized impacts to benthic organisms that reside immediately below the platform. Consequently, an intermediate shunt depth is optimal. The shunt depth on Platform Irene is 92 feet above the seafloor (150 feet below sea surface).

The seafloor area affected by the deposition of drilling particulates can be determined from modeling. The discharge of drilling fluids produces two distinct plumes within the water column. A dense plume that contains over 90% of the discharged cuttings descends rapidly to the seafloor in a convective jet. Large particles within this plume that are not immediately deposited on the seafloor below the platform are carried short distances away by prevailing currents. The depositional pattern of these heavy particulates depends largely on water depth, discharge (shunt), current speed, and the muds density. A second plume consisting of lightweight flocs of drilling muds particles also forms upon discharge. This plume remains suspended in the water column and can impact distant benthic communities (Hyland et al. 1994).

Appendix D of the 2002 FEIR and the 2006 DEIR (SBC 2002, SBC 2006) present site-specific modeling of drill-muds dispersion that was conducted as part of that environmental assessment. Results indicate that the deposition of drilling flocs far from Platform Irene would be negligible. Because of the along-shore alignment of prevailing currents, tangible deposition would not occur in State waters or in the Channel Islands Marine Sanctuary (SBC 2002).

Because most of the drill-muds flocs would settle to the seafloor within two days, impacts to marine water quality would be temporary and below the Threshold Criterion two, and as such are considered to be adverse but not significant. Deposition on the seafloor would increase trace-metal concentrations in marine sediments. However, the contribution would be small compared to natural sources and major constituents, such as barium, are relatively inert. Consequently, chemical toxicity from trace-metal accumulations resulting from the muds discharge would pose little threat to benthic organisms.

Mitigation Measures
No additional mitigation is required beyond the requirements imposed by the NPDES discharge permit.

Ocean discharge of drilling fluids as part of the proposed project would not result in significantly increased marine impacts. Provisions contained in the NPDES discharge permit limit the use of toxic additives and require bioassay monitoring. Fluids would be discharged at mid-depth and disperse rapidly within the energetic flow field. Shunting would reduce turbidity impacts to the photic zone near the sea surface and diminish benthic impacts resulting from the deposition of muds and cuttings on the seafloor. The majority of marine water- and sediment-quality impacts would be limited to an area of much less than 100 m around Platform Irene. Therefore, marine water and sediment quality impacts from project-related discharges of drilling fluids are adverse but not significant.

Impact #	Impact Description	Project/Phase
MWQ.3	Reduced marine water quality would result from the oceanic discharge of produced water.	New Operations

An additional 40,000 bpd of treated produced water could be discharged 55 m below the sea surface at Platform Irene as part of the proposed project (in addition to produced water discharges resulting from Platform Irene Point Pedernales Field development). The applicant is authorized to discharge to the ocean from the platform in accordance with the General NPDES Permit. A part of the produced water that would be shipped to Platform Irene may still be injected into Point Pedernales reservoir wells, as is currently the operation, to enhance current Point Pedernales production. Offshore water injection would be conducted as authorized by the MMS. Ocean discharge would locally alter the physical properties of the receiving seawaters and introduce contaminants. Produced water is warmer and lower in dissolved-oxygen concentration than the receiving water. However, upon discharge, the produced water would have reached a temperature close to ambient seawater after transit along the subsea pipeline from the onshore treatment facility. The produced water plume discharged from Platform Irene would be nearly neutrally buoyant because its salinity and temperature would both be close to that of ambient seawater. In addition, the concentrations of some trace metals are higher in produced water and radioactivity may be elevated although not to the levels observed in the Gulf of Mexico.

However, contaminant levels would be reduced by onshore treatment and rapid initial dilution would further minimize water quality impacts. If produced-water contaminants are restricted to levels comparable to those specified for the new general discharge permit, then there would be a low reasonable potential to exceed Federal receiving-water criteria (SAIC, 2000). Produced water discharges would be diluted by at least 10-fold within 10 m and more than 50-fold beyond 100 m (Brandsma, 2001). Because produced water dilutes rapidly, it is unlikely that its discharge would cause contaminant concentrations to measurably exceed ambient levels over areas that exceed the Threshold Criterion 1. Therefore, with implementation of NPDES permit requirements this impact is considered to be significant but mitigable.

A detailed quantitative assessment of potential impacts from produced-water discharges on federally managed fish species from fifteen California OCS Platforms, including Platform Irene, has been conducted (MRS 2005). Although maximum contaminant concentrations beyond the

100-m mixing zone are usually well within NPDES permit limits, the study focused on the toxicity and bioaccumulation potential of produced-water discharges to the fish populations that reside within the 100-m mixing zone beneath the platforms. These fish populations consist mostly of rockfish that utilize the platform as habitat, rarely venturing far from the protection of the structure. Consequently, contaminant concentrations at locations 100-m from the platform have little bearing on the potential impacts experienced by these fish. The quantitative exposure assessment found only one produced-water constituent, undissociated sulfide, that had the potential to impact federally managed fish species along the Pacific OCS.

There are several reasons for this general absence of impacts from the other 26 produced-water constituents that were examined in the study. Many of the produced-water constituents that are normally of concern for the protection of marine organisms were below biological effects levels prior to discharge. The occurrence of markedly high contaminant concentrations within produced-water samples was relatively rare and probably caused by erroneous laboratory results arising from matrix interference. Most of the measurements were below the detection limit, and rigorous statistical analyses using censored-data analysis techniques indicated that nominal concentrations, indicative of continuous chronic exposure levels, were low compared to biological effects concentrations for nearly all constituents. The same was true of upper-bound concentrations, which were low compared to acute exposure levels in marine finfish. These analyses were conducted on end-of-pipe concentrations without considering the rapid dilution that occurs within the produced-water plume shortly after discharge.

Five constituents had end-of-pipe concentrations that were elevated in produced water compared to thresholds of potential effects in finfish. However, high-resolution modeling demonstrated that produced-water discharges achieve high dilution almost immediately upon discharge. Contaminant concentrations were well below effects thresholds within 8 m of the discharge point and would impact only a small fraction of the receiving-water habitat. It is highly unlikely that a finfish would encounter these areas often enough, or for long enough, to elicit a lethal or sublethal response.

In contrast to the other produced-water constituents, the quantitative screening assessment could not rule out the possibility of potential chronic effects on federally managed finfish due to exposure to undissociated sulfide in produced water. However, the likelihood of an actual substantive adverse impact on federally managed finfish was thought to be minimal because the quantitative assessment was unduly conservative in its evaluation of finfish exposure to sulfide, especially with regard to Platform Irene. In particular, the screening study included:

1) An unrealistically low effects threshold for sulfide;
2) A low predicted dilution rate for the original conceptual design of a produced-water diffuser on Platform Irene;
3) High variability among sulfide concentrations initially measured in produced-water samples;
4) Contaminant concentrations in historical produced-water samples from Platform Irene that did not reflect potential benefits from future enhanced treatment;
5) No consideration of physicochemical degradation in sulfide introduced into oxygenated seawater; and

6) No consideration of potential finfish avoidance arising from the sulfide astringency.

Currently, produced-water discharges from all the California OCS platforms are being evaluated as part of the reasonable-potential phase of the General Permit. As part of this analysis, contaminant concentrations measured in produced-water samples from individual platforms are being evaluated for their potential to exceed receiving-water limitations at the edge of the 100-m mixing zone. A number of the limitations in Platform Irene's sulfide analysis are being resolved as part of the reasonable-potential analysis. This includes consideration of enhanced dilution resulting from a new diffuser design and a more realistic threshold for sulfide effects.

Depending on the outcome of the reasonable-potential analysis, produced water from Platform Irene could be treated to reduce contaminant concentrations prior to discharge. Produced water is not currently discharged from Platform Irene, and, because it is normally re-injected, it receives little or no additional treatment to reduce contaminant concentrations. Before discharge on a regular basis, its quality could be significantly improved by extensive treatment within upgraded treatment facilities both on the platform and within an onshore treatment facility. Upgrades to the onshore treatment facilities have been approved but have yet to be installed. Consequently, the sulfide concentrations historically measured in the Platform-Irene samples are not representative of future marine discharges. Also, because there are only a few sulfide measurements overall, the elevated Platform-Irene samples are highly influential in the determination of the median and 95th-percentile concentrations. Both are much higher than would be characteristic of future produced-water discharges.

Insofar as limitations in the sulfide effects threshold, an extensive series of bioassay analyses recently established a revised criterion for undissociated sulfide that is applicable to marine organisms near Platform Irene (Weston Solutions Inc. and MRS 2006). The threshold was six-times higher than the EPA National Standard that is currently promulgated in the General Permit.

The original criterion was developed using an extremely limited number of dated bioassay studies, conducted primarily on freshwater organisms, or on organisms exposed to sulfides in a complex chemical mixture. Because sulfide toxicity is closely related to the physicochemical properties of water, particularly pH and salinity, the freshwater data can greatly overestimate toxicity.

Thus, even without additional treatment of produced-water, potential impacts to finfish within the 100-m mixing zone around Platform Irene are not likely to be significant. The indeterminacy in potential sulfide impacts that was identified in the original screening study can be largely eliminated through consideration of the increased dilution rate achieved by a redesigned diffuser, and consideration of the higher effects threshold for finfish. With a dilution rate comparable to most other California OCS platforms, the computed contaminant concentrations will be well below the sulfide effects threshold within approximately 8 m of the discharge point and would impact only a small fraction of the receiving-water habitat around Platform Irene. It is highly unlikely that finfish would encounter this limited area on a regular basis, especially considering that they exhibit a strong avoidance reaction to sulfide (EPA 1976, 1986).

Except for zinc and barium, there is little indication that metals accumulate in bottom sediments around produced-water discharges. Barium concentrations in produced water are more than

1000-times higher than in seawater. However, when produced water mixes with sulfate-rich seawater much of the dissolved barium precipitates as barite. The solubility of barium sulfate is below the toxic effects threshold for marine organisms (SAIC 2000). Similarly, sediment zinc concentrations comparable to the 76 mg/Kg measured near Platform Hidalgo (Steinhauer et al. 1994) are lower than the lowest zinc toxic-effect level for marine organisms (TEL of 124 mg/Kg in Table 3.4.1).

Mitigation Measures

In addition to implementation of NPDES permit requirements, Mitigation Measure MB-3 would also apply to this impact.

Marine water and sediment quality impacts from the discharge of produced water would be localized and of limited magnitude.

Impact #	Impact Description	Project/Phase
MWQ.4	Reduced marine water quality would result from additional discharges of sanitary wastes, desalinization brine, and other materials from Platform Irene.	Drilling Extension of Life

The expanded offshore activities associated with the proposed project would increase the volume of other wastes discharged from Platform Irene. PXP estimates that annual muds and cuttings disposal volumes for the period of 2008 through 2010 will be 48,700 bbls/yr and 5,700 bbls/yr, respectively; well below the specified NPDES permit limits in Table 3.4.2. Impacts from the ocean discharge of materials related to field development and production, namely, drilling fluid and produced water, were addressed in Impacts MWQ.2 and MWQ.3. Other wastes include platform deck drainage, sanitary wastes, desalinization brine, fire-control system water, and antifoulants and trace metals leaching from the drilling rig and support vessels. Platform deck drainage water can contain contaminants, such as trace metals, petroleum hydrocarbons, and other toxic substances and particulates. The discharge of sanitary wastes, if inadequately disinfected, can degrade marine water quality by introducing pathogens. Tributyltin and other antifouling agents in paints on the bottom of support vessels can leach into seawater with deleterious effects. Similarly, sacrificial anodes on vessel hulls and the platform jacket dissolve continuously and release copper and zinc. The proposed project would increase the discharge of desalinization brine resulting from increased freshwater production. Finally, fire-control systems are regularly tested during fire drills aboard platform service vessels and Platform Irene, itself. Although they commonly use seawater, contaminants that have accumulated on the decks can be washed overboard during the drills.

Impacts to marine water quality resulting from these discharges are likely to be transient and localized. Moreover, the additional discharge due to expanded platform operations from the proposed project represents only a small incremental increase relative to current conditions. The NPDES General Permit addresses the following miscellaneous discharges: deck drainage, domestic and sanitary waste, blowout preventer fluid, desalination unit discharge, fire control system water, non-contact cooling water, ballast and storage displacement water, bilge water, boiler blowdown, test fluids, diatomaceous earth filter media, bulk transfer material overflow, uncontaminated water, water flooding discharges, laboratory waste, excess cement slurry, hydrotest water, and H_2S gas processing waste water.

Presently, the discharge of most of these wastes is controlled. For example, the platform drainage system limits the release major contaminants by processing the discharge through oil-water separators and other treatment processes. In addition, overboard deck discharges are monitored visually for free oil and grease. Sanitary wastes are biodegraded and disinfected prior to discharge. The expected increased output of desalinization brine, and sanitary and domestic waste would be proportional to the small incremental increase in personnel on the platform that results from the proposed project. The minute amount of antifoulants and trace metals released into the marine environment as a result of the project activities is not expected to generate concentrations toxic to marine organisms in the open-ocean waters near Platform Irene (CSA 1995). As such the impact is considered to be adverse, but not significant.

Mitigation Measures
No mitigation measures beyond the restrictions currently imposed on the offshore facility are required.

Because the increased water quality impacts from additional discharges under the proposed project are limited in magnitude, spatial extent, and duration, and are mitigated through NPDES permit requirements, they are found to be mitigable.

3.4.4.2 Onshore Water Resources Impacts

The following section discusses potential impacts to onshore water resources, mitigation measures (where appropriate), and residual impacts associated with the proposed project. Because the proposed project would use existing facilities (e.g., LOGP and pipelines), requirements for new facilities or equipment with potential for impacting onshore water resources are minimal. Impacts from the existing Point Pedernales facilities and operations are discussed in the 1985 Point Pedernales EIR/EIS (Arthur D. Little 1985). Impacts associated with the proposed project are related to changes in the present facilities or operating conditions, and are described below.

Impact #	Impact Description	Project/Phase
OWR.1	Project related construction could cause erosion or siltation resulting in substantial degradation of surface water quality.	Construction

The proposed project requires new construction activities related to the installation of pumps and associated equipment at Valve Site #2 and the installation of power poles and a substation to connect the pumps to the existing power along Ocean Avenue. These construction activities have the potential for disturbances to existing soil conditions, changes in surface water flow patterns, or surface water impoundment and increased siltation of drainages and the Santa Ynez River. Installation of power poles immediately adjacent to the Santa Ynez River could cause run-off into the river from excavated or disturbed areas or soil storage piles associated with pole installation.

Mitigation Measures
Mitigation Measure OWR-1 and GR-1 would reduce the magnitude of potential impacts to onshore water quality associated with disturbances to soils and vegetation. The currently

proposed construction footprint does not exceed one acre, and would not require acquisition of a construction storm water General Permit from the RWQCB.

OWR-1 Prepare a Stormwater Pollution Prevention Plan (SWPPP) that describes best management practices to be implemented for the purpose of minimizing soil loss and other construction-related sources of water pollution for any new construction associated with the project. The SWPPP shall be submitted for review and approval prior to construction.

With the implementation of the erosion and siltation mitigation measures, impacts are considered to be significant but mitigable.

Impact #	Impact Description	Project/Phase
OWR.2	A rupture or leak from the emulsion, produced water or dry oil pipelines could substantially degrade surface and groundwater quality.	Increased Throughput Extension of Life

A spill or large leak of crude oil or oil emulsion could allow either emulsion or dry oil to be released into the environment, which could substantially degrade surface and groundwater quality in nearby drainages and streams or rivers. Because the potential for spills already exists within the project area, the possible significance of a spill to onshore water resources associated with the proposed project is related to the incremental change in the size of the spill event. Small leaks or spills, which are contained and cleaned up quickly, may have minor or negligible impacts to onshore water resources. In contrast, large spills, or pipeline ruptures, which spread to surface waters and/or groundwater may substantially degrade water quality, with potential long-term impacts to beneficial uses and biological resources. Since the potential impacts to water resources associated with the baseline conditions are considered locally and regionally significant (Arthur D. Little 1985), an increase in spill size would increase the severity of an already significant impact. In addition, the proposed project increases the lifetime probability of leaks or spills.

Each of the oil emulsion, produced water, and gas pipelines from Platform Irene to LOGP has the potential to rupture or leak. Gas leaks would have negligible impacts to water resources because leaked materials would volatilize and, therefore, not directly affect surface or groundwater. In contrast, both produced water and oil emulsion spills could affect surface and groundwaters depending on the location and size of the spill. Although the proposed project would treat produced water to achieve compliance with offshore receiving water criteria, onshore spills still may contain some soluble hydrocarbons with the potential for affecting surface and/or groundwater quality. Under worst-case conditions, maximum estimated spill volumes of oil or oil/water emulsion would be lost from a pipeline rupture immediately adjacent to surface waters at a location with no containment basins to impede oil dispersion. Although some of the more toxic components of oil would be lost rapidly due to weathering (e.g., volatilization), spills reaching the Santa Ynez or Santa Maria Rivers could have significant, long-term and widespread impacts to water quality and, consequently, sensitive biological resources. Similarly, subsurface (i.e., underground) spills, or surface spills in areas with porous surface soils and a shallow aquifer, could result in significant, long-term contamination of groundwater.

Increased throughput of oil emulsion, produced water, and crude oil would increase the maximum potential spill volumes. Further, the oil content of the emulsion would increase from present levels of 10 to approximately 34%. Consequently, the total mass of oil released by an oil emulsion spill would be greater than under existing conditions.

The total volume of the emulsion pipeline between Platform Irene and the LOGP is 46,000 barrels. However, due to the onshore terrain (and pipeline path), and the series of existing check valves in the pipeline, only a portion of the total pipeline volume would be lost. The specific volume would depend on the time between leak occurrence and system shutdown and the pumping rate. Maximum possible spill volumes for different pipe segments are presented in Section 3.2, Oil Spill Analysis.

At Valve Site #2, the worst-case emulsion spill volume is 2,054 barrels. As mentioned previously, the probability of a rupture at this location would increase to 8.9% over the life of the project. (The probability of leaks from pumps would approach 100% due to potential failure of the new pumps, although leaks would not likely affect onshore water resources.) Surface water resources at this location would also be vulnerable for three reasons. Valve Site #2 does not have an adjacent catchment basin, the facility is within one kilometer directly upslope from the lower portion of the Santa Ynez River, and oil emulsion spilled at this location could flow directly along, and on top of, the road to the river without substantial impediment by local terrain or sorption by surface soils.

Oil from a surface spill would disperse and weather. Weathering would, in turn, affect the long-term persistence and toxicity of oil. The oil emulsion would have a lower viscosity than crude oil, which would increase the potential for transport in surface flows (e.g., runoff) or movement towards and with groundwaters. On the other hand, the soluble and more toxic components of crude oil (e.g., benzenes and other lower molecular weight aromatic compounds) would be lost more readily due to volatilization from an emulsion than from crude oil. Consequently, the toxicity of a potential spill may be reduced somewhat by natural weathering processes during dispersion. In contrast, insoluble oil fractions retained in low energy aquatic environments, due to burial in bottom sediments or trapped by aquatic vegetation, can affect water quality for periods up to several years. The possible dispersion and fate of a subsurface (underground) spill would be different and would depend in part on soil permeability and depth to groundwater. In most areas along the pipeline, the depth to groundwater is sufficiently great that an oil spill would not immediately contact groundwater. However, in some areas where the water table is shallow and soil is permeable, oil or produced water spills could affect groundwater.

In the event of a spill, containment facilities and cleanup procedures can reduce the potential impacts of the spill to onshore water resources. The success of the cleanup effort in preventing or minimizing impacts of the spill would depend on the volume and location of the spill, and the time needed to initiate the response action. A number of facilities, spill prevention methods, and response plans presently exist to minimize impacts from spills. These include: containment basins constructed along the pipeline route to retain and/or retard dispersion of spills; spill prevention and cleanup plans (SPCP) with regular preparedness reviews; monitoring, including regular pipe pigging to detect areas of significant corrosion within the pipeline; and automated flow monitoring and valving systems (e.g., SCADA) capable of detecting appreciable fluid losses from the pipeline and isolating specific pipeline sections in the event of spill to minimize spill volumes. The existing catchment basins along the onshore portion of the pipeline adjacent to the Santa Ynez River would be used to retain, and prevent dispersion, of the spill.

PXP has prepared an Oil Spill Response Plan which includes a Groundwater Protection Plan.

This plan calls for regular monitoring for leaks, subsurface investigation to assess the extent of contamination, and preparation of leak-specific remedial action plans (excavation and disposal, in-situ treatment, etc.). In the event that leaks reach the groundwater table, owners of wells that could potentially be affected will be notified, and remedial action plans developed. Since known existing irrigation and water supply wells in the down-gradient sensitive areas pump from below the water table surface, it is unlikely that water supply from these would be adversely affected.

Should this occur, however, the groundwater protection plan calls for backup water supplies, reconditioning the contaminated well, or installation of a new well.

The water pipeline has not experienced any leaks or failures to date. There are no anticipated changes to the corrosion control program, however, the frequency of the maintenance pigging may increase or decrease based on pipeline parameters. If, for example, the pipeline smart pigging demonstrates increased corrosion rates, then pigging would occur more frequently. A recent Smart Pig Survey (2005) showed evidence of corrosion. A section of pipe has been repaired and as a result of a confirmation dig for the identified anomalies, a monolithic isolation flange and pipe spool were replaced in 2005 at valve site #1. The internal corrosion survey conducted in 2005 using a high resolution pig showed 21 anomalies between 30 and 60 percent of wall thickness; the majority of anomalies (>99 percent) were between 10 and 29 percent of wall thickness.

Mitigation Measures

OWR-2 *Construct a berm around Valve Site #2 with sufficient capacity to retain 150% of the maximum spill volume associated with this portion of the onshore pipeline (see Section 3.2, Oil Spill Analysis).*

OWR-3 *The Applicant shall maintain a computerized SCADA system that shall continuously monitor the transfer of oil. SCADA will be used to remotely monitor the pipeline system for leaks and other abnormal operations. SCADA system shall be monitored at a facility that is manned 24 hours per day. SCADA Control System operators shall be specifically trained on how to respond and what procedures to follow in the event of system alarms and abnormal operations.*

The Applicant shall provide alarms if one of the following variances occurs: (1) the flow volume varies by 6% or more over a 15-minure period; or (2) the flow volume varies by 4.5% or more over a two-hour period. The SCADA system shall be set so that 10% and 15% deviations from the normal operating range (pressure and flow) sustained over a period of 5 seconds will trigger an alarm or an automatic shutdown respectively. Any automatic shut-down of the pipeline by the SCADA system shall require an immediate visual inspection of the pipeline. Should the SCADA system fail, the pipeline shall shutdown.

OWR-4 *Update the Oil Spill Contingency Plan and the Oil Spill Response Plan to address the SCADA system and GR.1 related requirements and conduct annual readiness exercises* *and audits to ensure that containment and cleanup equipment is readily available close to areas with greatest vulnerability to spills (e.g., along the lower sections of the Santa Ynez River).*

OWR-5 Ensure that catchment basins located along the Santa Ynez River section of the pipeline are cleaned and surveyed periodically to ensure that they are capable of holding at least 110% of the associated release volume from nearby pipeline segments. Include in the volume calculations 30 minutes of pumping time and the total pipeline emulsion fluids plus produced water fluids. Prior to land use clearance, PXP shall provide volume calculations for each of the catchment basins for the following leak scenarios: (1) 11 minutes of pumping time for a worst case leak in accordance with the MMS Oil Spill Response Plan, Volume 2, worst case scenario, and (2) 20 minutes of pumping time for a small leak as detected by the PXP leak detection system. The total pipeline emulsion fluids, including produced water, shall be included in the calculations. If it is determined that the volume of any of the catchment basins is insufficient to fully contain the leak scenarios analyzed, the catchment basins shall be expanded.

OWR-6 Implement a pipeline monitoring program for the water return pipeline to monitor for pipeline corrosion and erosion. The plan shall include annual smart-pig testing, corrosion inhibitor injection as appropriate and additional coupon and water testing similar to those conducted on the emulsion pipeline.

OWR-7 Continue the monitoring program for the oil emulsion pipeline to monitor for pipeline corrosion and erosion. The plan shall include annual smart-pig testing, corrosion inhibitor injection as appropriate and additional coupon and emulsion testing.

These mitigation measures, in combination with the mitigation measures listed in the Section 3.5, Biological Resources, and Section 3.8, Geological Resources, would reduce the severity of potential spill impacts to water resources.

Impact #	Impact Description	Project/Phase
OWR.3	Continued monitoring and pipeline maintenance and replacement activities associated with the onshore pipeline system could cause disturbances to soils that could cause erosion and subsequent siltation resulting in degradation of surface water quality.	Extension of Life

Extending the life of the facility would extend the risk of ground disturbances that could occur due to pipeline maintenance and repair activities. These ground disturbances could result in erosion, and siltation of nearby drainages and surface water bodies. These would be due primarily to the required excavation and replacement of pipeline segments. These activities are associated with the current operations. However, the extension of life of the facilities due to the Tranquillon Ridge Project would extend the potential for these types of disturbances. This issue is also discussed in Sections 3.5, Biological Resources, and 3.8, Geological Resources.

Mitigation Measures

Implementation of Mitigation Measure GR-1 would reduce potentials for causing significant erosion or siltation associated with excavation along the pipeline ROW, along with the following measure:

OWR-8 If soil excavation is needed to expose buried pipeline or cleanup a spill within a stream bed, the area should be regraded to the maximum extent feasible to pre-spill conditions after excavation is completed.

Impact #	Impact Description	Project/Phase
OWR.4	Remediation activities associated with a pipeline spill could increase erosion, and siltation and substantially degrade surface water quality.	Increased throughput Extension of Life

Remediation activities related to a release from the emulsion, produced water or dry oil pipelines would involve the mobilization of construction equipment, booms, might also involve the construction of berms, modification of drainage or steam/river terrain and the travel of construction equipment off road. These activities could result in erosion and siltation of nearby drainages and surface water bodies as well as permanent changes to drainage and stream/river bed characteristics, which could adversely impact surface water quality. These activities are associated with the current operations and are considered to be potentially significant. With the increased throughput associated with the Tranquillon Ridge Project, these significant impacts would increase in severity. In addition, the extension of life of the facilities due to the Tranquillon Ridge Project would extend the potential for these types of disturbances. This issue is also discussed in Sections 3.5, Biological Resources, and 3.8, Geological Resources.

Mitigation Measures

Implementation of Mitigation Measure GR-1 would reduce the potential for causing significant erosion or siltation associated with spill remediation activities along the pipeline ROW.

Impact #	Impact Description	Project/Phase
OWR.5	Increased water injection rates could potentially infiltrate fresh water aquifers.	Extension of Life

Increased throughput of crude oil could increase the volume of produced water disposal via onshore injection, which could infiltrate fresh water aquifers. Produced water would be separated from the crude oil at the LOGP and transported to Platform Irene and/or the onshore Lompoc Oil Field and injected into existing designated disposal wells. An increase in produced water could potentially exceed the safe capacity of each onshore injection well. This scenario could allow produced water to infiltrate fresh water aquifers, which would contaminate them with non-potable water.

To increase groundwater protection, the Safe Drinking Water Act (SDWA) of 1974 established a federal Underground Injection Control (UIC) program, which established minimum requirements for effective state UIC programs. Because ground water is a major source of drinking water in the United States, the UIC program requirements were designed to prevent contamination of

Underground Sources of Drinking Water (USDW) resulting from the operation of injection wells. A USDW is defined as an "aquifer or its portion which supplies any public water system, or contains less that 10,000 milligrams per liter total dissolved solids and is not an exempt aquifer" (Groundwater Protection Council).

In California, all Class II injection wells are regulated by the Department of Conservation, Division of Oil, Gas, and Geothermal Resources, under provisions of the state Public Resources Code and the federal Safe Drinking Water Act. Class II injection wells fall under the division's Underground Injection Control (UIC) program, which is monitored and audited by the U.S. Environmental Protection Agency. The division received EPA primary authority "primacy" for regulation of Class II wells in 1983. The main features of the UIC program include permitting, inspection, enforcement, mechanical integrity testing, plugging and abandonment oversight, data management, and public outreach. In California, Class II injection wells have an outstanding record for environmental protection. A peer review conducted by a national organization, the Ground Water Protection Council, found that the division has an excellent program that effectively protects underground sources of drinking water (Ground Water Protection Council, 2000). The CDOGGR is the state agency responsible for approving injection wells within the state of California. The CDOGGR imposes well construction, monitoring, testing, and operational requirements that make it unlikely that fresh water aquifers would be affected from the injection of produced water.

Mitigation Measures

No mitigation measures have been proposed because of existing regulatory oversight of injection wells.

Impact #	Impact Description	Project/Phase
OWR.6	LOGP's contribution to overdraft of the Lompoc groundwater basin would occur over a longer period.	Extension of Life

The proposed project would extend LOGP's contribution to the overdraft of the Lompoc groundwater basin over the longer life of the project. As mentioned in the environmental setting above, the groundwater basin is presently in a state of overdraft with net extractions exceeding recharge by 913 acre-feet per year in 2000. Continued operation of LOGP beyond its current permitted life would continue the consumption of an overused resource. However, their annual usage is comparable to a small office building according to their water supplier (MHCSD 2002), and represents only a small fraction of overall consumption and is less than SBC's threshold of significance for extractions from the Lompoc Basin. Therefore, the impact would be considered insignificant.

Mitigation Measures

No mitigation measures have been proposed.

3.4.5 Comparison of Impacts Between Proposed Project and 1985 Point Pedernales EIS/EIR

Impact No.	Project Phase	Tranquillion Ridge Project Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
MWQ.1	Increased Throughput Extension of Life	Accidental discharge of petroleum hydrocarbons into marine waters would adversely affect marine water quality.	Surface oil slicks, tar balls, contamination of sediment and other adverse water quality changes (lowering of dissolved oxygen, solubilization of potentially toxic chemicals, decrease in light transmittance) due to unlikely major oil spill.	Oil throughput of the 1985 EIR was 36,000 bpd of dry oil. The 2002 EIR throughputs are the same.
MWQ.2	Drilling	Reduced marine water and sediment quality would result from increased oceanic discharge of drilling fluids.	Increase in temperature, suspended solids, oil and grease, BOD, ammonia, and other inorganic and organic pollutants in the water column near each platform resulting from discharges of drill cuttings, drill muds, formation water, sanitary sewage, and other wastewaters.	
MWQ.3	New Operations	Reduced marine water quality would result from the oceanic discharge of produced water.	Increase in temperature, suspended solids, oil and grease, BOD, ammonia, and other inorganic and organic pollutants in the water column near each platform resulting from discharges of drill cuttings, drill muds, formation water, sanitary sewage, and other wastewaters.	
MWQ.4	Drilling Extension of LIfe	Reduced marine water quality would result from additional discharges of sanitary wastes, desalinization brine, and other materials from Platform Irene.	Increase in temperature, suspended solids, oil and grease, BOD, ammonia, and other inorganic and organic pollutants in the water column near each platform resulting from discharges of drill cuttings, drill muds, formation water, sanitary sewage, and other wastewaters.	
OWR.1	Construction	Project related construction could cause erosion or siltation resulting in substantial degradation of surface water	Increased erosion and sediment loading to streams because of removal of vegetation.	

Impact No.	Project Phase	Tranquillion Ridge Project Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
		quality.	Notching of stream banks during trenching of pipeline.	
OWR.2	Increased Throughput Extension of Life	A rupture or leak from the emulsion, produced water or dry oil pipelines could substantially degrade surface and groundwater quality	Degradation of groundwater quality because of likely dry oil spill, unlikely emulsion, or produced water spill. Degradation of surface water quality at Santa Ynez River mouth because of unlikely pipeline spill in flood plain.	Note 1985 is slightly more limited in scope for surface waters, applying to surface waters at the River mouth only. The 1985 EIR indicated that produced water would be discharged to the ocean. The 2002 EIR indicated that discharges could be to the ocean or reinjected into the reservoir.
OWR.3	Extension of Life	Continued monitoring and pipeline maintenance and replacement activities associated with the onshore pipeline system could cause disturbances to soils that could cause erosion and subsequent siltation resulting in degradation of surface water quality.	Increased erosion and sediment loading to streams because of removal of vegetation. Notching of stream banks during trenching of pipeline.	
OWR.4	Increased Throughput Extension of Life	Remediation activities associated with a pipeline spill could increase erosion, and siltation and substantially degrade surface water quality.	Degradation of surface water quality at Santa Ynez River mouth because of unlikely pipeline spill in flood plain.	Note 1985 is slightly more limited in scope for surface waters, applying to surface waters at the River mouth only.
OWR.5	Extension of Life	Increased water injection rates could potentially infiltrate fresh water aquifers.	Degradation of water quality from potentially contaminated discharge	1985 refers mainly to surface waters, runoff collection and treatment system discharges, not groundwater injections. 2002 refers to onshore injection only.

3.4.6 References

3.4.6.1 Marine Water Quality

ABC Labs. 1995. South San Luis Obispo County sanitation district receiving water monitoring report. September, 1995. 38 pp.

Amstutz, R.W. 1980. Deep Well Disposal: A Valuable Natural Resource. Chapter 17, pp 281-189. In: R.B. Pojasek, Editor, Toxic and Hazardous Waste Disposal. Volume 4, New and Promising Ultimate Disposal Options. Annharbor Science, Annharbor Michigan.

Arguello Inc. 2000. Rocky Point Unit Development Environmental Report. Submitted to: The Minerals Management Service, Pacific OCS Region. November 30, 2000.

Arthur D. Little, Inc. 1998a. Guadalupe Oil Field Remediation and Abandonment Project: Final Environmental Impact Report. Prepared for County of San Luis Obispo. March 1998.

—. 1998b. Unocal Avila Beach Cleanup Project, Environmental Impact Report/Statement, Final Report. Prepared for County of San Luis Obispo. SCH #95071094 February 1998.

Battelle Ocean Sciences (BOS). 1991. Phase 5 Final Report on National Status and Trends Mussel Watch Project: Collection of Bivalves and Surficial Sediments from Coastal U.S. Atlantic and Pacific Locations and Analyses for Organic Chemicals and Trace Elements. Contract Number 50-DGNC-0-00048. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Ocean Assessments Division, Rockville, Maryland. April 1, 1991. 127pp+appendices.

Boehm, P.D., D.S. Page, E.S. Gilfillan, W. A. Stubblefield, and E.J.Harner. 1995. Shoreline ecology program for Prince William Sound, Alaska, following the Exxon Valdez oil spill: Part 2 - Chemistry and Toxicology. In: Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters, ASTM STP 1219, P.G. Wells, J.N. Butler, and J.S. Hughes, Eds., American Society for Testing and Materials, Philadelphia.

Brandsma, M.G. 2001. Near-Field Produced Water Plume, Platform Irene. Prepared for: Arthur. D. Little, Inc. 3916 State Street #2A, Santa Barbara, CA 93105. A. D. Little Purchase Order: 21944700S. Prepared 18 July 2001. BRANDSMA ENGINEERING, 102 E. Eighth Street, Suite 203, Durango, Colorado 81301.

California Coastal Commission (CCC). 2001. Adopted Finding on Consistency Certification CC-126-00, EPA, General NPDES Permit, Offshore Oil Platforms. Date of revised findings 11/20/2001.

Coats, D. 1994. Deposition of drilling particulates off Point Conception, CA. Mar. Env. Rev. 37:95-127.

Colwell R. R., P. R. Brayton, D. J. Grimes, D. B. Roszak, S. A. Huq, and L. M. Palmer. 1985. Viable but Non-Culturable *Vibrio cholerae* and Related Pathogens in the Environment: Implications for Release of Genetically Engineered Microorganisms. Bio/Technology 3: 817-820.

Continental Shelf Associates, Inc. (CSA). 1985. Assessment of the Long-Term Fate and Effective Methods of Mitigation of California Outer Continental Shelf Platform Particulate Discharges. A final report for the U.S. Department of Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. Contract No. 14-12-0001-30056. 2 Volumes.

—. 1993. Draft Environmental Impact Report: SWEPI/UNOCAL Huntington Beach Upper Main Zone Cooperative Waterflood Project. Submitted to State Lands Commission January 1993.

—. 1995. Final Environmental Impact Report: Subsea Well Abandonment and Flowline Abandonment/Removal Program. Prepared for: State Lands Commission. June 1995.

County of Santa Barbara (SBC). 1997. Torch Oil Spill – The Response and Cleanup Effort. In: Offshore Oil and Gas Status Report. County of Santa Barbara Planning & Development, Energy Division. November, 1997.

—. 2001. Torch Point Pedernales Project Final Development Plan 94-DP-027. 1998-2000 Condition Effectiveness Review Revised Final Analysis. Prepared by Santa Barbara County Planning & Development Department, Energy Division. January 11 2001.

—. 2002. Final Environmental Impact Report Tranquillon Ridge Oil and Gas Development Project LOGP Produced Water Treatment System Project Sisquoc Pipeline Bi-Directional Flow Project. Prepared by Arthur D. Little Inc., Marine Research Specialists, and SAIC. June 2002.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon

Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

—.2004. Natural Seep Inventory and Identification for the County of Santa Barbara, California. Final Report. Prepared for the County of Santa Barbara by the U.S. Geological Survey, Western Coastal and Marine Geology Team, Menlo Park, CA. March 25 2004.

de Margerie, S. 1989. Modeling Drill Cutting Discharges. In: Englehart, F.R., Ray, J.P., and A.H. Gillam, eds. Drilling Wastes. Elsevier Applied Science, New York. pp. 627-646.

Fischer, H.B., E.J. List, R.C.Y. Koh, J. Imberger, and N.H. Brooks. 1979. Mixing In Inland and Coastal Waters. New York: Academic Press. 483 pp.

Grimes, D.J., R.W. Atwall, P.R. Brayton, L.M. Palmer, D.M. Rollins, D.B. Roszak, R.L. Singleton, M.L. Tamplin, and R.R. Colwell. 1986. The fate of enteric pathogenic bacteria in estuarine and marine environments. Microbiological Sciences 3(11):324-329.

Hornafius, S.J., d. Quigley, and B.P. Luyendyk. 1999. The world's most spectacular marine hydrocarbon seeps (Coal Oil Point, Santa Barbara Channel, California): Quantification of Emissions. Journal of Geophysical Research. v104: pp 20,703-20,711. September 15, 1999.

Hyland, J.L., J. Kennedy, J. Campbell, S. Williams, P. Boehm, A. Uhler, and W. Steinhauer. 1989. Environmental effects of the *Pac Baroness* oil and copper spill. In: Proceedings of the 1989 Oil Spill Conference, San Antonio, Texas; API, EPA, and USCG. pp. 413-419.

Hyland, J., D. Hardin, M. Steinhauer, D. Coats, R. Green, and J. Neff, 1994. Environmental Impact of Offshore Oil Development on the Outer Continental Shelf and Slope off Point Arguello, California, Marine Environmental Research. Vol. 37(1994): 195-229.

Kinnetic Laboratories, Inc. (KLI). 1996. Unocal Santa Maria Refinery NPDES Receiving Water Ocean Monitoring Program, 1995. Prepared for Unocal Corporation, Arroyo Grande, California. 31pp+appendices.

Long, E.R. and L.G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. 175 pp. U.S. Dept. of Commerce National Oceanographic and Atmospheric Administration (NOAA).

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Env. Management*. 19(1):81-97.

MacDonald, D.D. 1993. Development of an Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Prepared by MacDonald Environmental Sciences, Ltd. of Ladysmith, British Columbia for the Florida Department of Environmental Regulation, Tallahassee, Florida. Two volumes.

Marine Research Specialists (MRS). 1996. City of Morro Bay and Cayucos Sanitary District, Offshore Monitoring and Reporting Program, 1995 Annual Report. Prepared for the City of Morro Bay, Morro Bay, California. February, 1996. 173 pp.

—. 2000. Supplemental Environmental Report: Source of Metal Contamination within the Seafloor Sediments of Northern Estero Bay, October 2000. City of Morro Bay and Cayucos Sanitary District Offshore Monitoring and Reporting Program. December 2000.

—. 2005. The Effect of Produced-Water Discharges on Federally Managed Fish Species along the California Outer Continental Shelf. Submitted to: Western States Petroleum Association June 29, 2005.

—. 2006. City of Morro Bay and Cayucos Sanitary District, Offshore Monitoring and Reporting Program, 2005 Annual Report. Prepared for the City of Morro Bay, Morro Bay, California. February 2006.

Minerals Management Service (MMS). 2001. Delineation drilling activities in Federal Waters offshore Santa Barbara, CA, draft environmental impact statement. OCS EIS/EA MMS 2001-046. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

—. 2003. OCS Environmental Assessment (EA) Revisions to the Point Arguello Field Development and Production Plans to Include Development of the Eastern Half of Lease OCS-P 0451. Arguello Inc. June 19, 2003.

—. 2005a. Environmental Information Document for Post-Suspension Activities on the Nine Federal Undeveloped Units and Lease OCS-P 0409 Offshore Santa Barbara, Ventura, and San Luis Obispo Counties. Prepared for U.S. Department of Interior, Minerals Management Service, Pacific Outer Continental Shelf Region. Prepared by Aspen Environmental Group, January 2005.

—. 2005b. Environmental Assessment (Final) Minerals Management Service to Grant Suspensions of Production for Aera Energy LLC's, Lion Rock Unit, Purisima Point Unit, Point Sal Unit, and Santa Maria Unit. February 11, 2005. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

Morro Group, Inc. 2000. MFS Globenet Corp./WorldCom Network Services Fiber Optic Cable Project Final Environmental Impact Report. SCH No. 98091053. Volume I. Submitted to: County of San Luis Obispo Department of Planning and Building. Prepared in association with Arthur D. Little, Inc. and Marine Research Specialists. January 2000.

Neff, J.M. 1997. Potential for Bioaccumulation of Metals and Organic Chemicals from Produced Water Discharged Offshore in the Santa Barbara Channel, California: A Review. Report prepared for the Western States Petroleum Association, Santa Barbara, CA.

Panzer, D. 2000. Monitoring Wastewater Discharges From Offshore Oil And Gas Facilities In The Santa Barbara Channel And Santa Maria Basin. Proceedings of the Fifth California Islands Symposium. Sponsored by the Minerals Management Service at the Santa Barbara Museum of Natural History. OCS Study MMS 99-0038.

Pickens, M.K. 1992. The transport and Long-Term Fate of Drilling Muds Discharged in Marine Environments. Ph.D. Dissertation. University of California, Santa Barbara. September 1992.

Regional Water Quality Control Board (RWQCB) - Central Coast Region. 1994. Water Quality Control Plan (Basin Plan) Central Coast Region. Available from the RWQCB at 81 Higuera Street, Suite 200, San Luis Obispo, California. 148pp+appendicies.

—. 1999. Inactive Metal Mines in Four San Luis Obispo County Watersheds: Surface Water Quality Impacts and Remedial Options. Prepared by: D. Schwartzbart, D. Kukol, G. Hubner. June 1999.

Saenz, Joseph M. 2004. An Overview of the Geological Controls of Hydrocarbon Seeps in Santa Maria Basin, Offshore California. In: California and the World Ocean '02: Revisiting and Revising California's Ocean Agenda 2005. Pub. by the American Society of Civil Engineers. November 12, 2004.

Southern California Coastal Water Research Project (SCCWRP). 1994. Estimated Discharges from Offshore Oil Platforms in the Southern California Bight in 1990. In: Annual Report, 1992-93. Southern California Coastal Water Research Project Authority, Long Beach, CA. 166 pp.

Science Applications International Corporation (SAIC). 2000. Ocean Discharge Criteria Evaluation South and Central California for NPDES Permit No. CA 2800000. Submitted to U.S. Environmental Protection Agency Headquarters, Washington, D.C. and U.S. Environmental Protection Agency, Region 9, San Francisco, CA. EPA Contract No. 68-C4-0034, WA No. IM-5-30. January 3, 2000.

Schiff, K.C. and R.W. Gossett. 1998. Southern California Bight 1994 Pilot Project: III. Sediment chemistry. Southern California Coastal Water Research Project. Westminster, CA.

State Water Resources Control Board (SWRCB). 1988. California State Mussel Watch Ten Year Data Summary 1977 - 1987. May 1988. Water Quality Monitoring Report No. 87-3, Division of Water Quality. 313pp+appendices.

—. 2001. Water Quality Control Plan, Ocean Waters of California, California Ocean Plan. California Environmental Protection Agency. Effective December 3, 2001.

Steinhauer, W., E. Imamura, J. Roberts, J. Neff. 1992. History of Drilling Operations and Discharges in the Point Arguello Field, Offshore Southern California. Oil and Gas Journal, Vol. 90(18):20.

Steinhauer, M., E. Crecelius, and W. Steinhauer. 1994. Temporal and spatial changes in the concentrations of hydrocarbons and trace metals in the vicinity of an offshore production platform. *Mar. Environ. Res.* 37:129-163.

Taft, D.G., D.E. Egging, and H.A. Kuhn. 1995. Sheen Surveillance: An Environmental Monitoring Program Subsequent to the 1989 Exxon Valdez Shoreline Cleanup. In: Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters, ASTM STP 1219, P.G. Wells, J.N. Butler, and J.S. Hughes, Eds., American Society for Testing and Materials, Philadelphia.

Torch Operating Company. 2000. Oil Spill Response Plan for Operations on Torch Platform Irene and Point Pedernales 20-inch Wet Oil Pipeline. Owner: Nuevo Energy Company, 1800 30th Street, Suite 200, Bakersfield, California 93301. October 2000.

United States Environmental Protection Agency (EPA). 1976. Quality Criteria for Water. US Environ. Protection Agency Rep. PB 263-943.

—. 1986. Quality Criteria for Water. US Environ. Protection Agency Rep. 440/5-86-001.

—. 2000a. Fact Sheet: Proposed National Pollutant Discharge Elimination System ("NPDES") General Permit No. CAG280000 for Offshore Oil and Gas Exploration, Development and Production Operations off Southern California. July 18, 2000.

—. 2000b. General NPDES Permit Number CAG280000. Authorization to Discharge under the National Pollutant Discharge Elimination System For Oil And Gas Exploration, Development, And Production Facilities. December 2000.

Weston Solutions Inc., and Marine Research Specialists (MRS). 2006. Site-Specific Sulfide Criterion for Produced-Water Discharges at Five California OCS Platforms. Submitted to United States Environmental Protection Agency, Region IX (WTR-5) in support of General Permit No. CAG280000. April 25, 2006.

3.4.6.2 Onshore Water Resources

Arthur D. Little. 1985. Union Oil Project/Exxon Shamrock and Central Santa Maria Basin Area Study EIS/EIR. Prepared for County of Santa Barbara, U.S. Minerals Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development.

Arthur D. Little and SAIC. 2000. Public Draft, Tosco Sisquoc Pipeline Project Request for increased Throughput and Change in Tankage, 00-EIR-09. Prepared for County of Santa Barbara, U.S. Minerals Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development.

California Regional Water Quality Control Board (RWQCB). 1994. Water Quality Control Plan (Basin Plan). California Regional Water Quality Control Board, Region 3.

County of Santa Barbara. 2000. Final North County Siting Study. Planning and Development Department, Energy Division. Santa Barbara, CA.

Evenson, R.E. 1965. Suitability of Irrigation Water and Changes in Ground-Water Quality in the Lompoc Subarea of the Santa Ynez River Basin Santa Barbara County California. *Geological Survey Water-Supply Paper* 1809-S. U.S. Geological Survey, Washington, D.C.

Ground Water Protection Council. 2000. Groundwater Report to Congress, 2000.

Henningson, Durham, and Richardson, Inc. (HDR). 1984. Characteristics of Streams Crossed by the Proposed Union Oil Company Onshore Pipeline System Associated with the OCS Tract P-0441 Development Application, Santa Barbara County, California. A Data Summary. Prepared for Union Oil of California, Orcutt, California.

Miller, G.A. 1976. Ground-Water Resources in the Lompoc Area, Santa Barbara County, California. U.S. Geological Survey Open-File Report 76-183. U.S. Geological Survey, Washington, D.C.

Muir, K.S. 1964. Geology and Groundwater Resources of San Antonio Creek Valley, Santa Barbara County, California. *U.S. Geological Survey Water Supply Paper* 1664.

Santa Barbara County Public Works, Water Resources Department, Water Agency Division. 2005. 2004 Santa Barbara County Groundwater Report.

Tosco. 2000. Emergency Response Plan for Operations on Point Pedernales Onshore Facilities. Torch Operating Company.

University of California, Davis. California Rivers Assessment: Santa Ynez River. http//endeavor.des.ucdavis/newcara/basin.asp?cara_id=138.

Upson, J.E. and H.G. Thomasson, Jr. 1951. Geology and Water Resources of the Santa Ynez River Basin, Santa Barbara County, California. *Geological Survey Water-Supply Paper* 1107. U.S. Geological Survey, Washington, D.C.

United States Environmental Protection Agency (EPA). 1999. Watershed Information: Santa Ynez. http://www.epa.gov/surf2/hucs/18060010/.

United States Geological Survey (USGS). 2000. Water Resources Data-California, Water Year 2000, Volume 1, Southern Great Basin from Mexico Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River. Water Data Report CA-00-1.

Worts, G.F., Jr. 1951. Geology and Groundwater Resources of the Santa Maria Valley Area, California. *U.S. Geological Survey Water Supply Paper* 1000.

3.5 Biological Resources

3.5.1 Affected Environment

This section addresses both marine biological resources and terrestrial biological resources that may be affected by the proposed project, including threatened and endangered species. Marine and terrestrial biological resources in this region have been previously described by the Minerals Management Service (USDOI/MMS 2001, 2003, 2005ab) as well in the 2002 FEIR and 2006 DEIR (SBC 2002, SBC 2006).

3.5.1.1 Marine Biological Resources

The proposed project area, located slightly north of Point Arguello, is an oceanographically complex and dynamic region of the continental shelf. The region is characterized by strong seasonal coastal upwelling and high primary production (Brink et al., 1984; Dugdale and Wilkerson, 1990). Further, the project area is situated at a zone of biotic transition between two zoogeographic provinces, the Oregonian Province north of Point Conception and the Californian Province to the south (Valentine, 1966; Newman, 1979). Studies conducted in this region of central California have shown that this area supports abundant and diverse biological assemblages (e.g., Hyland et al., 1991; Montagna, 1991; Hardin et al., 1994).

The proposed project area is located in the southern offshore portion of the Santa Maria Basin. The Basin encompasses a majority of the continental margin between Point Conception and Monterey, including an onshore component situated between the Santa Ynez and San Rafael Mountains (McCulloch et al., 1982).

The continental shelf is oriented along a northwest to southeast axis between Point Conception and Point Arguello and along a north-to-south axis between Point Arguello and Point San Luis. The shelf extends seaward to approximately 110 m and varies in width from approximately 4 km in the Point Conception area to approximately 20 km between Point Arguello and Point San Luis (Uchupi and Emery, 1963). In the Point Arguello area, the slope drops rapidly to approximately 1,000 m and is cut by the Arguello Canyon; northward, the slope is less steep and is interrupted by the Santa Lucia Bank (Uchupi and Emery, 1963). Eastward of the bank is a sea valley that acts as a depositional sink for fine-grained sediments (Hyland et al., 1990). Four offshore platforms (Platforms Harvest, Hermosa, Hidalgo, and Irene) are presently located in the area. Their locations are shown in Figure 2-1.

Plankton

Plankton are organisms that have either limited or no swimming ability. They generally drift or float with ocean currents. Phytoplankton and zooplankton are the two broad categories of plankton. Phytoplankton, or plant plankton, form the base of the food web by photosynthesizing organic matter from water, carbon dioxide, and light. They are usually unicellular or colonial algae and support zooplankton, fish, and through their decay, large quantities of marine bacteria.

Zooplankton, or animal plankton, can spend their entire life as plankton (holoplankton) or spend a portion of their life cycle as plankton (meroplankton). Meroplankton are larval stages of benthic invertebrates while ichthyoplankton are larval stages of fish. Zooplankton are a primary link between phytoplankton and larger marine organisms in marine food webs.

Generally, plankton distribution, abundance, and productivity are dependent on several environmental factors. These factors include light, nutrients, water quality, terrestrial runoff, and upwelling. Plankton distribution tends to be very patchy and characterized by high seasonal and inter-annual variability. Because phytoplankton are photosynthetic, they are generally limited to the photic zone while zooplankton can occur throughout the water column from surface to bottom.

Phytoplankton
The phytoplankton community off the California coast primarily consists of diatoms, dinoflagellates, silicoflagellates, and coccolithophores (Hardy, 1993). Phytoplankton communities are typically described in terms of productivity, standing crop, and species composition.

Productivity, which is a measure of growth or new plant material per unit time, is extremely variable off the California coast (Owen, 1980). The highest productivity levels occur within approximately 50 km of the coastline (Owen, 1974) and tend to be the highest in upwelling areas, or approximately six times higher than the open ocean (Riznyk, 1974). Springtime primary production levels are approximately 5 times higher than summer and ten times higher than winter (Oguri and Kanter, 1971).

Standing crop, or the amount of phytoplankton cells present in the water, is also extremely variable and heterogeneous off the California coast. Owen (1974) reported the highest standing crop values during the summer (range of 2.50 to 3.00 mg/m^3) and lowest values during the winter months (range of 0.30 to 0.40 mg/m^3). Palaez and McGowan (1986) also reported high densities of phytoplankton in spring and summer that decreased in the fall. The lowest densities occurred in the late fall and early winter (Palaez and McGowan, 1986). They attributed the seasonal differences to ocean circulation patterns and the low nutrient content of waters off the California coast during the winter months.

Phytoplankton biomass has been reported to be higher near Point Conception than in locations north or south because of greater upwelling off the Point (Owen, 1974). Biomass reached peak levels during summer (July to September) and decreased from October to December and with distance from shore. Highest biomass values were reported during August and in the upper 20 m of the water column (Owen and Sanchez, 1974). Even during the 1998 El Nino, a warm-water period, there was high ocean productivity in the vicinity of Point Conception (Sydeman and Hyrenbach, 2002).

Data from several studies indicate that the composition of the phytoplankton community is similar along the entire coast of California (e.g., Bolin and Abbott, 1963; Allen, 1945). The diatom *Chaetoceros* was the most abundant species found along the coast (Bolin and Abbott, 1963; Cupp, 1943). Other dominant species included the diatoms *Skeletonema*, *Nitzschia*, *Eucampia*, *Thalassionema*, *Rhizosolenia* and *Asterionella*, and the dinoflagellates *Ceratium*, *Peridinium*, *Noctiluca*, and *Gonyaulax* (Bolin and Abbott, 1963).

Zooplankton
Zooplankton are those animals that spend part (meroplankton) or all (holoplankton) of their life cycle as plankton. Their temporal and spatial distributions are dependent on a number of factors

including currents, water temperature, and phytoplankton abundance (Loeb et al., 1983). Spring blooms occur for both meroplankton and holoplankton while fall blooms tend to be restricted to the holoplankton. The meroplankton include the larvae of many commercial species of fish, lobster, and crabs. Like phytoplankton, spatial distribution of zooplankton is extremely patchy.

Based on data collected by the California Cooperative Oceanic Fisheries Investigations (CalCOFI), McGowan and Miller (1980) reported a high degree of variability in species composition in offshore waters and that dominant species vary widely even from sample to sample. Fleminger (1964) reported 190 species and 65 genera of calanoid copepods. Kramer and Smith (1972) estimated that 546 invertebrate and 1,000 species of fish larvae occur in the California Current System. Major zooplankton groups off the California coast include copepods, euphausiids, chaetognaths, mollusks, thaliaceans, and fish larvae.

In studies conducted north of Point Conception, Icanberry and Warrick (1978) identified 94 taxonomic zooplankton categories. Dominant categories included calanoid copepod nauplii and copepodites, thalicians, *Oikopleura*, *Euphausia*, calyptopis, cyclopoid and harpacticoid copepodites, and the copepod *Acartia tonsa*. Zooplankton production was highest during June and July and in early Spring during periods that coincide with upwelling periods and increased levels of phytoplankton (Icanberry and Warrick, 1978; Smith, 1974).

During the 1990s zooplankton studies off southern California documented a marked decline in zooplankton stock that correlated with increased sea temperatures (NOAA, 2006). Roemmich and McGowan (1995) demonstrated that since 1951, the biomass of macrozooplankton in waters off Southern California decreased by 80 percent. Recent surveys indicate that zooplankton biomass has recovered from the dramatic decline of the 1990's (Goericke et al., 2005).

Ichthyoplankton

Ichthyoplankton, or fish eggs and larvae, are a major component of the zooplankton community. With the exception of a few fish species (e.g., the embiotocidae or surfperches that bear live young), most fish that occur in central California are present as larvae or eggs in the plankton community. The spatial and temporal distribution and composition of the ichthyoplankton are generally due to the spawning habits and the requirements of adult fish. Seasonal patterns of ichthyoplankton composition in nearshore waters are strongly influenced by the spawning cycles of demersal fish species and the northern anchovy, *Engraulis mordax*, while further offshore, composition is influenced by pelagic and migratory species and rockfish (*Sebastes* spp). Like phytoplankton and zooplankton, the spatial distribution of ichthyoplankton is patchy and influenced by several environmental factors.

In CalCOFI samples collected offshore California, ichthyoplankton densities were highest during January to March (Loeb et al., 1983). This was due to the peak spawning season for the northern anchovy, Pacific hake, Pacific mackerel, and the Pacific sardine. Larvae of these species comprised up to 84% of the samples. Generally, they found that ichthyoplankton densities decreased from north to south and inshore to offshore between San Francisco and Baja California.

In a summary of CalCOFI fish larvae data, Ahlstrom (1965) found that twelve taxa made up over 90% of the larvae collected. The most abundant was the northern anchovy, *Engraulis mordax.*

Other common larval species were the Pacific hake, *Merluccius productus*; rockfish, *Sebastes* spp.; flatfish, *Citharichthys spp*.; and the California smoothtongue, *Leuroglossas stilbius*. Anchovy and rockfish larvae were abundant from the winter to spring seasons. Spawning varied by season with no discernible pattern within the California Current system (Kramer and Ahlstrom, 1968; Ahlstrom et al., 1978).

In a year-round study off of Point Arguello, the white croaker, *Genyonemus lineatus*, and the northern anchovy, *Engraulis mordax* were the most abundant fish larvae collected (Chambers Consultants, 1980). A more recent study sampled planktonic fish eggs and larvae off Point

Arguello in the vicinity of the proposed project as well as off San Miguel Island, Anacapa Islandand Big Sycamore Canyon at the south end of the Santa Barbara Channel (Watson et al., 2002). This study found that season was the most important factor in species composition of theichthyoplankton. Northern anchovy, Pacific hake, white croaker, speckled sanddab (*Citharichthys stigmaeus*), and California halibut (*Paralichthys californicus*) eggs occurred most frequently and were among the most abundant during the winter surveys. In the summer, senorita (*Oxyjulis californica*), California sheephead (*Semicossyphus pulcher*), white seabass (*Atractoscion nobilis*) and Califonria barracuda (*Sphyraeena argentea*) eggs were abundant as were northern anchovy, speckled sanddab and California halibut eggs. The most abundant fish larvae in winter surveys were northern anchovy, California smoothtongue, northern lampfish (*Stenobrachius leucopsarus*), Pacific hake, and rockfishes. Northern anchovy and rockfish larvae were common in summer. The most common nearshore fish larvae at the mainland sites were rockfishes, white croaker and English sole (*Parophys vetulis*). The study found that the area around Vandenberg Air Force Base near the proposed project was not particularly productive for fish eggs and larvae. The Vandenberg study site is a high-energy area with strong currents, strong sand transport and relatively poor fish habitat.

Fish

The fish population in the project area consists of both year-round residents and seasonal migrants. Over 600 species of fish have been reported in the Pacific OCS region (United States Department of Interior (USDOI/MMS 1996). Large numbers of shellfish and other invertebrate species such as crabs, shrimp, bivalves, and squid also occur in the area. A wide variety of habitats are available in the region for fish resources and their distribution in the area fluctuates in accordance with food availability, environmental conditions, and migration (USDOI/MMS 1996).

With respect to fish distribution in the area, the offshore environment can generally be divided into two zones. They are the benthic or shelf and pelagic zones. Demersal or benthic species are those that live on or near the sea floor while pelagic fish species occur in the water column.

Demersal Fish

The offshore benthic environment generally consists of sandy, muddy, or rocky substrates. Important commercial or recreational fish species found beyond the tidal and wave zone include flatfishes, rockfishes, lingcod, and cods. In shallower water, common fish species are the perches, smelts, skates, rays, and flatfishes. Several researchers (e.g., Bence et al., 1992; Wakefield, 1990; Caillet et al., 1992) have reported that demersal fish species distributions are based on depth or depth-related factors. General depth distributions for fish common to the project area are summarized in Table 3.5.1.

Fish densities on the continental shelf between 50 and 200 m water depth are generally high, with flatfish densities being highest for species such as Pacific sanddabs and English and Dover sole. Rockfish, as a group, have historically been abundant on the shelf and at depths to 270 m (Bence et al., 1992). However, significant declines have been reported for many rockfish species in recent years (Love et al., 1998; Ralston, 1998). Rockfish biomass and commercial harvests have decreased substantially since the 1960's (Bloeser, 1999). Fish densities and biomass on the upper and middle slope are relatively high with rockfish, sablefish, and flatfish such as Dover sole dominating (SAIC, 1992). At deeper depths (greater than 1,500 m), the numbers of fish species, densities, and biomass are typically low. Rattails and slickheads are the most common species at this depth (SAIC, 1992).

Table 3.5.1 Depth Distribution of Demersal Fish Found in the Project Area

Water Depth			
50 to 200 m	**200 to 500 m**	**500 to 1200 m**	**1200 to 3200 m**
Sand dabs *Citharichthys sordidus*	Sablefish *Anoplopoma fimbria*	Thornyheads *Sebastolobus* spp.	Rattails *Coryphaenoides filifer*
English sole *Pleuronectes vetulus*	Pacific hake *Merluccius productus*	Pacific hake *Merluccius productus*	Thornyheads *Sebastolobus* spp.
Rex sole *Errex zachirus*	Slickhead *Alepocephalus tenebrosus*	Slickhead *Alepocephalus tenebrosus*	Finescale codling *Antimora microlepis*
Rockfish *Sebastes* spp.	Eelpouts *Lycenchelys jordani*	Rattails *Coryphaenoides filifer*	Eelpouts *Lycenchelys jordani*
Pink surfperch *Zalembius rosaceus*	Rockfish *Sebastes* spp.		
Plainfin midshipman *Porichthys notatus*	Thornyheads *Sebastolobus* spp.		
White croakers *Genyonemus lineatus*			

Pelagic Fish

Pelagic fish are those species associated with the ocean surface or the water column. Water depth, distance from shore, and other environmental factors generally govern distribution of pelagic fish. Ocean waters up to depths of approximately 200 m are referred to as the epipelagic zone. In this zone, waters are typically well lighted, well mixed, and support photosynthetic algal communities. Water depths from 200 to approximately 1,000 m are referred to as the mesopelagic zone, while depths greater than 1,000 m are classified as the bathypelagic zone. With increasing depths, light, temperature, and dissolved oxygen concentrations decrease as pressure increases. Hence, complete darkness, low temperature, low oxygen concentrations, and high pressure characterize the bathypelagic zone.

Pelagic fishes in the project area are a mix of year-round residents and migrants from several different habitats. Species include large predators (e.g., tunas, sharks, swordfish) and forage fish (e.g., northern anchovy, Pacific sardine, Pacific saury, Pacific whiting). The distributional ranges for pelagic fishes are generally quite extensive and cover much of the coastal California region.

Many fish in the pelagic zone such as albacore tuna and Pacific salmons migrate over vast areas in the Pacific.

Common epipelagic fish in the region include the mackerel, *Scomber japonicus*; and salmon, *Onchorhyncus* spp.; and schooling fish such as Pacific herring, *Clupea pallasii*; northern anchovy, *Engraulis mordax*; and rockfish, *Sebastes* spp. Bence et al. (1992) reported approximately 140 epipelagic species from midwater trawls. In those trawls, juvenile rockfish, Pacific herring, and northern anchovy were the dominant species. Other epipelagic species common to the area included medusafish, *Icichthys lockingtoni*; Pacific sardine, *Sardinops sagax*; Pacific saury, *Cololabis saira*; Pacific argentines, *Argentina sialis*; and tunas (ARPA, 1995). Epipelagic species such as albacore tuna (*Thunnus alalunga*) and salmon are important commercial and recreational fish species.

Love et al. (1999) conducted mid-water trawls from 1995 to 1997 in the Santa Barbara Channel and the southern portion of the Santa Maria Basin. Over the three years, 49 taxa were collected. The taxa represented during each of the three years did not change substantially, but the number of specimens of each species and their rank order varied from year to year (Love et al., 1999). The ten most common species captured during the surveys are listed in Table 3.5.2.

Table 3.5.2 Mid-Water Fish Species Found in the Santa Barbara Channel and Southern Santa Maria Basin (Love et al., 1999)

Family	Species	Common Name
Merlucciidae	*Merluccius productus*	Pacific Hake
Bathylagidae	*Leuroglossus stibius*	California smoothtongue
Engraulidae	*Engraulis mordax*	Northern anchovy
Argentinidae	*Argentina sialis*	Pacific argentine
Paralichthyidae	*Citharichthys stigmaeus*	Speckled sanddab
Paralichthyidae	*Citharichthys* spp.	Other sanddabs
Pleuronectidae	*Lyopsetta exilis*	Slender sole
Scorpaenidae	*Sebastes jordani*	Shortbelly rockfish
Scorpaenidae	*Sebastomus* spp.	

Love et al. (1999) reported that most taxa occurred infrequently or in low abundance. Many of the taxa occurred in only one year during the three-year study. Rockfish species were also rarely collected during the study.

Less is known on the pelagic fish in the mesopelagic and bathypelagic zones. Typical species in the area include the blacksmelt, *Bathylagus milleri*; northern lampfish, viperfish, and the lanternfish (Cross and Allen, 1993). Examples of bathypelagic fish include dragonfish, hatchetfish, and bristlemouth (Cross and Allen, 1993).

Oil and Gas Production Platforms

A wide variety of fish occur beneath offshore platforms. Love et al. (1999) conducted surveys at seven platforms between 1995 and 1997. Four of the platforms (Hermosa, Hidalgo, Harvest, and Irene) surveyed were located in the western Santa Barbara Channel or southern Santa Maria Basin area. Love et al. (1999) found different fish assemblages at midwater and bottom levels around all of the platforms surveyed. Although midwater and bottom assemblages were dominated by rockfishes, the midwater was dominated by young of the year (YOY) or juveniles up to two years old. Larger rockfish were rarely seen at the midwater level. However, larger or adult fish were dominant around the bottoms of the platforms. While fish density was higher in the midwater, the total biomass was greater at the bottom because of the larger fish. Also, there was a consistently greater number of fish species on the bottom compared to the midwater for each of the platforms surveyed. Love et al. (1999) attributed this to the wider variety of habitat types found on the bottom environment.

As the most northerly of the platforms, Irene is more exposed to both the colder waters of the California Current and to seasonal upwelling events than its counterparts to the south at Point Conception and within the Santa Barbara Channel. This, more than anything else, accounts for the substantially different biological assemblages present at Platform Irene as compared to the other platforms (Love et al., 1999).Generally, higher densities of young of the year rockfish were found beneath platforms north of Point Conception, including Platform Irene, compared to those in the Santa Barbara Channel. Fish species found at the midwater and bottom levels beneath Platform Irene are listed in Table 3.5.3.

Table 3.5.3 Fish Species Found at Midwater and Bottom Levels Beneath Platform Irene From Love et al. (1999)

Midwater Habitat 1996-1997				Bottom Habitat 1995-1997			
Species	**No.**	**Density100m^2**	**Biomasskg/100m^2**	**Species**	**No.**	**Density100m^2**	**Biomasskg/100m^2**
Rockfish YOY	2331	690.96	4.17	Rockfish YOY	1392	303.00	0.34
Widow rockfish	2319	586.46	17.20	Copper rockfish	519	104.32	19.03
Bocaccio	223	71.93	3.70	Vermillion rockfish	334	66.93	19.44
Blacksmith	120	51.69	0.32	Lingcod	177	34.10	8.11
Pile perch	10	5.33	0.93	Pacific sanddab	96	20.90	0.57
Copper rockfish	7	3.51	0.38	Halfband rockfish	67	13.86	0.15
Painted greenling	4	2.32	0.23	Pile perch	64	13.35	2.07
Blue rockfish	4	2.09	0.40	Painted greenling	53	10.95	0.54
Cabezon	3	1.57	0.09	Rosy rockfish	20	4.24	0.09
Yellowtail rockfish	3	1.24	0.06	Brown rockfish	9	1.90	0.42
Northern anchovy	2	0.73	0.00	Rubberlip surfperch	8	1.74	0.51
Calico rockfish	1	0.51	0.06	Bocaccio	7	1.49	0.34
				Calico rockfish	6	1.31	0.04
				Canary rockfish	5	1.09	0.21
				Sebastomus group	4	0.81	0.01
				Gopher rockfish	3	0.62	0.04
				Widow rockfish	3	0.41	0.02
				Yellowtail rockfish	2	0.41	0.12
				Kelp greenling	1	0.22	0.03
				Flag rockfish	1	0.19	0.03
				Yelloweye rockfish	1	0.22	0.03

At Platform Irene, YOY rockfish, and adults and subadults of copper and vermilion rockfishes were the most abundant species. The YOY rockfish consisted of bocaccio and widow rockfish. Platform Irene was also unique among the platforms surveyed in that large numbers of juvenile lingcod were associated with the platform (Love et al., 1999). The midwaters of Platform Irene were dominated by YoY and older, juvenile rockfish. Bocaccio, blue, YoY shortbelly, squarespot, treefish, and widow rockfishes were abundant at this platform, as were the complex of black-and-yellow, copper, gopher, and kelp rockfishes. The densities of these fishes were generally the highest observed at any platform. Jack mackerel and Pacific sardine were periodically seen in high numbers, and young painted greenling were also abundant at this platform. Blacksmith and kelp greenling were also seen to recruit in the midwater during various years, most notably in 1999 (WSPA 2005).

Fifty-two fish species were identified at the bottom of the seven platforms surveyed by Love et al. (1999). Thirty species were rockfishes. They made up 92.1% of all fishes identified on the bottom and 83.2% of the biomass. Halfbanded, greenspotted, copper, vermilion, widow, calico, flag, and bocaccio were the most commonly observed rockfishes. Several species of these rockfish were closely associated with the portions of the platform structure.

Endangered and Threatened Fish Species

The steelhead, *Oncorhynchus mykiss*, was listed as an endangered species in the Southern California ESU (from the Santa Maria River south to Malibu Creek) in August, 1997 (NMFS, 1999). Steelhead are migratory, anadromous rainbow trout. They hatch in fresh water, descend to the ocean, and return to fresh water to spawn. Depending on the stream, steelhead can be either summer or winter migrators, but, regardless of migration period, spawning usually takes place from March to early May (NMFS, 1999). NMFS (1999) identifies river reaches and estuarine areas as critical habitats for the steelhead. Steelhead can migrate extensively at sea (Eschmeyer and Herald, 1983). Additional information on the steelhead is provided in Section 3.5.1.2, Terrestrial and Freshwater Biology.

Like steelhead, green sturgeon (*Acipenser medirostris*) are also anadromous. Although these fish spend most of their lives at sea, they come into rivers and estuaries to spawn. Additionally, young green sturgeon may remain in freshwater rivers and streams for the first few years of their lives before traveling out to sea. The southern distinct population segment (south of the Eel River) of the green sturgeon was listed as a threatened species in July, 2006 (NMFS, 2006). Green sturgeon spawn regularly in the Rogue and Sacramento Rivers, and in the Klamath River Basin. Spawning is known to occur infrequently in the Umpqua River, and is suspected to occur in the South Fork of the Trinity River and the Eel River. However, there is no evidence of current spawning in the Fraser, Chehalis, Feather, San Joaquin rivers, and spawning is not expected in rivers further to the south. Although green sturgeon are a highly migratory species and travel widely at sea, critical areas of their habitat, such as the rivers and estuaries where they spawn and gather do not occur within the project area. Additional information on the green sturgeon is provided in Section 3.5.1.2, Terrestrial and Freshwater Biology.

Sebastes paucispinis or bocaccio, were listed as a candidate species for protection under the Endangered Species Act (ESA) in 1999. In 2001, NMFS received a petition to list the southern bocaccio (*Sebastes paucispinis*) as a threatened species and to designate critical habitat concurrent with the listing. NMFS found that the petition presented substantial scientific and commercial information indicating that the request for listing may be warranted. This determination was based on the fact that bocaccio have suffered precipitous population declines over the last several decades and that these population declines threaten bocaccio with extinction and compromise its ability to recover. The primary factor in the decline is over-utilization, specifically overfishing by fisheries targeting bocaccio and as bycatch in other fisheries. The population south of Cape Mendocino was designated as overfished under the Magnuson-Stevens Fishery Conservation and Management Act on March 3, 1999. Stock rebuilding measures were implemented, and, in 2002, NMFS concluded that listing under the ESA was not warranted at that time. Presently, bocaccio has no protection status under the ESA. Bocaccio commonly occurs beneath platforms in the Santa Barbara Channel and the Santa Maria Basin. As reported by Love et al. (1999), YOY bocaccio was a dominant species beneath Platform Irene.

Marine Mammals

Twenty-seven marine mammal species were reported by Dohl et al. (1983a) to occur off central California. These were categorized as: 1) migrants that pass through the area, 2) seasonal visitors that remain for a few weeks to feed on a particular food source, or 3) residents of the area. Of the 27 species, 21 were cetaceans (i.e., whales, dolphins, and porpoises), five were pinnipeds (i.e., seals and sea lions), and one was a fissiped (the sea otter). Marine mammals are generally characterized by large distribution ranges (Gaskin, 1982).

The central California area represents a region of overlap where populations of marine mammals having different ranges intermingle (Dohl et al., 1983a). Several marine mammal species reach the southern limit of their ranges in central California while other species are at their northern range limits (Hubbs, 1960; Bonnell and Daily, 1993). For example, boreal species such as Dall's porpoises, harbor porpoises, and the northern fur seals, are generally found in the cooler waters of the North Pacific. However, from winter through early summer they occur along central California where they are found in areas of coastal upwelling and in the coolest waters of the California current. In late summer and autumn, marine mammals found in the warmer waters to the south are found in central California. Examples of warm water species include California sea lions, northern elephant seals, bottlenose dolphins, and pilot whales.

Some species, like the southern sea otter, are endemic to coastal central California and occur year-round. Other species are largely restricted to the waters of the California Current, and occur in high numbers off of central California. These species include the California sea lion, and during its migration, the California gray whale (Dohl et al., 1983a).

Bonnell and Dailey (1993) list 39 species of marine mammals in the eastern North Pacific. This number has since increased to 40, as the ‘common dolphin’ is now recognized as being comprised of two separate species (Carretta et al 2006). Of the 40 species, 33 of them are cetaceans followed by six species of pinnipeds and one species of fissiped, the sea otter. A listing of these species and their abundance and status in the project area is provided in Table 3.5.4 and Table 3.5.5.

Table 3.5.4 Cetaceans of the Eastern North Pacific and Their Status off South Central California (Adapted from Bonnell and Dailey 1993 and Carretta et al 2006)

Common Name	Scientific Name	Abundance	Status
Cetaceans Baleen Whales (Suborder Mysticeti)			
Blue whale	*Balaeoptera musculus*	Population highest in summer due to northward migration from subtropics	E
Fin whale	*B. physalus*	Population highest in summer due to northward migration from subtropics	E
Sei whale	*B. borealis*	Rare. Seen only during summer months during migration	E
Bryde's whale	*B. edeni*	Rare. Single confirmed sighting between 1991 and 1996.	NA
Minke whale	*B. acutorostrata*	Common. Year round resident; peak abundance during spring and summer	NA
Humpback whale	*Megaptera novaeangliae*	Common, migratory population with peak abundance during summer and autumn	E
Gray whale	*Eschrichtius robustus*	Common during migration in winter and spring	NA
Northern (Pacific) right whale	*Eubalaena japonica*	Rare.	E
Order Cetacea Tooth Whales (Suborder Odontoceti)			
Sperm whale	*Physeter macrocephalus*	Occasional visitor. Rare on continental shelf but abundant in deeper waters.	E
Short-beaked common dolphin	*Delphinus delphis*	Common. Year-round resident	NA
Long-beaked common dolphin	*Delphinus capensis*	Common. Year-round resident	NA
Northern right-whale dolphin	*Lissodelphis borealis*	Common. Peak population in winter.	NA
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Common. Year-round residen with peak population in winter.	NA
Risso's dolphin	*Grampus griseus*	Common. Year-round resident with peak population in winter.	NA
Dall's porpoise	*Phocoenoides dalli*	Common. Year-round resident with peak population in autumn and winter	NA
Bottlenose dolphin	*Tursiops truncatus*	Common. Year-round resident	NA
Harbor porpoise	*Phocoena phocoena*	Common. Resident along the central California Coast, north of Point Conception	NA
Short-finned pilot whale	*Globicephala macrorhynchus*	Rare. Occurs in deep waters and along edge of continental shelf.	NA
Killer whale	*Orcinus orca*	Occasional visitor to area. Transient population.	NA
False killer whale	*Pseudorca crassidens*	Occasional visitor to area. Occurs primarily in tropical to warm temperate waters.	NA
Cuvier's beaked whale	*Ziphius cavirostris*	Rare. Occurs in deep waters. Most commonly encountered beaked whale.	NA
Baird's beaked whale	*Berardius bairdii*	Rare. Occurs in deep waters and along continental slopes.	NA
Hubb's beaked whale	*Mesoplodon carhubbsi*	Rare.	NA

Table 3.5.4 Cetaceans of the Eastern North Pacific and Their Status off South Central California (Adapted from Bonnell and Dailey 1993 and Carretta et al 2006)

Common Name	Scientific Name	Abundance	Status
Ginkgo-toothed beaked whale	*M. ginkgodens*	Rare.	NA
Perrin's beaked whale	*M. perrini*	Rare.	NA
Blainville's beaked whale	*M. densirostris*	Rare.	NA
Stejneger's beaked whale	*M. stejnegeri*	Rare. Possible visitor to area.	NA
Dwarf sperm whale	*Kogia simus*	Rare. Occurs in tropical and warm temperate waters. Known from strandings.	NA
Pygmy sperm whale	*K. breviceps*	Rare. Occurs in deep water and along continental slopes.	NA
Striped dolphin	*Stenella coeruleoalba*	Occasional visitor to area from offshore waters.	NA
Spinner dolphin	*S. longirostris*	Occurs in tropical waters; possible visitor to area	NA
Spotted dolphin	*S. attenuata*	Occurs in tropical waters; possible visitor to area	NA
Rough-toothed dolphin	*Steno bredanensis*	Occurs in tropical waters; possible visitor to area	NA

NA = Not Applicable; E = Endangered

Cetaceans

Cetaceans (whales, dolphins, and porpoises) occur in the project area year-round, although the species present may vary from season to season or from year to year. Cetacean population levels are at their lowest in spring and are at their highest levels during the autumn (Dohl et al., 1983a). Seven species of porpoises represent the major cetacean fauna found off of south central California. They are the Pacific white-sided dolphin *Lagenorhynchus obliquidens*, the northern right whale dolphin *Lissodelphis borealis*, Risso's dolphin *Grampus griseus*, Dall's porpoise *Phocoenoides dalli*, the harbor porpoise *Phocoena phocoena* and the two species of common dolphin. These species vary in their patterns of usage of the area and periods of peak abundances (Dohl et al., 1983a).

Contrary to common conception, baleen whales are not a major component of the area's cetacean fauna. However, four species, the California gray whale *Eschrichtius robustus*, the humpback whale *Megaptera novaeangliae*, the blue whale *Balaeoptera musculus*, and the fin whale *B. physalus* occur in the project area (Dohl et al. 1983a; Carretta et al. 2006). The majority of these whales use the coastal waters as migratory routes or are seasonal visitors. The California gray whale is the most common baleen whale that passes through the area, and is seen twice each year on their annual migration. The eastern population of gray whales in the North Pacific was removed from the list of endangered species under the U.S. Endangered Species Act in 1994 following the recovery of the stock with the cessation of commercial whaling in the first half of the 20th century. The eastern gray whale population increased over the last several decades to an estimated high of approximately 26,000 in 2000. Since then the population has subsided to approximately 17,000 individuals. The majority of gray whales are found close to shore over continental shelf waters (Herzing and Mate, 1984; Reilly, 1984; Rice et al. 1984; Rugh, 1984; Dohl et al., 1983a; Sund and O'Connor, 1974). During migration, the majority of the animals are

1.5 to 1.8 km offshore (0.8 to 1 nautical miles) and less than 20% are as close as 0.9 km (0.5 nautical mile) (Dohl et al., 1983a).

Generally, the abundance of baleen whales in the area peaks during the winter and spring migration seasons. However, as overall populations of certain species increase (e.g., gray whales and humpback), larger numbers are becoming resident to areas offshore California (Dohl et al., 1983a). Approximately 1,158 humpbacks and 1,744 blue whales are currently thought to utilize the waters off the California coast (Carretta et al. 2006; Cascadia 2006). Fin whales have also been observed offshore central California. Their numbers appear to be increasing outside of the normal peak abundance periods of summer through autumn.

Pinnipeds

A total of six pinniped species are known to occur off central California (Table 3.5.5). These include the California sea lion *Zalophus californianus*, the Northern (Steller) sea lion *Eumetopias jubatus*, the northern fur seal *Callorhinus ursinus*, the Guadalupe fur seal *Arctocephalus townsendi*, the northern elephant seal *Mirounga angustirostris*, and the harbor seal *Phoca vitulina* (Bonnell et al., 1983; Carretta et al 2006). Two of these species, the Guadalupe fur seal and Steller sea lion, are currently listed as threatened under the Endangered Species Act.

The overall population size of pinnipeds along the California continental shelf is estimated to exceed 50,000 animals in the fall and to approach nearly 50,000 animals during the spring, in conjunction with the seasonal breeding peaks of sea lions, and northern fur seals. On average, however, at least 30,000 pinnipeds are estimated to occur in the area year-round.

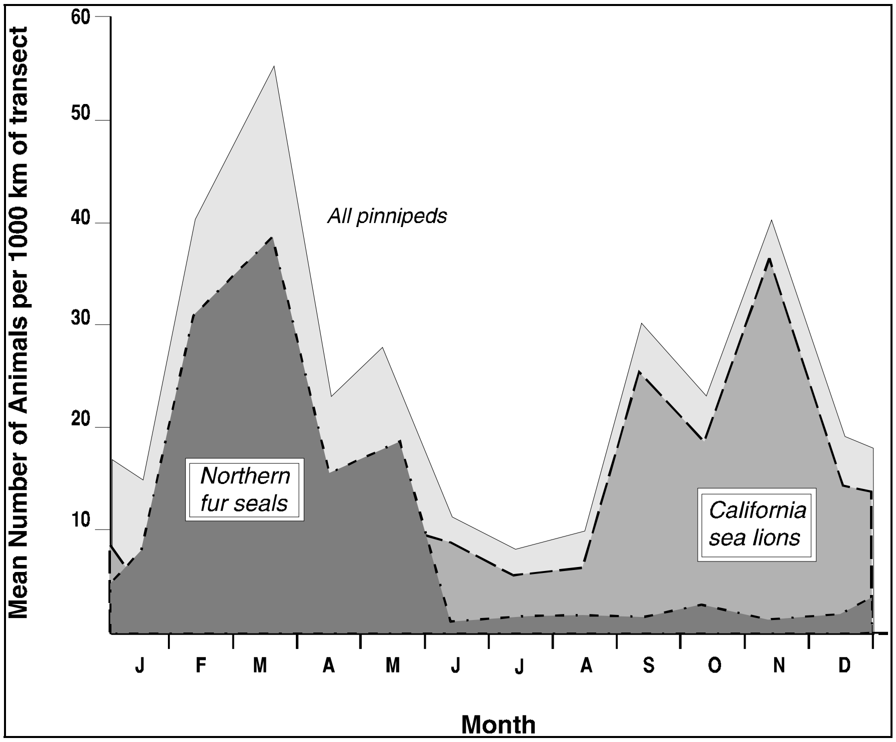
Table 3.5.5 Pinnipeds of the Eastern North Pacific and Their Status Off California (Adapted from Bonnel and Dailey 1993 and Carretta et al 2006)

Common Name	Scientific Name	Abundance	Status
California sea lion	*Zalophus californianus*	Abundant, year-round resident	NA
Steller sea lion (eastern stock)	*Eumetopias jubatus*	Not common. Occasional visitor to area from northern latitudes. No longer breeds on Channel Islands.	T
Northern fur seal	*Callorhinus ursinus*	Common, year-round resident	NA
Guadalupe fur seal	*Arctocephalus townsendi*	Not common Occasional visitor to area from southern breeding grounds.	T
Northern elephant seal	*Mirounga angustirostris*	Common, year-round resident.	NA
Pacific harbor seal	*Phoca vitulina*	Common, year-round resident.	NA

T = Threatened Species; NA = Not Applicable

The offshore pinniped population in the proposed project area is predominately composed of northern fur seals or California sea lions. When one population is at its peak, the other is at its low for the area (Bonnell et al., 1983). California sea lions reach their peak in fall (Figure 3.5-1), as the breeding population disperses northward from rookery islands (e.g., San Clemente, Santa Barbara, and San Nicolas Islands) in the Southern California Bight (Barlow et al., 1997; Carretta et al. 2006).

Figure 3.5-1 Seasonal Abundance of Pinnipeds in the Waters of Central and Northern California (from Bonnell et al., 1983)



The California sea lion *Zalophus californianus*, is the most common pinniped found both on land and in the waters over the continental shelf off California. These large, gregarious mammals breed in the summer months, from May through July, on islands from the Gulf of California in Mexico to the California Channel Islands. In the fall following the breeding season, thousands of California sea lions, mainly immature and adult males, disperse northward to winter along the coast as far north as British Columbia. The world population (excluding a small Galapagos population) of sea lions is estimated at over 200,000 animals, of which the U.S. population accounts for more than half.

In contrast to the sea lion, northern fur seals reach their peak in winter and spring, as migrants arrive from the Bering Sea. Although they established a small breeding colony on San Miguel Island in the 1960s, most of the population remains in offshore waters west of San Miguel Island. This population has been heavily influenced by El Nino events, most notably in 1997-1998, which resulted in an 80% decline in pup production as well as impacting the adult population (Melin et al 2002). By 2002, the population was beginning to show signs of recovery, with a total pup count of 1,946 for that year. Based on the 2002 count, the overall population estimate for the San Miguel Island stock of the northern fur seal was estimated at 7,700 in 2003 (Carretta et al. 2006). Although both northern fur seals and California sea lions feed along the central California coast, northern fur seals forage farther off shore, along the continental slope, while California sea lions forage over the continental shelf.

The northern elephant seal and the harbor seal are also common to the project area. At sea, harbor seals forage relatively close to shore, while elephant seals are generally found to forage further offshore in waters over and beyond the continental shelf. The most recent estimate of the Pacific harbor seal population in California is 31,600 seals (Carretta et al 2006). Since 1990 there has been no net population growth along the mainland or the Channel Islands, and there are indications that the population may have reached its environmental carrying capacity (Carretta et al., 2006). Rookery and haul-out areas for both species have been reported in several locations in central California and the Channel Islands (Barlow et al., 1997). In particular, harbor seal haul outs near Rocky Point as well as in Carpinteria, serve as refuges and rookeries, for several hundred harbor seals. Both harbor seals and northern elephant seals haul out to breed and molt on San Miguel Island.

Northern elephant seals typically come ashore only to breed and molt. The breeding season lasts from mid-December to March, and pups remain on the rookery for another month or so. .More than half of the total elephant seal population is associated with rookery islands in southern California. The largest populations are found on San Miguel and San Nicolas Islands; small colonies also exist on Santa Barbara and San Clemente Islands. Additionally, over the past 16 years, Piedras Blancas has become breeding and birthing area for over 8,000 northern elephant seals. After being hunted to the brink of extinction, primarily for their blubber, the northern elephant seal population currently numbers over 150,000 (Point Reyes National Seashore 2001).

The last two pinnipeds of interest in the project area are the Steller (northern) sea lion and the Guadalupe fur seal. Both these species are currently uncommon visitors to the area, though each has had a greater presence in the region historically. Both species were federally listed as threatened species, the fur seal following near extinction by commercial harvesting in the nineteenth century, and the Steller sea lion following a sharp decline in population more recently. Steller sea lion numbers in California, especially in southern and central California, have declined substantially from historic numbers. Counts in California between 1927 and 1947 ranged between 5,000 and 7,000 non-pups, but have declined by over 50% since then. Previously, Steller sea lions ranged southward to the Channel Islands, primarily using San Miguel Island but also Santa Rosa Island (Bonnot 1928, Rowley 1929). In the early and middle 20th century, as many as 2,000 Steller sea lions occupied the Channel Islands (Bonnot and Ripley 1948). It appears that sea lions used these sites seasonally and bred in small numbers (Stewart et al. 1993). However, no adults have been seen there since 1983 and no births recorded since 1982 (Stewart et al. 1993). Additionally, several rookery and haulout sites along the central California coast, primarily south of Año Nuevo, have also been abandoned (NMFS 2006).

In 1997 Steller sea lions were classified into two separate stocks. The eastern US stock, which was classified as threatened, is expected to occur infrequently in the project area. During 1980-2001 there remained between 1,500 and 2,000 non-pups. The most recent pup counts at Año Nuevo and the Farallon Islands were 221 in 2004 (NMFS 2006).

The Guadalupe fur seal was listed as a Federal threatened species and a California threatened and fully protected species because its populations have been reduced to near extinction by commercial sealing in the nineteenth century. Although it is a rare visitor from the south, individual animals are beginning to appear more regularly in the SB Channel. In 1997 a pup was born on San Miguel Island. There is evidence that Guadalupe fur seals once bred as far North as

Point Conception in central California. Due to hunting, they became extinct in California waters by 1825. Today, the only known breeding colony is on Guadalupe Island, off the Mexican coast. Increasing numbers have been seen in California's Channel Islands, and in recent years, several Guadalupe fur seals have stranded along the central California coast.

Fissipeds

The southern sea otter, *Enhydra lutris nereis*, is a federally listed threatened species whose population consists of approximately 2,735 individuals (USGS, 2005). Excluding the translocated colony of approximately 30 otters at San Nicolas Island, the range of the mainland population currently extends from Half Moon Bay in the north to Goleta in the south (USGS, 2005).

The southern sea otter population is estimated to have historically numbered approximately 150,000 animals ranging from Prince William Sound in Alaska to Morro Hermoso in Mexico (Kenyon, 1969). This population was hunted nearly to extinction by the fur trade between 1741 and 1911(Kenyon 1975). By 1911, when sea otters were first protected by international treaty, sea otters were no longer found off the Oregon or Washington coasts, and were thought have been extirpated from California waters as well. The present population in California is descendent from a remnant group of less than 50 animals that were rediscovered at Bixby Creek, near Big Sur in 1938. Since that time, substantial changes have occurred in the distribution and density of sea otters within the California range. As the population has increased in size, range expansion has also occurred. By the 1980s, the range had expanded north to Point Ano Nuevo and south to Point Sal. However, by 1995, sea otters were common as far south as Point Arguello and in 1998, they had increased their range to south of Point Conception. In recent years, they have been observed as far south as Carpinteria (USGS 1999).

The sea otter population migrates twice a year. The migrations coincide with the breeding season (June to November) and the non-breeding season (November to May). During the breeding season, the size of the southernmost group declines dramatically, due to a general northward movement of animals towards the center of the range (Bonnell et al., 1983; Estes and Jameson, 1983). This movement of males from the population fronts into the more established areas occupied by females during the summer and fall breeding season is a feature of the sea otter's annual cycle (Bonnell et al., 1983). Recent studies also suggest that resource limitations near the center of the otter’s range may be influencing migration movements (USDOI/MMS 2006).

In California, sea otters feed almost entirely on macroinvertebrates (Ebert, 1968; Estes et al., 1981). In rocky areas along the central California coast, major prey items include abalone, crab, and sea urchins. In sandy areas, prey items include clams, snails, octopus, scallops, sea stars, and echiuroid worms (Boolootian, 1961; Ebert, 1968; Estes, 1980; Estes et. al., 1981; Wendell et al., 1986, USFW 2003, USDOI/MMS 2006). These species occur at water depths ranging from the littoral zone to approximately 100 m (328 feet). Most of the animals occur between shore and the 20 m (65 feet) water depth (USFWS, 2000).

After a period of decline during the 1990s, recent otter surveys coordinated by the US DOI (USGS, 2003, 2004, 2005, 2006) off the coast of California have shown substantial increases in the otter population. For example, spring sea otter counts offshore California ranged between 2,095 in 1995 to 1,858 in 1999. However, the most recent spring survey, completed in May 2006 counted 2,692 sea otters, the third highest count on record. As individual year counts may be highly influenced by survey conditions, the final revised recovery plan for the southern sea otter recommends using the 3-year running average as the official benchmark of the sea otter population status (USFW 2003). Since 1997, sea otter counts east of Point Conception have increased. During the spring 1997 survey, 60 independent sea otters were counted east of Point Conception (USGS 1999). By 2000, 79 sea otters were counted east of the Point (USGS 2000). During the spring 2005 survey, over 80 otters were counted east of Pt. Conception (USGS 2005).

Marine Turtles

Marine turtles are generally infrequent visitors to the project area but they have occasionally been reported along the south- central California. Four species, all of which are protected under the Endangered Species Act, can occur in the project area. The four species are the green turtle *Chelonia mydas*, the olive ridley turtle *Lepidochelys olivacea*, the leatherback turtle *Dermochelys coriacea*, and the loggerhead turtle *Caretta caretta* (Table 3.5.6) (Hubbs, 1977). Of the four species, three of them (green, olive ridley, and loggerhead) are listed as threatened species while the leatherback is listed as endangered.

Table 3.5.6 Marine Turtles That May Occur in the Proposed Project Area

Common Name	Scientific Name	Status
Green turtle	*Chelonia mydas*	T
Olive ridley turtle	*Lepidochelys olivacea*	T
Leatherback turtle	*Dermochelys coriacea*	E
Loggerhead turtle	*Caretta caretta*	T

T-Threatened Species, E-Endangered

While marine turtles are seldom seen at sea locally, strandings do occur (NOAA, 1997). Fourteen marine turtle strandings were reported on Santa Barbara County beaches between 1982 and 1995. Of the 14 strandings, nine were leatherbacks, three were loggerheads, and two were green turtles (NOAA, 1997). Since 1995 an additional three olive ridleys and one green turtle have stranded in this area (Joe Cordaro, pers. comm.). Additionally, at the Diablo Canyon Nuclear Power Plant, in San Luis Obispo County, one green turtle was reported in 1994 and another in 1997 (NOAA, 1997; Port San Luis Harbor District, 1997).

During El Niño periods, sea turtles range well north of their normal distribution, and populations increase offshore southern California. As a result of this transient population shift, NOAA's National Marine Fisheries Service (NMFS) issued an interim final rule to protect loggerhead sea turtles that follow warmer El Niño currents into drift gillnet fishing areas off Southern California (USDOC 2002).

Most sea turtles are omnivorous and feed on a wide variety of marine life, including shellfish, jellyfish, squid, sea urchins, fish, and algae (Carr 1952 and Mager 1984). However, the green turtle is a benthic herbivore and feeds primarily on algae and sea grasses (Eckert 1993). Turtles of all four species can dive to several hundred feet during feeding activities (Eckert 1993). General distribution information for marine turtles is provided below.

Green Sea Turtles (*Chelonia mydas*)

Green sea turtles are generally tropical and occur worldwide in waters above 20°C. California represents the northern end of their range, so they are infrequent visitors to the area. However, green turtles have been reported as far north as Redwood Creek in Humboldt County and off the coast of Washington and Oregon (Green et al., 1991; Smith and Houck, 1983). The green sea turtle nests on sandy tropical beaches throughout the eastern, central, and western Pacific Ocean. There are no nesting sites on the US Pacific mainland (Eckert, 1993; Mager, 1984). Green sea turtles are benthic herbivores and subsist primarily on algae and sea grasses (Eckert, 1993).

Green turtle strandings were reported on a Santa Barbara beach and in Summerland in 1989. In San Luis Obispo County, two green turtles were reported at the Diablo Canyon Nuclear Power Plant, one in 1994 and one in 1997 (NOAA, 1997; Port San Luis Harbor District, 1997). Most recently an ill green turtle stranded near Vandenberg Air Force Base in 2000 (Joe Cordaro, pers. comm.). Green turtles are listed as a threatened species except for breeding colonies of green turtles in Florida and the Pacific Coast of Mexico, which are listed as an endangered species.

Olive Ridley Sea Turtle (*Lepidochelys olivacea*)

The olive ridley is a widely distributed tropical species. However, it has frequently been reported in cooler northern latitudes (Eckert, 1993). Off the western coast of the US, they have been reported as far north as the Gulf of Alaska, Washington, Oregon, and California by several investigators (Green et al., 1991; Marquez, 1990; Stinson, 1984; Houck and Joseph, 1958; NOAA, 1997). Stinson (1984) reported frequent sightings of olive ridley turtles around Point Conception. Since 1995, a total of three green turtle strandings have taken place on Santa Barbara County beaches. Generally, however, the range of olive ridley turtles in the eastern North Pacific extends from Columbia to Mexico, and they are considered infrequent visitors to the area (USDOI/MMS 1996).

The olive ridley sea turtle is omnivorous, feeding on crustaceans, fish, jellyfish, sea grasses and algae (Ernst and Barbour, 1972). The olive ridley is listed as a threatened species. However, breeding colonies off the coast of Mexico are listed as endangered.

Leatherback Sea Turtle (*Dermochelys coriacea*)

The endangered leatherback sea turtle has the most extensive range of any reptile. This highly-migratory species, which can be found from 60°N to 42°S in the Pacific (Stinson 1984), spends nearly its entire life in pelagic waters. In the eastern Pacific, they have been reported as far north as the Aleutian Islands and British Columbia and as far south as Chile (Mager, 1984; Smith and Houck, 1983; Hodge, 1979). In 1980, there were an estimated 126,000 adult female leatherbacks in the eastern Pacific; now it is estimated that only a few thousand may remain.

The leatherback is the most common sea turtle seen north of Mexico, occuring seasonally off central California (Dohl et al. 1983a; Green et al. 1989). Most sightings in the Point Conception area occur during July to September (Stinson 1984). The majority of sightings occur during the summer and fall seasons in deeper waters over the continental slope (Dohl et al., 1983a).

Individuals migrate from Papua New Guinea and Indonesia across the Pacific Ocean basin to the coasts of Oregon and California to take advantage of dense swarms of Scyphozoan jellyfish that occur from spring through fall. Adult leatherbacks feed primarily on scyphomedusae, salps and other soft-bodied invertebrates (Mager, 1984). Inshore waters off California, between Pt. Conception and Pt. Arena, are visited annually by approximately 150 to 170 leatherback turtles, with the greatest numbers occurring during early fall (Starbird et al. 1993; Benson et al. 2003).

A total of nine leatherback strandings were reported on Santa Barbara County beaches between 1982 and 1995 (NOAA 1997). Between 1995 and 2004, however, no further strandings were reported to have occurred (Joe Cordaro 2005 pers. comm.).

Loggerhead Sea Turtles (*Caretta caretta*)
Loggerhead turtles are highly migratory, and have a circumglobal distribution, inhabiting the continental shelves, bays, estuaries, and lagoons in the temperate, subtropical, and tropical waters of the Atlantic, Pacific, and Indian Oceans (Dodd, 1990; Mager, 1984). They are considered threatened throughout their entire distributional range.

In the Pacific, most loggerheads carry out an extensive developmental migration, traveling from nesting areas in Japan and Australia to distant developmental and foraging habitats in the eastern Pacific. After spending years foraging in the eastern Pacific, these turtles return to their natal nesting beaches for reproduction. Southern California is considered to be the northern limit of loggerhead sea turtle distribution in the eastern Pacific Ocean (Stebbins 1966) and they are considered infrequent visitors to the project area. However, during El Nino conditions, loggerhead turtles may be more abundant along California's coast as they follow prey sources further north. Loggerhead sea turtles are omnivorous and feed on a wide variety of marine life including shellfish, jellyfish, squid, sea urchins, fish, and algae (Carr, 1952; Mager, 1984). However, with the exception of juveniles, loggerhead turtles generally feed on benthic invertebrates found in hard bottom habitats (Ekert, 1993). Although loggerheads sometimes scavenge fish or fish parts, they are not considered fish-eaters.

Along the west coast of the US, loggerheads have stranded on beaches as far north as Alaska, Washington and Oregon (Ekert 1993; Green et al. 1991). A total of three loggerhead strandings were reported on Santa Barbara County beaches between 1982 and 2004 (NOAA 1997; Cordaro 2005 pers. comm.).

Seabirds
The seabird fauna of central California is large and diverse. Species found off the Point Conception area are far ranging species and come from all corners of the Pacific Ocean, Bering Sea, Arctic Ocean, inland North America, and the North Atlantic. Although Jones et al. (1981) reported 102 species of seabirds in central California, the seabird fauna is dominated by approximately 30 of these species, notably those that reach their highest numbers in areas of coastal upwelling in central California (Briggs et al. 1981). In a three-year survey for seabirds off of central and northern California, Dohl et al. (1983b) reported up to 35 five common species and 34 uncommon or rare species. They also reported that the seabird fauna of central California is dominated by cool-water species (e.g., boreal North Pacific), such as Cassin's auklets, but includes subtropical species during the late summer and autumn months. According to Dohl (1983b), the number of seabirds present off central California is similar to the numbers found in Oregon, the Gulf of Alaska, and Bering Sea, and is higher than those published for southern California.

The SB Channel supports a rich population of seabirds (Baird 1993), providing a major foraging area for numerous residents and migrants. Seabirds, along with sea ducks (scoters), loons, and western grebes, make up the greatest portion of the bird fauna that utilize the Channel. Of the seabirds, the shearwaters, storm petrels, phalaropes, gulls, terns, and auklets are the most abundant species. The dominant species in the area by season are provided in Table 3.5.7 (Dohl et al., 1983b).

Table 3.5.7 Seasonal Distribution of Coastal Seabirds in the Project Area (Briggs et al., 1981; Dohl et al., 1983b)

Winter	Spring	Summer	Autumn
Arctic Loon	Arctic Loon	Sooty Shearwater	Arctic Loon
Cassins's Auklet	Sooty Shearwater	Phalaropes	Sooty Shearwater
Common Murre	Phalaropes	Brown Pelican	Phalaropes
Western Gull	Bonaparte's Gull	Brandt's Cormorant	Cassin's Auklet
Western Grebe	Western Grebe	Western Gull	Common Murre
Brandt's Cormorant	Brandt's Cormorant	Heerman's Gull	California Gull
Pelagic Cormorant	Surf Scoter	Pigeon Guillemot	Western Gull
Surf Scoter	Western Gull	Pelagic Cormorant	Western Grebe
California Gull	Common Murre	Ashy Storm-Pertrel	Brown Pelican
Herring Gull	Pigeon Guillemot	Rhinoceros Auklet	Brandt's Cormorant
	Pelagic Cormorant		Heerman's Gull
	Ashy Storm-Pertrel		Bonaparte's Gull
	Rhinoceros Auklet		

Much of the taxonomic diversity in the bird population arises because the SB Channel acts as the transition zone between two zoogeographic provinces. The Channel supports boreal seabird populations, such as Cassin's auklets, that are more characteristic of colder regions as far north as the Gulf of Alaska. Conversely, the Channel Islands also harbor important nesting colonies for subtropical seabirds, such as those found in the Gulf of California. The latter include California's entire nesting population of endangered brown pelicans and the increasingly rare Xantus' murrelets. Both species have southern breeding distributions and nest on islands off southern and Baja California.

The distribution of the various seabird taxa within the SB Channel exhibits substantial seasonal and spatial variation (Pierson et al. 1999; USDOI/MMS 2001; Schmitt and Bonnell 2003). Coastal seabirds spend most of their time on the water surface within approximately five miles (eight km) of the mainland shore. The highest coastal seabird densities occur during the fall and winter months, between September and March or April. Western and Clark's grebes are the most abundant of the coastal seabirds. Their populations concentrate offshore western Ventura County (near Platform Hogan), where densities reach 1,036 birds/mile^2 (400 birds/km^2) in the winter but drop to peaks of 368 birds/mile^2 (142 birds/km^2) during the summer. Scoters, especially surf scoters (*Melanitta perspicillata*) and cormorants (*Phalacrocorax* spp.), which breed within the SB Channel, are, respectively, the second and third most populous coastal seabirds within the SB Channel. Although they also have population centers in the vicinity of Platform Hogan, they reach their highest densities near the Channel Islands. Average respective winter densities are 16.6 and 3.9 birds/mile^2 (6.4 and 1.5 birds/km^2). Loons (*Gavia* spp.) and brown pelicans are coastal seabirds with lower population densities. In contrast to the other coastal seabirds, brown pelican populations increase in the summer months when birds from large Mexican colonies migrate northward into the SB Channel.

Pelagic seabirds spend most of their time farther from shore. As with coastal seabirds, they spend much of their time on the sea surface or diving into the water column to feed. Consequently, they are particularly vulnerable to oil spills. The most common offshore birds within the SB Channel include: shearwaters (*Puffinus* spp.), northern fulmars (*Fulmarus glacialis*), phalaropes (*Phalaropus* spp.), jaegers (*Stercorarius* spp.), and common murres (*Uria aalge*). Although seasonal population peaks vary among the taxa, pelagic seabirds as a group are comparatively stable. Their densities average approximately 54 birds/mile^2 (21 birds/km^2) (USDOI/MMS 2001).

Twelve seabird species regularly breed within the SB Channel, with essentially all of the rookeries located on the northern Channel Islands (Table 3.5.8). Few, if any, seabirds nest on the mainland coast of the SB Channel (Carter et al. 1992). The westernmost island, San Miguel, harbors all but one of the breeding populations. The lone exception is the brown pelican (*Pelecanus occidentalis californicus*) which currently breeds only on a few islands offshore California. The largest nesting area is found on Santa Barbara Island, which lies south of the northern Channel Island chain. Nesting also takes place on the Anacapa Islands, and, in 2006 pelicans were seen nesting at Prince Island, a small islet off San Miguel Island. Estimates of the breeding population size for the pelican were around 6,000 pairs in 1991. The breeding season for brown pelicans extends from March through early August. The population trend of the California Brown Pelican is unknown at this time (CDFG 2004b); however a status review by USFWS to determine if delisting of the California Brown Pelican is warranted is currently under way.

Table 3.5.8 Seabirds That Nest on the Northern Channel Islands (Sowls et al., 1980; Carter et al., 1992; Schmitt and Bonnell 2003; Whitworth et al 2004)

San Miguel/Prince Island	Anacapa Island	Santa Rosa/Santa Cruz Islands
Brandt's Cormorant	Brandt's Cormorant	Brandt's Cormorant
Pelagic Cormorant	Pelagic Cormorant	Pelagic Cormorant
Black Oystercatcher	Black Oystercatcher	Black Oystercatcher
Western Gull	Western Gull	Western Gull
Pigeon Guillemot	Pigeon Guillemot	Pigeon Guillemot
Brown Pelican	Brown Pelican	Cassin's Auklet
Double-Crested Cormorant	Double-Crested Cormorant	Ashy Storm Petrel
Xantus' Murrelet	Xantus' Murrelet	Xantus' Murrelet
Ashy Storm Petrel	Cassin's Auklet	
Black Storm Petrel		
Leach's Storm Petrel		
Cassin's Auklet		
Rhinoceros Auklet		
Tufted Puffin		

Seabirds occur year-round in the project area and the species present vary according to the season (Briggs et al., 1981). Dohl et al. (1983b) reported the highest density of seabirds during the summer and autumn is due to the presence of migrants, winter visitors, and nesting residents at the same time. The lowest density of seabirds occurred during the winter.

According to Sowls et al. (1980), 17 seabird species nest on the central and northern California coastline. The most numerous of the nesting residents are the common murre, Cassin's Auklet, Brandt's Cormorant, and the Western Gull. The largest nesting sites off the California coast are located in northern California with the Farallon Islands being the most important location. However, Sowls et al. (1980) estimated that approximately 7% of the seabird population breeds in central California between Ventura and Monterey counties with the majority occurring on the Channel Islands. In the area from Morro Bay south to Point Conception, Chambers Consultants and Planners (1980) reported that very few seabirds breed in coastal mainland habitats due to human disturbances.

Endangered or Threatened Seabirds

Two seabird species occurring in the project area are protected under either the State or Federal Endangered Species Acts, and are potentially vulnerable to impacts from the proposed project. These are the California brown pelican (*Pelecanus occidentalis californicus*), and the Bald eagle (*Haliaeetus leucocephalus*).

The California brown pelican (*Pelecanus occidentalis californicus*) is a Federal and State listed endangered species that ranges from British Columbia to southwest Mexico. In the US, the California brown pelican currently nests only on a few of the Channel Islands off the southern California coast. Although most of the breeding population (4,000 to 6,000 pairs) nests on West Anacapa Island, smaller populations have become established the other islands. In 2005, the first-known nesting at Middle Anacapa Island occurred, small numbers were found breeding on East Anacapa Island (only the second time since 1928), and an expanded distribution of pelican nesting was observed at Santa Barbara Island. Most recently, in May 2006, 43 pelican nests were found on Prince Island, a small islet off San Miguel Island.These are the first nests seen in this location since 1939.

The listing of California brown pelican was based primarily on serious declines in the southern California population due to bioaccumulation of chlorinated hydrocarbon pesticides (DDT, DDE, dieldrin, and endrin) in the pelican's food chain (USDOI/MMS 1996). Bioaccumulation of these pesticides resulted in serious eggshell thinning and poor reproductive success (Schreiber and Risebrough, 1972). Food scarcity, primarily anchovies, also contributed to the species' decline (Keith et al., 1971).

The breeding season for California brown pelicans extends from March through early August. Preferred nesting habitat is on offshore islands. In 1991, approximately 12,000 breeding birds were reported at two colonies on Anacapa and Santa Barbara Islands (Carter et al., 1992). The California brown pelicans occur in coastal areas as far north as British Columbia and as far south as southwestern Mexico. Offshore rocks and coastal habitats such as rocky shores, sandy beaches, and piers provide important roost sites in the project area. They feed by plunge diving from heights of up to 15 to 20 m above the ocean surface and feed primarily on small schooling fish (e.g., anchovies) (USFWS 1982). This mode of feeding makes them particularly vulnerable

Pelicans return to specific roosts each day and do not normally remain at sea overnight. These roosts are usually located in regions of high oceanic productivity and are isolated from predation pressure and human disturbances.

The bald eagle (*Haliaeetus leucocephalus*), the country's national bird, is a type of sea eagle found only in North America, and is an integral component of the Channel Islands ecosystem. Bald eagles once numbered 50,000 in the United States; nesting areas were reported from at least 35 different locations on the Channel Islands from the 1800s to 1950. By the early 1960s, however, bald eagles had disappeared from the Channel Islands and were in decline nationwide due to human impacts, primarily release of the pesticide DDT and other contaminants into the environment. Bioaccumulation of these contaminants resulted in the thinning of the eagle's egg shells, and dramatic declines in reproductive success. By the time the U.S. restricted the use of DDT in 1972, only 800 breeding pairs of eagles remained nationwide.

Under the protection of the Endangered Species Act of 1973, bald eagles have made a steady recovery. The total number of breeding pairs in the United States now numbers around 7,000, with 160 nesting pairs found in California. In the spring of 2006, two bald eagle chicks hatched on Santa Cruz Island. This was the first time bald eagles have successfully reproduced on the Channel Islands without human help since 1949.

The bald eagle is a keystone species in the Channel Islands ecosystem. In the absence of bald eagles, non-native golden eagles established themselves on the northern Channel Islands, which led, in turn, to the precipitous decline of the native island fox due to predation. The re-establishment and continued success of bald eagle populations on the Channel Islands are key components to maintaining the unique ecosystem of the Channel Islands.

Benthic Invertebrates

The benthos consists of organisms that live in or on the ocean floor. Benthic habitats are often classified according to substrate type, either unconsolidated sediments (e.g., gravel, sand, or mud) or rock. The former category is often referred to as soft bottom and the latter hard bottom or rocky substrate. Each support their own characteristic biological community. In addition to substrate, water depth and water temperature play important roles in the distribution of benthic organisms. Distance from shore, food availability, and water quality are also important factors that influence the distribution of benthic organisms. Benthic organisms can be epifaunal (attached or motile species that inhabit rock or sediment surfaces) or infaunal (live in rock or soft sediments) (Thompson et al., 1993).

Intertidal and Shallow Subtidal

<u>Soft Substrate</u>

Sandy beaches occur along shoreline segments of the project area. Because of the difficulties in conducting ecological studies in sand, far less is known about invertebrate communities that live there than those found on rocky substrates. Sand dwelling organisms are very motile and cannot be easily monitored over time. Immigration and emigration rates are high and often contribute to the high level of temporal and spatial patchiness in density that is often reported (Thompson et al., 1993). Studies are also difficult to conduct in unstable sediments in a high-energy environment.

Although not obvious, vertical zonation of invertebrates occurs on sandy beaches. The invertebrates that live in sand (infauna) are quite motile and change position with respect to tidal level. Also, certain species will be found higher or lower than others. Common invertebrates in the upper intertidal are several species of amphipods in the genus *Orchestoidea*; the predatory isopod, *Excirolana chiltoni*; and several species of polychaetes (e.g., *Excirolana chiltoni*, *Euzonus mucronata*, and *Hemipodus borealis*). The middle intertidal is characterized by species such as the sand crab, *Emerita analoga* and the polychaete *Nephtys californiensis*. *Emerita* is generally the most abundant of the common middle intertidal organisms, often comprising over 99% of the individuals on a given beach (Straughan, 1983).

In the low intertidal, polychaetes and nemerteans dominate (Straughan, 1982). Also, the large sand crab, *Blepharipoda occidentalis*, and the Pismo clam, *Tivela stultorum* can be found. *Tivela*, however, was once more abundant in the intertidal. Its present reduction in population is probably the result of overharvesting and predation.

In shallow water <10 m, epifaunal (organisms which live on the sediment or rock surfaces) communities are generally well developed (Thompson et al., 1993). With increasing depth, the density of epifaunal species decline while that of infauna increases, probably because of the greater stability of sediments (Barnard, 1963). Also, with depth, polychaetes become more dominant over crustaceans (Oliver et al., 1980). Physical changes to nearshore subtidal habitats are associated with increasing depth. One of the most important is a decrease in wave surge and, as a result, finer sediments that influence the distribution of epifaunal species in nearshore environments (Thompson et al., 1993). Merrill and Hobson (1970) have shown that shoreward limit of the sand dollars (*Dendraster excentricus*) occurs near the break line with the inner most population consisting of small juveniles. Seaward, they found that sand dollars become progressively larger and more abundant.

The effects of wave action on benthic infauna are not well known. However, several studies indicate the declines in the abundance of tube-building polychaetes in shallow water (< 10 m) to increasing substrate disturbance (Oliver et al., 1980; Davis and VanBlaricom, 1978).

The composition of invertebrate assemblages on sandy beaches correlates to slope and sand texture. Within a beach, crustaceans and molluscs tend to be more common on steeper, coarser, and dryer upper intertidal zone. Polychaetes and nemerteans are the dominant invertebrates in the lower intertidal where slope is not as steep and the sand usually finer and wetter (Wenner, 1988; McLachlan and Hesp, 1984; Straughan, 1982).

Straughan (1982) conducted comprehensive intertidal surveys in central and southern California over a 12-year period. At a sampling site in northern Santa Barbara County, annelids and crustaceans dominated along a transect extending from the supratidal to intertidal areas. Common species she reported are listed in Table 3.5.9.

At offshore monitoring stations located at 18 m water depth in central California, approximately 97 benthic infaunal species were found (ABC, 1995). Rank order and the relative abundance of these species which are commonly found in central California are listed in Table 3.5.10. Annelid worms were the most abundant group found at the stations.

Epifaunal species collected at these stations include the echinoderms, *Amphiodia occidentalis* and *Dendraster excentricus*; the arthropod, *Heterocrypta occidentalis*; and the molluscs, *Nassarius fossata*, *N. perpinguis*, *Olivella baetica*, and *Polinices lewisii* (ABC, 1995).

Table 3.5.9 List of Soft-Bottom Intertidal Species Collected at a Northern Santa Barbara Location (from Straughan, 1982)

Annelida	Crustacea
Cerebratulus californiensis	*Archaeomysis grebnitzki*
Dispio uncinata	*A. maculata*
Eteone dilatae	*Emerita analoga*
Euzonus dillonensis	*Eohaustorius sawyeri*
E. mucronata	*E. washingtonianus*
Hemipodus californiensis	*Excirolana chiltoni*
Lumbrineris zonata	*Lepidopa californica*
Lumbrineridae	*Orchestoidea benedicti*
Nemertea sp.	*O. columbiana*
Nephtys californiensis	*O. corniculata*
Nephtys sp.	*Synchelidium sp.*
Opheliidae	Insecta/Arachnida
Orbinia johnsoni	Anthomyiidae
Orbiniidae	Calliphoridae larvae
Paranemertes californica	Cyclorrhapha larvae
Pygospio californica	Ephydridae larvae
Scoloplos armiger	Sarcophagidae pupae
S. acmeceps	Mollusca
Zygeupolia rubens	*Collisella strigatella*
	Siliqua patula

Rocky Substrates

California rocky intertidal areas are characterized by diverse assemblages of algae, invertebrates, and fish (Ricketts et al., 1985; Foster et al. 1991). The majority of intertidal species are restricted to certain elevations along the shoreline. While the vertical distribution of intertidal species is largely determined by the ability to withstand desiccation, other important factors that determine vertical zonation are competition, predation, and available microhabitats. On wave-exposed shores, wave run-up and splash enable species to survive at higher elevations than those normally found in protected, non-splash areas.

Table 3.5.10 Dominant Soft-Bottom Infaunal Species Reported From Five Monitoring Stations Located in Central California (N = Nemertea, A = Annelida, M = Mollusca, Ar = Arthropoda) (ABC, 1995)

Species	Total	Percent of Total
Carinoma mutabilis (N)	407	13.9
Lumbrineris tetraura (A)	377	12.9
Tellina modesta (M)	372	12.7
Magelona sacculata (A)	292	10.0
Prionospio pygmaea (A)	281	9.6
Glycera capitata (A)	144	4.9
Glycinde picta (A)	109	3.7
Nephtys caecoides (A)	74	2.5
Odostomia sp. (M)	74	2.5

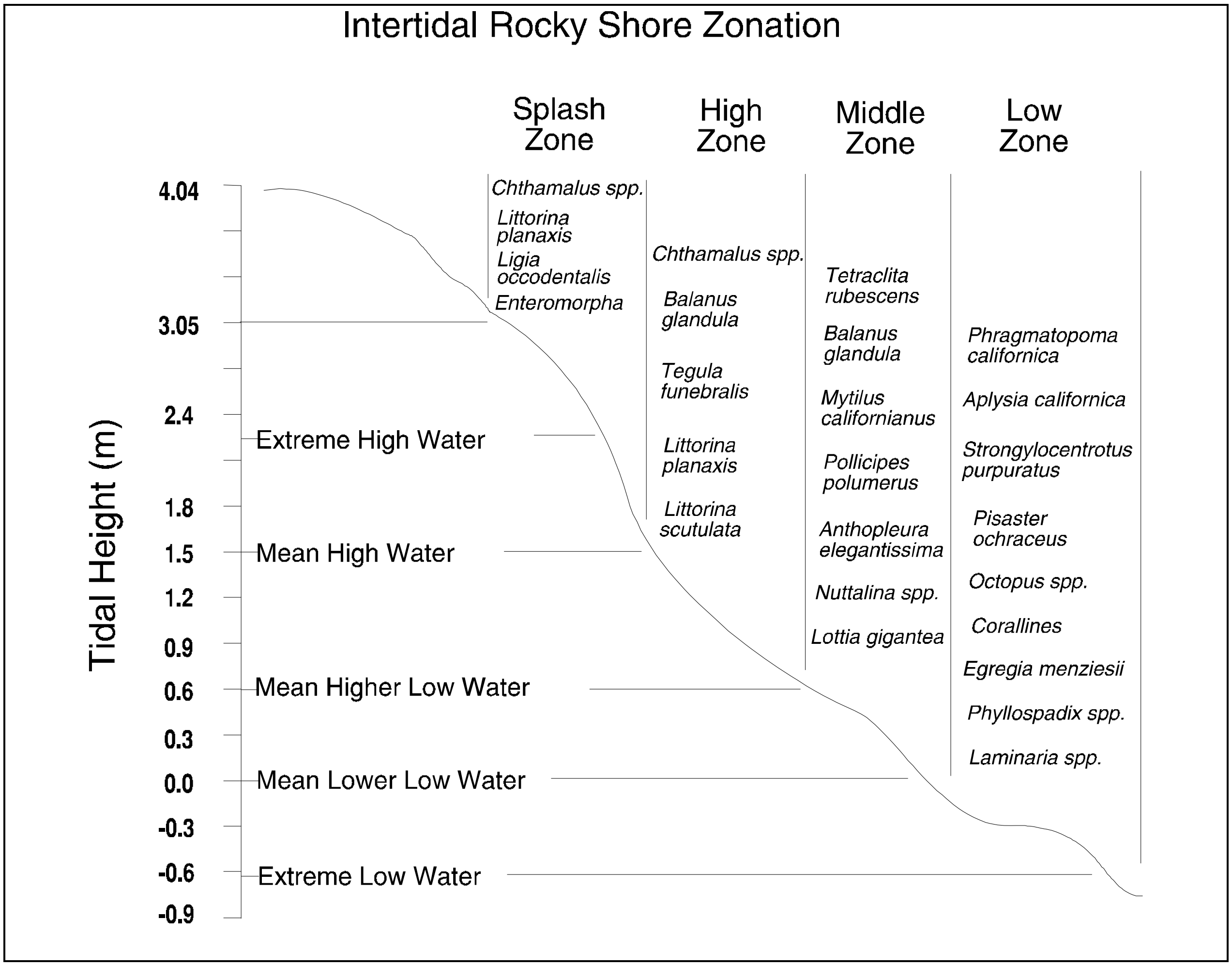
Table 3.5.10 Dominant Soft-Bottom Infaunal Species Reported From Five Monitoring Stations Located in Central California (N = Nemertea, A = Annelida, M = Mollusca, Ar = Arthropoda) (ABC, 1995)

Species	Total	Percent of Total
Leitoscoloplos pugettensis (A)	57	1.9
Chaetozone setosa (A)	55	1.8
Chione undatella (M)	51	1.7
Typosyllis fastigiata (A)	46	1.5
Nemertea sp. (N)	32	1.0
Macoma secta (M)	30	1.0
Mediomastus californiensis (A)	30	1.0
Spiophanes bombyx (A)	30	1.0
Chone magna (A)	27	1.0
Onuphis vexillaria (A)	22	1.0
Photis macinerreyi (Ar)	21	1.0
Thalenessa spinosa (A)	21	1.0

The diversity of algae and invertebrate species tends to increase from high to low elevations. Generally, because the high intertidal is only occasionally wet, it is sparsely covered by species such as the blue-green algae, *Bangia* sp. and *Enteromorpha* sp. In these areas, *Littorina* sp. (periwinkle snail) can be found in rock crevices and *Tegula funebralis* (turban snail) and *Pachygrapsus* (shore crab) can be found in the shade or crevices. The rock lice, *Ligia occidentalis* can also be found in the splash zone. In the intertidal, algal cover is more conspicuous with clumps of *Fucus* and *Pelvetia* (rockweeds) and *Endocladia* (red algae). The intertidal can also be inhabited by a variety of limpets, *Chthamalus* sp. (acorn barnacle), *Mytilus californianus (*mussels), *Pisaster ocraceus* (starfish), and various encrusting algae. In the lower intertidal, species such as *Mazzaella flaccida* and *Mastocarpus papillatus* are present. Rock-encrusting algae, *Pagurus* (hermit crab), snails, motile and tube-forming worms, encrusting bryozoans, sponges, tunicates, and *Strongylocentrus* sp. (urchins) are also common beneath the blades of upright algae. In the low intertidal, fish species such as *Xiphister* sp. (prickleback) can be found under cobbles, in pockets of water, and under dense algal cover. In the lower intertidal, red algae increase and species such as *M. flaccida*, *M. papillatus*, *Gastroclonium subarticulatum* and *Chondracanthus canaliculatus* are common. *Phyllospadix* sp. (surfgrass) can fringe the shoreline at the lower boundary of the intertidal zone.

The vertical zonation of typical rocky intertidal organisms along the California coast is shown in Figure 3.5-2.

Figure 3.5-2 Intertidal Zonation of a Rocky Shore in Southern California (modified from Dailey et al., 1993)



Currently, all major species of abalone in central and southern California are depleted, a result of cumulative impacts from commercial harvest, increased market demand, sport fishery expansion, an expanding population of sea otters, pollution of mainland habitat, disease, loss of kelp populations associated with El Niño events, and inadequate wild stock management (CDFG 2001).

The red abalone is associated with rocky kelp habitat ranging from Oregon into Baja California. In northern and central California they are found from the intertidal to the shallow subtidal depths. In southern California they are exclusively subtidal, restricted to upwelling locations along the mainland and the northwestern Channel Islands. Two canopy forming kelps, bull kelp and giant kelp, are primary components of the red abalone habitat and diet (CDFG 2001). It is possible that red abalone could be present in the subtidal areas along the coast in the project area.

Pink abalone occur from Point Conception to the central Baja California peninsula, Mexico. Their depth range extends from the lower intertidal zone to almost 200 feet, but most are found from about 20 to 80 feet. It has the broadest distribution of the southern California abalones (CDFG 2001). It is unlikely that pink abalone are within the project area since it is located north of Point Conception.

Green abalone are found on open coast shallow rocky habitat from Point Conception, California to Bahia Magdalena, Baja California, including parts of the Channel Islands. The species is associated with the warm-temperate California region from Baja California to southern California. Green abalone is commonly found in rock crevices, under rocks and other cryptic cavities from the low intertidal to subtidal zones. They are mostly found between 10 and 20 foot depths, often associated with surf grass beds, but is sometimes seen at 50 and 60 foot depths (CDFG 2001). It is unlikely that pink abalones are within the project area since it is north of Point Conception.

Black abalone are reported from as far north as Oregon, but most are found south of San Francisco Bay to southern Baja California including the offshore islands. By the mid- 1990s, only remnant populations existed at the Farallon and Channel Islands, and along the mainland southern California shoreline they were totally absent. Small populations exist in central and northern California. Essential habitat for these abalone includes rocky intertidal areas, often within the high energy surf zone (CDFG 2001). In 1998, NMFS added black abalone to the candidate species list for possible listing under the federal Endangered Species Act. Given the very limited populations of black abalone, it is unlikely that any would be found in the project area.

White abalone inhabits deep, rocky substrata from 60 to 200 feet deep, from Point Conception, in southern California to Bahia Tortugas, in central Baja California, including the offshore islands and banks. White abalone is primarily found in depths greater than about 75 feet (CDFG 2001). White abalone was added to the candidate species list by NMFS in 1997. It is unlikely that white abalones are within the project area since it is north of Point Conception.

Deep-Benthic Assemblages

Soft-Bottom

In a comprehensive three-year benthic infauna study offshore Point Conception (California Monitoring Program Phase II), Hyland et al. (1991) reported over 886 species representing 15 phyla. The 10 most abundant species reported by Hyland et al. (1991) for a transect located just north of Platform Irene are provided in Table 3.5.11.

Crustaceans (34%) and polychaetes (31%) were the most dominant taxa followed by gastropods (10%) and bivalves (8%). Together these four classes accounted for 83% of all taxa. Hyland et al. (1991) revealed patterns of decreasing infaunal abundances and diversity with increased water depth. Fauchald and Jones (1978) and SAIC (1986) have also reported similar patterns in the California Offshore Monitoring Program (CAMP) Phase I reconnaissance study.

Table 3.5.11 Ten Most Abundant Soft-Bottom Infaunal Species, by Water Depth, off the Coast of Point Arguello (Hyland et al., 1991)

Station R-4 (90 m)	Station R-5 (180 m)	Station R-6 (410 m)
Photis lacia (A)	*Mediomastus ambiseta* (P)	*Chloeia pinnata* (P)
Mediomastus ambiseta (P)	*Chloeia pinnata* (P)	*Nephtys cornuta* (P)
Myriochele sp. M (P)	*Tharyx* spp. (P)	*Tectidrilus diversus* (O)
Chloeia pinnata (P)	*Photis californica* (A)	*Chaetozone* nr. *setosa* (P)
Photis spp. (A)	*Minuspio lighti* (P)	*Huxleyia munita* (P)
Photis californica (A)	*Spiophanes berkeleyorum* (P)	*Cossura rostrata* (P)
Typhlotanais sp. A (T)	*Photis lacia* (A)	*Maldane sarsi* (P)
Sphiophanes missionensis (P)	*Prochelator* sp. A (P)	*Minuspio sp.* A (A)
Praxillella pacifica (P)	*Spiophanes missionensis* (P)	*Cossura candida* (P)
Minuspio lighti (P)	*Levinsenia gracilis* (P)	*Cossura pygodactyla* (P)
All Fauna (419 species)	All Fauna (358 species)	All fauna (215 species)

(A = Amphipoda, Oligochaeta, P = Polychaeta, T = Tanaidacea

The project area in the Santa Maria Basin is located at the boundary separating the Oregonian and Californian Provinces. Therefore, the composition of the infauna found in the CAMP Phase II Monitoring Program shows affinities with each province (Hyland et al., 1990). The majority of species (67%) occurring in the project area have northern faunal affinities (Oregonian Province), 27% with primarily southern affinities (Californian Province), while 31% are endemic to the region (Hyland et al., 1990).

Hard Substrate

Hard-bottom habitats in deep waters of the project area are rare. Generally, when they occur, they are discontinuous patches of exposed rock separated by soft bottom composed of mud and fine sands (BBA/ROS, 1986; Steinhauer and Imamura, 1990; SAIC and MEC, 1995). Several qualitative surveys of hard-bottom communities in this region of the Santa Maria Basin have been conducted over the years (e.g., Nekton, 1981; Dames and Moore, 1982; 1983; Nekton and Kinnetic Laboratories, 1983; and SAIC, 1986). However, on the comprehensive MMS sponsored CAMP, Phases II and III, nine rocky reefs were quantitatively surveyed for 10 years from 1986 to 1995. The goal of the hard-bottom studies was to determine the cumulative effects of offshore drilling and production activities on the hard-substrate communities. Impacts to hard-bottom communities, especially epifauna, were of particular interest, because of the greater sensitivity of many of these species to increased particulate flux, the importance of their trophic role, and the general rarity of these communities in the area.

From CAMP Phase II, Hardin et al. (1994) reported 263 taxa from low-relief (<0.5 m) and 222 taxa from high-relief (>1.0 m) structures. The ten most dominant species (mean percent cover), is provided in Table 3.5.12.

No one taxon dominated in percent cover on the hard-substrate in the project area. However, most of the cover that was found consisted of a turf composed of komokoiacea foraminerferans and hydroids. The turf varied in percent cover but, generally, it occupied most of the rock surfaces that were absent large epifauna. The 15 most abundant taxa in low-relief habitats totaled approximately 19.3% cover, and the 15 most abundant taxa in high-relief habitat totaled approximately 26.6% cover (Hardin et al., 1994). Despite the lack of dominance by any one taxon, of the 22 taxa comprising the 15 most abundant species, 10 were anthozoans. Anthozoans were followed by poriferans, ophiuroids, polychaetes, and urochordates.

Table 3.5.12 The Ten Most Abundant Hard-Bottom Taxa in Low Relief (0.2-0.5 m) and High-Relief (>1.0 m) Habitats Near Platform Hidalgo (adapted from Hardin et al., 1994)

Taxa	Taxon Group	Mean Percent Cover
Low Relief		
Ophiuroidea, unidentified	Ophiuroidea	5.8
Florometra serratissima	Crinoidea	2.7
Paracyathus stearnsii	Anthozoa	1.5
Metridium giganteum	Anthozoa	1.2
Sabellidae, unidentified	Polychaeta	1.1
Ophiacantha diplasia	Ophiuroidea	1.1
Caryophyllia sp.	Anthozoa	1.0
Pyura haustor	Urochordata	0.8
Terebellidae, unidentified	Polychaeta	0.8
Sponge, white encrusting	Porifera	0.7
High Relief		
Amphianthus californicus	Anthozoa	4.6
Ophiuroidea, unidentified	Ophiuroidea	3.5
Sabellidae, unidentified	Polychaeta	2.4
Desmophyllum cristagalli	Anthozoa	2.1
Galatheidae, unidentified	Decapoda	1.7
Metridium giganteum	Anthozoa	1.7
Lophelia californica	Anthozoa	1,6
Sponge, white encrusting	Porifera	1.5
Stomphia didemon	Anthozoa	1.6
Florometra serratissima	Crinoidea	1.3

A recent study on the California OCS looked at invertebrate and algal communities existing on offshore oil and gas platforms (CSA 2006). The study determined that the dominant taxa at Platform Irene, based on total density, included *Metridium senile*, *Mytilus californianus*, *Tetraclita squamosa*, *Balanus* spp., *Anthopleura elegantissima* (rosy morph), and calcareous worm tubes. *Metridium senile* had the highest frequency of occurrence (59 out of 64 photographs), followed closely by *Mytilus* spp. and a yellow encrusting sponge. *Metridium senile* exhibited the highest average density per occurrence at 331 individuals/0.0625 m2, with a dominant presence in across most of the platform leg. The next highest average densities were significantly lower, exhibited by calcareous worm tubes, *Mytilus californianus*, and *Tetraclita squamosa*, at 52, 43, and 42 individuals/0.0625 m2, respectively (CSA 2006).

Two surveys of hard-bottom habitats in the northern Santa Maria Basin off the coast of the Point San Luis - Montana de Oro area were conducted in 1999. The goal of the surveys was to characterize hard-bottom communities in submarine cable corridors proposed for installation in 2000. Twenty-two transects were surveyed at water depths ranging from 35 to 125 m. Relief height ranged from 0.5 m to 35+ m.

The species in the survey area were similar to those found on the CAMP, Phase II. However, there were substantial differences in dominant species and epifaunal percent cover. While anthozoa was the most common taxon as found in CAMP Phase II, percent cover of species such as *Stylantheca porphyra* (purple encrusting hydrocorals), *Balanophyllia elegans* (orange cup coral), *Paracyathus stearnsii* (brown cup coral), *Corynactis california* (club-tipped anemone), and *Epizoanthus* sp. (zoanthid anemones) were much higher (Morro Group, 2000). Percent cover typically reached 100%. At higher relief locations, these species (especially *Corynactis*) formed a solid carpet that extended for hundreds of meters. *Stylaster californicus* (formerly *Allopora californica*) or California hydrocoral, also occurred in the survey area at water depths <45 m.

Refuges, Preserves, Marine Sanctuaries, and Coastal National Monuments

Marine protected areas (MPAs) in the United States are widely used as a tool for helping conserve the nation's wealth of natural and cultural resources for all Americans. These resources, including coral reefs, kelp forests, whales, shipwrecks, and a wide variety of marine life in the oceans, coasts, and Great Lakes, are vital to the economic sustainability of the nation. MPAs provide recreation and economic opportunities, help sustain critical habitats and marine resources, and act as an "insurance policy" by helping protect marine resources from human impacts.

Marine Protected Areas are broadly defined "any area of the marine environment that has been reserved by Federal, State, territorial, tribal or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (Executive Order 13158, May 2000).

In 1999, the California Coastal Marine Life Protection Act (MLPA) was passed in response to a need to redefine and improve the array of MPAs existing in California waters. In contrast to previous legislation, one of the primary goals of the MLPA is to "protect representative and unique marine life habitats in California waters for their intrinsic value." The MLPA states that "marine life reserves" (defined as no-take areas) are essential elements of an MPA system because they "protect habitat and ecosystems, conserve biological diversity, provide a sanctuary for fish and other sea life, enhance recreational and educational opportunities, provide a reference point against which scientists can measure changes elsewhere in the marine environment, and may help rebuild depleted fisheries." By definition, the underlying change from the establishment of an MPA is a reduction in fishing effort within the MPA and a reduction in the removal of organisms due to fishing. Those species likely to benefit by a decrease in the level of harvest are those that are directly targeted by fisheries as well as those which are caught incidental to fishing for the target species (bycatch) and which cannot be returned to the water with a high rate of survival. Marine protected areas include state marine reserves, state marine parks and state marine conservation areas.

Near Point Arguello, the Vandenberg State Marine Reserve (formerly the Vandenberg Marine esources Protection Act Ecological Reserve) is a no-take area that covers approximately five miles of shoreline and nearshore waters. It was established in 1994 pursuant to the California Marine Resources Protection Act of 1990 "to provide for scientific research related to the management and enhancement of marine resources". Its role as an ecological reserve is to allow scientific research on the management and enhancement of marine resources. The Reserve includes area of hard- and softbottom habitat and is the site of several studies related to marine species and benthic habitat.

Additionally, the Vandenberg State Marine Reserve (SMR) contains the highest density of black abalone along the southern California mainland. The area supports large kelp beds and diverse intertidal and subtidal communities. The kelp beds and rocky outcroppings provide excellent habitat for abalone. Harbor seal haul-out areas are located west of Point Arguello Boathouse, at Jalama, and at Point Conception. Several species of seabirds nest at Point Arguello, Rocky Point, and Point Conception, and the endangered California brown pelican is often found feeding in the area. Grey whales pass directly through the area twice each year during migration.

The California Coastal National Monument, established on January 11, 2000, was established to protect the geological features, unique biota, vegetative communities, and forage and breeding habitats of these lands. The monument includes:

" …all unappropriated or unreserved lands and interests in lands owned or controlled by the United States in the form of islands, rocks, exposed reefs, and pinnacles above mean high tide within 12 nautical miles of the shoreline of the State of California."

The California Coastal National Monument (CCNM) includes over 11,500 rocks, islands, exposed reefs, and pinnacles off the California Coast totaling approximately 883 acres along 840 miles of coastline. (It does not include the major islands, such as Santa Catalina and the other Channel Islands, the Farallon Islands, or the islands of San Francisco Bay). Prior to establishment as a National Monument, the lands covered by the monument were managed as the California Rocks and Islands Wildlife Sanctuary (1983) by the Bureau of Land Management (BLM). In 1990 their status was further defined as an "Area of Critical Environmental Concern" (ACEC). This special designation applied to all rocks, pinnacles and reefs along the coast of California, from Oregon to Mexico. The ACEC designation increased the visibility and management protection of the wildlife sanctuary and ensured that the wildlife values associated with these lands were not overlooked in the BLM's everyday operations. These lands had already been withdrawn from mining, mineral leasing, settlement, and sale under land laws that established the California Islands Wildlife Sanctuary in 1983.

These islands and rocks comprise a narrow flight lane in the Pacific flyway, providing protected nesting sites as well as feeding and perching areas. It is estimated that the rocks along the coastline are used by over 200,000 seabirds, including the endangered Brown Pelican, Least Tern and Peregrine Falcon. They also provide rest stops and feeding and breeding habitat for sea lions, elephant seals, sea otters and harbor seals.

Since 1983, the wildlife sanctuary has been managed by California Department of Fish and Game (CDFG) through an interagency memorandum of understanding (MOU) with the BLM. The Department of Fish and Game regulated public use, allowing only that which is compatible with the protection of the wildlife resources. Specifically, CDFG prohibited removal of products which may have commercial values and limits activities during the pelagic bird nesting seasons which are detrimental to breeding. In the spring of 2000, the BLM, California Department of Fish and Game, and California Department of Parks and Recreation signed a new MOU to work jointly to manage the monument, develop a greater understanding of its resources, and provide information to the public. This MOU was signed by the State Secretary for Resources in 2002 and a Resource Management Plan (RMP) for the California Coastal National Monument was approved in September 2005.

Regardless, potential impacts from the proposed project on the CCNM could occur. These would be limited to potential oil spills from the platforms or pipeline, and produced water impacts. Produced water discharges would be regulated by the existing general NPDES permit, and potential impacts from these discharges would decrease with increasing distance from the platform. Since rapid initial dilution occurs within the first 100 m of the discharge beneath the platform, adverse impacts from produced water discharge on lands of the CCNM are unlikely.

Potential Impacts from oil spills would occur through exposure and accumulation of toxic oil components, or through smothering or coating. Smothering and coating are the primary concerns that would affect intertidal areas or areas where birds and marine mammals are present, as would be the case with the CCNM lands and habitat. Oil and oil components can reduce growth and photosynthetic capabilities of phytoplankton, and can cause mortality or alter metabolism and reproductive rates in zooplankton (Spies 1985). Rocky intertidal habitats could be smothered by oil, and intertidal organisms may be further impacted by remediation methods. Impacts to marine mammals and birds that utilize CCNM lands for haul-outs and rookeries could also occur. Marine mammal impacts will vary depending on the severity of the spill, and the sensitivity of the species due to differences in modes of thermoregulation, diet, and activity patterns (Geraci and St. Aubin 1990). Oil spill impacts to sea otters and marine and shore birds are historically particularly well documented. While laboratory studies indicate that oil is also highly toxic to pinnipeds, large scale mortality is seldom seen in these animals after oil spills (St. Aubin 1990). Abandonment of bird rookery and haul-out sites may also occur during oil spill cleanup activities.

3.5.1.2 Terrestrial and Freshwater Biology

Terrestrial Habitats and Biota

The native vegetation of the project area is composed mainly of shrub, oak woodland, modified grassland communities, agricultural lands, and Burton Mesa chaparral, distributed in a mosaic pattern over coastal terraces, dunes and bluffs, and through interior hills. Coastal and interior wetlands, and riparian woodlands are limited in extent in the project area, and are associated with the Santa Ynez River, tributary streams and coastal dunes. Evergreen forest communities are restricted to moister and cooler mountain environments, such as crests, ravines, and north-facing slopes. This habitat type is not common in the project area except for remnant eucalyptus stands that are classified as evergreen forests for the purposes of this analysis. Evergreen forests, dune, oak and riparian woodland, native grassland and wetland communities have decreased in area within the project area over time due to several factors including:

- A trend toward a warmer, more arid climate over geologic time,
- Changes in the frequency and distribution of wildfires since colonization of the area by Native Americans and European descendants,
- Grazing by non-native ungulates, and
- Agricultural and other development trends, including land clearing and grading.

Of the native vegetation species commonly found in the project area, many plant species are restricted in distribution (endemic) to the project area and/or reach their southern or northern mainland distributional limits in this area. Many of the plant species endemic to the project area have been listed by the USFWS, the California Department of Fish and Game (CDFG), or the California Native Plant Society (CNPS) as being rare, threatened or endangered. SBC P&D Department has also identified some plant species as being of local concern. The term "rare plant" as used in this report refers to plants listed by one or more of these groups.

Wildlife species distributions are determined largely by the distributions of their preferred habitats. Many species are restricted to one or a small number of plant communities, and often require additional special environmental features (e.g., rocky cliffs as nesting sites for certain birds) in order to complete their life cycles. The project area is characterized by a moderate degree of topographic complexity and a variety of plant community types that provide considerable wildlife habitat diversity. The combination of habitat diversity, and geographic location in a climatic transition zone and relatively undisturbed condition, are factors that contribute to the diverse assemblage of amphibians, reptiles, mammals, and birds found in the project area.

Within the geographic limits of the onshore project area, Burton Mesa, the Santa Ynez River, San Antonio Creek, Santa Maria/Sisquoc Rivers and Nipomo Creek support mainly natural communities, although some areas are used for agricultural activities including grazing and cultivated crops. In particular along the Santa Ynez River and at the base of the Purisima Hills, near the pipeline crossing of San Antonio Creek, there are extensive agricultural lands.

Important biological features within the geographic limits of the onshore project area include:

- Coastal beach and dune habitats between the Santa Ynez River mouth and Wall Beach, approximately a mile north of it, support rare plants (see Section 5.2.1.3 for the definition of "rare plant" as used in this report), and are used seasonally by federal and state-listed, threatened and endangered wildlife species including the California least tern (roosting, nesting, and foraging), California brown pelican (roosting), and western snowy plover (nesting and wintering) at Wall Beach, as well as beach/dune areas south of Wall Beach. The coastal beach and dune area has recently been designated by the U.S. Fish and Wildlife Service (USFWS) as critical habitat for the western snowy plover (USFWS 2000d).

- Coastal wetlands and riparian woodlands near the Santa Ynez River mouth include a nesting site and feeding area for the endangered California least tern and the endangered southwestern willow flycatcher. These habitats are also known to support several species of rare plants, amphibians, birds, and fish. Coastal beach, dune, estuarine and freshwater wetland, and riparian woodland habitats are all protected by the Santa Barbara County Coastal Plan policies (1982).

- The Santa Ynez River, a perennial stream listed in the Santa Barbara County Conservation Element (1979, as amended 1994) and Coastal Plan (1982), and the Santa Maria River, an intermittent river, provide habitat for the federally listed endangered Southern California steelhead trout, *Oncorhynchus mykiss irideus*. The rivers have also been recently designated by NOAA Fisheries (formerly the National Marine Fisheries Service (NMFS)) as critical habitat for the steelhead (NMFS 2000). Freshwater portions and tributaries to the rivers, including adjacent freshwater wetlands may also support the federally listed (threatened) California red-legged frog, *Rana aurora draytonii*. Its critical habitat has recently been designated by the USFWS (2001). The critical habitat areas for the California red-legged frog include Oak Canyon, a tributary to the Santa Ynez River that is crossed by the pipeline array. The tidewater goby, *Eucyclogobius newberryi* is an estuarine species known to inhabit the Santa Ynez River and Santa Maria River estuaries. It is currently afforded full protection under the Federal Endangered Species Act, but is under review by the USFWS for de-listing north of Orange County; its critical habitat has not been proposed nor designated.

There are also several intermittent blue-line streams, as indicated on 7.5 minute USGS quadrangles, within the project area that the existing pipeline crosses or is parallel to. SBC creeks include San Antonio Creek, and several unnamed tributaries in Graciosa Canyon adjacent to Highway1/135, Pine Canyon Creek, Orcutt Creek and an unnamed tributary to the Betteravia Lakes near the Santa Maria Airport, and Nipomo Creek in San Luis Obispo County.

Vernal pools (seasonal wetlands), protected by the SBC's Coastal Plan policies, occur in the vicinity of the pipeline corridor. Vernal pools, and their surrounding oak savanna habitats in central and northern SBC, particularly in the Purisima Hills and Santa Rita Hills are known to support populations of the California tiger salamander, a distinct vertebrate population segment that was recently listed as endangered by the USFWS (2000a&b). A vernal pool complex located on the grounds of the Lompoc Federal Penitentiary (south of the pipeline corridor) is also known to support populations of tiger salamanders; however the individuals found there are an introduced species (*Ambystoma tigrinum*), rather than the native, listed species (*Ambystoma californiense)* (Shaffer 2000).

Coast live oak woodland, Bishop pine forest, and Burton Mesa chaparral plant communities are also considered protected habitats under the Santa Barbara County Conservation Element (1979, as amended 1994). The latter two habitats mentioned above are comprised of relatively large numbers of regionally endemic and rare plant species, especially in the vicinity of Vandenberg Village, through the Purisima Hills and along Harris Grade to San Antonio Creek.

Further, a review of Meade (1999) also showed that several eucalyptus and Monterey pine habitats in the project area support transitory basking, autumnal, or overwintering aggregation sites for Monarch butterflies (*Danaus plexippus*), a species of local concern. Specifically, trees around the abandoned water treatment plant east of 13th Street on VAFB, Waller County Park, several eucalyptus windrows (the Airport Complex) around Foster Road, California Boulevard, Pioneer Park, and Preister Park in SBC support substantial populations of Monarch butterflies. The Airport Complex was also identified as an important autumnal aggregation site by Calvert (1991) and is considered a sensitive habitat area due to its use by Monarch butterflies and raptors.

San Antonio Creek, a perennial stream listed in the Santa Barbara County Conservation Element (1979, as amended 1994) and Coastal Plan (1982), provides habitat for the federally listed endangered unarmored threespine stickleback, Southern California steelhead, and tidewater goby. The creek has also been recently designated by NOAA Fisheries as critical habitat for the steelhead (NMFS 2000) based on its ocean connection. However, steelhead surveys conducted from 1999 to 2000 did not report any steelhead; historical occurrence has not been documented for San Antonio Creek, and the habitat has been characterized as poor to marginal in a recent steelhead habitat evaluation study by Swift in 2000 (N. Read Francine, VAFB 2002). The creek and adjacent uplands also support the federally listed (threatened) California red-legged frog. Its critical habitat has recently been designated by the USFWS (2001) and includes San Antonio Creek downstream of Harris Grade Road. The final rule on critical habitat excludes the portion of San Antonio Creek on VAFB because of the protective measures included in VAFB's Integrated Natural Resources Management Plan. Therefore, there is no designated critical habitat for California Red-legged frog on VAFB (N. Read Francine, VAFB 2002). The tidewater goby, although currently afforded full protection under the Federal Endangered Species Act, is under review by the USFWS for de-listing; its critical habitat has not been proposed nor designated, but it is known to occur in coastal estuaries including the mouth of San Antonio Creek. Southwestern pond turtles also inhabit this creek.

The Santa Maria/Sisquoc Rivers with a lagoon at the coast provides habitat for the federally listed endangered tidewater goby, Southern California steelhead (migratory passage of adults and juveniles), and La Graciosa thistle. Areas with perennial water sources along the river support the federally listed threatened California red-legged frog. Nipomo Creek, a tributary to the river, also supports the California red-legged frog.

Los Berros Creek, a tributary to Arroyo Grand Creek, provides habitat for the California red-legged frog, South-Central Coast steelhead, and southwestern pond turtles.

For non-avian wildlife, species and subspecies names follow those provided in the California Natural Diversity Database (CNDDB 2005), and plant species names are as listed in Hickman (1993). Common names of plants follow Smith (1998). Avian species are identified by common name only following current nomenclature given in the American Ornithologist's Union Checklist of Birds, Seventh Edition (AOU, 1998).

Table 3.5.13 is a list of sensitive plant and wildlife species and their status and includes a brief description of their habitat and potential occurrence within the project area. Table 5.2-6 of the 1985 Point Pedernales EIR/EIS, Technical Appendix F (Terrestrial and Aquatic Biological Resources) lists all of the sensitive species potentially present in the proposed project area. The Appendix F table includes a complete list of the avian California species of concern not listed below.

Table 3.5.13 Sensitive Species Potentially Occurring in the Proposed Projects Areas

Species	Status Fed/State/ CNPS	Habitat and Occurrence in Project Area
Federally-listed, State-listed, or CNPS-listed Plant Species		
Cirsium loncholepis La Graciosa thistle	E/T/1B	Wet soils surrounding dune lakes or dune ponds, and moist dune swales. A historical record for this species is present along the pipeline corridor in La Graciosa Canyon (CNDDB, 2005), but it has not been observed at this site in recent years. Suitable habitat and known occurrences of this species occur in downstream habitats, especially at the mouth of the Santa Maria River, which currently supports the largest known population of La Graciosa thistle.
Cirsium rhothophilum Surf thistle	-/T/1B	Limited to crests and valleys of stabilized, sometimes active foredunes. Suitable habitat is within project area. This species has been recorded in the foredunes crossed by the pipeline (CNDDB 2005).
Clarkia speciosa ssp. *Immaculata* Pismo clarkia	E/R/1B	Occurs in sandy soils in openings within chaparral and oak woodland habitat. Appropriate habitat for this species is present and it has been recorded near Summit Pump Station (CNDDB, 2005).
Cordylanthus rigidus ssp. *Littoralis* Seaside bird's-beak	-/E/1B	Sandy soil in coastal dune and coastal habitats. Suitable habitat for this species is present in the project area and has been recorded at several locations on the Lompoc Oil Field close to the pipeline (CNDDB 2005).
Dithyrea maritima Beach spectaclepod	-/T/1B	Occurs in widely scattered locations on coastal dunes. Suitable habitat is present within project area. This species has been recorded in the foredunes crossed by the pipeline (CNDDB 2005).
Eriodictyon capitatum Lompoc yerba santa	E/R/1B	Maritime chaparral communities. Suitable habitat is within project area.
Layia carnosa Beach layia	E/E/1B	Historically located within the Santa Ynez River dune system. Has not been seen in this location since 1929 (USFWS, 1992a). However, it was relocated on South VAFB by D. Keil during the 1990's (personal communication Gillespie 1999).
Rorippa gambelii Gambel's watercress	E/T/1B	Freshwater or brackish marsh habitats at the edge of lakes or along slow flowing streams. Known to occur in very few sites. Is known to occur at isolated location on VAFB but is not likely to occur within project area.
Federally-listed or State-listed Wildlife Species		
Oncorhynchus mykiss irideus Southern steelhead	E/CSC (Southern ESU) T/CSC (South-Central ESU)	Steelhead (sometimes called steelhead trout) are known to occur in the Santa Ynez River where they are the focus of ongoing restoration and management activities. Most of the historic spawning grounds are not available due to the presence of the Bradbury Dam. Steelhead also may use San Antonio Creek, the Santa Maria River, and Los Berros Creek.
Eucyclogobius newberryi Tidewater goby	E/CSC	Isolated populations inhabit California coastal lagoons, including the mouth of the Santa Ynez River, San Antonio Creek, and the Santa Maria River.

Table 3.5.13 Sensitive Species Potentially Occurring in the Proposed Projects Areas

Species	Status Fed/State/ CNPS	Habitat and Occurrence in Project Area
Gasterosteus aculeatus williamsoni Unarmored threespine stickleback	E/E	Present in San Antonio Creek, primarily downstream of Barka Slough.
Rana aurora draytonii California red-legged frog	T/CSC	Occurs in freshwater marshes and streams, usually associated with pools of water exceeding 0.5 m in depth. Recent observations of this species have been made by Bland and Meredith (2000) on the Santa Ynez River mainstem as well in ponds on the Lompoc Federal Penitentiary grounds. It has been observed in Santa Lucia Canyon near the Pine Canyon gate. This species also occurs in San Antonio Creek, along the Santa Maria River, in Nipomo Creek, and in Los Berros Creek.
Ambystoma californiense California tiger salamander	E/CSC	Breeds in vernal pools in Los Alamos, and Santa Rita valleys, Purisima and Santa Rita hills, and east of Orcutt in the Santa Maria Valley, but spends a majority of its life cycle in upland burrows within oak savanna or stabilized dune scrub habitats. This species is not believed to be present in the area that could be affected by the project.
Pelecanus occidentalis californicus California brown pelican	E/E	Common along the California coast. Observed year-round near the Santa Ynez River mouth. Largest flocks (several hundred individuals) occur in summer. Forages in estuary and offshore waters.
Falco peregrinus anatum American peregrine falcon	--/E	Frequents open country such as grasslands, agricultural areas, ponds, sloughs, river mouths and seacoasts for foraging activities. Regular observations of this species have been reported at the Santa Ynez River mouth. Historically nested on south VAFB, and unconfirmed report of nesting in 1993 near Point Arguello on VAFB (Lehman 1994). Nesting confirmed by tagging studies of the California Commercial Spaceport in the mid-1990's.
Charadrius alexandrinus nivosus Western snowy plover	T/CSC	Winters and breeds along beaches of the eastern Pacific to British Columbia. Locally, this species is known to winter and breed north and south of the Santa Ynez River, and is known to breed at Wall Beach around the area where the pipeline array makes landfall.
Empidonax traillii extimus Southwestern willow flycatcher	E/CSC	This species is known to breed from the Santa Ynez River southward. Nesting along the Santa Ynez River typically occurs in willow riparian habitats. Two populations along the Santa Ynez River were discovered between 1986 and 1991. One extends from just west of Buellton to several miles downstream, and the second extends from the Floradale Avenue bridge in Lompoc to the last stand of willows before the river. Additional populations may exist on private lands between these two areas, which have not been surveyed. Known to winter in Mexico, Central America, and possibly northern South America.

Table 3.5.13 Sensitive Species Potentially Occurring in the Proposed Projects Areas

Species	Status Fed/State/ CNPS	Habitat and Occurrence in Project Area
Federally-listed or State-listed Wildlife Species		
Sterna antillarum browni California least tern	E/E	Nests at isolated beaches near bays and lagoons, San Francisco Bay to Baja California. Present in project area from May to September. Historically nested in foredunes near the Santa Ynez River mouth, forages in estuary and nearshore waters. The Santa Ynez River estuary is a regional post-breeding staging area where numerous individuals gather and forage during late summer prior to their southward migration.
Passerculus sandwichensis beldingi Belding's savannah sparrow	-/E	Common but local permanent residents associated with pickleweed habitat, restricted to coastal salt marshes from the vicinity of Goleta and Devereux sloughs (southern Santa Barbara County) southward to San Diego County (Garrett and Dunn 1981). The subspecific status of savannah sparrows found in salt marshes at the Santa Ynez River mouth is probably either the *alaudinus* subspecies, which is known from Morro Bay (Garrett and Dunn 1981, Lehman 1994) or intergrades between *alaudinus* and *beldingi* (Lehman, 1994).
Other Sensitive Plant Species		
CNPS List 1B Plant Species (Rare, Threatened or Endangered in California and Elsewhere)		
Acrtostaphylos purissima Purisima manzanita	-/-/1B	Known to occur within the Burton Mesa chaparral, along the project pipeline corridor.
Arctostaphylos rudis Sand mesa manzanita	-/-/1B	Known to occur within the Burton Mesa chaparral, along the project pipeline corridor.
Arctostaphylos tomentosa ssp. *Eastwoodiana* Eastwood's manzanita	-/-/1B	Sandy soils on mesas in chaparral community. This species has been recorded in suitable habitat north of the LOGP in the Purisima Hills and on Burton Mesa (CNDDB 2005).
Arctostaphylos wellsii Wells' manzanita	-/-/1B	Occurs on sandstone in chaparral habitat. Present in the project area, south of Los Berros Creek, but not likely to occur within the pipeline corridor.
Delphinium parryi ssp. *Blochmaniae* Dune larkspur	-/-/1B	Occurs on sandy soils in chaparral and coastal scrub communities. Suitable habitat is present but none have been recorded within the project area.
Erigeron blochmaniae Blochman's leafy daisy	-/-/1B	Scattered about active and stabilized dunes. This species is present in the coastal dunes within project area, and has been recorded in the foredunes crossed by the pipeline (CNDDB 2005).
Lasthenia glabrata ssp. *Coulteri* Coulter's goldfields	-/-/1B	Occurs in salt marsh communities. Suitable habitat is present at the mouth of the Santa Ynez River, but none have been recorded.
Monardella crispa Crisp monardella	-/-/1B	Scattered mostly on unstable, active coastal dunes. Suitable habitat for this species is present in the foredunes and transition habitats and it has been recorded in the project area (CNDDB 2005). However, its distribution south of Point Sal is questionable and may be confused with *M. frutescens* (Smith 1998).

Table 3.5.13 Sensitive Species Potentially Occurring in the Proposed Projects Areas

Species	Status Fed/State/ CNPS	Habitat and Occurrence in Project Area
Monardella frutescens San Luis Obispo monardella	-/-/1B	Mostly located on stabilized dunes, coastal scrub. Suitable habitat for this species is present and it may occur within project area.
Scrophularia atrata Black-flowered figwort	-/-/1B	Scattered in coastal scrub and Burton Mesa chaparral habitats. Suitable habitat for this species is present and it has been recorded within pipeline corridor west and north of the LOGP (CNDDB 2005).
CNPS List 4 Plant Species (A Watch List)		
Abronia maritima Red sand verbena	-/-/4	Commonly scattered on upper beaches and primary dunes along ocean. Suitable habitat is present and this species was observed in the foredunes crossed by the pipeline.
CNPS List 4 Plant Species (A Watch List)		
Agrostis hooveri Hoover's bent grass	-/-/4	Occurs on dry sandy soils in open chaparral and oak woodland communities. Suitable habitat is present and this species may occur within project area.
Malacothrix incana Dunedelion	-/-/4	Frequent on dunes. Suitable habitat is present and this species was observed in the foredunes crossed by the pipeline.
Wildlife Species of Concern in the Project Area		
Danaus plexippus Monarch butterfly	-/CSC	Occurs in eucalyptus near the abandoned water treatment plant on VAFB east of 13th street, between Basins 8 and 9, Waller County Park, several eucalyptus windrows (known as the Airport Complex) around Foster Road, California Boulevard, Pioneer Park, and Preisker Park in SBC (Meade 1999).
Scaphiopus hammondi Western spadefoot toad	-/CSC	Occurs in dune scrub habitats in the Orcutt and Santa Maria valleys (CNDDB 2005).
Phrynosoma coronatum frontale California horned lizard	-/CSC	Occurs in dune scrub habitats in the vicinity of Lompoc and in the Burton Mesa Chaparral (CNDDB 2005).
Thamnophis hammondii Two-striped garter snake	-/CSC	Habitat includes freshwater streams and rivers bordered by riparian woodlands from South Coastal and Transverse ranges to the coast. Suitable habitat for this species occurs within Oak, Santa Lucia, and Pine Canyons, and San Antonio Creek and Los Berros Creek.
Clemmys marmorata pallida Southwestern pond turtle	-/CSC	Occurs in freshwater ponds and slow moving streams. Suitable habitat for this species occurs in Oak Canyon, Santa Lucia Canyon and Pine Canyon, as well as in off-channel areas of the mainstem of the Santa Ynez River. Known to occur in Pine Canyon on VAFB (CNDDB 2005), San Antonio Creek, and Los Berros Creek.
Dendroica petechia Yellow warbler	-/CSC	Occurs in dense willow riparian habitat. Likely breeder in project area. Known breeder along the Santa Ynez River (SAIC unpublished field notes).
Icteria virens Yellow-breasted chat	-/CSC	Inhabits dense willow riparian habitat. Likely breeder in project area. Known breeder along the Santa Ynez River (SAIC unpublished field notes).
Accipiter cooperi Cooper's hawk	-/CSC	Inhabits open woodlands and riparian corridors. Nests in woodland. Likely breeder in project area. CSC

Table 3.5.13 Sensitive Species Potentially Occurring in the Proposed Projects Areas

Species	Status Fed/State/ CNPS	Habitat and Occurrence in Project Area
		designation applies to nesting birds.
Antrozous pallidus Pallid bat	-/CSC	Inhabits much of western United States, widespread in California. Feeds largely on flightless insects and invertebrates such as Jerusalem crickets, scorpions, and June beetles which it captures on the ground (Jameson and Peeters 1988). Known to roost under the 13th Street Bridge (N. Read Francine, VAFB 2002).
Myotis yumanensis Yuma myotis	-/CSC	Occurs throughout California, especially common along wooded canyon bottoms (Jameson and Peeters 1988). Forages on flying insects, such as small moths, beetles, and midges.). Known to roost under the 13th Street Bridge (N. Read Francine, VAFB 2002).

Sources:
CNDDB 2005. California Natural Diversity Database
CNPS 1994. California Native Plant Society Inventory
Lehman 1994. Birds of Santa Barbara County
Smith 1998. A Flora of the Santa Barbara Region, California.
Species Status is determined by the USFWS, NOAA Fisheries, or CDFG
E *Endangered: In danger of extinction throughout all or a significant portion of its range.*
R *Rare.*
T *Threatened: Likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.*
CSC *California Species of Concern.*
ESU *Evolutionarily Significant Unit*
1B *Plants considered by CNPS as rare, threatened, or endangered in California and elsewhere.*
4 *Plants of limited distribution, a watch list.*
-- *No special status.*
The USFWS no longer maintains a list of Category 2 or Category 3 Candidates for listing as threatened or endangered (50 CFR Part 17; Federal Register 1996, Vol. 61, No. 4, 7596). Several bird and insect species that are known or expected to occur within the project area were formerly identified as Category 2 Candidates for federal listing as threatened or endangered and are not included in this table, unless their sensitivity has been recognized by another entity such as CDFG or CNPS. Since these species are likely to be limited in their distribution, they have been identified in the text under the habitat in which they would be expected to occur, as are species of local concern.

Vegetation and Wildlife Communities

The basic vegetation and wildlife community types of the project area are described below by habitat type. Appendix A of the 2002 FEIR (SBC 2002) shows important habitat areas and areas that support regionally rare botanical resources.

Sandy Beach and Foredunes

Foredunes are an especially well represented community along the north coast of SBC from Point Conception to Pismo Beach (in San Luis Obispo County). Some of the best-developed examples of this community in Southern California are found at VAFB. Dunes are poorly represented in other parts of SBC and Southern California in general. The sandy beaches along the coast of California typically consist of a narrow band of unvegetated beach just above the high water mark, followed by a sparsely vegetated area called pioneer dunes that eventually grades into well-developed foredunes and dune scrub transition away from the shore. The pioneer dunes typically consist of scattered, low hummocks with low growing, succulent herbs, that form spreading mats such as sea rocket (*Cakile maritima*), beachbur (*Ambrosia* *chamissonis)*, yellow sand verbena (*Abronia latifolia*) and red sand verbena (*Abronia maritima*), a CNPS List 4 species.

Inland, the hummocks become larger, higher and more vegetated creating the undulating topography characteristic of well developed coastal sand dunes. The vegetation becomes more diverse and, in addition to the typical pioneer dunes species, other common species include dune morning glory (*Calystegia soldanella*), beach evening primrose (*Camissonia cheiranthifolia),* dune saltbush (*Atriplex leucophylla*) and dunedelion *(Malacothrix incana)*, a CNPS List 4 species. In addition to the rare species already mentioned, other sensitive plant species restricted to the foredune habitats include the state-listed threatened surf thistle (*Cirsium rhothophilum*) and beach spectacle pod (*Dithyrea maritima*). Dune habitats are very fragile and easily disturbed by human activities. Disturbance of these communities has resulted in the displacement of native species by exotics such as ice plant (*Carpobrotus* sp.) and European beach grass (*Ammophila arenaria)*, historically planted as a method to control sand erosion. Low-growing forms of shrub species that commonly occur in dune scrub habitat, including mock heather (*Ericameria ericoides*), coast goldenbush (*Isocoma menziesii*) and loco weed (*Astragalus* sp.), are often found scattered in the more stabilized foredunes. Several rare plant species more commonly occur in dune scrub habitats but are sometimes found in foredune/dune scrub transition habitat areas, especially disturbed areas, include crisp monardella (*Monardella crispa)*, San Luis Obispo monardella (*Monardella frutescens*), and Blochman's leafy daisy (*Erigeron blochmaniae)*.

The pipeline landfall is at Wall Beach located just north of the mouth of the Santa Ynez River. The foredune habitat crossed by the pipeline supports large stands of iceplant as well as patches of European beach grass with smaller patches of native dune plants mixed in. Human activities, roads and facilities associated with VAFB operations, have likely contributed to the degradation of the foredunes habitat at this location. Sensitive plant species, including dunedelion and red sand verbena, were observed in the project area and several rare plant species have been reported from the project area. The Union Pacific Railroad track parallels the beach and crosses the pipeline corridor approximately 1,000 feet inland of the shoreline and corresponds to the transition of foredunes into coastal dune scrub habitat.

Sandy beach areas are important habitats for large numbers of shorebirds, gulls and feeding land birds, although only a few birds nest in these habitats. Some of SBC's most protected beaches are at VAFB. Due to historically low levels of use on VAFB, its beaches are relatively undisturbed and support the principal breeding localities remaining in SBC for the federally-listed endangered California least tern and western snowy plover. VAFB supports a significant proportion of the listed population of the western snowy plover (N. Read Francine, VAFB 2002). The endangered California brown pelican is also commonly observed on beaches and foraging in nearshore ocean waters and coastal bays; however, it does not breed on the California mainland. It is important to note that foredunes with coastal strand vegetation typically attract few birds; however, these habitats occasionally support a small subset of reptiles, amphibians and mammals characteristic of coastal scrub communities.

Coastal Scrub

Distinct forms of coastal scrub are present in the project area including coastal dune scrub and coastal sage scrub. Coastal bluff scrub is also a distinct scrub habitat that is well-represented in rocky areas of the north coast of SBC. However, this habitat is not present near the pipeline corridor and is not included in this discussion. Coastal dune scrub and coastal sage scrub have a few dominant species in common, but differ in site characteristics and associated species.

Coastal dune scrub is the dominant vegetation of the stabilized backdunes. This plant community is well represented north of Point Conception and absent from the south coast of SBC. Shrubs, sub-shrubs and herbs comprise this community including mock heather, seacliff buckwheat (*Eriogonum parvifolium*), deerweed (*Lotus scoparius*), dune lupine (*Lupinus chammissonis*), California aster (*Lessingia californica*), and croton (*Croton californica*). Rare species found in the dune scrub habitats include crisp monardella, Blochman's leafy daisy, and short-lobed broom-rape (*Orobanche parishii brachyloba*), all included on CNPS List 1B.

Coastal sage scrub is dominated by shrubs such as coyote brush (*Baccharis pilularis*), coastal sagebrush (*Artemisia californica*), and black, white and purple sages (*Salvia mellifera*, *S. apiana*, and *S. leucophylla*). Associated species include giant wildrye (*Leymus condensatus*), sticky monkey-flower (*Mimulus aurantiacus*), and California coffeeberry (*Rhamnus californica*). This plant community occurs on terraces, on canyon sides, and in foothills. It extends in some places well inland from the coast.

Coastal dune scrub is the primary habitat type along the pipeline corridor on sandy soils for approximately a half-mile inland of the foredunes transition. From here the vegetation is a mosaic of coastal dune scrub and coastal sage scrub with patches of other plant communities, such as grasslands. The coastal scrub habitats in this area have been invaded by iceplant and veldt grass (*Ehrharta calycina*), an aggressive, non-native perennial grass known to displace native species (Smith 1998). The pipeline corridor is adjacent to a road and much of the vegetation, both within and adjacent to the pipeline corridor, is disturbed and dominated by non-native species including veldt grass and iceplant and annual grasses. Coast goldenbush, a native shrub that often first colonizes disturbed areas, was often observed in the more disturbed areas. However, there are some areas adjacent to the pipeline that support high quality coastal scrub habitats with a diverse mix of native shrubs and low cover of non-native species. A large patch of alkali rye (*Leymus triticoides*), a native perennial grass, was observed adjacent to the pipeline corridor at Valve Site #2. Approximately one mile east of the landfall, the pipeline is exposed and suspended over a steep canyon. The vegetation in the canyon is riparian woodland (discussed below) with the coastal sage scrub, dominated by black sage, on upper slopes.

The vegetation along the corridor grades into a mosaic of coastal scrub and chaparral communities interspersed with non-native grasslands and other habitat types (discussed below) for most of the length of the pipeline. The pipeline ROW crosses large expanses of coastal sage scrub between 13th Street and Oak Canyon on VAFB and the western portion of the Lompoc Oil Field. The pipeline corridor within the oil field lease is largely vegetated and distinguished by man-made, above ground indicators. The pipeline corridor is still apparent in the vegetation as well as a corridor associated with a natural gas pipeline that runs directly adjacent to the Point Pedernales pipeline ROW. However, the area appears to be slowly recovering and cover of non-native species is very low. Protective plant cages and an abandoned irrigation system were observed associated with the pipeline corridor.

Coastal dune scrub, found along the north coast of SBC and in southwestern San Luis Obispo County, is characterized by relatively few breeding birds (e.g., Bewick's wren, California thrasher, white-crowned sparrow). Coastal sage scrub is more extensive and is known to support breeding activities of California quail, Anna's hummingbird, song sparrow, California towhee, greater roadrunner, Costa's hummingbird, rufous-crowned sparrow and white-crowned sparrow. Amphibians are scarce in coastal scrub habitats, but reptiles are often abundant. Larger mammals such as rabbits, coyote, raccoon, gray fox, skunk and bobcat are common in northern SBC and in the project area. The ringtail (*Basssariscus astutus*), an uncommonly encountered state-protected mammal, may occupy sites in this habitat near water and rocky outcroppings.

Grasslands
Grasslands are widespread on coastal plains and terraces, covering lower foothill slopes, and are common in valleys. Perennial native bunch grasses (such as *Nassella* spp.), which dominated these grasslands before the advent of grazing by non-native ungulates, are now restricted to remnant patches. Native grasslands are protected habitats pursuant to the SBC Coastal Plan (1982). Most grasslands of the study area are now dominated by non-native annual grasses, with non-native weedy species as well as native wildflowers as associates. The more common non-native annual grasses include wild oats (*Avena* spp.), bromes (*Bromus* spp.) and fescues (*Festuca* spp.). Grasslands of the project area have few endemic or rare species. Large areas of grassland can be found in the pipeline corridor east of Oak Canyon and near the LOGP. In addition, much of the pipeline corridor appears to be used for human access and non-native grasses and forbs are dominant within a large portion of ROW.

Bird species commonly observed in native and naturalized grassland communities include house finch, savannah sparrow, and western meadowlark. Grasslands in the vicinity of Point Sal Ridge (north of VAFB) are one of the last remaining breeding locations on the north coast of SBC of the grasshopper sparrow. A variety of raptors, including the white-tailed kite (a CDFG Fully-Protected species) forage in grasslands because they generally support large rodent populations. These rodent populations also serve as a food source for carnivores such as coyote, gray fox and bobcat. Mule deer, a native ungulate, are commonly observed grazing in grassland communities. Except in natural or artificial ponds, few amphibians occur in grassland communities; however, reptiles (primarily snakes) are more common inhabitants.

Chaparral
Chaparral is distributed widely within the study area. It covers large expanses of VAFB and the Burton Mesa terrace on sandy and shale soils. It is found interspersed with Bishop pine forest and coastal scrub on the upper slopes and crests of the Purisima Hills. Nipomo Mesa, north of the Santa Maria River, once supported large expanses of chaparral although due to development and intrusion by non-native species (planted and escaped), only remnant patches remain. The dominant plants are fire-adapted woody shrubs, many with limited distribution. Lompoc Yerba Santa (*Eriodictyon capitatum*), a federally-listed endangered species is associated with chaparral plant communities and occurs upstream of the pipeline corridor in Pine Canyon. Burton Mesa chaparral, a distinct form of chaparral characteristic of the sandy soils of Burton Mesa terrace and the nearby Purisima Hills, is noteworthy for the high rate of endemism in its flora. More than 20 plant species found in this community have restricted geographic distributions, including rare plants such as La Purisima manzanita (*Arctostapylos purissima*), sand mesa manzanita, (*Arctostaphylos rudis*), Eastwood's manzanita (*Arctostaphylos tomentosa* ssp. *eastwoodiana*), seaside bird's beak (*Cordylanthus rigidus littoralis*), Santa Barbara ceanothus (*Ceanothus impressus*) and black flowered figwort (*Scrophularia atrata*). Other associated species include

chamise (*Adenostoma fasciculatum*), toyon (*Heteromeles arbutifolia*), coast ceanothus (*Ceanothus cuneatus var cuneatus*), and coffee berry. Coast live oaks (*Quercus agrifolia*) are common among the Burton Mesa chaparral that surrounds the pipeline corridor; however these trees exhibit a distinctive, multi-trunk form, unlike live oaks in other areas of SBC. Pismo clarkia (*Clarkia speciosa* ssp. *immaculata*), federally-listed endangered and state-listed rare, and Wells' manzanita (*Arctostaphylos wellsii*), CNPS List 1b, are found in chaparral habitats near the project area, north of the Santa Maria River.

Burton Mesa chaparral is most commonly observed in the pipeline corridor east of Oak Canyon as the pipeline crosses the Burton Mesa Preserve north of the Lompoc Federal Penitentiary in a northeasterly direction, and north of the LOGP over Harris Grade. The Burton Mesa Preserve is an area approximately 6,000 acres in size that surrounds Vandenberg Village and extends generally from the eastern property line of VAFB and eastward to Mission Hills and bounded on the north and south by the LOGP and Highway 1, respectively. This plant community is the dominant feature between the VAFB eastern property line and the LOGP, and north of the LOGP over Harris Grade.

Characteristic lower elevation birds in chaparral habitats include the greater roadrunner, Anna's hummingbird, Bewick's wren, wrentit, California thrasher, California towhee, and lesser goldfinch. Bell's sage sparrow is closely associated with successional-stage Burton Mesa chaparral and may occur in proximity to some of the inland portions of the pipeline. This habitat is too arid for most amphibians, but supports a large diversity of reptiles including several species of lizards and snakes. Many species of small mammals (rabbit, striped skunk), and hence a number of larger, wide-ranging carnivores (gray fox, coyote, bobcat, ringtail, mountain lion) are also found in chaparral communities.

Oak Savanna and Woodland

Oak woodlands dominated by coast live oak cover many lower coastal slopes and canyons, as well as the moist interior hills. The trees in some places form a continuous canopy (woodland), while in other areas, trees are more scattered (savanna) and found in association with grassland and coastal sage scrub and chaparral species. Oak reproduction and regeneration over large areas of SBC, particularly valleys and foothills, is limited by current land use practices and conversion of lands previously used for grazing to vineyards. Individual oak trees are not currently protected by SBC policies on agriculturally zoned lands, nor on any lands in the County area unless there is a proposal for new development subject to SBC review. However, an oak tree protection program on these lands is currently under public review. A sudden oak death syndrome that affects apparently healthy adult oaks has been spreading southward from the San Francisco Bay Area and is a concern with regard to the long term future of oaks in coastal central California, including the project area. Along the pipeline corridor, there are a few areas in which the oak resources would be classified as oak savanna or oak woodland. Oak savanna typically consists of scattered oak trees with a grassland or herbaceous understory. Oak woodlands and forests usually exhibit a closed, or nearly closed canopy and are associated with an assemblage of understory species that differs from oak savanna habitats. Oak woodlands are more commonly observed on north facing (moister) slopes in SBC, an example of this habitat exists adjacent to and west of the pipeline corridor in Oak Canyon, north of the Santa Ynez River. The understory typically consists of shade-tolerant plants such as blackberry (*Rubus* spp.), gooseberry (*Ribes* spp.), snowberry (*Symphoricarpos mollis*) and a variety of ferns. Oak savanna habitat and small patches of oak woodland occur on the oil field west of the LOGP, and north and east of the Burton Mesa Preserve. Planted oak trees with protective tree cages were observed along the pipeline corridor near Oak Canyon and within the oil field.

Many species of wildlife utilize coast live oak woodland habitats. Representative bird species of oak woodlands include the acorn and Nuttall's woodpeckers, pacific-slope flycatcher, western scrub jay, oak titmouse, bushtit, Hutton's vireo, band-tailed pigeon, and several species of warblers. Oak savanna, with widely spaced trees among grassland or scrub-shrub communities support turkey vultures, red-tailed hawk, yellow-billed magpie, western bluebird, and other bird species. Moist shaded environments beneath the oaks harbor comparatively diverse populations of amphibians (salamanders and frogs), as well as reptiles (snakes and lizards). Many small mammals such as mice, Botta's pocket gopher, broad-footed mole, and dusky-footed woodrat, and larger species such as coyote, gray fox, raccoon, skunk, bobcat, feral pig, mule deer and mountain lion also frequent oak woodlands and savannas.

Oak savanna habitats in the Lompoc and Los Alamos valleys, the Purisima and Santa Rita Hills are also known to support populations of California tiger salamander. This species may also occur in the vicinity of Orcutt, near the Orcutt Pump Station, and is known to range up to one mile or more from breeding ponds (Trenham et al., submitted), but during non-breeding periods California tiger salamander live in burrows of rodent species such as ground squirrels and gophers. Due to conversion of these habitats from grazing to cultivated agriculture (vineyards), the amount of suitable upland oak savanna habitat has declined in recent years.

Evergreen Forests

Evergreen forest, specifically Bishop pine forest, is present along a segment of the pipeline that crosses the Purisima Hills north of the LOGP. The habitat is dominated by monotypic stands of Bishop pine interspersed with chaparral and coastal scrub on the slopes and other riparian woodlands in the lower canyons. Other species are present in openings in the pine stand including a number of endemic or rare plant species. Wildlife found in this habitat are species typical of oak woodland and chaparral communities similar to those species described above for the oak savanna and woodland community. Dense stands of eucalyptus and other planted trees may also be categorized as evergreen forest. However, since these habitats are not naturally occurring, they are included in the discussion below for Agricultural Lands and other Modified Habitats.

Coastal Wetlands

Coastal wetlands include saltwater, transitional (estuarine) and freshwater habitats near the mouth of the Santa Ynez River. Estuaries are characterized by low growing, often succulent species that exhibit zonation according to salinity and soil moisture gradients. A substantial estuary at the mouth of the Santa Ynez River supports an extensive pickleweed (*Salicornia virginica*) marsh that transitions into coastal dunes (to the west), riverine (to the south and east) and coastal sage scrub communities (to the north). Freshwater habitats support a diverse array of perennial herbs, including many tall reed-like plants such as cattails (*Typha* spp.) and bulrush (*Scirpus* spp.). Coastal wetlands are sensitive and susceptible to sedimentation, water pollution, terrestrial and marine oil spills, trampling and human activities that alter the natural influx of fresh or salt water. These habitats have declined significantly in area locally and statewide over many decades (Smith 1998, Jensen 1983). These habitats are protected by SBC's Coastal Plan

(1982), the California Coastal Act (1976), and in many cases the federal Clean Water Act (1972), because of their ecological importance, occurrence in jurisdictional wetlands, sensitivity and limited areal extent.

Coastal wetland habitats at the mouth of the Santa Ynez River are used by several federally-listed endangered species including the California brown pelican (bathing, preening, and loafing), California least tern (breeding and feeding), western snowy plover (breeding and feeding), and American peregrine falcon (feeding). This habitat also supports large concentrations of migrant and wintering herons, waterfowl, shorebirds, gulls and tern species. Coastal salt marsh is also the preferred habitat of the endangered light-footed clapper rail and the state-listed endangered Belding's savannah sparrow. However, the clapper rail is now restricted in SBC to Carpinteria Marsh, which now marks its northernmost extent. It was formerly found in Goleta and Devereux Sloughs, and may have occurred in the Santa Ynez River mouth estuary during pre-historic times (Lehman, 1994). Belding's savannah sparrow (*Passerculus sandwichensis beldingi*), a state-listed endangered species, is common in Goleta Slough, and occasionally in Devereux Slough and is not known from the north coast of Santa Barbara County or northward. The subspecific status of savannah sparrows found in the Santa Ynez River mouth salt marshes is probably either the *alaudinus* subspecies (Garrett and Dunn 1981, Lehman 1994) or intergrades between *alaudinus* and *beldingi* (Lehman, 1994).

Riparian Woodland

These streamside woodland habitats are dominated by dense growths of tall deciduous trees and shrubs including willows (*Salix* spp.), western sycamore (*Platanus racemosa*), cottonwood (*Populus* sp.), and white alder (*Alnus rhombifolia*). A large portion of the riparian woodlands in the project area are dominated by the deciduous arroyo willow (*Salix lasiolepis*). In some areas, the riparian woodland may be better classified as riparian scrub with lower growing willows, including shrubby forms of arroyo willow, and riparian shrub species, such as mulefat (*Baccharis salicifolia*) and coyote bush, are dominant. Riparian woodlands vary from narrow bands along streams in canyons to extensive floodplain groves. Although all perennial and some intermittent streams in the study area support riparian woodland or scrub habitats, the community is limited in area, and has been substantially reduced throughout Southern California by human activities such as development of urban and suburban areas, flood control practices, and agriculture. Riparian habitats are protected by SBC Comprehensive Plan policies (1982) because of their value as essential wildlife habitat and importance as buffers against flooding and erosion. The pipeline array parallels the Santa Ynez River for much of its length, turning north away from the river after crossing Oak Canyon. Riparian woodlands, occur along the Santa Ynez River, with substantial stands of trees east of 13^{th} Street on VAFB. The two tributaries to the Santa Ynez River, Oak Canyon and Santa Lucia Canyon (also crossed by the pipeline array), also support riparian woodland and scrub communities, with similar species composition as observed in the Santa Ynez River. Remnant stands of riparian woodlands also occur along San Antonio Creek and in portions of the unnamed tributaries in Graciosa Canyon, Orcutt Creek and Pine Canyon Creek near the Orcutt Pump Station. Dominant woody riparian species in these creeks include arroyo willow, mulefat and coyote bush.

Along the Santa Maria River, which is crossed by the pipeline ROW, mature riparian vegetation is lacking but stands of willows and freshwater marshes are found in scattered locations, primarily associated with agricultural drains or other freshwater sources. Well-developed riparian woodland and scrub habitats, as well as freshwater marshes, are present along Nipomo Creek and Los Berros Creek in San Luis Obispo County. In addition to willows, cottonwoods and sycamore, big-leaf maple (*Acer macrophyllum*) and box elder (*Acer negundo*) contribute to the riparian woodland canopy. The pipeline corridor parallels most of the length of Nipomo Creek and crosses the creek at two locations. Los Berros Creek flows near Summit Pump Station, the northern terminus of the proposed project.

Riparian woodlands have been much reduced in SBC and San Luis Obispo County during the 20^{th} century. Extensive areas remain along the Santa Ynez River in the vicinity of the project area, but these areas are threatened by ongoing agricultural activities and expansion of agricultural operations, and flood control activities. Riparian woodlands in the northern part of SBC support a large and diverse complement of migrant and resident breeding birds, including several species whose local populations have declined substantially in recent years (Cooper's hawk, Swainson's thrush, warbling vireo, yellow warbler, yellow-breasted chat), or have been extirpated as breeders along the south coast of SBC (tree swallow, Wilson's warbler). Many other birds are abundant, including species normally associated with foothill and montane woodlands. In contrast to other project area habitats, riparian woodlands support a diverse assemblage of amphibians (frogs, toads, salamanders). Wetlands adjacent to the Santa Ynez River support the threatened California red-legged frog, and may potentially support California tiger salamander; however, this species is most commonly associated with interior vernal pools and their associated oak savanna/grassland habitats. Wetlands and riparian woodlands along San Antonio Creek, the Santa Maria River, and Nipomo Creek support California red-legged frogs as well. Although there are no listed threatened or endangered reptiles expected in the project area, declining species that may occur in riparian woodlands include the southwestern pond turtle. Diversity of mammals in this habitat is relatively high. Common small mammals include shrews, mice, woodrats, gophers, rabbits, skunk, and ground squirrels. Riparian woodlands also provide excellent habitat for larger mammals including Virginia opossum, weasels, raccoon, bobcat, mule deer, and feral pigs (on VAFB).

Interior Wetlands

These include freshwater marshes and sloughs upstream from estuaries, inland vernal pools, seeps, and marshy places. Important plants include emergent aquatic and transitional wetland species. Along the pipeline corridor, several interior wetlands are traversed by the pipe array. These habitats occur on VAFB northwest of the pipe crossing at Highway 1, west of Vandenberg Village, and immediately west of Valve Site #9 adjacent to an agricultural field. Marshy areas are also present at scattered locations along the pipeline corridor adjacent to Highway 135, south of Orcutt. The interior wetland located at the intersection of Highway 1 and Santa Lucia Canyon Road is designated on the USGS Lompoc 7.5-minute quadrangle as an area where natural springs or seeps are present. The dominant plant species there include cattails, bulrush, willows, and ruderal vegetation. Other interior wetlands occur downslope of the pipeline corridor along Highway 135 and Graciosa Road. These wetlands support emergent aquatic species such as rushes and wet grassland communities. Vernal pools are also present in the project area south of the pipeline corridor on the Lompoc Federal Penitentiary grounds, approximately ½ mile south of the pipe array. All interior wetlands are important as wildlife habitat, and as traps or filters for sediment and pollutants. Interior wetlands and vernal pools receive protection by the federal Clean Water Act if they are not considered isolated waters and from recommended actions in SBC's Conservation Element.

The extent and quality of these habitats has diminished substantially over the 20th century, resulting in extirpation or significant reduction in local breeding populations of waterfowl and passerine bird species. Remnant marshy habitats support concentrations of migrant and wintering herons, waterfowl, shorebirds, gulls and terns. Marshes and vernal pools provide breeding habitat for native and non-native toads and frogs. Reptiles include the regionally declining southwestern pond turtle and two-striped garter snake. The federally-listed (threatened) California red-legged frog and California tiger salamander (endangered) are known from marshy habitats in the project area, and declining populations of the western spadefoot toad are also commonly associated with these habitats.

Ruderal Vegetation

Areas dominated by ruderal (i.e., weedy) species are generally highly disturbed habitats, such as roadsides, vacant lots, or lands subject to repeated ground disturbances. These species persist by being adapted to colonizing recently disturbed areas, and preventing establishment of native vegetation. Ruderal vegetation is present along the pipeline corridor, but is limited to areas where the pipeline crosses roads that already support this vegetation type.

Agricultural Lands and Other Modified Habitats

Agricultural lands in the study area are used primarily for livestock grazing, cultivated truck crops or wine grapes. Fields that produce truck crops are extensive within the Santa Ynez River floodplain, south of San Antonio Road along Highway 135, around the Santa Maria Airport, along the pipeline corridor adjacent to the Suey Junction, and adjacent to Nipomo Creek. Vineyards cover most of the eastern plateau of Graciosa Canyon along Highway 135, and vineyards are becoming more common in interior valleys, terraces and lower foothill areas with well-drained soils. Productive cultivated agricultural fields are also located adjacent to the pipeline corridor east of Valve Site #4 to the eastern side of Oak Canyon, and west of Valve Site #9 in the Santa Ynez River valley. Associated with agricultural fields or other development, large stands of planted eucalyptus (windrow) trees are also found in the study area. Some native habitats near the study area support livestock grazing; however, many of these grasslands, or coastal sage scrub habitats are being converted into vineyards.

Agricultural lands are utilized by a variety of introduced and native species. Commonly observed bird species include rock dove, yellow-billed magpie, European starling, Brewer's blackbird, house finch, and the like. Other common wildlife species are also observed on these lands, especially those that have adapted to human presence (coyote, skunk, opossum, squirrels, mice, voles). Extensive areas of planted trees (evergreen forests) including exotic species such as eucalyptus, tamarisk, and bottlebrush, as well as species native to California (Monterey Pine, Monterey cypress) have provided an important new winter food source for a number of bird species including several raptor species, and the Monarch butterfly (*Danaus plexippus*).

Monarch butterflies have been observed at several locations in the project area. These include the abandoned water treatment plant on VAFB east of 13th street, Waller County Park, several eucalyptus windrows (known as the Airport Complex) around Foster Road, California Boulevard, Pioneer Park, and Preisker Park in SBC (Meade 1999). Autumnal aggregations are typically occupied beginning in October but lack substantial numbers of butterflies by January. Overwintering aggregations often support thousands of individuals and are generally located in coastal drainages. The aggregations described above have been characterized as autumnal aggregations since very low numbers of Monarchs are observed at these sites after December (Meade 1999). This pattern suggests that Monarchs leave autumnal sites and move to overwintering aggregation sites for breeding activities that take place during the months of January, February and March.

Agricultural lands and their associated [planted] evergreen forests in the project area do not support any locally rare or unique bird populations or herpetofauna. These habitats however support a variety of land mammals, including small mammals (shrews, rats, mice, rabbits) and larger species (coyote, gray fox, raccoon, skunk, bobcat, mule deer). The regionally rare and declining western gray squirrel occurs in naturally occurring evergreen forests on VAFB and in the Purisima Hills in the vicinity of the project area.

In addition, modified habitats such as sewage treatment ponds, settling ponds, livestock ponds, and reservoirs associated with agricultural lands are frequented by waterfowl and shorebirds and have hosted a number of regional rare bird species over the years (such as semi-palmated, curlew and stilt sandpipers; Brewer's, red-winged and tri-colored blackbirds; and Franklin's gull). These man-made or modified habitats are also known to support federally-listed (threatened) California red-legged frogs which are known to range widely from water sources, and may potentially support the endangered California tiger salamander whose habitat includes portions of the project area (e.g., the Lompoc and Los Alamos valleys, and Purisima and Santa Rita hills). Populations of tiger salamander have also been reported from the Orcutt Valley and from vernal pools located east of Highway 101.

Aquatic Habitats and Biota

Aquatic habitats in the project area include the Santa Ynez River and its lagoon/estuary, tributaries to the Santa Ynez River (primarily intermittent and ephemeral), San Antonio Creek and its tributary in Harris Canyon, Orcutt Creek, the Santa Maria/Sisquoc Rivers, Nipomo Creek and its tributaries, Los Berros Creek, and a variety of ponds and springs. These habitats have been altered by human activities such as urban development, channelization and flood control, agricultural land use practices, water diversions and groundwater pumping, and runoff of pollutants from human activities in the watershed. The main tributaries to the Santa Ynez River in the project area are Oak Canyon, Santa Lucia Canyon, and Davis Creek.

Perennial and intermittent waters support aquatic invertebrate communities adapted to the water regime. These include aquatic insects, crustaceans, mollusks (primarily snails), and worms. The abundance and species composition of the invertebrates varies by season and habitat type. Algae and submerged and emergent plants range from scarce to abundant by season and habitat.

Both native and non-native fish are present in the Santa Ynez River (SYRTAC 2000b). Native freshwater species include threespine stickleback (*Gasterosteus aculeatus*), arroyo chub (*Gila orcutti*), and prickly sculpin (*Cottus asper*). Native estuarine and migratory species include tidewater goby (*Eucyclogobius newberryi*), Pacific lamprey (*Lampetra tridentata*), steelhead (*Oncorhynchus mykiss*), staghorn sculpin (*Leptocottus armatus*), starry flounder (*Platichthys stellatus*), topsmelt (*Atherinops affinis*), Pacific herring (*Clupea harengus*), and shiner perch (*Cymatogaster aggregata*). Except for the lamprey and steelhead, the estuarine and migratory species are found in the lagoon at the mouth of the river. Tidewater gobies and steelhead are discussed in more detail below. A number of non-native fish are present, primarily from stocking of Lake Cachuma. These include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), redear sunfish (*L. microlophus*), black crappie (*Pomoxis nigromaculatus*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), goldfish (*Carassius auratus*), carp (*Cyprinus carpio*), mosquitofish (*Gambusia affinis*), and fathead minnow (*Pimephales promelas*).

Native and non-native fish can occur in the streams tributary to the Santa Ynez River where flow is perennial or during intermittent flow through migration. Ponds may also have non-native species that have been introduced by landowners for mosquito control or recreational fishing.

San Antonio Creek is inhabited by both native and non-native fish species. The native species include prickly sculpin, arroyo chub, tidewater goby, unarmored threespine stickleback (*Gasterosteus aculeatus willimasoni*), and steelhead (Irwin and Soltz 1984, 1982; NMFS 2000). Staghorn sculpin and juvenile starry flounder have also been collected in the lagoon at the mouth of the creek (Irwin and Soltz 1984). Non-native species include carp and mosquitofish (Irwin and Soltz 1982). Steelhead, tidewater goby, and unarmored threespine stickleback are discussed in more detail below.

The Santa Maria River in the project area has intermittent flow, primarily during the rainy season and when releases are made from Twitchel Reservoir for groundwater recharge. The lagoon at the mouth of the river, however, is perennial and supports tidewater goby, threespine stickleback, mosquitofish, starry flounder, and staghorn sculpin (URS 1986).

The southwestern pond turtle (*Clemmys marmorata pallida*) is a California species of Special Concern. It inhabits fresh to brackish waters that are permanent to intermittent and feeds primarily on small aquatic invertebrates (Federal Register 57 No. 193 1992). Pond turtles prefer quiet waters of deep pools lined with aquatic vegetation. Nesting occurs in uplands adjacent to aquatic habitats. The nest site needs to be dry and warm enough for the eggs to hatch. Soil high in clay or silt on an unshaded slope is typically used. The females can lay eggs up to 0.25 mile away from a water source, but most eggs are laid within approximately 600 feet (Jennings and Hayes 1994). Pond turtles are found in the Santa Ynez River, San Antonio Creek, drainages into Betteravia Lakes, and Los Berros Creek.

Rare, Threatened and Endangered Species

Rare, threatened and endangered species are protected by one or more of the following: the California Endangered Species Act (1984), the Federal Endangered Species Act (1973, as amended), the California Native Plant Protection Act (1977), and the Migratory Bird Treaty Act (1918). The California Environmental Quality Act (1970) provides additional protection for unlisted species that meet the “rare” or “endangered” criteria defined in Section 15380. Table 3.5.13 provides a list of the state and federally-listed threatened and endangered plants and wildlife, and species of concern likely to be found in the project area.

Other rare species, obtained from sources listed below, that may occur in the project area could be protected under CEQA Section 15380, although there is some overlap with formal state and federal lists:

Inventory of Rare and Endangered Vascular Plants of California (California Native Plant Society, sixth edition, August 2001);

California Natural Diversity Database Special Plant List (CDFG, 2001);

Bird Species of Special Concern in California (Remsen 1978, published by the CDFG);

The National Audubon Society's "Blue List" (Tate and Tate 1982); and

The California Fish and Game Code (contains prohibitions against taking or possession of certain species).

The following species accounts provide the current listing status under the California state and federal Endangered Species Act(s), and by the CNPS, a brief description of proposed or designated critical habitats, the preferred habitat, species associations, current distribution, and factors threatening full recovery of the species.

Plants

Pismo Clarkia (Clarkia speciosa ssp. Immaculata)
The Pismo clarkia was federally-listed as endangered on December 15, 1994 and was state-listed as rare in November 1978. The following description is taken from the Federal Register (UFSWS 1994).

The Pismo clarkia is an erect or decumbent annual herb. It produces flowers with petals that are white or cream-colored at the base, streaking into pinkish or reddish-lavender in the upper part. It grows in pockets of dry sandy soils, possibly ancient sand dunes, within grassy openings in chaparral and oak woodlands. The historical range for this species includes the area between the town of Edna and the Nipomo Mesa area. Five out of nine original populations remain today in varying condition. Current threats include development and road maintenance.

The species is not known to occur within the immediate vicinity of the project. However, appropriate habitat for this species exists within or adjacent to the pipeline corridor near Summit Pump Station.

Lompoc Yerba Santa (*Eriodictyon capitatum*)
Lompoc yerba santa was recently listed by the USFWS (2000d) as endangered. Prior to the federal listing, the CDFG listed this species as rare in 1979. This species is a shrub, ranging in sizes. The leaf margins are rolled under with lavender, densely hairy flowers that bloom from May to August (Smith 1998). Lompoc yerba santa occurs in maritime chaparral communities and is often found in association with bush poppy (*Dendromecon rigida*), scrub oaks (*Quercus berberidifolia*, *Q. parvula*), buck brush (*Ceanothus cuneatus*), and in higher elevation areas where bishop pine forests intergraded with chaparral manzanita (*Arcostaphylos* spp.) and black sage (*Salvia mellifera*).

There are four known locations of this species in SBC, including two populations on VAFB. Suitable habitat for Lompoc yerba santa is present within the project area and a population of the species is known from Pine Canyon on VAFB, approximately a half mile upstream of the pipeline corridor. At this location *Eriodictyon capitatum* was noted in 1982 growing on a steep hillside of diatomaceous shale between *Arctostaphylos* sp. and *Pinus muricata*, and this population is presumed extant (CNDDB 2005). Threats to this species include fire management practices (particularly in areas where prescribed burns are used to control vegetation), and low seed productivity. However, the known population on VAFB receives special management considerations for preservation.

The USFWS recently proposed critical habitat for the Lompoc yerba santa (USFWS 2001e). Proposed critical habitat boundaries for the Lompoc yerba santa are located close to, but do not include the project area. Two of the four areas that have been proposed as critical habitat for Lompoc yerba santa include two areas on VAFB, both of which are north and upslope of the Platform Irene to the LOGP pipeline corridor. The Vandenberg East Unit includes the population in Pine Canyon. At this location, the pipeline corridor is adjacent to the southernmost boundary of the designated proposed critical habitat area, but is within a maintained firebreak that follows the northern boundary of the Federal Penitentiary.

Another endemic yerba santa (*Eriodictyon traskiae*) occurs in the Purisima Hills near the Tosco Point Pedernales Pipeline segment (LOGP to Santa Maria Pump Station), but this species has no special status.

<u>Seaside Bird's-beak (Cordylanthus rigidus ssp. littoralis)</u>
Seaside bird's-beak is listed as a federal Species of Concern and was listed in 1982 by the CDFG as endangered. This species is an annual root-parasite with in-rolled foliage, yellow-green flowers and blooms from June to October. This species is found in sandy soil in coastal dune and coastal habitats about Lompoc, Burton Mesa, Mission La Purisima area, to Buellton (Smith 1998). Seaside bird's-beak has been recorded at several locations within the project area. In 1989, thousands of plants were recorded on Lompoc Oil Field at the base of Purisima Hills in disturbed areas of coastal scrub vegetation in sandy soil (CNDDB 2005). Associated species included black sage *(Salvia mellifera),* mock heather *(Ericameria ericoides),* horkelia *(Horkelia cuneata)* and curly-leaved monardella (*Monardella undulata)* (CNDDB 2005). This record of occurrence is within or directly adjacent to the pipeline corridor and the population is presumed extant.

<u>La Graciosa Thistle (*Cirsium loncholepis*)</u>
La Graciosa thistle was state-listed as threatened in February, 1990 and federally-listed as endangered on March 20, 2000. It is a short-lived (1 or 2 years) member of the sunflower family. The plant produces one to many stems, 4 to 40 inches tall, from a rosette base. The rosette leaves are up to 12 inches long, dark green, deeply lobed with wavy, spine-tipped margins. Flower heads are in tight clusters at the tip of the stems and produce whitish flowers with dark purple anthers. La Graciosa thistle is found in wet soils surrounding dune lakes, moist dune swales, and on the floodplain near the Santa Maria River estuary. Its historical distribution included the backdunes and coastal wetlands from the Pismo Dunes of southern San Luis Obispo County to the Santa Ynez River in northern SBC. Historically, this species occurred in wetland habitats in the Orcutt region that have since been converted to agriculture or otherwise developed. Its current distribution is restricted to several colonies in the Guadalupe-Nipomo Dunes Complex, including the Santa Maria River Estuary, which supports the largest known occurrence of this species. It is threatened by ground water pumping and oil field development (USFWS, 2000). A historical record for this species is present along the pipeline corridor in La Graciosa Canyon (CNDDB 2005), but it has not been observed at this site in recent years.

The USFWS recently proposed critical habitat for the La Graciosa thistle (USFWS 2001e). Within the project area, proposed critical habitat for this species encompasses only one small portion of project area and is crossed by the pipeline corridor located south of Orcutt and just north of the intersection of Highway 1 and Highway 135.

Surf Thistle (Cirsium rhothophilum)

Surf thistle is listed as a federal Species of Concern and was listed as threatened by the CDFG in 1990. Although state and federal resource protection agencies, as well as the CNPS, recognize the sensitivity of this species, critical habitat has neither been proposed nor designated. Surf thistle is a short lived perennial, with white, felt-like foliage and whitish flowers, flowering from May to September. Surf thistle is sparsely scattered on crests and in valleys of stabilized, and sometimes active foredunes along the ocean at Point Conception, Point Arguello, Surf Beach, Casmalia Beach, at the mouth of the Santa Maria River, the Guadalupe Dunes, Nipomo Mesa and Pismo Beach (Smith 1998). Associated species include beach spectacle pod (*Dithyrea maritima*), sand verbena (*Abronia* spp.), sea rocket (*Cakile maritima*), and beachbur (*Ambrosia chamissonis*). Suitable habitat for surf thistle is present in the project area, and it has been recorded where the pipeline crosses the foredunes (CNDDB 2005). Populations are threatened by off-road vehicles, human and animal foot traffic, and competition from non-native plants including iceplant, which is prevalent in the foredunes within the project area (CNPS 1994).

Beach Spectacle Pod (*Dithyrea maritima*)

Beach spectacle pod is listed as a federal Species of Concern and was listed in 1990 by the CDFG as threatened. This species is a perennial with fruit that looks like spectacles. The leaves are fleshy with white to cream colored (sometimes purple) flowers, and flowers from April to July (Smith 1998). Although state and federal resource protection agencies, as well as the CNPS recognize the sensitivity of this species, critical habitat has neither been proposed nor designated. Beach spectacle pod is found on coastal dunes at Surf beach, Purisima Point to west of Casmalia, Guadalupe Dunes, Point Sal, Oso Flaco Lake and Morro Bay (Smith 1998), and often in association with surf thistle. Other species associated with beach spectacle pod include sea rocket (*Cakile maritima*), beachbur (*Ambrosia chamissonis*), crisp monardella (*Monardella crispa*), and sand verbena (*Abronia* spp.). Suitable habitat for beach spectacle pod is present in the project area and it has been recorded where the pipeline crosses the foredunes (CNDDB 2005). During a survey in 2000 at the former Guadalupe Oil Field to the north of the project site, approximately 2,500 plants were observed (Levine Fricke 2001). In various portions of its range populations are threatened by off-road vehicles, human and animal foot traffic, and competition from non-native plants including iceplant, which is prevalent in the foredunes and sandy soils in the project area (CNPS 1994).

Wildlife

Tidewater Goby (Eucyclogobius newberryi)

The tidewater goby was federally-listed as endangered on February 4, 1994 (USFWS 1994) and is a state-designated Species of Special Concern. A proposed rule to delist the species, except in Orange and San Diego counties, was published on June 24, 1999 (USFWS 1999a).

Tidewater gobies are small (usually less than 2 inches long) with large pectoral fins and fused pelvic fins that form a sucker-like disk. This is the only goby species along the coast of

California that is restricted to low salinity (less than 10 parts per thousand [ppt]) waters. All life stages are completed in these waters (i.e., no marine life history phase occurs), although the fish can live in waters with a salinity of over 40 ppt (Swift et al. 1989). This limits the frequency of genetic exchange between populations and lowers the potential for recolonization of a habitat once a population has been lost. Recolonization, however, has been documented to occur at distances up to 20 km from a source population (Lafferty et al. 1996). Tidewater gobies are benthic (living on the bottom substrate) and inhabit shallow waters (less than 3 feet deep) that are slow moving to still but not stagnant (Irwin and Soltz 1984). The coastal lagoons where these fish reside are typically closed off from the ocean by sand bars during summer. The substrate is generally sand and mud with abundant emergent and submerged vegetation (Moyle 1976). In addition to living in coastal lagoons, these fish can also move upstream at least 5 miles as has been documented in San Antonio Creek, SBC (Irwin and Soltz 1984).

Spawning in southern California takes place primarily from late April to July, when males dig a vertical burrow approximately 10 to 20 cm into clean coarse sand for nesting. The eggs are attached to the walls of the burrow by the female and are guarded by the male until they hatch in 9 to 10 days. Larval gobies are pelagic and found around vegetation for a short time and then become benthic (Swift et al. 1989). The life span of a tidewater goby is generally only one year, although individuals in the northern part of their range may live to 3 years (Lee et al. 1980).

This species formerly inhabited lower stream reaches and coastal lagoons from the Smith River in Del Norte County, California to Agua Hedionda Lagoon in San Diego County (Lee et al. 1980). Its present distribution extends southward only to the mouth of San Onofre Creek in San Diego County. A reassessment of tidewater goby populations (USFWS 1999a) indicates that 85 of approximately 110 historical populations remain. The remaining tidewater gobies in Orange and San Diego counties are located on the U.S. Marine Corps Base, Camp Pendleton.

In the project area, tidewater gobies inhabit the lagoon at the mouth of the Santa Ynez River and use the river for an unknown distance upstream from the lagoon. Surveys in 1998 (Swift 1999) indicated that the population in the lagoon was large. This species is not expected to occur in any of the tributary streams crossed by the pipeline. Tidewater gobies also inhabit the lagoon at the mouth of San Antonio Creek and have been found as far upstream as the Lompoc-Casmalia Road crossing, approximately 5 miles upstream from the lagoon (Irwin and Soltz 1982, 1984). The pipeline from the LOGP to Suey Junction crosses San Antonio Creek approximately 9 miles upstream of the Lompoc-Casmalia Road crossing. Tidewater gobies inhabit the lagoon at the mouth of the Santa Maria River as well (Swift et al. 1989).

<u>Steelhead (Oncorhynchus mykiss irideus)</u>

Steelhead populations in the Southern California Coast Evolutionarily Significant Unit (ESU), south of the Santa Maria River (inclusive) were federally-listed as endangered on August 18, 1997 (NMFS 1997). Populations from the Pajaro River on the north to the Santa Maria River on the south were federally-listed as threatened. Critical habitat was designated on February 15, 2000 (NMFS 2000). The species is a state-designated Species of Special Concern.

Steelhead are steel-blue to brown above and pale below with small, irregular black spots on the back and most fins and radiating rows of black spots on the caudal fin. Steelhead are the anadromous form of rainbow trout, migrating from the ocean up rivers and streams to spawning grounds. Adult steelhead enter creeks in the winter, usually after the first substantial rainfall (Moore 1980), and move upstream to suitable spawning areas. Spawning can occur in winter to spring, generally in riffle areas or the tails of pools that contain clean, coarse gravel. Suitable spawning gravels generally are 0.5 to 3 inches in diameter, 8 inches in depth or more, and not heavily compacted and have low amounts of sand or silt in them; however, steelhead can successfully spawn in gravels not meeting these characteristics (WESCO 1987). Females dig a nest in the gravel and deposit their eggs, the males fertilize the eggs, and the female covers the nest with gravel. After the eggs hatch (3.5 to 5 weeks), fry emerge from the gravel in 2 to 6 weeks and disperse throughout the creek, typically occupying shallow areas along stream margins. Juvenile steelhead often move to deeper pools as they grow and will remain in freshwater for an average of 2 years before migrating to the ocean (NMFS 1997; Titus et al. 1994). Downstream movement of adults after spawning and juveniles migrating to the ocean usually occurs from March through July. Photoperiod, stream flow, and temperature appear to influence emigration timing (Shapovalov and Taft 1954; Bjornn and Reiser 1991; Holubetz and Leth 1997). Juvenile steelhead may spend several weeks in the coastal lagoon or estuary of a stream before entering the ocean. They reside in the ocean for 2 to 3 years before returning to their natal stream to spawn (NMFS 1997), although in wet years steelhead may return to spawn after only one year in the ocean (Moyle et at., 1995). The adults can spawn more than once, although most do not spawn more than twice (NMFS 1997).

Optimal habitat for steelhead throughout its range on the Pacific Coast can generally be characterized by clear, cool water with abundant instream cover, well-vegetated stream banks, relatively stable water flow, and a 50:50 pool-to-riffle ratio (Raleigh et al. 1984). Pool-to-riffle ratios between 40:60 and 60:40 are generally thought to provide the most productive habitat for steelhead (WESCO 1987). Although optimal water temperatures for steelhead are considered to range from 12 to 20ºC, various sources document southern steelhead as persisting in streams with water temperatures ranging from 14.4 to 25.5ºC during the summer and early fall months of drought years (WESCO 1987; Titus et al., 1994). The Critical Thermal Maximum is reported to be up to 29.4ºC (Lee and Rinne 1980).

The presence of a well-developed riparian corridor along the stream course is considered an essential component in southern steelhead streams. This plant community inhibits substantial erosion of stream banks during high flows, maintains lower stream temperatures, and provides organic input to the stream (Faber et al., 1989). Good rearing habitat contains low current velocities (such as behind boulders or other velocity barriers) and good cover (e.g., undercut banks, logs or brush, surface turbulence). Cobble embeddedness (amount of sediment surrounding rocky substrate) can be used as a measure of shelter availability for aquatic insects (food for fish) and young fish. At an embeddedness of above 35%, rearing habitat quality decreases substantially (WESCO 1987). Embeddedness can also be used to indirectly evaluate habitat suitability for incubation of fish eggs and for salmonid overwintering.

Stream flow within the southern extent of southern steelhead range varies seasonally and annually. In central and southern California coastal drainages, droughts of one or more years can cause streams to have intermittent flow in late summer and fall with reductions in pool depths, thereby reducing the quality and quantity of available habitat. Although southern steelhead are capable of withstanding substantial seasonal and annual fluctuations in stream flow and other physical conditions, prolonged drought periods can periodically result in mortality to juvenile fish inhabiting a stream (Moore 1980).

Steelhead primarily use the lower Santa Ynez River for migration passage to and from the Pacific Ocean (SYRTAC 2000a, 2000b). The lagoon at the mouth of the Santa Ynez River may be used briefly by steelhead preparing to enter the sea (SYRTAC 2000b). Adult steelhead generally spawn from January to April depending on streamflows (SYRTAC 2000a, 2000b). The smolting and migration of juveniles out to the ocean generally occurs between February and May depending on stream flows (SYRTAC 2000a, 2000b). Historically, steelhead have spawned in many of the perennial tributaries and on the upper main stem of the Santa Ynez River. Before the construction of Bradbury Dam steelhead were believed to spawn on the main stem of the Santa Ynez River from Solvang to Gibraltar Reservoir during wet years (SYRTAC 2000b). Currently it is believed that under average conditions small numbers of steelhead migrate into the Santa Ynez River to spawn mainly in the lower tributaries such as Salsipuedes and El Jaro Creeks (SYRTAC 2000a, 2000b). The low flows and stream characteristics often found along the Santa Ynez River below Buellton offer poor physical habitat conditions for steelhead. However, during wetter years steelhead have also been observed to spawn in the mainstem of the Santa Ynez River above Buellton and in upper tributaries, such as Quiota and Hilton creeks.

Two key areas on the main stem of the Santa Ynez River were identified by SYRTAC (2000b) as important rearing and spawning habitats for steelhead. These key reaches are as follows: the Santa Ynez River below Bradbury Dam to the highway 154 bridge and the reach between Refugio Road and Alisal Road. In the Santa Ynez River basin most of the steelhead occur in tributaries that originate from the south side of the basin. Southern basin tributaries originate from cooler and more vegetated north facing slopes, which have a greater tendency for perennial flow and more favorable steelhead habitat characteristics than do the dryer south facing slopes of the north side of the basin. The project pipelines are located on the north side of the Santa Ynez River and do not cross any tributaries noted by SYRTAC to support important steelhead populations or habitat.

Salsipuedes, El Jaro, and San Miguelito creeks are three tributaries that originate from the southern side of the of the lower Santa Ynez River basin that are located nearest to the project area and recognized by SYRTAC (2000b) as streams of interest for steelhead habitat. El Jaro is a tributary to Salsipuedes Creek. Salsipuedes and San Miguelito both enter the Santa Ynez River upstream from where project pipelines parallel the Santa Ynez River. San Miguelito is closest to project pipelines, but enters the Santa Ynez river approximately 4 to 5 miles upstream from where the project pipelines bend away from the river toward the LOGP.

Steelhead also may use San Antonio Creek when conditions are favorable, and this creek is included as the critical habitat for this species (NMFS 2000). No information is available to describe based on its ocean connection. However, steelhead surveys conducted from 1999 to 2000 did not find any steelhead; historical occurrence has not been documented for San Antonio Creek, and the habitat has been characterized as poor to marginal in a recent steelhead habitat evaluation study by Swift in 2000 (N. Read Francine, VAFB 2002). .Steelhead use the Santa Maria River for passage to habitats upstream in the Sisquoc River and are known to use Los Berros Creek as well.

Within the project area, critical habitat has been designated for steelhead and includes Santa Ynez, San Antonio and Santa Maria Rivers, excluding areas above Bradbury (Santa Ynez River) and Vaqueros (Santa Maria River) dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

Unarmored Threespine Stickleback (*Gasterosteus aculeatus williamsoni*)
The unarmored threespine stickleback was federally-listed as endangered on October 13, 1970 (35 FR 16047) and was state-listed as endangered on June 27, 1971. Critical Habitat has been proposed but not finalized and is not in the project area. The following description was taken from a biological opinion for this species (Reference No. 9322 in USFWS 1993) and other sources as noted.

The unarmored threespine stickleback is a small (less than 6 cm standard length), scaleless freshwater fish with three dorsal spines and a bony keel on the sides of the caudal peduncle. The back is dark, often with vertical bars, and the undersides are silvery. This species requires slow flow with aquatic vegetation for cover and nest material. The fish are sight feeders, and are intolerant of high turbidity. Most unarmored threespine sticklebacks complete their life cycle in one year, although a few individuals in a population apparently live two or three years. Spawning can occur throughout the year, but peak activity occurs between May and September. The males establish breeding territories, construct a nest of vegetation and sand, and brood the eggs until they hatch (Irwin and Soltz 1982).

The species was once widely distributed in southern California with records from the Santa Clara, Los Angeles, San Gabriel, and Santa Ana rivers as well as from the Santa Maria River drainage and San Antonio Creek in SBC. By the 1940s this fish had been extirpated from the Los Angeles basin and from the Santa Maria River drainage. Factors leading to these population losses include large scale impoundments, stream channelization, increased water turbidity, introduction of non-native competitors and predators, water pollution, and hybridization with other subspecies of threespine stickleback (USFWS 1980b). The present distribution of the species includes the headwaters of the Santa Clara River, its tributary San Francisquito Creek, and San Antonio Creek. Fish from the San Antonio Creek population have been introduced into Honda Creek on South VAFB, and ones from San Francisquito Creek have been transplanted to San Felipe Creek in Imperial County.

Unarmored threespine sticklebacks appear to be relatively abundant where found but continue to be threatened by stream degradation. The species is currently being managed by a recovery team, and the recovery plan was revised in 1985. The agencies cooperating in the recovery effort have undertaken several actions to conserve the species, including (1) surveys to discover additional populations, (2) transplants to establish it in other waters, (3) surveys to discover exotic organisms, (4) eradication programs to remove or control exotic species, (5) a contingency plan to establish response procedures in case of oil or toxic chemical spills, and (6) genetic studies to ascertain taxonomic relationships. As a result of these efforts, a remnant population was discovered in Shay Creek (San Bernardino County), additional unarmored threespine stickleback populations have been established, and a potential change in the taxonomic status of one or more of the recognized extant populations was found. USFWS policy is to wait until the taxonomic revisions have been published in a reputable scientific journal before initiating changes in the management of a listed species.

This species is known to inhabit San Antonio Creek primarily downstream of Barka Slough on VAFB (Irwin and Soltz 1982), and unidentified threespine sticklebacks have been observed as far upstream as Los Alamos in the 1980s (R. Thompson field notes).

Green Sturgeon (Ambystoma medirostris**)**

Two species of sturgeon exist along the Pacific coast of the United States: white and green sturgeon. White sturgeon (*Acipenser transmontanus*) support substantial sport fisheries and, are well studied and intensively managed. Green sturgeon (*Acipenser medirostris*), however, are not a commercially popular food fish, and most information on them comes from bycatch from the white sturgeon fishery and from recreational catch records. In response to uncertainty surrounding the potential reduction in the number and geographic distribution of spawning populations in North America, NOAA listed the the southern distinct population of the North American green sturgeon as threatened in July 2006 (NMFS, 2006). The southern distinct population segment is comprised of those sturgeon which spawn in rivers and estuaries south of the Eel River. Within this population segment, a majority of spawning adults are concentrated into one river. Recent declines in juvenile green sturgeon abundance, and loss of spawning habitat in two of the sturgeon's spawning rivers (the upper Sacramento and Feather Rivers) also led to the listing of this species as threatened.

Green sturgeon are anadromous; they live much of the time in marine waters, but return to fresh water (rivers) to spawn. The largest threat for green sturgeon, until very recently, was a lack of information regarding their behavior, life history, and migratory patterns. Other threats include potentially excessive harvest rates, poor water quality (e.g. agricultural run off), predation by seals and sea lions, and dredging. Although these fish spend most of their lives at sea, they come into rivers and estuaries to spawn. Additionally, young green sturgeon may remain in freshwater rivers and streams for the first few years of their lives before traveling out to sea. Green sturgeon spawn regularly in the Rogue and Sacramento Rivers, and in the Klamath River Basin. Spawning is known to occur infrequently in the Umpqua River, and is suspected to occur in the South Fork of the Trinity River and the Eel River. However, there is no evidence of current spawning in the Fraser, Chehalis, Feather, San Joaquin rivers, and spawning has not been documented in rivers further to the south. Although green sturgeon are a highly migratory species and travel widely at sea, the few rivers and estuaries where they spawn are essential areas of their habitat, and impacts to these areas from an oil spill could negatively affect the green sturgeon. A designation of critical habitat for this species by NOAA is still underway; however, as the nearest known rivers where green sturgeon spawn are located several hundred miles north of the project area, impacts to critical spawning and gathering areas from the proposed project will not occur.

California Tiger Salamander (*Ambystoma californiense*)

The California tiger salamander in SBC was emergency listed as endangered on January 19, 2000 (USFWS 2000a) and was formally listed on September 21, 2000 (USFWS 2000b). It is a state Species of Special Concern. This distinct vertebrate population segment is largely isolated and thought to be genetically distinct. The following description was taken from Jennings and Hayes (1994).

California tiger salamanders are black with pale yellow spots. This species is a lowland inhabitant restricted to grasslands and low foothill regions of central and northern California. It breeds in long-lasting rain pools (e.g., vernal pools) that are often turbid, and sometimes in permanent ponds with no fish predators. During the dry season, the salamanders use rodent burrows, such as ground squirrel or Botta's pocket gopher, as well as man-made structures (e.g., pipes, septic tank drains, and wet basements) on occasion, at distances of up to 1 mile from the breeding pool. Adults migrate to the pools to breed during relatively warm late winter or spring rains. The eggs hatch into larvae that require a minimum of 10 weeks to reach metamorphosis. Juveniles emigrate in mass at night from the drying pool to refuge sites (rodent burrows).

The species occurs in the Central Valley from near Petaluma in Sonoma County to northwestern Tulare County and in the Coast Range south to near Buellton in SBC. Fragmentation and loss of breeding habitat, introduction of exotic and transplanted predatory fish, loss of refuge habitat adjacent to breeding pools due to changes in land use (e.g., agriculture, urbanization, and converting dry land pasture to irrigated pasture), and barriers to migration (roads, berms, and road dividers) have all contributed to the decline of this species.

California tiger salamanders breed in vernal pools in the Los Alamos and Santa Rita valleys, Purisima and Santa Rita hills, and east of Orcutt in the Santa Maria Valley, but spends a majority of its life cycle in upland burrows within oak savanna or stabilized dune scrub habitats. This species is not believed to be present in the affected project area. However, the pipeline corridor from the ridge north of the LOGP to Orcutt falls within the mapped range of the California tiger salamander (USFWS 2001), although the mapped range shows no records for species presence within at least one mile of the pipeline area.

California Red-legged Frog (*Rana aurora draytonii*)

The California red-legged frog was proposed for listing as endangered on February 2, 1994 (59 FR 4888). The species was listed as threatened on May 23, 1996, and the final rule became effective on June 24, 1996 (USFWS 1996b). Critical habitat was proposed for the California red-legged frog on September 11, 2000 (65 FR 54893) and includes suitable aquatic habitat, associated uplands, and suitable dispersal habitat connecting suitable aquatic habitat. Watersheds within the project area that have been proposed for critical habitat include Santa Ynez River and San Antonio Creek. The following description was taken from the Biological Opinion (1-8-96-F-16) for the Coastal Aqueduct (USFWS 1993 and 1996a), the final rule for listing the species as threatened (USFWS 1996b), and the proposed rule for critical habitat (USFWS 2000c).

The California red-legged frog is one of two subspecies of the red-legged frog (*Rana aurora*) found on the Pacific coast. It is a fairly large frog with adults reaching 5 inches (snout to vent length). The skin of the back is brown, gray, olive, red, or orange with dark flecks or spots. A prominent dorsolateral fold of skin extends from the eye to the hip. The underside is white, often with patches of bright red or orange on the abdomen and hind legs. The final rule states that the species occupies a fairly distinct habitat, combining both specific aquatic and riparian components. Adults prefer dense, shrubby or emergent riparian vegetation closely associated with deep (more than 2.3 feet in depth), still or slowly moving water. However, recent observations indicate that California red-legged frogs will occur in a variety of habitat types, including aquatic, riparian, and upland habitats with permanent water nearby. Well-vegetated terrestrial areas within the riparian corridor may provide important sheltering habitat during winter, foraging areas, and dispersal corridors. California red-legged frogs breed from November to March, with the earlier breeding records occurring in southern localities. Eggs hatch in 8 to 14 days while larvae take 3.5 months or longer to metamorphose. California red-legged frogs may live 8 to 10 years. The frogs disperse upstream and downstream of breeding habitat to forage and seek resting habitat. They take cover in small mammal burrows and moist leaf litter (up to 100 feet from water) in dense riparian vegetation with drying of creeks in summer, but will use other cover sites when traveling overland. Adults can be found within streams over 1.8 miles from breeding habitat and within dense riparian vegetation more than 328 feet from water. After winter rains begin, red-legged frogs may move away from aquatic habitats, primarily at night, and can travel one mile from those habitats (USFWS 1997a). Juveniles may also disperse locally shortly after metamorphosis in July-September and away from their natal habitats during warm rain events.

The historical range of the California red-legged frog extended from northwestern Baja California, Mexico to a northern boundary extending from the vicinity of Point Reyes National Seashore, Marin County, California on the coast inland to the vicinity of Redding, Shasta County, California. The species has sustained a 70% reduction in its geographic range in California as a result of several factors acting singly or in combination. Habitat loss and alteration, combined with over-exploitation and introduction of exotic predators, were significant factors in its decline in the early to mid 1900s. California red-legged frogs were probably extirpated from the Central Valley in the 1960s. Remaining aggregations of California red-legged frogs in the Sierra Nevada foothills became fragmented and were later eliminated by reservoir construction, increased exotic predator populations, grazing, and drought. The pattern of disappearance of California red-legged frogs in southern California is similar to that seen in the Central Valley, except that urbanization and its associated roadways, large reservoirs, exotic predators, and stream channelization projects were the primary factors causing population declines.

As of 1996, California red-legged frogs were known to occur in 243 streams or drainages from 22 counties in central and southern California. Monterey, San Luis Obispo, and Santa Barbara counties support the greatest amount of currently occupied habitat. California red-legged frogs are known to use wetlands and riparian habitats along the lower Santa Ynez River, the unnamed creek draining the LOGP area (approximately 3 km downstream from that site), San Antonio Creek, drainages into Betteravia Lakes, drains into the Santa Maria River, Nipomo Creek, and Los Berros Creek. The potential exists for California red-legged frogs to be present in the project area wherever open water is accessible, including stock ponds, cattle troughs, and other manmade structures that hold water.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

The willow flycatcher was state-listed as endangered on December 3, 1990; federal listing of the southwestern willow flycatcher as endangered occurred on February 27, 1995 (USFWS 1995), and critical habitat was designated on July 22, 1997 (USFWS 1997b). No critical habitat is present in the project area. The following description was taken primarily from “A Southwestern Willow Flycatcher Natural History Summary and Survey Protocol” (Sogge et al. 1997).

The southwestern willow flycatcher is one of four subspecies recognized in North America (Unitt, 1987). All four subspecies breed in North America but winter to the south in Mexico, Central America, and possibly northern South America. The southwestern willow flycatcher is a brownish-green bird (5.25 to 6.5 inches) with an orange lower mandible and no eye ring. It breeds in California from the Santa Ynez River southward. This subspecies historically nested along the Salinas and Carmel rivers in Monterey County until the early 1970s. Dense riparian habitats 13 to 23 feet tall near surface water or saturated soil are used for nesting. Openings and areas of shorter or sparser vegetation are often present in the riparian habitats used. Southwestern willow flycatchers arrive in May to June for breeding and leave for wintering areas in August to September.

The willow flycatcher was once a common summer resident in California (CESA No. 9317 in USFWS 1993) and included two subspecies. Breeding has been almost eliminated in the state, primarily due to the extensive loss, fragmentation, and modification of riparian habitats. Habitat losses continue as a result of urbanization, recreation, agricultural development, water diversion and impoundment, stream channelization, livestock grazing, and replacement of native plant species with non-natives. Brood parasitism by the brown-headed cowbird is another threat to the southwestern willow flycatcher.

The southwestern willow flycatcher is known to breed in willow riparian habitats along the Santa Ynez River. Two population centers were discovered in the period between 1986 and 1991. One extends from just west of Buellton to several miles downstream, and the second extends from the Floradale Avenue bridge near Lompoc to the last stand of willows before the river mouth. Due to the inability of biologists to survey on private lands between these two areas, it is not known if there are more territories in between them. A total of “at least 28 territories” were estimated to exist along the Santa Ynez River between Buellton and the coast during the 1995 breeding season (information packet from Willow Flycatcher Workshop, 1995). Surveys in 2000 found 2 territories between the Floradale bridge and the coast, but neither was successful in completing nesting (Mark Holmgren, personal communication, 2001). Between 1995 and 1999, nesting southwestern flycatchers or territorial individuals were present about 50 meters west of the 13th Street Bridge on VAFB. This particular nest site was destroyed in winter storms after that time and nesting was not confirmed in that area during 2000–2001. However, suitable habitat is still present and recolonization of the area is possible (N. Read Francine, VAFB 2002). Away from the Santa Ynez River within the affected project area, a low potential exists for southwestern willow flycatchers to be present, but may use some of the larger tributaries of the Santa Ynez River on a transitional basis, such as in Santa Lucia Canyon.

<u>Western Snowy Plover (Charadrius alexandrinus nivosus)</u>
The western snowy plover is one of two subspecies of snowy plover recognized in North America. The Pacific Coast population (e.g., within 80 km [50 miles] of the coast) breeds from southern Washington to southern Baja California, Mexico, and is a federally-listed threatened species. It is classified as a "distinct population segment" under the ESA, separate from populations that nest in inland areas from Nevada and Utah to Kansas, Oklahoma and Texas. Critical Habitat for the western snowy plover was designated on December 7, 1999, and was re-designated on September 29, 2005 (USFWS 1999c; USFWS 2005). The current population estimate for the U.S. portion of the Pacific Coast population is approximately 2,300, based on a 2005 survey. The largest number of breeding birds occurs from south of San Francisco Bay to southern Baja.

Western snowy plovers are found on beaches, open mudflats, salt pans and alkaline flats, and sandy margins of rivers, lakes, and ponds. Snowy plovers nest in depressions in the sand above the drift zone. This species was formerly found on quiet beaches the length of the state, but recently it has declined in abundance and become discontinuous in its distribution. Disturbance to its nest sites, by humans, dogs, and wild predators is a primary reason for its decline (Garrett and Dunn, 1981). This species is a fairly common winter visitor to the mouth of the Santa Ynez River, with a few pairs breeding there (Lehman, 1994). Surveys between 1977 and 1980 by Point Reyes Bird Observatory found up to 150 wintering birds (Page, et al., 1981), with approximately 5 pairs nesting in 1978 (Lehman, 1994). Snowy plovers nested and produced young at Wall Beach in 2000 (David Hubbard, personal communication) around the area where the pipeline array makes landfall.

California Least Tern (*Sterna antillarum browni*)

California least terns were federally-listed as endangered on October 10, 1970, and listed as endangered by the state on June 27, 1971. These birds generally arrive in this area in early May and depart by August (Lehman, 1994). They are the smallest member of the tern subfamily, nine inches in length with a wingspan of 20 inches. Nesting occurs in open expanses of light-colored sand, dirt, or dried mud, in close proximity to a lagoon or estuary that offers a readily available food supply (USFWS, 1980).

California least terns have historically nested along the coast of California as far north as San Francisco (USFWS, 1980). However, the distribution of sites has always been discontinuous, and extralimital breeding, as far north as Oregon, has on occasion occurred (USFWS, 1980). Locally, this species now nests only at the mouths of the Santa Maria and Santa Ynez rivers, and several locations on VAFB (at the mouth of San Antonio Creek and at Purisima Point) (Lehman, 1994). During the last two decades the number of nesting birds near the Santa Ynez River mouth has been low, averaging 1-3 pairs per year (Lehman, 1994). Within the project area, the potential exists for breeding or foraging California least terns to occur around the area where the pipeline array makes landfall. In 1999 a total of 27 pairs of terns fledged 15 young from Purisima Point. The dune habitat adjacent to the point currently provides nesting habitat for approximately 160 least terns.

California Brown Pelican (Pelecanus occidentalis californicus)

The California brown pelican was federally-listed as endangered on October 13, 1970. It was listed by the state of California as endangered on June 27, 1971.

Brown pelicans occur in marine habitats along the Pacific, Atlantic, and Gulf Coasts in North America and range southward through the Gulf and Caribbean areas to Central and South America. The California subspecies nests on Channel Islands off the coast of southern California, mainly on Anacapa (Garrett and Dunn, 1981). The major portion of the population nests south along the coast of Baja California and the Gulf of California, to Guerrero, Mexico. After the breeding season, California brown pelicans wander as far north as British Columbia, Canada and as far south as South America.

Brown pelicans are found primarily in warm estuarine, marine subtidal, and marine pelagic waters. They occur mostly over shallow waters along the immediate coast, especially near beaches and on salt bays. Brown pelicans roost on water, rocks, rocky cliffs, jetties, piers, sandy beaches, and mudflats, and forage in open water. When foraging, the brown pelican dives headfirst into the water from as high as 18 m (60 ft) in the air. It completely or partially submerges itself in an attempt to capture fish, which is almost the exclusive prey of this carnivorous species.

Brown pelican populations declined greatly in the mid-twentieth century due to human persecution, disturbance of nesting colonies, and reproductive failure caused by eggshell thinning and the adverse behavioral effects of pesticides. Most North American populations of this species were extirpated by 1970. Since the banning of DDT and other organochlorines in the early 1970s, brown pelicans have made a strong recovery and are now fairly common and perhaps still increasing on the southeast and west coasts. The endangered southern California Bight population of the brown pelican grew to 7,200 breeding pairs by 1987, but has experienced considerable population fluctuations in recent years and has not, as yet, been considered sufficiently stable for delisting. In 1992, there were an estimated 6,000 pairs in southern California and approximately 45,000 pairs on Mexico's west coast.

Locally, brown pelicans forage in spring and summer along the mainland coast, including birds nesting on Anacapa Island, and non-breeding birds. Numbers peak in July, as post-breeding birds arrive from the nesting grounds. Number decline through winter and early spring, although there are always some brown pelicans in the area (Lehman, 1994). Although the Santa Ynez River mouth and estuary are not considered major aggregation sites for brown pelicans (Lehman, 1994), they are frequent visitors to the area and occasionally form flocks of 100 or more birds. The potential exists for California brown pelicans to be present in the project area around the area where the pipeline array makes landfall. Recent observations indicate that pelicans still use this area regularly.

American Peregrine Falcon (*Falco peregrinus*)

The American peregrine falcon was listed as an endangered species on June 2, 1970. Populations of this species have recovered substantially since this federal listing, which has prompted the recent removal of the American peregrine falcon from the federal endangered species list (USFWS 1999b); however, it remains a California state-listed endangered species. The American peregrine falcon was de-listed as an endangered species on August 25, 1999. This species is currently undergoing a five-year monitoring program to ensure that the falcon populations continue to improve and that delisting of the species was an appropriate action.

Peregrine falcons are medium size raptors with a wingspan of approximately 112 cm and weight of approximately 1 kg (USFWS 1999b). The crown and back of adult peregrine falcons is dark gray in color, while the abdomen is pale with dark bars or streaks. The diet of the peregrine falcon is almost entirely composed of other birds that are caught in mid air (USFWS 1999b).

American peregrine falcons have an extensive range as the species can be found from the subarctic boreal forests of Alaska and Canada, south to Mexico (USFWS 1999b). Nesting of this species occurs from central Alaska, central Yukon Territory, and northern Alberta and Saskatchewan, east to the Maritimes and south (excluding coastal areas north of the Columbia River in Washington and British Columbia) throughout western Canada and the United States to Baja California, Sonora, and the highlands of central Mexico. Populations that nest in subarctic areas often winter in South America. Populations that nest in lower latitudes tend to display variable migratory patterns while some are nonmigratory.

The American peregrine falcon populations significantly declined after WWII (USFWS 1999b). It was found that population declines were due largely to direct mortality or reproductive complications as a result of environmental contamination by organochlorine pesticides like DDT. Populations declined to extremely low levels by the 1960's, prompting the species listing as an endangered species. Banning of the use of pesticides like DDT and efforts from recovery programs have helped the species recover to more stable levels and have resulted in successful reintroduction of populations in many areas were they had been extirpated in earlier years.

The American peregrine falcon is known to frequent open country such as grasslands, agricultural areas, ponds, sloughs, river mouths and seacoasts for foraging activities. Regular observations of this species have been reported at the Santa Ynez River mouth. Historically, this species nested on south VAFB, and there was an unconfirmed report of nesting in 1993 near Point Arguello on VAFB (Lehman 1994); however nesting was confirmed on south VAFB by tagging studies conducted in the mid-1990's on behalf of the California Commercial Spaceport.

Within the project area, the potential exists that peregrine falcons may be present in the vicinity of where the pipeline array makes landfall. Peregrine falcons are still regularly seen foraging in this part of the project area, especially in winter.

3.5.2 Regulatory Setting

3.5.2.1 Federal Laws and Policies

The Outer Continental Shelf Lands Act

Under the Outer Continental Shelf Lands Act (OCSLA), the Department of the Interior (DOI) is required to:

- Manage the orderly leasing, exploration, development, and production of oil and gas resources on the Federal OCS;
- Ensure the protection of the human, marine, and coastal environments;
- Ensure that the public receives a fair and equitable return for these resources; and
- Ensure that free-market competition is maintained.

Within the DOI, the MMS is charged with the responsibility of managing and regulating the development of the OCS oil and gas resources in accordance with the provisions of the OCSLA. The MMS operating regulations are presented in Chapter 30, CFR Part 250.

In many instances, the MMS develops protective measures that are applied to specific lease blocks. For example, if the MMS Regional Manager (RM) has reason to believe that biological populations or habitats exist and require protection, the RM shall provide the lessee notice that the lessor is invoking the provisions of a biological resource stipulation and the lessee shall comply with the following requirement. Prior to the any drilling activity or the construction or placement of any structure for exploration or development on lease areas including, but not limited to, well drilling and pipeline and platform placement, the lessee must conduct site-specific surveys as approved by the RM and in accordance with prescribed biological survey requirements to determine the existence of any special biological resource including, but not limited to: 1) very unusual, rare, or uncommon ecosystems or ecotones; and 2) a species of limited regional distribution that may be adversely affected by any lease operation. If the results of the survey suggest the existence of a special biological resource that may be adversely affected by any lease operation, the lessee shall: 1) relocate the site of operation so that the resource identified is not adversely affected; 2) modify operations so that the biological resource or habitat is not adversely affected; or 3) establish to the satisfaction of the RM on the basis of the site-specific survey, either that the operation will not have a significant adverse effect upon the resource or that a special biological resources does not exist.

The National Environmental Policy Act (NEPA)

NEPA requires all Federal agencies to use a systematic, interdisciplinary approach to protect the human environment. The approach ensures the integrated use of natural and social sciences in any planning and decision making that may have an impact on the environment. The NEPA also requires the preparation of a detailed EIS on any major Federal action that may have a significant impact on the environment. The EIS must address any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term resources and long-term productivity, and irreversible and irretrievable commitments of resources.

In 1979, the Council on Environmental Quality (CEQ) established uniform procedures for implementing the procedural provisions of NEPA. These regulations provide for the use of the NEPA process to identify and assess reasonable alternatives to proposed actions that avoid or minimize adverse effects upon the quality of the human environment. “Scoping” is used to identify the scope and significance of important environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies; the general public; and any interested individual or organization prior to the development of an impact statement. The process also identifies and eliminates from further detailed study, issues that are not significant or that have been covered by prior environmental review.

The Marine Mammal Protection Act (MMPA)

Under the MMPA of 1972, the Secretary of Commerce is responsible for the protection of all cetaceans and pinnipeds (except walruses) and has delegated this authority to the National Marine Fisheries Service (NMFS). The Secretary of Interior is responsible for walruses, polar bears, sea otters, manatees, and dugongs and has delegated this authority to the US Fish and Wildlife Service (USFWS).

The MMPA established a moratorium on the taking of marine mammals in waters under US jurisdiction. The Act defines “take” as hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal.” “Harassment” is defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild; or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. The moratorium may be waived when the affected species or population stock is within its optimum sustainable population range and would not be disadvantaged by the authorized taking. The Act directs the Secretary, upon request, to authorize the unintentional taking of small numbers of marine mammals incidental to activities other than commercial fishing when, after notice and opportunity for public comment, the Secretary finds that the total of such taking during the five-year (or less) period would have a negligible impact on the affected species.

The Act also specifies that the Secretary shall withdraw, or suspend for a specified period of time, permission to take marine mammals incidental to oil and gas production, and other activities if the applicable regulations regarding methods of taking, monitoring, or reporting are not being complied with, or the taking is having, or may be having, more than a negligible impact on the affected species or stock.

In 1994, a new subparagraph (D) was added to Section 101(a)(5) to simplify the process of obtaining "small take" exemptions when unintentional taking is by incidental harassment only. Specifically, the incidental take of small numbers of marine mammals by harassment can now be authorized for periods of up to one year without rulemaking, as required by Section 101(a)(5)(A), which remains in effect for other authorized types of incidental taking.

To ensure that activities on the OCS adhere to MMPA regulations, MMS must actively seek information concerning impacts of OCS activities on local species of marine mammals.

The Endangered Species Act (ESA)

The Endangered Species Act of 1973, as amended, establishes protection and conservation of threatened and endangered species and the ecosystem on which they depend. The US Fish and Wildlife Service and the NMFS administer the Act. Section 7 of the Act governs interagency cooperation and consultation to ensure that activities do not jeopardize the existence of threatened or endangered species or result in adverse or modification or destruction of their critical habitat.

The Magnuson-Stevens Act

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSFCMA) is the cornerstone legislation of fisheries management in US jurisdictional waters. Its purpose was to stop overfishing by foreign fleets and aid in the development of the domestic fishing industry. The Act gave the US sole management authority over all living resources within the 200-nautical mile exclusive economic zone of the US. The Act created eight regional Fishery Management Councils (FMCs) and mandated a continuing planning and management program for marine fisheries by the FMCs. The Act, as amended, requires that a Fishery Management Plan (FMP) based upon the best available scientific and economic data be prepared for each commercial species or group of related species of fish that is in need of conservation and management within each respective region. The regional council for the Pacific OCS is the Pacific Fishery Management Council. In accordance with the Act, the councils report directly to the US Secretary of Commerce whose job is to review, approve and prepare fishery management plans. In reality, this function is delegated to the Administrator of the NOAA and the NMFS.

The Act has been amended several times. In 1996, Federal law governing fisheries management underwent a major overhaul. The amendments, termed the Sustainable Fisheries Act (SFA) of 1996, identified fish habitat as critical to healthy fish stocks and sustainable fisheries. The SFA implemented a program to designate and conserve Essential Fish Habitat (EFH) for species managed under a FMP. EFH is defined as "those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity." The intention is to minimize any adverse effects on habitat caused by fishing or nonfishing activities and to identify other actions to encourage the conservation and enhancement of such habitat. The documents prepared for West Coast groundfish EFH include all species of rockfish managed by the Council (Bloeser, 1999).

The Oil Pollution Act

The OPA of 1990 establishes a single uniform Federal system of liability and compensation for damages caused by oil spills in US navigable waters. OPA requires removal of spilled oil and establishes a national system of planning for and responding to oil spill incidents. OPA includes provisions to:

1) Improve oil-spill prevention, preparedness, and response capability;
2) Establish limitations on liabilities for damages resulting from oil pollution;
3) Provide funding for natural resource damage assessments;
4) Implement a fund for the payment of compensation for such damages; and
5) Establish an oil pollution research and development program.

The Secretary of Interior is given the authority over offshore facilities and associated pipelines for all Federal and State waters, including responsibility for spill prevention, oil-spill contingency plans, oil-spill containment and clean-up equipment, financial responsibility certification, and civil penalties. The US Coast Guard is responsible for enforcing vessel compliance with the OPA.

The Clean Water Act

The Federal Water Pollution Control Act (FWPCA) of 1972, as amended, is commonly referred to as the CWA. It authorizes the USEPA to issue National Pollutant Discharge Elimination System (NPDES) permits to regulate discharges into waters of the US. USEPA, Region 9, has jurisdiction for NPDES permitting of the proposed project.

The Marine Plastic Pollution Research and Control Act

The Marine Plastic Pollution Research and Control Act (MPPRCA) of 1987 implements Annex V of the International Convention of the Prevention of Pollution from Ships (MARPOL). Fixed and floating platforms, drilling rigs, manned production platforms, and support vessels operating under a Federal oil and gas lease are required to develop waste management plans and to post placards reflecting discharge limitations and restrictions.

The Coastal Zone Management Act

In accordance with the CZMA and the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), OCS oil and gas exploration and development activities affecting the coastal zone must be carried out consistent with California's Coastal Management Program (CCMP) (i.e., the policies of the California Coastal Act). The CCMP sets forth objectives, policies, and standards regarding coastal uses and resources.

Coast Guard Regulatory Authority

Primary responsibility for the enforcement of US maritime laws and regulations falls upon the US Coast Guard. The Coast Guard's responsibilities for regulating activities on the OCS, the continental shelf, and in ports and harbors, as applicable to the proposed action, are presented in

Title 33 CFR, chapters 1-199; Title 43 USC section 1331; Title 46 USC, Parts A and B; and OPA 90. The Coast Guard is responsible for managing and regulating provisions for safe navigation of vessels in US waters, as well as the enforcement of environmental and pollution prevention regulations. As such, the Coast Guard provides for the regulation and enforcement of hazardous working conditions on the OCS, for the management and regulations of measures for pollution prevention in territorial waters, and for ensuring the implementation of the OPA 90 and MPPRCA (MARPOL Annex V) provisions.

Executive Order 11988 and 11990

Executive Order 11988, Floodplain Management, and 11990, Protection of Wetlands require that governmental agencies, in carrying out their responsibilities, provide leadership and take action to restore and preserve the natural and beneficial values served by floodplains and wetlands.

Executive Order 13112

Executive Order 13112, Invasive Species, establishes an Invasive Species Council whose members include the Secretaries of State, Treasury, Defense, Interior, Agriculture, Commerce, Transportation, and the Administrator of the Environmental Protection Agency and orders establishment of an advisory committee to the Council and orders preparation of a national Invasive Species Management Plan to be updated biennially. The Council is ordered to provide national leadership concerning invasive species and to see that Federal agency activities concerning invasive species are coordinated, complementary, cost-efficient, and effective.

3.5.2.2 State and Local Laws and Policies

California Endangered Species Act (CESA)

The California Endangered Species Act (CESA) generally parallels the main provisions of the Federal Endangered Species Act and is administered by the California Department of Fish and Game (CDFG). Under the CESA, an “endangered species” is defined as a species of plant, fish, or wildlife that is “in serious danger of becoming extinct throughout all, or a significant portion of its range” and is limited to species or subspecies native to California. The CESA establishes a petitioning process for the listing of threatened or endangered species. The CDFG is required to adopt regulations for this process and establish criteria for determining whether a species is endangered or threatened.

The CESA prohibits the “taking” of listed species except as otherwise provided in State law. Unlike its Federal counterpart, the CESA applies the take prohibitions to species petitioned for listing (i.e., State candidates). CDFG code defines “take” as “hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.” State lead agencies are required to consult with the CDFG to ensure that any action it undertakes is not likely to jeopardize the continued existence of any endangered or threatened species or result in destruction or adverse modification of essential habitat. A “lead agency” as defined under the CEQA as the public agency that has principal responsibility for carrying out or approving a project that may have a significant effect on the environment.

The California Environmental Quality Act (CEQA)

The goal of the CEQA (Pub. Res. Code §21000 et seq.) is to develop and maintain a high-quality environment. It directs California's public agencies to identify the significant environmental effects of their actions and avoid or mitigate those significant environmental effects, where feasible. The California Resources Agency administers the CEQA. CEQA requires that an EIR be prepared for any major project, which states the pros and cons of that project. If it is determined that a project has no significant environmental effects and is not exempt from CEQA, then the lead agency must adopt a negative declaration to that effect. The purpose of an EIR is to provide State and local agencies and the general public with detailed information on the potentially significant environmental effects which a proposed project is likely to have and to list ways which the significant environmental effects may be minimized and indicate alternatives to the project.

California Coastal Act of 1976, Public Resources Code Section 30000 et seq.
The California Coastal Act (Division 20 of the Public Resources Code, Section 30000, et seq.) became law in 1976 as a means of providing a comprehensive framework for the protection and management of coastal resources. The main goals of the act are to protect and restore coastal zone resources; assure balanced and orderly utilization of such resources; maximize public access to and along the coast; assure priority for coastal dependent and coastal-related development; and encourage cooperation between state and local agencies toward achieving the Act's objectives.

The Coastal Act contains policies to guide local and state decision-makers in the management of coastal and marine resources. The policies are organized into chapters by topics relating to public access; recreation; marine environment; land resources; and development. The act also contains provisions for development controls and land-use entitlements for certain types of new development in the coastal zone.

The California Coastal Act, which is administered by the California Coastal Commission, also identifies protective measures for nearshore marine resources. For example:

Coastal Act section 30230 states:

> *"Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."*

Coastal Act section 30231 states:

> *"The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams."*

Coastal Act section 30260 states:

> *"Coastal-dependent industrial facilities shall be encouraged to locate or expand within existing sites and shall be permitted reasonable long-term growth where consistent with this division. However, where new or expanded coastal-dependent industrial facilities cannot feasibly be accommodated consistent with other policies of this division, they may nonetheless be permitted in accordance with this section and Sections 3026l and 30262 if (1) alternative locations are infeasible or more environmentally damaging; (2) to do otherwise would adversely affect the public welfare; and (3) adverse environmental effects are mitigated to the maximum extent feasible."*

California Native Plant Protection Act

Includes provisions that prohibit the taking of listed rare or endangered plants from the wild and a salvage requirement for landowners. It provides the Department of Fish and Game the power to designate native plants as endangered or rare.

California Fish and Game Code

California Fish and Game Code, Sections 1601 and 1603, regulates activities that will "substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of a natural watercourse." Prior to such activities, notification of CDFG is required. If fish or wildlife would be substantially adversely affected, an agreement to implement mitigation measures identified by CDFG would be required.

California Regional Water Quality Control Board (RWQCB)

The RWQCB determines permit requirements on a case-by-case basis. They require a Waste Discharge Permit (WDP) if the action creates problems or if the action becomes permanent. The duration and size of a project are important factors and concerns may include the amount of water quality degradation.

The Water Quality Control Plan developed by the Central Coast Division of the RWQCB established water quality standards for the region. The plan incorporates the California Ocean Plan that establishes standards to protect the quality of ocean waters for use and enjoyment by the people of California. The Ocean Plan, which is administered by the State Water Resources Control Board, is reviewed periodically to guarantee that the current standards are adequate and are not allowing degradation to marine species or posing a threat to public health (State Water Resources Control Board, 1990). In general, Chapters I, II, and III establish discharge standards for non-point discharges to marine waters. For example:

The California Ocean Plan, Chapter I, Beneficial Uses states:

> *"The beneficial uses of the ocean waters of the State that shall be protected include industrial water supply, water contact and non-contact recreation, including aesthetic enjoyment, navigation, commercial and sport fishing, mariculture, preservation and enhancement of Areas of Special Biological Significance, rare and endangered species, marine habitat, fish migration, fish spawning and shellfish harvesting."*

The California Ocean Plan, Chapter II, Water Quality Objectives states, in part, in Section E Biological Characteristics, that:

1) *Marine communities, including vertebrate, invertebrate, and plant species shall not be degraded.*
2) *The natural taste, odor, and color of fish, shellfish, or other marine resources used for human consumption shall not be altered.*
3) *The concentration of organic materials in fish, shellfish or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.*

The California Ocean Plan, Chapter III, General Requirements for Management of Waste Discharge to the Ocean states, in part, in Section B that waste discharged to the ocean must be essentially free of the following:

1) *Material that is floatable or will become floatable upon discharge.*
2) *Settleable material or substances that may form sediments which will degrade benthic communities or other aquatic life.*
3) *Substances that will accumulate to toxic levels in marine waters, sediments or biota.*
4) *Substances that significantly decrease the natural light to benthic communities and other marine life.*
5) *Materials that result in aesthetically undesirable discoloration of the ocean surface.*

Central Coast Basin Plan

The Central Coast Region of the RWQCB has established a Water Quality Control Plan (Basin Plan) for the coastal waters that include the Tranquillon Ridge Field (RWQCB, 1994). The standards of the RWQCB incorporate the applicable portions of the ocean plan and are more specific to the beneficial uses of marine waters adjacent to the project site. These water quality objectives and toxic material limitations are designed to protect the beneficial uses of ocean waters within specific drainage basins. The Basin Plan identifies the following existing beneficial uses for the coastal waters contained within the project area (RWQCB, 1994).

Water Contact Recreation (REC-1): Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing and fishing.

Marine Habitat (MAR): Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife such as marine mammals and shorebirds.

Shellfish Harvesting (SHELL): Uses of water that support habitats suitable for the collection of filter-feeding shellfish such as clams, oysters, and mussels, for human consumption, commercial, or sport purposes. This includes waters that have in the past, or may in the future, contain significant shell fisheries.

Ocean Commercial and Sport Fishing (COMM): Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including uses involving organisms intended for human consumption or bait purposes.

Wildlife Habitat (WILD): Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Lempert-Keene-Seastrand Oil Spill Prevention and Response Act

Under the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act, the California Department of Fish and Game became the State lead agency in spill response and created the Office of Oil Spill Prevention and Response (OSPR). The Act requires that persons causing a spill begin immediate cleanup, follow approved contingency plans, and fully mitigate impacts to wildlife. Under an Interagency Agreement with OSPR, the CCC operates an oil spill program and maintains an oil spill staff. Before and after a spill, CCC staff are involved in review and comment to both State (e.g., OSPR) and Federal (e.g., U.S. Coast Guard) agencies on contingency plans and regulations related to marine vessels, marine facilities and marine vessel routing.

Santa Barbara County

The coastal reaches adjacent to the Tranquillon Ridge Field fall under the jurisdiction of SBC. Consequently, SBC is one of the agencies responsible for reviewing project actions including integration of policies established by the California Coastal Act. An Energy Division was established within the SBC’s Planning and Development Department to participate in environmental reviews and permitting of major oil and gas development projects. The Division also ensures that oil and gas projects are developed and operated in compliance with the permit conditions imposed by the County decision-makers, including the Board of Supervisors and the Planning Commission.

3.5.3 Significance Criteria

Changes or impacts to biological resources will be considered significant if the impacts cause:

- Adverse change to or the reduction in a population or habitat used by a State or Federally listed endangered, threatened, regulated or sensitive species. Any “take” of a listed species shall be considered significant;

- Adverse change to or the reduction in a population or habitat of a species that is recognized as biologically or economically significant in local, State, or Federal policies, statutes or regulations;
- Adverse change in community composition or ecosystem relationships for species that are recognized for scientific, recreational, ecological, or commercial importance;
- Any impedance of fish or wildlife migration routes that lasts for a period that significantly disrupts migration;
- Any alteration or destruction of habitat that prevents re-establishment of biological communities that inhabited the area prior to the project;
- Long-term (more than one year) loss or disturbance to biological communities or to ecosystem relationships;
- Reduction or elimination of species diversity or abundance;
- Reduction or elimination of quantity or quality of nesting areas;
- Loss of individuals or habitat that limits reproductive capacity;
- Fragmentation, elimination, or otherwise a disruption of foraging areas and/or access to food sources;
- Limitation or fragmentation of range and movement (geographic distribution or animals and/or seed dispersal routes); and
- Interference with natural processes, such as fire or flooding, upon which the habitat depends.
- Changes in biological resources caused by the project will be considered significant if the changes:
- Last longer than a month for toxicological impacts (e.g., those caused by oiling events or toxicity caused by the discharge of drilling muds and cuttings); and
- Last longer than one year for impacts caused by habitat disturbance (e.g., discharge of drilling fluids and construction activities) or habitat reduction (e.g., damage to hard-bottom structures during construction activities).

3.5.4 Impact Discussion

3.5.4.1 Marine Biological Resources/Off Shore Impacts

Impact #	Impact Description	Project/Phase
MB.1	Oil spills from the project may impact benthic and intertidal organisms, fish, marine mammals, marine birds, and marine turtles. Oil spills from the project may impact plankton.	*Increase Throughput* *Extension of Life*

The degree of impacts to marine biota from an oil spill will depend on several factors. Among them are the location, volume, rate, and type of oil that is spilled; amount of weathering, evaporation, and dispersion of oil in the water column and shoreline; and the amount of oil that is contained and cleaned immediately after the spill. Oil effects to marine biota include mortality or can be sublethal by inhibiting growth and reproduction. Oil can also bioaccumulate in certain marine species and can also cause histological damage, alter physiology and metabolism, and decrease reproductive capacity (NRC, 1985). In the section that follows, impacts that could occur to marine biota from an oil spill in the project area are described. It should be recognized that much of the discussion is based on studies documenting spills, such as the Exxon Valdez spill, that are much larger than a spill that would be expected from the proposed project. The impacts of the large spills are included because they are the best studied and also because they demonstrate the worst case of impacts that can occur from an oil spill. Realistically, the impacts of a worst case spill from the proposed project are likely to be similar to those of the Torch/Platform Irene spill. The primary impacts of the Torch/Platform Irene spill were to seabirds, sand and gravel beach habitats and rocky intertidal shoreline habitats (Torch/Platform Irene Trustee Council 2006).

The maximum oil spill volumes estimated for the Tranquillon Ridge Project are 7,900 bbls for the offshore pipeline and 4,500 bbls for Platform Irene. The oil spill modeling showed that in the event of a spill the likely areas that would be impacted would be the area from Point Sal to Point Conception. This is consistent with what was observed for the 1997 oil spill from the Point Pedernales oil emulsion pipeline. The MMS OSRA modeling showed that there was a greater than 40 percent chance that the area from Point Sal to Point Conception would be impacted in the event of a worst case oil spill.

The modeling also showed that under certain weather and ocean conditions, the portions of the western Channel Islands (San Miguel and Santa Rosa Islands) could be impacted from an offshore oil spill. The MMS OSRA modeling results showed that there was less than a 30 percent change that oil would impact the western most Channel Islands. These impact probabilities were based upon the assumption that no action was taken to contain the spill, and therefore, represent very conservative estimates of impact areas.

The remainder of the impact discussion focuses on the types of impacts that could occur to marine organisms in the event of an oil spill from the project.

Benthic Communities

Spilled oil that is not recovered by mechanical means, or does not evaporate or wash ashore, is eventually incorporated into bottom sediments. Oil can reach the benthos or ocean floor by the formation of nonbuoyant residues, adsorption onto particulate matter, or through incorporation in the food chain by ingestion and subsequent sinking of fecal pellets (Jordan and Payne, 1980). Contrary to oil in water that can dilute and disperse, oil that is incorporated into sediments can become a chronic pollutant source. It can be ingested by benthic organisms or incorporated into organisms by contact with gill membranes.

Adsorption onto particulate matter is a common pathway for the transport of oil to the benthic environment (Jordan and Payne, 1980). The amount of oil deposited on the seafloor after a spill can vary in relation to the nature and quantity of suspended particulate matter in the water column. For example, the large amounts of oil that settled to the benthic environment following the Santa Barbara Channel oil spill in 1969 were attributed to the mixing and adsorption of oil into sediments (Kolpack, 1971; McAuliffe et al., 1975). Mixing and absorption of oil into sediment during the *Amoco Cadiz* spill (1978) off the Brittany coast, the *Tsesis* spill (1980) in the

Baltic Sea, and the *IXTOC I* blowout (1979) in the Gulf of Mexico also contributed to the sinking and accumulation of oil in bottom sediments (Hess, 1978; Boehm, et al., 1980; Boehm and Fiest, 1980).

Spilled oil could also impact abalone that might be in the project area. The mostly area to be impacted in the event of an oil spill is from Point Sal to Point Conception. Red abalone would be the only species that would likely occur in this area. Smothering is the most common cause of mortality for abalone and would be limited to direct contact with weathered tar balls from the oil spill (USDOI/MMS 2001). During past oil spill responses, oil has collected in the nearshore kelp canopies. Recovery of the oil has been hindered by the kelp because it has fouled skimming equipment, thereby requiring the kelp to be cut to recover the oil. This has amplified the impacts to marine organisms by increasing the exposure of kelp-associated organisms to released oil (CDFG comment letter March 25, 2002). Given that a number of abalone species are kelp associated organisms, clean up of spilled oil in nearshore kelp areas could increase the impacts to abalone.

The severity of oil spill impacts to benthic organisms can vary according to the degree of weathering of the oil and the location of the spill. Impacts to benthos are more likely to occur from a nearshore pipeline break and in shallow waters in general. Oil that sinks quickly before it has weathered would contain appreciable amounts of toxic hydrocarbons that may be accumulated by benthic organisms resulting in mortalities. Weathered oil, although not as toxic, could potentially smother sessile organisms associated with hard substrates. Hence, the potential impacts of spilled oil to benthic communities are considered to be significant because if spilled oil did become incorporated into sediments or if abalone were impacted, the impacts could persist for more that a year.

Intertidal

When spilled oil reaches the shoreline or intertidal zone, it becomes concentrated in a narrow zone. Because of the shallow water depth, hydrocarbon concentrations can reach toxic levels. Thus, intertidal biota are exposed to higher concentrations of oil for a longer period of time than most other marine organisms. Impacts to the intertidal biota can be caused by physical smothering and hydrocarbon toxicity.

The severity and duration of impacts to the intertidal biota is, to a large part, a function of the biological and geomorphologic characteristic of the shoreline habitat. Based on the shoreline ranking system for oil spill sensitivity developed by Gundlach and Hayes (1978), habitats with a low energy regime are characterized by high biological populations, high oil residence time, and high sensitivity to oil. Recovery of such areas can take several years. Gravel and mixed sand/gravel beaches have relatively small biological populations, but oil impacting these habitats is resistant to cleaning. Despite intensive cleanup and remediation of gravel and cobble beaches oiled by the *Exxon Valdex* spill in Prince William Sound, oil remained in sediments eight years after the spill (Hayes and Michel, 1998).

Shoreline types in the project area consist primarily of sandy beaches and rocky intertidal habitat. The Torch pipeline spill of September 28, 1997, oiled approximately forty miles of coastline, stretching from the northern end of Minuteman Beach to Boat House. Approximately 100 acres of sandy beach were disturbed by oiling and cleanup operations. In addition, another

263 acres of sandy beach were very lightly oiled (less than or equal to 10% oiling by area), but were relatively undisturbed by heavy equipment during cleaning operations (OSPR 1999). Following the spill, certain beaches and rocky areas were not cleaned due to inaccessibility (SBC, 1997, 2001). Two intertidal sites (Boat House and Stairs) within the exposure zone were surveyed by Raimondi et al. (1999) after the spill for the MMS. There was no confirmation that spilled oil had reached the two intertidal sites and no confirmation that spilled oil had caused significant biological changes at either site. At the Boat House study site, there were no significant changes in percent cover for four common species (the algae, *Endocladia* and *Pelvetia*, and mussels and barnacles). At the Stairs study site, a statistically significant decrease that coincided with the spill was detected for barnacles. However, the decrease was not attributed to the oil spill because no visible oil was observed at the study site (Raimondi et al., 1999). In addition, a statistically significant decrease in barnacles was found during the same sampling period at another Santa Barbara County site located well outside the spill zone (Raimondi et al., 1999). At Point Arguello just north of the Boat House, large amounts of fresh oil and tar were observed on rocks throughout the middle to lower intertidal zone. "Sticky globs of tar were seen on black abalone and seastars. Tar covered the respiratory pores of some abalone. Based on these observations, some mortality may have occurred" (Raimondi et al., 1999, OSPR, 1998).

For rocky intertidal habitats, the Trustee Agencies that conducted the Natural Resources Damage Assessment reported very "light oiling" in numerous locations throughout the rocky intertidal habitat within the 40-mile oil exposure zone. While it is true that "light oiling" can occur from natural seeps, the NRDA agencies attributed the light oiling to the spill. At the Stairs study site, a statistically significant decrease that coincided with the spill was detected for barnacles (OSPR, 1998).

In addition to the direct impacts of oil, clean up, operations can have additional impacts on intertidal communities (MMS, 2005). For example, hot water wash used in cleanup of the Exxon Valdez spill had adverse impacts on the intertidal area. In another example, Rolan and Gallagher (1991) found that for the Esso Bernicia spill in the Shetland Islands of Great Britain, the biological communities of the rocky intertidal returned to nearly normal populations within 1 year, with the exception of areas that had been mechanically cleaned. Cleaned areas still had not recovered after 9 years.

After the 1969 Santa Barbara Channel oil spill, effects to several intertidal species were recorded. Impacts included smothering of barnacles (*Chthalamus fissus*), mortality of surfgrass (*Phyllospadix torreyi*) and algae such as *Hesperophycus harveyanus*, and reduced reproduction in the stalked barnacle (*Pollicipes polymerus*) (Straughan, 1971). There may have been impacts on additional intertidal biota, but the lack of pre-spill data and heavy rains and flooding at the time hampered a complete impact assessment (Straughan, 1971). Should an oil spill reach shore, intertidal biota could experience significant impacts. The probability of an oil spill from the project pipeline land falling in the Point Arguello region is discussed in Appendix G, Oil Spill Trajectory Analysis, of the 2002 FEIR, and the 2006 DEIR (SBC 2002, SBC 2006).

Plankton

Laboratory studies, field enclosure studies, and field studies conducted during oil spills have shown that oil spills have measurable effects upon marine phytoplankton and zooplankton. Impacts to phytoplankton include mortality, reduced growth and reduced photosynthesis. In some instances, growth stimulation has occurred at low hydrocarbon concentrations (Spies, 1985). Impacts to zooplankton include mortality and sublethal effects such as lowered feeding and reproductive rates and altered metabolism. Early life stages such as eggs, embryos, and larvae of zooplankton are considered to be more susceptible than adults to oil spills because of their higher sensitivity to toxicants and higher likelihood of exposure to oil at the surface of the ocean. The lethal and sublethal effects of oil on plankton depend on the persistence of sufficiently high concentrations of petroleum hydrocarbons in the water column. The effects would most likely be short-lived because of the limited residence time of oil in the water column in an open ocean environment. Most of the components of crude oil are insoluble in seawater and because oil floats on the sea surface, impacts to the water column would be limited. Aromatic hydrocarbons, such as benzene and toluene, that are considered to be most toxic to marine life evaporate quickly as the spill weathers in the marine environment. Other weathering processes such as spreading, dissolution, dispersion, emulsification, photochemical oxidation, and microbial degradation decrease the volume of spilled oil and increase the viscosity and specific gravity of the spilled oil. Also, the short generation time of plankton would result in short term recovery and preclude long term effects. Impacts are considered to be adverse but not significant.

Fish

The majority of fish data regarding oil effects have been obtained in the laboratory. Field data generally consist of reports on fish kills and some measurements of sublethal effects. Field data regarding effects other than massive fish kills are extremely difficult to obtain because of the difficulty in quantitatively sampling fish populations. In laboratory studies, typical responses to toxic hydrocarbon concentrations include a brief period of increased activity, followed by reduced activity, twitching, narcosis, and eventually death (NRC, 1985). Sublethal effects include histological damage, altered physiological and metabolic patterns, decreased growth and reproduction, and vulnerability to disease (NRC, 1985). Among fishes, benthic species are more sensitive than pelagic species and intertidal species are the most tolerant (Rice et al., 1979). In general, early life stages of fishes such as embryos and larvae are more sensitive to petroleum hydrocarbons than later life stages.

Although sensitivity is demonstrated in laboratory studies, only in a few instances have adverse effects been observed on fish following major oil spills. Examples include the *Florida* spill off West Falmouth, Massachusetts, and the *Amoco Cadiz* spill off the coast of Brittany. Sublethal effects were also documented in both cases. In the *Florida* spill, killifishes from contaminated marshes had a lower rate of lipogenesis than their counterparts from uncontaminated sites (Sabo and Stegeman, 1977). In the *Amoco Cadiz* spill, a large number of histological abnormalities were noted in estuarine flatfish (*Pleuronectes platessa*) (Haensly et al., 1982). According to Straughan (1971), there were no indication of fish kills or other evidence of effects on fishes from the Santa Barbara Channel blowout in 1969. No impacts to fishes were documented from the the Torch/Platform Irene oil spill, the previous spill with impacts most likely to be similar to a spill form the proposed project.

Although damage to fish populations following oil spills has rarely been documented, several species were severely impacted from the *Exxon Valdez* spill. Juvenile pink (*Oncorhynchus gorbuscha*) and sockeye (*O. nerka*) salmon were directly affected by the spill in 1989 and their eggs may have been affected through 1993 (Spies, 1996). Exposure to oil was documented by oil in the stomachs of salmon fry, measurements of polynuclear aromatic hydrocarbons (PAH) in salmon fry, and by increases in P450 and bile hydrocarbon metabolites in Dolly Varden (*Salvelinus malva*) (Spies, 1996). Impacts on growth were shown for pink salmon, Dolly Varden, and cutthroat trout (*O. clarki*) even though changes in food availability were not detected (Spies, 1996).

An estimated 40 to 50% of the egg biomass of the Pacific herring (*Clupea pallasi*) deposited within Prince William Sound was exposed to oil during developmental stages (Brown et al., 1996). The resulting 1989 year class of herring showed sublethal effects such as premature hatch, low weights, reduced growth, and increased morphologic and genetic abnormalities (Brown et al., 1996). The 1989 year class recruiting as 4-year old adults in 1993 was one of the smallest cohorts observed in Prince William Sound, and it returned to spawn with an adult herring population that was reduced by approximately 75% (Brown et al., 1996).

Adult fish, due to their mobility, may be able to avoid or minimize exposure to spilled oil. However, there is no conclusive evidence that fish will avoid spilled oil (NRC, 1985). Egg and larval stages would also not be able to avoid exposure to spilled oil. Because fish species can be economically important and because long-term loss can result from an oil spill, impacts to fish are considered to be significant.

Marine Mammals

Marine mammals that could be impacted by an oil spill include cetaceans (whales and dolphins), pinnipeds (seals), and fissipeds (sea otter). Animals that are unable to avoid contact with oil could be impacted by fouling, inhalation, or ingestion that could result in sublethal or lethal effects. Reviews on the effects of oil on marine mammals have been conducted by Geraci and St. Aubin (1982, 1985, 1990), Englehardt (1983), and the NRC (1985).

It is unlikely that oil spills would substantially threaten cetaceans (NRC, 1985). However, a massive oil spill could result in fouling of the baleen, toxicity from ingestion, respiratory difficulties, and irritation of membranes that contact oil. Although some observations suggest that cetaceans would avoid surfacing in oil slicks by staying submerged longer, other observations suggest that some cetaceans may not avoid oil-covered waters (NRC, 1985). Oil does not tend to cling to cetacean skin as it does to pelage of other marine mammal species. Geraci and St. Aubin (1982) suggest that oil fouling of cetacean skin and accidental ingestion would not reach toxic levels and that any irritation would likely be temporary. Should an oil spill occur in the project area, the species that would most likely be impacted, depending on the time of year, are the gray whale, blue, humpback, and fin whales. The blue, humpback, and fin whales are presently listed as endangered species.

Although seals apparently have the ability to detect and avoid oil slicks (Engelhardt 1983), Cowell (1979) reported that breeding seals swam through oil to reach rookery beaches during the breeding season. Davis and Anderson (1976) found no differences in the growth and mortality of oiled and unoiled grey seal pups. LeBoeuf (1971) reported similar results from the 1969 Santa Barbara Channel blowout with elephant seal pups. According to Brownell, (1971) and Geraci and Smith (1977), no deaths to marine mammals could be linked to the 1969 spill. However, wildlife survey capabilities at that period of time were less extensive than they are today. Geraci and Smith (1977) reported that surface contact with oil has a much greater impact on seals than absorption of the petroleum. In controlled experiments, seals that were exposed to floating oil resulted in reversible eye damage (in the wild, "reversible" eye damage could significantly affect an animal's ability to function). The project area occurs in a foraging area for pinnipeds (e.g., California sea lions). Also, oil spill trajectory analyses indicate that oil released from a spill in the project area can come ashore exposing adults and subadults to potentially long term lethal and sublethal effects. Onshore clean up activities would also be extremely disruptive to pinniped populations. DeLong (1975) reported that seals disturbed on San Miguel Island retreated into the sea and did not return for several days. Such impacts could result in significant behavior impacts should a spill occur during the breeding season (Davis and Anderson, 1976).

A marine mammal (sea otters and pinnipeds) injury assessment survey was conducted during the Torch Point Pedernales pipeline spill that occurred on September 28, 1997. The purpose of the survey was to assess the degree of exposure and oil-related injuries to sea otters and pinnipeds from the spill. With respect to pinnipeds, it was concluded that pinnipeds were exposed to oil from the spill and that one female California sea lion likely died as a result of oil exposure (CDFG et al., 1998). The conclusion for the death from oil exposure was based on oil in the mouth and coat of the dead animal, the oil on the dead animal was a positive match with the spilled source oil, and the animal had distended pulmonary alveoli and edema that is often associated with exposure to petroleum hydrocarbons (CDFG et al., 1998). CDFG et al. (1998) concluded that pinnipeds in the proximity of the spill most likely were exposed to oil and suffered sub-lethal injuries.

Sea otters, a threatened species, have increased in numbers in the Purisima Point to Point Conception area and have extended their range eastward. A small breeding colony now resides in the Purisima Point region. An oil spill, should one occur, has the potential to impact a substantial number of sea otters in this region.

Oil spill impacts to sea otters are well documented (Costa and Kooyman, 1982; Siniff, 1982; Davis et al., 1988). After exposure to oil, death usually results from either an increase in metabolic rate, hypothermia, or inhalation of volatile vapors (Geraci and Williams, 1990). An oil spill that occurs during the non-breeding season (November to May) could kill more sea otters than one that occurs during the breeding season (June to November). This is because during the non-breeding season, sea otters extend their range and have been reported as far east as Carpinteria. The range of this southernmost group, which consists mostly of young males, generally retracts to the center of the range north of Point Arguello during the breeding season from June to November. In any case, sea otters in the Purisima Point to Point Conception region are vulnerable to oil spills. Of the 364 oiled otters that were processed at oiling centers following the *Exxon Valdez* oil spill, only 53% were rehabilitated (Geraci and Williams, 1990). Nearly 1,000 sea otter carcasses were recovered within a few months of the *Exxon Valdez* spill (Loughlin et al., 1996). Total sea otter fatalities from this spill were estimated at 2,800 (Garrott et al., 1993).

No sea otter fatalities were reported in the project area from the September 1997 spill. Field observations from the marine mammal injury assessment survey suggested possible oil exposure to sea otters but there were no indications of anomalies or change in the number of sea otters in the area. There were no direct observations of oiled sea otters or otter deaths in the spill area. It is likely, however, that sea otters in the proximity of the spill were exposed to oil and may have experienced sub-lethal effects, but did not experience acute effects or death as a result of the spill (CDFG et al., 1998).

In addition to sea otters, the harbor seal *Phoca vitulina* and the Steller sea lion *Eumetopias jubatus,* were impacted by the *Exxon Valdez* oil spill (Loughlin et al., 1996). Tissue from animals found dead in spill areas contained elevated levels of hydrocarbons. Also, population declines for both species were noted in Prince William Sound after the oil spill (Loughlin et al., 1996).

In summary, the marine mammal species that occur in the project area exhibit varying degrees of vulnerability to oil spills. Impacts can be caused either by oil contact or by ingestion. There is evidence that cetaceans species may avoid contact with oil at sea; however, pinniped species and sea otters could potentially suffer lethal and long term sublethal effects resulting in significant impacts. Onshore cleanup activities, depending on location, could disrupt pinniped haul-out and rookery areas and could also result in a significant impact.

Marine Birds

Oil spills pose a significant threat to marine birds. Bourne (1976), Holmes and Cronshaw (1977), Brown (1982), Hunt (1985), NRC (1985) and others have reviewed oil spill effects on marine birds. Due to the migratory nature of many bird species, the severity of oil spill impacts on marine birds would depend on the time of the year, the species present, and their numbers. According to Holmes and Cronshaw (1977), these factors accounted for the relatively low number of marine birds (3,600) that were killed during the Santa Barbara blowout in 1969.

Exposure to oil can injure marine birds by two general mechanisms: 1) physical effects of oil on plumage and 2) toxic effects. A large proportion of the acute mortality caused by spills is due to physical oiling of birds which results in hypothermia and reduced ability to feed. Oil on a marine bird clogs and damages the fine structure of the feathers which is responsible for maintaining water repellency and heat insulation. Acute (short-term) mortality, as well as sublethal effects, can also result from toxicity after birds ingest or inhale oil.

In addition to coating by oil, marine birds are also subject to chronic, long term effects from oil that remains in the environment. Chronic (long-term) effects of oiling likely include reduced reproduction and survivability. For example, small amounts of oil on a bird’s plumage may be transferred to eggs during incubation. This contact has been shown to kill developing embryos (Albers, 1978; Szaro et al., 1978). Birds can also consume oil through their diet or through preening which results in physiological stress (Holmes and Cronshaw, 1977; Brown, 1982).

An oil spill that affects bird habitat (e.g., shoreline, marshes) can pose long-term problems (Albers, 1984). Birds have been observed to leave an area that has been affected by a spill (Hope et al., 1978; Chapman, 1981). Such movement away from their habitat could result in severe impacts should it occur during the breeding or nesting season (Albers, 1984).

The endangered brown pelican, California least tern, Xantus’s murrelet, and marbled murrelet could all be severely impacted by an oil spill. The brown pelican and both murrelets are offshore foragers, and are, therefore, highly susceptible to oil ingestion and fouling. Effects of oil contamination on the overall populations of these species could be significant as the brown pelican continues to recover from the effects of DDT contamination, and both murrelet species are severely reduced populations that have been impacted by nesting habitat reduction and predation. The California least tern is a coastal inhabitant but forages offshore. It also is highly susceptible to oil spills because it skims the ocean surface for prey with occasional diving.

Should a spill reach the coastal habitat, significant mortality could also occur, and shore species such as western snowy plover would be affected. Impacts to these species are considered to be significant and not mitigable.

A rupture in the Torch pipeline from Platform Irene to the shoreline occurred on September 28, 1997, releasing at least 163 bbl of crude oil (County of Santa Barbara, 2001a). Surveys for dead or live oiled seabirds that were beached were conducted from September 29 to October 5, 1997. Both shoreline and aerial surveys were conducted to locate and collect oiled birds and estimate the number and distribution of seabirds at risk from the spill. To estimate the total number of birds injured from the spill, beach searches were conducted, scavenging rates (removal of bird carcasses by predators or scavengers) were estimated, and estimates were made regarding the numbers of birds beached along inaccessible segments of the coast.

A summary of the spill related birds that were found on the surveys is shown in Table 3.5.13. Of the 140 birds that were collected during the survey, 122 were either dead or died after sampling. It needs to be noted that the 140 birds collected during the surveys is a conservative number of oiled birds. For example, it does not include birds that may have been missed by the surveyors, dead or oiled birds that drifted to sea or beyond the survey area and did not reach the shoreline, or birds that reached the shoreline in the survey area but were removed by scavengers or predators such as vultures and coyotes.

Various methods and studies were used to estimate the number of affected birds missed by the survey for each of the areas listed above. Ford Consulting (1998) estimated that 353 birds died from oiling and were not recovered during the surveys. Therefore, the total number of seabirds and shorebirds impacted by the Torch 1997 spill has been estimated at 635 to 815 (OSPR, 1998). This estimate includes 90 dead birds that were recovered, 32 birds that died in the rehabilitation center, and 18 birds that were rehabilitated and released.

Table 3.5.14 A Summary of the Oiled Birds Recovered from the Torch Pipeline Spill (from Ford Consulting, 1998)

Species	Dead	Live-Died	Live-Released	Total
Red-Throated Loon	1	1	0	2
Pacific Loon	1	0	0	1
Common Loon	0	1	0	1
Eared Grebe	0	1	2	3
Western Grebe	6	5	0	11
Brandt’s Cormorant	34	1	1	36
Common Murre	28	21	0	49
Rhinoceros Auklet	1	0	0	1
Pigeon Guillemot	1	0	0	1
American Coot	1	0	0	1
Sooty Shearwater	2	0	0	2
Black-Vented Shearwater	1	0	0	1
Brown Pelican	0	0	2	2
Western Gull	3	0	7	10

Table 3.5.14 A Summary of the Oiled Birds Recovered from the Torch Pipeline Spill (from Ford Consulting, 1998)

Species	Dead	Live-Died	Live-Released	Total
Heermann's Gull	2	0	2	4
California Gull	1	0	2	3
Ring-Billed Gull	1	0	0	1
Elegant Tern	0	1	0	1
Northern Phalarope	1	1	0	2
Sanderling	1	0	2	3
Unknown	5	0	0	5
Total	**90**	**32**	**18**	**140**

Dead oiled birds were recovered as far south as Honda Cove, just north of Point Pedernales, and as far north as Morro Bay. Live oiled birds were observed as far southeast as Santa Barbara Harbor and as far north as Morro Bay. It is reasonable to assume that some live oiled birds, such as endangered brown pelicans, flew well beyond the area immediately affected by the spill. Dead birds may also have drifted passively beyond the area since spill-affected seabird carcasses frequently persist longer than detectable quantities of oil (Ford et al. 1996).

Although deaths from oiling for the endangered brown pelican and western snowy plover were not reported from the spill, Ford Consulting (1998) estimated that 14 brown pelicans and 13 snowy plovers were directly harmed through fouling by oil from the pipeline rupture.

While some species, such as western snowy plovers, were impacted after the oil reached shore, many of the birds, particularly diving birds such as brown pelicans and alcids, were likely oiled at sea. Other impacted bird species included Brandt's cormorant, common murre, western grebe, rhinoceros auklet, pigeon guillemot, elegant tern, long-billed curlew, common loon, shearwaters, gulls, sanderlings, northern phalarope, and American coot. The majority of species impacted by the spill did not breed in the area and originated from other geographic areas, but occured in the spill zone during their respective migrations.

The Santa Ynez River Mouth and VAFB shoreline is mentioned repeatedly in The Birds of Santa Barbara County, California (Lehman, 1994) as one of the best places to observe birds, especially listed species such as western snowy plovers (Charadrius alexandrinus) and California least terns (Sterna antillarum). Estuary habitat supports large concentrations of marine birds that use the lagoons for roosting and foraging. Several marsh dwelling birds depend on its large stands of tule for nesting. The endangered peregrine falcon, California brown pelicans, and California least terns are among the regular visitors to the Santa Ynez estuary. The Belding's savanna sparrow (state-endangered) are permanent residents of the coastal salt marsh at this location.

Marine Turtles

Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, disruption of salt gland function, asphyxiation, and displacement from preferred habitats (Vargo et al., 1986; Lutz and Lutcavage, 1989). Turtles may become entrapped by tar and oil slicks and rendered immobile (Witham, 1978; Plotkin and Amos, 1988). Small juvenile turtles are particularly vulnerable to contacting or ingesting oil because the currents that concentrate oil spills also form the debris mats in which they are found (Carr, 1980; Collard and Ogren, 1990). Contact with oil may not cause direct or immediate death but cumulative sublethal effects, such as salt gland disruption or liver impairment could impair the marine turtle's ability to function effectively in the marine environment (Vargo et al., 1986; Lutz and Lutcavage, 1989).

Although oil spills can adversely affect marine turtles. However, they rarely occur in the project area. In the 13-year period from 1982-1995, fourteen stranding were reported on SBC beaches. Although they are rare in the proposed project area, oil spill impacts to marine turtles are considered to be adverse because of their threatened and endangered status.

Mitigation Measures

Although the technology has improved in recent years, complete containment and cleanup of an oil spill at sea is nearly impossible. The effectiveness of offshore containment and cleanup equipment and procedures is largely dependent on the type of oil, volume, sea state (e.g., swells, wind waves, chop, etc.), and proper use of the equipment. A major spill from the Point Pedernales offshore facilities would likely result in shoreline contamination, regardless of the sea and weather conditions, due to the proximity of land and prevailing winds and currents in the area. Mitigation Measure TB.6d would also apply to this impact to address impacts to marine birds from an oil spill. Mitigation measure OWR-2, which covers the SCADA system, would also serve to reduce the likelihood of a spill to the marine environment.

With respect to wind wave conditions, the containment effectiveness of booms begins to lessen at a significant wave height of 2 feet. Above 2 feet, booms and skimmers are ineffective; however, it is likely that a slick would be dispersed and mixed into the water column. For long-period swell conditions, booms and skimmers can retain effectiveness in significant wave heights greater than 2 feet. High winds can cause some type of booms to lay over, allowing oil to splash and flow over the boom. High winds can also affect the deployment or shape of the deployment and thus the containment effectiveness of the boom. More information on oil spill cleanup methods is found in Appendix E of SBC 2002 and SBC 2006.

MB-1a The November 2004 Core OSRP and July 2005 Supplement shall be updated to incorporate changes in platform activities that result from the proposed project. For example, the plan shall incorporate detailed response procedures for marine oil spills resulting from a blowout if wells producing the Tranquillon-Ridge field are expected to be free flowing. Worst-case discharge scenarios shall be updated accordingly. In addition, lessons learned from the cleanup of the 1997 oil spill shall be incorporated into the Response Plan. The efficacy of various containment and cleanup techniques applied during the 1997 spill shall be evaluated with regard to potential future spills. Hindcasts of the observed oil-spill trajectory shall be used to improve site-specific trajectory models. Potential ecological damage resulting from cleanup techniques applied in 1997 shall be discussed.

The personnel and training sections of the OSRP shall be updated and identify training requirements for all personnel that would be utilized to respond to oil spills. At a minimum, new personnel shall be trained immediately in the overall operational aspects of oil spill response including the proper use of all equipment that would be utilized in oil spill response. Annual training for all personnel shall also be included in the OSRP. The annual training shall include training in the operation of new equipment that may be *utilized in oil spill response, retraining in the operation of existing equipment, and review of the oil spill response requirements that are identified in the OSRP.*

Most of the County's western coast is considered relatively unaffected by oil deposition. A UCSB researcher who studies sandy beach invertebrates uses Surf Beach for a clean control as a counterpoint to her studies conducted at South Coast beaches (CSFG 1999). However, some portions of the shoreline within the potential spill zone of Platform Irene and the Point Pedernales Pipeline are subject to tar deposition (i.e. tarballs) from natural offshore oil seeps. The amount, variability, and chemical fingerprints of the tars normally present in the intertidal zone in the spill zone are not well documented. A 2004 study indicates that there are (SBC 2004). If oil from an offshore spill reached the shore, it could be difficult to differentiate residues of the spilled oil from any naturally occurring tar, particularly in areas of light oiling. Because the baseline condition of the shore is not well documented, determining the extent of shoreline clean-up needed to restore the environment to prespill conditions following a spill can be problematic. After the 1997 spill, the question of whether any of the oil on the beach was from sources other than the spill came up in several contexts. Lack of a full understanding of baseline oiling conditions could result in either inadequate oil removal or excessive disturbance to intertidal environments from an overly aggressive clean-up effort.

MB-1b In order to provide a baseline for shoreline clean-up efforts in the event of a spill, the applicant shall contribute to the funding of a program to document the amount, variability, and chemical fingerprint of the tar normally present in the intertidal zone within the potential oil spill zone. The program shall include both visual observations and chemical sampling of tar along five segments (less than or equal to one-mile each) of shoreline located within the area of the coast located between Point Sal and Point Conception. The program shall continue for as long as Tranquillon Ridge Field development is occurring or until analysis of the collected data indicates that extension of sampling will not significantly increase understanding of the pattern of tar deposition and improve documentation of the baseline.

The amount of tar shall be estimated and its chemical fingerprint determined, based on the shoreline tar sampling protocol used by the U.S. Geological Survey (USGS) in its MMS-funded study "Submarine Oil and Gas Seeps of the Southern Offshore Santa Maria Basin, California" (2001-2004). The program shall document visual observations and chemical sampling. The samples shall be analyzed for chemical fingerprint in the USGS laboratory. If analysis by the USGS is not available, another comparable fingerprinting method may be substituted. Annual cost of the applicant's contribution to this program shall not exceed $100,000. The program shall be developed in cooperation with Santa Barbara County's Department of Planning and Development, and shall be coordinated by the Energy Division. The Energy Division shall evaluate the program on an annual basis in coordination with staffs of the California State Lands Commission, California Coastal Commission, Department of Fish and Game Office of Spill Prevention and Response, and Minerals Management Service. If new information indicates that changes to the methodology or protocol would improve the efficiency or accuracy of determining baseline oiling conditions, the County shall revise the program. Any revisions to the program shall not cause the annual cost to the applicant to exceed the $100,000 limitation.

Because there are limitations to thorough containment and cleanup of an offshore oil spill, significant impacts could remain for benthic organisms, intertidal communities, marine mammals, marine turtles, and marine birds. Appendix E of the 2002 FEIR and the 2006 DEIR (SBC 2002, SBC 2006) provides additional information on the impacts associated with containment and cleanup of offshore oil spills.

Impact #	Impact Description	Project/Phase
MB.2	The discharge of drilling muds and cuttings from Platform Irene may potentially impact marine organisms in the project area.	*Drilling phase*

Benthic Organisms

Drill cuttings discharged and deposited beneath Platform Irene may potentially bury benthic organisms. Also, small quantities of drilling muds deposited on the seafloor could adversely affect certain benthic organisms.

Drilling muds, which consist primarily of barite and bentonite clays, are used in the drilling process for a variety of purposes. Drilling muds cool and lubricate the drill bit and drill string, seal and control hydrostatic pressure in the hole, and they remove cuttings from beneath the drill bit and transport them to the surface. In accordance with NPDES permit requirements on the west coast of the US, only water-based drilling muds can be discharged to the ocean. Drilling muds that are contaminated or contain mineral or diesel oil will be transported to shore for disposal and not discharged into the ocean. The estimated 30-well program would consist of drilling operations for approximately 60 to 90 days per well, with an occasional short break between wells. The permitted limit under the NPDES general permit is 105,000 barrels per year of muds and 30,000 barrels per year of cuttings. Assuming that drilling operations start in the third quarter of 2007, the following muds and cuttings volumes are expected to be discharged per year. These volumes are well below the NPDES muds and cuttings limits noted:

- 2007, starting 3rd quarter: Mud 28,000 bbls; cuttings 3,000 bbls
- 2008: Muds 52,000 bbls; cuttings 7,000 bbls
- 2009: Muds 48,000 bbls; cuttings 5,000 bbls
- 2010: Muds 46,000 bbls; cuttings 5,000 bbls

The deposition of drill cuttings could impact benthic organisms by smothering or by altering the character of the sediments near the drill site. The magnitude and extent of cuttings accumulation would, however, depend on a number of variables including water depth, type of formation that is drilled, hydrodynamic regime, and the volume of cuttings that are discharged. Zingula and Larson (1977) reported that the typical size for a cuttings pile in the Gulf of Mexico was approximately 50 m in diameter and up to 1 m in height. Where currents are strong, as in the project area, there may be no visible buildup of cuttings on the seafloor (Ray and Meek, 1980; BNEML/WHOI 1983).

Only a few studies have examined the effects of burial of benthic organisms by drill cuttings or drilling muds. Hence, results from studies of benthic impacts from disposal of dredged materials have been used to infer impacts from the deposition of drill cuttings (Maurer, 1983). The results indicate that the effects of burial largely depend on the thickness of the material deposited, and the burrowing capabilities and the tolerances of the benthic organisms. In the Santa Barbara Channel, Zingula and Larson (1977) reported that piles of cuttings were colonized by motile benthic organisms from surrounding areas within a few months after completion of drilling.

Sessile organisms such as sea pens were subject to burial within 100 m of a drilling unit and their absence persisted up to a year after the completion of drilling (EG&G, 1982).

In 1996, Platforms Hazel, Hilda, Hope, and Heidi (collectively known as the 4H platforms), located in the eastern portion of the Santa Barbara Channel were removed. The platforms were located in water depths ranging from 29 m (95 feet) to 46 m (150 feet). Beneath the platforms, shell mounds ranged from 6.7 to 8.5 m (20 to 28 feet) in height and from 56.9 to 70.1 m (185 to 230 feet) in width. The estimated volume of material within the mounds ranged from 5,352 to 10,704 m^3 (7,000 to 14,000 yd^3) (de Wit, 2001). The shell mounds beneath each of the four platforms had similar physical characteristics and was comprised of three distinct layers: 1) an upper layer of shell hash approximately 0.3 to 2.1 m (1 to 7 feet) thick , 2) an intermediate layer of drill cuttings approximately 0 to 5.5 m (1 to 18 feet) thick, and 3) the underlying natural seafloor sediments (de Wit, 2001). The shell hash layer was comprised of mussel, clam, and barnacle shells with varying amounts of clay infilling while the intermediate layer consisted of drilling muds and cuttings. Pockets of oil sheen or petroleum odor were also present within this layer.

Modeling results (provided in Appendix D of SBC 2002 and SBC 2006) indicate that the majority of drilling muds and cuttings will be deposited close to Platform Irene. Results indicate that over half of the muds will be deposited within 1.7 km and over 80% will be deposited within 3.6 km of the Platform. Less than 0.4% is expected to travel farther than 10 km before being deposited on the seafloor. Based on the depositional pattern, drilling muds plumes would seldom enter into State waters. This is partially due to the along-shore alignment of ocean currents in the area.

The discharge of drilling muds and cuttings from the proposed project would affect soft-bottom benthic organisms in the immediate vicinity of Platform Irene. Benthic organisms, especially those within 1.7 km of the Platform, could potentially be buried beneath the accumulation of discharged materials. The discharge of muds and cuttings would be gradual and occur over a 7 to 8 year period. Rock outcrops have not been identified in the vicinity of Platform Irene so it is very unlikely that drill cuttings from discharges would impact hard-bottom organisms. Because the area affected by the deposition is small relative to the entire project area, the impacts caused by the discharge of drillings muds and cuttings are considered to be adverse but not significant.

Drilling muds are a mixture of barite, bentonite clays, and a variety of special purpose additives. In laboratory studies, both lethal and sublethal effects on benthic organisms have been noted from thin layers (1 mm) of drilling muds layered over natural sediments or a mixture (0.3%) of drilling muds with natural sediments (NRC, 1983; Neff, 1983, 1985). The different species that have been tested have shown varying tolerances to drilling muds. Some species were unaffected by mixtures up to 20 to 30% or more of drilling muds and natural sediment. It is not known if the effects that have been noted are due to toxicity of drilling muds components, altered sediment properties, or a combination of these factors.

Based on chemical analyses of sediments collected at shell mounds beneath four platforms in the Santa Barbara Channel, DeWit (2001) reported that ERL (Effects Range Low after Long et al., 1995; chemical concentrations below ERL are not expected to have an effect) concentrations were exceeded for all analyses except for Hg, DDT, and PCBs. At one of the platforms (Hazel), sediments exceeded the ERL or ERM (Effects Range Medium after Long et al., 1995; chemical concentrations at which effects are expected to occur) for 14 analytes. Elutriate bioassay testing indicated that sediment from Platform Hazel was toxic to mysid shrimp. The 96-hour LC50 (lethal concentration resulting in 50% mortality) was 48.57% meaning that sediment elutriate diluted to 48.57% killed 50% of the test organisms. The toxicity was thought to be due to the synergistic effects of high sediment concentrations for several trace metals and organic compounds (de Wit, 2001). Species associated with the shell mounds included the bat star *Asterina miniata*, the gorgonian coral *Lophogorgia chilensis*, the coral *Coenocyathus stearnsii*, and the anemone *Corynactis californica*.

Because there are inherent problems with laboratory toxicity studies, several field studies have been conducted near drilling operations to evaluate impacts of discharged drilling muds or cuttings on benthic organisms. According to Carney (1985), most of these studies have had design limitations whereby subtle impacts could not be resolved from natural, background variability. In general, when impacts have been reported on benthic organisms, they have been noted only in the immediate vicinity of recent drilling operations where visual, physical, or chemical evidence of persistent accumulation of drilling muds or cuttings are observed. However, in other studies, impacts were not detected even though drilling muds was present in sediments (BNEML/WHOI 1983; Nekton and KLI 1984).

The effects of drilling muds and cuttings on hard-bottom biota were studied in detail during the comprehensive California Monitoring Program (CAMP), Phases II and III, which lasted from 1986 to 1995. CAMP, sponsored by MMS, monitored discharges from Platforms Harvest, Hidalgo, and Hermosa. The conclusion provided at the end of the study was that platform discharges had not caused changes to nearby hard-bottom communities (Diener and Lissner, 1995). There was no consistent pattern of response for a single taxon over the three habitat types (deep high and low relief, and shallow low relief). Statistical tests concluded that the cumulative distribution of responses could have been due to chance alone (Diener and Lissner, 1995). Based on the results of CAMP Phases II and III, and the absence of hard-bottom habitat in the project area, adverse impacts to hard-bottom epibiota due to drilling muds and cuttings are not expected to occur.

Based upon laboratory bioassay studies, de Wit (2001) reported toxic sediments beneath Platform Hazel located in the eastern Santa Barbara Channel. Toxic effects were not observed in the field. The toxic sediments that were tested in the laboratory were collected in shell mounds measuring 56.9 to 70.1 m (185 to 230 feet) wide and 6.7 to 8.5 m (20 to 28 feet) in height. Should toxic impacts to benthic organisms occur beneath Platform Irene, they are expected to be restricted to depositional areas having high concentrations of drilling muds. Because of the highly localized nature of potential impacts, they are considered adverse but not significant.

Drilling muds and cuttings would be discharged from Platform Irene in accordance with the guidelines established in the general National Pollutant Discharge Elimination System (NPDES) permit. The permit does not allow the discharge of drilling muds containing free oil or oil-based fluids or toxic additives or “pills” (e.g., diesel oil). Also, based on the results of toxicological tests, the permit also contains limits on the levels of mercury and cadmium in drilling muds that can be discharged on the OCS. Additionally, under the new NPDES permit, the platform operator is required to demonstrate compliance with limits for both drilling fluids and cuttings by conducting and reporting the results of drilling fluids bioassays for each mud system that is used and discharged on the OCS. Drilling fluid samples for the bioassays are to be taken at the time that maximum well footage is reached for each generic mud system used and discharged. Because of the strict toxicological requirements that must be satisfied, significant impacts are not expected to occur.

Plankton

The discharge of drilling muds and cuttings from Platform Irene would increase turbidity in the water column and decrease water clarity in waters adjacent to the platform. Elevated turbidity or an increase in suspended matter could inhibit photosynthesis by phytoplankton and could interfere with zooplankton interactions. Discharged muds, however, tend to dilute rapidly and to concentrations that are much lower than those known to be toxic to marine organisms in 96-hour bioassays (NRC, 1983). Plankton in waters close to Platform Irene may be affected by the discharge of drilling muds. However, due to the intermittent discharge of drilling muds, the shunting system, the rapid descent of most mud solids to the bottom, and the rapid dispersion of suspended mud in the water column, any impact should be localized and transient.

Field studies have shown that water clarity may be affected up to 2000 m from a drill site for surface bulk drilling muds discharges. However, shunting of discharges to 150 feet below the ocean's surface would significantly diminish the dispersion of drilling muds. Since plankton are carried by currents, those in the receiving waters near the discharge would be exposed to elevated turbidity for as long as it takes for the plume to disperse to background levels. Petrazzuolo (1983) and Neff (1985) have reported that this dispersion would occur within a few minutes to a few hours. Hence, the impacts to plankton are considered to be adverse but not significant.

Fish

The discharge of drilling muds could affect fishes due to increased turbidity or to the toxic properties of certain mud components. Most of the fishes would probably avoid the plume during a bulk discharge. Drilling muds contain some toxic components; however, the concentrations that fish could be exposed to in the water column, except within a few meters of the discharge pipe, would be lower than levels known to kill fishes in laboratory studies. Also, the duration of the exposure from any particular discharge would be much shorter than any exposure used in laboratory bioassays (typically 96 hour). Sublethal effects (e.g., altered metabolism, physiology, behavior) can occur at lower concentrations and over shorter exposure intervals that those known to cause mortality (Petrazzuolo, 1983). Also, larval fish can be more sensitive to drilling muds than adult fish. Because they are planktonic, they would not be able to minimize exposure by swimming out of a drilling muds plume. Although drilling muds discharges are unlikely to result in mortality to adult fish in the discharge area, sublethal impacts to fish larvae can occur. However, the number of fish affected would be small because muds discharges are discrete events of short duration.

Drilling muds and cuttings could potentially affect fishes by ingestion of prey that have bioaccumulated toxins from the discharges. However, the biological assessment for the General NPDES permit for OCS operations in southern California concluded that direct toxicity to fish or their food base should be minimal (SAIC, 2000a,b). Because all discharges resulting from the project will be required to meet NPDES water quality criteria that are designed to protect biological resources, potential impacts to fish are expected to be adverse but not significant.

Marine Mammals

The discharge of drilling muds and cuttings would increase turbidity in the vicinity of Platform Irene. Reduced visibility may interfere with foraging activity in the vicinity of the platform after a bulk discharge. Reduced water clarity could also reduce the feeding ability of visually foraging species such as the California sea lion.

The impacts to marine mammals due to the ingestion of prey contaminated with trace metals are not well documented. However, studies of trace metals and their occurrence in food chains in the vicinity of ocean outfalls indicate that the potential for bioaccumulation in marine mammals is low (Schafer et al., 1982). The impacts to marine mammals due to the discharge of drilling muds and cuttings would be adverse but not significant.

Marine Birds

The discharge of drilling muds and cuttings would result in turbid waters in the vicinity of Platform Irene. Marine birds may avoid feeding in the area because of the reduced visibility of prey. Drilling muds discharges, however, would be intermittent and the resulting plume would be localized. Muds discharges would not reduce the ability of marine birds to find sufficient prey and feed because the birds would be able to forage in adjacent areas. Also, because little or no bioaccumulation of metals is anticipated in fishes, marine birds should not accumulate metals from drilling discharges. Impacts to marine birds from the discharge of drilling muds and cuttings are therefore considered to be adverse but not significant.

Intertidal Habitats

Discharges of drilling muds and cuttings from drilling activities are unlikely to have any impacts on intertidal organisms because of the distance of the discharge point to shore and because of the direction of the prevailing currents. Should discharges be transported shoreward, drilling muds would be substantially diluted by the time they reached shore. Dilution, combined with the short duration and intermittent nature of muds discharges and the low toxicity of drilling muds, make the possibility of adverse impacts to the intertidal habitat very unlikely. Hence, impacts to the intertidal habitat from the discharge of drilling muds and cuttings are considered to be adverse but not significant.

Mitigation Measure

MB-2 The shunt depth (150 feet below the sea surface) for the discharge of drilling muds and cuttings shall be continued for the proposed project.

Drilling muds discharged from Platform Irene would dilute rapidly and the dispersion would be limited to a few km from the platform. The majority of drill cuttings would be deposited in the immediate vicinity of the platform. The impacts to marine organisms caused by the discharge of drilling muds and cuttings are considered to be adverse but not significant.

Impact #	Impact Description	Project/Phase
MB.3	Discharge of produced water from Platform Irene may potentially impact marine organisms in the project area.	*New Operations*

Produced water refers to the total water discharged from the oil and gas extraction process. It is the largest single source of material discharged during oil and gas operations. Typically, produced water consists of formation water, injection water, and chemicals that are used in the oil and water separation process (USDOI/MMS 1996).

Produced water generally represents a small portion of the initial fluid extracted from a well. As a reservoir becomes depleted, however, the amount of formation water extracted generally increases. Constituents found in produced water are iron, calcium, magnesium, sodium, bicarbonate, sulfates, and chloride. Produced water can also contain entrained petroleum hydrocarbons, including the lighter BTEX and PAH fractions, and measurable trace metal concentrations. Relative to ambient water, produced water contains increased organic salts and trace metals, decreased dissolved oxygen, and is higher in temperature. These same properties may adversely affect the marine environment (USDOI/MMS 1996).

In the proposed project, approximately 40,000 barrels of produced water would be piped to Platform Irene for disposal after it is processed and treated onshore at the LOGP. During processing, all impurities would be removed from the produced water in accordance with NPDES requirements prior to it being piped to Platform Irene for disposal. Also, the salinity and temperature (after treatment) of the produced water from Platform Irene, when it is discharged, will be approximately equal to ambient seawater (Brandsma, 2001). Modeling studies conducted for Platform Irene indicate rapid dilution (10-fold within 10 m and 50-fold within 100 m) (Brandsma, 2001). Because of the rapid rate of dilution, impacts to plankon, seabirds, marine mammals, and benthic organisms are not expected to occur. Results of produced water modeling are provided in Appendix F of the 2002 FEIR and the 2006 DEIR (SBC 2002, SBC 2006).

The modeling, discussed in Appendix F of the 2002 FEIR and the 2006 DEIR (SBC 2002, SBC 2006), shows that all constituent concentrations are far below the NPDES permit limits at distances well within the 100-meter mixing zone. Most constituents regulated under the NPDES discharge permit are diluted below the permit limits at distances within 10 meters of the discharge point for the maximum centerline concentration. The distances are less than 10 meters based upon average concentrations in the plume. However, for this analysis, centerline concentrations have been used because they represent a “worst-case” scenario. The volume of the plume that would be above the current NPDES permit limits can be conservatively estimated, assuming the plume is a cone that is 10 meters long with a radius of 10 meter at its widest point. This would give a volume of approximately 1,000 cubic meters.

In the center of the plume, less than 10 meters from the discharge point, arsenic, copper, mercury, silver, and zinc concentrations could exceed the NPDES limits established for receiving waters. However, ongoing initial dilution rapidly reduces these concentrations and all constituent concentrations are reduced to levels below the receiving-water limits at distances beyond 10 m of the discharge point, making it highly unlikely that a finfish would encounter these areas often enough, or for long enough, to elicit a lethal or sublethal response.

Although the discharge values for produced water constituents would be within NPDES permit limits, concerns remain regarding the toxicity and the bioaccumulation potential of the fish populations that occur beneath the platforms. Love et al. (1999) surveyed the rockfish aggregations residing at mid-water and bottom levels beneath Platform Irene. At Platform Irene, YOY rockfish, and adults and subadults of copper and vermilion rockfishes were the most abundant species. The YOY rockfish consisted of bocaccio, blue, olive, yellowtail, and widow rockfish. During the three-year survey, a total of 21 species of fish were observed at Platform Irene. Platform Irene was also unique among the platforms surveyed in that large numbers of juvenile lingcod were associated with the platform (Love et al., 1999).

Since the produced water would be discharged at a mid-water depth (180 (55 m) feet below the sea surface) and will not impinge upon bottom waters (Brandsma, 2001), only the mid-water population of fishes is of potential concern. Generally, Love et al. (1999) found that mid-water depths (>20-30 m) were dominated by young-of-the-year (YOY) and juvenile (<10 cm) rockfishes. Rockfishes larger than 20 cm were rarely seen in the mid-water. Rockfish YOY, widow rockfish, bocaccio, and blacksmith were the dominant fish observed at mid-water depths at Platform Irene.

For the most part, the effects of produced water on marine biota, especially Pacific coast fish, have not been studied. Previously, studies conducted on Gulf of Mexico species have been used to provide insights to possible impacts to the biota in the project area (Neff, 1997). In bioassay studies conducted on brown and white shrimp, barnacles, and crested blennies exposed to formation water from the Buccaneer Field in Texas, the blennies were the least sensitive species and the white shrimp the most sensitive with an LC50 value of 37,000–92,000 ppm (Rose and Ward, 1981). In an earlier study conducted by Zein-Elden and Keney (1978) using produced water treated with biocides, the LC50 values (96 hr) for juvenile white shrimp ranged from 1,750–6,500 ppm. Because the produced water was treated with biocides, these values represent a conservative estimate of the toxicity to the juvenile white shrimp.

Studies conducted by Anderson *et al*. (1974) and Rice *et al*. (1976, 1979, 1981) examined the effects of the water soluble fractions of oil and treated ballast water on marine organisms. Although not produced water, these studies provide insight into the acute lethal toxicity of produced water. Rice *et al*. (1979), using the water soluble fractions of Cook Inlet crude oil on Alaskan species, found that the sensitivity increased from lower to higher invertebrates and then to fish. LC50 values for pelagic fish and shrimp were 1–3 ppm. Benthic fish, crabs, and scallops had LC50 (96 hr) values of 3–8 ppm for total aromatic hydrocarbons. Using ballast water toxicity tests with shrimp and fish, Rice *et al*. (1981) reported an LC50 range of 0.8–3.2 ppm for total aromatic hydrocarbons.

In studies on the accumulation of hydrocarbons in the water column on sediments, fish, benthos, plankton, and the fouling community in the Buccaneer Field in Texas, Middleditch (1981) found that measurable quantities of hydrocarbons occur only very near to the platform. No concentration gradient was detected. There was no evidence of hydrocarbon accumulation in the biota except for the platform fouling community.

Recently, however, a detailed quantitative assessment of potential impacts from produced-water discharges on federally managed fish species from fifteen California OCS Platforms, including

Platform Irene, has been conducted (MRS 2005). Although maximum contaminant concentrations beyond the 100-m mixing zone are usually well within NPDES permit limits, the study focused on the toxicity and bioaccumulation potential of produced-water discharges to the fish populations that reside within the 100-m mixing zone beneath the platforms. These fish populations consist mostly of rockfish that utilize the platform as habitat, rarely venturing far from the protection of the structure. The quantitative exposure assessment found only one produced-water constituent, undissociated sulfide, that had the potential to impact federally managed fish species along the Pacific OCS. However, the likelihood of an actual substantive adverse impact on federally managed finfish was thought to be minimal because the quantitative assessment was unduly conservative in its evaluation of finfish exposure to sulfide.

As described in the Marine Water Quality Section 3.4.4.1, impacts from sulfide in future produced-water discharges from Platform Irene will be mitigated by construction of a diffuser structure capable of high dilution rates. In addition, subsequent to the initial screening study, the threshold for sulfide toxicity to marine organisms near Platform Irene was found to be six times higher than the EPA National Standard that is currently promulgated in the General Permit. The new threshold was based on an extensive series of bioassay analyses conducted by Weston Solutions Inc. and MRS (2006). Based on this new information, the region around the discharge point where sulfide concentrations would be high enough to potentially impact finfish represents only a small fraction of the receiving-water habitat surrounding Platform Irene. Consequently, it is highly unlikely that finfish would encounter this limited area on a regular basis, especially considering that they exhibit a strong avoidance reaction to sulfide.

Except for zinc and barium, there is little indication that metals accumulate in bottom sediments around produced-water discharges. Barium concentrations in produced water are more than 1000-times higher than in seawater. However, when produced water mixes with sulfate-rich seawater much of the dissolved barium precipitates as barite. The solubility of barium sulfate is below the toxic effects threshold for marine organisms (SAIC 2000). Similarly, sediment zinc concentrations comparable to the 76 mg/Kg measured near Platform Hidalgo (Steinhauer et al. 1994) are lower than the lowest zinc toxic-effect level for marine organisms (TEL of 124 mg/Kg).

Based on the dilution modeling performed by Brandsma (2001), produced-water concentrations that approach these toxicity levels will only occur within 10 m of the discharge point, if at all. Moreover, elevated constituent concentrations will occur only within the limited volume of water occupied by the discharge plume. The cross-sectional dimension of the plume 20 meters from the discharge point is on the order of 30 meters or less, and at a cross-sectional distance of 10 meters, the concentrations are all less than the current NPDES discharge limits. Due to the very limited water volume occupied by the plume and mobile nature of fish, it is highly unlikely that fish will remain stationary within the effluent plume for considerable periods of time. Hence, toxicological effects on these fish species are not expected to occur.

Neff (1997), in his review of produced water in the Santa Barbara Channel, summarized the potential effects of arsenic, barium, cadmium, mercury, phenols, and BTEX and PAH compounds to marine organisms. His conclusions were as follows:

- Arsenic concentrations in produced water are low. In some cases, concentrations can be 30 times higher than that found in seawater. However, a five-fold dilution would decrease the concentration in the receiving water to less than the marine chronic water quality criterion. Two studies of arsenic bioaccumulation in bivalves and fish in the Gulf of Mexico indicated that arsenic is not accumulated above background concentration ranges.
- Barium concentrations in produced water are high, relative to seawater (greater than 1,000 times). However, mixing with sulfate-rich seawater rapidly dilutes high barium concentrations and result in precipitation of dissolved barium as barite that has low solubility in seawater (ca. 50 ug/L). The solubility of remaining dissolved barium sulfate of 1.05×10^{-10} is below the threshold of toxic effects for marine organisms. Tissue concentrations of barium in soft tissues in fish and bivalves located adjacent to produced water discharges in the Gulf of Mexico were not different from reference samples.
- Cadmium concentrations from offshore California produced water can range from below the detection limit to 15 ug/L. Although the levels can be higher than background levels of 0.02 ug/L, rapid dilution lower these concentrations to background concentrations. Cadmium levels in produced water are always below the acute water quality criterion of 43 ug/L and usually below the chronic criterion of 9 ug/L. There was no evidence from bioaccumulation studies in the Gulf of Mexico that organisms exposed to produced water with these cadmium concentrations would accumulate cadmium above background levels.
- Mercury, predominately in the inorganic form, occurs in produced waters from offshore California in very low concentrations. In some cases, they may be 20–50 times higher than that found in seawater. However, it is expected to dilute rapidly in receiving water. There was no evidence in studies conducted in the Gulf of Mexico that mercury would bioaccumulate in marine organisms over background levels.
- The phenols and alkylated homologues present in produced waters dilutes rapidly after discharge. A combination of photolysis and microbial degradation remove these compounds from the water column at a rate as high as 5 percent an hour. In Gulf of Mexico studies, there was no indication that phenol was bioaccumulated from produced waters.
- Although BTEX compounds may attain high concentrations in produced waters, these compounds are known to dilute so rapidly that instances of exceeding water quality criteria for these compounds near produced water discharges are rare. There are also no documented cases that confirm that contamination levels in marine organism tissue represent a risk to human health.
- There is limited PAH concentration data for produced water from offshore California. However, levels up to 25 ug/L have been observed. This concentration is on the low end of produced waters observed in the Gulf of Mexico. PAHs are efficiently bioaccumulated by marine organisms and while there is evidence of accumulation in organisms exposed to produced waters in the Gulf of Mexico, there is no indication of deleterious impacts to receptor organisms or for biomagnification in the food chain to harmful levels.

The rates of dilution and dispersion of chemicals in produced water following discharge to the ocean are influenced by the density of the produced water relative to that of the receiving water, discharge depth, vertical stratification of the water column, and current speed and direction. Produced waters from offshore the Pt. Arguello Field have salinities lower than ambient seawater. Hence, produced water will be slightly buoyant and dilute rapidly within a short distance from point of discharge (Neff, 1997). Also, surface and near-surface current velocities are generally more than 10 cm/sec and often exceed 30 cm/sec, ensuring rapid mixing of produced water plumes with ambient sea water. At Platform Irene 100-fold dilution will occur within 10 meters to several thousand-fold dilution within 100 m from the point of discharge. Hence, fish residing beneath the platforms are not expected to bioaccumulate the chemical constituents found in produced water.

Hence, based on the available information, produced water effects to marine organisms and fish occurring beneath Platform Irene are considered adverse but not significant based on the significance thresholds.

Mitigation Measures

MB-3 The shunt depth (180 feet (55 m) below the sea surface) for the discharge of produced water shall be continued for the proposed project.

Because of the rapid dilution and dispersion of produced water discharged at Platform Irene, impacts to marine organisms are considered to be adverse but not significant.

Impact #	Impact Description	Project/Phase
MB.4	Noise caused by drilling activities may potentially disturb marine mammals and marine birds in the project area.	*Drilling*

Noise caused by drilling equipment, and helicopters may potentially disturb marine mammals and seabirds. The degree of noise impact would depend on the sound level, proximity of the emitted sound to the marine mammals and marine birds, and the duration of the sound events.

The literature indicates that while marine mammals hear man-made noises and sounds generated by construction activities, there is no indication that they are affected deleteriously by the noise (Richardson et al., 1995).

Above-water Noise

Noise associated with drilling operations or from helicopters that may service the drill rig or platform could disturb foraging seabirds near the drilling sites or from helicopter flight corridors. Low-flying aircraft, especially helicopters, can frighten large numbers of feeding or resting seabirds or short-term diving activities as they pass nearby, resulting in a flight response. However, this localized disturbance is likely to be very brief. The current marine biology impact reduction plan requires a minimum flight altitude of 1,000 feet as well as avoidance of sensitive habitat areas. The low-frequency sounds emitted during drilling operations have not been shown to displace marine birds from offshore areas along the California coast (USDOI/MMS 1996).

Underwater Noise

Marine mammals may be disturbed by drilling noises as well as the noise of increased vessel operations. NOAA Fisheries has adopted 160 dB as an acceptable level of impulsive underwater sound. Based on available scientific evidence, acoustic harassment of marine mammals would not be expected to occur below this conservative level. Drilling rigs may produce noise up to 174 dB (CSLC, 2006). However, drilling from platforms has been found to generate considerably less noise than drilling from mobile vessels (Richardson et al., 1995). Gales (1982) measured noises of 119 to 127 dB near platforms and man-made islands off California where drilling or production were occurring. He found that platform noise was so weak that it was nearly undetectable even alongside the platform during sea states of 3 or greater.

Studies of the reaction of cetaceans to drilling noise suggest that cetaceans may avoid stationary industrial activities such as dredging, drilling and production when the received sounds are strong but not when the sounds are barely detectable (Richardson et al., 1995). Whales seem most responsive when the sound level is increasing or when a noise source first starts up, such as during a brief playback experiment or when migrating whales are swimming toward a noise source. The limited available data suggest that stationary industrial activities producing continuous noise result in less dramatic reactions by cetaceans than do moving sound sources, particularly ships. Some cetaceans may partially habituate to continuous noise. Sea otter have been observed to show no evidence of changes in behavior during underwater playbacks of drillship, semisubmersible, and production platform sounds (Richardson et al., 1995). Pinnipeds are often observed around offshore platforms and do not seem disturbed by drilling noises. These data suggest that drilling sounds from Platform Irene will be below the level determined to constitute acoustic harassment and are unlikely to have a significant adverse impact on marine mammals.

Marine mammals also could be disturbed by vessels traveling to and from Platform Irene. Vessels are major contributors to overall background noise in the sea (Richardson et al., 1995). Sound levels and frequency characteristics are roughly related to ship size and speed. The dominant sound source is propeller cavitation. In general, pinnipeds and odontocetes tend to be tolerant of vessels. The level of avoidance of baleen whales to vessels appears to be related to the speed and direction of approaching vessels (Richardson et al., 1995). Whales often move away in response to strong or rapidly changing vessel noise, especially when a boat approaches directly. Gray whales have been observed to change course at a distance of 650 to 1,000 ft (200 to 300 m) in order to move around a vessel in their paths. On the other hand, some gray whales have not been observed to react until a ship is within 50 to 100 ft (15 to 30 m). Humpback whales have been observed to avoid vessels and change behavior when a boat approached within a half mile.

As presented in the Project Description, during normal operations there would be no increase in boat traffic to Platform Irene. During drilling of new wells, there would be an increase from 107 trips per year to 120 vessel trips per year, which is within the permitted FDP limits. Tug and crewboats have been found to emit sounds of 150 to 165 dB, just barely at the level considered to constitute acoustic harassment (Chambers Group, 1987). Because the additional vessels represent a temporary incremental increase in boat traffic in the project area, the disturbance to marine mammals from vessel noise would be an insignificant impact.

Because of the localized and temporary nature of the disturbance and the existing mitigation measures, noise impacts to marine mammals and seabirds caused by new operations and drilling activities are considered to be adverse but not significant.

Mitigation Measure
No mitigation measures have been identified.

Because of the temporary nature of the disturbance, noise or sound impacts from new operations and drilling to marine mammals and marine birds are adverse but not significant.

Impact #	Impact Description	Project/Phase
MB.3	Increased vessel traffic resulting from the proposed project may impact marine mammals and marine turtles.	*Drilling*

Marine Mammals
Watkins (1986), Malme et al. (1989), and Richardson et al. (1991) have reported that noise from vessels elicit a startle reaction from gray whales and mask their reception capabilities. They also reported that avoidance and approach responses vary according to whale activity. Migrating gray whales have been observed to avoid the approach of vessels to within 200-300 m (Wyrick, 1954) or to within 350-550 m (Bogoslovskaya et al., 1981). Based upon the results of Wyrick (1954) and Bogoslovskaya et al. (1981), noise effects on gray whales from vessels can be expected to be limited to within 200-550 m of approaching vessels and to be sublethal and temporary. However, collisions between vessels and gray whales occur frequently. Twelve collisions resulting in six deaths of gray whales occurred off southern California between 1975 and 1980 (Patten et al., 1980). Young gray whales, especially, are more likely to be hit by moving vessels (Laist et al. 2001).

A gray whale calf was severely injured offshore Morro Bay, California during installation of a trans-Pacific cable. The injury consisted of a severely cut tail stock and flukes completely severed off the animal. The extent of the injury (severing of the caudal peduncle) was consistent with a propeller strike (Harvey, 2001). Although the carcass of the calf was never recovered, it is unlikely that the injured calf traveled far from the location where it was observed (Harvey, 2001).

The frequency and duration of offshore support vessels would increase as a result of this project (approximately 2 additional supply boat trips per month) Since collisions between vessels and federally protected gray whales can result in severe injury or death, collisions are considered to be a significant impact.

Very little information describing pinniped responses to vessels is available. Johnson et al. (1989) reported that northern fur seals can be wary and show an avoidance reaction to vessels at distances of up to one mile. Wickens (1994), however, reported that fur seals are often attracted to fishing vessels to feed. Sea lions in the water often tolerate close and frequent approaches by vessels, especially around fishing vessels. Sea lions hauled-out on land are more responsive and react when boats approach within 100 to 200 m (Peterson and Bartholomew, 1967). Also, harbor seals often move into the water in response to boats. Even small boats that approach within 100 m displace harbor seals from haulout areas and less severe disturbance can cause alert reactions without departure (Bowles and Stewart, 1980; Allen et al., 1984; Osborn, 1985).

Dolphins of many species tolerate or even approach vessels. Reactions to boats often appear to be related to the dolphins' activity. Resting and foraging dolphins tend to avoid boats while socializing dolphins may approach them (Richardson et al., 1995).

Riedman (1983) reported that while sea otters often allow close approaches by small boats, they tend to avoid high activity areas. He also noted that some rafting sea otters exhibit mild interest in boats at distances of a few hundred meters and are not alarmed. Garshelis and Garshelis (1984) reported that sea otters in Alaska tend to avoid areas with frequent boat traffic. Udevitz et al. (1995) reported that sea otters tend to move away from approaching boats.

Marine Turtles

Noise from service-vessel traffic may elicit a startle reaction from marine turtles and produce a temporary sublethal stress (NRC, 1990). Service vessels could also collide with and injure marine turtles at the sea surface. However, sea turtles are estimated to be at the sea surface less than 4% of the time (Byles, 1989; Lohoefener et al., 1990) and are generally infrequent visitors to the area. Although vessel-related injuries have been reported in the Gulf of Mexico, only one has been known to occur in project waters. In 2004, an olive ridley was found stranded on Ellwood Beach near Santa Barbara with a cracked carapace that was consistent with injury from a boat collision. Comparatively, in the Gulf of Mexico, 9% of stranded turtles examined showed signs of vessel injuries (USDOC, 1989).

Although marine turtles could be harmed or killed by project related vessels, collision impacts are considered to be adverse but not significant. Marine turtles are very rare in the project area and collisions with vessel traffic are not expected to occur.

Mitigation Measure

MB-4 A marine mammal observer shall be employed on each of the vessel servicing Platform Irene. The observer shall be provided training, which focuses on the identification of marine mammal species, the specific behavior of species common to the project area, and awareness of seasonal concentrations of marine mammals. A marine mammal observer shall be placed on all support vessels during the spring and fall gray whale migration periods and during periods/seasons having high concentrations of marine mammals in the project area. The observer shall have no other responsibilities during periods when the vessels are in transit.

The observer shall have unobstructed views onboard each vessel and serve as lookout so that collisions with marine mammals can be avoided. Additionally, vessel operators or the Applicant shall develop, submit for approval, and impliment a contingency plan, that focuses on avoidance procedures when marine mammals are encountered at sea. Minimum components of the plan include:

a) Vessel operators will make every effort to maintain a distance of 1,000 feet from sighted whales and other threatened or endangered marine mammals or marine turtles.

b) Support vessels will not cross directly in front of migrating whales or any other threatened or endangered marine mammals or marine turtles.

c) When paralleling whales, support vessels will operate at a constant speed that is not faster than the whales.

d) Female whales will not be separated from their calves.

e) Vessel operators will not herd or drive whales.

f) If a whale engages in evasive or defensive action, support vessels will drop back until the animal moves out of the area.

g) Any collisions with marine wildlife will be reported promptly to the Federal and State agencies listed below pursuant to each agency's reporting procedures.

Stranding Coordinator, Southwest Region
National Marine Fisheries Service
Long Beach, CA 90802-4213
(562) 980-4017
Enforcement Dispatch Desk
California Department of Fish and Game
Long Beach, CA 90802
(562) 590-5133
California State Lands Commission
Environmental Planning and Management Division
Sacramento, CA 95825-8202
(916) 574-1890

MB-5 PXP shall make a yearly contribution of $90,000 toward establishing a marine mammal and sea bird impact mitigation fund. The funding shall be used for either facilities construction or operating costs associated with the rescue and rehabilitation of injured marine mammals and sea birds. This yearly contribution shall be in lieu of the applicant's annual three (3) point Coastal Resource Enhancement Fund (CREF) assessment for biological resource impacts, as currently required by Condition N-1 of PXP's Final Development Plan for the Point Pedernales Project.

Trained vessel operators and marine mammal observers onboard support vessels and the implementation of a contingency plan that focuses on avoidance of marine mammals and marine turtles reduce the probability for collisions.

3.5.4.2 Terrestrial Biological Resources/Onshore Impacts

The installation of the power line to Valve Site #2 and construction of the new transformer station would include ground disturbances outside of an existing pad or disturbed area. Installation of the power lines would involve minimal ground disturbance, as poles would be augured into place.

No pipeline maintenance or replacement of pipeline sections are proposed at this time; however, in the event such maintenance work is needed in the future, these activities may be subject to a locally issued grading permit and may require a CDFG and/or U.S. Army Corps of Engineers

Section 404 permit for maintenance activities across streams or in other jurisdictional water bodies.

Impacts of the project are associated with construction at Valve Site #2 and accidental oil spills. Increased throughput in existing oil and water pipelines would result in an increase in the potential spill volume, both for normal operation and worst-case (these increases are evaluated in Section 3.2, Oil Spill Analysis). However, with respect to the produced water pipeline, there would be no changes in the operating pressure of the gas line associated with the proposed project. The water would be treated to meet the NPDES permit requirements, which is not currently the case.

Impact #	Impact Description	Project/Phase
TB.1	Modification of Valve Site #2 and installation of power poles and transformer station would result in disturbance or loss of less than one acre of native vegetation and wildlife habitat and possible injury to wildlife.	*Construction New Operations*

According to the project description, modifying Valve Site #2 would be accommodated within the existing footprint of the site, therefore there would be no disturbance to vegetation.

Installing up to three miles of power line would include minimal grading and clearing around each installed pole. The average span of the power poles is 350 to 400 feet, which means approximately 13 to 15 poles per mile. Installing the poles would result in approximately 315 square feet of temporary ground disturbance and removal of vegetation due to pole setting and equipment maneuvering per pole. Assuming 45 poles total, the disturbance would be approximately 0.33 acre of vegetation and wildlife habitat, including habitat of the Santa Ynez River.

The proposed transformer station, which would be constructed near the intersection of Renwick Road and Route 246 in the field, would be 10 feet by 5 feet in size and require 60 feet by 70 feet of area for installation. This would result in the temporary impacts to 4,200 square feet and permanent loss of 150 square feet of vegetation or wildlife habitat (depending on location), for a total of less than 0.1 acre of impact.

The vegetation and wildlife habitat potentially affected by the above activities varies in type and quality. The habitat in the immediate vicinity of Valve Site #2 is primarily degraded dune scrub with a substantial cover of non-native annual grasses and forbs, including veldt grass (*Ehrharta calycina*), an invasive exotic species. From Valve Site #2 to the intersection of Terra Road and 13th Street, the habitat quality improves with greater cover of native perennial vegetation, except for narrow strips of land immediately adjacent to the road. The pipeline ROW that parallels the road in the proposed location of the power poles is vegetated with good quality native scrub habitat. Near Valve Site # 3, chaparral is present near the unnamed arroyo spanned by the pipeline array. Both La Purisima manzanita and sand mesa manzanita are present in the chaparral at this location (both are CNPS List 1B species, see Table 3.5.13). It is likely that the locations of the poles on either side of the arroyo can be sited to avoid removal of sensitive plant species. The pipeline corridor in the vicinity of 13th Street is vegetated with primarily non-native grasses and forbs. Temporary loss of less than 0.2 acre and potential permanent loss of approximately 500 square feet (0.01 acre) of vegetation and wildlife habitat would be considered adverse but not significant. Installation of the power line outside of the riparian corridor incrementally increases the risk of avian collisions with the power line (Terres 1980), but collisions are expected to be infrequent and to have a not significant impact on any species population.

During installation of the poles across the river or in adjacent willow riparian habitat, wildlife species, including sensitive species, could be subject to temporary disturbances and loss of habitat from human activity, and possible injury or mortality from trampling or by alerting predators to their location (flushing nesting birds). Southwestern pond turtles and adults and egg masses of California red-legged frogs could possibly be in harm's way and crushed. Roosting bats, including pallid bat, big brown bat, California myotis, Yuma myotis, and Mexican free-tailed bat, which have been found to roost under the 13th Street bridge, could be temporarily disturbed by construction activities on or under the bridge. Several sensitive bird species, including southwestern willow flycatcher, yellow warbler and yellow-breasted chat, could nest in the vicinity of the 13th Street bridge, near which the new power pole line would be installed. Southwestern willow flycatcher has nested both upstream and downstream from this location, and may potentially nest here. Between 1995 and 1999, nesting southwestern flycatchers or territorial individuals were present about 50 meters west of the 13th Street Bridge on VAFB. This particular nest site was destroyed in winter storms after that time and nesting was not confirmed in that area during 2000–2001. However, suitable habitat is still present and recolonization of the area is possible (N. Read Francine, VAFB 2002).

Other than migrating through, steelhead are not likely to spawn or be present in the project area. Such impacts would be relatively short-term, and could be mitigated to insignificance by implementing a number of measures.

The presence of the power line wires that span the river may cause several impacts to bird species. Improperly designed powerlines can cause electrocution and mortality of large birds, especially raptors, an impact avoidable by use of raptor-safe pole designs. Many birds transit along the river at heights below the tops of the trees. This affords them some protection from predators. However, the presence of wires across the river at approximately the same height at which the birds typically fly would likely cause increased rates of injury and mortality to such birds. This would be especially true for peregrine falcons (SE), since they chase their prey in the air, flying at speeds approaching 200 mph. During such high-speed pursuits peregrines are known to collide with power lines (USFWS 1982). Other aerial predators, such as sharp-shinned hawk (CSC) and Cooper's hawk (CSC), may also be at risk for collisions. The situation is exacerbated by the frequent presence of fog in this location.

Another potential impact of poles and elevated wires in riparian habitat is that the poles and wires could be used as perches by brown-headed cowbirds, thereby facilitating brood parasitism by them on southwestern willow flycatcher, yellow warbler, and yellow-breasted chat. Brood parasitism is known to be one of the main factors in the decline of southwestern willow flycatchers, and is known to occur along other portions of the Santa Ynez River (Holmgren, pers. comm. 2000). Existing power lines now spanning the river are elevated above the level of the willow canopy. There is no evidence that perches for cowbirds are currently a limiting factor in their ability to parasitise nests, however, highly elevated wires may place cowbirds too far from the nesting trees to use such perches effectively. Therefore, potential impacts to listed species from the power wires across the river are considered to be mitigable.

Mitigation Measure

TB-1a Prior to construction, a survey of the power line corridor shall be conducted to verify the location of sensitive plants, including Gaviota tarplant, La Purisima manzanita and sand mesa manzanita and dune vegetation that includes coast buckwheat (Eriogonum parvifolium), and thus may support El Segundo blue butterfly. Power poles shall be sited to avoid impacting these resources.

TB-1b Prior to constructing the power line to Valve Site #2, the Applicant shall enter into discussions with VAFB to determine the feasibility of placing the power line on the 13th Street bridge or using the existing VAFB power poles for crossing the Santa Ynez River. If placing the power line on the bridge or the existing poles is determined to be not feasible, the Applicant shall site the power poles outside the limits of the Santa Ynez River riparian vegetation, use "raptor-safe" pole designs with the conductors spaced as far apart as possible to minimize the potential for bird wings to span them, install poles and lines outside the breeding season of birds (March 1 through August 15), cover the augered holes if the poles are not installed immediately, elevate the power line above the level of the tree canopy, taking into consideration future growth of the canopy, and fit wires with some type of device to make them more visible, such as bright-colored plastic balls. If the pole lines are of a type that raptors might nest on, investigate the feasibility of fitting the poles with 3 ft. by 3 ft. nesting platforms a minimum of 4 feet above the tops of the poles as recommended by CDFG.

TB-1c Surveys within the disturbance area shall be conducted by a SBC-approved wildlife biologist to document and remove individuals of wildlife species encountered, including reptiles, amphibians, and badgers and other burrowing animals, as appropriate to suitable habitat outside the area of impact. The project area should be regularly monitored to ensure that wildlife species do not enter areas where they would be exposed to hazards.

Impact #	Impact Description	Project/Phase
TB.2	Modification of Valve Site #2, modifications at LOGP, and installation of power poles and the transformer station have the potential to increase erosion and sedimentation in aquatic habitats.	*Construction*

Ground disturbing activities at Valve Site #2 during winter rains could result in runoff of sediments into local drainage swales that lead to the Santa Ynez River. Due to distance (approximately 0.5 km), the small area that would be disturbed, and the temporary nature of the work activity, impacts are not expected to be significant. Modification of the LOGP would be within the existing site and is expected to result in minimal runoff of sediments and construction materials. Site runoff primarily enters a catch basin before overflowing into the intermittent creek adjacent to the site. Impacts are expected to be not significant for aquatic habitats and biota. Installation of a new power line from 13th Street to Valve Site #2 would have no impacts on aquatic resources because no aquatic habitats would be affected. Erosion of and runoff from disturbed areas would be reduced or eliminated by conducting the work during the dry season or implementation of erosion control measures included in the geologic resources section.

Mitigation Measures

TB-2a *All ground disturbance activities shall occur, if feasible, during the dry season (generally April 1 through November 1). Work can continue during the rainy season if a county-approved erosion and sediment control plan is in place.*

TB-2b *Erosion and sediment control measures (e.g., silt fencing, dust control, and other appropriate measures) shall be implemented at any drainages; along portions of the affected project area that intersect slopes greater than a 2-to-1 incline; and within 200 feet of downslope water bodies. Appropriate erosion and sediment control measures shall be installed and maintained until after the rainy season or until vegetation has become re-established in the disturbed areas.*

Implementation of the above measures to conduct work in the dry season and to control erosion and sedimentation from disturbed areas would further reduce the potential for impacts to aquatic habitats.

Impact #	Impact Description	Project/Phase
TB.3	Pipeline maintenance and repair, if needed, would result in potential removal of native vegetation and wildlife habitat and erosion and sedimentation as a result of ground disturbance.	*Extension of Life*

Pipeline maintenance and repair would involve excavating and replacing old sections of pipeline on an as-needed basis. This is not a new impact because the pipeline already exists. However, this impact would continue for a longer period of time and may occur more frequently. Due to the proposed project, the lifetime (and age) of the facilities would be extended beyond the lifetime of the approved Point Pedernales Project. The level of impact would depend on several factors including location, type and condition of existing vegetation, presence of sensitive plant species, and disturbance area. All pipeline repair and maintenance activities are expected to result in temporary loss of and disturbance to existing vegetation and wildlife habitats. In most cases, the pipeline corridor is surrounded by similar habitat type, and the corridor represents a small portion of the adjacent habitat. Although the pipeline ROW was re-vegetated with native species after construction, long segments of the pipeline corridor have become colonized with non-native species or remain unvegetated as fuelbreaks (access corridors or roads). In some cases, where relatively high quality native habitat is adjacent to both sides of the pipeline ROW, re-vegetation with native plants has been successful. It is likely that pipeline repair and maintenance activities can be confined to existing disturbed areas or, at a minimum, can be restricted in native habitats thus minimizing loss of native vegetation, including sensitive plant species. If sensitive plant species, other than state or federally listed species discussed below, are present in the pipeline corridor, it is likely that they would represent a small portion of the number of individuals present in the adjacent habitat. Indirect impacts to vegetation may occur if ground disturbance or removal of vegetation results in increased soil erosion or if non-native plants become established and expand into existing native habitats.

Monitoring of the pipelines would continue, and sections of existing pipe would be replaced with new pipe, as required, to maintain a sufficient MAOP in order to continue operation of the Point Pedernales Project with the Tranquillon Ridge Project.

Some of these activities, as well as other unexpected maintenance and repairs, may be exempt from grading and land use permits but would be subject to applicable CCC and County permit conditions. A CDFG Streambed Alteration Agreement and/or Corps Section 404 permit may be required for maintenance activities across streams or in other jurisdictional water bodies. These permits and agreements would normally include conditions of approval addressing avoidance or minimization of impacts, erosion control measures, and provisions for re-vegetation and habitat restoration following maintenance and repair, such as those described below.

The following measures shall be implemented for pipeline repair and maintenance projects that disturb areas with a predominance of native vegetation on the ROW or in adjacent habitat. For relatively small segments of pipeline to be replaced, a scaled down version of the following measures may be appropriate.

Mitigation Measures

TB-3a *Minimize disturbance to native habitats by the development of a Standard Maintenance and Repair Plan. Where ground disturbances are required, the Plan would include:*

- *Restrict construction activities, equipment and personnel to existing disturbed areas (such as roads, pads, or otherwise disturbed areas) to the maximum extent feasible.*
- *Clearly mark and delineate in the field the limits of the construction zone. Personnel or equipment in native habitats outside the construction limits shall be prohibited.*
- *Biologically sensitive resources, such as occurrences of sensitive plant species including sand mesa manzanita, la Purisima manzanita, and black-flowered figwort as well as individual oak trees, shall be identified through surveys conducted by a qualified biologist acceptable to the resource agencies prior to ground disturbance and shall be clearly marked on work or construction plans so they may be avoided.*
- *Where avoidance of biologically sensitive features is infeasible, the plan shall specify means by which impacts on the features would be minimized and their survival and recovery facilitated (such as preserving the root system and root crown of resprouting species such as sand mesa manzanita).*

TB-3b *Prior to the issuance of the Land Use Permit for repair and maintenance, a Restoration, Erosion Control, and Revegetation Plan shall be submitted to Planning and Development for approval. Once approved, the plan shall be implemented by Torch and monitored by Planning and Development through advanced written updates of construction status and plans. Success of the restoration and revegetation plans should be monitored by a qualified independent biologist. The plan shall contain, but not be limited to, the following:*

- *Procedures for stockpiling and replacing topsoil, replacing and stabilizing backfill, such as at stream crossings, steep or highly erodible slopes, and in dune areas. Additionally, provisions should be made for recontouring to approximate* *the original topography. Excess fill shall be disposed of offsite unless suitable arrangements are made with the property owner. Excess fill shall not be deposited in any drainage, or on any unstable slope. Topsoil shall be salvaged, protected, and replaced. This shall include at a minimum the upper 6-12 inches of topsoil in all areas of open land, other than road shoulders. Final construction plans shall designate areas of topsoil storage and protection, and procedures for handling excess trench spoils. Within wetland areas, topsoil salvage shall be as described above except that wetland topsoil shall be stored separately from all other spoil piles. It shall be labeled with signs as "wetland topsoil." The plan shall contain specific provisions for protection of topsoil stockpiles (such as covering them or using a tackifier or temporary hydromulch) if the soil is to be left for an extended period of time to prevent loss of topsoil due to erosion;*

- *Specific plans for control of erosion, gully formation, and sedimentation, including, but not limited to, sediment traps, check dams, diversion dikes, culverts, and slope drains. Plans would also include, where applicable, dikes and catch basins proposed along the pipeline route, to ensure protection and maintenance of the height of berms and containment capacity of the basins, for the life of project. A soil conservation program, to be applied in areas of 20% (or greater) slopes along the pipeline corridor, detailing site specific techniques, such as use of jute or excelsior netting, to stabilize soil and sand and encourage revegetation of steeper slopes. Plans shall identify areas with high erosion potential and the specific control measures for these sites;*
- *Procedures for containing sediment and allowing continued downstream flow at stream or biologically significant drainage crossings (identified in the EIS/EIR [84-EIR-7]), including scheduling construction activities during periods of historical low-flow and having erosion control structures or sediment retention devices in place prior to start of construction. Existing water levels in all streams shall be maintained at all times during construction;*
- *Procedures for timely re-establishment of vegetation that replicates indigenous and naturalized communities disturbed. These should include: measures preventing invasion and/or spread of undesired plant species; restoration of wildlife habitat; restoration of native communities and native plant species propagated from locally-acquired existing plant species, including any sensitive species (such as sand mesa manzanita, la Purisima manzanita, and black-flowered figwort); and replacement of trees at the appropriate rate;*
- *Procedures for minimizing tree removal, tree root and branch damage, and removal of or damage to other significant plant species including confining disturbance to the approved ROW; providing for onsite monitoring of construction by a qualified independent local biologist; and flagging significant species and areas that should be avoided;*

- *Procedures for restoration of riparian corridor stream banks and streambed substrates and elevation, emphasizing natural and existing materials, shall be included as well as methods for minimizing exposure of riparian habitats to disturbance during construction; and.*
- *Monitoring procedures and minimum performance criteria to be satisfied for revegetation and erosion control. The performance criteria should consider the level of disturbance and the condition of adjacent habitats. Monitoring should continue for 3-5 years, depending on habitat, or until performance criteria are met. Appropriate remedial measures, such as replanting, erosion control or weed (including invasive exotic species) control, shall be identified and implemented if it is determined that performance criteria are not being met.*

Reestablishment of affected vegetation may take as little as one growing season (grasses and some other herbaceous species) to several years (e.g., sycamores and oaks). Implementation of the above mitigation measures is expected to reduce impacts to native vegetation and wildlife habitats. Incorporating Mitigation Measure TB-2a, scheduling the work during the dry season, and the above measures to protect any sensitive plant species, not including state or federally-listed species discussed below, removed or damaged during project activities into the re-vegetation plan, would also reduce impacts.

Impact #	Impact Description	Project/Phase
TB.4	Pipeline repair may injure or eliminate individuals or colonies and habitat of state or federally listed plant species including seaside bird's beak, Surf thistle, beach spectacle pod, La Graciosa thistle and possibly Pismo clarkia.	Tranquillon Ridge *Extension of Life*

The federally listed endangered Lompoc yerba santa is known at few locations within the area affected by the Tranquillon Ridge Project (i.e., landfall to LOGP), all of which are upslope from the pipeline, and is not likely to be affected by pipeline repair or maintenance activities. Surf thistle and beach spectacle pod, both state-listed as threatened, have been recorded in the foredunes crossed by the pipeline corridor and, if present at the time of pipeline repair, could be removed or damaged by project related activities. Seaside bird's-beak, state-listed endangered, is known to occur within or directly adjacent to the pipeline corridor north of the Federal Penitentiary and west of the LOGP and individuals may be removed or damaged by activities associated with pipeline repair. The loss of individuals or colonies of federally or state-listed rare, threatened or endangered plant species could be considered significant.

Mitigation Measures

TB–4a Prior to ground disturbance or other activities, a qualified botanist shall survey all proposed construction, staging and access areas for presence of state or federally-listed plant species. Colonies shall be mapped and clearly marked and numbers of individuals in each colony and their condition determined and recorded. To the maximum extent feasible, construction areas and access roads shall avoid loss of individual plant and or damage to habitats supporting federal or state-listed plants.

TB-4b Where impacts to these species are unavoidable, the project proponent shall develop and implement a salvage, propagation, replanting, and monitoring program that would utilize both seed and salvaged (excavated) plants constituting an ample and representative sample of each colony of the species that would be impacted. The program plan shall include measures to perpetuate to the maximum extent feasible the genetic lines represented on the impacted sites by obtaining an adequate sample prior to construction, propagating them and using them in the restoration of that site. The program plan shall be approved by the USFWS and CDFG prior to its implementation. Activities involving handling of federal and/or state-listed plant species may require permits including a memorandum of understanding from USFWS and/or CDFG.

TB-4c The plan shall incorporate provisions for recreating suitable habitat and measures for re-establishing self-sustaining colonies of seaside bird's beak, beach spectacle-pod and Surf thistle should they be impacted on the site. The plan shall include provisions for monitoring and performance assessment including standards that would allow annual assessment of progress, and provisions for remedial action, should the species fail to re-establish successfully.

It is likely that pipeline repair or other project activities that require a planning period prior to implementation would be able to avoid most, if not all, impacts to individuals or colonies, of federally or state-listed plant species. Moreover, maintenance and repair activities would generally be confined to the previously disturbed ROW. Implementation of Mitigation Measure TB-4a above would reduce impacts. Where impacts to listed species are unavoidable, such as needing to excavate a section of pipeline over which listed species have established, or indirect impacts occur due to soil erosion or invasion by exotic species, then implementation of Mitigation Measures TB-4b and TB-4c, above, in addition to TB-3a and TB-3b, to protect vegetation and wildlife habitats, would reduce impacts to listed plant species. Project activities are expected to be temporary, and site restoration activities can be implemented immediately following completion of pipeline repair. Successful reestablishment of native habitats including individuals or colonies of state-listed plant species would reduce potential impacts.

Impact #	Impact Description	Project/Phase
TB.5	Pipeline repair or maintenance may cause injury or mortality to individuals and affect habitat of common and federally and state-listed fish and other sensitive wildlife species including western snowy plover, California least tern, California red-legged frog, southwestern pond turtle, tidewater goby, and steelhead.	Tranquillon Ridge *Extension of Life*

Pipeline repair or maintenance activities could adversely affect listed wildlife species at various locations along the route depending on the location, type and extent of repair activity and timing of repair activity. Sensitive locations are landfall (snowy plover, California least tern), tributaries to the Santa Ynez River such as Oak Canyon and Santa Lucia Canyon, where activities could affect California red-legged frogs and southwestern pond turtles or cause sedimentation or pollution to enter the Santa Ynez River in habitats used by tidewater goby and southern steelhead.

Repair or maintenance activities would temporarily expose disturbed soils to wind and water erosion, and thereby increase the potential for transport of sediment into the drainages and downstream areas. In all but Santa Lucia Canyon, water is unlikely to be present in the project area during construction, and no aquatic organisms would be directly affected by the construction activities in these drainages. If water were present in the drainages, impacts to aquatic species would be adverse in the immediate downstream areas but not significant due to their short duration and time of year (fall to winter when rain runoff normally introduces turbidity into the streams). Once flows begin in the drainages during the following rainy season, some turbidity and natural reshaping of the drainages would occur. Impacts of sediments on aquatic organisms are expected to be not significant due to the small area affected within each drainage and the short duration of the work.

Santa Lucia Canyon contains the only perennial stream crossed by the pipeline. This drainage supports a variety of aquatic invertebrates and is used by several common amphibians, such as Pacific chorus frogs and western toads. Red-legged frogs have been observed in Santa Lucia Canyon near the Pine Canyon gate on VAFB, approximately 0.75 mile upstream of the pipeline crossing. Impacts of construction activities on these species would be adverse but not significant. The small area affected would be recolonized within a few months. Sediment runoff in erosion-prone areas, such as portions of Oak Canyon and Santa Lucia Canyon, could be potentially significant but mitigable.

At the western end of the pipeline route, repair and maintenance activities could disturb western snowy plovers, which nest and winter in the landfall area. Disturbances within the nesting area can result in loss of productivity, either due to the incubating birds being flushed off the nest and the eggs cooling, or from exposure of the eggs to predators. Snowy plovers are known to nest at Wall Beach. Therefore, if construction activities occurred during the nesting season of the snowy plover (March 1 to September 30) plovers could be adversely affected.

California least terns have historically nested near the mouth of the Santa Ynez River, and could also be affected by repair and maintenance activities that occurred during their nesting season (April through July), depending on the proximity of the nesting site to the construction activity. Impacts on nesting snowy plovers or California least terns could be considered significant. Other sensitive avian species, such as brown pelican, do not nest here. Pelicans and wintering snowy plovers would likely just move a short distance up or down the beach to avoid human activity. Impacts on brown pelicans and wintering snowy plovers could be considered adverse but not significant.

Mitigation Measures

Implementation of Mitigation Measures OWR-1, and TB-2a, scheduling the work during the dry season, GR-1 and TB-2b, controlling erosion, TB-3a, minimizing disturbance to native habitats, and TB-3b, preparing and implementing of an approved Habitat, Revegetation, Restoration and Monitoring Plan would reduce impacts to native wildlife including sensitive wildlife species. Pre-project surveys by a qualified biologist to determine presence/absence of sensitive species, and monitoring to ensure that sensitive species do not enter the construction, area are additional species protection measures. Scheduled maintenance and repair activities would normally be conducted after specific environmental review conducted as part of issuance of a grading permit or other permit by Santa Barbara County. Emergency repairs are subject to a different set of guidelines.

Implementation of the following measure would further reduce impacts to wildlife species:

TB-5 All routine pipeline repair and maintenance activities occurring within the beach and foredune habitats at Wall Beach need to be scheduled to avoid the breeding season (March 1 to September 30) of the western snowy plover and California least tern. A contingency plan for emergency repairs in this area during the nesting season needs to be developed in coordination with 30 CES/CEVPN at VAFB and with the USFWS. This may require Section 7 consultation.

Depending on the species, impacts are preventable or can be minimized through implementation of the general mitigation measures outlined above. The potential for impacts associated with siltation and disturbance to wildlife are considered short-term and are expected to persist until completion of ground disturbing activities and re-establishment of vegetation in disturbed areas along the pipeline route.

Impact #	Impact Description	Project/Phase
TB.6	A pipeline leak or rupture could result in an oil spill and subsequent degradation of upland, riparian and aquatic habitats and injury to plants and terrestrial and aquatic wildlife through direct toxicity, smothering, and entrapment as well as through resultant cleanup efforts.	*Increased Throughput* *Extension of Life*

Emulsion Pipeline

Because the life of the project facilities would be extended, the period of time over which spills could occur would also increase. However, based on the risk analysis (evaluated in Section 3.2, Oil Spill Analysis), the rate of pipeline failure would change very little from that calculated for the pipeline when it was built. Because the amount of oil relative to emulsion water would be higher in the emulsion pipeline from Platform Irene to LOGP, and the volumes transported would be higher, the amount of oil in such a spill would be proportionately larger. The maximum spill volumes of emulsion (oil and water combined) for the major tributaries that may be affected by an oil spill are provided in Section 3.2, Oil Spill Analysis.

Impacts to aquatic biota would be similar as previously addressed in the EIR for the project pipeline (Point Pedernales 1985 EIR/EIS). While the risk of an oil spill and/or pipeline rupture is a risk already associated with the existing oil pipeline, the proposed increase in throughput and oil percentages would increase the potential volume of oil spilled, thereby exacerbating an already existing significant impact with the primary concern for spilled oil or produced water affecting aquatic resources. Oil could also enter drainages through overland flow; however, under dry conditions, overland flow of oil would be relatively slow due to the viscous nature of the crude oil. The rate of spread would slow as the oil cools and becomes more viscous. As the water fraction of the oil-water emulsion increases over the life of the project the emulsion would have different behaviors when spilled. Areas where the pipeline crosses or is very close to creeks or streams increases the likelihood of oil from a rupture or leak entering these waterways and transporting to larger streams, such as the Santa Ynez River. If the oil reaches the active channel of the river during a period of stream flow, it could spread downstream and affect plants and wildlife in and near the lagoon at the river mouth and potentially reach the ocean. For example, a spill of approximately 10 barrels of crude oil in the Lompoc Oil Field in early 1998 during high flow conditions oiled the Santa Lucia drain and flowed to the Santa Ynez River and reached the Pacific Ocean at the river mouth.

Emphasis is placed on aquatic and wetland habitats because of their sensitivity, proximity to the pipeline, and the potential for spilled oil to flow in a downslope direction and to collect in low spots. Flow can occur overland or through voids in trench backfill. The seasonal or year around presence of water is also taken into account because water, especially flowing water, facilitates the spread of oil.

Environmental conditions such as temperature, slope, soil type, vegetation, and stream flow would influence the transport of oil away from a spill within or adjacent to a drainage channel and affect the weathering process. Spilled oil can alter aquatic habitats by filling crevices, changing substrate characteristics, and coating hard substrates. Volatile components would rapidly evaporate, although some soluble ones would dissolve in the water (where present). Other weathering processes include photochemical oxidation, emulsion, adsorption onto particulates with sedimentation, and compaction into tar balls. Loss of the lower molecular weight components over time reduces the acute toxicity of the oil to aquatic organisms.

An oil spill could enter aquatic habitats through direct entry, runoff from upland areas within the watershed (especially during storm runoff), and contamination of groundwater feeding streams. Direct entry of oil into dry stream channels would have no immediate direct impact on aquatic organisms. However, oil entering flowing streams would be carried downstream and affect aquatic organisms present. Toxic effects would decrease with distance downstream as weathering takes place. Oil remaining in the habitat would lose its toxicity through weathering but could affect organisms colonizing these areas during the wet season through physical and chemical alteration of the habitat.

The effects of spilled oil on biological resources depend on such factors as the physical and chemical properties of the oil, specific environmental conditions at the time of the spill, and the species present. Crude oil is a complex mixture containing thousands of compounds, most of which are hydrocarbons. Organic compounds and numerous metals or metal-like elements are also present. The hydrocarbons are of three types: aliphatic, alicyclic, and aromatic. Their solubility in water generally decreases with increasing molecular weight, and the lighter weight ones are more volatile. Several of the petroleum hydrocarbons are also produced by plants and animals, and a variety of organisms ranging from bacteria to fish have developed metabolic pathways for oxidizing these compounds.

Certain types of communities would be more severely affected by an oil spill than others. Salt or freshwater marshes would be most sensitive because the biological activity of these communities is concentrated near the soil or water surface, where oil would be stranded. Oil could also be widely dispersed through these types of communities by stream or tidal flow. Several sensitive upland habitat areas are crossed by the pipeline corridor or lie close to and down slope of the corridor. These include foredunes, coastal dune scrub, coastal sage scrub, Burton Mesa chaparral, and Bishop pine forest. Riparian woodland communities may be somewhat less sensitive in one respect because leaves in the canopy would not be susceptible to oiling. Spills or subsequent clean up activities in upland areas that do not reach one of the drainages in the project region would result in degradation and loss of habitat from ground disturbance associated with removal of contaminated soils and vegetation. These impacts are expected to be temporary as habitat recovers. These impacts would be significant adverse impacts on terrestrial biological resources if the spills or subsequent clean-up efforts result in the removal of native vegetation.

An oil spill would impact vegetation both directly and indirectly. Direct effects include reductions in the availability of soil water, nutrients, and oxygen to plant root systems; the physical “smothering” of oiled plants; and toxic effects of oil on foliage and root systems. All of these would lead to reduced growth and reproduction, and possible mortality in plants exposed to oil. Vegetation recovery may be slow in areas of oiled soil because of lingering toxicity and altered soil characteristics. Indirect effects would result from attempts to contain and clean up an oil spill. Impacts of clean up add cumulatively to oil spill impacts, and in some habitats may be more substantial than the effect of the spilled oil. Clearing or grading could be required to provide access at some locations, and oiled vegetation and soil would probably require removal.

Oil spills from pipeline leaks and ruptures are also expected to directly affect wildlife species such as Pacific chorus frogs, western toads, a wide range of invertebrates and sensitive species such as western pond turtles and two-striped garter snakes. Depending on the size and areal extent of the spill, an unknown number of birds, reptiles and land mammals could be killed if they come in direct contact with the oil. Aquatic reptiles, amphibians and birds would be the most vulnerable to oil spills. Organisms can be affected physically through smothering, interference with movements (especially benthic organisms), coating of external surfaces with black coloration (leading to increased solar heat gain), and fouling of insulating body coverings (birds and mammals). Toxicity can occur via absorption through the body surface (skin, gills, etc.) or via ingestion. Biological oxidation (through metabolism) can produce products more toxic than the original compounds. Acute toxicity would be lowered for fish, especially after some weathering. Sublethal effects include reduced reproductive success, narcosis, interference with movement, and disruption of chemosensory function (e.g., similar to human smell or taste).

Direct impacts to wildlife from oil spills also include physical contact with oil, ingestion of oil, and loss of food and critical nesting and foraging habitat. Mammals could be expected to die from exposure since oiled fur will lose its water shedding and insulation properties. Waterbirds become waterlogged and will be unable to fly if their feathers are oiled (Nelson-Smith 1972). Mortality can result from a combination of starvation and exposure brought on by a loss of appetite and sickness as a result of ingesting oil while preening their feathers (Hartung 1967). Turtles, frogs, and aquatic larval stages of salamanders could be directly impacted and die as a result of exposure to oil. The eggs, larvae and young of these animals have a low tolerance for oil toxicity and have limited dispersal abilities. Aquatic habitats used for breeding by turtles, frogs, and salamanders can become fouled as a result of an oil spill that in turn could prevent successful future reproductive success at affected locales by aquatic dependent wildlife. While the effects of an oil spill on terrestrial habitats adjacent to a stream channel may be only minor and short-term, changes in the food chain or in the habitat of any sensitive aquatic wildlife could result in some impacts.

Cleanup activities alter the habitat where excavation is used to remove contaminated sediments. For spills that affect large areas (such as several miles of channel), impacts would be significant, especially if bed and bank alteration resulting from contamination or cleanup activities results in greater erosion and sedimentation which would affect habitat quality for species such as California red-legged frogs, steelhead trout or results in barriers to steelhead migration. Access to the creek for spill response is limited in many areas by steep banks, dense trees lining the creeks, and limited road access. These factors would need to be considered in spill response planning. Impacts of habitat alteration during cleanup could be mitigated by restoration of native vegetation after cleanup is completed or by leaving the spilled oil in the habitat, if appropriate.

Impacts on resident biota would be short to long term depending on the amount of oil spilled, specific environmental conditions at the time, and containment and cleanup measures taken.

Produced Water Pipeline

There would be an increase in throughput in the water return pipeline, which would result in an increase in the potential spill volume; however, the water would be cleaned to a level acceptable to the NPDES permit requirements, which is not currently the case. A rupture of the produced water return pipeline could result in localized erosion where the produced water, under pressure, leaves the pipeline and may have localized short- to moderate-term effects on vegetation and wildlife due to temporary elevation of salinity and trace element levels. Impacts due to a produced water pipeline spill would be considered significant.

The Applicant has prepared an Oil Spill Contingency Plan (OSCP) for the LOGP and an Emergency Response Plan for operations including Platform Irene, the LOGP and the pipeline from Platform Irene to the LOGP. Sensitive terrestrial resources are identified in the OSCP that would be affected by and oil spill from the LOGP and include oak woodland and Burton Mesa chaparral habitat downslope of the LOGP; the Santa Ynez River and its estuary; dune scrub and coastal strand adjacent to the river, the coastline in the vicinity of the Santa Ynez River; and the marine environment. The OSCP focuses on the actions that would be initiated in the event of an oil spill at the LOGP that would contain the spill as soon as possible in order to prevent damage to these environments. The Emergency Response Plan also focuses on the actions required in the event of a spill and training of spill response personnel, but does not identify sensitive terrestrial resources that may be potentially affected by a spill from the onshore pipeline. The following mitigation measures require these plans to be updated to include identification of sensitive terrestrial biological resources, response methods to protect or otherwise minimize damage to these resources from an oil spill as well as subsequent actions to be implemented for clean up if a spill did occur.

Mitigation Measures

PXP has prepared a Core Oil Spill Response Plan (OSRP) and related supplement for offshore facilities and onshore pipelines for the Point Arguello and Point Pedernales projects (PXP, 2004 and 2005). This plan is in addition to the OSRP for the LOGP and an Emergency Response Plan for operations including Platform Irene, the LOGP and the pipeline from Platform Irene to the LOGP (Torch Operating Company, 2000a and 2000b, respectively). Sensitive terrestrial resources are identified in the OSRP that would be affected by an oil spill from the LOGP and include oak woodland and Burton Mesa chaparral habitat downslope of the LOGP; the Santa Ynez River and its estuary; dune scrub and coastal strand adjacent to the river; the coastline in the vicinity of the Santa Ynez River; and the marine environment. The OSRP focuses on the actions that would be initiated in the event of an oil spill at the LOGP that would contain the spill as soon as possible in order to prevent damage to these environments. Similar plans have been prepared for the pipeline segments from the LOGP to Summit Pump Station. The OSRP also focuses on the actions required in the event of a spill, training of spill response personnel, and identifies sensitive terrestrial resources that may be potentially affected by a spill from the onshore pipeline. Restoration and revegetation guidelines are presented as well. The following mitigation measures require these plans to be updated to include identification of sensitive terrestrial biological resources, response methods to protect or otherwise minimize damage to these resources from an oil spill as well as subsequent actions to be implemented for clean up if a spill did occur.

The OSRP is one of a number of plans that address emergency response issues related to the Point Pedernales facilities. It addresses requirements common to the Minerals Management

Service (MMS), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA), the California Office of Spill Prevention and Response in the Department of Fish and Game. The Oil Spill Response Plan contains preventive measures and contingency response plans.

In addition to clean-up measures identified in the OSPR, measures identified in Section 3.4, Water Quality, have the potential to reduce impacts on biological resources. Where a spill or clean up results in the loss of native vegetation, implementation of Mitigation Measures TB-3a and TB-3b would reduce impacts to native vegetation. Mitigation measures described above would also apply to a produced water spill. The following measures are recommended to further reduce impacts to terrestrial and aquatic biota. Note that these mitigation measures apply to the proposed project pipeline sections only.

TB–6a The November 2004 Core Oil Spill Response Plan and July 2005 Supplement shall be revised and updated to address increased potential spill volumes and updated procedures for oil and produced water spill clean up beneath ground surface and in sensitive habitats including rivers and streams. This plan shall include site-specific measures for spill containment along watercourses and at other sensitive habitats. It shall specify that sensitive habitats shall be avoided to the maximum extent feasible during oil spill clean up activities. It shall include specific measures to avoid impacts on listed endangered and threatened species during response and repair operations and minimize impacts on riparian and other native habitats. The plan shall include identification of specific access points at locations where containment and clean up efforts can be initiated under different scenarios. The access points need to be identified immediately adjacent to pipeline river crossings and points where spilled oil could enter the Santa Ynez River. This plan shall be reviewed by the SBC P&D Department, CSLC and CCC as well as resource agencies including the USFWS, NOAA Fisheries, and CDFG. The committee shall provide recommendations for implementation of the plan. This plan shall be finalized and approved by the Lead Agencies.

TB-6b. Where habitat disturbance cannot be avoided as determined by a P&D or a P&D approved biologist, the OSCP shall also provide stipulations for development and implementation of site-specific habitat restoration plans and other site-specific and species-specific measures appropriate for mitigating impacts on local populations of *sensitive wildlife species and to restore native plant and animal communities to prespill conditions. Access and egress points, staging areas, and material stockpile areas that avoid sensitive habitats shall be identified. The OSCP shall include species- and site-specific procedures for collection, transportation, and treatment of oiled wildlife, particularly sensitive species. The plan shall be reviewed by the federal, state, and local agencies identified in Measure TB-6a prior to approval by the lead agencies.*

TB-6c Where feasible, low-impact site-specific clean up techniques such as hand cutting contaminated vegetation and using low-pressure water flushing from boats shall be specified in the OSCP to remove spilled material from particularly sensitive wildlife habitats (e.g., coastal estuaries), because procedures such as shoveling, bulldozing, raking, and draglining can cause more damage to a sensitive habitat than the oil spill itself. The OSCP shall evaluate the non-clean up option for ecologically vulnerable habitats such as coastal estuaries.

TB-6d. Spill response personnel shall be adequately trained for response in terrestrial environments and spill containment and recovery equipment shall be inspected at least annually and maintained at full readiness. Periodic drills shall be conducted at least annually and the results evaluated so that spill response personnel are familiar with the equipment and with the project area, including sensitive terrestrial biological resources. Rehabilitation centers, within the project area, for birds and other wildlife species affected by spilled material shall be involved in the drills. If a rehabilitation center is not available in the project area, the Applicant shall contribute a pro-rata share of funds necessary to cover the costs of establishing and operating a bird and wildlife rehabilitation center.

The mitigation measures identified above coupled with those identified in Section 3.4, Water Quality, can reduce but cannot eliminate the risk of spill impacts on biological resources. Large spills entering riparian, wetland, and aquatic habitats could have significant impacts. Re-vegetating with native species in areas where vegetation is removed or otherwise impacted by a spill or clean up activities should reduce significant impacts.

Impacts to Listed Species

Several listed endangered or threatened species that could be affected by spills associated with this project were not listed at the time of the 1992 impact analysis that referenced this pipeline segment. Species listed since 1992 include steelhead (also known as steelhead trout), California red-legged frog, tidewater goby, western snowy plover, Lompoc yerba santa, Pismo clarkia, and La Graciosa thistle. In addition, critical habitat has been designated for the western snowy plover, steelhead and the California red-legged frog, Lompoc yerba santa, and La Graciosa thistle and encompass various portions of the proposed project area. Because of the currently recognized status of these species and the protection afforded them by the Endangered Species Act, these species must be specifically addressed in contingency planning to minimize the potential for harm from spilled oil, and from cleanup activities. The potential for impacts on rare, threatened, and endangered species are discussed below.

Impact #	Impact Description	Project/Phase
TB.7	A spill and/or subsequent cleanup efforts may directly or indirectly cause the loss of habitat and individuals or colonies of state-or federally-listed plant species including seaside bird's beak, Surf thistle, beach spectacle pod, La Graciosa thistle or degrade designated critical habitat for the Lompoc yerba santa and the La Graciosa thistle.	Tranquillon Ridge *Increased Throughput* *Extension of Life*

Lompoc yerba santa, federally-listed as endangered, is known from few locations in the project area, all of which are upslope from the oil pipeline from landfall to the LOCP, and are not likely to be affected by impacts associated with an oil spill or cleanup activities. La Graciosa thistle has the potential to be impacted by an oil spill or cleanup activities if a spill reaches its habitat. Surf thistle and beach spectacle pod, both state-listed as threatened, have been recorded in the foredunes crossed by the pipeline corridor and, if present at the time of an oil spill, could be removed or damaged by project related activities. Seaside bird's-beak, state-listed endangered, is known to occur within or directly adjacent to the pipeline corridor north of the Federal Penitentiary and west of the LOGP and individuals may be removed or damaged by activities associated with an oil spill and cleanup. The loss of individuals or colonies of federal or state-listed rare, threatened or endangered plant species would be considered a significant impact. The level of impact would depend on the numbers of individuals lost and whether that loss represents a significant portion of the colony at a particular location or otherwise affects the ability of that colony to sustain itself.

Mitigation Measures

Impacts to listed species would be reduced through implementation of Mitigation Measures TB-6a through TB-6d, which include, but are not limited to, minimization of habitat disturbance during clean up, the use of low-impact clean up techniques, and restoration of the site to pre-spill conditions. Mitigation Measure TB-2b would reduce the effects of sedimentation in the event clean up activities disturb soil and increase erosion. Implementation of Mitigation Measures TB-3a and TB-3b, which address, in part, the restoration of native plant species would also reduce impacts in areas where spills or cleanup results in the loss of native vegetation. These measures described above would also apply to a produced water spill.

The most credible worst case scenarios would result in impacts to relatively small numbers of plants in localized areas with substantial portions of the local populations left intact. Project cleanup activities would be temporary and soil stabilization and re-vegetation measures can be initiated immediately following completion of pipeline repair and cleanup after a spill. Successful reestablishment of native habitats including individuals or colonies of state-listed plant species could reduce potential impacts; however, impacts would still remain.

Impact #	Impact Description	Project/Phase
TB.8	An oil spill and/or subsequent cleanup effort may directly or indirectly cause the loss of individual state or federally-listed wildlife species or cause the loss or degradation of sensitive species habitat. An oil spill and/or subsequent cleanup effort may impact designated critical habitat for steelhead, western snowy plover, and California red-legged frog.	Tranquillon Ridge, *Increased Throughput* *Extension of Life*

Spills from the emulsion pipeline could affect sensitive wildlife species on or near the pipeline ROW. The impacts to wildlife discussed above would also apply to listed wildlife. The impacts described below could also occur under a produced water spill scenario.

Spills from the pipeline between the shoreline and LOGP could enter the Santa Ynez River, which is designated critical habitat for steelhead. Effects on steelhead would depend on the time of year and size of the spill. Impacts would be greatest if the spill occurred during adult or juvenile migration to or from spawning and rearing areas upstream of the project. Steelhead exposed to the spill could sustain lethal to sub-lethal toxic effects. Cleanup efforts could also adversely affect steelhead present through direct mortality or stress from harassment or capture and relocation. Impacts could range from not significant when no steelhead are present during and shortly after a spill to significant if individual steelhead were affected.

Oil or produced water spills that enter the river, however, have a greater potential to affect tidewater gobies than steelhead because the gobies reside in the lower river and lagoon all year. Large spills that reach occupied habitat downstream would have an impact on tidewater gobies and their habitat in either of these streams. Cleanup activities could also impact tidewater gobies present and their habitat. The level of impact would depend on the location, time of year, and size of the spill. A large spill during the breeding season (spring to summer) would affect the greatest number of individuals and would be a significant impact. For small spills that do not result in mortality of tidewater gobies or alteration of their habitat, impacts would be not significant.

Oil spills that affect the Santa Ynez River estuary have the potential to adversely affect the American peregrine falcon, primarily through ingestion of contaminated prey. However, due to the scarcity of peregrines in the area (one or two at most), and the fact that peregrines usually only prey on birds caught in flight, the likelihood of a peregrine eating a significantly oiled prey item is low. Impacts to American peregrine falcons would be significant if directly affected by an oil spill.

The western snowy plover would be adversely affected by an oil spill that occurred on the beach where plovers nest or forage. The 1997 oil spill was estimated to have adversely affected at least 13 individuals of this species. Critical habitat for this species has been designated by the USFWS from Point Sal to Point Conception. Spills from the pipeline could enter the Santa Ynez River channel and flow downstream to the shoreline. Estuaries and river mouths are an important resource to western snowy plovers for breeding habitat and for foraging habitat immediately after hatchlings fledge. Cleanup efforts could also significantly impact breeding success of this species if cleanup efforts were to occur in the foredunes and beach habitat near the Santa Ynez River mouth. The greatest potential for impacts would occur during this species' breeding season from March 1 through September 30. Impacts to western snowy plovers would range from not significant during the non-breeding season to significant if individual snowy plovers or critical habitat were affected.

Oil and/or produced water spills have the potential to adversely affect the California least tern. Spills from the pipeline could enter river channels and flow downstream to the foredune habitat near rivermouths where this species has been known to nest. Oil and/or produced water could also affect the smaller species of fish inhabiting the estuaries and rivermouth which are preyed upon by least terns. California least terns forage in estuaries and would be affected be an offshore spill that reaches the coastline near river mouths or lagoons. Coastal areas inhabited by California least tern include the Santa Maria River mouth and Santa Ynez River mouth. These sites are within the trajectory range described in the oil spill modeling, although the probability of a spill reaching any particular site is small. Clean up efforts could also result in disturbances to breeding habitat if cleanup efforts were to occur near the rivermouths in foredunes and beach habitats. Impacts to California least terns would range from not significant during the non-breeding season to significant if individual least terns were affected.

Oil and/or produced water spills have the potential to adversely affect the California brown pelican if spills enter river channels and flow downstream to the estuary and beach habitats. California brown pelicans use the rivermouth and beach habitats near the Santa Ynez River during the summer and winter as a temporary roost site and for foraging habitat. Individual birds could be oiled and food resources could be affected by spills. Impacts to this species would be significant if individual brown pelicans were affected.

Oil or produced water spills reaching the Santa Ynez River could potentially affect California red-legged frogs and proposed critical habitat. Egg and larval (tadpole) life stages would be the most sensitive to toxic effects of such spills, although juvenile and adult frogs could also be affected through contact with their skin. Impacts would be not significant for small spills that do not result in mortality of individuals or alteration of their habitat. For large spills that result in mortality of eggs, larvae, juvenile, or adult California red-legged frogs, impacts would be significant if many individuals or their habitat were affected.

Mitigation Measures

Impacts to listed wildlife species would be reduced through implementation of Mitigation Measures TB-6a through TB-6d, which include, but are not limited to, updating the OSCP, minimizing habitat disturbance during clean up, using low-impact clean up techniques, and restoring of the site to prespill conditions. Implementation of Mitigation Measures TB-3a and TB-3b, which address, in part, the restoration of native plant species would also reduce loss of foraging and breeding habitat in areas where spills or cleanup results in the loss of native vegetation. Mitigation Measure TB-2b would reduce the effects of sedimentation in the event clean up activities disturb soil and increase erosion. Mitigation measures identified in Section 3.4, Water Quality, would also reduce the impacts of oil spill on state and federally listed species in the project area. These mitigation measures would also apply to a produced water spill.

3.5.5 Comparison of Impacts Between Proposed Project and 1985 Point Pedernales EIS/EIR

Impact No.	Project Phase	Tranquillon Ridge Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
MB.1	Increased Throughput Extension of LIfe	Oil spills from the project may impact benthic and intertidal organisms, fish, marine mammals, marine birds, and marine turtles.	Mortality and disturbance of seabirds and/or marine mammals due to unlikely major oil spill and cleanup activities. Damage to subtidal ecology due to major oil spill	Note that 1985 is somewhat limited to seabirds, marine mammals and subtidal ecology.
MB.2	Drilling	The discharge of drilling muds and cuttings from Platform Irene may potentially impact marine organisms in the project area.	Disruption of activity patterns of water column organisms by platform, utility and hydrocarbon pipeline construction and operations	
MB.3	New Operations	Discharge of produced water from Platform Irene may potentially impact marine organisms in the project area.	Disruption of activity patterns of water column organisms by platform, utility and hydrocarbon pipeline construction and operations	
MB.4	Drilling	Noise caused by drilling activities may potentially disturb marine mammals and marine birds in the project area.	Noise effects on wildlife (of pipeline construction).	Associated with pipeline construction under terrestrial and freshwater biology.
MB.5	Drilling	Increased vessel traffic resulting from the proposed project may impact marine mammals and marine turtles.	Damage to kelp canopy due to crew boat traffic.	Note that 1985 only indicates kelp canopy. There is no mention of vessel traffic impacts on marine mammals and turtles.
TB.1	Construction New Operations	Modification of Valve Site #2 and installation of power poles and transformer station would result in disturbance or loss of less than one acre of native vegetation and wildlife habitat and possible injury to wildlife.	Impact on wildlife of removal of agricultural land, Coastal Sage Scrub, Chaparral, and Grassland.	
TB.2	Construction	Modification of Valve Site #2, modifications at LOGP, and installation of power poles and	Impact on wildlife of removal of agricultural land, Coastal Sage Scrub, Chaparral, and Grassland.	

Impact No.	Project Phase	Tranquillon Ridge Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
		the transformer station have the potential to increase erosion and sedimentation in aquatic habitats.		
TB.3	Extension of LIfe	Pipeline maintenance and repair, if needed, would result in potential removal of native vegetation and wildlife habitat and erosion and sedimentation as a result of ground disturbance.	Removal or disturbance of native vegetation and wildlife habitat. Effects of accelerated erosion and sedimentation and noise on vegetation, wildlife and aquatic habitats and biota.	1985 EIR, this was a cumulative impact due to construction, operations and accidents. In 1985 EIR, this was an impact from pipeline construction.
TB.4	Extension of LIfe	Pipeline repair may injure or eliminate individuals or colonies and habitat of state or federally listed plant species including seaside bird's beak, Surf thistle, beach spectacle pod, La Graciosa thistle and possibly Pismo clarkia.	Removal or disturbance of native vegetation and wildlife habitat. Effects of accelerated erosion and sedimentation and noise on vegetation, wildlife and aquatic habitats and biota.	1985 EIR, this was a cumulative impact due to construction, operations and accidents. In 1985 EIR, this was an impact from pipeline construction.
TB.5	Extension of LIfe	Pipeline repair or maintenance may cause injury or mortality to individuals and affect habitat of common and federally and state-listed fish and other sensitive wildlife species including western snowy plover, California least tern, California red-legged frog, southwestern pond turtle, tidewater goby, and steelhead.	Removal or disturbance of native vegetation and wildlife habitat. Effects of accelerated erosion and sedimentation and noise on vegetation, wildlife and aquatic habitats and biota.	1985 EIR, this was a cumulative impact due to construction, operations and accidents. In 1985 EIR, this was an impact from pipeline construction.
TB.6	Increased Throughput Extension of Life	A pipeline leak or rupture could result in an oil spill and subsequent degradation of upland, riparian and aquatic habitats and injury to plants and terrestrial and aquatic wildlife through direct toxicity, smother-ing, and entrapment as well as	Offshore oil spill reaches coastline. Impacts to vegetation, wildlife and aquatic habitats and biota, including ten or more rare species.	

Impact No.	Project Phase	Tranquillon Ridge Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
		through resultant cleanup efforts.		
TB.7	Increased Throughput Extension of Lfe	A spill and/or subsequent cleanup efforts may directly or indirectly cause the loss of habitat and individuals or colonies of state-or federally-listed plant species including seaside bird's beak, Surf thistle, beach spectacle pod, La Graciosa thistle and possibly Pismo clarkia or degrade designated critical habitat for the Lompoc yerba santa and the La Graciosa thistle.	Offshore oil spill reaches coastline. Impacts to vegetation, wildlife and aquatic habitats and biota, including ten or more rare species.	
TB.8	Increased Throughput Extension of Life	An oil spill and/or subsequent cleanup effort may directly or indirectly cause the loss of individual state or federally-listed wildlife species or cause the loss or degradation of sensitive species habitat. An oil spill and/or subsequent cleanup effort may impact designated critical habitat for steelhead, western snowy plover, and California red-legged frog.	Offshore oil spill reaches coastline. Impacts to vegetation, wildlife and aquatic habitats and biota, including ten or more rare species.	

3.5.6 References

Marine Biological Resources

Advanced Research Projects Agency (ARPA). 1995. FEIS/FEIR for the California acoustic thermometry of Ocean Climate Project. Arlington, VA.

Ahlstrom, E.H. 1965. Kinds and abundances of fishes in the California Current region based on egg and larval surveys. Calif. Coop. Oceanic Fish Invest. Rep. 10:32-52.

Ahlstrom, E.H., G. Moser and E.M. Sandknop. 1978. Distributional atlas of the fish larvae in the California current region: rockfishes, *Sebastes* spp., 1950 through 1955. CalCOFI Atlas No. 26.

Albers, P.H. 1978. The effects of petroleum on different stages of incubation on bird eggs. Bull. Environ. Contam. Toxicol. 19:624-630.

—.1984. Ecological considerations for the use of dispersants in oil spill response: bird habitats, draft guidelines. Report to the ASTM dispersants use guidelines task force. 14 pp.

Allen, W.E. 1945. Occurrences and abundances of plankton diatoms offshore in southern California. Trans. Amer. Microscop. Soc. 64:21-27.

Allen, S.G., D.H. Ainley, G.W. Page and C.A. Ribic. 1984. The effect of disturbance on harbor seal haul out patterns at Bolinas Lagoon, CA. Fish. Bull. 82(3):493-500.

Barlow, J., et al. 1997. U.S. Pacific mammal stock assessments; 1996. NOAA Tech. Memo. NMFS. Report No. NOAA-TM-NMFS-SWFSC-248. Pp. 223.

Bence, J.R., D. Roberts, and W.H. Lenarz. 1992. An Evaluation of the Spatial Distribution of Fishes and Invertebrates off Central California in Relation to EPA Study Areas with Emphasis on Midwater Ichthyofauna. Report to U.S. Environmental Protection Agency, Region IX. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Tiburon Laboratory, Southwest Fisheries Science Center, Tiburon, California. Pp. 234.

Bloeser, J.A. 1999. Diminishing returns: the status of West Coast rockfish. Pacific Marine Conservation Council, Astoria, OR. p. 94.

BNEML/WHOI. 1983. Georges Bank infauna monitoring program. Report to the US Department of Interior, Minerals Management Service, Atlantic OCS Region.

Boehm, P.D. and D.L. Fiest. 1980. Aspects of the transport of petroleum hydrocarbons to the offshore benthos during IXTOC-1 blowout in the Bay of Campeche, pp. 207-238. In: Proceedings of a symposium on preliminary results from the September 1979 Researcher 1 and Pierce IXTOC-1 cruise. A report to the US Department of Commerce, Boulder, CO. p. 591.

Boehm, P.D., J. Barak, D.L. Fiest, and A. Elskus. 1980. The analytical chemistry *of Mytilus edulis*, *Macoma balthica*, sediment trap and surface sediment samples, pp. 219-276. In J.J. Kineman, R. Elmgren, and S. Hansson (eds.). The Tsesis oil spill. A report to the US Department of Commerce, Boulder, CO. p. 296.

Bogoslovskaya, L.S., L.M. Votrogov, and T.N. Semenova. 1981. Feeding habits of the gray whale off Chukhotka. *Rept. Int. Whale Comm*., v. 31. Pp. 507-510.

Bolin,R.L. and D.P. Abbott. 1963. Studies on the marine climate and phytoplankton of the central coast of California, 1954-1960. California Cooperative Fisheries Investigation (CalCOFI) Report 9:23-45.

Boolootian, R.A. 1961. The distribution of the California sea otter. California Department of Fish and Game 47:287-292.

Bonnell, M.L. and M.D. Daily. 1993. Marine mammals. In: M.D. Dailey, D.J. Reish, and J.W. Anderson [Eds.]. Ecology of the Southern California Bight, a synthesis and interpretation. Berkeley: University of California Press. Pp. 604-681.

Bonnell, M.L., M.O. Pierson and G.D. Farrens. 1983. Pinnipeds and sea otters of central and northern California, 1980-1983: status, abundance, and distribution. U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, California. Pp. 220.

Bourne, W.R.P. 1976. Seabirds and pollution, pp. 403-502. In R. Johnston (ed.). Marine pollution. *Academic Press*: New York, NY.

Bowles, A. and B.S. Stewart. 1980. Disturbances to the pinnipeds and birds of San Miguel Island, 1979-1980. In: J.R. Jehl, Jr., and C.F. Cooper (eds.), Potential effects of space shuttle sonic booms on the biota and geology of the California Channel Islands: Research Report. Tech. Rep. 80-1. Prepared by Center for Marine Studies, San Diego State Univ. and Hubbs/Sea World Res. Inst., San Diego, CA, for US Air Force, Space Div. Pp. 246.

Brandsma, M.G. 2001. Near field produced water plumes, Platform Irene. Report to Arthur D. Little, Santa Barbara, CA. p. 7.

Briggs, K.T., et al. 1981. Distribution, numbers, and seasonal status of seabirds of the Southern California Bight. In: Summary report 1975-1978: marine mammal and seabird survey of the Southern California Bight area. Vol. III, Book 3. U.S. Department of Commerce, NTIS Rpt. PB-81-248-197. Springfield, Va.

Brink, K.H., D.W. Stuart, and J.C. Vanleer. 1984. Observations of the coastal upwelling region near 34°30'N off California: Spring 1981. J. Phys. *Oceanography, v. 14*. Pp. 378-391.

Brown, E.D., et al. 1996. Injury to the early life history stages of Pacific herring in Prince William Sound after the *Exxon Valdez* oil spill. In: Rice, S.D., R.B. Spies, D.A. Wolfe, B.A. Wright (eds.). Proceedings of the *Exxon Valdez* oil spill symposium. Amer. Fish. Soc. Symposium 18, Bethesda, MD. Pp. 931.

Brown, R.G.B. 1982. Birds, oil and the Canadian environment, pp. 105-112. In: J.B. Sprague, J.H. Vandermeulen, and P.G. Wells (eds.). Oil and dispersants in Canadian seas – research appraisal and recommendations. Economic and Technical Report EPS-3-EC-82-2. Environment Canada, Environmental Protection Service.

Brownell, R.L. 1971. Whales, dolphins, and oil pollution, pp. 255-276. In: D. Straughan (ed.). Biological and oceanographic survey Santa Barbara Channel oil spill 1969-1970. Vol. 1, biology and bacteriology. Allan Hancock Foundation, USC, Los Angeles, CA.

Byles, R.A. 1989. Satellite telemetry of Kemp's ridley sea turtle, Lepidochelys kempi, in the Gulf of Mexico. In: Eckert, S.A., K.L. Eckert, and T.H. Richardson (eds). Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology. Feb. 7-11, 1989, Jekyll Island, GA. NOAA Tech. Memo NMFS-SEFC-232. Miami, FL. Pp. 306.

Cailliet, G.M., et al. 1992. The Deep-Sea Fish Fauna from the Proposed Navy Ocean Disposal Site, Using Trap, Otter and Beam Trawl, and Camera Sled Samples. Final Report to PRC Environmental Management, Inc. Navy Clean Contract No. N62474-88-D-5086, Washington, DC.

Carney, R.S. 1985. A review of study designs for the detection of long-term environmental effects of offshore petroleum activities. In: D.F. Boesch and N.N. Rabalais (eds.). The long-term effects of offshore oil and gas development: an assessment and a research strategy. A report to the National Marine Pollution Program Office, NOAA, Rockville, MD.

Carr, A.F. 1952. Handbook of turtles: the turtles of the United States, Canada, and Baja California. *Cornell University Press*: Ithaca, NY. Pp. 542.

Carr, A.F. 1980. Some problems of sea turtle ecology. *American Zoology, v. 20*. Pp.489-498.

Carretta, J.V., K.A. Forney, M.M. Muto, J. Barlow, J. Baker, B. Hanson, and M.S. Lowry. 2006. U.S. Pacific Marine Mammal Stock Assessments: 2005. NOAA Tech. Memo. NMFS. Report No. NOAA-TM-NMFS-SWFSC-388. Pp. 318.

Carter, H.R., et al. 1992. Breeding populations of seabirds in California, 1989-1991. Vols. 1 and 2. Report to US Department of the Interior, Minerals Management Service, Washington, DC. Prepared under Inter-agency Agreement 14-12-001-30456.

Carter, H.R. and R.A. Erickson. 1992. Status and conservation of the Marbled Murrelet in California 1892-1987. In: Carter, H.R. and M.L. Morrison (eds.). Status and conservation of the marbled murrelet in North America. Proc. West. Found. Vert. Zool. 5:92-108.

California Department of Fish and Game (CDFG) et al. 1998. Preliminary injury determination for marine mammals. Torch/Platform Irene pipeline oil spill, September 1997, Santa Barbara County, CA., April 22, 1999.

—.1998b. Release and Pathway of Oil in the Environment: Torch/ Platform Irene Pipeline Oil Spill, September 1997, Santa Barbara County, CA., April 16, 1999.

—. 2001. California's Living Marine Resources-A Status Report, December 2001.

Chambers Consultants and Planners. 1980. Marine biological study of the Point Arguello boathouse area. Prepared for Space Division, Air Force Systems Command, Los Angeles Air Force Station.

Chapman, B.R. 1981. Effects of the IXTOC I oil spill on Texas shorebird population, pp. 461-466. In: Proceedings, 1981 oil spill conference: prevention, behavior, control, cleanup. American Petroleum Institute. Publ. No. 4334. Pp. 742.

Collard, S.B. and L.H. Ogren. 1990. Dispersal scenarios for pelagic post-hatchling sea turtles. *Bulletin of Marine Science, v 47*. Pp. 233-243.

Continental Shelf Associates, Inc. (CSA) 2005. Survey of invertebrate and algal communities on offshore oil and gas platforms in southern California: Final report. Prepared for the U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, CA. December 2005. OCS Study MMS 2005-070. 232 pp. plus appendices.

Costa, D.P. and G.L. Kooyman. 1982. Oxygen consumption, thermoregulation, and the effect of fur oiling and washing on the sea otter, *Enhydra lutris. Canadian Journal of Zoology, v. 60*. Pp. 2761-2767.

Cowell, E.B. 1979. Oil spills and seals. *Soc. Petr. Ind. Biol. Newsletter, v 4*. Pp. 3-4.

Cross, J.N. and L.G. Allen. 1993. Fishes. In: Ecology of the Southern California Bight: A synthesis and interpretation. M.D. Dailey, D.J. Reish and D.W. Anderson (eds.). *University of California Press*: Berkeley, CA.

Cupp, E.E. 1943. Marine plankton diatoms of the west coast of North America. *Bulletin for Scripps Institute of Oceanography, v. 5*. Pp. 1-238.

Dalebout, M.L., J.G. Mead, C.S.Baker, A.N. Baker, and A.L. van Helden. 2002. A New Species of Beaked Whale, *Mesoplodon perrini* sp. n (Cetacea: Ziphiidae), Discovered Through Phylogenic Analysis of Mitochondrial DNA Sequences. Marine Mammal Science 18(3):577-608. July 2002.

Davis, J.E. and S.S. Anderson. 1976. Effects of oil pollution on breeding grey seals. *Marine Pollution Bulletin, v. 7*. Pp. 115-118.

del Hoyo, J., A. Elliott, J. Sargatal. 1996. Handbook of the Birds of the World vol 3. Barcelona: Lynx Editions.

DeLong, R.L. 1975. San Miguel Island management plan. A report for the Marine Mammal Commission, Washington, DC. p. 38.

de Wit, L.A. 2001. Shell mounds environmental review, final technical report. Prepared for CA State Lands Commission and the CA Coastal Commission. Bid Log No. RFP99-05.

Diener, D.R. and A.L. Lissner. 1995. Long-term variability of hard-bottom epifaunal communities: effects from offshore oil and gas production and development. In: SAIC and

MEC. 1995. Monitoring assessment of long-term changes in biological communities in the Santa Maria Basin: Phase III. Final Report OCS Study MMS 95-0049. Submitted to the US Department of the Interior, MMS, Camarillo, CA.

Dodd, C.K. Jr. 1990. Reptilia: Testudines: Cheloniidae: *Caretta caretta*, P. 483.1 to 483.7. In: Ernst, C.H. (ed.). Catalogue of American amphibians and reptiles. Soc. Study Amphibians. Reptiles Herpetol. Circ.

Dohl, T.D., R.C. Guess, M.L. Duman, R.C. Helm. 1983a. Cetaceans of central and northern California, 1980-1983: status, abundance, and distribution. Prepared for the U.S. the Department of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, California. Pp. 284.

Dohl, T.D., M.L. Bonnell, R.C. Guess, and K.T. Briggs. 1983b. Marine mammals and seabirds of central and northern California, 1980-1983: synthesis of findings. Prepared for the U.S. the Department of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, California. Pp. 248.

Dugdale.R.C. and F.P. Wilkerson. 1989. New production in the upwelling center at Point Conception, California: Temporal and spatial patterns. *Deep-Sea Res., v. 36*. Pp. 985-1007.

Ebert, E.E. 1968. A food-habits study of the southern sea otter, *Enhydra lutris nereis*. Calif. Fish and Game 54. Pp. 33-42.

Eckert, K.L. 1993. The biology and population status of marine turtles in the North Pacific Ocean. NOAA Tech. Memo. NMFS. Report No. NOAA-TM-NMFS-SWFSC-186. p. 156.

EG&G. 1982. A study of environmental effects of exploratory drilling on the Mid-Atlantic OCS. Final report of the block 684 monitoring program. Report to the offshore operators committee and Exxon Production Research Company.

Engelhardt, F.R. 1983. Petroleum effects on marine mammals. *Aquatic Toxicology, v. 1*. Pp. 175-186.

Erickson, R. A., Hamilton, R.A., Howell, S.N.G., Pyle, P., and Patten, M . A. 1995.

First record of the Marbled Murrelet and third record of the Ancient Murrelet for

Mexico. W. Birds 26:39-45.

Ernst, L.H. and R.W. Barbour. 1972. Turtles of the United States. *University of Kentucky Press*: Lexington, Kentucky. p. 347.

Eschmeyer, W.N. and E.S. Herald. 1983. Pacific Coast Fishes. *Houghton Mifflin Company*: New York.

Estes, J.A. 1980. *Enhydra lustris*. American Society of Mammalogists. *Mammalian Species*, No. 133. p. 8.

Estes, J.A. and R.J. Jameson. 1983. Size and status of the sea otter population in California. Unpublished Report. p. 19.

Estes, J.A., R.J. Jameson, and A.M. Johnson. 1981. Food selection and some foraging tactics of sea otters. In: D.A. Chapman and D. Pursley (eds.). Worldwide furbearer confererence proceedings, August 3-11, 1980. Frostburg, MD. Pp. 606-636.

Fleminger, A. 1964. Distributional atlas of calanoid copepods in the California Current Region, Part. I. California Cooperative Fisheries Investigation (CalCOFI) Atlas No. 24.

Ford, R.G. Consulting Company. 1998. Preliminary bird injury assessment for the Torch/Platform Irene pipeline oil spill, September 1997. Prepared for Office of Spill Prevention and Response, California Department of Fish and Game.

Forney K.A. and Barlow J. 1998. Seasonal patterns in the abundance and distribution of California cetaceans, 1991-1992. Marine Mammal Science 14:460-489.

Garrott, R.A., L.L. Eberhardt and D.M. Burn. 1993. Mortality of sea otters in Prince William Sound following the *Exxon Valdez* oil spill. *Mar. Mam. Sci*., *v. 9*. Pp. 343-359.

Garshelis, D.L. and J.A. Garshelis. 1984. Movements and management of sea otters in Alaska. *J. Wildl. Manage., v. 48(3)*. Pp. 665-678.

Gaskin, D.E. 1982. The ecology of whales and dolphins. *Heinemann Educational Books Ltd.*: London. p. 459.

Geraci, J.R. and T.G. Smith. 1977. Consequences of oil fouling on marine mammals, pp. 399-410. In: D.C. Malins (ed.). Effects of petroleum on arctic and subarctic marine environments and organisms. Vol. II, Biological effects. *Academic Press*: NY. p. 500.

Geraci, J.R. and D. J. St. Aubin. 1982. Study of the effects of oil on cetaceans. Report to the US Department of the Interior, Bureau of Land Management, Atlantic OCS Region, NY.

Geraci, J.R. and D. J. St. Aubin. 1985. Effects of offshore oil and gas development on marine mammals and turtles, pp. 12-1 to 12-34. In: D.F. Boesch and N.N. Rabalais (eds.). The long term effects of offshore oil and gas development: an assessment and a research strategy. Report to the Natinal Marine Pollution Program Office, NOAA, Rockville, MD.

Geraci, J.R. and T.D. Williams. 1990. Physiologic and toxic effects on sea otters. In: J.R. Geraci and D.J. St. Aubin (eds.). Sea mammals and oil, confronting the risks. *Academic Press*: NY.

Green, G.A., J.J. Brueggeman, C.E. Bowlby, R.A. Grotefendt, M.L. Bonnell, and K.C. Balcomb, III. 1991. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. In: J.J. Brueggeman [Ed.]. Oregon and Washington marine mammal and seabird surveys. U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, California. OCS Study MMS 91-093. p. 100.

Gundlach, E.R. and M.O. Hayes. 1978. Vulnerability of coastal environments to oil spill impacts. *Mar. Tech. Soc. J., v. 12*. Pp. 18-27.

Hardin, D.D., J.T. Toal, T. Parr, P. Wilde, and K. Dorsey. 1994. Spatial Variation in Hard-Bottom Epifauna in the Santa Maria Basin, California: The Importance of Physical Factors. Marine Environmental Research, v. 37. Pp. 165-193.

Hardy, J.T. 1993. Phytoplankton. In: M.D. Dailey, D.J. Reish, J.W. Anderson (eds.). Ecology of the Southern California Bight. *University of California Press*: Berkeley. p. 926.

Harvey, J.T. 2001. Injured gray whale off Morro Bay. Report to County of San Luis Obispo, California Coastal Commission, and California State Lands Commission. p. 3.

Hayes, M.O. and J. Michel. 1998. Evaluation of the condition of Prince William Sound shorelines following the Exxon Valdez oil spill and subsequent shoreline treatment, 1997 geomorphological monitoring survey. NOAA Tech. Memo. NOS ORCA 126. Seattle, WA.

Herzing, D.L. and B.R. Mate. 1984. Gray whale migration along the Oregon coast, 1978-1981. In: M.L. Jones, S.L. Swartz, and S. Leatherwood [Eds.]. The Gray Whale, *Eschrichtius robustus*. *Academic Press*: Orlando, Florida:. Pp. 289-307.

Hess, W.N. 1978. The Amoco Cadiz oil spill. A scientific report for the US Department of Commerce, Boulder, CO. p. 349.

Hodge, R.P. 1979. *Dermochelys coriacea schlegeli* (Pacific Leatherback) USA Alaska. Herpetol. Rev. 10(3). p. 102.

Holmes, W.N. and J. Cronshaw. 1977. Biological effects of petroleum on marine birds, pp. 359-398. In: D.C. Malins (ed.). Effects of petroleum on arctic and subarctic marine environments and organisms. Vol. II, Biological effects. *Academic Press*: NY. p. 500.

Hope, J.P. J.Y. Monnat, C.J. Cadbury, and T.J. Stowe. 1978. Birds oiled during the Amoco Cadiz incident: an interim report. *Mar. Pollut. Bulletin. v. 9*. Pp. 307-310.

Houck, W.J. and J.G. Joseph. 1958. A northern record for the pacific ridley, *Lepidochelys olivacea*. *Copeia* 1958(3). Pp. 219-220.

Hubbs, C.L. 1960. The marine vertebrates of the outer coast. *Syst. Zool.*, v. 9. Pp. 134-147.

Hubbs, C.L. 1977. First record of mating of ridley turtles in California with notes on commensals, characters, and systematics. *Calif. Fish and Game* 63(4). Pp. 262-267.

Hudson, J.H., E.A. Shinn and D.M. Robbin. 1982. Effects of offshore oil drilling on Philippine reef corals. *Bull. Mar. Sci., v. 32*. Pp. 890-908.

Hunt, G.L. Jr. 1985. Offshore oil development and seabirds: the present status of knowledge and long term research needs, pp. 11-1 to 11-53. In: D.F. Boesch and N.N. Rabalais (eds.). The long term effects of offshore oil and gas development: an assessment and a research strategy. Report to the National Marine Pollution Office, NOAA, Rockville, MD.

Hyland, J., D. Hardin, E. Crecelius, D. Drake, P. Montagna and M. Steinhauer. Monitoring long-term effects of offshore oil and gas development along the southern California outer continental shelf and slope: background environmental conditions in the Santa Maria Basin. Oil and Chem. Poll. 6:195-240.

Icanberry, J.W. and J.W. Warrick. 1978. Seasonal distribution of plankton in the nearshore marine environment of Diable Canyon Nuclear Power Plant. In: Pacific Gas and Electric Company, environmental investigations at Diablo Canyon, 1975-1977, Vol. II.

Johnson, S.R., J.J. Burns, C.I. Malme and R.A. Davis. 1989. Synthesis of information on the effects of noise and disturbance on major haulout concentrations of Bering Sea pinnipeds. OCS Study MMS 88-0092. Report from LGL Alaska Res. Assoc. Inc., Anchorage, AK to U.S. Minerals Management Service. NTIS PB89-191373. 267 p.

Jordan, R.E. and J.R. Payne. 1980. Fate and weathering of petroleum spills in the marine environment. Ann Arbor Science Publ. Inc., Ann Arbor, MI. 174 pp.

Kenyon, K.W. 1969. The sea otter in the Eastern Pacific Ocean. North American fauna, No. 68, U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife. 352 pp.

—.1975. The sea otter in the eastern Pacific Ocean. Dover, New York.

Keith, J.O., L.A. Woods, Jr., and E.G. Hunt. 1971. Reproductive failure in brown pelicans on the Pacific coast. *Trans. N. Amer. Wildl. and Nat. Res. Conf*. 35:56-63.

Kolpack, R.L. 1971. Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970. Vol. II. Physical, chemical, and geological studies. Allan Hancock Foundation, USC, Los Angeles, CA.

Kramer, D. and E.H. Alstrom. 1968. Distributional atlas of fish larvae in the California current region: Northern anchovy, *Engraulis mordax* (Girard), 1951 through 1965. CalCOFI Atlas No. 9.

Kramer, D. and P.E. Smith. 1972. Seasonal and geographic characteristics of fishery resources: California current region. Vol. VIII, Zooplankton. *Comm. Fish. Rev*. 34(5-6):33-40.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17:35-75.

Lehman, P. E. 1994. The Birds of Santa Barbara County, California. Vertebrate Museum, University of California, Santa Barbara.

Loeb, V.J., P.E. Smith, and H.G. Moser. 1983. Ichthyoplankton and zooplankton abundance patterns in the California current area, 1975. California Cooperative Fisheries Investigation *(CalCOFI) Report* 23:109-131.

Lohoefener, R., W. Hoggard, K. Mullin, C.Roden, and C. Rogers. 1990. Association of sea turtles with petroleum platforms in the north-central Gulf of Mexico. US Dept. of Interior, MMS, Gulf of Mexico Region, New Orleans, LA. OCS Study MMS 90-0025. 90 pp.

Loughlin, T.R., B.E. Ballachey and B.A. Wright. 1996. Overview of studies to determine injury caused by the *Exxon Valdez* oil spill to marine mammals. In: S.D. Rice, R.B. Spies, D.A. Wolfe, B.A. Wright (eds.). Proceedings of the *Exxon Valdez* oil spill symposium. American Fisheries Society, Bethesda, MD.

Love, M.L., J.E. Caselle and K. Herbinson. 1998. Declines in nearshore rockfish recruitment and populations in the Southern California Bight as measured by impingement rates in coastal electrical generating stations. In press.

Love, M., M. Nishimoto, D. Schroeder and J. Caselle. 1999. The ecological role of natural reefs and oil and gas production platforms on rocky reef fishes in southern California. Report No. USGS/BRD/CR-1999-0007, prepared for the US Geological Survey, Biological Resources Division.

Lutz, P.L. and M. Lutcavage. 1989. The effects of petroleum on sea turtles: applicability to Kemp's ridley. In: Caillouet, C.W., Jr. and A.M. Landry, Jr. (eds.). Proceedings of the first international symposium on Kemp's ridley sea turtle biology, conservation, and management. TAMU-SG-89-105.

Mager, A. 1984. Status review: marine turtles. Under jurisdiction of the endangered species act of 1973. U.S. Department of Commerce, National Oceanic Atmospheric Administration, Protected Species Management Branch. 90 pp.

Malme, C.I., P.R. Miles, G.W. Miller, W.J. Richardson, D.G. Roseneau, D.H. Thomson, and R.G. Greene, Jr. 1989. Analysis and ranking of the acoustic disturbance potential of petroleum industry activities and other sources of noise in the environment of marine mammals in Alaska. Report No. 6945 prepared for the US Department of the Interior, Minerals Management Service Anchorage, AK.

Marine Research Specialists (MRS). 2005. The Effect of Produced-Water Discharges on Federally Managed Fish Species along the California Outer Continental Shelf. Submitted to: Western States Petroleum Association June 29, 2005.

—. 2006. City of Morro Bay and Cayucos Sanitary District, Offshore Monitoring and Reporting Program, 2005 Annual Report. Prepared for the City of Morro Bay, Morro Bay, California. February 2006.

Marquez, M.R. 1990. Sea turtles of the world. FAO species catalogue vol. 11. Food and Agric. Organization of the UN. Rome, 81pp.

Maurer, D. 1983. Background paper on burial effects of drilling fluids and cuttings. In: Adaptive environmental workshop on the fate and effects of drilling fluids and cuttings. June 1983, Breckenridge, CO.

McAuliffe, C.D., A.E. Smalley, R.D. Grover, W.M. Welsh, W.S. Pickle, and G.E. Jones. 1975. Chevron Main Pass Block 41 oil spill. Chemical and biological investigations, pp. 555-566. In: Proceedings, 1981 oil spill conference: prevention, behavior, control, cleanup. Amer. Petrol. Inst., Washington, DC.

McGowan, J.A. and C.B. Miller. 1980. Larval fish and zooplankton community structure. CalCOFI Report, Vol. XXI. Abstract.

McShane, C., T. Hamer, H. Carter, G. Swartzman, V. Friesen, D. Ainley, R. Tressler, K. Nelson, A. Burger, L. Spear, T. Mohagen, R. Martin, L. Henkel, K. Prindle, C. Strong, and J. Keany. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon, and California. Unpublished report. EDAW, Inc. Seattle, Washington. Prepared for the U.S. Fish and Wildlife Service, Region 1. Portland, Oregon.

Mearns, A.J. and M.M. Moore. 1976. Biological study of oil platforms Hilda and Hazel, Santa Barbara Channel, California. Institute of Marine Resources, Scripps Institution of Oceanography, La Jolla, CA.

Melin, Sharon R., R.L. DeLong, and A.J. Orr. 2002. The status of the northern fur seal population at San Miguel Island, California in 2000 and 2001. In Fur Seal Investigations 2000-2001, ed. B.W. Robson. National Oceanic and Atmospheric Administration. National Marine Mammal Laboratory. pp. 51-58. Available online at: http://nmml.afsc.noaa.gov/AlaskaEcosystems/nfshome/nfsi01/nfsi01smi.htm

Montagna, P. Meiobenthic communities of the Santa Maria Basin on the California continental shelf. Cont. Shelf Res. 11:1355-1378.

NMFS (National Marine Fisheries Service). 1999. Endangered and threatened species of the US Pacific coast. Northwest Fisheries Center, Seattle, WA.

—.2006. Draft Revised Recovery Plan for the Steller sea lion (*Eumetopias jubatus*). National Marine Fisheries Service, Silver Spring, MD. 285 pages.

—.2006. Endangered and Threatened Species: Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon. Final Rule. Federal Register 71(67):17757-17766. Accessed online, July 2006: at: http://swr.nmfs.noaa.gov/pdf/FinalRuleGreenSturgeon.pdf

NOAA (National Oceanic and Atmospheric Administration). 1997. Sea turtle strandings reported to the California marine mammal stranding network database. US Department of Commerce, NOAA, NMFS, Southwest Region, Long Beach, CA. 18 p.

—.2005. A Biogeographic Assessment of the Channel Islands National Marine Sanctuary: A Review of Boundary Expansion Concepts for NOAA's National Marine Sanctuary Program.

Prepared by National Centers for Coastal Ocean Science's (NCCOS) Biogeography Team in cooperation with the National Marine Sanctuary Program. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 21. 215 pp.

NRC (National Research Council). 1983. Drilling discharges in the marine environment. National Academic Press. Washington, DC.

—.1985. Oil in the sea. Inputs, fates, and effects. National Academy Press. Washington, DC. 601 pp.

—.1990. The decline of sea turtles: causes and prevention. Committee on sea turtle conservation. Washington DC: National Academy Press. 183 pp.

Neff, J.M. 1983. A review of the toxicity and ecological impacts of used oil well drilling fluids discharged to the marine environment. In: California offshore operators ad hoc committee, workshop comments volume. California Coastal Commission, workshop on drilling muds and cuttings. November 1983, San Pedro, CA.

—.1985. Biological effects of drilling fluids, drill cuttings, and produced water, Chapter 10. In: D.F. Boesch and N.N. Rabalais (eds.). The long-term effects of offshore oil and gas development: an assessment and a research strategy. A report to the National Marine Pollution Program Office, NOAA, Rockville, MD.

—.1997. Potential for bioaccumulation of metals and organic chemicals from produced water discharged offshore in the Santa Barbara Channel, California: A review. Report to Western States Petroleum Association. Santa Barbara, CA. 201 pp.

Nekton Inc. and KLI. 1984. An ecological study of discharged drilling fluids on a hard bottom community in the western Santa Barbara Channel. Report to Texaco, Inc.

Newman, W.A. 1979. California transition zone: Significance of short-range endemics. Pages 399-416 In: J. Gray and A. Boucot (eds.). Historical biogeography, plate tectonics, and the changing environment. Oregon State Univ. Press, Corvallis, OR.

Oguri, M. and R. Kanter. 1971. Primary productivity in the Santa Barbara Channel. In: D. Straughan, (ed) Biological and oceanographic survey of the Santa Barbara Channel oil spill. Vol. 1, Biology and Bacteriology. Allan Hancock Foundation, University of Southern California, Los Angeles, CA.

Osborn, L.S. 1985. Population dynamics, behavior, and the effect of disturbance on haulout patterns of the harbor seal *Phoca vitulina richardsi*/Elkhorn Slough, Monterey Bay, CA. B.A. Thesis, Dep. Environ. Stud. And Dep. Biol., Univ. Calif., Santa Cruz. 75 p.

Owen, R.W. Jr. 1974. Distribution of primary production, plant pigments, and Secchi depth in the California current region, 1969. California Cooperative Fisheries Investigation (CalCOFI) Atlas No. 20.

—.1980. Eddies of the California Current System: Physical and ecological characteristics. In: D.M. Power (ed.). The California islands. Santa Barbara Museum of Natural History.

Owen, R.W. Jr. and C.K. Sanchez. 1974. Phytoplankton Pigment and Production Measurements in the California Current Region, 1969-1972. NOAA Tech. Report No. 91. Seattle, WA.

Palaez, J. and J.A. McGowan. 1986. Phytoplankton pigment patterns in the California Current as determined by satellite. *Limnol. Oceanogr*. 31(5):927-950.

Patten, D.R., W.F. Samaras, and D.R. McIntyre. 1980. Whales, move over! Whalewatcher 14:13-15.

Peterson, R.S. and G.A. Bartholomew. 1967. The natural history and behavior of the California sea lion. Am. Soc. Mammal., Spec. Publ. 1. 79 p.

Petrazzuolo, G. 1983. Proposed methodology: drilling fluids toxicity test for the offshore subcategory: oil and gas extraction industry. Technical Resources Inc., Bethesda, MD.

Plotkin, P. and A.F. Amos. 1988. Entanglement in and ingestion of marine debris by sea turtles stranded along the south Texas coast. In: Proceedings of the eighth annual workshop on sea turtles conservation and biology. US Dept. of Commerce. NOAA Tech. Memo. NMFS-SEFC-214.

Point Reyes National Seashore. 2001. Official extended homepage. National Park Service. Accessed online on May 10, 2006 at: http://www.nps.gov/pore/nature_wldlf_eseals.htm

Port San Luis Harbor District. 1997. Unocal Avila Beach clean-up project, comments. Avila Beach, CA. 12 p.

Raimondi, P.T., R.F. Ambrose, J.M. Engle, S.N. Murray, and M. Wilson. 1999. Monitoring of rocky intertidal resources along the central and southern California coastline. Three-year report for San Luis Obispo, Santa Barbara, and Orange Counties (Fall 1995-Spring 1998). Report to US Department of the Interior, Minerals Management Service, Camarillo, CA. MMS 99-0032.

Ralston, S. 1998. The status of federally managed rockfish on the US West Coast. In: Marine harvest refugia for West Coast rockfish: a workshop. M. Yoklavich (ed.). NOAA Tech Memo. NMFS-SWFSC-255.

Ray, J.P. and R.P. Meek. 1980. Water column characterization of drilling fluid dispersion from an offshore exploratory well on Tanner Bank, pp. 223-258. In: Symposium on research on environmental fate and effects of drilling fluids and cuttings. January 1980, Lake Buena Vista, FL.

Reilly, S.B. 1984. Assessing gray whale abundance: a review. In: M.L. Jones, S.L. Swartz, and S. Leatherwood [Eds.]. The Gray Whale, *Eschrichtius robustus*. Orlando, Florida: Academic Press. pp. 203-223.

Rice, D.W., A.A. Wolman and H.W. Braham. 1984. The gray whale, *Eschrichtius robustus*. In: J.M. Briewick and H.W. Braham [Eds.]. The Status of Endangered Whales. *Mar. Fish. Rev.* 46(4):7-14.

Rice, S.D., A. Moles, T.L. Taylor and J.F. Karinen. 1979. Sensitivity of 39 Alaskan marine species to Cook Inlet crude oil and no. 2 fuel oil. In: Proceedings, 1979 oil spill conference. API Publ. 4308. API, Washington, DC.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1991. Effects of noise on marine mammals. Report No. TA834-1 prepared for the U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region.

—.1995. Marine mammals and noise. Academic Press, NY, NY. 576 pp.

Riedman, M.L. 1983. Studies of the effects of experimentally produced noise associated with oil and gas exploration and development on sea otters in California. Prepared by Center for Coastal Mar. Stud., Univ. Calif. Santa Cruz, CA for US Minerals Management Service, Anchorage, AK. NTIS PB86-218575.

Riznyk, R. 1974. Phytoplankton of the Southern California Bight area and literature review. In: M.D. Dailey, B. Hill, and N. Lansing (eds.). A summary of knowledge of the southern California coastal zone and offshore areas, southern California ocean studies conservation. A report to the U.S. Department of the Interior, Bureau of Land Management, Los Angeles, CA.

Rugh, D.J. 1984. Census of gray whales at Unimak Pass, Alaska: November-December 1977-1979. In: M.L. Jones, S.L. Swartz, and S. Leatherwood.[Eds.] The Gray Whale, *Eschrichtius robustus*. Orlando, Florida: Academic Press. pp. 225-248.

Sabo, D.J. and J.J. Stegeman. 1977. Some metabolic effects of petroleum hydrocarbons on marine fish. In: F.J. Vernberg, A. Calabrese, F.P. Thurberg, and W. Vernberg (eds.). Physiological responses of marine biota to pollutants. Academic Press, New York, NY.

SAIC. 1992. Trawl and Remotely Operated Vehicle Ocean Studies Report for Detailed Physical and Biological Oceanographic Studies for an Ocean Site Designation Effort Under the Marine Protection, Research, and Sanctuaries Act of 1972. Prepared for the U.S. EPA under Contract No. 68-C8-0062.

—.2000a. Biological assessment for endangered species in outer continental shelf waters of south and central California for consultation with the National Marine Fisheries Service. Submitted to the US EPA, Region 9, San Francisco, CA. 35 pp.

—. 2000b. Biological assessment for endangered species in outer continental shelf waters of south and central California for consultation with the US Fish and Wildlife Service. Submitted to the US EPA, Region 9, San Francisco, CA. 29 pp.

Santa Barbara, County of (SBC). November 1997. Offshore oil and gas, status report. County of Santa Barbara, Energy Division, Santa Barbara, CA. p. 4.

—. December 1997. Offshore oil and gas, status report. County of Santa Barbara, Energy Division, Santa Barbara, CA. p. 4.

—.2001. Comments to the Tranquillon Ridge oil and gas development and Sisquoc pipeline bi-directional flow projects ADEIR.

—.2001a. Torch Point Pedernales project final development plan 94-DP-027. 1998-2000 condition effectiveness review, revised final analysis. County of Santa Barbara, Planning and Development Department, Energy Division.

—.2002. Final Environmental Impact Report Tranquillon Ridge Oil and Gas Development Project LOGP Produced Water Treatment System Project Sisquoc Pipeline Bi-Directional Flow Project. Prepared by Arthur D. Little Inc., Marine Research Specialists, and SAIC. June 2002.

—.2004. Natural Seep Inventory and Identification for the County of Santa Barbara, California. Final Report. Prepared for the County of Santa Barbara by the U.S. Geological Survey, Western Coastal and Marine Geology Team, Menlo Park, CA. March 25 2004.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon

Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

Schafer, H.A., G.P. Hershelman, D.R. Young, and A.J. Mearns. 1982. Contaminants in ocean food webs, pp. 17-28. In: W. Bascom (ed.). Coastal Water Research Project, biennial report for the years 1981-1982. Southern California Coastal Water Research Project, Long Beach, CA.

Schmitt, Russel J. and Bonnell, Michael L. 2003. Aerial Surveys of Distribution and Abundance of Marine Birds and Mammals in Santa Barbara Channel and Santa Maria Basin. MMS OCS Study 2003-012. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-30758. 23 pages. March 2003.

Schreiber, R.W. and R.W. Risebrough. 1972. Studies of the brown pelican. *Wilson Bull*.:84:119-135.

Siniff, D.B. T.D. Williams, A.M. Johnson and D.L. Garshelis. 1982. Experiments on the response of sea otters, Enhydra lutris, to oil contamination. *Biol. Conserv*. 23:261-272.

Smith, P.E. 1974. Distribution of zooplankton volumes in the California current region, 1969. CalCOFI Investigations, Atlas 20.

Smith, S.A. and W.J. Houck. 1983. Three species of sea turtles collected from northern California. *Calif. Fish and Game* 70(1):60-62.

Sowls, A.L., A.R. Degange, J.W. Nelson, and G.S. Lester. 1980. Catalog of California seabird colonies. U.S. Dept. Interior, Fish and Wildlife Serv. Rpt. FWS/OBS-80-37. 371 pp.

Southwest Research Institute. 1981. Ecological investigations of petroleum production platforms in the central Gulf of Mexico. Report to the US Department of Interior, Bureau of Land Management, New Orleans, LA.

Spies, R.B. 1985. The biological effects of petroleum hydrocarbons in the sea: Assessment from the field and microcosms, Chapter 9. In: D.F. Boesch and N.N. Rabalais (eds.). The long-term effects of offshore oil and gas development: an assessment and a research strategy. Report to the National Marine Pollution Program Office, NOAA, Rockville, MD.

Spies, R,B., S.D. Rice, D.A. Wolfe, B.A. Wright. 1996. The effects of the *Exxon Valdez* oil spill on the Alaskan coastal environment. In: Rice, S.D., R.B. Spies, D.A. Wolfe, B.A. Wright (eds.). Proceedings of the *Exxon Valdez* oil spill symposium. Amer. Fish. Soc. Symposium 18, Bethesda, MD. 931 pp.

Stebbins, R.C. 1966. A field guide to western reptiles and amphibians. Boston: Houghton Mifflin Co. 279 pp.

Stinson, M.L. 1984. Biology of sea turtles in San Diego Bay, CA, and in the northeastern Pacific Ocean. M.S. Thesis, San Diego State Univ., CA. 578 pp.

Straughan, D. 1971. “What has been the effect of the spill on the ecology of the Santa Barbara Channel?” In: D. Straughan (ed.). Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970. Vol. 1. Biology and bacteriology. Allan Hancock Foundation, USC, Los Angeles, CA.

Sund, P.N. and J.L. O’Connor. 1974. Aerial observations of gray whales during 1973. Mar. Fish. Rev. 36(4):51-55.

Szaro, R.C., P.H. Albers, and N.C. Coon. 1978. Petroleum: effects on mallard eggs hatchability. J. Wildl. Manage. 42:404-406.

Uchupi, E. and K.O. Emery. 1963. The continental slope between San Francisco, California and Cedros Island, Mexico. Deep-Sea Res. 10(4):397-447.

Udevitz, M.S., J.L. Bodkin and D.P. Costa. 1995. Detection of sea otters in boat-based surveys of Prince William Sound, AK. Mar. Mamm. Sci. 11(1): 59-71.

USDOC (U.S. Department of Commerce). 1989. Annual report of the sea turtle stranding and salvage network, Atlantic and Gulf coasts of the US, Jan.-Dec. 1988. CRD-88-89-19. Southeast Fisheries Center, Miami, FL.

USDOI/MMS (U.S. Department of the Interior, Minerals Management Service). 1996. Outer continental shelf oil and gas leasing program: 1997-2002, final environmental impact statement. U.S. Department of the Interior, Minerals Management Service, Herndon, VA. OCS EIS/EA MMS 96-0043.

—.2001. Delineation Drilling Activities in Federal Waters Offshore Santa Barbara County, California. Draft environmental impact statement. Minerals Management Service, Pacific OCS Region, Camarillo, CA. OCS EIS/EA MMS 2001-046.

—.2003. OCS Environmental Assessment (EA) Revisions to the Point Arguello Field Development and Production Plans to Include Development of the Eastern Half of Lease OCS-P 0451. Arguello Inc. June 19, 2003.

—.2005a. Environmental Information Document for Post-Suspension Activities on the Nine Federal Undeveloped Units and Lease OCS-P 0409 Offshore Santa Barbara, Ventura, and San Luis Obispo Counties. Prepared for U.S. Department of Interior, Minerals Management Service, Pacific Outer Continental Shelf Region. Prepared by Aspen Environmental Group, January 2005.

—.2005b. Environmental Assessment (Final) Minerals Management Service to Grant Suspensions of Production for Aera Energy LLC's, Lion Rock Unit, Purisima Point Unit, Point Sal Unit, and Santa Maria Unit. February 11, 2005. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

—.2006. Population Dynamics and Biology of the California Sea Otter (Enhydra lutris nereis) at the Southern End of its Range. Final Technical Summary. Final Study Report MMS 2006-007. Minerals Management Service, Pacific OCS Region, Camarillo, CA. May 2006.

USGS (U.S. Department of the Interior, Geological Survey). 1997. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.1998. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.1999. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.2000. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.2001. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.2002. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.2003. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.2004. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.2005. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

—.2006. Spring and fall mainland California sea otter survey. Prepared by Biological Resources Division, Piedras Blancas Field Station, San Simeon, CA.

USFWS (U.S. Department of the Interior, Fish and Wildlife Service). 1982. California brown pelican recovery plan. Portland, OR.

—.2003. Final revised recovery plan for the southern sea otter. Region 1, USFWS, Portland, OR. 59 pp + Appendices. February 24, 2003.

—.2004. Candidate and Listing Priority Assignment Form, Xantus's Murrelet (*Synthliboramphus hypoleucus)*. Region 1. March 2004. Accessed online, March 2006 at: http://permanent.access.gpo.gov/websites/fwsgov/ecos.fws.gov/docs/candforms_pdf/r1/synhypscr.pdf

Valentine, J.W. 1966. Numerical analysis of marine molluscan ranges on the extratropical northeastern Pacific shelf. Limnol. Oceanogr. 11:198-211.

Vargo, S., P. Lutz, D. Odell, E. Van Vleet, and G. Bossart. 1986. Effects of oil on marine turtles. Final report to the MMS. OCS Study MMS 86-0070. 3 vols., 360 pp.

Wakefield, W.W. 1990. Patterns in the distribution of demersal fishes on the upper continental slope off central California with studies on the role of ontogenetic vertical migration in particle flux. Ph.D. Thesis, University of California, San Diego. 281 pp.

Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. *Mar. Mam. Sci.*:2(4):251-262.

Wendell, F.E., R.A. Hardy, and J.A. Ames. 1986. Temporal and spatial patterns in sea otter, *Enhyra lutris*, range expansion and in the loss of Pismo Clam Fisheries. Calif. Fish and Game 72:197-212.

Wickens, P.A. 1994. Operational interactions between seals and fisheries in South Africa. Report from Mar. Biol. Res. Inst., Univ. Cape Town, Rondebosch, South Africa for S. Africa Department of Environmental Affairs and S. African Nature Foundation. 162 pp.

Witham, R. 1978. Does a problem exist relative to small sea turtles and oil spills? In: Proceedings, Conference on the assessment of ecological impacts of oil spills, AIBS, CO.

Whitworth, D.L., J.Y. Takekawa, H.R. Carter, and W.R. McIver 1997. A night-lighting technique for at-sea capture of Xantus's Murrelets. Colonial Waterbirds 20: 525-531.

Whitworth, D.L., J.Y. Takekawa, H.R. Carter, S.H. Newman, T.W. Keeney, and P.R. Kelly. 2000. Distribution of Xantus' Murrelet Sythliboramphus hypoleucus at sea in the Southern California Bight, 1995-97. Ibis 142; 268-279.

Whitworth, D. L and H. R. Carter. 2002. Alolkoy. Xantus's murrelets and predation in the Channel Islands. Vol 15 No. 1. p 5.

Wyrick, R.F. 1954. Observations on the movements of the Pacific gray whale Eschrichtius glaucus (cope). *Jour. Mam*. 35:596-598.

Zingula, R.P. and D.W. Larson. 1977. Fate of drill cuttings in the marine environment, pp. 553-555. In: Proceedings, ninth annual offshore technology conference. May 1977, Houston, TX.

Terrestrial Biological Resources

American Ornithologists' Union. 1998. Checklist of North American Birds, 6th Edition. Allen Press, Inc. Lawrence, Kansas.

Arthur D. Little, Inc. 1985. Union Oil Project/Exxon Shamrock and Central Santa Maria Basin Area Study EIS/EIR. EIS/EIR 84-EIR-7, SCH#84062703. Prepared for County of Santa Barbara, U.S. Minerals Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development. June 24, 1985.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. Pages 83-138 in W. R. Meehan (ed.), *Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats*. American Fisheries Society Special Publication 19.

California Native Plant Society (CNPS) 1994. Inventory of Rare and Endangered Vascular Plants of California. Special Publication No. 1. Fifth Edition.

California Department of Fish and Game. 1996. The Status of Rare, Threatened, and Endangered Animals and Plants of California. Combined Annual Report for 1993, 1994, and 1995. An addendum to the 1992 Report. State of California, Resources Agency, Department of Fish and Game. 63 pages.

California Department of Fish and Game. 2005. List of State and Federally-listed Endangered, Threatened, and Rare Plants of California, text reports and overlays. California Natural Diversity Database (CNDDB).

Calvert. 1991. Monarch Butterfly Overwintering in Santa Barbara County. Final Report Submitted to Santa Barbara County Department of Environmental Review.

Faber, P.M., E. Keller, A. Sands, and B.M. Massey. 1989. The Ecology of Riparian Habitats of the Southern California Coastal Region: A Community Profile. *USFWS Biological Report 85* (7.27), National Wetlands Research Center, Washington, D.C.

Francine, N. Read and Vandenberg Air Force Base (VAFB). March 22 and 25, 2002. Comment Letter from VAFB to Santa Barbara County.

Garrett, K. and J. Dunn. 1981. Birds of Southern California: status and distribution. Los Angeles Audubon Society, Los Angeles, California.

Hickman, James C. 1993. The Jepson Manual, Higher Plants of California. University of California Press Berkeley and Los Angeles, California.

Holubetz, T.B., and B.D. Leth. 1997. Evaluation and Monitoring of Wild/natural Steelhead Trout Production. Annual Progress Report: January 1, 1995-December 31, 1995. Prepared for U. S. Department of Energy, Bonneville Power Administration, Portland.

Irwin, J. F., and D. L. Soltz. 1982. The distribution and natural history of the unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni* (Girard), in San Antonio Creek, California.

—.1984. The natural history of the tidewater goby, *Eucyclogobius newberryi*, in the San Antonio and Shuman Creek systems, Santa Barbara County, California. Prepared for U.S. Fish and Wildlife Service, Contract No. 11310-0215.

Jameson, E. W., Jr. and H. J. Peeters. 1988. California Mammals. Berkeley. University of California Press. 403 pp.

Jennings, M.R., and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. Prepared for California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova.

Jensen, D.B. 1983. The Status of California's Natural Communities: Their Representation on Managed Areas. The Nature Conservancy. Unpublished report. 301 pp.

Lafferty, K.D., C.C. Swift, and R. F. Ambrose. 1996. Post-flood persistence of tidewater goby populations. Southern California Academy of Sciences Annual Meeting, May 1996.

Lee, R.M., and J.N. Rinne. 1980. Critical Thermal Maxima of Five Trout Species in the Southwestern United States. *Transaction of the American Fisheries Society, v. 109*. Pp. 632-635.

Lee, D.S., C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer, Jr. 1980. Atlas of North American freshwater fishes. North Carolina State Museum of Natural History. p. 854.

Lehman, P.E. 1994. The Birds of Santa Barbara County, California. Vertebrate Museum, University of California, Santa Barbara.

Meade, D.E. August 1999. Monarch Butterfly Overwintering Sites in Santa Barbara County, California. Final Report Submitted to Santa Barbara County Planning and Development Department.

Moore, M.R. 1980. Factors Influencing the Survival of Juvenile Steelhead Rainbow Trout (*Salmo gairdneri gairdneri*) in the Ventura River, California. Master of Science Thesis, Humboldt State University, Arcata, California.

Moyle, P.B. 1976. Inland fishes of California. University of California Press, Berkeley. p. 405.

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish Species of Special Concern in California. Second Edition. Prepared for California Department of Fish and Game, Rancho Cordova. Contract No. 2128IF.

National Marine Fisheries Service (NMFS). 1997. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead. Final Rule. Federal Register 62(159):43937-43954.

—.2000. Critical Habitat for 19 Evolutionarily Significant Units of Salmon and Steelhead in Washington, Oregon, Idaho, and California. Federal Register 65(32):7764-7787.

—.2006. Endangered and Threatened Species: Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon. Final Rule. Federal Register 71(67):17757-17766. Accessed online, July 2006: at: http://swr.nmfs.noaa.gov/pdf/FinalRuleGreenSturgeon.pdf

Page, G., et al. 1981. Distribution of wintering snowy plovers on the west coast of the United States. Point Reyes Bird Observatory.

Persons, P.E., and T.E. Applegate. 1997. Monitoring of the western snowy plover at Vandenberg Air Force Base in 1997: population size, reproductive success, and management. Point Reyes Bird Observatory, Stinson Beach, CA. p. 30.

Raimondi, P.T. 1999. 1997 Torch oil spill. Pp. 34-41 in: Monitoring of rocky intertidal resources along the central and southern California mainland. 3-Year Report for San Luis Obispo, Santa Barbara, and Orange Counties (Fall 1995-Spring 1998) (Raimondi, P.T., R.F. Ambrose, J.M. Engle, S.N. Murray and M. Wilson). OCS Study, MMS 99-0032, U.S. Minerals Management Service, Pacific OCS Region.

Raleigh, R.F., T. Hickman, R.C. Solomon, and P.C. Nelson. 1984. Habitat Suitability Information: Rainbow Trout. Department of Interior, U.S. Fish and Wildlife Service, Washington, D. C. FWS/OBS-82/10.60.

Remsen, J.V. 1978. Bird Species of Special Concern in California. California Department of Fish and Game, Sacramento.

Santa Barbara, County of (SBC). 1982. Santa Barbara County Coastal Plan Policies.

—.1979 and 1994, as amended. Santa Barbara County Conservation Element.

—.May 31, 2001. Tosco Sisquoc Pipeline Project Request for Increased Throughput and Change in Tankage. 00-EIR-09.

Santa Ynez River Technical Advisory Committee (SYRTAC). October 2000a. Lower Santa Ynez River Fish Management Plan: Executive Summary. Technical Support by ENTRIX.

—.July 21, 2000b. Lower Santa Ynez River Fish Management Plan: Management Plan. Vol. 1. July 21, 2000.

Shaffer, H.B. 2000. Molecular Characterization of the Lompoc Prison Site Tiger Salamander Populations: Introduced Exotic or Native Santa Barbara Tiger Salamander. Final Report to the Federal Bureau of Prisons and the U.S. Fish and Wildlife Service.

Shapovalov, L., and A.C. Taft. 1954. The life Histories of the Steelhead Rainbow Trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*) with Special Reference to Waddell Creek, California, and Recommendations Regarding their Management. State of California, Department of Fish and Game. Fish Bulletin 98.

Shipman, G.E. 1972. Soil Survey of Northern Santa Barbara Area, California. U.S. Department of Agriculture, Soil Conservation Service in cooperation with University of California Agricultural Experiment Station. Washington, D.C.: GPO.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbitts. 1997. A southwestern willow flycatcher natural history summary and survey protocol. Technical Report NPS/NAUCPRS/NRTR-97/12. National Park Service and USGS Colorado Plateau Research Station.

Smith, Clifton F. 1998 (Second edition). A Flora of the Santa Barbara Region, California. Santa Barbara Botanic Garden and Capra Press, Santa Barbara, California.

Swift, C.C., J.L. Nelson, C. Maslow, and T. Stein. 1989. Biology and distribution of the tidewater goby, *Eucyclogobius newberryi* (Pisces: Gobiidae) of California. Natural History Museum of Los Angeles County, Contributions in Science 404. Pp. 1-19.

Swift, C.C. May 5, 1999. Letter to Ms. Grace McLaughlin, U.S. Fish and Wildlife Service, Ventura, California.

Tate, J. Jr. and D.J. Tate. 1982. The Blue List for 1982. *American Birds, v.* 36(2). Pp. 126-135.

Terres, J. K. 1980. The Audubon Society Encyclopedia of North American Birds. *Alfred Knopf*: New York.

Titus, R.G., D.C. Erman, and W. M. Snider. 1994. History and Status of Steelhead in California Coastal Drainages South of San Francisco Bay. Hilgardia (accepted for publication).

Torch Operating Company. December 2000a (last revised). Torch Operating Company Lompoc Oil and Gas Plant Oil Spill Contingency Plan.

—. September 2000b. Torch Operating Company Emergency Response Plan for Operations on Point Pedernales Onshore facilities, Platform Irene Production Pipeline from Beach to Lompoc Oil and Gas Plant and Lompoc Oil and Gas Plant.

Trenham, P.C., W.D. Koenig and H.B. Shaffer. Spatially autocorrelated demography and interpond migration in the California tiger salamander (*Ambystoma californiense*). Submitted to Ecology.

Unitt, Philip. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds, 18. Pp. 137-162.

URS. 1986. Cities Service Oil and Gas Corporation and Celeron Pipeline Company of California San Miguel Project and Northern Santa Maria Basin Area Study Final EIS/EIR. Prepared for County of San Luis Obispo, U.S. Minerals Management Service, California state Lands Commission, County of Santa Barbara, California Coastal Commission, and California Office of Offshore Development. SCH 85042406, LSO ED 85-100, SLO D 850415:1,2, OCS EIS/EIR MMS 85-0106, SLC-EIR 392.

USFWS (U. S. Fish and Wildlife Service). April 2, 1980a. California least tern recovery plan. Prepared by the U. S. Fish and Wildlife Service, Region 1, Portland, Oregon, in cooperation with the recovery team.

—.1980b. Proposed designation of critical habitat for the endangered unarmored threespine stickleback. *Federal Register* 45(223): 76012-76015.

—.1993. Biological opinion for the proposed construction and operation of the coastal aqueduct through Kern, San Luis Obispo, and Santa Barbara counties, California (1-8-93-F-20) with enclosures of the state biological opinion for DWR and the management agreement for CCWA.

—.1994. Final rule. Tidewater goby. *Federal Register* 59: 5498. U. S. Fish and Wildlife Service. 1995. Final rule. Southwestern willow flycatcher. *Federal Register* 60: 10693.

—.1996a. Biological opinion for construction of the coastal aqueduct through Kern, San Luis Obispo, and Santa Barbara counties (1-8-96-F-16).

—.1996b. Determination of threatened status for the California red-legged frog. *Federal Register* 61(101): 25813.

—.February 18, 1997a. Guidance on Site Assessment and Field Surveys for California Red-legged Frogs. Appendix, California red-legged frog ecology and distribution.

—.1997b. Final determination of critical habitat for the southwestern willow flycatcher. *Federal Register* 62(140): 39129.

—.1999a. Proposed Rule. Proposed Rule to Remove the Northern Populations of the Tidewater Goby From the List of Endangered and Threatened Wildlife. *Federal Register* 64 (121): 33816.

—.1999b. Final Rule. Final Rule To Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-Flying Peregrines in the Conterminous United States. *Federal Register* 64 (164): 46541.

—.1999c. Designation of Critical Habitat for the Western Snowy Plover (*Charadrius alexandrinus nivosus*). Final Rule. *Federal Register* 64 (234) 65808.

—.2000a. Emergency Rule. Emergency Rule to List the Santa Barbara County Distinct Population of the California Tiger Salamander as Endangered. *Federal Register* 65(12): 3096.

—.2000b. Final Rule to list the Santa Barbara County Distinct Population of the California Tiger Salamander as Endangered. *Federal Register* 65(184): 57242.

—.2000c. Endangered and Threatened Wildlife and Plants; Final Rule for Endangered Status for Four Plants from South Central Coastal California. *Federal Register* 65(54): 14888.

—.2001d. Final Designation of Critical Habitat for the California Red-Legged Frog. Final Rule. Federal Register 66 (49): 14626-14674.

—.2001e. Proposed Designation of Critical Habitat for *Cirsium loncholepis* (La Graciosa thistle), *Eriodictyon capitatum* (Lompoc yerba santa), and *Deinandra increscens* ssp. *villosa* (Gaviota tarplant); Proposed Rule. Federal Register 66: 57559-57600.

—.2003. Final Revised Recovery Plan for the Southern Sea Otter (*Enhyda lutris nereis*). Portland, Oregon. xi +165 pp.

WESCO (Western Ecological Services Company, Inc.). 1987. Steelhead Trout and Un-ionized Ammonia Toxicity – San Luis Obispo Creek. Prepared for Brown and Caldwell, Walnut Creek, California. BAC8701.

3.6 Commercial and Recreational Fishing/Kelp Harvesting

3.6.1 Affected Environment

This section describes the techniques and level of commercial and recreational fishing and kelp harvesting that occur within the region potentially impacted by the proposed project. Fishing and kelp-harvesting activities in this region have also been described in by the Minerals Management Service (MMS 2001, 2003, 2005ab).

Commercial and recreational fishing activities occur at various locations in the study region, while kelp is harvested in specific beds that are managed by the California Department of Fish and Game (CDFG). A wide variety of finfish, shellfish, and other invertebrates are harvested commercially in this region. An analysis of fishery data collected within statistical fish-block units around Platform Irene for the ten-year period from 1996 to 2005 forms the basis for following summary of commercial and recreational fishing (Figure 3.6-1). Fish blocks are used by the CDFG (2006a) to organize and report commercial and recreational harvest of marine organisms off the California coast. Monthly catch is reported within rectangular fish blocks nominally covering 100 square miles (9 by 11-mile rectangular areas). However, where the coastline bisects fish blocks, they can cover a much smaller ocean area. Similarly, the blocks located farthest offshore, such as Blocks 650 and 697, cover a larger area.

The 50 Fish Blocks shaded in Figure 3.6-1 are used to assess potential impacts to commercial and recreational fisheries in the region. This 50-block study region encompasses an area of 6,300 square miles. Platform Irene is located within Block 644 and has a 0.3-square mile safety zone surrounding it where fishing is precluded (33 CFR 147.1116). It lies 4.7 miles offshore in 242 feet of water.

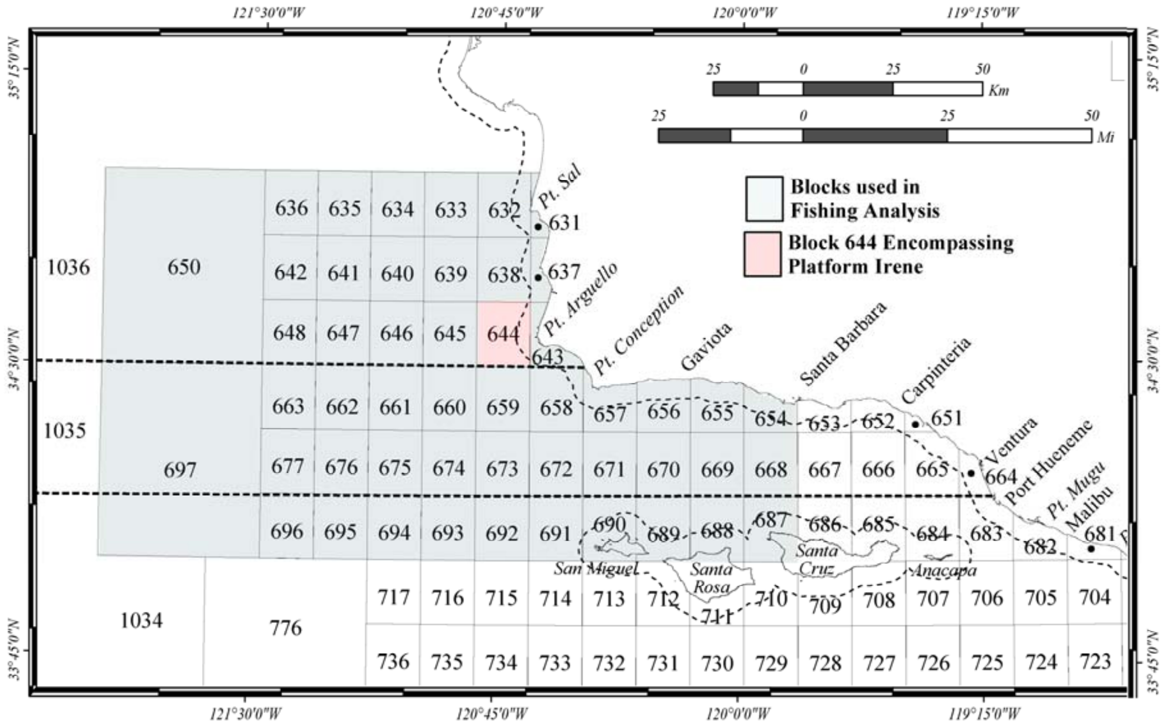
3.6.1.1 Commercial Fishing

Over the last decade, 101 different fish taxa were harvested commercially in the 50-block study region near Point Arguello. This 91,660-ton harvest was valued at $73.8 Million (M). It had a profound impact on local economies because over 92% of the weight and value was landed at the four major ports within the Santa Barbara Channel (Santa Barbara, Ventura, Oxnard, and Port Hueneme), and the two major ports along the central California coast (Avila and Morro Bay). Nearly all of the remaining fish caught in the Point Arguello region were landed at either the Los Angeles or Long Beach harbors to the south.

Regional Fisheries

A few major taxonomic groups represented the bulk of the commercial catch in the region (Table 3.6.1). Squid represented two thirds of the biomass and one fifth of the dollar value of the catch. Of the 20 major taxonomic groups, urchins, sardines, tuna, crab, shrimp, and rockfish made up most (28%) of the remaining biomass. However, pound for pound, the value of individual fish taxa varied significantly. Consequently, more expensive taxa ranked higher in total dollar value. Urchin, shrimp, lobster, and crab represented 72% of the value of the non-squid fish harvest.

Figure 3.6-1 Location of Fish Blocks Included in the Fishery Assessment



Source: CDFG 2006a.

Table 3.6.1 Ranking of Top Twenty Commercial Fish Taxa Harvested in the 50-Block Region from 1996 to 2005

Weight (Tons)			Value ($M)		
Taxon	**Weight**	**%**	**Taxon**	**Value**	**%**
Squid	62,071	67.7	Urchin	22.9	31.1
Urchin	14,860	16.2	Squid	16.0	21.6
Sardine	3,490	3.8	Shrimp	7.7	10.4
Tuna	2,482	2.7	Lobster	6.3	8.6
Crab	1,888	2.1	Crab	4.8	6.5
Shrimp	1,586	1.7	Rockfish	3.8	5.1
Rockfish	966	1.1	Tuna	3.2	4.3
Mackerel	760	0.8	Abalone	2.1	2.8
Sole	735	0.8	Swordfish	1.8	2.4
Sea Cucumber	485	0.5	Halibut	1.2	1.7
Anchovy	485	0.5	Sole	0.8	1.1
Lobster	425	0.5	Sea Cucumber	0.7	0.9
Swordfish	310	0.3	Shark	0.6	0.8
Shark	266	0.3	Seabass	0.5	0.6
Halibut	200	0.2	Sheephead	0.4	0.5
Seabass	114	0.1	Sardine	0.2	0.3
Abalone	112	0.1	Salmon	0.2	0.3
Sablefish	87	0.1	Sablefish	0.2	0.2
Sheephead	71	0.1	Anchovy	0.1	0.1
Salmon	63	0.1	Mackerel	0.1	0.1

Table 3.6.2 shows that the type of fish landed at each of the five port complexes vary. This is largely due to differences in fishing fleets, areas fished, and the type of available commercial facilities. The high dollar value ($41.2 M) of commercial catch landed at Santa Barbara is largely due to non-finfish species. Urchin, lobster, crab, shrimp, and abalone are of high commercial value and were the five most-valuable taxa landed during the ten-year period. They are preferentially landed at the Santa Barbara harbor because of its proximity to the fishing grounds along the western Channel Islands. Well over half (68% by value) of the Urchin, lobster, crab, shrimp, and abalone harvested in the 50-block study region were from only four fish blocks (687 through 690 in Figure 3.6-1) that encompass the north shore of western Channel Islands.

Table 3.6.2 Top Ten Commercial Taxa for 1996-2005 Harvested in the 50-Block Region and Landed at Morro Bay/Avila, Santa Barbara, Ventura, Port Hueneme/Oxnard, and Los Angeles/Long Beach.

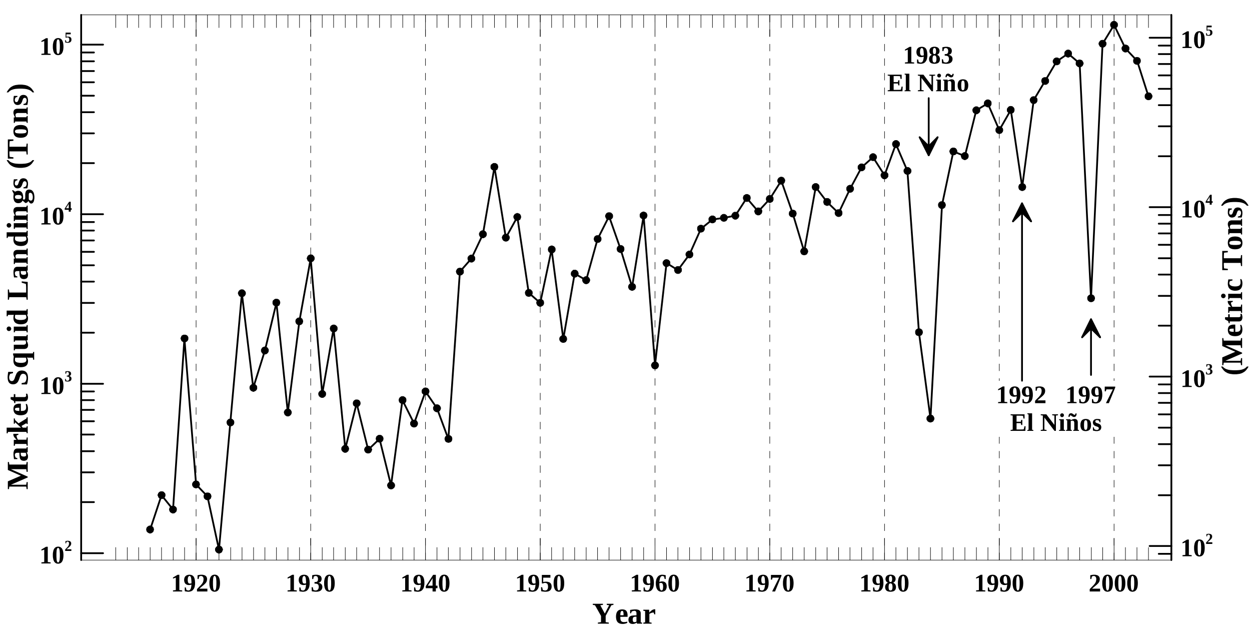
Morro Bay/Avila		Santa Barbara		Ventura		Port Hueneme/ Oxnard		Los Angeles/ Long Beach	
Weight (tons)	**Value ($M)**	**Weight (tons)**	**Value ($M)**	**Weight (tons)**	**Value ($M)**	**Weight (tons)**	**Value ($M)**	**Weight (tons)**	**Value ($M)**
Squid (994)	Shrimp (2.5)	Urchin (13,920)	Urchin (21.4)	Squid (13,154)	Squid (3.5)	Squid (40,486)	Squid (10.3)	Squid (4,047)	Tuna (1.8)
Sole (706)	Rockfish (2.0)	Squid (3,390)	Lobster (6.2)	Halibut (101)	Shrimp (0.6)	Sardine (3,089)	Urchin (1.3)	Tuna (1,538)	Squid (1.0)
Rockfish (663)	Crab (0.9)	Crab (1,506)	Crab (3.6)	Shrimp (88)	Halibut (0.6)	Urchin (812)	Shrimp (0.6)	Sardine (323)	Swordfish (0.3)
Shrimp (403)	Swordfish (0.8)	Shrimp (996)	Shrimp (3.5)	Sardine (78)	Crab (0.2)	Mackerel (503)	Rockfish (0.2)	Mackerel (248)	Rockfish (0.1)
Crab (279)	Sole (0.8)	Sea Cucumber (427)	Abalone (2.0)	Crab (74)	Urchin (0.1)	Anchovy (485)	Sardine (0.2)	Swordfish (58)	Shrimp (0.1)
Tuna (146)	Squid (0.3)	Lobster (418)	Rockfish (1.4)	Urchin (70)	Swordfish (0.1)	Rockfish (63)	Halibut (0.1)	Urchin (47)	Urchin (0.1)
Swordfish (145)	Tuna (0.2)	Rockfish (151)	Squid (0.8)	Rockfish (39)	Seabass (0.1)	Shrimp (50)	Anchovy (0.1)	Rockfish (38)	Shark (<0.1)
Sablefish (82)	Sablefish (0.1)	Shark (140)	Sea Cucumber (0.6)	Tuna (32)	Rockfish (0.1)	Sea Cucumber (37)	Seabass (0.1)	Shark (17)	Seabass (<0.1)
Shark (50)	Halibut (0.1)	Abalone (108)	Halibut (0.4)	Shark (30)	Shark (0.1)	Tuna (27)	Sheephead (0.1)	Shrimp (11)	Sardine (<0.1)
Halibut (25)	Shark (0.1)	Seabass (64)	Shark (0.3)	Grouper (27)	Abalone (<0.1)	Crab (19)	Sea Cucumber (0.1)	Seabass (10)	Mackerel (<0.1)
Total (3,586)	**Total (8.2)**	**Total (21,378)**	**Total (41.2)**	**Total (13,794)**	**Total (5.6)**	**Total (45,660)**	**Total (13.3)**	**Total (6,351)**	**Total (3.6)**

Note: Totals are for all taxa, not just the top ten listed in the table

In contrast to the taxa landed at Santa Barbara, market squid (*Loligo opalescens*) overwhelmingly dominated the landings at the Hueneme/Oxnard (89% by weight and 78% by value) and Ventura (95% by weight and 64% by value) harbors over the last decade. During the 1990s, squid often ranked as California's largest commercial fishery and highest edible fishery export. The market squid fishery was an unregulated, open access fishery prior to April 1998 (CDFG, 2001). The annual squid catch offshore California has increased exponentially, doubling approximately every 9 years from 1961, when it was 5,000 tons to 2000, when the catch exceeded 100,000 tons (Figure 3.6-2). However, Figure 3.6-2 also shows that the commercial landings of squid did not steadily increase in recent years. Significant declines in catch volumes occurred during major El Niño events in 1983, 1992, and 1997. Also, to control this rapidly expanding fishery in the mid-1990s, the CDFG instituted new regulations, such as the restricted use of lights, documentation of fishing activity in logbooks, weekend closures, light-boat shielding, and wattage restrictions. Between 2000 and 2005, most of the squid landed near the project area were close to shore between Point Arguello and Point Conception (Figure 3.6-3). This area could be impacted by an oil spill associated with the proposed project as described predicted by spill modeling in Section 3.2.

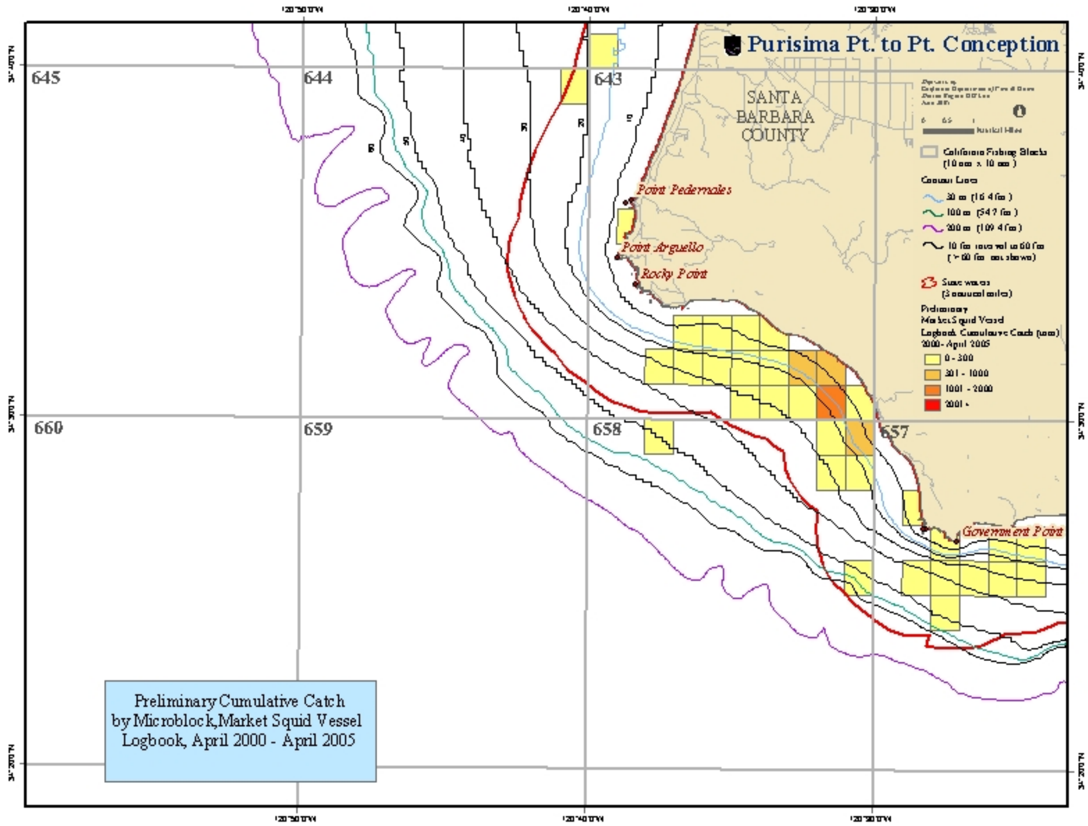
Similar to the variability in squid landings, the catch statistics for abalone varied over time. However, in the case of abalone, landings were only recorded in the 50-block survey area through 1996 and part of 1997. The California Fish and Game Commission closed the commercial and recreational abalone fishery in southern and central California under emergency action in May 1997. By legislative action in January 1998, the closure was extended indefinitely. Currently, all five major species of abalone in central and southern California are depleted, a result of cumulative impacts from commercial harvest, increased market demand, sport fishery expansion, an expanding population of sea otters over the past two decades, pollution of mainland habitat, disease, loss of kelp populations associated with El Niño events, substantial poaching losses, and inadequate wild stock management (CDFG 2001).

Figure 3.6-2 Annual Statewide Commercial Squid Landings



Source: CDFG 2001.

Figure 3.6-3 Commercial Squid Landings near Point Arguello



Differences in the volume and dollar value of the catch landed at each of the five port complexes over the last decade are also apparent in Table 3.6.3. Of the five port complexes, landings at Morro Bay and Avila were comparatively consistent over the last decade. Although Santa Barbara ranked first in value of commercial catch from the 50-block study region, the highest values were recorded in 1996 and 1997 when the abalone fishery was still active. Landings at Ventura and Port Hueneme/Oxnard correlated closely and exhibited a significant drop in 1998 in response to the 1997 El Niño event. The major increase in landings at the Los Angeles/Long Beach port complex in 1999 was due to increased squid landings.

Table 3.6.3 Volume and Value of Fish Commercially Harvested in the 50-Block Region by Year and Port

Year	Morro Bay/Avila		Santa Barbara		Ventura		Port Hueneme/ Oxnard		Los Angeles/ Long Beach	
	Weight (tons)	Value (M)	Weight (tons)	Value (M)	Weight (tons)	Value (M)	Weight (tons)	Value (M)	Weight (tons)	Value (M)
1996	399	0.80	3,715	6.41	818	0.29	12,708	2.82	581	0.16
1997	492	0.96	3,009	5.72	1,889	0.53	11,440	2.78	103	0.07
1998	486	1.10	1,670	3.96	139	0.24	725	0.63	734	0.35
1999	247	0.68	2,028	4.70	1,598	0.77	11,050	3.51	2,416	1.44
2000	134	0.80	1,721	3.31	1,903	0.57	2,295	0.53	997	0.73
2001	263	0.85	1,195	2.66	2,446	0.69	2,524	0.47	815	0.45
2002	490	0.91	1,105	2.89	2,284	0.77	844	0.31	307	0.15
2003	282	0.47	1,746	3.45	850	0.62	1,758	0.97	153	0.09
2004	432	0.74	2,563	3.96	1,060	0.57	1,807	0.90	175	0.08
2005	361	0.87	2,627	4.16	807	0.50	509	0.35	70	0.06
Total	**3,587**	**8.18**	**21,378**	**41.21**	**13,794**	**5.57**	**45,660**	**13.25**	**6,351**	**3.57**

Site-Specific Fisheries

As described above, the commercial fishery fluctuates during El Niño events, and landings differ among ports for individual taxonomic groups. In addition, the catch is not uniformly distributed across the 50-block study region. Instead, it is heavily weighted toward the Channel-Island blocks (687 through 690 in Figure 3.6-1). Over 57% of the total weight and value of the commercial catch was from those four fish blocks.

In contrast, Fish Block 644, which encompasses the Platform Irene location, accounts for less than one percent of the commercial landings in the 50-block study region (Table 3.6.4). Because the area around the Platform is relatively far from ports, and because weather conditions are often unfavorable, Block 644 is not as heavily fished as other blocks within the Santa Barbara Channel. However, when favorable conditions prevail, commercial fishers will travel long distances to reach this area when target species such as squid and shrimp are present. Over half (56%) of the biomass recovered from the block was squid, which was landed almost exclusively at the central-coast ports of Morro Bay and Avila. Figure 3.5-3 shows that essentially all of the squid that was harvested from Block 644 between 2000 and 2005 came from the microblock in the northeast corner. Although lower in biomass, the higher-value shrimp catch ranked highest in overall value in Block 644. Nearly all of these shrimp were spot prawns and were landed at the central-coast ports. Other high-value non-finfish taxa such as urchin, lobster, and crab were conspicuously absent due to the water depth. Within Block 644, the harvests of tuna, sole, and rockfish also ranked in importance for both biomass and value.

Table 3.6.4 Ranking of Top Fifteen Commercial Fish Taxa Harvested in the Irene Block 644 from 1996 to 2005

Taxon	Weight (Tons)		Taxon	Value ($M)
Squid	237		Shrimp	0.31
Tuna	61		Squid	0.10
Sole	30		Tuna	0.09
Rockfish	24		Rockfish	0.04
Shrimp	22		Sole	0.04
Anchovy	16		Salmon	0.03
Salmon	10		Crab	0.02
Crab	7		Swordfish	0.02
Sanddab	3		Halibut	0.01
Shark	3		Shark	0.01
Swordfish	3		Seabass	0.01
Halibut	3		Anchovy	0.01
Sablefish	2		Sablefish	<0.00
Seabass	1		Sanddab	<0.00
Sea Cucumber	1		Sea Cucumber	<0.00
Total	**424**		**Total**	**0.69**

Gear

Commercial fishers utilize several types of fishing gear within the 50-block study area. Many fishers do not fish for a single species or use only one gear type. Most switch fisheries during any given year depending on the market demand, prices, harvest regulations, and fish availability. The region is fished with several different gear types capable of targeting multiple species (MMS 2005b) including: 1) seines for coastal pelagics such as sardine, northern anchovy, mackerel, and market squid; 2) trawls for shrimp, sole, flounder, and halibut; 3) hook and line/longlines for rockfish and other rocky outcrop fish; 4) traps for crab and lobster; 5) drift/set gillnets for shark and swordfish; and, 6) trolls for albacore and salmon.

Seiners targeting squid were responsible for the landing the largest biomass within the 50-block study area overall, and within Block 644 encompassing Platform Irene (Table 3.6.5). However, the numbers of seiners and their location within the region at any given time is highly variable because they follow schools of pelagic fish. Market squid dominate the catch. Although sardines, mackerel, anchovy, and tuna are also targeted, none of these other taxa were landed within Block 644 over the last decade.

Although there are several variations, seines are used to encircle schools of pelagic fish species. Seiners generally traverse an area along an erratic course searching for schools on sonar. Once a school is found, a net is laid out on the surface to encircle the prey species. Floats along the upper lead line keep the top end of the net at the water surface. Metal rings are sewn along the bottom edge and a cable is passed through the rings. When the cable is drawn tight, the net "purses" (Fields, 1965). Squid is landed exclusively by purse seines (Vojkovich, 1998). In prior years, high-intensity lamps were used to attract squid to the surface and a brail net was the only net used to scoop the squid onto the ship (Kato and Hardwick, 1975). Due to economics, however, brail vessels could not compete with the more efficient seiners (Vojkovich, 1998). Although the season for pelagic fishes is open all year, the CDFG sets catch quotas. When quotas are filled, the fishery is over for that year unless an extended quota is subsequently issued.

Table 3.6.5 Comparison of Landings within the 50-Block Study Area and within Irene Block 644 from 1996 to 2005 as a Function of the Gear Type used to Harvest Commercial Fish

Weight (Tons)				Value ($M)		
Gear	**Region**	**Block 644**		**Gear**	**Region**	**Block 644**
Seine	67,154	237		**Diving**	25.15	<0.00
Diving	15,090	1		**Seine**	16.53	0.10
Trawl	3,236	67		**Trap**	11.83	0.03
Trap	2,423	9		**Trawl**	9.82	0.37
Hook & Line	2,045	35		**Hook & Line**	5.95	0.06
Gill Net	1,046	17		**Gill Net**	3.83	0.04
Net	361	20		**Troll**	0.55	0.07
Troll	299	38		**Net**	0.12	0.01
Other	6	0		**Other**	0.04	0.00
Total	**91,661**	**424**		**Total**	**73.82**	**0.69**

Trawlers are responsible for extracting the greatest value from Block 644 (Table 3.6.5), principally from shrimp, sole, and rockfish. Trawls can be conducted either in midwater or along the seafloor. Bottom trawls occur most often in the study region. They are designed to maintain contact with the seafloor. Although there are several types of trawls depending on the species fished, in their most basic form they are funnel-shaped nets that are towed over the seafloor. As they are towed over the seafloor surface, the rope, chain, or line (e.g., tickler chain, bridles, etc.) that precedes the net opening scare prey up off the ocean bottom. As the trawl is towed forward, prey is captured in the netting that follows. The opening of the trawl is maintained by a headrope with floats on the top, a footrope with weights on the bottom, and doors to each side that spread the net horizontally on the seafloor. Trawling varies seasonally in the 50-block study region.

Several fishing methods that use hooks attached to lines are utilized in the area for specific fisheries. Although they account for smaller biomass and value extracted from Block 644 than seining and trawling, they are important throughout the 50-block study region. Vertical longlines employ a series of hooks attached to a weighted line and are suspended vertically in the water column. Vertical longlining is commonly used to fish for rockfish over hard-bottom structures. Horizontal bottom longlines are similar to vertical longlines except that the hooks lay on the seafloor. Weighted ends keep the line on the seafloor. Horizontal longlines are used to catch bottom fish such as halibut.

Trolling consists of towing a baited hook or lure behind a boat. Pelagic fish such as salmon or albacore tuna are the primary target catch in the study region. Trolling commonly occurs in the water column high off the bottom, but in certain years, trolling for salmon can occur close to seafloor.

Gill and other nets are also used within Block 644. Gill nets consist of a vertical wall of netting. Weights and anchors on the bottom horizontal line anchor the bottom portion of the net to the seafloor while a series of floats on the top lead line lift the upper portion of the net towards the ocean surface. Gill nets are used for a wide variety of fish including halibut, yellowtail, and rockfish. Presently, however, set and drift gill nets for rockfish and lingcod are restricted from use in waters <70 fathoms (420 feet) south of Point Sal and in waters <40 fathoms (280 feet) from Point Sal north to Point Piedras Blancas.

Although trapping is an important fishery within the 50-block study area, pots and traps are rarely used within Block 644. Pots and traps come in a variety of shapes and sizes. In the project area, they are used primarily to capture crabs, lobsters, and to a lesser extent, prawns and certain fish species. Typically, several pots or traps are attached to a heavy groundline with an anchor or heavy weights attached at both ends. The ends of the line are connected to a surface buoy containing markers such as flags, radar reflectors, or even lights. Crab pots in particular are set in hard-bottom habitats. They can be set individually or in groups attached to a common groundline. During installation and retrieval of traps and pots, they can be dragged several meters along the bottom. Pots and traps are generally used at water depths less than 200 m near hard bottom habitat or along edges of canyons. However, pot fishing for sablefish can occur at depths up to 500 m along the edge of the continental shelf.

Diving has been one of the most important commercial fisheries within the 50-block study area, particularly in terms of the value of the catch. However, the contribution of Block 644 to the dive fishery is insignificant. Most of the commercial diving occurs along the Channel Islands. Commercial divers primarily harvest sea urchins, although some abalone were harvested in 1996 and 1997 within the study region. A small fishery also exists for sea cucumbers.

3.6.1.2 Recreational Fishing

Recreational fishing activities in the project area occur from a variety of platforms. They include private or charter vessels, piers, or from the shoreline (e.g., beaches, jetties, breakwaters). Other than fishing logs maintained by the commercial passenger fishing vessel (CPFV) fleet, reliable recreation fish landing data for specific locations of the coast are not available. Fish landed (numbers of fish) by the CPFV fleet that fish in the project area are provided in Table 3.6.6. The numbers provided in the table are conservative estimates of CPFV catch landings because not all CPFV operators participate in the logbook program (Thompson, 1999).

Table 3.6.6 Ranking of Top Twenty Recreational Fish Taxa Harvested in the Project Area from 1996 to 2005 by Commercial Passenger Fishing Vessel (CPFV) Fleet

Taxon	Count	%	Irene Block Count
Rockfish	352,637	65.9	
Ocean Whitefish	56,441	10.5	
Scallop	32,704	6.1	
Lobster	19,141	3.6	
Lingcod	16,064	3.0	
Sheephead	14,189	2.7	
Tuna	12,035	2.2	437
Kelp Bass	8,578	1.6	40
Abalone	4,239	0.8	
Barred Sand Bass	4,047	0.8	1,770
Barracuda	2,537	0.5	69
Seabass	2,350	0.4	1
Scorpionfish	2,188	0.4	
Cabezon	1,837	0.3	
Flounder	928	0.2	
Halibut	803	0.2	
Mackerel	800	0.1	6
Sea Cucumber	794	0.1	
Surfperch	413	0.1	
Yellowtail	387	0.1	
Total	**535,242**		**2,329**

Note: Totals are for all taxa, not just the top twenty listed in the table

As a group, rockfish dominate the CPFV catch. Rockfish accounted for over 65% of the catch from 1996-2005. Thompson (1999) has estimated that private boats and the CPFV fleet land an equal number of rockfish. Combined, they account for 20% of the rockfish caught offshore California since 1982.

There are over 60 different species of rockfish in California. The 15 rockfish species that have been formally assessed to date have populations that are currently below optimal abundance levels. Six rockfish species, including four that are important to California anglers (bocaccio, canary rockfish, widow rockfish, and cowcod), are at such low levels (estimated at or below 25% of the pristine population of each species) that they have been declared overfished by the Pacific Fisheries Management Council. For the recreational fishery, bag limits have been reduced, gear restrictions imposed, seasons closed, and minimum size limits established (CDFG 2001).

However, rockfish are spatially localized, preferring high-relief hard-substrate seafloor features that are regularly visited by the CPFV fleet that targets them. Optimal areas are located along the northern shoreline of Santa Rosa and San Miguel Islands within Fish Blocks 688, 689, and 690 (Figure 3.6-1). Together, these blocks account for 78% of the rockfish reported in Table 3.6.6. In contrast, no suitable hard-substrate features are frequented by the CPFV fleet within the fish-block (644) that encompasses Platform Irene. As a result, no rockfish landings were recorded within that block in the last decade (right hand column of Table 3.6.6).

The CPFV fishery came under stringent regulations in mid-2002 when fishing was prohibited for rockfish, lingcod, ocean whitefish, and California scorpionfish (sculpin) in waters 20 fathoms and greater in depth (Dotson and Charter 2003). As a result, counts for these species dropped in 2003 (Table 3.6.7). The restricted species were a mainstay for the winter CPFV fishery throughout the region. In mid-2003, depth restrictions were relaxed and numbers increased correspondingly in subsequent years.

Table 3.6.7 Recreational Landings of Rockfish, Whitefish, and Lingcod by Year

Year	Rockfish	Whitefish	Lingcod
1996	70,168	10,222	3,889
1997	62,434	9,569	3,449
1998	58,159	9,345	1,693
1999	49,574	8,554	1,426
2000	18,735	3,866	330
2001	12,334	2,491	409
2002	11,471	3,027	1,960
2003	5,233	1,579	660
2004	31,747	4,692	539
2005	32,782	3,096	1,709
Total	**352,637**	**56,441**	**16,064**

Except for scallops and lobsters, few landings of non-finfish species were reported by recreational charter boats to the CDFG. The numbers provided in the table are particularly conservative counts, as most recreational fishers do not report non-finfish catch to local authorities. The top-two taxa were the rock scallop and spiny lobster. These species were largely harvested by recreational divers at the western end of the Channel Islands and below Point Conception at shallow subtidal water depths. As discussed in the previous section on commercial fisheries, landings of abalone were largely restricted to the earliest portion of the decade-long analysis period.

A large number of barred sand bass have been recreational harvested within Block 644 (Table 3.6.6). The Block-644 catch represents 43% of the barred sand bass reported in the 50-block study area. However, nearly all (1,524 of the 1,770) were caught during a single year (1997 – an El Niño year). Similarly, all 437 of the tuna reported caught within Block 644, were harvested during 2002.

3.6.1.3 Commercial Kelp Harvesting and Mariculture

Kelp has been harvested commercially along the coast of California since the early 1900s (Scofield, 1959, McPeak and Glantz, 1984; Neushul, 1987; Tarpley and Glantz, 1992). Beginning in 1911, many small companies began harvesting along the coast between Santa Barbara and San Diego. In the early years, kelp was harvested for the extraction of potash and acetone. These chemicals were used to manufacture explosives during World War I. In the 1920s, P.R. Park, Inc. of San Diego began harvesting kelp for use as an additive to livestock and poultry food.

Kelco, now known as ISP Alginates, has harvested and processed giant kelp for the extraction of algin since 1929. Over the years, they developed many applications for algin, which is found in the cells of the kelp. It is mostly used as a thickening, stabilizing, suspending, and gelling agent. As such, it is used in a wide range of foods, such as desserts, gels, dairy products, and salad dressings. It also has industrial applications, and is used in paper coatings, textile printing and welding-rod coatings. Algin is also used in pharmaceutical, cosmetic, and dental products. Annual sales of algin products manufactured in California exceeds $40 million (CDFG, 2000).

Initially, ISP Alginates only harvested kelp beds near San Diego. However, as production needs increased or kelp productivity near San Diego decreased, ISP Alginates extended their harvest area. In recent years, they leased 15 kelp beds or approximately 28 square miles from Monterey Bay to Imperial Beach near the US-Mexico border and accounted for 95% of the kelp harvested in the entire state (CDFG, 2000). After 2006, the statewide kelp harvest will dramatically decrease because ISP Alginate moved its manufacturing facilities from San Diego California to Scotland in early 2006.

Mariculture companies also use giant kelp commercially as food for their abalone stock. Abalone aquaculture businesses range in size from large companies to small hobby operations. In 1999, the combined abalone aquaculture firms accounted for less than 1.7% of the annual kelp harvest (CDFG, 2000). However, their harvest is expected to increase in future years as the supply of wild abalone decrease worldwide. The Cultured Abalone of Santa Barbara currently leases bed 27 north of Santa Barbara. Since 1966, its kelp harvest has increased by 15% annually in response to a growing abalone market (CDFG, 2000). In 1999, the Cultured Abalone harvested 560 tons of kelp. Its kelp harvest is expected to increase by 15% annually.

Statewide, approximately 22 other harvesters hold current licenses to collect kelp. Their combined harvest has historically accounted for less than 2% of the total annual kelp harvest. The harvest from these licensees is expected to drop below 1% in future years.

Kelp Species

In southern California, kelp beds are primarily composed of the giant kelp *Macrocystis pyrifera*, while in the central California region (Point Montara south to Point Arguello), the kelp beds are a mix of the giant kelp and the bull kelp *Nereocystic luetkeana*.

Giant kelp (*Macrocystis pyrifera*) occurs from Baja California to Santa Cruz in central California (Druehl, 1970). Populations of the giant kelp commonly form dense patches that are referred to as kelp beds. Wave exposure and rocky substrates generally control their distribution. Except for a specialized population of giant kelp that grow on sand near Santa Barbara, the kelp holdfast attach to solid substrates or rock for attachment (North, 1971). Giant kelp can occur in the intertidal zone in protected areas, but the shoreward boundary of giant kelp is largely determined by where the largest waves normally break (Seymore et al., 1989; Graham, 1997). The outer limit of giant kelp beds is largely determined by water clarity (Dean and Deysher, 1983). In turbid waters, the offshore edge of kelp beds occurs at depths of approximately 50 to 60 feet, while in clear waters around the Channel Islands, the offshore edge of kelp beds extend to more than 100 feet (North, 1971).

Giant kelp is very productive. Gerald (1976) reported that productivity varied between 0.4 wet kg/m^2 and 3.0 wet kg/m^2 with an average of 23 wet kg/m^2/year or 102.4 tons/acre/year. Conversely, there are many factors that cause mortality to giant kelp. Storms and large swells that can dislodge plants cause the greatest mortality (Cowen et al., 1982; Dayton et al., 1984; Foster and Schiel, 1985; Dayton, 1985; North, 1986; Seymour et al., 1989). Storms can cause a gradient of damage from single plants and holdfasts to cleared areas several acres in size (Dayton et al., 1984).

Bull kelp (*Nereocystis luetkeana*) ranges from Alaska south to San Luis Obispo County, CA (Hawkes et al., 1978; Scagel et al., 1987). In central California south of Carmel, both giant and bull kelp occur together, forming very dense kelp beds. Like the giant kelp, bull kelp is associated with hard substrates for attachment and other environmental factors (McLean, 1962; Foreman, 1970). Bull kelp generally occurs at water depths of 13 to 72 feet (McLean, 1962; Nicholson, 1970; Vadas, 1972).

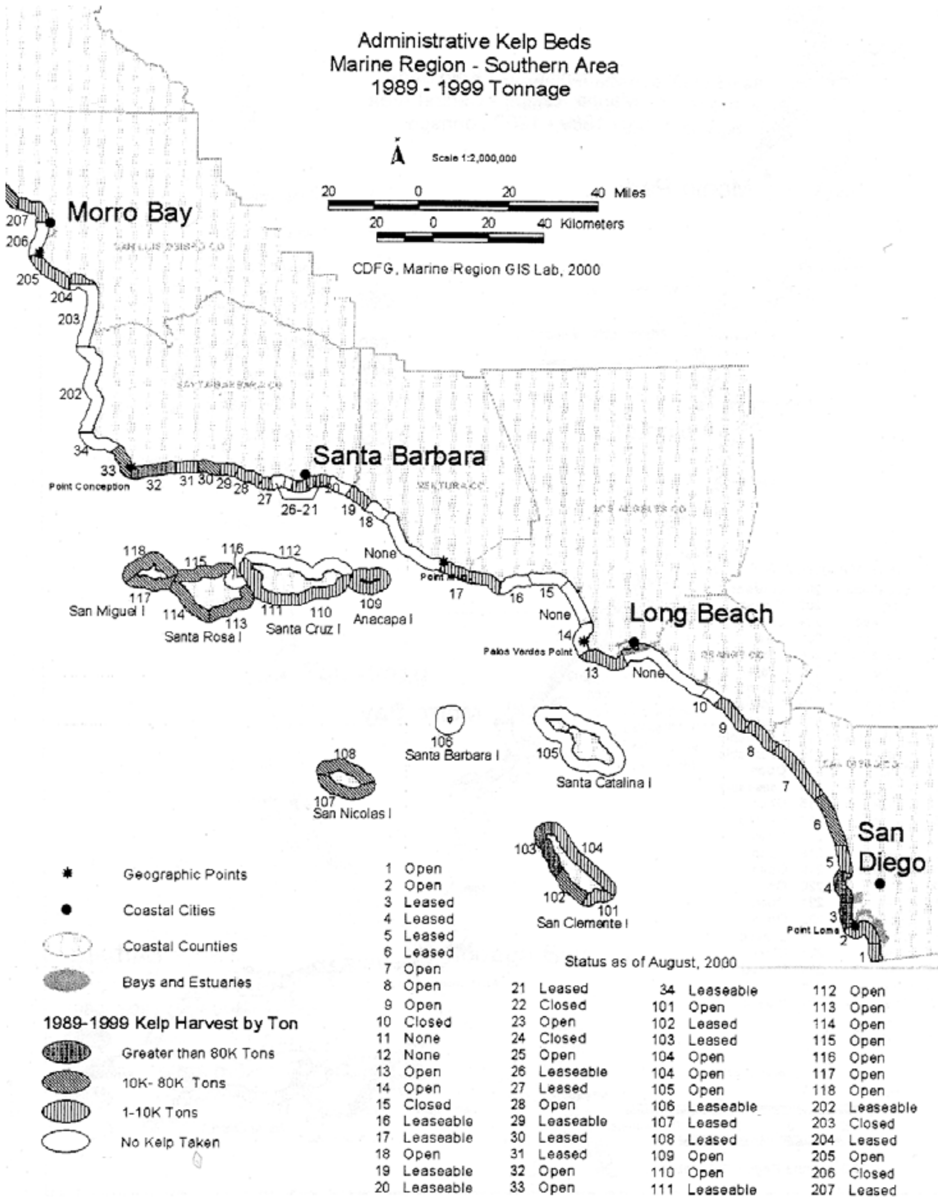
The productivity of bull kelp is also high. Gotshall et al. (1986) monitored bull kelp at Diablo Cove in San Luis Obispo County. Over a 12-year period, productivity of bull averaged 9 kg/m^2 or 40.5 tons/acre. During the same period, productivity ranged from a high of 45 kg/m^2 (200 tons/acre) to a low of 1.09 kg/m^2 (4.8 tons/acre). The most influential factor for bull kelp survival is light availability (Vadas, 1972). Reduction of light caused by plankton blooms, storm turbulence, overcast or foggy conditions, or overshadowing by other algae can inhibit growth substantially (Vadas, 1972; Dayton et al., 1984; Miller and Estes, 1989). Nutrient levels and water temperature are also important to the survival of bull kelp (Dawson, 1966; Jackson, 1983).

Unlike the giant kelp, storms have varying effects on bull kelp. While spring storms cause mortality on young and juvenile plants, summer storms had little effect on this species (Foreman, 1970). Bull kelp, by nature, is more abundant in high disturbance areas with extremely large swells. Because of the resiliency and strength of the stipe of this plant, it is able to survive under these extreme conditions. Koehl and Wainwright (1977) reported that bull kelp stipes can stretch approximately 38%. During winter storms, bull kelp canopies are removed by wave action. Because this plant is an annual species, this result is consistent with its life history. By late fall, photosynthetic activity has decreased resulting in weakened plants and holdfasts. The increase in wave energy during the winter months in combination with the shortened day length result in the death of this species as part of its life cycle.

Kelp Harvests

The California Fish and Game Commission is responsible for the management of kelp beds off the coast of California. In 1931, the CDFG charted and numbered the kelp beds in coastal waters for management purposes. The numbering system has changed over the years, but presently, there are 74 designated beds from the US-Mexico border to Point Montara in San Mateo County (CDFG, 2000). Kelp beds in the southern California region from the US-Mexico border to Point Arguello are numbered 1 to 34 along the mainland and 101 to 118 around the Channel Islands (see Figure 3.6-4). Each kelp bed is of varying size and is delineated by true bearings. The amount of kelp that appear within each bed changes with time.

Figure 3.6-4 Location and Yield from Kelp Beds in Southern California (CDFG, 2000)



Commercial kelp landings have been monitored since 1915 (Tarpley and Glantz, 1992). Two types of data are collected as part of the monitoring effort. The first type of data consists of landing records that provide the weight, species, collector, and location of kelp harvested. Harvesters are required to provide this data to the CDFG on a monthly basis (CDFG, 2000). The second type of data consists of non-landing statistics that are normally collected by the State agencies, the kelp harvesters, and the academic institutions. For example, ISP Alginates, the primary kelp harvester in California until 2006, conducted resource aerial surveys on a regular basis since 1958. Most of the data they collected, however, has been proprietary and unavailable to the public. The CDFG also conducts aerial surveys but annual surveys were intermittent prior to 2002. Since that time, they have been flying annual aerial photo surveys of all of California's kelp beds.

The harvest or landing data submitted to the CDFG provide information on the category of plant landed, amount landed, location of harvest, and the name and address of the person or firm to whom the harvest was sold. Statewide kelp harvest data is summarized in Table 3.6.8 and site-specific data from five active kelp beds located in the project area are provided in Table 3.6.9. Annual California kelp harvest since 1916 has also been published by the National Marine Fisheries Service (NMFS, 2006) and shows a trend of declining harvests since the 1960’s and 1970’s when more than 120,000 tons were consistently harvested annual basis. As described early, the harvest in 2006 is expected to dramatically decline because ISP Alginate moved its manufacturing facilities from San Diego California to Scotland. The unusually low total landings reported in Table 3.6.8 during 2002 is inconsistent with the NMFS data and suggests that the CDFG totals are 25,284 tons too low, probably because of underreported harvest in the leased beds. Except for 2001, 2002, and 2003, the total harvest from the leased beds was significantly higher than in open beds, even though there were half as many active leased beds as open beds.

Table 3.6.8 California Kelp Harvest (*Macrocystis pyrifera*) for 1995-2005

Year	Open Beds	Leased Beds	Total Tons
1995	4,217	73,536	77,753
1996	13,537	64,924	78,461
1997	12,366	32,977	45,343
1998	2,090	23,223	25,313
1999	8,076	34,135	42,211
2000	14,506	27,438	41,944
2001	23,035	17,262	40,297
2002	18,953	7,631	26,584
2003	25,111	25,633	50,744
2004	8,185	33,986	42,171
2005	26,463	46,142	72,605

Kelp harvest from active kelp beds that could be potentially affected by an oil spill from the proposed project are located near Point Conception and on San Miguel and Santa Rosa Islands (Table 3.6.9 and Figure 3.6-4). Although all these beds are listed as “Open” in the Figure, Bed Number 32 was leased between 2000 and 2005. Total harvest over the 12 years listed in Table 3.6.9 was higher in this bed than in others. It lies east of Point Conception in an area where oil-spill modeling indicates a low probability of landfall (See Section 3.2). In addition, in the absence of harvest by ISP Alginates after 2006, Bed Number 32 is likely to experience significantly lower harvest throughout the life of the project. Landfall probabilities are higher on the north side of San Miguel Island where Bed Numbers 118 is located. However, there has been no commercial kelp harvest from Bed Number 118 since 1997. Conversely, Bed Number 115, on the north shore of Santa Rosa Island has seen some recent harvest activity, but the probability of a spill impact is lower than for San Miguel Island.

Table 3.6.9 Kelp Harvest in Metric Tons for Beds in the Project Area

Year	Kelp Bed Numbers				
	32	**33**	**115**	**117**	**118**
1994	6,895	601	311	1,303	323
1995	0	0	0	591	427
1996	0	0	5,715	1,803	2,969
1997	16,506	5,677	1,265	3,053	668
1998	779	646	0	10,750	0
1999	228	614	310	2939	0
2000	0	0	0	100	0
2001	0	1,176	0	0	0
2002	0	0	0	400	0
2003	0	0	4,908	0	0
2004	3,948	0	584	250	0
2005	4,551	441	6,049	0	0
Total	**32,907**	**9,155**	**19,142**	**21,189**	**4,387**

Kelp Harvesting Vessels

The vessels used for harvesting commercial kelp beds range in length from 140 to 180 feet. The majority of the length of the vessel is comprised of the bin for holding the cut kelp (CDFG, 2000). Kelp is cut by reciprocating blades mounted at the base of a conveyor system (drapers) located at the stern end of the ship. The draper system is lowered into the water to a depth of 3 feet, and the harvest ship moves stern-first through the kelp bed. As the kelp is cut, it is brought aboard on the conveyor system and deposited in the bin. The harvest vessels can carry as much as 600 tons of kelp, which can all be collected in a single day (CDFG, 2000). The large harvest vessels have a draft of approximately 12 feet and work at water depths greater than 30 feet.

Kelp harvest vessels used by abalone aquaculturists are smaller than those used by the commercial harvesters. The smaller vessels are capable of working in shallower waters because of their shallow draft. They typically carry between 15 and 25 tons of kelp. Kelp is also harvested by hand from smaller boats to supply abalone farms. It is either cut at the surface using a knife attached to a pole, or cut beneath the water surface by a diver. The cut fronds are bundled together and pulled aboard the boat by hand.

3.6.1.4 Recreational Kelp Harvesting

Very little information is available on the quantity of kelp harvested for recreational purposes. However, several Native American Indian tribes and Asian groups do utilize kelp as a food source. The kelp that is collected can be drift kelp that has washed up onto the beach or fresh kelp that is harvested during low tides. In addition to kelp, local Asian groups harvest seaweeds such as *Porphyra* spp. and *Ulva* spp. in the project area during spring low tides. These algae are utilized as a food source. Other recreational uses of kelp include its use as an ingredient in a form of ceramic art called Sagger firing and by gardeners for use as compost (CDFG, 2000). It has been estimated that less than 25 tons of kelp is collected annually by recreational users (CDFG, 2000).

3.6.2 Regulatory Setting

3.6.2.1 Federal Laws and Policies

The Outer Continental Shelf Lands Act (OCSLA)
Under the OCSLA, the DOI is required to:

- Manage the orderly leasing, exploration, development, and production of oil and gas resources on the Federal OCS;
- Ensure the protection of the human, marine, and coastal environments;
- Ensure that the public receives a fair and equitable return for these resources; and
- Ensure that free-market competition is maintained.

Within the DOI, the MMS is charged with the responsibility of managing and regulating the development of the OCS oil and gas resources in accordance with the provisions of the OCSLA. The MMS operating regulations are presented in Chapter 30, CFR, Part 250.

The National Environmental Policy Act (NEPA)
NEPA requires all Federal agencies to use a systematic, interdisciplinary approach to protect the human environment. The approach ensures the integrated use of natural and social sciences in any planning and decision making that may have an impact on the environment. The NEPA also requires the preparation of a detailed EIS on any major Federal action that may have a significant impact on the environment. The EIS must address any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term resources and long-term productivity, and irreversible and irretrievable commitments of resources.

In 1979, uniform procedures were established for implementing the procedural provisions of NEPA. These regulations provide for the use of the NEPA process to identify and assess reasonable alternatives to proposed actions that avoid or minimize adverse effects upon the quality of the human environment. "Scoping" is used to identify the scope and significance of important environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies; the general public; and any interested individual or organization prior to the development of an impact statement. The process also identifies and eliminates from further detailed study, issues that are not significant or that have been covered by prior environmental review.

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)
The MSFCMA of 1976 is the cornerstone legislation of fisheries management in US jurisdictional waters. Its purpose was to stop overfishing by foreign fleets and aid in the development of the domestic fishing industry. The Act gave the US sole management authority over all living resources within the 200-nautical mile exclusive economic zone of the US. The Act created eight regional Fishery Management Councils (FMCs) and mandated a continuing planning and management program for marine fisheries by the FMCs. The Act, as amended, requires that a Fishery Management Plan (FMP), based upon the best available scientific and economic data, be prepared for each commercial species or group of related species of fish that is in need of conservation and management within each respective region. The regional council for

the Pacific OCS is the Pacific Fishery Management Council. In accordance with the Act, the councils report directly to the US Secretary of Commerce whose job is to review, approve and prepare FMPs. In reality, this function is delegated to the Administrator of the NOAA and the NMFS.

The Act has been amended several times. In 1996, federal law governing fisheries management underwent a major overhaul. The amendments, termed the Sustainable Fisheries Act (SFA) of 1996, identified fish habitat as critical to healthy fish stocks and sustainable fisheries. The SFA implemented a program to designate and conserve Essential Fish Habitat (EFH) for species managed under a FMP. EFH is defined as "those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity." The intention is to minimize any adverse effects on habitat caused by fishing or nonfishing activities and to identify other actions to encourage the conservation and enhancement of such habitat. A number of FMPs that apply to the west coast have been developed. These include the West Coast Groundfish FMP, the Coastal Pelagics FMP, and the Pacific Salmon FMP. The documents for West Coast groundfish EFH include all species of rockfish managed by the Council (Bloeser, 1999).

The Coastal Zone Management Act (CZMA)
In accordance with the CZMA and the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, OCS oil and gas exploration and development activities affecting the coastal zone must be carried out consistent with the California Coastal Management Program (CCMP), namely, the policies of the California Coastal Act). The CCMP sets forth objectives, policies, and standards regarding coastal uses and resources within California.

Coast Guard Regulatory Authority
Primary responsibility for the enforcement of US maritime laws and regulations falls upon the US Coast Guard. The Coast Guard's responsibilities for regulating activities on the OCS, the continental shelf, and in ports and harbors, as applicable to the proposed action, are presented in Title 33 CFR, chapters 1-199; Title 43 USC section 1331; Title 46 USC, Parts A and B; and OPA 90. The Coast Guard is responsible for managing and regulating provisions for safe navigation of vessels in US waters, as well as the enforcement of environmental and pollution prevention regulations. As such, the Coast Guard provides for the regulation and enforcement of hazardous working conditions on the OCS, for the management and regulations of measures for pollution prevention in territorial waters, and for ensuring that the provisions of OPA 90 and the MPPRCA (MARPOL Annex V) are implemented.

3.6.2.2 State and Local Laws and Policies

The California Environmental Quality Act (CEQA)
The goal of the CEQA (Pub. Res. Code §21000 et seq.) is to develop and maintain a high-quality environment. It directs California's public agencies to identify the significant environmental effects of their actions and avoid or mitigate those significant environmental effects, where feasible. The California Resources Agency administers the CEQA. CEQA requires that an EIR be prepared for any major project, which states the pros and cons of that project. If it is determined that a project has no significant environmental effects and is not exempt from CEQA, then the lead agency must adopt a negative declaration to that effect. The purpose of an EIR is to provide State and local agencies and the general public with detailed information on the

potentially significant environmental effects which a proposed project is likely to have and to list ways which the significant environmental effects may be minimized and indicate alternatives to the project.

California State Lands Commission.

Pursuant to Public Resources Code section 6873.5(b), the commission shall (prior to the adoption of a form of lease for leasing offshore tide and submerged lands between the mean high tide line and the three-mile jurisdictional limit) consider the potential impacts of the proposed lease on the fisheries and marine habitat within the area being considered for leasing. This EIR provides information relevant to such consideration.

California Coastal Act of 1976

The California Coastal Act (Division 20 of the Public Resources Code, Section 30000, et seq.) became law in 1976 as a means of providing a comprehensive framework for the protection and management of coastal resources. The main goals of the act are to protect and restore coastal zone resources; assure balanced and orderly utilization of such resources; maximize public access to and along the coast; assure priority for coastal dependent and coastal-related development; and encourage cooperation between State and local agencies toward achieving the Act's objectives.

The Coastal Act contains policies to guide local and State decision-makers in the management of coastal and marine resources. The policies are organized into chapters by topics relating to public access; recreation; marine environment; land resources; and development. The act also contains provisions for development controls and land-use entitlements for certain types of new development in the coastal zone.

The California Coastal Act, which is administered by the California Coastal Commission, also identifies protective measures for nearshore marine resources. For example:

Coastal Act section 30230 states:

> *"Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."*

Coastal Act section 30234 states:

> *"Facilities serving the commercial fishing and recreational boating industries shall be protected and, where feasible, upgraded. Existing commercial fishing and recreational boating harbor space shall not be reduced unless the demand for those facilities no longer exists or adequate substitute space has been provided. Proposed recreational boating facilities shall, where feasible, be designed and located in such a fashion as not to interfere with the needs of the commercial fishing industry."*

Coastal Act section 30234.5 states:

> *The economic, commercial, and recreational importance of fishing activities shall be recognized and protected.*

California Regional Water Quality Control Board (RWQCB)

The California RWQCB determines permit requirements on a case-by-case basis. They require a waste discharge permit (WDP) if the action creates problems or if the action becomes permanent. The duration and size of a project are important factors and concerns may include the amount of water quality degradation.

The Water Quality Control Plan developed by the CRWQCB, Central Coast Division, established water quality standards for the region. The plan incorporates the California Ocean Plan that establishes standards to protect the quality of ocean waters for use and enjoyment by the people of California. The Ocean Plan, which is administered by the State Water Resources Control Board, is reviewed periodically to guarantee that the current standards are adequate and are not allowing degradation to marine species or posing a threat to public health (State Water Resources Control Board, 2005). In general, Chapters I, II, and III establish discharge standards for non-point discharges to marine waters. For example:

The California Ocean Plan, Chapter I, Beneficial Uses states:

> *"The beneficial uses of the ocean waters of the State that shall be protected include industrial water supply, water contact and non-contact recreation, including aesthetic enjoyment, navigation, commercial and sport fishing, mariculture, preservation and enhancement of Areas of Special Biological Significance, rare and endangered species, marine habitat, fish migration, fish spawning and shellfish harvesting."*

The California Ocean Plan, Chapter II, Water Quality Objectives states, in part, in Section E Biological Characteristics, that:

4) *Marine communities, including vertebrate, invertebrate, and plant species shall not be degraded;*
5) *The natural taste, odor, and color of fish, shellfish, or other marine resources used for human consumption shall not be altered; and*
6) *The concentration of organic materials in fish, shellfish or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.*

The Central Coast Region of the RWQCB has established a Water Quality Control Plan (Basin Plan) for the coastal waters that include the Tranquillon Ridge Field (RWQCB, 1994). The standards of the RWQCB incorporate the applicable portions of the ocean plan and are more specific to the beneficial uses of marine waters adjacent to the project site. These water quality objectives and toxic material limitations are designed to protect the beneficial uses of ocean waters within specific drainage basins. The Basin Plan identifies the following existing beneficial uses for the coastal waters contained within the project area (RWQCB, 1994):

- ***Water Contact Recreation (REC-1):*** Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing and fishing;
- ***Marine Habitat (MAR):*** Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife such as marine mammals and shorebirds;
- ***Shellfish Harvesting (SHELL):*** Uses of water that support habitats suitable for the collection of filter-feeding shellfish such as clams, oysters, and mussels, for human consumption, commercial, or sport purposes. This includes waters that have in the past, or may in the future, contain significant shell fisheries; and
- ***Ocean Commercial and Sport Fishing (COMM):*** Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including uses involving organisms intended for human consumption or bait purposes.

Santa Barbara County

The coastal reaches adjacent to the Tranquillon Ridge Field fall under the jurisdiction of SBC. Consequently, SBC is one of the agencies responsible for reviewing project actions including integration of policies established by the California Coastal Act. An Energy Division was established within the SBC's P&D Department to participate in environmental reviews and permitting of major oil and gas development projects. The Division also ensures that oil and gas projects are developed and operated in compliance with the permit conditions imposed by the SBC decisionmakers, including the Board of Supervisors and the Planning Commission.

3.6.3 Significance Criteria

Changes or impacts to commercial and recreational fishing or kelp harvesting will be considered significant if:

- More than 10% of fishers are precluded from fishing in a specific area for most or all of a fishing season;
- Kelp beds lessees are not able to harvest for most or all of a kelp season (e.g., one year);
- Fish or kelp resources of commercial importance have the potential to be reduced by more than 10% in a specific area; and
- The project results in the loss or damage to any commercial or recreational fishing or kelp harvesting equipment.

3.6.4 Impact Discussion

Impact #	Impact Description	Project/Phase
CRF/KH.1	Oil spills may potentially impact commercial and recreational kelp harvests in the proposed project area.	*Increased Throughput* *Extension of Life*

The effects of oil spills on beds of *Macrocystis* have been examined several times along the Pacific coast. After the tanker *Tampico* spill in 1957 in Baja California, North et al. (1964) reported high mortality of invertebrates but no damage to *Macrocystis*. Within five months of the spill, they reported increased amounts of algal vegetation, including *Macrocystis*. North et al. (1964) reported that the oil had killed sea urchins that had been maintaining the bottom and once killed, *Macrocystis* and other algal species began to develop. The kelp had recruited and produced a canopy in the cove approximately 18 months following the spill.

The 1969 Santa Barbara crude oil spill impacted a large portion of the mainland coast and Channel islands (Foster et al., 1971a). There was little damage to the *Macroscystis* beds even though considerable quantities of crude oil fouled the surface canopies (Foster et al., 1971b). The partially weathered crude oil appeared to stay on the surface of the water and did not stick to the fronds of the giant kelp.

Also, there are extensive natural gas and oil seeps that occur near kelp beds in the Santa Barbara Channel (Mertz, 1959). The seeps often produce continuous oil slicks on the surface of the water and tar mounds on the ocean bottom within kelp bed communities (Spies and Davis, 1979). The natural seeps do not appear to cause visible damage to *Macrocystis* and extensive canopies regularly develop in these beds.

The literature indicates that oil spills or its cleanup cause little damage to kelp beds. Should damage occur, such as from the *Tampico* spill, recruitment and recolonization occurs rapidly and within one year. Hence, impacts to kelp and commercial and recreational kelp harvesting operations are adverse but not significant.

Mitigation Measure

CRF/KH-1 Same as Mitigation Measure MB-1 in Section 3.5, Biological Resources.

Because of the temporary nature of the disturbance, oil spill impacts to commercial and recreational kelp harvesting operations are adverse.

Impact #	Impact Description	Project/Phase
CRF/KH.2	Oil spills may potentially impact commercial and recreational fishing in the proposed project area.	*Increased Throughput* *Extension of Life*

A wide variety of fish and shellfish species are commercially harvested in the project area. As described in Biological Resources Impact MB-2, biota residing in the intertidal and shallow subtidal habitat are most vulnerable to oil spills. Several species are commercially and recreationally harvested in the intertidal zone. Sea urchins, for example, ranked first in dollar value and second in biomass over the ten-year period from 1996 to 2006. Sea urchins alone, accounted for almost one-third (31.1%) of the dollar value of the commercial catch during the ten years. In pounds landed, it accounted for 16.2% of the total catch and half of the non-squid catch. Mass mortalities of invertebrates such as sea urchins, abalone, and lobsters were reported following the *Tampico* spill in Baja California (North et al. 1964).

Although abalone is not presently harvested in the project area, both sea urchins and lobsters are high value species that are harvested both commercially and recreationally in the area. In the event of an oil spill, there could be impacts to abalone, which is a taxon of concern because of dramatic population declines within the project area over the last decade. Smothering is the most common cause of mortality and would be limited to direct contact with weathered tar balls from the oil spill. Although not high value species, other intertidal or shallow subtidal organisms that are harvested include sea cucumbers and whelks.

Results of the oil spill trajectory analyses in Section 3.2 indicate that key areas for harvesting these species along the northern and western edge of San Miguel and Santa Rosa Islands (between 0.3 and 5.3% probability) and the coastline between Point Arguello and Point Conception (between 0.0 and 12.7% probability) may be impacted by oil spills. The degree of oiling and the oil spill impacts depend on several factors. They include location of spill, volume, type of oil, amount of weathering, evaporation, dispersion of oil into the water column or shoreline, and the amount of oil that is contained and cleaned immediately after a spill.

For the spills that occurred on the Pacific and Gulf of Mexico OCS between 1971 and 1999, the mean volume of oil spills was 159 barrels (MMS, 2001). Large spills (e.g. >2000 barrels) are rare and unlikely to occur; however, the Santa Barbara oil spill of 1969 was estimated at 80,900 barrels (MMS, 2001). The spill from the rupture of the Torch Pedernales pipeline in the project area was estimated at 163 to 1,242+ barrels (SBC, 2001) [1]. While the probability for oil contacting and fouling the shoreline or shallow subtidal areas where commercial or recreational species are harvested is low, it nevertheless can occur. While contaminated shorelines may be cleaned, in some instances, depending on substrate type, oil may persist in sediments for several years.

On rocky cobble beaches in Prince William Sound, oil was clearly visible in sediments eight years after the *Exxon Valdez* spill that occurred in 1989 (Hayes and Michel, 1998). A surface sheen in intertidal waters caused by the release of hydrocarbons from oiled sediments was noticeable eight years after the spill (Hayes and Michel, 1998). In addition to direct oiling effects, impacts caused by the cleanup method, or sublethal effects such as histological damage, altered physiological and metabolic patterns, decreased growth and reproduction, vulnerability to diseases, or even area closures can continue for several years (NRC, 1985; Coats et al., 1999). Oil spill impacts to commercial and recreational fisheries in the intertidal environment or shallow subtidal may be long lasting and can result in loss of areas for most if not all of a harvesting season.

Damage to fish populations were documented from the *Exxon Valdez* oil spill (Spies, 1996). Juvenile pink and sockeye salmon were directly affected by the spill in 1989 and their eggs may have been affected through 1993 (Spies, 1996). Other indications of exposure to oil included the presence of oil in the stomachs of salmon fry, measurements of polynuclear aromatic hydrocarbons (PAH) in salmon fry, and increases in P450 and bile hydrocarbon metabolites in Dolly Varden (Spies, 1996). Impacts to growth were also shown for pink salmon, Dolly Varden and cutthroat trout even though changes in food availability were not detected (Spies, 1996).

Brown et al. (1996) estimated that 40 to 50% of the egg biomass of Pacific herring in Prince William Sound was exposed to oil during developmental stages. The resulting 1989 year class showed sublethal effects such as premature hatch, low weights, reduced growth, and increased morphologic and genetic abnormalities (Brown et al., 1996). The 1989 year class recruiting as 4-

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[1] The CDFG's official spill volume from the Torch Point Pedernales pipeline was 163 barrels (CDFG,1989). The 1,242 bbl estimate is from Santa Barbara County and is based upon additional factors that were not taken into account with the CSFG official number. These include drainage from the landward side of the pipeline, oil between pigs 1 and 2, and oil behind pig 2.

year old adults in 1993 was one of the smallest to return to spawn in Prince William Sound with an adult population that had already been reduced by approximately 75% (Brown et al., 1996).

Adult fish, due to their mobility, may be able to avoid or minimize exposure to spilled oil. However, there is no conclusive evidence that fish will avoid spilled oil (NRC, 1985). Egg and larval stages would also not be able to avoid exposure to spilled oil. Because losses to commercial and recreational fish resources and losses due to closure of fishing areas for most or all of a fishing season can occur, impacts to commercial and recreational fishing from oil spills are considered to be significant. Fish harvested from contaminated areas may also be reduced in value and fishing gear can be damaged due to oil fouling, causing potential additional impacts.

Mitigation Measure

CRF/KH-2 Same as Mitigation Measure MB-1 in Section 3.5, Biological Resources.

Because there are limitations to thorough containment and cleanup of an offshore oil spill, some impacts could remain for commercial and recreational fisheries in the intertidal zone.

Impact #	Impact Description	Project/Phase
CRF/KH.3	The discharge of drilling muds and drill cuttings from Platform Irene may potentially impact kelp communities in the project area.	*Drilling*

The discharge of drilling muds and drill cuttings at Platform Irene would result in increased turbidity in ocean waters near the platform. However, the mud discharges would not affect the photosynthetic ability by kelp due to the great distance between the discharge point and the kelp beds along the shoreline. Because of the intermittent nature of the drilling mud discharges, the rapid descent of most mud solids to the ocean bottom, and the dispersion of suspended mud particles, these impacts are considered to be potentially adverse but not significant.

Impact #	Impact Description	Project/Phase
CRF/KH.4	Marine Vessel traffic to and from Platform Irene could cause loss or damage to commercial fishing gear in the project area.	*Drilling* *Extension of Life*

Supply boats servicing Platform Irene use Port Hueneme as the shore-based facility. The supply boat traffic from Port Hueneme crosses nearshore set gear fishing areas such as Hueneme Flats, and could cause damage to the fishing gear. If support vessels hit fishing gear, the gear can be damaged or lost. With the increase in the number of supply boat trips during the drilling phase, the likelihood of supply boats impacting commercial fishing gear would increase. In addition, with the Tranquillon Ridge project, supply boats would continue to service the platforms for a longer period of time due to the extension of life.

In 1983 the Joint Oil/Fisheries Liaison Office, a private nonprofit service, was formed along with the Joint Oil/Fisheries Committee of South Central California to provide an inter-industry communications link and dispute resolution/mediation process between the offshore oil and gas industry and the commercial fishing industry in the Santa Barbara Channel and Santa Maria Basin.

To reduce the conflict between support vessel traffic and the commercial fishing industry, a Vessel Traffic Corridor Program has been developed by the Joint Oil/Fisheries Committee of South Central California, which went into effect in August 1984. These vessel traffic corridors are approximately 1,500 feet wide. Use of these corridors is voluntary. The Applicant has stated that the supply boats servicing Platform Irene use the defined corridors from Port Hueneme to the shipping lanes.

Use of mooring areas along the coast also poses a potential conflict with nearshore commercial fishing. One mooring location of particular concern is Cojo anchorage, which is in a prime set gear fishing area. Support vessels that service the oil platforms in the Southern and Central Santa Maria Basin use the Cojo anchorage as a safe anchoring spot during rough weather. As the vessels move in and out of Cojo Bay, it is possible that they could impact set fishing gear, resulting in damage or loss of the gear.

Given that the support vessels servicing Platform Irene use the vessel traffic corridors and the fact that there is a Joint Oil/Fisheries Liaison Office that provides dispute resolution/mediation, this impact is considered adverse but not significant.

Mitigation Measure

CRF/KH-3 *Disputes over damage to commercial fishing gear resulting from support vessel traffic to and from Platform Irene shall be submitted to the Joint Oil/Fisheries Committee for resolution.*

Impact #	Impact Description	Project/Phase
CRF/KH.5	The deposition of shells, or shell mounds, could prevent commercial trawling activities beneath Platform Irene	*Drilling* *Extension of Life*

Epibiota such as mussels and barnacles fall from their attachment points on submerged portions of a platform and can accumulate on the seafloor. The accumulation or deposits of shells, referred to as shell mounds, also contain drilling related discharges such as drilling muds and drill cuttings (deWit, 2001). In 1996, Platforms Hazel, Hilda, Hope, and Heidi (collectively known as the 4H platforms), located in State Waters in the eastern portion of the Santa Barbara Channel were removed. The platforms were located in water depths ranging from 95 feet (29 m) to 150 feet (46 m). The shell mounds beneath the platforms ranged from 20 to 28 feet (6.7 to 8.5 m) in height and from 185 to 230 feet (56.9 to 70.1 m) in width. The estimated volume of material within the mounds ranged from 7,000 to 14,000 yd^3 (5,352 to 10,704 m^3) (de Wit, 2001). Compared to samples collected at a reference site, chemical analyses of sediments collected within the shell mounds indicated elevated levels of metals, hydrocarbons, and PCB’s. Elutriate bioassay testing also showed that shell mound sediments collected at Platform Hazel were toxic enough at 48% concentration to kill 50% of mysid shrimp (*Mysidopsis bahia*) within 96 hours (deWit, 2001).

Several trawl tests were conducted after the platforms were removed. The purpose of the tests was to demonstrate that permit conditions requiring that the sites could be trawled had been satisfied. The tests were all unsuccessful and trawling could not be conducted in the shell-mound area beneath the former 4H platforms. Love et al. (1999) surveyed the mussel mounds beneath seven platforms in the Santa Barbara Channel and the Santa Maria Basin. The mound beneath

Platform Irene was one of the seven mounds that were surveyed. Because the focus of the study conducted by Love et al. (1999) was to document fish assemblages associated with mussel mounds, the physical and chemical character of the mound is not provided. However, their survey confirms the presence of a mound beneath Platform Irene, but found that the shell mound was small in size and low reef.

In 2001 the MMS conducted multibeam hydrographic survey around and under eight oil platforms in the Santa Barbara Channel and Santa Maria Basin. The study found that the size, height, or volume of the mounds under the platforms may be related to platform age. The oldest platform (Houchin) has the largest mound and the 3 youngest platforms (Gail, Hermosa, and Hidalgo) either have the smallest mounds or none. Other factors must influence the size, height, and volume of the mounds, because three platforms (Gina, Henry, and Grace) were installed within a year of each other and have mounds with significantly different heights and volumes (MMS, 2001).

The study also found that the size and volume of the mounds under the offshore platforms may be related to the geographic location of the platforms. The largest mounds are under Platforms Henry and Houchin, which are located near one another in Central Santa Barbara Channel. Platforms Gina and Grace, located in the Southern Santa Barbara Channel, have mounds of similar size and volume. Although located far apart, Platforms Gail and Hondo are both located in deep water (740 ft and 835 ft, respectively) and have similar-sized mounds. The two platforms surveyed in the Santa Maria Basin (Hermosa and Hidalgo) have very small or no mounds (MMS, 2001).

Recent data suggest that the shell mounds at Platform Irene <u>cannot</u> be removed using technology that is available today. Feasibility studies for the Chevron 4H shell mounds indicate that 135 feet of water is the practical limit for removal of shell mounds based upon currently available technology. The shell mound located at Platform Irene, which lies in 242 feet of water, could not be removed with current technology. Removal of the mounds may be neither feasible nor the environmentally preferred project when Irene is abandoned. This would have to be determined as part of the environmental review that would be conducted for the abandonment of Platform Irene.

It is likely that with the Tranquillon Ridge Project the expected life of Platform Irene will be extended. This extension of life could lead to an increase in the size and volume of the shell mound beneath the platform. However, the extent to which the shell mound may change due to the extended life of Platform Irene is unknown. This potential increase in the size of the shell mound was found to be an adverse but not significant impact on commercial fishing since a shell mound already exists at the platform site.

Mitigation Measure

CRF/KH-4 *At the time of platform abandonment, the Applicant shall ensure that the environmental review of the abandonment activities pursuant to the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), as appropriate, includes an analysis as to whether or not the shell mounds should be removed or modified so they do not interfere with commercial trawling activities. This subsequent NEPA/CEQA review shall evaluate the best available* *technologies for removal or modification of the shell mounds. The best available technology shall be determined by the Applicant and the permitting agencies, in consultation with the Joint Oil/Fisheries Liaison Office.*

Because a shell mound already exists at the platform site, the residual impact due to an incremental increase in the size of the shell mound due to extension of life is not considered significant.

3.6.5 Comparison of Impacts Between Proposed Action and 1985 Point Pedernales EIS/EIR

Impact No.	Project Phase	Tranquillon Ridge Project Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
CRF/KH. 1	*Increased Throughput Extension of LIfe*	Oil spills may potentially impact commercial and recreational kelp harvests in the proposed project area.	Preemption of harvest in any of various productive fishing grounds by unlikely major oil spill.	
CRF/KH. 2	*Increased Throughput Extension of Life*	Oil spills may potentially impact commercial and recreational fishing in the proposed project area.	Preemption of harvest in any of various productive fishing grounds by unlikely major oil spill.	
CRF/KH. 3	*Drilling*	The discharge of drilling muds and drill cuttings from Platform Irene may potentially impact kelp communities in the project area.	Disruption of activity patterns of commercially valued species by offshore discharges.	
CRF/KH. 4	*Drilling Extension of Life*	Marine Vessel traffic to and from Platform Irene could cause loss or damage to commercial fishing gear in the project area.	Damage to fishing gear and/or vessels due to collision with and/or hangup on oil and gas pipelines or debris.	
CRF/KH. 5	*Drilling Extension of Life*	The deposition of shells, or shell mounds, could prevent commercial trawling activities beneath Platform Irene.	Damage to fishing gear and/or vessels due to collision with and/or hangup on oil and gas pipelines or debris.	

3.6.6 References

Brown, E.D., et al.. 1996. Injury to the early life history stages of Pacific herring in Prince William Sound after the *Exxon Valdez* oil spill. In: Rice, S.D., R.B. Spies, D.A. Wolfe, B.A. Wright (eds.). Proceedings of the *Exxon Valdez* oil spill symposium. Amer. Fish. Soc. Symposium 18, Bethesda, MD. Pp. 931.

California Department of Fish and Game (CDFG). 2000. Giant and bull kelp commercial and sport fishing regulations, 2000 final environmental document (draft). State clearinghouse no. 2000012089.

—. 2001. California's Living Marine Resources: A Status Report. December 593 pp

—. 2006a. Fish-catch data based on CDFG fish bulletins and commercial landing receipts for the ten-year period 1996-2005. Customized data files provided by CDFG, Marine Fisheries Statistical Unit, Los Alamitos, CA.

—. 2006b. Kelp harvest in metric tons for California beds, 1994-2005. Customized data files provided by CDFG, Marine Fisheries Statistical Unit, Los Alamitos, CA.

Central Coast RWQCB Basin Plan, September 8, 1994.

Coats, D.A., et al. 1999. Monitoring of biological recovery of Prince William Sound intertidal sites impacted by the Exxon Valdez oil spill. NOAA Tech. Memo. NOS OR&R 1. Seattle, WA.

County of Santa Barbara. 2001. Torch Point Pedernales project final development plan 94-DP-027, 1998-2000 condition effectiveness review, revised final analysis. Santa Barbara County, Planning and Development Department, Energy Division, Santa Barbara, CA.

County of Santa Barbara. (SBC). 2006. Draft Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

Cowen, R.K., C.R. Agegian and M.S. Foster. 1982. The maintenance of community structure in a central California giant kelp forest. *Journal of Exp. Mar. Bio. Ecol., v. 64*. Pp. 189-201.

Dawson, E.Y. 1966. Marine botany, an introduction. *Holt, Rinehart and Winston, Inc.*: NY. p. 371.

Dayton, P.K. 1985. Ecology of kelp communities. *Ann. Rev. Ecol. Systems, v. 16*. Pp. 215-245.

Dayton, P.K., V. Currie, T. Gerrodette, B.D. Keller, R. Rosenthal and D. Ven Tresca. 1984. Patch dynamics and stability of some California kelp communities. *Ecol. Monog., v. 54(3)*. Pp. 253-289.

Dean, T.A. and L.E. Deysher. 1983. The effects of suspended solids and thermal discharges on kelp. In: W. Bascom (ed.). The effects of waste disposal on kelp communities. Southern California Coastal Water Research Project. Long Beach, CA.

DeWit, L.A. 2001. Shell mounds environmental review, final technical report, vols 1 and 2. Prepared for California State Lands Commission and California Coastal Commission. Bid Log No. RFP99-05.

Druehl, L.D. 1970. The pattern of Laminariales distribution in the northeast Pacific. *Phycologia, v. 9(3/4)*. Pp. 237-247.

Dotson, R., and R. Charter. 2003. Trends in the southern California sport fishery. Calif. Coop. Oceanic Fish. Invest. Rep. 44:94-106

Fields, W.G. 1965. The structure, development, food relations, reproduction, and life history of the squid, *Loligo opalescens* Berry. CA Dept. Fish and Game, Fish Bull. 131. p. 108.

Foreman, R.E. 1970. Physiology, ecology, and development of the brown alga *Nereocystis luetkeana* (Mertens). Ph.D. Dissertation, Univ. of California, Berkeley. p. 114.

Foster, M.S., A.C. Charters, and M. Neushul. 1971a. The Santa Barbara oil spill. Part 1. Initial quantities and distribution of pollutant crude oil. *Environ. Poll., v. 2*. Pp.97-113.

Foster, M.S., M. Neushul, and R. Zingmark. 1971b. The Santa Barbara oil spill. Part 2. Initial effects on ontertidal and kelp bed organisms. *Environ. Poll., v. 2*. Pp. 115-134.

Foster, M.S. and D.R. Schiel. 1985. The ecology of giant kelp forests in California: a community profile. Biol. Report No. 85 (7.2). US Fish and Wildlife Service. p. 152.

Gerald, V.A. 1976. Some aspects of material dynamics and energy flow in a kelp forest in Monterey Bay, CA. Ph.D. Dissertation, Univ. of California, Santa Cruz. p. 179.

Gotshall, D.W., et al. 1986. Pre-operational baseline studies of selected nearshore marine biota at the Diablo Canyon power plant site: 1979-1982. California Depart. Of Fish and Game. Marine Resources Tech. Report No. 50. p. 370.

Graham, M.H. 1997. Factors determining the upper limit of giant kelp, *Macrocystis pyrifera* (Agardh), along the Monterey Peninsula, central California, USA. *Journal of Exp. Mar. Bio. Ecol., v. 218(1)*. Pp. 127-149.

Hawkes, M.W., C.E. Tanner and P.A. Lebednik. 1978. The benthic marine algae of northern British Columbia. *Syesis , v. 11*. Pp. 81-115.

Hayes, M.O. and J. Michel. 1998. Evaluation of the condition of Prince William sound shoreline following the Exxon Valdez oil spill and subsequent shoreline treatment, 1997 geomorphology monitoring survey. NOAA Tech. Memo. NOS ORCA 126. Seattle, WA.

Jackson, G.A. 1983. The physical and chemical environment of a kelp community. In: W. Bascom (ed.). The effects of waste disposal on kelp communities. Southern California Coastal Water Research Project, Long Beach, CA.

Kato, S. and C. Hardwick. 1975. The California squid fishery. In: Expert consultation on fishing for squid. FAO Fish. Rep. 170, supplement 1. Pp. 170-127.

Koehl, M.A.R. and S.A. Wainwright. 1977. Mechanical adaptations of a giant kelp. Limn. Ocean. 22(6). Pp. 1067-1071.

Love, M., M. Nishimoto, D. Schroeder, and J. Caselle. 1999. The ecological role of natural reefs and oil and gas production platforms on rocky reef fishes in southern California. OCS Study MMS 99-0015. Prepared for the US Geological Survey, Biological Resources Division.

McLean, J.G. 1962. Sublittoral ecology of kelp beds of the open coast area near Carmel, California. *Biol. Bulletin, v. 122(1)*. Pp. 95-132.

McPeak, R.H. and D.A. Glantz. 1984. Harvesting California's kelp forests. *Oceanus, v. 27(1)*. Pp. 19-26.

Mertz, R.C. 1959. Determination of the quantity of oily substances on beaches and in nearshore waters. California State Water Pollution Control Board, Sacramento. Pub. 21. p. 45.

Miller, K.A. and J.A. Estes. 1989. Western range extension for *Nereocystis luetkeana* in the north Pacific Ocean. *Bot. Marina, v. 32*. Pp. 535-538.

MMS. 2001. Delineation drilling activities in Federal Waters offshore Santa Barbara, CA, draft environmental impact statement. OCS EIS/EA MMS 2001-046. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

MMS. 2003. OCS Environmental Assessment (EA) Revisions to the Point Arguello Field Development and Production Plans to Include Development of the Eastern Half of Lease OCS-P 0451. Arguello Inc. June 19, 2003.

MMS. 2005a. Environmental Information Document for Post-Suspension Activities on the Nine Federal Undeveloped Units and Lease OCS-P 0409 Offshore Santa Barbara, Ventura, and San Luis Obispo Counties. Prepared for U.S. Department of Interior, Minerals Management Service, Pacific Outer Continental Shelf Region. Prepared by Aspen Environmental Group, January 2005.

MMS. 2005b. Environmental Assessment (Final) Minerals Management Service to Grant Suspensions of Production for Aera Energy LLC's, Lion Rock Unit, Purisima Point Unit, Point Sal Unit, and Santa Maria Unit. February 11, 2005. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

MMS. 2001. Multibeam Hydrographic Survey Around and Under Oil Platforms in The Santa Barbara Channel and Santa Maria Basin, California. Minerals Management Service, Pacific OCS Region, Camarillo, CA.

NMFS. 2006. Historic California Kelp Harvest: *Macrocystis pyrifera*. http://swr.nmfs.noaa.gov/fmd/bill/kelp.htm accessed on August 16, 2006.

Neushul, P. 1987. Energy from marine biomass: the historical record. In: K.T. Bird and P.H. Benson (eds.). Seaweed cultivation for renewable resources. Elsevier, NY. p. 37.

Nicholson, N.L. 1970. Field studies of the giant kelp *Nereocystis. J. Phycol., v. 6*. Pp. 177-182.

North, W.J. 1971. Introduction and background. In: W.J. North (ed.). The biology of giant kelp beds (*Macrocystis*) in California. Beih. Zur Nova Hedwigia. 32. J. Cramer. Lehre.

—. 1986. Biology of the *Macrocystis* resource in North America. Fisheries Tech. Papers No. 281. FAO, United Nations.

North, W.J., M. Neushul, and K.A. Clendenning. 1964. Successive biological changes observed in a marine cove exposed to a large spillage of mineral oil. In: Proc. Symposium on pollution of marine organisms. Prod. Petrol., Monaco. Pp. 335-354.

NRC (National Research Council). 1985. Oil in the sea. Inputs, fates, and effects. *National Academy Press*: Washington, DC. p. 601.

Scagel, R.F., D.J. Garbary, L. Golden and M.W. Hawkes. 1987. A synopsis of the benthic marine algae of British Columbia, Northern Washington and Southeast Alaska. Phycological contribution number 1, Depart. of Botany, Univ. of British Columbia, Vancouver, British Columbia, Canada. p. 444.

Scofield. W.L. 1959. History of kelp harvesting in California. CA Fish and Game 45(3). Pp. 135-157.

Seymore, R.J., M.J. Tegner, P.K. Dayton and P.E. Parnell. 1989. Storm wave induced mortality of giant kelp, *Macrocystis pyrifera*, in southern California. Estuarine, Coastal and Shelf Science 28(6). Pp. 277-292.

Spies, R.B. and P.H. Davis. 1979. The infaunal benthos of a natural oil seep in the Santa Barbara Channel. Mar. Biol. 50. Pp. 227-237.

Spies, R,B., S.D. Rice, D.A. Wolfe, B.A. Wright. 1996. The effects of the *Exxon Valdez* oil spill on the Alaskan coastal environment. In: Rice, S.D., R.B. Spies, D.A. Wolfe, B.A. Wright (eds.). Proceedings of the *Exxon Valdez* oil spill symposium. Amer. Fish. Soc. Symposium 18, Bethesda, MD. p. 931.

SWRCB. 2005. California Ocean Plan, Water Quality Control Plan, Ocean Waters of California. State Water Resources Control Board, California Environmental Protection Agency. Effective February 14, 2006.

Tarpley, J.A. and D.A. Glantz. 1992. Marine plant resources: giant kelp. In: W.S. Leet, C.M. DeWees and C.W. Haugen (eds.). California's living marine resources and their utilization. California Sea Grant Exten. Pub. UCSGEP-92-12.

Thompson, C.J. 1999. Economic and management implications of no-take reserves: an application to *Sebastes* rockfish in California. CalCOFI Rep. 40. Pp. 107-117.

Vadas, R.L. 1972. Ecological implications of culture studies on *Nereocystis luetkeana*. *J. Phycol., v. 8*. Pp. 196-203.

Vojkovich, M. 1998. The California fishery for market squid (*Loligo opalescens*). CalCOFI Rep. 38. Pp. 55-60.

3.7 Recreation and Tourism

This section describes recreation and tourism in the vicinity of the proposed project and the impacts of the proposed project. The analysis is based upon a review of local, regional, and federal resource statistics and recreation maps, as well as discussions with appropriate agencies.

3.7.1 Affected Environment

California ranks first in the nation for the total number of residents that participate in marine recreation annually (12.2 percent); estimated beach visitation rates throughout the State, for local residents and regional and out-of-State visitors, range from 150 million to more than 378 million annually (National Oceanic and Atmospheric Administration [NOAA], 2006). In 2000, it was estimated that at a State level 61, 18, 11 and 10 percent of all beach visits within the State were for the purposes of beach-related marine activities, recreational boating, recreational fishing, and "other" activities, respectively (Kildow and Colgran, 2005). Within the category of beach-related marine activities, 51.4, 32.1, 7.7, and 7.0, 1.3, and 0.5 percents were attributed to beach visits, swimming, surfing, waterside visits (besides beach visits), snorkeling, and diving, respectively (Kildow and Colgran, 2005). Within the categories of recreational boating and fishing, the estimated proportion of marine-oriented activity days for 2000 was as follows: recreational fishing – 49 percent; motor boating – 28 percent; sailing – 16 percent; and, personal watercraft – 7 percent (Kildow and Colgran, 2005).

Western Santa Barbara and San Luis Obispo Counties contain a varied and scenic physical environment, ranging from coastal bluffs, sand dunes, and beaches, to inland mountains and forests. The coastal area offers broad, sweeping vistas of the coastal range and Pacific Ocean and, between Santa Barbara and Point Conception, views of the Channel Islands. The coastal area is largely undeveloped in Santa Barbara County and built up in and around Pismo Beach, and the region contains several existing oil processing and missile launch facilities interspersed with coastal parks and agriculture.

Outdoor recreation resources include state, county, and locally managed public and private parks, reserves, golf courses, and recreational clubs along shoreline and inland areas. Recreational activities include boating, diving, surfing, swimming, sunbathing, nature observation, hiking, camping, biking, and off-road vehicle use. (Recreational fishing is discussed in Section 3.6, Commercial and Recreational Fishing/Kelp Harvesting.) Given fine weather and proximity to mountains and beaches, residents and visitors enjoy year-round participation in these activities.

Along the coast, popular recreational pursuits include surfing, diving, swimming, hiking, and boating. The central coast of California is one of the most popular surfing areas in the world. California is home to approximately 45% of the nation's 1.6 million surfers (NOAA 2001). Popular surfing locations west of Gaviota include the Hollister Ranch shoreline, which is generally limited to boat access, Jalama Beach and Pismo Beach in San Luis Obispo County. Diving is popular all along the coastal kelp beds and reefs in depths of 60 feet or less. Access to diving areas west of Gaviota and north to Point Sal is by boat only, but shore entry is possible at any of the beach or park locations. Boats can be launched from the Channel Islands, Ventura and

Santa Barbara Harbors, Goleta and Gaviota Piers, and at Port San Luis Obispo. Sites for State Marine Reserves and a park have been proposed near San Miguel, Santa Rosa, and Santa Cruz islands. While no records exist of diving participation in the region, NOAA reports an estimated 32,000 divers in California, and 525 PADI Dive Operators (dive centers or resorts) (2000).

Visitation to the Channel Islands for hiking, camping, swimming, and kayaking is estimated at 30,000 visitors per year and 60,000 in the waters surrounding the islands for whale watching, diving, and pleasure boating (NPS 2001). The City of Santa Barbara Harbor Department estimates the daily pleasure boating usage in the Channel at hundreds of vessels per day during the boating season (March 1 through December 1) and over a thousand vessels on peak days (2001). Whale watching in the Santa Barbara Channel is another recreational resource with 8,266 person-days measured in 1999, while kayaking and sightseeing measured 1,168 person-days (NOAA 2001).

Skin and SCUBA diving take place from the shoreline, private boats, and party boats. Boats may be launched at any of the ports and harbors or at Gaviota Pier, and smaller boats are also launched from the shore. Most diving occurs in kelp beds or rocky reef areas to depths of 60 feet. In 1999, a total of 3,171 party boat diving person-days, 7,935 private boat diving person-days, and 4,498 non-consumptive diving person-days were recorded from party boats operating in SBC. Most of the dive trips were to Anacapa Island and Santa Cruz Island (Arthur D. Little 1985).

Jalama Beach lies north of Point Conception on 23.5 acres of coast and is a popular location for camping, surfing, and nature observation. Jalama Beach Park includes barbeque grills, benches and picnic tables, bike trails, bird watching, boating, fishing, horseshoe pits, a playground, concessionary stand, restaurants, surfing, swimming, and 98 sites for tent and recreational vehicle camping; there is a $6.00 fee for day use of the facility (SBC, 2006a). For the calendar year 2005, approximately 76,000 vehicles entered Jalama Beach Park (Stone, 2006). The County’s standard for estimating the number of visitors at County-operated beaches and parks is 22.5 visitors per vehicle; consequently, the total number of people that visited Jalama Beach Park in the year 2005 is estimated to be 190,000. Peak attendance occurs during the summer months and declines during the winter months.

Surf Beach lies west of Lompoc on VAFB property. Parking facilities were developed to serve the Amtrak station, but the site is also used for coastal access. Ocean Beach County Park is located west of Lompoc on 36 acres adjacent to the coast. The park provides safe coastal access with a wheelchair accessible ramp that passes under a train trestle. The park contains a sand dune/wetland environment with the Santa Ynez River mouth as a northern boundary. The park has restrooms, picnic tables, one chemical toilet, and several fire pits. This normally windy and isolated area is used mostly by fishermen, windsurfers, and family picnickers. With peak attendance during summer months and lowest attendance in winter months, average attendance per day is 330 people, based on 4,000 monthly vehicle trips and 2.5 visitors per vehicle (SBC Parks Department 2006).

Beginning in the summer of 2000, access to Ocean Beach County Park and Surf Beach was restricted by VAFB as a result of USFWS’s order to protect an endangered shorebird, the snowy plover, during its nesting season. The complete or partial closure of the beaches occurred again in 2001 and will occur each year for the foreseeable future.

Rancho Guadalupe Dunes County Park, located south of the boundary between Santa Barbara and San Luis Obispo Counties, provides beach access, bike and equestrian trails, fishing, bird watching and hiking. There is no fee for day use of the park (SBC, 2006a).

Nipomo Dunes Complex, which partially overlaps Pismo State Beach, is the largest coastal dune ecosystem in western North America and extends 10 miles from the Callender Dunes in the north to the Mussel Rock Dunes in the south and comprises approximately 12,000 acres. The Nipomo Dunes Complex contains one of the most unique and fragile ecosystems in the state and is a heavily utilized recreational resource, owing primarily to the off-road vehicle use described above.

Pismo State Beach stretches 23 miles along the coast in San Luis Obispo County. Recreation activities include camping, hiking, swimming, surfing, bicycling, horseback riding, bird watching, and observation of the annual winter migration of millions of monarch butterflies (the park has the largest over-wintering colony in the U.S.). It also features an eight-mile section on which cars and off-road vehicles are permitted. Cars and RVs are permitted on the northern section of the State beach while off-road vehicles use the southern dunes area (SVRA). Camping is permitted in parts of the dunes area. The gates for vehicle access to the beach are found in the communities of Grover Beach and Oceano. Annual visitation rates of Pismo State Beach and the SVRA have been steadily rising in the past three to four years; in 2005 an estimated 2.6 million visitors accessed the area, with 2.1 million people using the SVRA and .5 million people using the Pismo State Beach facilities (Bellman, 2006).

Avila Beach and Port San Luis are located three miles north of Pismo beach on a south-facing coastline of hills, cliffs, and sandy beaches. Recreational activities include kayaking, boating, swimming, surfing, and nature observation. From 1998 to 2000, visitor numbers were lower than normal due to an oil spill remediation project that closed the main beach and much of the town, (Arthur D. Little, et. al., 2002). However, since completion of remedial activities, recreational uses of, and annual visitor numbers at, these areas has increased substantially, including the main beach and Avila Pier, as well as a new two-acre beach-front park and a new plaza area managed by the San Luis Obispo County Parks Department (Jenny, 2006; Ziehn,2006).

Montana de Oro State Park lies six miles southwest of Morro Bay and covers approximately 8,000 acres of cliffs, sandy beaches, coastal plains, streams, and hills. Recreational activities include mountain biking, equestrian, surfing, camping, and nature observation.

The sole inland recreation resource adjacent to the project area is the Burton Mesa Ecological Reserve, a CDFG-managed parcel adjacent to the LOGP and surrounding three sides of Vandenberg Village. It covers approximately 5,000 acres of sensitive ecological habitat and provides passive recreational opportunities such as walking, hiking, naturalist activities such as bird watching, and bicycling (SBCRMD 1994).

The natural beauty and recreational amenities of the region support a strong tourism industry in Santa Barbara and San Luis Obispo Counties. Tourism is not a standard category in which economic data are collected. Tourism activities generally affect several service sectors through expenditures such as lodging, dining, and special activities. Tourism also generates transportation activity and increases in retail sales. In all these areas there is local demand as well as tourist demand. Tourism is typically defined as any non-routine visit to an area. This definition encompasses business and personal travel in addition to the leisure travel most typically associated with tourism. In the absence of a discrete measure of tourism activity, a number of indicators may be used to estimate the activity (MMS 2001).

Studies to estimate economic activity associated with tourism in Santa Barbara and San Luis Obispo Counties have been conducted by Dean Runyan Associates (2005). Total travel spending in Santa Barbara County was $1.22 billion in 2003, a three percent increase from 2002. Local tax receipts associated with tourism for 2003 were $36.4 million, an 8 percent increase from 2002. In San Luis Obispo County, total travel spending was $926 million in 2003, a three percent increase from 2002. Local tax receipts associated with tourism in 2003 were $22 million, almost one percent less than 2002 (Dean Runyan Associates 2005).

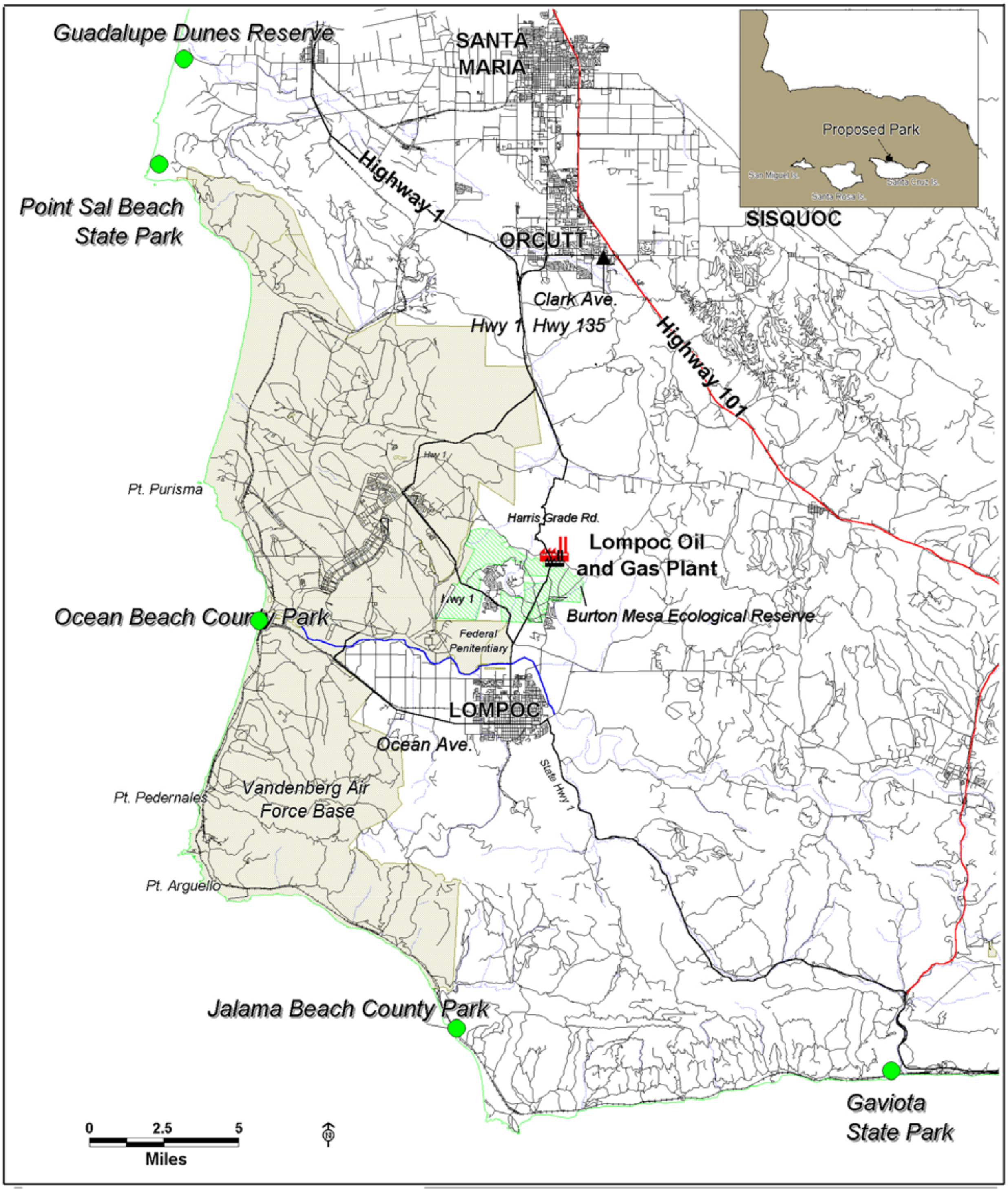
Current Point Pedernales Facility Operations

The project site is located in northwestern Santa Barbara County. The pipelines and power cables come ashore from Platform Irene north of the Santa Ynez River near Ocean Beach County Park. This park is located on the beach at the end of State Highway 246. From its landfall north of the Santa Ynez River, the pipeline traverses largely undeveloped land owned by VAFB. The pipeline crosses the Burton Mesa Ecological Reserve, which is managed by CDFG, before reaching the LOGP.

Current drilling and production operations could cause a blowout or other accident, resulting in an offshore oil spill with the potential for temporarily interfering with recreational use of marine and shoreline recreational resources and facilities. (The Applicant is currently making payments to the Coastal Resource Enhancement Fund to offset its contribution to cumulative recreation impacts.) While Ocean Beach Park is the nearest onshore recreational area, Gaviota State Park and Jalama Beach County Park to the south and Point Sal State Beach and the Guadalupe Dunes Reserve to the north could also be adversely affected by an oil spill (see Figure 3.7-1). San Miguel, Santa Rosa, and Santa Cruz Islands and the CINMS could also be affected by an oil spill. The extent of a spill's impacts would depend on the volume of spill, its origin and trajectory, and the effectiveness of containment and offshore cleanup activities.

Aquatic recreation activities such as surfing, scuba diving, swimming, and boating as well as shoreline recreation activities (both passive and active) could be adversely impacted for an extended period of time in the event of an oil spill from current operations. During the 1997 spill, for example, Surf Beach was used as a spill response staging area, and both Surf Beach and Ocean Beach County Park were closed to the public. The impacts to diving in the project area could be similarly restrictive, but the coastline north of Point Conception is infrequently used for diving due to limited access and unfavorable diving conditions. San Miguel Island also features some popular diving spots that are sometimes inaccessible due to ocean conditions but could be affected by a spill.

Figure 3.7-1 Coastal Beaches and Parks



Source: SBC 2002.

In addition to directly affecting on- and offshore recreational resources, a spill would require a cleanup work force whose temporary housing and the use of some public and private campground space could create a temporary adverse impact to recreational facilities.

An onshore oil spill from pipelines might arise from accidental events such as pipeline leaks and ruptures. A pipeline spill from current operations could adversely affect Ocean Beach Park because of its proximity to the pipeline's landfall or because it lies downstream from the potential spill zone. A pipeline spill from onshore operations could also adversely affect the Burton Mesa Ecological Reserve near LOGP. There are no attendance data available for the Reserve, but proposed recreational improvements, which include parks, campsites, sports fields, and BBQ pits, would greatly increase the number of recreational users. In general, onshore spills are more easily controlled than offshore spills, which are dispersed through wave action and ocean water currents, so the impacts to recreational activities in the Reserve would be short-term.

3.7.2 Regulatory Setting

The Federal Coastal Zone Management Act of 1972, as administered by the State of California, applies to this project. The California Coastal Act (California Public Resources Code sections 30000 et seq.) was enacted by the State Legislature in 1976 to provide long-term protection of California's 1,100-mile coastline for the benefit of current and future generations. Section 30001.5 states that the goals are to:

(a) Protect, maintain, and where feasible, enhance and restore the overall quality of the coastal zone environment and its natural and artificial resources;

(b) Assure orderly, balanced utilization and conservation of coastal zone resources, taking into account the social and economic needs of the people of the state;

(c) Maximize public access to and along the coast and maximize public recreational opportunities in the coastal zone consistent with sound resources conservation principles and constitutionally protected rights of private property owners;

(d) Assure priority for coastal-dependent and coastal-related development over other development on the coast; and

(e) Encourage state and local initiatives and cooperation in preparing procedures to implement coordinated planning and development for mutually beneficial uses, including educational uses, in the coastal zone.

The following California Coastal Act policies address recreation and apply to this project:

- 30211. Development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization, including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation;
- 30220. Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses;
- 30221. Oceanfront land suitable for recreational use shall be protected for recreational use and development unless present and foreseeable future demand for public or commercial

recreational activities that could be accommodated on the property is already adequately provided for in the area; and

- 30260. Coastal-dependent industrial facilities shall be encouraged to locate or expand within existing sites and shall be permitted reasonable long-term growth where consistent with this division. However, where new or expanded coastal-dependent industrial facilities cannot feasibly be accommodated consistent with other policies of this division, they may nonetheless be permitted in accordance with this section and Sections 30261 and 30262 if (1) alternative locations are infeasible or more environmentally damaging; (2) to do otherwise would adversely affect the public welfare; and (3) adverse environmental effects are mitigated to the maximum extent feasible.

Other relevant Coastal Act policies are addressed in the appropriate issue area within this section of the Environmental Evaluation. In addition a full analysis of the project's consistency with the California Coastal Act has been provided in the Supporting Information Volume, Coastal Zone Consistency Analysis and Findings.

3.7.3 Significance Criteria

Impacts would be considered significant if they resulted in loss or degradation of recreational value of a recreational use (including public perception of degradation).

3.7.4 Impact Discussion

The following sections discuss potential impacts to recreation and tourism, mitigation measures (where appropriate), and residual impacts associated with the proposed project. Because the proposed project would largely use existing facilities (e.g., LOGP and pipelines), requirements for new facilities or equipment with potentials for impacting recreational activities are minimal. Impacts from the existing Point Pedernales facilities and operations are discussed in the Point Pedernales EIR/EIS, 1985 (Arthur D. Little). The impacts associated with the proposed project are related to changes in the present facilities or operating conditions, and are described below.

Impacts could come from construction, normal operations, abandonment, accidents, and/or catastrophic events. Onshore construction and modification activities along the pipeline route and at the processing facilities are not expected to adversely affect recreation resources. Offshore noise may irritate boaters who approach Platform Irene (see discussion in Section 3.11, Noise) but would not result in any loss to recreational resources or the tourism industry.

To offset impacts to recreation resources in the project area, the Applicant is already contributing annually to the Coastal Resource Enhancement Fund. Condition N-1 of the Pt. Pedernales Final Development Plan requires annual contributions for the life of the project, which would be extended under the proposed project.

Impact #	Impact Description	Project Phase
Rec.1	The proposed project would increase the likelihood and volume of an oil spill, which could result in public access restrictions to coastal and inland recreational resources.	Increased Throughput Extension of Life

The increased throughput between Platform Irene and the LOGP and the extension of life of the facilities and pipelines increases the probability and volume of an oil spill. An offshore spill caused by an accident or failure at Platform Irene or in the offshore pipeline could lead to beach closures and boating restrictions during spill response and cleanup and a lingering public perception that recreation resources are polluted, even after the cleanup period. The recreation resources within the project area are shown in Figure 3.7-1.

The duration and extent of beach closures would depend on the volume of the spill and prevailing ocean and local weather conditions. A worst-case scenario oil spill could reach recreational resources as far north as Montana de Oro State Park near Morro Bay and as far south as the Santa Barbara Channel Islands (see Section 3.2, Oil Spill Analysis). The coastline east of Point Conception, including Gaviota and Refugio State Beaches would likely avoid direct spill impacts. The area from Point Sal to Point Arguello is at greatest risk from a spill due to its proximity to the Point Pedernales facilities; therefore Ocean Beach County Park, Point Sal Beach State Park, and Jalama Beach County Park would be impacted more than other recreation areas, with as much as 7,900 barrels of oil reaching the beaches if there were a pipeline failure of the oil emulsion pipeline.

An onshore spill near the pipeline landfall could pose a similarly adverse effect on the recreational utilization of Ocean Beach Park. As detailed in Section 3.2, Oil Spill Analysis, the worst-case scenario for a spill near the beach is in excess of 7,900 barrels of crude oil emulsion. An onshore spill further inland could adversely affect recreational resources such as the Burton Mesa Ecological Reserve, the Santa Ynez River, and Ocean Beach Park (via a spill into the river). Section 3.2, Oil Spill Analysis, contains estimated probabilities of spill landfall for a variety of spill locations. An oil spill would likely degrade the environment and create a safety concern at a number of recreational areas. In addition, oil spill response could also affect recreational resources. During the 1997 spill, Surf Beach was used as a spill response staging area, and both Surf Beach and Ocean Beach County Park were closed to the public.

Compared with the baseline likelihood of an oil spill, the impact of the proposed project would increase the impact slightly due to the increased oil throughput through the pipeline and potentially increased spill size. Restricted access to Ocean Beach County Park and Surf Beach could be moot, however, if the beach is already closed to the public as a result of protections for the nesting snowy plovers.

Mitigation Measures

See Mitigation Measures MWQ-1, MWQ-2, MWQ-3; MB-2; and CRF/KH-1 in Sections 3.4, Water Quality; 3.5, Biological Resources; and 3.6, Commercial and Recreational Fishing/Kelp Harvesting, respectively.

3.7.5 Comparison of Impacts Between Proposed Project and 1985 Point Pedernales EIS/EIR

Impact No.	Project Phase	Tranquillon Ridge Project Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
Rec.1	Increased Throughput, Extension of Life,	The proposed project would increase the likelihood and volume of an oil spill, which could result in public access restrictions to coastal and inland recreational resources.	Potential disruption of recreational experience due to offshore and onshore oil spills.	Only class III impacts were included in the 1985 EIR under the Other Uses: Recreation and Tourism. Socioeconomic lists “Inconsistency of industrial oil development along the South Coast, Santa Barbara County, with existing local Coastal Land Use Plan and Comprehensive Plan”. (class I) Marine Biology lists” Mortality and disturbance of seabirds and/or marine mammals due to unlikely major oil spill and cleanup activities. Damage to subtidal ecology due to major oil spill”. (class I)

3.7.6 References

Arthur D. Little. 1985. Union Oil Project/Exxon Project Shamrock and Central Santa Maria Basin Area Study: Final Environmental Impact Statement/Environmental Impact Report. Prepared for County of Santa Barbara, U.S. mineral Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development.

___. 1997. Guadalupe Oil Field Remediation and Abandonment Project. Final Environmental Impact Report. Prepared for the County of San Luis Obispo Department of Planning and Building.

California State Parks. January 14, 2002. Personal communication with Andy Zilke.

Dean Runyan Associates. 2005. California Travel Impacts by County, 1992-2003, 2004 Preliminary State Estimates. Prepared for the California Travel and Tourism Commission, Division of Tourism. March.

Minerals Management Service (MMS). 2001. Delineation Drilling Activities in Federal Waters Offshore Santa Barbara County, California. Draft Environmental Impact Statement. U.S. Department of the Interior, Minerals Management Service, Pacific Outer Continental Shelf Region, OCS EIS/EA MMS 2001-046.

National Oceanic and Atmospheric Administration. 2000. Working Draft of Environmental Impact Statement for Channel Islands National Marine Sanctuary.

___. 2001. Channel Islands National Marine Sanctuary Management Plan Revision, Marine Reserves Working Group Socioeconomic Panel. Data Distribution and Exclusion Zones Commercial Fishing and Recreation. Prepared by Dr. Vernon R. Leeworthy and Peter C. Wiley.

National Park Service. November 5, 2001. Channel Islands Nat. Park. http://www.nps.gov/chis/homepage.htm

Santa Barbara City, Waterfront Department. November 2, 2001. Personal communication with Mick Kronman.

Santa Barbara County (SBC). 2002. Tranquillon Ridge Oil and Gas Development Project, LOGP Produced Water Treatment System Project, and Sisquoc Pipeline Bi-Directional Flow Project. Final Environmental Impact Report. Appendix I. EIR # 01-EIR-04, SCH # 2000071130. June.

Santa Barbara County, Parks Department. January 16, 2001. Personal communication with Jeff Stone.

Santa Barbara County, Planning Department, Energy Division. 2000. North County Siting Study.

Santa Barbara County, Resource Management Department. January 1994. Burton Mesa Management Plan. Prepared for California State Lands Commission.

—. 1982. Santa Barbara County Comprehensive Plan: Land Use Element, Circulation Element, and Environmental Resource Management Element. Adopted December 1980 and revised August 1982 to include text amendments through October 1992.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the TranquillonRidge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

U.S. Departments of Interior and Commerce. 1997. 1996 National Survey of Fishing, Hunting, and Wildlife-related Recreation.

3.8 Traffic

This section describes both the onshore and offshore transportation systems in the vicinity of the proposed project and the impacts of the proposed project. The analysis in this section is based on field surveys, a review of local and regional maps, and discussions with appropriate agencies.

3.8.1 Environmental Setting

This section is divided into two parts. The first part covers onshore traffic and the second offshore traffic.

3.8.1.1 Onshore Traffic

This section provides a discussion of the onshore traffic baseline in the vicinity of the proposed project.

Roadway and Intersection Classification
Circulation conditions are often described in terms of levels of service (LOS). LOS is a means of describing the amount of traffic on a roadway versus the design capacity of the roadways. The design capacity of a roadway is defined as the maximum rate of vehicle travel that can reasonably be expected along a section of roadway. Capacity is dependent on a number of variables including road classification and number of lanes, weather, and driver characteristics. The LOS rating uses qualitative measures that characterize operational conditions within a traffic stream and their perception by motorists. These measures include freedom of movement, speed and travel time, traffic interruptions, types of vehicle, comfort, and convenience. Ideal conditions for a roadway would include good lane widths and roadside clearances, the absence of trucks or other heavy vehicles, and level terrain. LOS is generally a function of the ratio of traffic volume (V) to the capacity (C) of the roadway or intersection, which provides the V/C ratio.

Trucks impact LOS by occupying more roadway space and by having poorer operating qualities than passenger cars. Because heavy vehicles accelerate more slowly than passenger cars, gaps form in traffic flow that affects the efficiency of the roadway. Also, intersections present a number of variables that can influence LOS including curb parking, transit buses, turn lanes, signal spacing, pedestrians, and signal timing.

The Transportation Research Board (TRB) has developed the Highway Capacity Manual (HCM) that details the procedures to be used in predicting LOS for a range of roadways and intersections. The LOS of a roadway is defined by levels ranging from A to F. The highest quality of traffic service occurs on roadways when motorists are able to drive their desired speed without strict enforcement and are not delayed by slow-moving vehicles more than 30% of the time. This condition is representative of LOS A. The classifications of LOS B and C are characterized when average drivers are delayed up to 45 and 60% of the time, respectively, by slow moving vehicles. LOS D is characterized by 31 to 70% of the signal cycles having one or more vehicles that wait through at least one signal cycle. Level E is normally associated with the maximum design capacity that a roadway can accommodate. When an area drops to LOS E, the speed of traffic is restricted 71 to 100% of the time; and intersection signal cycles have one or more vehicles waiting through more than one signal cycle during peak traffic periods. The LOS of A, B, and C are generally considered satisfactory.

Santa Barbara County P&D uses the County's thresholds for V/C ratios to calculate LOS. As discussed above, LOS is determined not only by traffic volumes, but also by a number of roadway conditions and intersection details. Determining a roadway's potential to present a traffic flow problem is a time-consuming process; therefore, a screening approach is often recommended. The screening approach involves comparing the roadway class with a traffic volume level for each level of service. The screening levels are developed by making generic assumptions for the data input in the Highway Capacity Manual calculations. Table 3.8.1 shows the screening volume levels that are proposed for this study. Note that the screening tool is for roadways and not for intersections.

Table 3.8.1 LOS Screening Classifications, Roadway Daily Volumes

Roadway Class	LOS (high values)				
	A	B	C	D	E
Arterial - 4 Lanes	23,900	27,900	31,900	35,900	39,900
Arterial - 2 Lanes	12,000	14,000	16,000	18,000	20.000
Major - 4 Lanes	19,200	22,300	25,500	28,700	31,900
Major - 2 Lanes	9,600	11,200	12,800	14,400	16,000
Collector	7,100	8,200	9,400	10,600	11,800

Source: Based on SBC Public Works Department Roadway Design Capacities.

In addition, LOS values are often developed by the respective county engineering and public works departments to address future land use and impacts on requirements of future roadway projects. These analyses are normally conducted as part of a community plan and are available for only limited locations in the proposed project area. They generally utilize the detailed approach given in the HCM and include both roadways and intersections.

Existing Conditions

Routes that could be affected by the proposed project include major routes to and from the pipeline route areas and major roads accessing the LOGP. Major roads that then connect these areas to Highway 101 for north or south travel are also included. These routes are shown on Appendices A and B and include the following:

- *State Highway 1* can be used for travel to Highway 101 North in the City of Orcutt or for travel south at Las Cruces (near Gaviota). Highway 1 also passes directly through the middle of the City of Lompoc along East Ocean Avenue and north along North H Street. It is a four-lane road from southern Lompoc north until Orcutt. It is a two-lane road south of Lompoc until Highway 101;
- *State Highway 246*, also called West Ocean Avenue, can be used to access the western part of the pipeline route via VAFB, south entrance at 13th Street. Highway 246 is a two-lane road from Highway 1 west to Ocean Beach Park on the coast;
- *Harris Grade Road* passes directly in front of the LOGP. From the plant, travel north on Harris Grade Road connects to Highway 135. Traveling south connects to Highway 1 just north of the City of Lompoc and Highway 1 Santa Ynez River crossing. This is a two-lane road;

- *State Highway 135* travels east from Harris Grade Road to connect with Highway 101 at Los Alamos. Westward travel on Highway 135 from Harris Grade Road joins with Highway 1 north of VAFB. Highway 135 continues south of the City of Orcutt where it branches off from Highway 1 in an east and then northerly direction. Here it connects with Clark Avenue where the route can continue to Highway 101. This is a two-lane road; and
- *Clark Avenue* is an east/west road that connects Highway 1 and Highway 135 with Highway 101 passing through the southern part of the community of Orcutt. This is a four-lane road except for the western segments, which have two lanes.

The road network in the project area is depicted in Figure 3.8-1. Existing traffic circulation and roadway operating conditions for the proposed project area were compiled for the roadways and intersections along the transportation routes in the vicinity of the project. Average daily traffic (ADT) rates and peak hour traffic flow measurements were used to classify the road segments according to the LOS shown in Table 3.8.1. The LOS provides an indication of the extent to which the roads are currently congested. Information was obtained for the State highways (Highways 1, 135 and 246) from CalTrans, and for major roads and arterial roads from the SBC Public Works Department. For areas where peak hour traffic was not available, it was assumed to be 10% of ADT. Table 3.8.2 lists the segments of each route, along with the corresponding traffic volumes, LOS classification, and volume to capacity ratios.

All routes that could reasonably be affected by the proposed project show acceptable LOS levels. The most congested area is along Highway 1 through the City of Lompoc (East Ocean Avenue and North H Street). The segment at the Santa Ynez River shows the most congested area with an LOS B level and a V/C ratio of 0.63. These are based on 2005 CalTrans traffic counts.

Roadways within VAFB are under the control of the military. Traffic counts are not available for these facilities. Coast Road south of Bear Creek Road is a main thoroughfare and critical infrastructure for Base operations.

Future Conditions

Future conditions of the roadways are important in understanding the potential impacts of a proposed project. Most of the routes examined in this document are CalTrans governed and maintained roadways. Traffic data from CalTrans is available for the past 5 years. The past growth rate of a maximum of 1.8 % per year was extrapolated to estimate future traffic conditions. It was considered that traffic volumes would grow in the area at the same rate as population over the next ten years (or an annual growth rate of approximately 0.9 % to 2016. Table 3.8.3 lists the projected future traffic conditions and LOS for the proposed project area in the year 2016.

Growth rates of traffic range are estimated to be from a low of approximately 2% annually to a high of close to 7% annually. Future development and growth in the area over the next 10 years is estimated to produce LOS ratings of worse than LOS C for Highway 1 through the City of Lompoc. The areas immediately around the Santa Ynez Bridge and the Casmalia Road would produce LOS levels of LOS C with V/C ratios as high as 0.76. It is estimated that Highway 135 near Clark Avenue could also produce a LOS C level with a V/C ratio of 0.71.

Figure 3.8-1 Transportation Routes in the Project Area

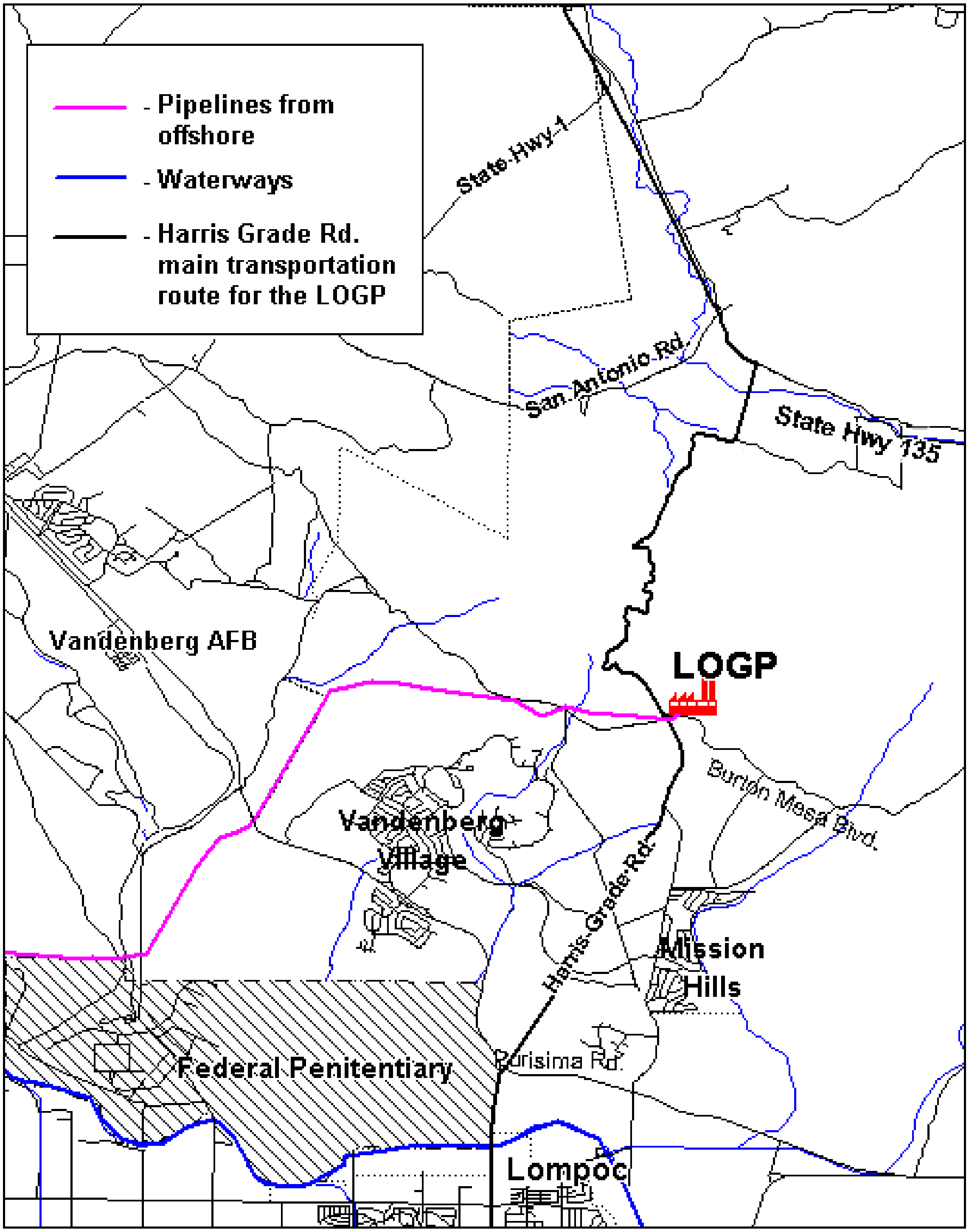


Table 3.8.2 Traffic Conditions Along Project Related Routes

Road/ Route	Class	ADT	ADT LOS	Peak Hr	Design Cap	V/C Ratio	Ref.
State Highway 1 from Gaviota to Black Rd.							
Las Cruces, Jct. Rte. 101	Major - 2 Lanes	7,700	A	850	16,000	0.48	1
Jalama Road	Major - 2 Lanes	7,900	A	930	16,000	0.49	1
Lompoc, South Jct. Rte. 246	Major - 4 Lanes	16,300	A	1,700	31,900	0.51	1
Lompoc, North Jct. Rte. 246	Major - 4 Lanes	16,000	A	1,300	31,900	0.50	1
Lompoc, Santa Ynez River Bridge	Major - 4 Lanes	20,000	B	1,600	31,900	0.63	1
Lompoc-Casmalia Road	Major - 4 Lanes	20,000	B	1,700	31,900	0.63	1
Pine Canyon Road	Major - 4 Lanes	16,100	A	1,400	31,900	0.50	1
Vandenberg Air Force Base, main gate	Major - 4 Lanes	15,200	A	1,600	31,900	0.48	1
South Jct. Rte. 135; Vandenberg, North	Major - 4 Lanes	16,200	A	1,550	31,900	0.51	1
Orcutt, Jct. Rte. 135 North	Major - 4 Lanes	2,400	A	300	31,900	0.08	1
Clark Avenue	Major - 4 Lanes	3,800	A	450	31,900	0.12	1
State Hwy 246 (Ocean Ave) from Hwy 1 West to Surf							
Lompoc west of City Limits	Major - 2 Lanes	6,200	A	900	16,000	0.35	1
W. Ocean Ave.: E of Floradale	Major- 2 Lanes	5,375	A	538	16,000	0.34	2
W. Ocean Ave.: E of Arguello	Major – 2 Lanes	2,718	A	272	16,000	0.17	2
Harris Grade Road from Hwy 1 to State Hwy 135							
North of State Hwy 1	Major - 2 Lanes	8,223	A	822	16,000	0.51	2
N of Rucker Road	Major - 2 Lanes	1,663	A	166	16,000	0.10	2
State Hwy 135 East from Harris Grade Road to Hwy 101							
Los Alamos, Jct. Rte. 101	Major - 2 Lanes	5,500	A	490	16,000	0.34	1
Old State Highway	Major - 2 Lanes	3,200	A	310	16,000	0.20	1
Old Route 1/Cabrillo Highway	Major - 2 Lanes	2,700	A	290	16,000	0.17	1
State Hwy 135 West from Harris Grade Road to Hwy 1							
San Antonio Road	Major - 2 Lanes	2,700	A	290	16,000	0.17	1
South Jct. Rte. 1	Major - 2 Lanes	2,700	A	270	16,000	0.17	1
State Hwy 135 from Highway 1 to Clark Avenue							
Orcutt, North Jct. Rte. 1	Major - 4 Lanes	14,800	A	1,400	31,900	0.46	1
East Clark Avenue	Major - 4 Lanes	19,000	A	2,150	31,900	0.60	1
Clark Avenue in Orcutt from Hwy 1 to Hwy 101							
Clark Avenue: W of Blosser	Major - 2 Lanes	2,459	A	246	16,000	0.15	2
Clark Avenue: W of 101	Major - 4 Lanes	18,207	A	1,821	31,900	0.57	2

References: 1 = Caltrans, 2005; 2 = Santa Barbara Public Works Traffic Volumes, 2006;
V/C = the volume to capacity ratio, capacity is based on roadway class with LOS of E.
ADT = Average Daily Traffic
Harris Grade Road peak hour based on 10% of AADT

Table 3.8.3 Area Routes and Future LOS Classifications – 10 year projection

Road/ Route	No. of Lanes*	ADT	Future ADT	ADT LOS	V/C Ratio	Ref.
State Highway 1 from Gaviota to Black Rd.						
Las Cruces, Jct. Rte. 101	2	7,700	9,204	A	0.58	1
Jalama Road	2	7,900	9,443	A	0.59	1
Lompoc, South Jct. Rte. 246	4	16,300	19,483	B	0.61	1
Lompoc, North Jct. Rte. 246	4	16,000	19,125	A	0.60	1
Santa Ynez River Bridge	4	20,000	23,906	**C**	0.75	1
Lompoc-Casmalia Road	4	20,000	23,906	**C**	0.75	1
Pine Canyon Road	4	16,100	19,244	B	0.60	1
VAFB, main gate	4	15,200	18,169	A	0.57	1
South Jct. Rte. 135; Vandenberg, North	4	16,200	19,364	B	0.61	1
Orcutt, Jct. Rte. 135 North	4	2,400	2,869	A	0.09	1
Clark Avenue	4	3,800	4,542	A	0.14	1
State Hwy 246 (Ocean Ave) from Hwy 1 West to Surf						
Lompoc west of City Limits	2	6,200	7,411	A	0.46	1
W. Ocean Ave:E of Floradale	2	5,375	6,425	A	0.40	2
W Ocean Ave:E of Arguello	2	2,718	3,249	A	0.20	2
Harris Grade Road from Hwy 1 to State Hwy 135						
North of State Hwy 1	2	8,223	12,056	C	0.75	2
N of Rucker Road	2	1,663	2,438	A	0.15	2
State Hwy 135 East from Harris Grade Rd to Hwy 101						
Los Alamos, Jct. Rte. 101	2	5,500	6,574	A	0.41	1
Old State Highway	2	3,200	3,825	A	0.24	1
Old Route 1/Cabrillo Highway	2	2,700	3,227	A	0.20	1
State Hwy 135 West from Harris Grade Rd to Hwy 1						
San Antonio Road	2	2,700	3,227	A	0.20	1
South Jct. Rte. 1	2	2,700	3,227	A	0.20	1
State Hwy 135 from Highway 1 to Clark Avenue						
Orcutt, North Jct. Rte. 1	4	14,800	17,690	A	0.55	1
East Clark Avenue	4	19,000	22,711	**C**	0.71	1
Clark Avenue in Orcutt from Hwy 1 to Hwy 101						
Clark Avenue: W of Blosser	2	2,459	3,027	A	0.19	2
Clark Avenue: W of 101	4	18,207	15,259	C	0.70	2

References: 1= Caltrans, 2005; 2 = Santa Barbara Public Works traffic Volumes (2006) * - All roadways are classified "Major".

Truck Traffic

Truck traffic affects the LOS of a roadway by affecting traffic flow. Information on truck traffic is available from CalTrans for Highways 1, 135 and 246. Table 3.8.4 lists the truck traffic percentages for each highway segment. For comparison, trucks comprise approximately 2% of traffic on local urban arterial roads under normal conditions. A method for estimating the truck traffic effects on the LOS is included in the Highway Capacity Manual. Essentially, for each 10% increase in truck traffic, the LOS volume rating is decreased by approximately 5%.

Table 3.8.4 Truck Traffic Volumes

Route	Peak Truck Traffic, % of AADT
State Highway 1 from Gaviota to Orcutt	10.1
State Highway 246 (Ocean Ave) from Highway 1 west to Surf	4.0
Harris Grade Road from Highway 1 to State Highway 135	7.0
State Highway 135 East from Harris Grade Road to Hwy 101	10.2
State Highway 135 West from Harris Grade Road to Hwy 1	11.5
State Highway 135 from Hwy 1 to Clark Ave.	4.5

Source: CalTrans 2004 Truck Traffic Volumes.

Proposed Roadway Projects

According to the SBC Land Use Element and the Lompoc City General Plan, there are no projects proposed for the roadways which would be affected by the proposed project discussed in this EIR. However, in the SBC Year 2030 Study (1999), for the Lompoc area, it states that some road improvements along Highway 1 through the City of Lompoc would be needed due to increased traffic congestion.

Rail Facilities

A mainline for the Union Pacific Railroad runs parallel to the coastline within the vicinity of the project area. The railway carries both passenger and freight traffic. There are three Amtrak trains per day in each direction and seven regularly scheduled freight trains per day. In addition, there may be other scheduled freight trains on the line in peak demand periods. There is a spur line that travels parallel to West Ocean Avenue from the City of Lompoc west to the main rail line. There is also an Amtrak passenger railroad station on the west side of Coast Road at Surf Beach.

Current Point Pedernales Project Operations

PXP currently operates facilities at the LOGP along Harris Grade Road and along the pipeline route between Ocean Beach Park area and the LOGP. Currently, the LOGP facility generates vehicle trips due to employee commuting and due to transport of gas liquids and sulfur. These vehicle trips are shown in Table 3.8.5 below.

3.8.1.2 Offshore Traffic

The U.S. Coast Guard’s recommended traffic corridors are located approximately 13 miles to the south of Platform Irene and 5.6 miles south of Point Conception, running in an approximately east-west direction in the Santa Barbara Channel and in a north-south direction west of Point Conception (see Figure. 3.12-2). The Coast Guard Marine Waterways Division estimates that traffic within the main northbound and southbound lanes can run up to 30 to 50 vessels per day for both directions combined. Fishing and pleasure boat traffic along the coast is limited, but traffic is estimated to be on the order of five craft per day between Platform Irene and the shoreline. Supply boat traffic to Platform Irene for current operations averages approximately 50 return trips per year.

Table 3.8.5 Current Point Pedernales Project Vehicle Volumes

Vehicles	Annual Average Trips*	Average Daily Trips*	Comments
LOGP			
LOGP Commuters	9,490	26.0	Based on 26 workers currently employed.
Trucks – Gas Liquids	278	0.8	Based on monthly reports to SBC for the year 2005.
Trucks – Sulfur	24	0.1	Based on monthly reports to SBC for the year 2005.
Trucks – misc. (vacuum trucks, etc.)	104	0.3	Estimated at 2 per week.
Platform Irene			
Commuters	2,616	7.2	Based on 654 helicopter rouond trips per year (2005) and an estimated 2 person per trip.
Trucks – Materials related to supply boats	214	0.6	Based on 107 one-way supply boat trips per year and an estimated two truck loads of materials per supply boat.
Supply Boats – Marine Traffic	107	0.29	Based on 107 one-way supply boat trips per year.

* One-way trips.

Helicopter round-trips associated with operation of the Point Pedernales Project in 2005 numbered approximately 654 with a daily maximum of six one-way trips, which is below the permitted annual number of 2,190 trips.

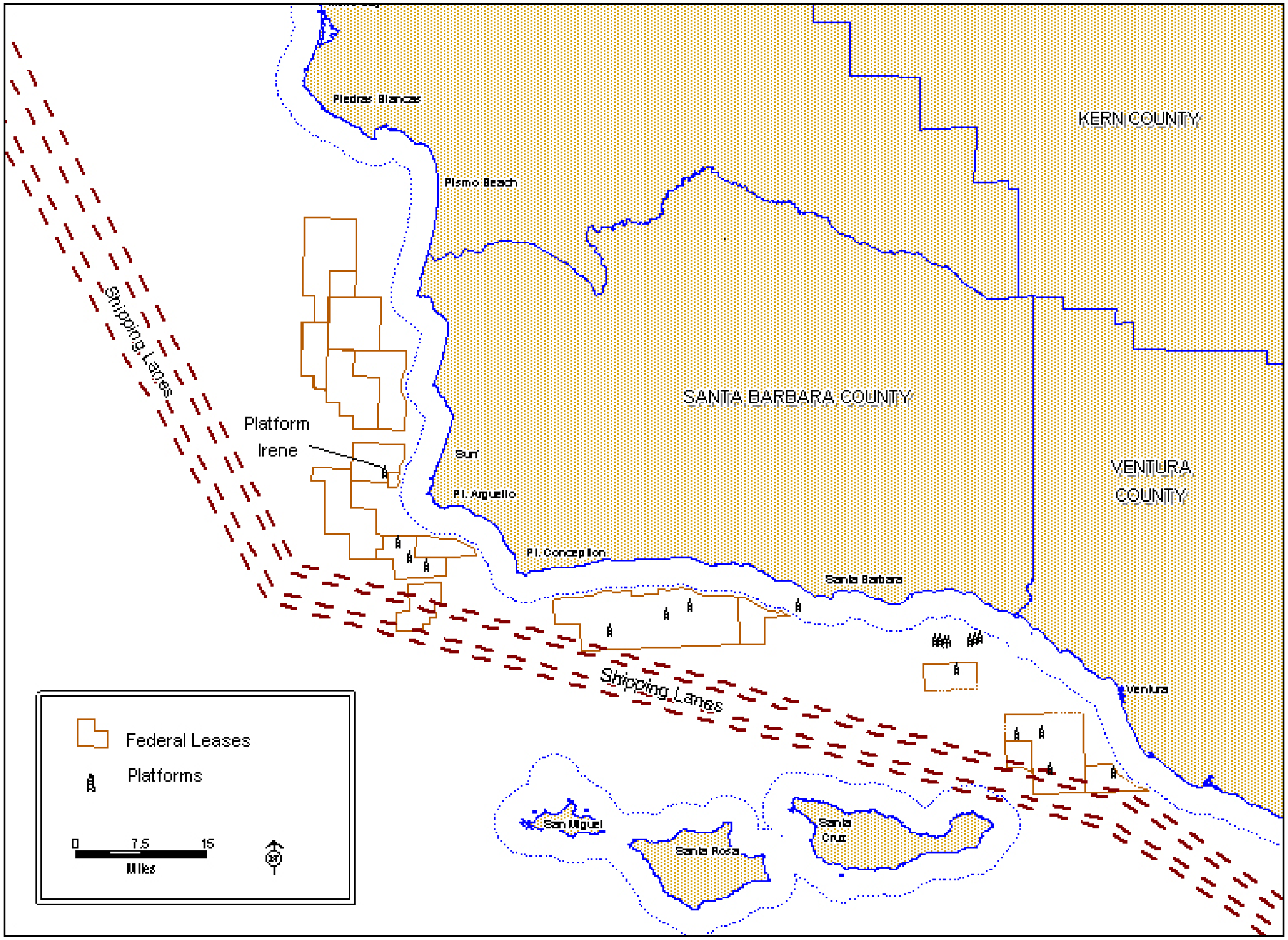
3.8.2 Regulatory Setting

The transportation system requirements for the proposed project are subject to the policies and plans of SBC and CalTrans.

SBC outlines policies and standards in the Circulation Element of the SBC Comprehensive Plan. The standards provide guidance in defining whether the proposed project is consistent with established roadway capacity levels and intersection LOS. Project consistency with roadway standards is based on the number of ADTs contributed by the project and the potential for exceedances of acceptable capacity, design capacity, and the estimated future volumes for roadways in the project area. In addition, the SBC Environmental Thresholds and Guidelines Manual defines the impact thresholds for determining significance of proposed projects.

Maximum load limits for trucks and safety requirements for oversized vehicles are generally regulated by CalTrans for operation on highways, and by the counties and cities for their roads.

Figure 3.8-2 Offshore Shipping Lanes



3.8.3 Significance Criteria

Transportation/Circulation significance criteria have been established in SBC. These are included in the SBC's Environmental Thresholds and Guidance Manual. The main criterion is based on the V/C ratio (see Table 3.8.1). Impacts are regarded as significant when the addition of project traffic to an intersection increases the peak hour V/C ratio by the value provided in Table 3.8.6 or sends at least 5, 10, or 15 peak hour trips to a LOS F, E or D, respectively.

Table 3.8.6 Significance Criteria

Peak Hour LOS (including project)	Increase in V/C	Additional Trips
A	0.20	-
B	0.15	-
C	0.10	-
D	-	15
E	-	10
F	-	5

Transportation impacts would be considered significant by the SBC Circulation Element of the SBC Comprehensive Plan if the project led to any of the following:

- Project access to a major road would require a driveway that would create an unsafe condition or a new traffic signal or major revisions to an existing traffic signal;
- Project adds traffic to a roadway that has design features or receives use that would be incompatible with substantial increases in traffic. This could be indicated by exceedance of the Circulation Element Capacity designation for the roadway; or
- Project traffic would utilize a substantial portion of an intersection's capacity that is currently at an acceptable LOS (LOS A through C) but is projected to have an LOS D or less (V/C of 0.81).

Offshore transportation impacts would be considered significant if the project led to any of the following:

- The project disrupts commercial shipping, fishing, or recreational traffic due to an oil spill of sufficient volume to require mobilization of oil spill response crews or other emergency response activity;
- The project alters normal commercial maritime traffic due to construction, maintenance, or other project-related transportation activities (i.e., increased boat trips to Platform Irene).

Marine traffic significance criteria were developed by the preparer of this EIR because SBC does not have significance thresholds for marine traffic.

3.8.4 Impact Analysis for the Proposed Project

This section addresses the impacts on onshore vehicular and offshore marine vessel traffic associated with the proposed project. Attention is focused primarily on roadway conditions and marine traffic in the immediate vicinity of the proposed project area. Due to the location of the proposed project, impacts associated with private property access restrictions, parking restrictions, and pedestrian circulation are not applicable in this analysis. All construction activities would take place at locations where public access is restricted: at Platform Irene, at Valve Site #2 on VAFB, and at the LOGP. While the installation of power lines along 13th Avenue between Ocean Avenue and Terra Road may require a temporary lane closure for one day, off-site vehicle trips would constitute the majority of the impact to roadway networks surrounding the project areas.

While the well drilling phase of the Tranquillon Ridge Project would be spread over 15 years, the upgrades at the LOGP and the addition of shipping pumps at Platform Irene are estimated to take approximately 9 months to complete. The addition of booster pumps and associated equipment including the power pole installation at and to Valve Site #2 is estimated to take 14 weeks. Installation of the transformer is estimated to take 4 weeks.

The applicant would be required to comply with all existing federal lease stipulations governing Platform Irene that apply to missions that originate from VAFB.

Impact #	Impact Description	Project Phase
T.1	Onshore construction associated with the project would temporarily add to local road traffic.	Construction

Construction traffic would increase local road traffic but would not change the LOS of any roadways. As shown in Table 2.5, the modifications at Valve Site #2 and the LOGP would require an estimated 20 construction workers. Even if every worker were to drive a vehicle, the increase in traffic would not change the LOS of the adjacent Highway 246 west of Lompoc near Valve Site #2 or on Highway 1 across the Santa Ynez River, the busiest roadway south of the LOGP. Therefore, this impact is considered adverse but not significant.

Mitigation Measures

T-1 PXP shall include a restriction on delivery of equipment and supplies to non-rush hour periods (rush hour periods are considered to be 7a.m. to 9a.m. and 4p.m. to 6p.m.)in the project construction plans that are sent out in the contractor bid packages. The construction plans shall be submitted to Santa Barbara County for review and approval prior to land use clearance.

During the estimated 9 months of construction at LOGP and Valve Site #2, adjacent roadways would experience a temporary increase in vehicle volume. The residual impact would be considered insignificant.

Impact #	Impact Description	Project Phase
T.2	Increased production at LOGP would increase facility truck traffic on local roads.	Increased Throughput, Extension of Life

Operational traffic would increase local road traffic but would not change the LOS of any roadways. The increased pipeline throughput would result in increased production of LPG/NGL and possibly sulfur products. These truck trips would increase from 2.9 per week to 5 per week. This impact to traffic represents an increase of less than 0.1% in daily vehicle trips on Harris

Grade Road, which would not change the LOS. Therefore, this impact is considered adverse but not significant. Additional traffic safety impacts are discussed in Section 3.2, System Safety.

Mitigation Measures

T-2 PXP shall include a restriction on LPG/NGL and sulfur truck traffic at the LOGP to non-rush hour periods (rush hour periods are considered to be 7a.m.-9a.m. and 4p.m.-6p.m.) in their contracts with vendors. PXP shall also document arrival and departure times for these trucks. This requirement shall be included in the Traffic Management Plan (TMP). The revised TMP shall be submitted to Santa Barbara County for review and approval prior to land use clearance.

The residual impact caused by a small increase in roadway traffic resulting from increased transportation of LPG would be considered not significant.

Impact #	Impact Description	Project Phase
T.3	Increased offshore drilling activity would increase offshore traffic.	Drilling

The proposed Tranquillon Ridge Project would increase supply boat traffic servicing Platform Irene only during the drilling phase of the project. Supply boat traffic would increase from the current average of one one-way trip every 3 to 4 days to an average of one one-way trip every three to four days. Existing marine traffic (project- and non-project-related) between Platform Irene and the shoreline is estimated at five vessels per day. Once drilling operations are complete, the supply boat traffic would be the same as for the current operations. The impact during drilling would represent a one percent increase over existing levels. Because the projected ocean traffic is minimal and the area large, this small increase would not affect commercial or recreational boat traffic.

During drilling only, helicopter traffic would increase to six one-way trips per day every day. Although this increase is within the limits of the existing Point Pedernales FDP, it represents an adverse but not significant impact.

Mitigation Measures

T-3 Require supply boats from Port Hueneme to use the Coast Guard's recommended marine traffic corridors to the maximum extent feasible.

The residual impact caused by an increase in marine traffic would be small and therefore considered insignificant.

Impact #	Impact Description	Project Phase
T.4	An oil spill from the proposed Tranquillon Ridge project could result in the disruption of commercial shipping, fishing, and recreational marine traffic.	Increased Throughput Extension of Life

An oil spill could result in the closure of the Coast Guard's recommended marine traffic corridors through the Santa Barbara Channel and restrict boating along up to 70 miles of coastline and San Miguel, Santa Rosa, and western Santa Cruz Islands (see Appendix G in SBC 2006 regarding oil spill modeling), a regionally significant impact. Estimated daily shipping traffic in the main traffic corridors consists of 30 to 50 vessels per day. Commercial/recreational fishing vessel traffic is estimated at five vessels per day between Platform Irene and the shoreline. The event of an oil spill could disrupt marine traffic for a number of days, due to clean-up activities. Depending on the location of the spill, marine traffic might have to use routes outside of the Coast Guard's recommended marine traffic corridors. Also, commercial/recreational fishing boat traffic could be precluded from areas around the spill during the cleanup activities (see Section 3.6, Commercial and Recreational Fishing/Kelp Harvesting, for impacts on fishing).

Mitigation Measures

The proposed mitigation measures would not be completely effective in reducing the significant risk of a spill, nor would they adequately eliminate the significant effect of a spill on marine recreational or commercial traffic. Mitigating impacts from a marine oil spill is largely a function of the effectiveness of the spill-response measures. The effectiveness of spill cleanup measures is dependent on the response time, availability and type of equipment, the size of the spill, and the weather and sea conditions during the spill. Only some of these aspects are within the control of the spill response team. Therefore, residual impacts are considered significant.

3.8.5 Comparison of Impacts Between Proposed Project and 1985 Point Pedernales EIS/EIR

Impact No.	Project Phase	Tranquillon Ridge Project Impact Description	Point Pedernales EIS/EIR, 1985 Impact Description	Comments
T.1	Construction	Onshore construction associated with the project would temporarily add to local road traffic.	Increased traffic near project components during construction phases.	
T.2	Increased Throughput Extension of Life	Increased production would increase facility truck traffic on local roads.	Increased traffic near project components during construction phases.	
T.3	Drilling	Increased offshore drilling activity would increase offshore traffic.	Damage to fishing gear and/or vessels due to collision with and/or hang-up on oil and gas pipelines or debris. Increased Santa Barbara Channel Boat traffic due to platform supply and crew boat requirements. Impacts center on Port Hueneme and Ellwood Pier and any as yet unapproved supply/crew bases. (class III)	First 1985 impact is under commercial fishing issue area.
T.4	Increased Throughput Extension of Life	An oil spill from the proposed Tranquillon Ridge project could result in the disruption of commercial shipping, fishing, and recreational marine traffic.	Preemption of harvest in any of various productive fishing grounds by unlikely major oil spill.	1985 impact located in the Commercial Fishing section.

3.8.6 References

Arthur D. Little. 1985. Union Oil Project/Exxon Project Shamrock and Central Santa Maria Basin Area Study: Final Environmental Impact Statement/Environmental Impact Report. Prepared for County of Santa Barbara, U.S. Mineral Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development.

California Department of Transportation (CalTrans). 1998. The 1998 Annual Average Daily Truck Traffic On the California State Highway System. Available from the State of California Business, Transportation and Housing Agency Department of Transportation (CalTrans) Division of Traffic Operations Office of Traffic Data in Sacramento, California and on the Internet.

___. 1999. Traffic Volumes on the California State Highway System. Available from the State of California Business, Transportation and Housing Agency Department of Transportation (CalTrans) Division of Traffic Operations Office of Traffic Data in Sacramento, California and on the internet.

___. 2000 - 2004. Traffic Volumes on the California State Highway System. Available on the Internet.

Lompoc, City of. 1997. Lompoc General Plan, revision to GP-94-01.

Santa Barbara County. 2002. Planning and Development Department Environmental Thresholds and Guidelines Manual. October.

___. November 2000. Santa Barbara County 2030 Land and Population, Santa Barbara County Planning and Development.

Santa Barbara County, Public Works Department, Transportation Division. May 1996. Transportation Division, Roadway Traffic Volumes.

Santa Barbara County, Resource Management Department. 1982. Santa Barbara County Comprehensive Plan - Land Use Element, Circulation Element, and Environmental Resource Management Element. Adopted December 1980 and revised August 1982 to include text amendments through October 1992.

Santa Barbara County, Traffic and Engineering Department. January 22, 2001. Personal communication with Brad Probst.

___. January 14, 2002. Personal communication with Court Eilertson.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

Transportation Research Board. 1994. Highway Capacity Manual Special Report 209, Third Edition. National Research Council Transportation Research Board of the National Academy of Sciences, Washington DC.

3.9 Environmental Justice

On February 11, 1994, President Clinton signed Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, designed to focus attention on environmental and human health conditions in areas of high minority populations and low-income communities, and promote non-discrimination in programs and projects substantially affecting human health and the environment. The order requires the U.S. Environmental Protection Agency (EPA) and all other federal agencies (as well as state agencies receiving federal funds) to develop strategies to address this issue. The agencies are required to identify and address any disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and/or low-income populations. In 1996 EPA issued guidance for incorporating environmental justice concerns in environmental analysis (EPA 1996).

In 1995, the U.S. Department of the Interior (DOI) issued Environmental Compliance Memorandum No. ECM95-3 concerning National Environmental Policy Act (NEPA) Responsibilities Under the Departmental Environmental Justice Policy. This guidance states that all environmental documents should specifically analyze and evaluate the impacts of any proposed projects, actions, or decisions on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risks of those decisions (DOI 1995).

3.9.1 Affected Environment

The project area is offshore and onshore in western Santa Barbara County. The communities most immediately affected by the project are Vandenberg Village and Mission Village, north of the City of Lompoc. This area comprises U.S. Census Tract 28.08, Block Groups 1 through 6. The pipeline from Platform Irene to the LOGP passes through Block Groups that include the northern areas of Vandenberg Village and the area south of Highway 1 near the penitentiary. U.S. Census data from 2000 were used to characterize the project study area for this analysis.

According to EPA guidance, a minority or low-income community is disparately affected when the community will bear a disproportionate level of health and environmental effects compared to the general population. Further, the guidelines recommend that the Communities of Comparison that are selected be the smallest governmental unit that encompasses the impact footprint for each resource. The onshore pipelines and LOGP are located in unincorporated Santa Barbara County, west and north of the City of Lompoc. Therefore, the Communities of Comparison for this analysis were defined as Santa Barbara County and the City of Lompoc.

In 2000, the population of Census Tract 28.08 was 5,814 (U.S. Census Bureau 2006a). The population of Lompoc was 41,103 and Santa Barbara County was 399,347 in 2000 (U.S. Census Bureau 2006a). Of the study area, 16 percent of the population was considered to be of a minority race, compared to 34 percent for Lompoc and 27 percent for Santa Barbara County.

As an added measure to ensure that study area minority populations are adequately identified, census data were gathered for Hispanic origin. Hispanic is considered an origin, not a race, by the U.S. Census Bureau. An origin can be viewed as the heritage, nationality group, lineage, or country of birth of the person or the person's parents or ancestors before their arrival in the United States (U.S. Census Bureau 2006a). People who identify their origin as Spanish, Hispanic, or Latino may be of any race. Approximately 9 percent of the study area population was Hispanic or Latino in origin, compared with 37 percent for Lompoc and 34 percent for Santa Barbara County (U.S. Census Bureau 2006a).

Census data were also analyzed to determine poverty status in the study area. Approximately 5 percent of the project study area individuals for whom poverty status was determined had income in 1999 below the poverty level, compared to 15 percent and 14 percent for Lompoc and Santa Barbara County, respectively (U.S. Census Bureau 2006b).

The populated areas near the pipeline in northern Vandenberg Village and south of Highway 1 had minority percentages of 11 percent and 22 percent, respectively, and poverty levels of 1 percent and 10 percent, respectively (SBC 2002).

3.9.2 Significance Criteria

An environmental justice impact would be considered significant if the proposed project would:

- Have the potential to disproportionately impact minority and/or low-income populations at levels exceeding the corresponding medians for the County in which the project is located;
- Result in a substantial disproportionate decrease in the employment and economic base of minority and/or low-income populations residing in the County and/or immediately surrounding cities; or
- Result in a substantial negative impact to traditional subsistence fishing or gathering by native populations.

3.9.3 Impact Discussion

3.9.3.1 Offshore Impacts

Offshore impacts associated with the project, particularly those as a result of accidental oil or gas releases, would potentially affect the marine and coastal environment along Santa Barbara and San Luis Obispo Counties. People from every ethnicity and income level would be included in the potentially affected area. These impacts would affect resources used by many different people, regardless of ethnicity or income and would, therefore, not have a disproportionate impact on a minority or low-income populations. Section 3.9, Cultural Resources, discusses the cultural and religious practices of the native populations. No impacts to subsistence fishing or gathering would result from the project.

3.9.3.2 Onshore Impacts

The project study area has lower levels of minority, Hispanic or Latino, and low-income populations than those of the City of Lompoc and Santa Barbara County. Therefore, the onshore facilities associated with the project would not result in disproportionate impacts to minority or low-income populations.

3.9.4 Comparison of Impacts Between Proposed Action and 1985 Point Pedernales EIS/EIR

The 1985 Point Pedernales EIS/EIR did not address Environmental Justice since the Executive Order was signed in 1994.

3.9.5 References

Council on Environmental Quality (CEQ). 1997. Environmental Justice Guidance Under the National Environmental Policy Act. Washington, DC: Executive Office of the President.

Santa Barbara County (SBC). 2002. Tranquillon Ridge Oil and Gas Development Project, LOGP Produced Water Treatment System Project, and Sisquoc Pipeline Bi-Directional Flow Project. Final Environmental Impact Report. Appendix I. EIR # 01-EIR-04, SCH # 2000071130. June.

Santa Barbara County (SBC). 2006. Draft Environmental Impact Report for the Tranquillon Ridge Oil and Gas Development Project. Prepared by Aspen Environmental Group. SCH #2006021055, EIR #06EIR-00000-00005. October.

U.S. Census Bureau. 2006a. Census 2000 Summary File 1 (SF 1) 100-Percent Data. Accessed via the Internet: http://factfinder.census.gov/. March.

U.S. Census Bureau. 2006b. Census 2000 Summary File 3 (SF 3) Sample Data. Accessed via the Internet: http://factfinder.census.gov/. March.

U.S. Department of Interior (DOI). 1995. Environmental Compliance Memorandum No. ECM95-3, National Environmental Policy Act Responsibilities Under the Departmental Environmental Justice Policy. Washington, DC: Office of the Secretary.

U.S. Environmental Protection Agency (EPA). 1996. Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analysis. Washington, DC: U.S. Environmental Protection Agency, Office of Federal Activities.

PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Supporting Information Volume
Biological Evaluation of
Threatened and Endangered Species

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Plains Exploration & Production Company

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1.0 SUMMARY

Plains Exploration & Production Company (PXP) currently operates the Point Pedernales Unit, which includes all or portions of Leases OCS-P 0437, 0438, 0440, and 0441 on the federal outer continental shelf (OCS) in the southern Santa Maria Basin. The associated oil and gas drilling and production platform, Platform Irene, is located on (OCS) Lease P-0441. PXP is proposing the development of the adjacent Tranquillon Ridge Unit, which will encompass the following activities.

The Tranquillon Ridge unit will be developed from Platform Irene, and is hydrocarbon reserves located within the adjacent State waters (<3 miles from shoreline). No seismic surveys are planned. No construction of either offshore or onshore facilities is proposed. To develop the Tranquillon Ridge Unit, PXP plans to drill up to 17 development wells into the Tranquillon Ridge Unit from Platform Irene. PXP expects to begin drilling the first well during the second or third quarter of 2008. PXP estimates that production will begin in the third or fourth quarter of 2008 and last up to 15 years. Production from the Tranquillon Ridge Field is estimated to peak at around 30,000 bbls/day of oil and 7 mmscfd of gas. With the proposed Tranquillon Ridge Project, overall production from Platform Irene will peak at around 35,000 bbls/day of oil and 10 mmscfd of gas. Based upon the Applicant's estimates, the ultimate recovery at the economic limit for the Tranquillon Ridge Field is estimated to be approximately 103 million barrels of oil and 40 to 50 billion standard cubic feet of gas.

All the production from the Tranquillon Ridge Field will be combined with the Point Pedernales Field oil and gas and transported to the Lompoc Oil and Gas Plant (LOGP) in the existing pipelines. Produced water will either be discharged to the ocean under the current NPDES permit or injected offshore in accordance with the MMS authorization, or injected onshore. From LOGP, the combined oil production from the Tranquillon Ridge and the Point Pedernales Fields will be transported to the Santa Maria Refinery via pipeline. The combined gas production will either be sold and transported via pipeline or used as fuel at the LOGP.

PXP has identified 26 federally threatened and endangered species that may occur in the project area and be affected by activities and accidental events associated with the proposed development of the Tranquillon Ridge Unit. A listing of these species and the corresponding agency of oversight for each species is included as Appendix A of this report (see also Section 4.0). These species are addressed in this biological evaluation.

The primary impact-producing activities associated with the proposed Tranquillon Ridge Unit development project include drilling and production operations, with associated support activities. For listed species, the major impacting agents expected from these proposed activities are noise and disturbance, platform discharges (including produced water), and potential oil spills.

Analysis of these potential impacts from oil and gas development and production activities associated with the Tranquillon Ridge Unit project indicates that the most serious potential threats to listed species in the project area are from accidental oil spills. The most likely size of a spill in the range of 50-1,000 bbl is less than 200 bbl. Table 1.1 summarizes the potential impacts to the species addressed. The following sections also discuss potential impacts for each species.

Species Unlikely to Be Adversely Affected by the Proposed Project

The proposed development of the Tranquillon Ridge Unit is expected to have no adverse impacts on the following federally listed species:

Blue whale
Humpback whale
Fin whale
Sei whale
Northern right whale
Sperm whale
Steller sea lion
Guadalupe fur seal
Leatherback sea turtle
Green sea turtle
Pacific ridley sea turtle
Loggerhead sea turtle
Bald eagle
Light-footed clapper rail
Marbled murrelet
California red-legged frog
White abalone
Green sturgeon
Unarmored threespine stickleback
Salt marsh bird's-beak
California sea-blite

Species Likely to Be Adversely Affected by the Proposed Project

The proposed development of the Tranquillon Ridge Unit is likely to have adverse impacts on the following species:

California Least Tern: Oil spills associated with the proposed Tranquillon Ridge Unit development project are likely to result in very low impacts to the California least tern. Impacts would be limited to colonies from Point Sal to Point Conception.

Tidewater Goby: Oil spills associated with the proposed Tranquillon Ridge Unit development project are likely to result in low impacts to the tidewater goby. These impacts would be most likely associated with a rupture of the Irene-to-shore pipeline, rather than a spill originating at Platform Irene. However, tidewater goby are fairly resilient and have shown the ability to disperse and re-colonize areas where they were previously extirpated. Therefore, impacts to this species are likely to be low.

Steelhead trout: Oil spills associated with the proposed Tranquillon Ridge Unit development project are likely to result in low impacts to the southern steelhead trout. These impacts would be most likely associated with a nearshore rupture of the Irene-to-shore pipeline, rather than a spill originating at Platform Irene. Impacts to steelhead would be most severe if an oil spill occurred during the months of November to April when the anandromous fish are migrating upstream to breed, and juveniles are migrating down to sea. However, impacts to winter steelhead would likely be limited to the area from Pt. Sal to Pt. Conception. Therefore, impacts to this species are likely to be low.

Southern Sea Otter: Oil spills associated with the proposed Tranquillon Ridge Unit development project are likely to result in low to moderate impacts to the southern sea otter, including limited mortality. Impacts to otters would be most likely to occur from a rupture in the Irene-to-shore pipeline, and could affect otters in the area from Guadalupe to Pt. Conception. These impacts would be more severe if a spill occurred during spring months when seasonal migration brings large rafts of (predominately male) otters to the southern extent of their current range, off Point Conception. Additionally, if southward range expansion by the southern sea otter continues, increasing numbers of otters will be expected to occur off Point Arguello and Point Conception that could be affected in the event of an oil spill.

Western Snowy Plover: Impacts to western snowy plovers from oil spills associated with the Tranquillon Ridge Unit project are likely to be limited to the mainland coastal area between Point Sal and

Point Conception, although if a spill were to move southward it could also contact San Miguel and Santa Rosa Islands. Impacts to the nesting populations at any of these locations could be severe, including loss of adults, disruption of nesting activity, and abandonment of nesting beaches. However, the level of impact at mainland locations could be somewhat higher than on the affected Channel Islands because the current island populations comprise only a small part of the total population, while the population of plovers inhabiting the nearby mainland coastal area is substantially larger (>10%). Nevertheless, overall impacts to this species are likely to be low.

California Brown Pelican: Oil spills associated with the proposed Tranquillon Ridge Unit development project are likely to result in low impacts to the California brown pelican, including limited mortality. However, if a spill were to move southward it could contact San Miguel and Santa Rosa Islands. Impacts to the nesting population of brown pelicans that has recently re-established itself at Prince Islet off San Miguel Island could include loss of adults, disruption of nesting activity, and abandonment of nesting sites. The Channel Islands comprise the only nesting areas in the United States for this species; however, nesting currently remains concentrated at the more easterly (Anacapa) and southerly (Santa Barbara) lying islands. Overall impacts to this species are therefore likely to be low.

For the cumulative analysis, a total of six proposed oil and gas development projects were evaluated. Three proposed oil and gas development projects were identified in State waters, near Coal Oil Point in the central Santa Barbara Channel, and offshore Carpinteria. Additionally, a total of four proposed projects were identified in Federal waters within the Channel. These projects are in various stages of environmental review. Five of these projects involve resumption or continuation of oil production, some through extended-reach drilling from existing platforms in the central Santa Barbara Channel. Overall, these projects would be expected to contribute some increase in the oil spill risk in the Santa Barbara Channel and Santa Maria Basin. One of the remaining projects involves development of a mariculture operation from an existing platform near Ventura, while the other project proposes the conversion of that same platform to an offshore LNG terminal. An oil spill from Platforms Hogan or Grace would be more likely to contact threatened and endangered species that occur along the coasts of Santa Barbara, Ventura, and Oxnard. These would include the California brown pelican, California least tern, and western snowy plover.

Table 1.1 Tranquillon Ridge - Summary of Estimated Impacts to Threatened and Endangered Species.

Impact Level		
No Impact	**Low Impact**	**Moderate Impact**
Marine Mammals Blue Whale Humpback Whale Fin Whale Sei Whale Northern Right Whale Sperm Whale Steller Sea Lion Guadalupe Fur Seal		Southern Sea Otter
Birds Bald Eagle Light-footed Clapper Rail Marbled Murrelet	Western Snowy Plover California Least Tern California Brown Pelican	

Table 1.1 Tranquillon Ridge - Summary of Estimated Impacts to Threatened and Endangered Species.

Impact Level		
No Impact	**Low Impact**	**Moderate Impact**
Reptiles Leatherback Sea Turtle Green Sea Turtle Pacific Ridley Sea Turtle Loggerhead Sea Turtle		
Amphibians California red-legged Frog		
Invertebrates White Abalone		
Fish Unarmored Threespine Stickleback Green Sturgeon	Steelhead Trout Tidewater Goby	
Terrestrial Plants Salt Marsh Bird's-Beak California Sea-blite		

2.0 PURPOSE

Section 7(c) of the Endangered Species Act (ESA), as amended, requires that a federal agency request from the appropriate authority a list of threatened and/or endangered species present in an area of a proposed major federal action. When such species are believed to be present, and the proposed action is a "major construction activity," the federal agency prepares a Biological Assessment to evaluate the potential effects and determines whether they are likely to be adversely affected by the proposed action.

In support of this process, PXP has prepared this biological evaluation of the proposed Tranquillon Ridge Unit project. The project will be developed using an existing platform (Irene) and pipelines and will not result in any new construction other than installation of a new electric pump for muds handling, replacement and upgrade of several existing shipping pumps, and associated deck modifications. Therefore, this biological evaluation describes the project, identifies those threatened and endangered species most likely to be affected by the action, identifies potentially significant impact sources, and analyzes potential effects, including cumulative effects.

This document has been prepared to assist the MMS in fulfilling its requirements under Section 7(c) of the ESA to solicit a Biological Opinion from both the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS).

3.0 DESCRIPTION OF PROPOSED ACTION

This chapter presents an overview of Plains Exploration and Production's (PXP) proposed development project for the Tranquillon Ridge Unit and includes a discussion of drilling operations, associated manpower and transportation requirements, and a proposed schedule for activities.

3.1 OVERVIEW OF PROPOSED ACTION

To develop the Tranquillon Ridge Unit, PXP has requested approval to drill up to 22 extended-reach production wells and eight utility wells into State lands from the existing Point Pedernales Unit Platform, Irene. Platform Irene is located immediately to the north and west of the unit, respectively (Figure 3.1). The need to drill the remaining 3 wells will be contingent upon the success of previous wells, the interpretation of 3D seismic data, and economic factors.

No new facilities or equipment will be required to develop the Tranquillon Ridge Unit. Drilling of the unit wells and production of the resources is expected to last fifteen years

3.2 PROPOSED DRILLING ACTIVITIES

PXP expects to drill development wells into the Tranquillon Ridge Unit from Platform Irene using extended-reach drilling (ERD) technology. Platform Irene is located in 73.7 m (242 ft) of water on Lease OCS-P 0441 in the adjacent Point Pedernales Unit, approximately 7.56 km (4.7 mi) from the mainland; its exact location is 34°28.1'N/120°40.8'W. There are 72 slots on the platform, of which 12 are currently in use for development of the Point Pedernales Field.

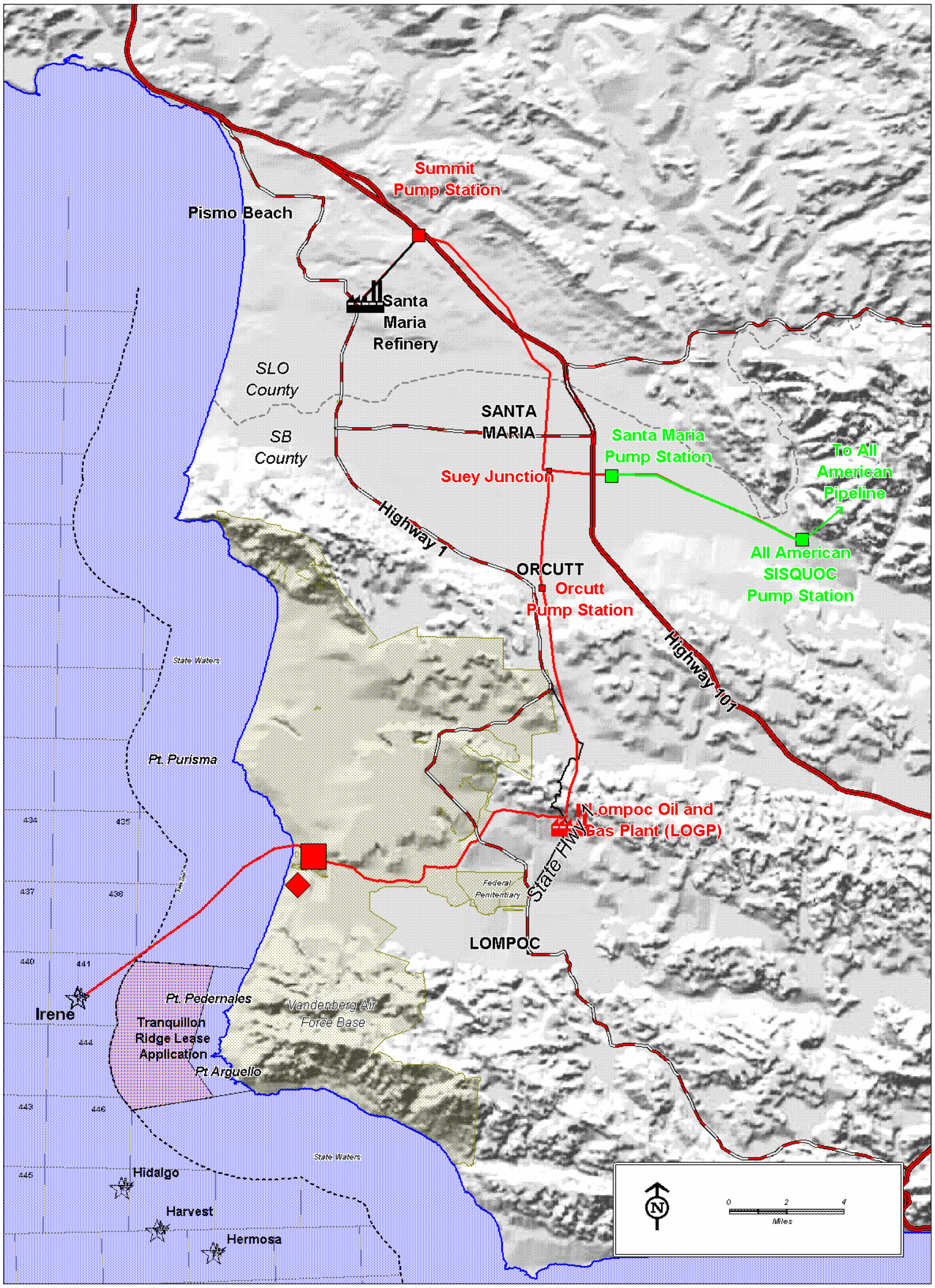
The proposed development wells would be drilled from Platform Irene to bottom well locations in State waters. All of the wells will be drilled using existing well slots on the platform. Total measured well lengths for the 14 wells will range from 12,000 to over 25,000 feet, with vertical depths below the ocean surface averaging between three and five thousand feet (3,000-5,000 feet).

The proposed drilling program sequence includes rig installation and necessary platform modifications, drilling and tripping operations, setting the well casing, well logging, and well completion and testing. Drilling each well is estimated to require 2 to 4 months. Under the current schedule for the Tranquillon Ridge Unit, the first production well will be spudded during the second or third quarter of 2008, and drilling activities are expected to continue for 15 years. Production is expected to begin in the third or fourth quarter of 2008 and last up to 15 years.

Drill Muds and Cuttings. During drilling operations, a mud system is used to control formation pressure, lubricate the drill pipe and bit, and return drill cuttings to the surface. Detailed information on the mud system equipment and the estimated mud composition for the Tranquillon Ridge Unit drilling program is provided in other supporting information documents. These muds comply with the current, existing Pollution Discharge Elimination System (NPDES) permit for operations at Platform Irene (EPA 2000a, b).

The Cementing Program and Muds and Cuttings, in the Supporting Information Volume contains estimates of the volumes of water-based cuttings, mineral oil based cuttings, and drilling fluid volumes that would be produced and discharged during drilling for each of the 22 proposed wells in the Tranquillon Ridge Unit. It is expected that oil-based muds may be used for drilling the longer sections of each of the wells, specifically for the 12 ¼ and 8 ½ inch drill hole sizes. The other drill hole sizes will use water-based drilling fluids. Oil-based muds, plus any muds containing additives not approved by the EPA or in concentrations above EPA limits, will be shipped to shore via supply boat for disposal at an approved onshore disposal site or facility. Alternatively, oil-based drilling cuttings could also be re-injected into the Monterey formation, as has been performed at the nearby Rocky Point field. The estimated volumes of mineral oil based muds and cuttings for each of the 22 wells are provided in other supporting information documents.

Figure 3.1 Location of Tranquillon Ridge Unit in Relation to Other OCS Units Off Pt. Arguello.



For a typical well, approximately 14,000 barrels (bbls) of material will be injected into the underground formation. This includes about 4,000 bbls of cuttings and absorbed fluids for the mineral oil based portion of the well and approximately 7,000 bbls of fluids that would be injected into the casing annulus.

Support Activities. Personnel for the Tranquillon Ridge Unit will require additional helicopter and supply boat trips during drilling. While helicopter routes in the past have originated in Lompoc, they now originate from Santa Maria Airport and pass to the north of restricted air space area R-2516 over VAFB. The present flight path is designed to limit flights over urban areas and sensitive wildlife areas on VAFB. Development of the Tranquillon Ridge Unit will almost double the number of daily helicopter flights to Platform Irene (increasing from a current average of 3.2 up to 6.0 one-way flights per day) during drilling. During normal operations, however, although the total annual number of helicopter trips will increase, there would be no daily increase.

The proposed project would increase supply boat traffic servicing Platform Irene only during the drilling phase of the project. Supply boat traffic would increase from the current average of one one-way trip every 3 to 4 days to an average of one one-way trip every 3 days. The drilling rig and equipment, rig supplies, and bulk drilling mud and cement materials for the project will be transported to Platform Irene by supply boat from Port Hueneme. All support vessels will travel along the vessel corridors specified in the Santa Barbara Channel/Santa Maria Basin Oil Service Vessel Traffic Corridor Program (see Section 5.1.1). The impact during drilling would represent a one percent increase over existing levels. However, once drilling operations are complete, supply vessel traffic is expected to return to current baseline levels.

4.0 PROTECTED SPECIES

4.1 SPECIES EXCLUDED FROM THIS ANALYSIS

Over 50 federally threatened and endangered species are known to occur or may occur in coastal Ventura, Santa Barbara, and San Luis Obispo counties and the surrounding waters. However, a number of these species are unlikely to be affected by any of the activities associated with the development of the Tranquillon Ridge Unit. Therefore, after reviewing the relevant literature and consulting with area experts, we have identified the following federally listed species for exclusion from this analysis:

4.1.1 Wildlife

Morro Bay kangaroo rat (*Dipodomys ingens*). No onshore facilities are proposed for this project, and this species' current habitat would not be subject to either direct or indirect effects from a project-related oil spill.

California coastal gnatcatcher (*Polioptila californica californica*). No onshore facilities are proposed for this project, and this species' current habitat would not be subject to either direct or indirect effects from a project-related oil spill.

The marbled murrelet (*Brachyramphus marmoratus*). This small, secretive seabird was listed as threatened in 1992 by the FWS. It inhabits the pacific coast of North America from the Bering Sea south to the Santa Cruz mountains. The marbled murrelet is an unusual member of the auk family, staying close to shore when at sea, and nesting up to 70km inland in old growth forests. There are approximately 1,000 murrelets remaining in central California; the next closest population is located 3,000 kilometers away, off of the Humboldt County coast in northern California.

Recent radio-telemetry studies have uncovered that although the foraging range of breeding marbled murrelets is less than twenty-five kilometers, several birds have been tracked nearly 200 kilometers south, down to the southern end of the Monterey Bay National Marine Sanctuary near Pt. Piedras Blancas. The birds were presumably traveling a considerable distance for some predictable food source. Little is known of the at-sea distribution or seasonal occurrence of marbled murrelets in this area; however, their numbers at this southern extreme appear to be limited. Although marbled murrelets may migrate long distances and enter the project area at the southern end of their range, critical areas of their habitat, such as the old growth forests where they breed within or near the project area. Therefore, the Tranquillon Ridge Unit project activities are not likely to affect this species.

Island night lizard (*Xantusia riversiana*). This species is an island endemic found on three of the southern Channel Islands (San Clemente, San Nicolas, and Santa Barbara Islands). Its habitat would not be subject to either direct or indirect effects from a project-related oil spill.

Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*). The unarmored threespine stickleback was listed as endangered under the Endangered Species Act in 1970. It is a small, scaleless, native fish that resides in slow water creeks along the California coast. Populations within the study area are located on Vandenberg AFB in San Antonio and Canada Honda Creeks, and above Piru Creek in the Santa Clara River system. Threats include habitat loss through stream channelization, increased water turbidity, introduction of nonnative competitors, water pollution, aquifer draw downs, and beaver activity. This species' current range is not in the area of concern for the Tranquillon Ridge Unit project activities because although most species of stickleback can adapt to salt, brackish, or fresh water, unarmored threespine sticklebacks appear to be limited to fresh water.

North American green sturgeon (*Ambystoma medirostris*). The southern distinct population (SDP) of the North American green sturgeon (*Ambystoma medirostris*) was listed as threatened in July 2006 (NMFS, 2006). The SDP is comprised of those sturgeon that spawn in rivers and estuaries south of the Eel River. Within this population segment, a majority of spawning adults are concentrated in the Sacramento River. Green sturgeon are anadromous; they live much of the time in marine waters, but return to fresh water (rivers) to spawn. Additionally, young green sturgeon may remain in freshwater rivers and streams for the first few years of their lives before traveling out to sea. Although green sturgeon are a highly migratory species and travel widely at sea, critical areas of their habitat, such as the rivers and estuaries where they spawn and gather do not occur within the project area. Therefore, the Tranquillon Ridge Unit project activities are not likely to affect this species.

Santa Ana sucker (*Catostomus santaanae*). The Santa Ana sucker was listed as threatened under the Endangered Species Act on April 12, 2000. The FWS has designated critical habitat for the Santa Ana Sucker (in three noncontiguous populations) in the Santa Ana River in San Bernardino, Riverside, and Orange counties; the San Gabriel River in Los Angeles County; and lower Big Tujunga Creek, in Los Angeles County. The Santa Clara River and estuary system also supports a population of Santa Ana suckers, but this population is outside the species' native range and is regarded as introduced and was not designated as threatened pursuant to the Act by FWS. Consequently, this species' current, native range is not in the area of concern for the Tranquillon Ridge Unit project activities.

Morro shoulderband snail (*Helminthoglypta walkeriana*). The Morro shoulderband snail was listed as endangered on January 17, 1995. It is found in the Los Osos area near Morro Bay, usually within or near coastal dune scrub vegetation. However, an oil spill would not impact the habitat of this species, and any clean-up efforts would avoid the established coastal dunes and scrub vegetation that make up its habitat.

4.1.2 Plants

The habitats of the following Channel Islands endemic plants would not be subject to either direct or indirect effects from a project-related oil spill:

- Hoffmann's rock-cress (*Arabis hoffmannii*),
- Santa Rosa Island manzanita (*Arctostaphylos confertiflora*),
- Island barberry (*Berberis pinnata* ssp. *insularis*),
- Soft-leaved paintbrush (*Castilleja mollis*),
- Santa Cruz Island dudleya (*Dudleya nesiotica*),
- Island bedstraw (*Galium buxifolium*),
- Hoffmann's slender-flowered gilia (*Gilia tenuiflora* ssp. *hoffmannii*),
- Island rush-rose (*Helianthemum greenei*),
- Santa Cruz Island bushmallow (*Malacothamnus fasciculatus* ssp. *nesioticus*),
- Santa Cruz Island malacothrix (*Malacothrix indecora*),
- Island malacothrix (*Malacothrix squalida*),
- Island phacelia (*Phacelia insularis* ssp. *insularis*),
- Santa Cruz Island fringepod (*Thysanocarpus conchuliferus*), and
- Santa Barbara Island liveforever (*Dudleya traskiae*).

The following mainland plants are also being excluded from this analysis because no onshore facilities are proposed for this project, and their current habitats would not be subject to either direct or indirect effects from a project-related oil spill:

- Gaviota tarplant (*Deinandra increscens ssp. villosa*),
- La Graciosa thistle (*Cirsium loncholepis*),
- Lompoc yerba santa (*Eriodictyon capitatum*),
- Morro manzanita (*Arctostaphylos morroensis*),
- Marsh sandwort (*Arenaria paludicola*),
- Nipomo Mesa lupine (*Lupinus nipomensis*),
- Pismo Clarkia (*Clarkia speciosa* ssp. *immaculata*).

The remaining species are described in the following sections.

4.2 MARINE MAMMALS

4.2.1 Blue Whale (Endangered)

Status. The blue whale (*Balaenoptera musculus*) was listed as a federal endangered species on June 2, 1970 (35 FR 8495). No critical habitat has been identified for this species. The blue whale recovery plan was finalized in 1998, (Reeves et al., 1998a). The main reason for listing was a severe worldwide population decline due to intensive commercial whaling. The current population worldwide remains unknown; however, the eastern pacific population, which frequents the waters off California, has been estimated at slightly over 2,100 individuals.

Range and Habitat. The largest of all animals, blue whales are distributed worldwide in circumpolar and temperate waters and inhabit both coastal and pelagic environments (Leatherwood et al., 1982; Reeves et al., 1998a). Like most baleen whales, they migrate between warmer waters used for breeding and calving in winter and high-latitude feeding grounds where food is plentiful in the summer. In the eastern North Pacific, blue whales are found from the Gulf of Alaska south to at least Costa Rica (Reeves et al., 1998a; Mate et al., 1999). Rice (1992) concluded that the California population is separate from that in the Gulf of Alaska and the eastern Aleutians, and this view is supported by other recent work (Barlow, 1995; Calambokidis and Steiger, 1995; Calambokidis et al., 1995).

The eastern North Pacific stock of blue whales feeds off California in summer and fall, and migrates to Mexico to breed and calve in winter and spring. Blue whales occur along the west coast of Baja California from March through July (Gendron and Zavala-Hernández, 1995). They are first observed in Monterey Bay, around the Channel Islands, and in the Gulf of the Farallones in June-July, and are present on the continental shelf in these areas from August to November (Calambokidis et al., 1990; Calambokidis, 1995; Larkman and Veit, 1998; NMFS, 1998; Mate et al., 1999). Based on sighting data collected off southern California from 1992 through 1999 by Cascadia Research Collective (Cascadia Research, unpubl. data), blue whales tend to aggregate in the Santa Barbara Channel along the shelf break (seaward of the 200-m line). Sighting frequencies were highest west of San Miguel Island and along the north sides of San Miguel, Santa Rosa, and the western half of Santa Cruz Island.

It is known that some blue whales do migrate south to Mexican waters in the fall, reaching waters off Baja California in October; calving may occur in subtropical waters farther to the south or offshore (Rice, 1974; Reeves et al., 1998a). Some blue whales apparently remain in lower latitudes, such as waters off Central America and in the Gulf of California, year-round (Leatherwood et al., 1987; Bonnell and Dailey, 1993). Data from radio-tracking experiments indicate that blue whales feeding off California in the summer winter in the vicinity of the Costa Rican Dome (Mate et al., 1999; Stafford et al., 1999), supporting the hypothesis of Reilly and Thayer (1990) that blue whales may select winter habitat suitable for feeding. Mate et al. (1999) hypothesize that, given their larger size and higher absolute energy requirements, blues whales may not be able to fast through the winter reproductive season (as gray and humpback whales do).

Reproduction. In the North Pacific, mating occurs on the wintering grounds from October-November through February or March (Mizroch et al., 1984a). Gestation lasts approximately 10-12 months, and calves are weaned at 6-7 months of age (Leatherwood et al., 1982; Reeves et al., 1998a). Females may calve as often as every 2 to 3 years (Mizroch et al., 1984a). Age at sexual maturity is thought to be 5-15 years (Mizroch et al., 1984a; Yochem and Leatherwood, 1985).

Diet. Blue whales are filter feeders that feed primarily on a variety of euphausiids. In the North Pacific, predominant prey species include *Euphausia pacifica* and *Thysanoessa spinifera* (Rice, 1986; Schoenherr, 1991). *Thysanoessa inermis*, *T. longipes*, *T. raschii*, and *Nematoscelis megalops* also have been reported as prey in the North Pacific (Kawamura, 1980; Yochem and Leatherwood, 1985; Reeves et al., 1998a). Off Baja California, blue whales have also been observed to eat pelagic red crabs (*Pleuroncodes planipes*) (Leatherwood et al., 1982; Rice, 1986). In the Santa Barbara Channel, Croll et al. (1998) recorded blue whales diving to depths where krill concentrations were most dense (mean = 68.1 ± 57.5 m).

Population Status. Blue whales were heavily exploited by commercial whalers following the introduction of modern whaling equipment and techniques in the late19th century. Worldwide, the blue whale population was reduced from a pre-exploitation estimate of 228,000 animals to less than 10,000 (Brownell et al., 1989). The pre-exploitation population of blue whales in the North Pacific has been estimated at 4,500-5,000 animals (Braham, 1984; Leatherwood, et al., 1987). No reliable population estimate exists for the North Pacific, except for the population that summers off California (Reeves et al., 1998a). More than 700 individual blue whales had been photo-identified in California and Mexican coastal waters through 1993 (Calambokidis, 1995), and the best estimate for this stock is 2,134 blue whales (CV = 0.27; Reeves et al., 1998a). Mate et al. (1999) hypothesized that these animals may constitute the largest remnant blue whale population in the world. Although the population appears to be growing, the observed increase in blue whale abundance off California during the past two decades is considered to have been too large to be explained by population growth alone and may be due to a shift in their distribution (Barlow et al., 1997; Reeves et al. 1998a, Carretta et al. 2005).

4.2.2 Fin Whale (Endangered)

Status. The fin whale (*Balaenoptera physalus*) was listed as a federal endangered species on June 2, 1970 (35 FR 8495). No critical habitat has been identified for this species. The draft fin and sei whale recovery plan was issued in 1998, (Reeves et al., 1998b). The main reason for listing was a severe worldwide population decline due to intensive commercial whaling.

Range and Habitat. The second largest cetaceans, fin whales are distributed worldwide. NMFS recognizes three stocks in U.S. Pacific waters: Alaska; California, Oregon, and Washington; and Hawaii (Mizroch et al., 1984b; Barlow et al., 1997; Hill et al., 1997; Reeves et al., 1998b). According to Rice (1974), the summer distribution of fin whales includes immediate offshore waters throughout the North Pacific, from central Baja to Japan and north to the Chukchi Sea. Numbers in these areas peak in late May-early July. In recent years, fin whales have occurred year-round off central and southern California, with peak numbers in summer and fall (Dohl et al., 1981, 1983; Barlow, 1995; Forney et al., 1995). In the Southern California Bight, summer distribution is generally offshore and south of the northern Channel Island chain, particularly over the Santa Rosa-San Nicolas Ridge (Leatherwood et al., 1987; Bonnell and Dailey, 1993). Since fin whale abundance decreases in winter/spring off California (Dohl et al., 1981, 1983; Forney et al., 1995) and Oregon (Green et al., 1992), the distribution of this stock probably extends outside these waters seasonally.

Fin whale migratory behavior in the eastern North Pacific appears to be complex, with either inshore-offshore or north-south movements depending on individual's age, reproductive status, or "stock" affinity (Reeves et al., 1998b). Evidence from serological studies (Fujino, 1960) and field observations (Brueggeman et al., 1987; Stewart et al., 1987a) indicates that fin whales migrate back to the same feeding areas each year. Analysis of data from several studies of humpback whale distribution (Nasu, 1974; Dohl et al., 1983; Brueggeman et al., 1987) shows the relationship of fin whales to the continental shelf, particularly near submarine canyons in Alaska and the shelfbreak in California and Alaska. These are areas that presumably feature seasonal convergence zones where upwelling occurs, resulting in high prey concentrations for feeding whales (Green et al., 1989).

Reproduction. Fin whales breed during the winter, from November through March, in lower latitude oceanic waters (generally between 20° and 40°N), although wintering grounds have not been precisely defined (Rice, 1974; Haug, 1981). The gestation period lasts about 11 months, and calves are usually weaned on the feeding grounds at 6-7 months of age (Leatherwood et al., 1982; Bonnell and Dailey, 1993). Although apparently capable of calving every year, females often rest one or more years between pregnancies (Leatherwood et al., 1982). Sexual maturity apparently occurs at 10 years of age or greater in populations near carrying capacity, and possibly as early as 6-7 years of age in exploited populations (Gambell, 1985b; Reeves et al., 1998b).

Diet. In the North Pacific, fin whales feed primarily on euphausiids (including *Euphausia pacifica*, *Thysanoessa longipes*, *T. spinifera*, and *T. inermis*) and large copepods (mainly *Calanus cristatus*). They also feed to a lesser extent on schooling fish such as herring, walleye pollock, capelin, and lanternfish, and occasionally on squid (Nemoto, 1970; Kawamura, 1982; Leatherwood et al., 1982). Several euphausiid species known to be important to North Pacific fin whales occur only in waters less than 300 m deep (Nemoto and Kayusa, 1965, cited in Green et al., 1989).

Population Status. The world population of fin whales before exploitation may have been as high as 500,000 animals (Gambell, 1985a). Due to their strength and speed, fin whales were not effectively harvested by early whalers, but came to be intensively hunted with the development of modern whaling equipment and techniques in the late 1800's (Tonnesson and Johnsen, 1982; Webb, 1988). By 1976, when fin whales were protected from commercial harvest, the world population had been reduced to approximately 103,000-122,000 animals (Gambell, 1985a).

The pre-exploitation population of fin whales in the North Pacific has been estimated at 42,000-50,000 animals (Ohsumi and Wada, 1974; Tillman, 1975; Allen, 1980). Recent estimates range between 7,890 and 20,000 animals (Ohsumi and Wada, 1974; Rice, 1974; Wada, 1976; Allen, 1980), with approximately 60 percent occurring in the eastern half of the North Pacific (Ohsumi and Wada, 1974). Allen (1980) argued that it would take 25 to 30 years for the eastern North Pacific population to recover to 90 percent of its original levels. Current estimates place the California-Oregon-Washington population at about 750-930 animals (Barlow and Gerrodette, 1996; Barlow et al., 1997). There is some evidence that recent increases in fin whale abundance have occurred in California waters (Barlow, 1994; Barlow and Gerodette, 1996), but these have not been significant (Barlow et al., 1997).

4.2.3 Sei Whale (Endangered)

Status. The sei whale (*Balaenoptera borealis*) was listed as a federal endangered species on June 2, 1970 (35 FR 8495). No critical habitat has been identified for this species. The draft fin and sei whale recovery plan was issued in 1998, (Reeves et al., 1998b). The main reason for listing was a severe worldwide population decline due to intensive commercial whaling.

Range and Habitat. Sei whales are distributed worldwide and are primarily a pelagic, temperate-water species (Leatherwood et al., 1982; Barlow et al., 1997; Reeves et al., 1998b). There are believed to be three stocks in the North Pacific (Mizroch et al., 1984c). In the eastern North Pacific, sei whales migrate northward from wintering grounds in temperate and subtropical waters to feeding grounds that extend from west of the California Channel Islands as far north as the Gulf of Alaska and the Aleutians in the summer (Leatherwood et al., 1982; Mizroch et al., 1984c). Evidence from tag recoveries indicates movement between central California and Vancouver Island (Rice, 1977; Reeves et al., 1998b). Unlike fin whales, sei whales seldom enter the Bering Sea (Leatherwood et al., 1982). The winter range stretches from about 18°30'N latitude off Baja California to near 35°30'N off the central California coast (Leatherwood et al., 1982), but may be centered between 20° and 23°N (Mizroch et al., 1984c). Some individuals apparently approach the equator (Leatherwood et al., 1982).

Reproduction. Sei whales breed mainly on the wintering grounds, from September through March (Rice, 1977). Gestation lasts approximately 12 months (Rice, 1977; Leatherwood et al., 1982). Calves are born in wintering areas and are weaned on summer feeding grounds, approximately 6 to 9 months later (Rice, 1977; Mizroch et al., 1984c). Females most often give birth at 3-year intervals (Rice, 1977; Leatherwood et al., 1982). The mean age at sexual maturity is 10 years (Rice, 1977).

Diet. Sei whales are generally skimming feeders. They are known to prefer copepods, but also take a variety of prey, including euphausiids, small schooling fishes, and squid (Nemoto and Kawamura, 1977; Leatherwood et al., 1982; Bonnell and Dailey, 1993). Off central California, sei whales have been known to consume northern anchovy, Pacific saury, and jack mackerel (Leatherwood et al., 1982).

Population Status. Sei whales were heavily exploited by commercial whalers in the 1960's, following the decline of the fin whale populations; their numbers were reduced from an estimated pre-exploitation world population of 256,000 to about 50,000 whales (Brownell et al., 1989). Pre-whaling abundance in the North Pacific was estimated at 58,000-62,000 by Ohsumi and Wada (1974). Tillman (1977) revised this estimate to 42,000 and further estimated a population of 7,260-12,620 for 1974. The North Pacific population is currently estimated at 22,000-37,000 whales (DOC, 1987).

Sei whales are now rare in California waters (Dohl et al., 1981, 1983; Bonnell and Dailey, 1993; Mangels and Gerodette, 1994; Barlow, 1995; Forney et al., 1995; Barlow et al., 1997). Although there is no current estimate for the sei whale population off California, the population in these waters is believed to be very low, in the tens to several hundreds (Reeves et al., 1998b).

4.2.4 Humpback Whale (Endangered)

Status. The humpback whale (*Megaptera novaeangliae*) was listed as a federal endangered species on June 2, 1970 (35 FR 8495). No critical habitat has been identified for this species. The humpback whale recovery plan was finalized in 1991, (NMFS, 1991a). The main reason for listing was a severe worldwide population decline due to intensive commercial whaling.

Range and Distribution. Humpbacks are distributed worldwide and undertake extensive migrations in parts of their range (Leatherwood et al., 1982). They aggregate from late spring through fall to feed in productive waters of temperate and high latitudes and migrate in winter months to lower latitudes for breeding and calving, which often occur near tropical islands and in shallow coastal waters. In the eastern North Pacific, humpbacks range from arctic waters south to central California in the summer. On their feeding grounds, humpbacks are found primarily on the continental shelf near shallow banks and inshore marine waters (Rice, 1974; Wolman, 1986). Humpback whales winter in three areas: waters off Mexico (Rice, 1974); Hawaii (Baker et al., 1986); and the Marianas, Bonin, and Ryukyu Islands and Taiwan (Nishiwaki, 1959). Whales from all three wintering grounds apparently intermingle during the summer months in Alaskan waters (Baker et al., 1986).

Based on photo-identification work, Calambokidis et al. (1996) concluded that humpback whales off California, Oregon, and Washington form a single, intermixing population, with very little interchange with areas farther north. Whales from this population feed off California through summer and fall (Dohl et al., 1983; Calambokidis et al., 1996). Based on sighting data collected off southern California from 1992 through 1999 by Cascadia Research Collective (Cascadia Research, unpubl. data), humpback whales occur throughout the western two-thirds of the Santa Barbara Channel and, to a lesser extent, in the Santa Maria Basin. As was the case for blue whales, there appears to be a tendency for humpbacks to concentrate along the shelfbreak north of the Channel Islands.

Reproduction. Breeding activity occurs year-round, with a strong winter-spring peak (Leatherwood et al., 1982; NMFS, 1991a). Most calves are born on the wintering grounds between January and March, following a 12-month gestation period (Leatherwood et al., 1982; DOC, 1989), and are weaned after approximately 11 months (Johnson and Wolman, 1984). Female humpbacks give birth approximately every other year, although annual and multi-year calving has been reported (Glockner-Ferrari and Ferrari, 1984; Clapham and Mayo, 1987; Baker et al., 1988; NMFS, 1991a).

Diet. Humpback whales exhibit a variety of feeding behaviors and appear to feed whenever and wherever sufficient concentrations of suitable-sized prey are encountered (Winn and Reichley, 1985; NMFS, 1991a). Major humpback whale prey includes a number of species of small schooling fishes and large zooplankton, mainly euphausiids (Tomilin, 1967; Nemoto, 1970; Wolman, 1986). Fish species eaten by humpbacks in the North Pacific include Pacific herring, capelin, walleye pollock, northern anchovy, eulachon, mackerel, sand lance, cod, salmon, and rockfishes (Rice, 1963, 1977; Frost and Lowry, 1981). Important invertebrate prey includes euphausiids (*Euphausia pacifica*, *Thysanoessa raschii*, *T. spinifera*, *T. longipes*), mysids (*Mysis oculata*), pelagic amphipods (*Parathemisto libellula*), shrimps (*Eualus gaimardii*, *Pandalus goniurus*), and copepods (*Calanus* spp.) (Rice, 1963; Tomilin, 1967; Bryant et al., 1981; Frost and Lowry, 1981).

Population Status. The pre-exploitation world population of the humpback whale has been estimated at about 115,000 animals (Brownell et al., 1989). Made vulnerable by their coastal distribution and gregariousness, humpback whale populations were greatly depleted throughout the world in this century by both land station and pelagic whaling operations (Rice, 1974, 1978; Tønnessen and Johnsen, 1982; Reeves et al., 1985; Brownell et al., 1989). The total humpback population in the North Pacific is now believed to be greater than 3,000 animals (Barlow, 1994; Barlow et al., 1997). The best current estimate for the west coast population is about 600 animals (Calambokidis and Steiger, 1995; Barlow et al., 1997), and there are indications that this population has increased during the past two decades (Barlow, 1994; Barlow and Gerodette, 1996; Barlow et al., 1997).

4.2.5 Northern Right Whale (Endangered)

Status. The northern right whale (*Eubalaena glacialis*) was listed as a federal endangered species on June 2, 1970 (35 FR 8495). The overall range of the North Pacific right whale at the time it was listed extended from about 40ºN to 60ºN. Critical habitat for this species, encompassing a total of approximately 36,750 square nm within the Gulf of Alaska and the Bering Sea, became effective on 7 August 2006. The northern right whale recovery plan was finalized in 1991, (NMFS, 1991b). The main reason for listing was a severe worldwide population decline due to intensive commercial whaling.

Range and Habitat. Right whales apparently migrate from high-latitude feeding grounds toward more temperate waters in the fall and winter. The location of calving grounds is unknown; summer feeding grounds may generally stretch across the North Pacific from about 50° to 63°N (Omura, 1958; Omura et al., 1969). In the northeastern Pacific, the major northern right whale whaling ground was the "Kodiak Ground," which encompassed essentially the Gulf of Alaska and was a major summer feeding ground for the species (Leatherwood et al., 1982). Waters off the eastern Aleutian Islands and in the southern Bering Sea were apparently also important areas of concentration (Braham and Rice, 1984; NMFS, 1991b). Catches of right whales on the summer feeding grounds were widespread on the continental margin, generally away from shore (Townsend, 1935; Brueggeman et al., 1985).

The scarcity of sightings along the west coast of North America suggests that right whales migrate to summer grounds from the western or central North Pacific or well offshore in the eastern North Pacific (Braham and Rice, 1984), although the location of seasonal migration routes is unknown (Scarff, 1986). Reeves and Brownell (1982) concluded that the usual wintering ground of northern right whales extended from northern California to Washington, although sightings have been recorded as far south as 23°N off Baja California and near the Hawaiian Islands (Scarff, 1986; NMFS, 1991b; Gendron et al., 1999). However, Scarff (1986) reviewed the literature and whaling records and concluded that right whales overwinter in the western or mid-North Pacific. Since 1955, five sightings of right whales have been recorded in waters off southern California. However, all these sightings were of individuals and were recorded between February and May (Scarff, 1991; Carretta et al., 1994). Although right whales have, on rare occasions, been recorded off California, there is no evidence that this region was ever important habitat for right whales (NMFS 2006).

Reproduction. Almost nothing is known about the reproductive biology of right whales in the Pacific, although productivity is obviously very low (Leatherwood et al., 1982). The gestation period for North Atlantic right whales is thought to be around 16 months (NMFS, 1991b), and females in that population give birth once every 3-5 years (Knowlton and Kraus, 1989). Sexual maturity apparently occurs between ages 5 and 9 (Knowlton and Kraus, 1989).

Diet. Northern right whales are not known to eat fish; their primary prey includes calanoid copepods, particularly *Calanus cristatus* and *C. plumchrus*, and euphausiids (Omura, 1958; 1986; Omura et al., 1969; Nemoto, 1970; Leatherwood et al., 1982).

Population Status. Northern right whales are the rarest of the endangered cetaceans. In the North Pacific, the population is currently believed to number 100-200 animals, which is considerably below the estimated pre-exploitation size of 15,000 animals (Braham, 1984; NMFS, 1991b). Although northern right whales were hunted for centuries in temperate coastal waters, the major cause for their population decline was 19th-century whaling (Rice, 1974; Scarff, 1986; Brownell et al., 1989). These large, slow moving whales have a thick layer of blubber; attributes which made them a particularly attractive target for the whaling industry in the early 1900s.

From 1855 to 1982, only 23 reliable sightings of Northern Pacific right whale were noted (Scarff 1986). Two of these sightings were made in the Santa Barbara Channel. More recently, since 1996, NMFS and other surveys (directed or otherwise) have detected small numbers of right whales in the southeastern Bering Sea, including an estimated 24 animals in the summer of 2004 (NMFS 2006). This aggregation included three sets of cows with calves, and nearly doubled the currently known population of this species. The southernmost sighting in recent years was made in 1998 off Cabo San Lucas, Baja California, Mexico (Gendron et al. 1999).

4.2.6 Sperm Whale (Endangered)

Status. The sperm whale (*Physeter macrocephalus*) was listed as a federal endangered species on June 2, 1970 (35 FR 8495). No recovery plan has been prepared for this species. The main reason for listing was a severe worldwide population decline due to intensive commercial whaling.

Range and Habitat. The largest of the toothed whales, sperm whales are found predominantly in temperate to tropical waters in both hemispheres (Gosho et al., 1984). In the North Pacific, females and juveniles generally remain south of about 45°N latitude year-round, while adult males range northward as far as the Bering Sea in the summer (Gosho et al., 1984). During the winter, most of the population is distributed south of 40°N (Gosho et al., 1984). Off California, sperm whales are present in offshore waters year-round, with peak abundance from April to mid-June and again from late August through November as they pass by during migration (Dohl et al., 1981, 1983; Gosho et al., 1984; Barlow et al., 1997).

Sperm whales are primarily a pelagic species and are generally found in waters with depths of greater than 1,000 m (Watkins, 1977), although their distribution does suggest a preference for continental shelf margins and seamounts, areas of upwelling and high productivity (Leatherwood and Reeves, 1986). The majority of sightings by Dohl et al. (1983) in their three-year study off central and northern California were in waters deeper than 1,800 m, but near the continental shelf edge.

Reproduction. Sperm whale groups generally fall into two categories: breeding schools (also called harems), and bachelor schools. One or more mature males may be associated with the breeding schools, which form in early spring (Gosho et al., 1984) and consist of females and juvenile males. Bachelor schools consist almost entirely of younger, but sexually mature, males. Older males are generally solitary and join breeding schools only during the mating season.

The sperm whale mating season lasts from April through August (Rice et al., 1986). Gestation lasts 14-15 months, and calves are normally born between June and November (Leatherwood et al., 1982; Rice et al., 1986). Calves are weaned at 1-2 years of age, and females give birth at 3- to 5-year intervals (Leatherwood et al., 1982).

Diet. Sperm whales are deep divers and feed primarily on large squid and deepwater fishes (Leatherwood and Reeves, 1986; Rice, 1988). Stomachs of whales taken or stranded off Oregon, Washington, and British Columbia contained predominantly squid and octopus, with some deepwater rockfish and ragfish (Pike and MacAskie, 1969; Mate, 1981).

Population Status. Prized for the high quality of its spermaceti oil, the species was subjected to two major phases of commercial whaling: during the mid-18th to mid-19th centuries; and in the modern whaling era, particularly between 1946 and 1980 (Gosho et al., 1984; Brownell et al., 1989). Between 1958 and 1975, the annual world catch rose to more than 20,000 animals, with a peak of 27,000 in 1966 (Gosho et al., 1984; Brownell et al., 1989). The eastern North Pacific stock was given protective status from commercial whaling in 1980 (Leatherwood and Reeves, 1986; IWC, 1988). The current world population of sperm whales has been estimated at 1,950,000 animals, down from an estimated pre-exploitation population of 2,400,000 (Brownell et al., 1989). The initial population size for the eastern North Pacific (mature animals only) was estimated at 311,000 animals, and the population is currently estimated at 274,000 animals (Braham 1984).

Using acoustic methods, Barlow and Taylor (1998) estimated 39,200 sperm whales in a 7.8 million-km^2 study area encompassing waters between the U.S. west coast and Hawaii. The sperm whale population off California has been estimated between about 900 and 1,200 animals (Forney et al., 1995; Barlow and Gerrodette, 1996) and appears to be relatively stable (Barlow et al., 1998).

4.2.7 Steller Sea Lion (Threatened)

Status. The Steller, or northern sea lion (*Eumetopias jubatus*) was listed as a federal threatened species on December 4, 1990 (55 FR 50006). Critical habitat identified for this species includes the major California rookeries at Año Nuevo and the Farallon Islands. The Steller sea lion recovery plan was finalized in 1992, (NMFS, 1992). The main reason for listing was a severe decline in the Steller sea lion population, particularly in the Alaskan portions of its range, for reasons that were not clearly understood.

Range and Habitat. The species' range extends along the North American coast from the Bering Strait in Alaska to southern California. At least 90 percent of the species' world population is centered in the Gulf of Alaska, the Bering Sea, and the Sea of Okhotsk (Loughlin et al., 1984). Steller sea lions breed during the summer on rookery islands from the Pribilof Islands, Alaska, south to Año Nuevo Island in central California (Green et al., 1989). Following the breeding season, adult males in California and Oregon move northward into Washington, British Columbia, and Alaska; by the end of October, no adult males are found along the Oregon Coast (Bartholomew and Boolootian, 1960; Gentry, 1970; Mate, 1975; 1981). Female and immature Steller sea lions may not disperse as widely following the breeding season (Green et al., 1989).

Steller sea lions are presently uncommon in southern California waters (Bonnell and Dailey, 1993). A few adult or subadult males occasionally may occupy territories on relict rookeries at the west end of San Miguel Island and adjacent rocks in the summer months, but the last reported pups on San Miguel Island were seen in the summer of 1980 (Stewart, 1980; Bonnell and Dailey, 1993; DeLong and Melin, 2000). North of Point Conception, a few animals have been sighted in on offshore rocks at Point Sal, at Diablo Canyon near Point Buchon, and at Point Piedras Blancas (Bonnell et al., 1983). Off California, Steller sea lion sightings at sea have been concentrated in shallow waters over the shelf and upper slope (<400 m) and within 50 km from land (Bonnell et al., 1983).

Reproduction. The timing of the Steller breeding season is uniform throughout the species' range (Gentry, 1970; Sandegren, 1970; Calkins and Pitcher, 1982). Adult males begin arriving on the rookeries first, in mid-May, and establish territories. Pregnant females arrive in late May and give birth to a single pup (Gentry, 1970; Higgins et al., 1988). Females and pups begin leaving the rookeries in September (Orr and Poulter, 1967), and pups typically remain with their mother through the first year (Le Boeuf, 1981).

Diet. Steller sea lions are known to feed on a variety of nearshore, sublittoral prey in estuarine and marine waters. Jones (1981) reported that Steller sea lions feed mainly on bottom-dwelling fishes, and that all the prey items normally eaten by this species inhabit waters less than about 200 m deep. Common prey of the Steller sea lion includes lamprey, rockfishes, herring, anchovy, salmon, smelts, whiting, pollock, tomcod, greenlings, sculpins, sand lance, flatfishes, midshipman, sharks, skates, squid, octopus, shellfish, and shrimp (Wilke and Kenyon, 1952; Spalding, 1964; Fiscus and Baines, 1966; Jameson and Kenyon, 1977; Antonelis and Fiscus, 1980; Jones, 1981; Roffe and Mate, 1984). Stellers are also known to prey upon the pups of several other species of pinnipeds and on sea otters (Gentry and Johnson, 1981; Pitcher, 1981; Pitcher and Fay, 1982; Hoover, 1988; Byrnes and Hood, 1994).

Population Status. The Steller sea lion population in the U.S., which occurs primarily in Alaska, has declined to less than 75,000 during the past 20 plus years; this is a decrease of approximately 75 percent (Calkins et al., 1999). Although the reasons for this decline are still unclear, recent research indicates that a major factor may be nutritional stress (Merrick et al, 1987; Calkins et al., 1998). This may result from reduction in the abundance or availability of prey and/or a change in prey composition to less nutritious species (Calkins et al., 1998).

Although total numbers in Oregon and California have been relatively stable in recent decades, the overall Steller sea lion distribution appears to have shifted northward (Hill et al., 1997). Once the most abundant sea lion in California, the Steller sea lion has declined in numbers since the 1940s (Bonnot, 1928; Bartholomew, 1967; Le Boeuf and Bonnell, 1980; Bonnell et al., 1981). Ainley and Lewis (1974) hypothesized that the Steller sea lion decline in California might have been connected with the collapse of the Pacific sardine (*Sardinops sagax*) fishery in California in the 1940s and 1950s. Año Nuevo Island is now the southernmost Steller sea lion rookery in the species' range and the largest in California, although it too is decreasing in size (Bonnell et al., 1983). Between 1990 and 1993, pup counts at Año Nuevo dropped from about 310 to 230 (Westlake et al., 1997). Smaller rookeries also exist at Cape Mendocino, the Farallon Islands, and the Point St. George Reef (Bonnell et al., 1983).

4.2.8 Guadalupe Fur Seal (Threatened)

Status. The Guadalupe fur seal (*Arctocephalus townsendi*) was listed as a federal threatened species on December 16, 1985 (50 FR 51252). No recovery plan has been prepared for this species. The main reason for listing was the reduction of the population to near extinction by commercial sealing in the nineteenth century.

Range and Habitat. The Guadalupe fur seal is the only representative of the genus *Arctocephalus* in the Northern Hemisphere (Repenning et al., 1971). Historically, the Guadalupe fur seal apparently ranged northward from Islas Revillagigedo off the coast of Mexico to at least Point Conception (Repenning et al., 1971; Fleischer, 1978; Walker and Craig, 1979). Like the other species of *Arctocephalus*, its numbers were severely reduced by commercial hunting in the nineteenth century, and for many years it was considered extinct (Hubbs, 1956). At present, the species breeds only on Isla de Guadalupe off the coast of Baja California, Mexico, although individual animals appear regularly in the California Channel Islands (Stewart et al., 1987b; Bonnell and Dailey, 1993), and a single pup was born on San Miguel Island in 1997 (DeLong and Melin, 2000).

Little is known about the distribution of Guadalupe fur seals at sea (Gallo, 1994), but recent strandings have been reported from as far north on the California coast as Sonoma County (Antonelis and Fiscus, 1980; Hanni et al., 1993).

Reproduction. Guadalupe fur seals breed during the summer (Peterson et al., 1968; Pierson, 1987; Figueroa, 1994; Gallo, 1994). Adult males arrive on Isla de Guadalupe in late May or early June and establish territories, while females begin arriving on the rookery in June, with the major influx occurring during the last two weeks of the month. Pupping apparently peaks in late July. Females alternate foraging trips to sea with stays on land to nurse their pups; nursing probably continues for at least 8 months. Territorial males leave the rookery by mid-August.

Diet. Limited analysis of Guadalupe fur seal scats and stomach contents indicates that they feed on pelagic squid and schooling fishes such as mackerel and sardine (Hanni et al., 1993; Gallo, 1994).

Population Status. The Guadalupe fur seal population is still small, but is growing; Gallo (1994) calculated the growth rate between 1955 and 1993 to have been 13.7 percent per year and estimated the 1993 population at approximately 7,400 animals.

4.2.9 Southern Sea Otter (Threatened)

Status. The southern sea otter (*Enhydra lutris nereis*) was listed as a federal threatened species on January 14, 1977 (42 FR 2968). The original recovery plan was finalized in 1982 (FWS, 1982). A revised recovery plan was finalized in 2003 (FWS, 2003). No critical habitat has been identified for this species. The main reasons for listing the southern sea otter were 1) its small population size and limited distribution, and 2) the threat of oil spills, pollution, and competition with humans. The current population consists of approximately 2,692 individuals (USGS, 2006).

Range and Habitat. Before commercial hunting began in the late 18th century, sea otters inhabited coastal waters of the North Pacific in an almost continuous band stretching from central Baja California, Mexico, across the Aleutians to the northern islands of Japan (Kenyon, 1969). By 1911, when sea otters were afforded protection under the North Pacific Fur Seal Convention, only 13 isolated colonies remained throughout the species' range; most of these eventually became extinct (Kenyon, 1969; Estes, 1980).

From that low point, the species began slowly to recover. Several surviving Alaskan populations began reoccupying former habitats from Prince William Sound southwest across the Aleutian Islands (Kenyon, 1969). Meanwhile, a small remnant California population in California, near Big Sur, began recovering from a low of about 50 animals around 1914 (Bryant, 1915; Riedman, 1987). Beginning in 1965, efforts were made to recolonize former habitats by translocating Alaskan otters to areas in southeast Alaska, the Pribilof Islands, British Columbia, Washington, and Oregon (Jameson et al., 1982; Riedman, 1987).

Since early part of this century, the California sea otter population has expanded much farther southward than northward from its initial location near Point Sur. Sea otters now range in nearshore waters from near Año Nuevo Island south to approximately Point Conception (Riedman, 1987; FWS, 2000; USGS 2006). Northward expansion had more or less stopped at Año Nuevo by the mid-1990s (FWS, 2000); however, 20 otters were sighted between Point Año Nuevo and a point 30 miles north in the late 1990s (CDFG, 1998). In contrast, by 1995, sea otters were relatively common as far south as Point Arguello and were routinely sighted near Point Conception (FWS, 2000).

In spring 1998, about 100 sea otters were sighted south of Point Conception (FWS, 2000). By mid-summer, most of these otters had presumably returned to waters north of the point. However, by January 1999, more than 150 animals were again counted south of Conception (FWS, 2000). As late as May 1999, tens of otters were still present along the Santa Barbara Channel shoreline as far east as Goleta Point (USGS, unpubl. data). This trend continued into 2005, when more than 88 otters were spotted east of Point Conception during the spring census survey (USGS 2005). Currently, excluding the remaining colony at San Nicolas Island, the range of the mainland population currently extends from Half Moon Bay in the north to Goleta in the south (USGS, 2005).

Sea otters typically inhabit shallow nearshore waters with rocky or sandy bottoms supporting large populations of benthic invertebrates (Riedman, 1987). Observed densities are higher over rocky (about $5/km^2$) than sandy habitat (about $0.8/km^2$) (Riedman and Estes, 1990). In California, otters live in waters less than 18 m deep and rarely move more than 2 km offshore (Riedman, 1987).

Sea otter home ranges generally consist of several heavily used areas connected by travel corridors (Riedman and Estes, 1990). Males generally have larger home ranges, due in part to seasonal movements they make to either end of the parent range. These migrations coincide with the breeding season (June to November) and the non-breeding season (November to May). During the breeding season, the size of the southernmost group declines dramatically, due to a general northward movement of animals towards the center of the range (Bonnell et al., 1983; Estes and Jameson, 1983). This movement of males from the population fronts into the more established areas occupied by females during the summer and fall breeding season is a feature of the sea otter's annual cycle (Bonnell et al., 1983). Recent studies also suggest that resource limitations near the center of the otter’s range may be influencing these migration movements (USDOI/MMS 2006). Female otters are more sedentary, but are also known to travel long distances (Riedman and Estes, 1990).

Breeding males maintain territories in female areas seasonally, excluding juvenile and subordinate males from their areas (Garshelis and Garshelis, 1984; Ralls and Siniff, 1990). They generally join male groups in the winter and spring (Riedman and Estes, 1990; FWS, 2000).

Reproduction. Sea otters breed and pup throughout the year in all parts of the range, but there appear to be one or more peaks in most areas (Riedman, 1987; Rotterman and Simon-Jackson, 1988). In California, peak pupping occurs from January through March (Riedman and Estes, 1990). Females typically give birth to a single pup (Jameson and Bodkin, 1986; Riedman, 1987), and births occur both on land and in the water (Kenyon, 1969; Jameson, 1983). Although the time between fertilization and implantation of the embryo may vary substantially, the period between copulation and parturition appears to last about 6 months (Riedman, 1987; Rotterman and Simon-Jackson, 1988; Jameson and Johnson, 1993). Pups remain with their mothers for approximately 6 months, and the normal pupping interval for females that successfully raise pups to independence appears to be a little over a year (Wendell et al., 1984; Rotterman and Simon-Jackson, 1988; Jameson and Johnson, 1993).

Diet. Sea otters have high metabolic demands and may consume up to 23-33 percent of their body weight per day (Riedman and Estes, 1990). Ralls and Siniff (1990) found that sea otters in California tend to be crepuscular in activity, resting mainly in the middle of the day; they estimated that California otters spend 35 to 50 percent of their time foraging.

California sea otters feed almost entirely on macroinvertebrates (Ebert, 1968; Wild and Ames, 1974; Estes et al., 1981). In rocky areas along the central California coast, major prey items include abalones (*Haliotis* spp.), rock crabs (*Cancer* spp.), and sea urchins (*Strongylocentrotus* spp.), and, in areas where populations of principal prey species have been reduced, kelp crabs (*Pugettia* spp.), clams (various spp.), turban snails (*Tegula* spp.), mussels (*Mytilus* spp.), octopus (*Octopus* spp.), barnacles (*Balanus* spp.), scallops (*Hinnites* spp.), sea stars (*Pisaster* spp.), chitons (*Cryptochiton stelleri*), and echiuroid worms (*Urechis caupo*) (Boolootian, 1961; Ebert, 1968; Estes, 1980; Estes et. al., 1981; Wendell et al., 1986, USFW 2003, USDOI/MMS 2006). These species occur at water depths ranging from the littoral zone to approximately 100 m (328 feet). Not surprisingly, most of the animals occur between shore and the 20 m (65 feet) water depth (USFWS, 2000).

In sandy areas, sea otters prey primarily on bivalve molluscs, such as Pismo clams (*Tivela stultorum*), which are a principal prey item in sandy areas in Monterey and Morro Bays, gaper clams (*Tresus nuttalii*), and Washington clams (*Saxidomus nuttali*) (Wade, 1975; Stephenson, 1977; Wendell et al., 1986; Riedman and Estes, 1987). Sea otters in California have occasionally been observed to prey on seabirds (VanWagenen et al., 1981), but predation on fish is very rare (Hall and Schaller, 1964; Miller, 1974; Estes et al., 1986). Diet and foraging strategies apparently differ significantly among individuals; individual females tend to specialize in one to three types of prey (Lyons and Estes, 1985).

Population Status. Kenyon (1969) estimated the original North Pacific sea otter population at 100,000 to 150,000 animals, while Johnson (1982) suggested that there may have been as many as 300,000 before exploitation by the fur trade decimated the population between 1741 and 1911(Kenyon 1975). However, taxonomic investigations conducted in the early 1990’s (Wilson et al., 1991) support recognition of the California sea otter, or southern sea otter, as a distinct subspecies, *Enhydra lutris nereis*. The southern sea otter population is estimated to have numbered approximately 14,000 animals before the onset of commercial hunting (FWS, 1995a), and is currently estimated at about 2,692 individuals (USGS 2006).

By 1911, when sea otters were first protected by international treaty, sea otters were no longer found off the Oregon or Washington coasts, and were thought have been extirpated from California waters as well. The present population in California is descendent from a remnant group of less than 50 animals that were rediscovered at Bixby Creek, near Big Sur. The remnant California population began recovering from a low of about 50 animals around 1914 (Bryant, 1915; Riedman, 1987). The California sea otter population grew steadily at a rate of about 5 percent per year until the mid-1970's, when it was estimated to contain nearly 1,800 animals (Riedman, 1987; Riedman and Estes, 1990). The population then began declining, due to increased mortality from entanglement in set nets (Wendell et al., 1985), reaching an estimated low of fewer than 1,400 animals in 1984. A series of restrictions on nearshore net fisheries culminated in 1991, when the State of California closed waters less than 30 fathoms deep to fishing with nets. Soon thereafter, sea otter numbers began increasing, and a peak spring count of 2,377 was recorded in 1995 (FWS, 2000). However, following that survey the number of otters seen during the annual spring surveys declined steadily until 1999, when 2,090 sea otters were counted, representing a 12-percent decrease over the preceding four years (FWS, 2000). Numbers increased again in May 2000, when 2,317 sea otters were counted, an almost 11 percent increase over the previous year.

Recent otter surveys coordinated by the US DOI (USGS, 2003, 2004, 2005, 2006) off the coast of California have shown substantial increases in the otter population. For example, spring sea otter counts offshore California ranged between 2,095 in 1995 to 1,858 in 1999. However, the most recent spring survey, completed in May 2006 counted 2,692 sea otters, the third highest count on record (USGS 2006). As individual year counts may be highly influenced by survey conditions, the final revised recovery plan for the southern sea otter recommends using the 3-year running average as the official benchmark of the sea otter population status (USFW 2003).

Range expansion to the south has brought an increasing number of otters into the project area. In spring of 2005, close to 200 otters were observed in the region extending from Point Purisma to Point Conception during the semi-annual census (USGS 2005; Hatfield, pers. comm.). Additionally, during this same survey, a large raft of over 88 otters was observed to the east of Point Conception. As such, otters seen south of Point Purisma comprised approximately 10% of the total 2005 population of 2,735 (USGS 2005).

Since 1997, the annual spring sea otter counts east of Point Conception have steadily increased. During the spring 1997 survey, 60 independent sea otters were counted east of Point Conception (USGS 1999). By 2000, this number had increased to 79 (USGS 2000). More recently, during the 2005 spring survey, around ninety independent sea otters (and zero pups) were spotted east of Point Conception (USGS 2006; Hatfield USGS, pers. comm.). One recent hypothesis for the increasing seasonal presence of otters at the southern end of their range is that it is a response to density pressures occurring near the middle of the otters' range (MMS 2006). In 2006, the southern-most otter sighting occurred at Tajiguas, Santa Barbara County, just west of Refugio State Beach (Hatfield USGS, pers. comm.).

Between August 1987 and July 1990, the U.S. Fish and Wildlife Service translocated 139 sea otters from the central California range to San Nicolas Island (FWS, 2000). Of these, 36 are known to have returned to the parent population range, 10 were captured in the management zone and returned to the parent range, 15 are known to have died, and the fate of the remaining animals is unknown. Bimonthly counts have indicated no significant change in the population (range 6-17) since July 1990. In 2002, the translocated colony at San Nicolas Island contained approximately 27 individuals, including pups. The presumed causes for this include poor recruitment (failure of pups to reach maturity), immigration, and mortality (FWS, 1995b, 2000). Of the 50 sea otter pups known to have been born at San Nicolas Island as of December 1998, 6 died, 13 weaned successfully (but subsequently disappeared), and the fate of the remaining 31 is unknown (FWS, 2000). Approximately 32 sea otters were present at San Nicolas Island in spring 2006 (Hatfield USGS, pers. comm.).

4.3 BIRDS

4.3.1 Brown Pelican (Endangered)

Status. The California brown pelican (*Pelecanus occidentalis*) was listed as endangered on October 13, 1970 (35 FR 8320). To date, no critical habitat has been designated for this species. A recovery plan for this species was finalized in 1983 (FWS, 1983). The main reasons for listing this species were low reproductivity due to pesticide effects and food scarcity. A petition to delist the brown pelican was received by USFWS in December 2005. A status review by USFWS to determine if the proposed delisting is warranted is currently under way; the decision is expected in December 2006.

Range. The overall range of the California subspecies of the brown pelican extends from British Columbia to the coast of southwest Mexico, but the species' current breeding range is much more restricted. Most pelicans nest on islands in the Gulf of California (Baja California) and on the Tres Marias Islands off mainland Mexico near the city of Nayarit (FWS, 1983). In the U.S., pelicans historically nested in several locations including Anacapa Island, Santa Barbara Island, Prince Island, Scorpion Rock, and even as far north as Point Lobos near Monterey. However, they currently nest only on Anacapa and Santa Barbara Islands in the Southern California Bight. Although a few pairs nested on Scorpion Rock during the 1970s, this site is considered unlikely to be used in the future due to high levels of human activity in the area. Listing of the California brown pelican was based primarily on serious declines observed in the Southern California Bight population of this subspecies. Other populations of brown pelicans (those nesting in the Gulf of California and along the west coast of southern Baja California and mainland Mexico) did not suffered colony-wide reproductive failures to the degree that the southern California population did, although human disturbance has been an increasing source of concern in these areas (FWS, 1983).

Habitat. Most pelicans seen foraging off the coast of California have been sighted within 20 km (11 nm) of the coast; however, a few individuals have been recorded over waters deeper than 3,000 m (1,640 fm) and at distances of 88 km (48 nm) off the coast of central California (Briggs et al., 1987). The preferred nesting habitat is on offshore islands, although some individuals nest in mangroves along the Mexican coast.

Roosting Sites. Because brown pelicans have wettable plumage, as is typical for many other members of the order Pelecaniformes, they must have terrestrial roost sites for drying their plumage after feeding or swimming, and for resting and preening. Roost sites, therefore, are considered essential habitat for this species. Roosting habitat includes offshore rocks and islands, river mouths with sand bars, breakwaters, pilings, jetties, and estuaries (FWS, 1983). Pelicans usually return to specific coastal roosts each day (usually by late afternoon, but sometimes not until several hours after sunset) and do not normally remain at sea overnight. Night roosts are usually in regions with high oceanic productivity and isolated from predation pressure and human disturbance. Pelicans may also periodically return to land during the day to rest, but requirements for daytime roosts are less restrictive, and these roosts are more numerous and usually much smaller than night roosts (Briggs et al., 1983; Jacques and Anderson, 1987).

Based on Jaques and Anderson's research (1987), pelican roosts are widespread and abundant in the general area of concern for the Rocky Point Unit. Important pelican roost areas include the area between Morro Bay and Point Sal (especially the Pismo Beach and Diablo Canyon areas and the Santa Maria River mouth), where offshore rocks, estuaries, and beaches are used primarily. Very few offshore rocks exist to the south, and along the southern coast primary roost sites include breakwaters, jetties, and other man-made structures. Undisturbed coastal stretches of Vandenberg AFB have also become a roosting area for pelicans. One of the most important roosting areas along the southern coast is the breakwater at the Long Beach Harbor, which is located outside the general area of concern for this analysis. Other, less regularly used roost sites include Pt. Mugu Lagoon, the Santa Clara River mouth, and the Marina del Rey breakwater. The greatest number of pelicans, however, uses the Channel Islands (especially Santa Cruz Island) and the many offshore rocks in that area for roosting.

Reproduction. The breeding season for brown pelicans off California is generally from March through early August, although breeding may begin as early as January in some years (FWS, 1983). Mexican colonies are frequently active several weeks or even months before those in California, with egg laying at some beginning as early as November. Pelicans generally do not breed until they are three to five years old. They mainly lay clutches of three eggs, with incubation estimated to last for about 30 days; young birds are able to fly by about 9 weeks of age

Diet. The northern anchovy (*Engraulis mordax*) is the primary prey species of the brown pelican (FWS, 1983). Estimates of the portion of the pelican's diet consisting of anchovies range as high as 90–95 percent (FWS, 1981). Other prey species include Pacific sardine (*Sardinops sagax*) and Pacific mackerel (*Scomber japonicus*) (Thelander and Crabtree, 1994).

Migration. After the breeding season, pelicans begin to disperse along the Pacific coast to as far north as British Columbia, and as far south as the southwestern coast of Mexico (FWS, 1983). Since the breeding season for pelicans nesting in Mexico may begin and end earlier than for those in California, large numbers of pelicans may begin moving northward into the Southern California Bight as early as May. Pelicans usually begin appearing north of Point Conception by July, with numbers increasing through September and October. Although the intensity and extent of the northward movement of post-breeding pelicans depends largely on oceanographic conditions that influence prey availability (Anderson and Anderson, 1976), relatively large numbers of pelicans have become a regular late summer to early autumn feature along the coast of southern Oregon in recent years as the population has expanded. Since 1985, as many as a few thousand birds may be present at the period of peak abundance in late summer (R. Lowe, pers. comm., cited in Briggs et al., 1987). Currently, several hundred pelicans may also occur in southern Washington during the peak period (D. Jaques, pers. comm., cited in Briggs et al., 1989). Pelicans begin to disappear from the northern portions of their range in November. From December through March, when pelicans are nesting to the south, fewer than 500 remain north of Point Conception (Briggs et al., 1987).

Reasons for Decline. The history of the California brown pelican's decline due to pesticides and scarcity of food (i.e., anchovies) is well documented in the literature (Schreiber and DeLong, 1969; Jehl, 1973; Gress, 1970; Risebrough et al., 1971; Anderson, 1977; Keith et al., 1971; Anderson et al., 1975; Anderson and Gress, 1983) and is summarized in the Brown Pelican Recovery Plan (FWS, 1983). These reports identified the drastic decline in abundance of brown pelicans observed in the mid-1960s and early 1970s to be primarily due to bioaccumulation of chlorinated hydrocarbon pesticides (DDT, DDE, dieldrin, and endrin) in the pelican's food chain. Bioaccumulation of these pesticides resulted in serious eggshell thinning and poor reproductive success (Schreiber and Risebrough, 1972). Food scarcity (primarily anchovies) on the west coast also contributed to the species' decline (Keith et al., 1971). Although the effects of pesticides linger, pelicans are now successfully breeding on Anacapa and Santa Barbara Islands, as well as on the small islet of Prince Island, in the Southern California Bight. A colony also occurs on the Mexican Islas Los Coronados, but this colony has not been surveyed since 1993 (F. Gress, UC Davis, pers. comm.).

Food Scarcity. Prey availability (i.e., northern anchovy availability) remains an ongoing problem for the brown pelican. Anchovy abundance and distribution may fluctuate widely from year to year, and a well-documented relationship exists between anchovy abundance and pelican reproductive success (FWS, 1983). Anchovies are found from British Columbia to the tip of Baja California and in the Gulf of California, but they are most abundant from Pt. Conception south. They can be found from the surface to depths over 1,000 feet and from the surf zone out to at least 300 miles. Adult anchovies are pelagic schooling fish, generally found offshore in fall and winter and moving inshore in spring, and generally occur well below the surface during the day and nearer the surface at night (see Ganssle, 1973). Adults rarely live more than four years. The eggs are planktonic in the upper water layers, and hatch at two to four days of age. Most spawning occurs within 60 miles of shore in all seasons, but is heaviest in late winter and spring. The larvae are planktonic in the upper water layers. Young fish move into very shallow water where they transform into juveniles in about 70 days. Warm water years slow the growth rates of northern anchovies, perhaps due to low food supply.

Biomass of northern anchovy in the central subpopulation, which supports most of the U.S. fisheries, averaged 400,000 metric tons (t) from 1964 to 1970, increased rapidly to 1,800,000 t in 1974, and then declined to 490,000 t in 1978. Since 1978, biomass levels have tended to decline slowly. The biomass in 1989 was 261,000 t. The decline is believed to be due to warm water conditions since the mid-70's and recent increases in sardine biomass (Love, 1996). However, biomass appears to be on the increase in recent years. The most recent stock estimate of spawning biomass of northern anchovy is 388,000 t during February 1995 (Jacobson et al., 1995). Although the stock has not been reassessed since 1995, the abundance and biomass of northern anchovy in February 1997 was at least as high as in 1995 based on a qualitative assessment of existing data (Jacobson, et al., 1997).

Northern anchovy fisheries are managed under the Coastal Pelagic Species Fishery Management Plan. Historically, anchovy were harvested for reduction into fishmeal, oil, and soluble protein products. Other uses include human consumption (fresh, frozen, canned, and paste), and as bait (live and frozen for recreational fisheries). Landings by the United States have varied from less than 10,000 t to nearly 140,000 t (see NMFS, 1999). Since 1983, U.S. landings have been low (less than 10,000 t), and they have been used mostly for live bait and other nonreduction uses.

Population Status. Currently, California Brown Pelicans have an estimated population of approximately 200,000 birds. A petition to delist the brown pelican was received by USFWS in December 2005. A status review by USFWS to determine if the proposed delisting is warranted is currently under way; the decision is expected in December 2006.

Historical accounts of pelican abundance on Anacapa Island and/or the Southern California Bight are sketchy at best, but indicate that at least a few thousand pelicans nested on Anacapa during the first half of the twentieth century (FWS, 1983). Beginning in the 1950s, the breeding population on Anacapa went through a slow decline, and the maximum number of pairs during the 1950s and 1960s was about 1,000 (Anderson and Anderson, 1976). By 1968, however, the Anacapa breeding population had crashed, and a survey conducted that year found no more than 100 pairs (FWS, 1983). During the 1969 breeding season, no more than four young were successfully fledged on Anacapa due to eggshell thinning from DDT. With the banning of DDT in 1972, the number of nesting pairs and reproductive success increased. In 1981, on Anacapa, there was an average of 2,946 breeding attempts, which produced 1805 young that survived to fledging. However, the number of nesting pairs and productivity remain highly variable from year to year probably due to fluctuations in the abundance of northern anchovy. Based mainly on the work of Gress, the number of nests on Anacapa between 1981 and 1992, ranged from 628 in 1984 to 6,326 in 1987 (nesting attempts and productivity data are summarized in Ingram and Carter, 1997). In 1991, Carter et al. (1992) working jointly with Gress (1992) estimated the number of breeding pairs on West Anacapa Island at 5,340. The number of nests continued to be highly variable throughout the 1990s. In 1998 there were only about 2,500 nesting attempts on West Anacapa (F. Gress, UC Davis, pers. comm.), while in 1999 there were about 5,300 nesting attempts. At least some of the variation observed in the 1990s was due to El Niño effects.

Although most of the breeding population (4,000 to 6,000 pairs) still nests on West Anacapa Island, smaller populations have become established on several of the other islands. In 2005, the first-known nesting at Middle Anacapa Island occurred, small numbers were found breeding on East Anacapa Island (only the second time since 1928), and an expanded distribution of pelican nesting was observed at Santa Barbara Island. Most recently, in May 2006, 43 pelican nests were found on Prince Island, a small islet off San Miguel Island. These are the first nests seen in this location since 1939.

Prior to the 1980s, nesting pelicans used Santa Barbara Island only sporadically. However, beginning in 1985, when there were 1,046 nests on the island, pelicans have nested every year (nesting attempts and productivity data are summarized in Ingram and Carter, 1997). Currently, the pelican population on Santa Barbara Island averages between 400-700 nests each year (CINPS 2006), and remains second in size only to that found on West Anacapa Island. Estimates of the breeding population size for the pelican were around 6,000 pairs in 1991. The breeding season for brown pelicans extends from March through early August. The population trend of the California Brown Pelican is unknown at this time (CDFG 2004b); however a status review by USFWS to determine if delisting of the California Brown Pelican is warranted is currently under way (FWS 2006).

Another historically important Southern California Bight colony is located in the Mexican Islas Los Coronados, located about 27 km (17 mi) south of San Diego. From the late 1880s until 1920, about 500-1,000 pairs nested predominately on the northern island (FWS, 1983). Peak abundance probably occurred in the 1930s when somewhat more than 5,000 pelicans nested on the islands. The colony declined throughout the 1950s and 1960s to as few as 300 pairs by about 1970. In 1993, the last time the colony was surveyed, there were only about 600 pairs on the islands (F. Gress, pers. comm.).

4.3.2 California Least Tern (Endangered)

Status. The California least tern (*Sterna antillarum browni*) was listed as endangered on October 13, 1970 (35 FR 16047). A recovery plan for the species was published in 1980 (FWS, 1980b), but critical habitat has not been designated. The main reasons for listing this species were loss of habitat, human disturbance, and predation. Recently, on October 2, 2006, the FWS announced the completion of a 5-year review of the status of the California least tern, wherein they recommended it for downlisting from endangered to threatened.

Range. The breeding range of the California least tern, which the population occupies from about April to September each year, extends from San Francisco Bay south to northern Baja California, Mexico. The winter range of the California least tern is somewhat unknown, but probably extends from the Pacific coast of southern Mexico south to Central America, and possibly South America.

During the last 20-25 years, about 50 sites in California have been occupied by nesting least terns at some time (Fancher, 1992; Caffrey, 1995). These range from Pittsburg in northern California to the Tijuana River mouth at the south end of the state. However, the number of sites actually used fluctuates from year to year, as potential nesting areas become available naturally or through site preparation efforts, or unavailable due to natural or human disturbance and/or predation. Fewer sites have been used in recent years; for example, only 35 sites were used in 1996 (Caffrey, 1998). Furthermore, the number of nesting pairs is concentrated at only a few locations. In 1996, 7 of the 35 sites used that year accounted for 58% of the breeding pairs (Caffrey, 1998). These seven sites were NAS Alameda, Venice Beach, Huntington Beach, Santa Margarita River/North Beach, Mission Bay/FAA Island and Mariner's Point, and Delta Beach/North.

Habitat. Nesting colonies are usually located on open expanses of sand, dirt, or dried mud, typically in areas with sparse or no vegetation. Colonies are also usually in close proximity to a lagoon or estuary where they obtain most of the small fish they consume, although they may also forage up to 3-5 km (2-3 miles) offshore. Least terns are fairly faithful to breeding sites and return year after year regardless of past nesting success.

Reproduction. Least terns usually begin arriving in southern California in April. Nests consist of a shallow scrape in the sand, sometimes surrounded by shell fragments. Eggs (usually two per clutch) are laid from mid-May to early August. Incubation takes 20-28 days, and young fledge in about 20 days (FWS, 1980b). Least terns breed after their second year, and first-time breeders are more likely to nest later in the breeding season (Massey and Atwood, 1981). For a detailed account of least tern reproductive biology, see Thompson et al. (1997).

Diet. Least terns are opportunistic feeders known to capture more than 50 species of fish. Prey species include the northern anchovy (*Engraulis mordax*), deepbody anchovy (*Anchoa compressa*), jacksmelt *(Atherinopsis californiensis)*, topsmelt *(Atherinopsis affinis)*, California grunion *(Leuresthes tenuis)*, shiner surfperch *(Cymatogaster aggregata)*, California killifish *(Fundulus parvipinnis)*, and mosquitofish *(Gambusia affinis)*.

Migration. As mentioned above, least terns arrive in California in April. Early arrival dates include April 8, 1978 for San Diego (Garrett and Dunn, 1981) and April 27, 1976 for Santa Barbara (Lehman, 1994). The southward migration of least terns may begin as early as August and few, if any, terns remain in California after late September (Garrett and Dunn, 1981). The migration route and winter distribution of these birds remains mostly unknown, although they probably winter along the Pacific coast of southern Mexico and Central America.

Reasons for Decline. Although loss of habitat and human disturbance were the primary reasons for the decline of least terns in California, predation continues to be an ongoing problem for the species. Least tern chicks are preyed on by several mammalian and avian species, including coyotes (*Canis latrans*), red fox (*Vulpes vulpes*), domestic cats (*Felis domesticus*), American kestrels (*Falco sparverius*), northern harriers (*Circus cyaneus*), red-tailed hawks (*Buteo jamaicensis*), and western gulls (*Larus occidentalis*). One predator, the American crow (*Corvus brachyrynchus*), has become a major problem in recent years. With the ever-increasing urbanization of American crows, this species is now occupying many coastal areas of southern California where they are preying on least tern nestlings. During the 1999 breeding season, all the nests at the important Venice Beach colony were lost to crows.

Population Status. In 1970, when California least terns were listed as endangered by the federal government and California, their population in California was estimated at 600 breeding pairs. Population growth rates have increased, especially since the mid-1980s, when active management for least terns was initiated. Management of California least tern colonies has included intensive monitoring of nesting colonies, site preparation to reduce vegetative cover, protection of sites by means of reduced access to humans, and predator management. Although the increase in the breeding population has not been consistent from year to year (there were only about 2,598 pairs in 1995 vs. 2,792 in 1994; Caffrey 1995, 1997, 1998; Keene 2000), the long-term trends have shown steady population growth. This, despite a decline of more than 10 percent occurred from the 1998 to 1999 when the population dropped from a peak of 4,141-4,182 pairs down to only 3,493-3,711 pairs. By 2004, however, the population was back up, with an estimated 6354-6805 pairs establishing nests (Marschalek 2005). Fluctuations in the least tern population are thought to be attributable to a combination of high levels of predation and low prey availability.

In the general area of concern for the Tranquillon Ridge Unit, from 1994 onward, as many as 12 sites have been used for nesting by least terns, depending to some degree on how some sites have been lumped or split in different years (Caffrey 1995, 1997, 1998; Keane 1998, 2000; Marschalek 2005). However, nesting site fidelity among least terns appears to be patchy, and may depend heavily on local prey availability. Only 7-9 of these sites were in use in any one year, again depending on how they were tabulated. The general locations of these sites are: Oceano Dunes, Guadalupe Dunes, Mussel Rock Dunes, Vandenberg Air Force Base (Beach 2 and Purisima Point), Santa Clara River mouth, Ormond Beach (3 sites), Pt. Mugu, and Venice Beach. The number of pairs at most of these locations has generally been low (<50); however, both Venice Beach and Pt. Mugu have periodically hosted large numbers of nesting terns. Venice Beach is often one of the largest colonies in California, and had 383 pairs in 1998 (Keane, 2000). In 2004, however, although several hundred terns were observed at Venice early in the season, a food (anchovy) shortage was believed fingered as the culprit for why only 17 pairs attempted nesting at this location (Marschalek 2005). In contrast, Pt. Mugu had 490 pairs in 2004, while for the last several years, neither of the two Vandenberg sites has produced more than one or two successful nestings (Marschalek 2005).

The implementation of protected beach areas for the Western Snowy Plover at Coal Oil Point Reserve in Goleta has had the added benefit of increasing the appeal of this location for least tern nesting. Beginning in 2004, small numbers of terns have begun to attempt to nest there. Most recently, in 2006, five chicks were successfully hatched at this location.

4.3.3 Bald Eagle (Threatened)

Status. In 1978 (43 FR 6233), the bald eagle (*Haliaeetus leucocephalus*) was listed as endangered throughout the lower 48 states except Washington, Oregon, Minnesota, Wisconsin, and Michigan, where it was listed as threatened. The main reasons for listing this species were the harmful effects of pesticides, especially DDT, and habitat loss. A recovery plan for the Pacific recovery region was approved in 1986 (FWS, 1986). The bald eagle was reclassified in 1995 from endangered to threatened throughout the lower 48 states as a result of the significant increase in numbers of nesting pairs, increased productivity, and expanded distribution (60 FR 36000). Critical habitat has not been designated for this species. The bald eagle was proposed for delisting in 1999 (50 FR 36453). The delisting review process is still ongoing at this time.

Range. The bald eagle occurred historically throughout North America except extreme northern Alaska and Canada and central and southern Mexico. Bald eagles nest on both coasts from Florida to Baja California, in the south, and from Labrador to the western Aleutian Islands, Alaska, in the north.

Habitat. Although the nesting habitat of bald eagles varies somewhat from area to area, one important characteristic shared by most eagles is proximity to water; most eagles nest within 0.8 km (0.5 miles) of a coastal area, bay, river, lake, or other body of water. In winter, bald eagles often congregate at specific wintering sites that are generally close to open water and that offer good perch trees and night roosts.

Diet. Fish, whether scavenged or live, is the primary food of most bald eagles (Bent, 1937; Stalmaster, 1987), which often steal from other species. Carrion can make up a large portion of their diet, but they also prey on birds and mammals (Bent, 1937; Retfalvi, 1970; Dunstan and Harper 1975; Sherrod et al., 1977; DeGange and Nelson, 1982; Grubb and Hensel, 1978; Stalmaster, 1987). On Santa Catalina Island in the Southern California Bight, the main prey (Garcelon 1994a) consists of fish (86 percent), followed by birds (10 percent), and sea lions (2 percent).

Reproduction. The bald eagle nests in tall trees located near coastal areas, lakes, and rivers. The same nest may be used for several years in the absence of disturbance (McVey et al., 1993). Bald eagles mature slowly; most probably do not breed until they are 4-5 years of age. Eagles usually lay 1-3 eggs per year, although they do not necessarily nest every year. Bald eagles are relatively long-lived, and adult mortality is believed to be only 5-10 percent per year (Sherrod et al., 1977; Grier, 1980). However, as with most birds of prey, immature and sub-adult mortality is thought to be very high, and over 90 percent do not survive.

Reasons for Decline. The status of the bald eagle has been a concern since at least the late 1800s, and the bald eagle was one of the first species to be listed as endangered under the original Endangered Species Preservation Act of 1966 (16 U.S.C. 668aa-668cc). Several historic accounts mention that noticeable population declines occurred prior to 1900, and widespread shooting for feathers and trophies led to extirpation of eagles in some areas. Shooting also reduced part of the bald eagle's prey base. Big game animals like American bison (*Bison bison*), which were seasonally important to eagles as carrion, were decimated. Waterfowl, shorebirds and small mammals were also reduced in numbers. Loss of nesting habitat from forest clearing and development also contributed to the species' decline. By 1940, declines had been mentioned in articles describing nesting populations in at least 12 states, including California (Green, 1985). Based on these declines, Congress passed the Bald Eagle Protection Act of 1940 (16 U.S.C. 668-668d); at that time, the major problems affecting the species were habitat loss and shooting. The effect of DDT on avian reproduction is well known, and, beginning in 1947 (although the cause was unknown then), its effect on bald eagles could be seen by the dramatic decline in reproductive success that occurred in several nesting areas. Bald eagle reproductive success remained at extremely low levels through at least the early 1970s, when the use of DDT was banned in the U.S. Other human-related mortality factors that have contributed to the decline or extirpation of historic nesting populations include electrocution, poisoning (especially lead poisoning acquired through ingestion of lead shot), and disturbance from various activities such as logging, mining, and recreation. However, the two most important factors besides DDT are probably shooting and habitat loss. Although mortality from shooting has been reduced extensively, habitat loss continues to be a problem throughout the species' range, affecting both nesting and wintering populations.

Population Status. An estimated quarter to a half million bald eagles lived on the North American continent before the first Europeans arrived. A partial survey conducted by the National Audubon Society in 1963 reported 417 active nests in the lower 48 States, with an average of 0.59 young produced per nest. Surveys coordinated by the Fish and Wildlife Service in 1974 (see 50 FR 36453) resulted in a population estimate of 791 occupied breeding areas for the lower 48 States. Since that time, the bald eagle population has increased significantly, essentially doubling every 7 to 8 years during the past 30 years. Currently, around 7,066 breeding pairs are thought to exist, with 160 nesting pairs found in California. Additionally, in the spring of 2006, two bald eagle chicks hatched from separate nests on Santa Cruz Island. This was the first time bald eagles have successfully reproduced on the Channel Islands without human help since 1949.

In 1998, the estimated breeding population of bald eagles exceeded 5,748 occupied breeding areas (see 50 FR 36453). In the recovery plan for the Pacific Recovery Region (FWS, 1986) the goals for delisting bald eagles included a minimum of 800 nesting pairs with an average reproductive rate of 1.0 fledged young per occupied breeding area, and an average success rate for occupied breeding areas of not less than 65 percent over a 5 year period. These goals have mostly been met since 1995, and in 1999, the FWS proposed the bald eagle for delisting (50 FR 36453).

Historically, the bald eagle was found throughout the Channel Islands (Grinnell and Miller, 1944). Historic nesting sites along the mainland coast include the Goleta and Carpinteria areas of Santa Barbara County, La Jolla Canyon near Pt. Mugu in Ventura County, and Zuma Canyon west of Malibu in Los Angeles County (Garrett and Dunn, 1981). The bald eagle disappeared as a breeding bird from the Channel Islands in the late 1950s (Garrett and Dunn, 1981). Although the eagles are again actively nesting on the islands, they still suffer from the effects DDE, which remains in the nearby waters. This is particularly true for birds residing to the south, on Catalina island (Garcelon, 1994b; Sharpe and Garcelon, 1999). Since 2002, more than 49 bald eagles have been hacked on the northern Channel Islands with approximately 25 still living on the islands (Anacapa, Santa Cruz, Santa Rosa , and San Miguel).

Bald eagles also occur at Lake Cachuma in Santa Barbara County. Several birds winter there, and bald eagles have nested there since the late 1980s (Lehman, 1994). A few transients may also occur along the mainland coast and the Channel Islands during migration.

4.3.4 Western Snowy Plover (Threatened)

Status. The coastal population of the western snowy plover (*Charadrius alexandrinus nivosus*) was listed as threatened in the Federal Register on March 5, 1993 (58 FR 12864). The main reasons for listing this population were loss and degradation of habitat from human disturbance. On December 7, 1999, a designation of critical habitat was published in the Federal Register (64 FR 68507). This designation was updated on September 9, 2005 (70 FR 56970). A Draft Recovery Plan for this species was published in the Federal Register on August 14, 2001 (66 FR 42676); a Final Recovery Plan is still under development at this time.

Two petitions to delist the plover were submitted in July, 2002, and June, 2003, respectively. The petitions contended that the Pacific Coast population of the plover is genetically indistinguishable from the inland population, and therefore does not qualify for listing as a distinct population, and that the population is in a state of flux rather than decline. On April 21, 2006, the FWS published a 12-month finding on the original petition addressing these arguments (50 CRF 20607). In its finding, the FWS upheld the threatened status of the plover, while acknowledging that significant progress had been made toward the species' recovery of over the past decade. Concurrently, the FWS published a proposed rule that will exempt those counties which have met population recovery goals from the existing general prohibition on take as long as populations remain above recovery goals. The current population of this species is estimated at 2,300 birds throughout California, Oregon, and Washington states.

Range. Western snowy plovers are found in several western states including Washington, Oregon, California, Nevada, Utah, and Arizona as well as Baja California and mainland Mexico. However the range of the threatened Pacific coast population is much more limited. This population is defined as those individuals that nest adjacent to tidal waters, and includes all nesting birds on the mainland coast, peninsulas, offshore islands, adjacent bays, estuaries, and coastal rivers (58 FR 12864). The breeding range of the threatened population extends along Pacific coast of North America from southern Washington to southern Baja California, Mexico. The winter range is somewhat broader and may extend to Central America (Page et al., 1995); most plovers winter from California south, however.

Habitat. The nesting habitat of the coastal population is mainly dune-backed beaches, barrier beaches, salt flats, and salt evaporation ponds (Page and Stenzel, 1981; Palacios and Alfaro, 1994). Habitat of wintering birds includes beaches where nesting is not known to occur. In the U.S., over 150 currently used or historical nesting and/or wintering areas have been identified (64 FR 68507), most of which (about 85 percent) are found in California. Additionally, at least four major nesting areas are known to exist in Baja, California. In coastal California, plovers historically nested at 53 locations prior to 1970 (Page and Stenzel, 1981). Currently, 44 of these sites are no longer used by nesting plovers (50 CFR 20607). Declines in the overall number of nesting sites have also occurred in Oregon and Washington (see 35 FR 16047).

The largest number of breeding birds occurs from south San Francisco Bay to southern Baja California. Major breeding areas within the project area include Morro Bay, the Callendar-Mussel Rock Dunes area, the Point Sal to Point Conception area, and the Oxnard Lowlands. Most of these areas and many others have been designated as critical habitat for the western snowy plover (70 FR 56970). Designated critical habitat in the general area of concern for the Tranquillon Ridge Unit is shown in Table 4.1.

Table 4.1 Designated Critical Habitat for the Western Snowy Plover in the Vicinity of the Tranquillon Ridge Unit (70 FR 56970)

Site No.	Name	County	Plover Population	
			Nesting	Winter
CA-15	Estero Beaches			
Unit A	Villa Creek Beach	San Luis Obispo	21-31	30
CA-18	Deveareaux Beach	Santa Barbara	Up to 18	up to 60
CA-19	Oxnard Lowlands			
Unit A	Mandalay to Santa Clara River	Ventura	9-70	up to 33
Unit B	Ormond Beach	Ventura	20-34	up to 123
Unit D	Mugu Lagoon S.	Ventura	40-80	up to 62
CA-20	Zuma Beach	Los Angeles	NA	130

Reproduction. Snowy plovers breed in loose colonies where colony size can range up to 150 pairs. Site fidelity is high, and they often nest in the exact same location as the previous year (Warriner et al., 1986). The breeding season for western snowy plovers extends from early March to late September, with birds at more southerly locations beginning to nest earlier in the season than birds at more northerly locations (64

FR 68507). In most years, the earliest nests on the California coast generally occur during the first to third week of March. Peak nesting in California occurs from mid-April to mid-June, while hatching lasts from early April through mid-August.

During courtship, males defend territories and usually make multiple scrapes (slight depressions) in flat, open areas with sandy or saline substrates. The male constructs the scrapes by leaning forward on his breast and scratching his feet while rotating his body. Females choose which scrape becomes the nest site by laying eggs in one of them. Coastal plovers lay usually three eggs (range = 2-6, Page et al. 1995) in a nest. The nest is increasingly lined with beach debris (e.g. small pebbles, shell fragments, plant debris, and mud chips) as incubation progresses. Both sexes incubate the eggs, with the female tending to incubate during the day and the male at night. Nest initiation and egg laying occur from mid-March through mid-July (Wilson, 1980; Warriner et al., 1986).

Snowy plover chicks are precocial, leaving the nest within hours after hatching to search for food. Adult plovers do not feed their chicks, but lead them to suitable feeding areas. Females generally desert both mates and broods by the sixth day after hatching, leaving the males to continue rearing the brood, while the females obtain new mates and initiate new nests. The chicks reach fledging age approximately one month after hatching; however, broods rarely remain in the nesting area throughout this time. Plover broods may travel along the beach as far as 6.4 kilometers (4 miles) from their natal area.

Diet. Snowy plovers are primarily visual foragers. They forage for invertebrates across sandy beaches from the swash zone to the macrophyte wrack line of the dry upper beach. They also forage in dry sandy areas above the high tide, on salt flats, and along the edges of salt marshes and salt ponds (58 FR 12864). They may also sometimes probe for prey in the sand and pick insects from low-growing plants. Their diet consists primarily of molluscs, worms, crabs, sandhoppers, and insects (Soothill and Soothill, 1982; Page et al., 1995).

Migration. The coastal population consists of both resident and migratory birds. Some birds winter in the breeding areas, while others migrate north or south to wintering areas (Page et al., 1986; Warriner et al., 1986). The majority of birds winter south of Bodega Bay, California (Page et al., 1986).

Reasons for Decline. The primary reasons for the decline in the coastal population of the western snowy plover are habitat loss, human disturbance, and predation. Habitat loss has resulted from both the urbanization (construction of residential, commercial, and recreation facilities, harbors, roads, campgrounds, etc.) of the Pacific coast, especially the coast of southern California, and the spread of introduced beach grasses (e.g., marram grass) used for the stabilization of coastal sand dunes. Introduced grasses are particularly a problem in the northern portion of the plover’s range.

Plovers are highly susceptible to human disturbance, and human activity (walking, jogging, dog walking, off-road vehicle use, beach raking, etc.) has also played an important role in the decline of the coastal population. The breeding season of the western snowy plover (mid-March to mid-September) coincides with the time of greatest beach use by people, and Page et al. (1977) found that snowy plovers were disturbed more than twice as often by human activities than all other natural causes combined. If the level of disturbance is sufficiently high, plovers may abandon their nests, and eggs have been stepped on and run over by vehicles. Chicks that become separated from adults through human disturbance may die of exposure. At one site in coastal California, humans were directly responsible for the loss of at least 14 percent of nests over a 6-year period (Warriner et al., 1986).

Loss of eggs, chicks, and adults to a variety of predators including gulls (*Larus* spp.), American crows (*Corvus brachyrynchus*), common raven (*Corvus corax*), red fox (*Vulpes vulpes*), skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*) is a major concern at a number of nesting sites. Accumulation of trash at beaches attracts these as well as other predators (Stern et al., 1990; Hogan, 1991).

Population Status. The first reliable information on the abundance of snowy plovers along the California coast came from surveys conducted during the 1977 to 1980 breeding seasons by Point Reyes Bird Observatory (PRBO). The surveys suggested that the snowy plover had disappeared from significant parts of its coastal California breeding range by 1980. When these surveys were initially conducted, the breeding population had been estimated at 1,565 birds (Page and Stenzel, 1981). However, based on the number of historical nesting sites that are no longer occupied, the number of plovers nesting along the coast was likely much higher.

The breeding population continued to decline after the 1981 surveys, and subsequent surveys estimated the number of breeding birds at 1,386 in 1989 (Page et al., 1991), 1,180 in 1991, and 967 in 1995 (G. Page, Point Reyes Bird Observatory, Stinson Beach, California, unpublished data). Based on Christmas Bird Counts from 1962 to 1984, the number of wintering birds had also declined, at least in southern California (Page et al, 1986). The current population estimate for the U.S. portion of the Pacific Coast Western Snowy Plover is approximately 2,300 based on the 2005 breeding window survey (71 FR 20625).

Within the project area, the snowy plover populations have fluctuated substantially over the years. One of the largest plover currently active breeding areas is located on Vandenberg Air Force Base in northern Santa Barbara County where the western snowy plover occupies 12.5 miles (20 km) of beach and dune habitat. Formerly, Vandenberg AFB supported approximately 20 percent of the entire Pacific coast population of western snowy plovers. However, declines in nesting plovers at this location were so severe during the late 1990s that a beach closure was put into effect beginning in spring 2000 for all but about 2 miles of beach. In 1997, the breeding population on the base was estimated at 240 birds, but by 1999 the count had declined to only 78. Fortunately, the western snowy plover population has rebounded significantly following the institution of the beach closure, with breeding populations of 259 and 245 birds in 2005 and 2006 respectively (C. Dellith, FWS 2006, pers. comm.).

Declines have also recently occurred on the nearby islands of Santa Rosa and San Miguel in the Channel Islands National Park. A total of 72 snowy plovers were counted on eastern end of Santa Rosa Island (Skunk Point) during the 1998 breeding season, but only 41 the following year. In 2005, 37 birds were counted, however, during the latest breeding season (2006) only 19 birds were counted on the island (D. Richards, CINPS, pers. comm.). Although the breeding population has declined, SRI island still supports a substantial wintering population, with over 200 birds counted in 2006 (D. Richards, CINPS, pers. comm.). A limited breeding population was known to occur on San Miguel Island in the early 1990s; however, no breeding plovers have been observed at this island in the last six years (D. Richards CINPS, pers. comm.).

In contrast to Vandenberg AFB and the northern Channel Islands, the last several years have seen increases in nesting at two other nearby mainland colonies: Coal Oil Point and Ormond Beach. Although plovers historically bred at University of California, Santa Barbara (UCSB)'s Coal Oil Point Reserve, the site produced no snowy plover chicks from the time it opened to the public in 1970 until the summer of 2001. Implementation of an aggressive management plan including predator management, public outreach, and protective fencing resulted in re-establishment of a small, but viable plover breeding population beginning in 2002. Over the last four years, this location has supported a small number of breeding plovers, culminating in 2006 with a total of 39 (C. Dellwith, FWS 2006, pers. comm.). Coal Oil Point also supports a substantial population of wintering snowy plovers. In December 2003, 361 western snowy plovers were counted at this location, while during the survey conducted in January 2006, 325 wintering plovers were observed.

Since 2000, the breeding population at Ormond Beach has remained between 10 and 35 birds. In 2005, a total of 22 nesting attempts resulted in 15 hatchings at this location. This number increased in 2006, when 24 hatchings took place from a total of 28 nests (S. Matsumoto, The Nature Conservancy, pers. comm.)

4.3.5 Light-footed Clapper Rail (Endangered)

Status. The light-footed clapper rail (*Rallus longirostris levipes*) was listed as endangered on October 13, 1970 (35 FR 8320). There are currently believed to be only 250-350 pairs left in California, with most found in Upper Newport Bay and the Tijuana Marsh. A recovery plan was approved in 1979 (FWS, 1979). Critical habitat has not been designated for this subspecies. Habitat loss was the primary reason for listing this species.

Range. The current and historic range of the light-footed clapper rail extends from Bahia de San Quintin, Baja California, Mexico to Santa Barbara County, California where they are restricted to coastal salt marshes. Although, historically, most of the salt marshes in this region were probably occupied by rails, no more than 24 marshes have been occupied since about 1980 (Zembal and Hoffman, 1999). Only a portion of these marshes are used each year. For example, from 1997 to 1999, 16, 17, and 14 marshes were occupied, respectively (Zembal and Hoffman, 1999). The vast majority (more than 95 percent) of the remaining rails are in Orange and San Diego counties. For example, of the 222 pairs recorded in 1998, 189 (85 percent) of these occurred at only three sites: Upper Newport Bay and Seal Beach and Tijuana marsh National Wildlife Refuges. In the general area of concern for the Tranquillon Ridge Unit, there are presently only two marshes that are, or have the potential to be, occupied by rails. These are Carpinteria Marsh in Santa Barbara County and Mugu Lagoon in Ventura County. The next closest location for rails is the Seal Beach National Wildlife Refuge in Orange County.

Habitat. The light-footed clapper rail is normally found in estuarine habitats, particularly salt marshes with well-developed tidal channels. Dense growths of cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia* sp.) are conspicuous components of rail habitat, and nests are located most frequently in cordgrass. In a radio-telemetry study conducted in Newport Back Bay, radio-tagged rails spent about 90 percent of their time in cordgrass, in the lower marsh (Zembal et al., 1989). At low tides they also hunted along creek banks. When water covered the lower marsh, radio-tagged rails foraged on higher ground in sparser vegetation.

Reproduction. Clapper rails construct loose nests of plant stems, either directly on the ground when in pickleweed or somewhat elevated when in cordgrass (FWS, 1979). Although nests are usually located in the higher portions of the marsh, they are buoyant and will float up with the tide. Eggs are laid from mid-March to the end of June, but most are laid from early April to early May. Clutch size ranges from 3-11, with clutches of 5-9 most common. The incubation period is about 23 days, and young can swim soon after hatching.

Diet. Clapper rails forage mainly by shallow probing of sediment or surface gleaning. Their diet includes small crabs, other crustaceans, slugs, insects, small fish, and eggs (Edelman and Conway, 1998).

Reasons for Decline. Rails may have suffered declines originally in the early 1900s due to overhunting. By far, however, the main reason for the decline has been habitat destruction and degradation. Of the approximate 26,000 acres of historic coastal wetlands, less than 8,500 acres remain (Speth, 1971), and only a fraction of the remaining acreage provides suitable habitat for the light-footed clapper rail. Also, the remaining coastal wetlands often lack important "buffers" where species can retreat during high water and where pollutants and sediments can be filtered before entering the wetland itself, as well as good connections to uplands and to the ocean. Predation has also played a role in the decline of the species.

With the implementation of active management, there is hope for improving the health of this species. Ongoing management efforts include habitat restoration through the reestablishment or enhancement of tidal action to historic habitat; predator management, research, and control; nest site enhancement; captive breeding; translocation; and continuing research into the life history of the species.

Population Status. Based on the first statewide survey, the California population was estimated at about 500 birds (Wilbur, 1974), although this estimate is believed to be somewhat high (FWS, 1979). Since 1980, the California population has ranged from a low of 284 birds in 1985 to a high of 816 in 2006 (Zembal and Hoffman 1999; Zembal et al 2006). The number of marshes occupied has also varied from a low of 8 in 1989 to a high of 19 in 1984. In 2006, a total of 408 pairs of light-footed clapper rails exhibited breeding behavior in 18 marshes in southern California (Zembal et al 2006). This is the largest statewide breeding population detected since the counts began in 1980, and represents a 13.3% increase over the 2005 count. It also represents the third successive year of record-breaking high counts. Although surveys have not been conducted in Baja California for several years, the Baja population is thought to consist of at least 400-500 pairs.

Upper Newport Bay currently comprises the largest subpopulation in California, with 158 pairs (38.7 percent of the state population) in 2006. Together with the subpopulation in the Tijuana Marsh, these two marshes contain a total of 260 pairs, comprising 63 percent of the breeding population in California.

In the general area of concern for the Tranquillon Ridge Unit, two marshes that have historically been occupied by clapper rails, Carpinteria Marsh and Mugu Lagoon (Zembal et al 2006). These wetlands represent the northernmost habitat for the light-footed clapper rail. Although as many as 26 pairs have been known to occur at Carpinteria Marsh, the rail population of the marsh declined sharply in 1985, and no rails were found during annual surveys from 1989 to about 1994. From 1995 to 2002, there were approximately 1-5 nesting pairs, along with a few apparently unmated birds. However, the last know clapper rail call from Carpinteria Marsh was heard from an unmated female in 2003. In April 2004, two males were released in the marsh in the hope they would find and mate with the previously heard female; however, recent surveys have not detected the presence of rails at this marsh (Zembal et al 2006). The chances for a viable subpopulation of light-footed clapper rail to become re-established in Carpinteria Marsh are currently considered non-existent without improvements in predator and habitat management at this location (Zembal et al 2006).

The rail subpopulation at Mugu Lagoon fluctuated between 3 and 7 pairs for nearly 20 years until recent augmentations fostered its growth. A captive breeding program for the light-footed clapper rail was first established in 1998. Although the first several years of the program were unproductive, since 2000, over 100 rails have been released into the wild, including several at Mugu Lagoon. Additionally, there have been occasional re-sightings of banded rails at Point Mugu, indicating that some of the captive-bred rails remained local after being released into the marsh (Zembal et al 2006). The increased population at this location appears to have led to an expansion of habitat use within the lagoon. For example, in 2004, a pair of rails was observed attempting to breed in the eastern arm of the lagoon for the first time in many years (Zembal et al 2006).

4.4 REPTILES

Sea turtles typically inhabit tropical and subtropical seas and are uncommon in eastern North Pacific waters north of Mexico. Historically, four species of sea turtles have been recorded in the eastern North Pacific: the leatherback sea turtle (*Dermochelys coriacea*), the green sea turtle *(Chelonia mydas*), the Pacific (or olive) ridley sea turtle (*Lepidochelys olivacea*), and the loggerhead sea turtle (*Caretta caretta*) (Caldwell, 1962; Marquez, 1969; Hubbs, 1977). Sea turtle populations have been greatly reduced by overharvesting, incidental bycatch by the fishing industry, and, to a lesser extent, coastal development of nesting beaches in developed countries (Ross, 1982). Three of these species (leatherback, green, and Pacific ridley) are listed as endangered, the fourth (loggerhead) as threatened under the U.S. Endangered Species Act. The leatherback was listed on June 2, 1970 (35 FR 8495), the other three species on July 28, 1978 (43 FR 32808). No critical habitat has been designated for these species in the Pacific. The recovery plans for the Pacific populations of all four species were finalized in 1998 (NMFS and FWS, 1998a-d).

In the eastern Pacific, most sea turtles probably nest on the Pacific coasts of Mexico and Central America. Sea turtles reach sexual maturity at about 4 to 9 years, depending on the species (Mager, 1984). They breed at sea, and the females instinctively return to their natal beaches to lay eggs (although leatherbacks are not such strict remigrators). The nesting season varies with species (Mager, 1984). Females typically nest four to seven times during the nesting season (again depending upon the species) with clutch sizes of 80 to 150 eggs. About 2 months after being laid in the sand, eggs hatch, and the young instinctively make for the sea. Once at sea the males very rarely, if ever, return to land (Mager, 1984).

While marine turtles are seldom seen at sea locally, strandings do occur (NOAA, 1997). Fourteen marine turtle strandings were reported on Santa Barbara County beaches between 1982 and 1995. Of the 14 strandings, nine were leatherbacks, three were loggerheads, and two were green turtles (NOAA, 1997). Since 1995 an additional three olive ridleys and one green turtle have stranded in this area (Joe Cordaro, pers. comm.). Additionally, at the Diablo Canyon Nuclear Power Plant, in San Luis Obispo County, one green turtle was reported in 1994 and another in 1997 (NOAA, 1997; Port San Luis Harbor District, 1997).

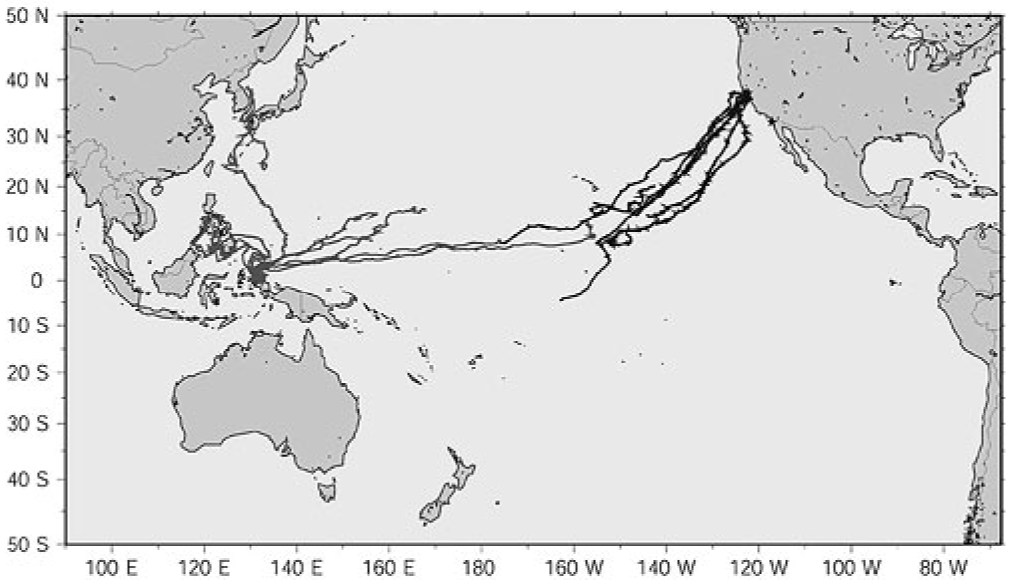
4.4.1 Leatherback Sea Turtle (Endangered)

Leatherback sea turtles, the largest of the sea turtles, occur in the Atlantic, Indian, and Pacific Oceans (Mager, 1984). Full-grown specimens reach average lengths of 7 feet, have a span of 8.9 feet from flipper to flipper, and can weigh as much as 650 to 1200 lbs (Eckert, 1997). Leatherbacks commonly range farther north than other sea turtles, probably because of their ability to maintain warmer body temperatures over longer time periods (Frair et al., 1972). They have been sighted in the eastern north Pacific as far north as Alaska (Mager, 1984).

Leatherbacks nest at beaches in tropical latitudes, and it was long thought that the local visitors observed off the Pacific coast of the United States originated from the western Mexico, Central America, and northern Peru breeding population (Mager, 1984). However, genetic analyses of individuals sampled off Monterey, California, and from turtles stranded on California beaches, indicate that the majority of these animals originate from western Pacific nesting stocks, most likely North Papua, Papua New Guinea, or the Solomon Islands (Dutton et al 2001). Satellite telemetry studies, shown in Figure 4-1, support the revised interpretation of the leatherbacks' origins (MBNMS 2002).

Additional tagging efforts have revealed that leatherbacks in the western Pacific region, although considered a single genetic stock, comprise multiple foraging populations. Turtles that nest during the winter months undertake migrations to the south, while those that nest during summer months move to northern foraging grounds, including the North American West Coast. Leatherbacks originating from the eastern Pacific nesting grounds off Mexico and Costa Rica tend to migrate south from their nesting beaches to forage areas located off South America and the Galapagos Islands (Morreale et al. 1996, Eckert and Sarti 1997). Female leatherbacks migrate between foraging and breeding grounds at 2 to 3-year intervals (NMFS and FWS, 1998a).

Figure 4-1 Satellite-Tracked Leatherback Movements from Nesting Beaches in Papua, Indonesia and from Foraging Areas off the California Coast in 2003-2004.



Source: http://www.montereybay.noaa.gov/reports/2005/eco/openocean.html

Pritchard (1971) estimated that there were at least 8,000 nesting females in the eastern Pacific; on the basis of additional information, he later estimated a total world population of 115,000 mature females (Pritchard, 1982). However, by 1995 the worldwide population estimate had dropped to between 26,200 and 42,900 adult females (Spotila et al. 1996). The Pacific portion of the population, in particular, continued to undergo dramatic decline. Between 1996 and 2000, the number of female leatherbacks in the eastern Pacific population dropped from 4,638 to about 1,690. Meanwhile, the western Pacific population also underwent substantial declines. The entire Pacific Ocean is currently thought to contain perhaps as few as 2,300 breeding females.

Leatherbacks are the most common sea turtle in U.S. waters north of Mexico (Dohl et al., 1983; Green et al., 1989; NMFS and FWS, 1998a). Inshore waters off California, between Pt. Conception and Pt. Arena, are visited annually by approximately 150 to 170 leatherback turtles, with the greatest numbers occurring during early fall (Benson et al. 2003). On aerial surveys of Washington and Oregon waters conducted in 1989 and 1990, Green et al. (1991) recorded 16 sightings of leatherbacks (no other sea turtles were seen); all sightings were made between June and September, when sea surface temperatures were highest, in waters over the slope and shelf. Most (83 percent) of the sea turtles sighted off northern and central California by Dohl et al. (1983) during their 3-year survey were leatherbacks, and nearly 90 percent of these sightings were made during the summer and fall. Sightings were widely distributed from 10 to 185 km offshore, and most were recorded in waters over the continental slope.

Although considered omnivorous (feeding on sea urchins, crustaceans, fish, and floating seaweed), leatherbacks feed principally on soft foods such as jellyfish (scyphomedusae) and tunicates (salps, pyrosomas) (Mager, 1984; NMFS and FWS, 1998a). Dense swarms of jellyfish can contain nearly 80% as much carbon as the densest copepod populations (Shenker 1984), providing a rich food source for predators such as the leatherback. Leatherbacks also may forage nocturnally at depth on siphonophores and salps in the deep scattering layer (Eckert et al., 1989; NMFS and FWS, 1998a).

4.4.2 Green Sea Turtle (Endangered)

Green sea turtles are distributed worldwide in waters that remain above 20°C during the coldest month. No reliable population estimates are available for the green sea turtle in the Pacific (Mager, 1984). Prior to commercial exploitation, green turtles were abundant in the eastern Pacific from Baja California south to Peru and west to the Galapagos Islands (NMFS and FWS, 1998b). Off the Pacific coast, sightings have been recorded as far north as British Columbia, although most have been reported from northern Baja California and southern California (Mager, 1984; NMFS and FWS, 1998b). Green turtles have stranded in northern California and on the Washington and Oregon coasts in recent decades (Smith and Houck, 1984; Green et al., 1991).

Green sea turtles were once common in San Diego Bay, but now appear limited to a single channel in the southern part of the bay (Hubbs, 1977), where they seem to be year-round residents (NMFS and FWS, 1998b). Regular sightings of small juveniles suggest that turtles are continuing to migrate into the bay (NMFS and FWS, 1998b).

At present, the main nesting sites for eastern Pacific green turtles are located along the Pacific coast of Mexico (State of Michoacán) and in the Galapagos Islands (Mager, 1984; NMFS and FWS, 1998b). There are also smaller nesting grounds along the Central American Pacific coastline (NMFS and FWS, 1998b).

Green sea turtles are primarily herbivorous, feeding on sea grasses and algae, although they may feed on a variety of marine animals in some areas (Mager, 1984; NMFS and FWS, 1998b). Identified animal food items include molluscs, crustaceans, bryozoans, sponges, jellyfish, polychaetes, echinoderms, fish and fish eggs (NMFS and FWS, 1998b).

4.4.3 Pacific Ridley Sea Turtle (Endangered)

Pacific, or olive, ridley sea turtles are the smallest of the sea turtles (Mager, 1984). Olive ridleys occur worldwide in tropical to warm temperate waters and are considered to be the most abundant sea turtle in the world (NMFS and FWS, 1998c). In the eastern North Pacific, the species' main foraging areas extend between Colombia and Mexico. Major nesting beaches are, as with many other eastern Pacific sea turtles, on the Pacific coasts of Mexico and Costa Rica, although a few may nest as far north as Baja California (Mager, 1984; NMFS and FWS, 1998c). Currently, as many as 200,000 females are estimated to nest in Mexico each year (Márquez, 1990; NMFS and FWS, 1998c).

These sea turtles are infrequent visitors to waters north of Mexico. According to Green et al. (1991) Pacific ridleys have stranded on the Washington and Oregon coasts during the past decade, and strandings have also been recorded from northern California (Houck and Joseph, 1958; Smith and Houck, 1984). Hubbs (1977) observed a pair of Pacific ridleys mating in the water off La Jolla, San Diego County, California, in August 1973.

In the eastern Pacific, ridleys nest throughout the year, with peaks occurring from September through December (NMFS and FWS, 1998c).

They are considered omnivorous, feeding on a variety of benthic and some pelagic items (NMFS and FWS, 1998c). Identified prey include fish, crabs, shrimp, snails, oysters, sea urchins, jellyfish, salps, fish eggs, and vegetation (Ernst and Barbour, 1972; NMFS and FWS, 1998c). Pacific ridleys may also scavenge (NMFS and FWS, 1998c).

4.4.4 Loggerhead Sea Turtle (Threatened)

Loggerhead sea turtles inhabit subtropical to temperate waters worldwide, and are generally found in waters over the continental shelf (Carr, 1952; Mager, 1984). In the Pacific, loggerheads nest only in the western region, primarily at and near Japan and Australia (NMFS and FWS, 1998d). There are no reliable population estimates for the loggerhead sea turtle in the Pacific (Mager, 1984).

Stebbins (1966) listed southern California as the northern limit of the loggerhead range. In recent years, most sightings of this species have been reported from southern California and Baja California waters, generally during the summer (Guess, 1982; NMFS and FWS, 1998d). Although Smith and Houck (1984) reported no sightings of this species for northern California, Green et al. (1991) state that this species has stranded on the Washington and Oregon coasts during the past two decades.

Loggerhead sea turtles are omnivorous, feeding on a variety of benthic prey including shellfish, crabs, barnacles, oysters, jellyfish, squid, sea urchins, and occasionally on fish, algae, and seaweed (Carr, 1952; Mager, 1984; NMFS and FWS, 1998d).

4.5 MARINE INVERTEBRATES

4.5.1 White Abalone (Endangered)

Status. The white abalone (*Haliotis sorenseni*) was listed by NMFS as an endangered species on May 29, 2001, effective June 28, 2001, after a comprehensive status review of the species was completed (NOAA 2001; 66 FR 29054). A draft recovery plan for the species was published on November 2, 2006 (NMFS 2006). This comprehensive document is the primary source of information from which the following subsections were drawn. No critical habitat has been designated for this species due to concerns that identifying critical habitat areas would increase the threat of poaching (66 FR 29048).

Range. The historic range of white abalone extended from Point Conception, California, USA to Punta Abreojos, Baja California, Mexico with the historical population center located at the California Channel Islands (NMFS 2006). In the northern part of the California range, white abalone were reported as being more common along the mainland coast, while in the middle portion of the California range, they were noted to occur more frequently at the offshore islands (especially San Clemente and Santa Catalina Islands). At the southern end of the range, in Baja California, Mexico, white abalone were reported to occur more commonly along the mainland coast, but were also found at a number of islands. It remains unknown whether this distribution pattern resulted because of lack of suitable habitat along the mainland coast in the middle portion of the range, or was due to overfishing in the more accessible mainland regions (NMFS 2006).

Since the mid-1990s, extremely low numbers of isolated survivors have been identified along the mainland coast in Santa Barbara County and at some of the offshore islands and banks in the middle portion of the range. This information indicates that the current range of white abalone in California may be similar to what it was historically. No recent information on current range is available for Baja California.

Habitat. Adult white abalone occur in open, low relief rocky reefs or boulder habitat surrounded by sand. They are usually found between 20-60 m depths, but were most common historically between 25-30m deep. A recent survey found the highest densities of white abalone at 40-50m depth. Suitable habitat for the white abalone is inherently patchy, thus, the distribution of white abalone is likewise patchy.

Factors controlling the depth distribution of white abalone are poorly known. Biological factors, such as competition and predation, have been implicated as factors controlling the upper limit, while water temperature and food availability have been implicated as factors controlling the lower limit. Speculation has also occurred over whether white abalone may have been restricted to deeper waters (> 25 m) as a result of sea otter predation or competition from pink abalone. There is also some evidence that abalone may shift to increasing depths as they age.

Reproduction. White abalone are dioecious, with separate sexes occurring in approximately a 1:1 ratio. They reproduce through broadcast spawning (i.e. directly releasing gametes into the water column for external fertilization). Factors known to affect fecundity in abalone include organism size and food availability.

Synchronization of gonadal maturation and spawning are critical to successful fertilization in abalone. Gonads of white abalone mature on an annual cycle, and the spawning season of white abalone is of limited duration. Spawning in white abalone occurs in winter months, but sometimes extends into the spring. The duration of an individual spawning event is unknown. Experimental evidence suggests that fertilization rates are maximized when substantially more than one sperm contacts an egg, and the probability of this occurring decreases significantly with increasing distance between individuals (Leighton 2000).
Adult abalone of intermediate size are capable of spawning over two million viable eggs. In the laboratory, fertilization success rates of 96-100% have been achieved. Fertilized white abalone eggs are about 190-200 microns in diameter and are negatively buoyant.

Diet. The specific dietary preferences of white abalone are not well established. Like other abalone species, white abalone are herbivorous. Small individuals generally scrape bacteria and diatoms from the rocky bottom using their radula, while larger abalone depend on drift algae, especially deteriorating kelp. Laminaria and Macrocystis (brown algae) are believed to make up a large portion of the diet. The reddish brown color of the shell indicates that white abalone also consume some type of red algae throughout their life (NMFS 2006).

Reasons for listing. Overexploitation leading to a lack of reproductive success was the most significant factor in the listing of this species. White abalone in California were subject to serial depletion by the commercial fishery during the early 1970s. Due to their life history characteristics as long-lived, slow moving bottom dwellers with external fertilization, abalone are particularly susceptible to local and subsequent serial depletion. If male and female abalone are not within a few meters of one another when they both spawn, the sperm will be too diluted by diffusion to fertilize the eggs. As local abalone densities declined with overfishing, the probability of successful fertilization and subsequent recruitment also declined. Regulatory measures instituted at the time also proved inadequate to conserve the species.

Population Status. At least a 99% reduction in white abalone density has occurred between the 1970s, when the last successful white abalone recruitment is thought to have occurred, and today. Current information on white abalone population size structure suggests that no evidence of recent recruitment exists, and that any ongoing recruitment is negligible throughout most of its former range. Data on density from areas where they have been located suggest that the remaining abalone are not close enough together to spawn (85% of the animals identified in 2002 were separated by linear distances that exceeded 10 m).

During the 1990s the combined estimate for both California and Mexico was approximately 2,600 animals. A 1999 survey of white abalone habitat in U.S. waters found only 157 live white abalone, an average density of only 2.7 abalone per hectare of habitat. However ROV and multi-beam sonar surveys of two shallow banks off of the southern California coast conducted since 2000 have revealed that the white abalone population may be higher (approximately 12,820 for Tanner Bank and approximately 7,360 for Cortes Bank) than previously thought. Regardless, the viability of animals in the wild remains uncertain because mostly large (>13 cm in shell length) animals were detected on the two offshore banks, and most animals observed were >2 m apart from their nearest neighbor (NMFS 2006).

4.6 AMPHIBIANS

4.6.1 California Red-legged Frog (Threatened)

Status. The California red-legged frog (*Rana aurora draytonii*) was listed as threatened on May 23, 1996 (61 FR 25813). A final recovery plan for the species was published in September 2002, and on April 13, 2006, the U.S. Fish and Wildlife Service issued its final designation of critical habitat for this species (USFWS 2002, USFWS 2006). This final designation includes 450,288 acres in 20 California counties. The California red-legged frog has been extirpated from 70 percent of its former range and is threatened in its remaining range by a wide variety of human impacts, including urban encroachment, construction of reservoirs and water diversions, introduction of exotic predators and competitors, livestock grazing, and habitat fragmentation.

Range. The historical range of the California red-legged frog extended coastally from the vicinity of Point Reyes National Seashore, Marin County, and inland from the vicinity of Redding, Shasta County, southward to northwestern Baja California, Mexico (Jennings and Hayes, 1985; Hayes and Krempels, 1986).

The following recovery units within the historical range of the California red-legged frog have been established: (1) the western foothills and Sierran foothills to 5,000 feet in elevation in the Central Valley Hydrographic Basin; (2) the central coast ranges from San Mateo and Santa Clara counties south to Ventura and Los Angeles counties; (3) the San Francisco Bay/Suisun Bay hydrologic basin; (4) southern California, south of the Tehachapi Mountains; and (5) the northern coast range in Marin and Sonoma counties. These five units are essential to the survival and recovery of the California red-legged frog. Designation of recovery units assists the FWS and other agencies in identifying priority areas for conservation planning under the consultation (Section 7) and recovery (Section 4) programs.

Habitat. The California red-legged frog occupies a fairly distinct habitat, combining both specific aquatic and riparian components (Hayes and Jennings, 1988; Jennings, 1988). Adults require dense, shrubby or emergent riparian vegetation closely associated with deep (>0.7 m) still or slow moving water (Hayes and Jennings, 1988). The largest densities of California red-legged frogs are associated with deep-water pools with dense stands of overhanging willows (*Salix* spp.) and an intermixed fringe of cattails (*Typha latifolia*) (Jennings, 1988). Well-vegetated terrestrial areas within the riparian corridor may provide important sheltering habitat during winter. Adult frogs may be found seasonally in the coastal lagoons of the central California coast. They move upstream to freshwater when sand berms are breached by seawater from storms or high tides.

California red-legged frogs disperse upstream and downstream of their breeding habitat to forage and seek estivation habitat. Estivation habitat is essential for the survival of California red-legged frogs within a watershed. Estivation habitat and the ability to reach estivation habitat can be limiting factors in California red-legged frog population numbers and survival.

Estivation habitat for the California red-legged frog is potentially all aquatic and riparian areas within the range of the species and includes any landscape features that provide cover and moisture during the dry season within 300 feet of a riparian area. This could include boulders or rocks and organic debris such as downed trees or logs; industrial debris; and agricultural features, such as drains, watering troughs, spring boxes, abandoned sheds, or hay-ricks. Incised stream channels with portions narrower than 18 inches and depths greater than 18 inches may also provide estivation habitat.

Two designated critical habitat units exist in the general project area. At Jalama Creek, about 4.4 miles south of the City of Lompoc, 7,662 acres along the coast were designated, while at Gaviota Creek 11,328 acres were designated (USFWS, 2006).

Reproduction. California red-legged frogs breed from November through March, with earlier breeding records occurring in southern localities (Storer, 1925). Egg masses that contain about 2,000-5,000 eggs are typically attached to vertical emergent vegetation, such as bulrushes or cattails. California red-legged frogs are often prolific breeders, laying their eggs during or shortly after large rainfall events in late winter and early spring (Hayes and Miyamoto, 1984). Eggs hatch in 6-14 days (Jennings, 1988). Larvae undergo metamorphosis 3.5 to 7 months after hatching (Storer, 1925; Wright and Wright, 1949). Sexual maturity normally is reached at 3-4 years of age (Storer, 1925; Jennings and Hayes, 1985).

Diet. The diet of California red-legged frogs is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food items of adult frogs. Vertebrates, such as Pacific tree frogs (*Hyla regilla*) and California mice (*Peromyscus californicus*), represented over half of the prey mass eaten by larger frogs (Hayes and Tennant, 1985). Hayes and Tennant (1985) found juvenile frogs to be active diurnally and nocturnally, whereas adult frogs were largely nocturnal. Feeding activity likely occurs along the shoreline and on the surface of the water (Hayes and Tennant, 1985).

Reasons for listing. The California red-legged frog has sustained a 70-percent reduction in its geographic range in California as a result of several factors acting singly or in combination (Jennings et al., 1993). Habitat loss and alteration, overexploitation, and introduction of exotic predators were significant factors in the California red-legged frog's decline in the early to mid 1900s. It is estimated that California red-legged frogs were extirpated from the Central Valley floor before 1960. Remaining aggregations (assemblages of one or more individuals, not necessarily a viable population) of California red-legged frogs in the Sierran foothills became fragmented and were later eliminated by reservoir construction, continued expansion of exotic predators, grazing, and prolonged drought. Within the Central Valley hydrographic basin, only 14 drainages on the Coast Ranges slope of the San Joaquin Valley and one drainage in the Sierran foothills are actually known to support or may support California red-legged frogs, compared to over 60 historic locality records for this basin (a 77-percent reduction). The pattern of disappearance of California red-legged frogs in southern California is similar to that in the Central Valley, except that urbanization and associated roadway, large reservoir (introduction of exotic predators), and stream channelization projects were the primary factors causing population declines. In southern California, California red-legged frogs are known from only five locations south of the Tehachapi Mountains, compared to over 80 historic locality records for this region (a reduction of 94 percent).

Population Status. California red-legged frogs are known to occur in 243 streams or drainages in 22 counties, primarily in the central coastal region of California. The term “drainage” is used to describe named streams, creeks, and tributaries from which California red-legged frogs have been observed. A single occurrence of California red-legged frog is sufficient to designate a drainage as occupied by, or supporting California red-legged frogs. Monterey (32), San Luis Obispo (36), and Santa Barbara (36) counties support the greatest number of currently occupied drainages. Historically the California red-legged frog was known from 46 counties, but is now extirpated from 24 of those counties (a 52-percent reduction in county occurrences). In seven of the 22 occupied counties (32 percent), California red-legged frogs are known from a single occurrence. The most secure aggregations of California red-legged frogs are found in aquatic sites that support substantial riparian and aquatic vegetation and lack exotic predators (e.g., bullfrogs (*Rana catesbeiana*), bass (*Micropterus* spp.), and sunfish (*Lepomis* spp.)). Only three areas within the entire historic range of the California red-legged frog may currently support more than 350 adults, Pescadero Marsh Nature Preserve (San Mateo County), Point Reyes National Seashore (Marin County), and Rancho San Carlos (Monterey County). The San Francisco Airport drainage population, identified in the originally proposed rule as containing over 350 individuals, is now thought to be nearly extirpated. Threats, such as expansion of exotic predators, proposed residential development, and water storage projects, occur in the majority of drainages known to support California red-legged frogs.

4.7 FISH

4.7.1 Tidewater Goby (Endangered)

Status. The tidewater goby (*Eucyclogobius newberryi*) was listed by FWS as endangered on February 4, 1994 (59 FR 5498). On June 24, 1999, FWS published a proposed rule to remove the northern populations of the tidewater goby from the endangered species list; the proposed rule was withdrawn on November 7, 2002. Critical habitat for this species was designated on November 20, 2000 (65 FR 69693), and a final recovery plan was published on December 7, 2005 (FWS 2005). The following discussion is derived primarily from the recently published recovery plan. The tidewater goby is threatened primarily by modification and loss of habitat as a result of coastal development, channelization of habitat, diversions of water flows, groundwater overdrafting, and alteration of water flows..

Range. The tidewater goby ranges from Del Norte County (near the Oregon border) south to Agua Hedionda Lagoon in northern San Diego County. Most are found very close to the coast, though a few have been found as much as 8 km (5 mi) inland. Gobies are mostly coastal lagoon fishes that prefer shallow, usually brackish water (Love, 1996).

Habitat. Primary tidewater goby habitat is found in small, shallow coastal lagoons that are separated from the ocean most of the year by beach barriers. They are typically found in water less than 1 meter (3.3 feet) deep (FWS 2005). This includes shallow areas of bays and areas near stream mouths in uppermost brackish portions of larger bays. Tidewater gobies are absent from areas where the coastline is steep and streams do not form lagoons or estuaries. Although tidewater gobies can tolerate full seawater, they are most common in waters with salinities of less than 12 parts per thousand. Adults are benthic, and larvae are briefly pelagic (Love, 1996).

Feeding Ecology. At all sizes examined, tidewater gobies feed on small invertebrates, usually mysids, amphipods, ostracods, snails, and aquatic insect larvae, particularly dipterans. The food items of the smallest tidewater gobies (4-8 mm) have not been examined, but these gobies, like many other early stage larval fishes, probably feed on unicellular phytoplankton or zooplankton (64 FR 33816).

Life cycle. Tidewater goby populations may fluctuate seasonally. In Aliso Creek Lagoon in Orange County, the winter-early spring population was estimated at 1,000-1,500 fish; after the summer-fall spawning, the population rose to 10,000-15,000 individuals. They are found in small groups or in aggregations of hundreds. The tidewater goby is typically an annual species, with few individuals living longer than a year.

Reproduction in the tidewater goby occurs year-round, although distinct peaks in spawning, often in early spring and late summer, do occur. They exhibit a female-dominant breeding system that is unusual in vertebrates, whereby female tidewater gobies aggressively spar with each other for access to males with burrows for laying their eggs. Females are oviparous and generally produce between about 300 to 500 eggs per clutch, and between 6 to 12 clutches per year. After the male goby has excavated a vertical burrow in coarse sand, a female will lay the eggs on the roof and sides of the burrow, suspending them one at a time. The males guard the eggs until they hatch in 9-10 days (Love, 1996).

Population Status. It is a small fish that inhabits coastal areas ranging from Del Norte County (near the Oregon border) south to Agua Hedionda Lagoon in northern San Diego County. At the time of listing in 1994, tidewater gobies were known to have occurred in at least 87 of California's coastal lagoons, but were considered extirpated in approximately half of these (FWS 2005). These assessments, however, followed a prolonged period of drought, when conditions in many habitats were at extremely low levels. Subsequent surveys found that populations in several locations had become re-established, or had been overlooked in the initial surveys. Additionally, new populations continue to be discovered, increasing the number of known historic populations to 134. As a result, presently only 23 (17 percent) of the known historic populations are considered extirpated. However, 55 to 70 (41 to 52 percent) of the localities are naturally so small, or have been degraded over time, that their long-term persistence is uncertain. Currently, the goby is found in approximately 46 localities within the general project area (San Luis Obispo, Santa Barbara, and Ventura counties).

4.7.2 Steelhead Trout (Endangered)

Status. The effective date for listing the Southern California Evolutionarily Significant Unit (ESU) of west coast steelhead (*Oncorhynchus mykiss*) as endangered and the South-Central California Coast ESU as threatened is October 17, 1997 (63 FR 32996). Critical habitat for this species was designated in September 2005 (70 FR-52488). Steelhead from the Southern California ESU have already been extirpated from much of their historical range. There is a strong concern about the widespread degradation, destruction, and blockage of freshwater habitats within the region, and the potential results of continuing habitat destruction and water allocation problems. There is also concern about the genetic effects of widespread stocking of rainbow trout. Total abundance of steelhead in the South-Central Coast ESU is extremely low and declining. Risk factors for this ESU are habitat deterioration due to sedimentation, and flooding related to land management practices and potential genetic interaction with hatchery rainbow trout.

Range. Southern California--This coastal steelhead ESU occupies rivers from the Santa Maria River to the southern extent of the species range. Historically, *O. mykiss* occurred at least as far south as Rio del Presidio in Mexico (Behnke, 1992; Burgner et al., 1992), and in years of substantial rainfall, spawning steelhead were found as far south as the Santa Margarita River in San Diego County (Barnhart, 1986). , at the time of listing, however, the southernmost stream used by steelhead for spawning was generally thought to be Malibu Creek (Behnke, 1992; Burgner et al., 1992). In 1999 and 2000, new information became available which indicated that steelhead or their progeny occurred in at least two coastal streams south of Malibu Creek (Topanga Creek and San Mateo Creek). This new information included observations of juvenile O. mykiss in Topanga Creek and field and laboratory investigations conducted by the CDFG which demonstrated the presence and spawning of anadromous *O. mykiss* in San Mateo Creek (67 FR 21586). In 2002, NMFS published a notification of this extension of the known range, south to the U.S. - Mexico Border (67 FR 21586).

South-Central California Coast--This coastal steelhead ESU occupies rivers from the Pajaro River, Santa Cruz County, to, but not including, the Santa Maria River. Most rivers of this region drain the Santa Lucia Range, the southernmost unit of the California Coast Ranges. The climate is drier and warmer than in the north, which is reflected in the vegetational change from coniferous forest to chaparral and coastal scrub. Another biological transition at the north end of this area is the southern limit of the distribution of coho salmon (*O. kisutch*). The mouths of many rivers and streams in this area are seasonally closed by sand berms that form during periods of low flow in the summer. The southern boundary of this ESU is near Point Conception, a well-recognized transition area for the distribution and abundance of marine flora and fauna.

Life history. Migration and life history patterns of southern California steelhead depend more strongly on rainfall and streamflow than is the case for steelhead populations farther north (Moore, 1980; Titus et al., in press). Average rainfall is substantially lower and more variable in southern California than in regions to the north, resulting in increased duration of sand berms across the mouths of streams and rivers and, in some cases, complete dewatering of the lower reaches of these streams from late spring through fall. Young steelhead remain in fresh water anywhere from less than 1 year to 3 years. Juveniles migrate to sea usually in spring, but throughout their range steelhead are entering the ocean during every month, where they spend 1-4 years before maturing and ascending streams for the first time. Only winter steelhead are found in southern and south-central California. Winter steelhead enter their home streams from about November to April. Spawning takes place from March to early May. Some steelhead, primarily females, do not die after spawning, and may spawn as many as four times throughout their lives. Females produce 200-12,000 eggs, which hatch in about 50 days (Love, 1996).

Population status. Southern California--Estimates of historical (pre-1960s) abundance are available for several rivers in this ESU: Santa Ynez River, before 1950, 20,000-30,000; Ventura River, pre-1960, 4,000-6,000; Santa Clara River, pre-1960, 7,000-9,000; Malibu Creek, pre-1960, 1,000. In the mid-1960s, the California Department of Fish and Game (CDFG) estimated steelhead spawning populations for smaller tributaries in San Luis Obispo County to be 20,000, but they provided no estimates for streams farther south.

The present total run sizes for six streams in this ESU were summarized by Titus et al. (in press); all were less than 200 adults. Titus et al. (in press) concluded that populations have been extirpated from all streams south of Ventura County, with the exception of Malibu Creek in Los Angeles County. However, steelhead are still occasionally reported in streams where stocks were identified by these authors as extirpated. This includes the rediscovery of the presence of *O. mykiss* in Topanga and San Mateo Creeks in 1999 and 2000 (67 FR 21586).

South-Central California Coast--Historical estimates of steelhead abundance are available for a few streams in this region. The California Advisory Committee on Salmon and Steelhead (CACSS, 1988) cited an estimate of 20,000 steelhead in the Carmel River in 1928. In the mid-1960s, CDFG estimated 27,750 steelhead spawning in many rivers of this ESU. However, comparisons with recent estimates for these rivers show a substantial decline during the past 30 years. In contrast to the CDFG estimates, McEwan and Jackson (1996) reported runs ranging from 1,000 to 2,000 in the Pajaro River in the early 1960s, and escapement of about 3,200 steelhead for the Carmel River for the 1964-75 period.

While there are no recent estimates of total run size for this ESU, recent run-size estimates are available for five streams. The total of these estimates is less than 500, compared with a total of 4,750 for the same streams in 1965, indicating a substantial decline for the entire ESU from 1965 levels.

Minor habitat blockages (smaller dams, impassable culverts, etc.) are likely throughout the region. Titus et al (in press) reported blockages on 28 of 66 tributaries in this ESU, and some passage impairments on most other tributaries. Streams in this region probably suffer from a variety of habitat factors similar to those affecting neighboring ESUs. Forest practices have contributed to incremental degradation of stream habitats (McEwan and Jackson, 1996), and dewatering due to irrigation and urban water diversions is also a problem. Titus et al. (in press) have documented some of these problems for specific tributaries in the southern portion of this ESU.

Habitat. Steelhead, like all salmon, need clean, cool water with plenty of oxygen and low amounts of suspended solids and contaminants. They also need gravel and rocks to spawn. Fine sediment is lethal to steelhead. It clogs the spaces between the rocks and gravel, buries the eggs, and prevents oxygen and flowing water from reaching the eggs. Sediment can also damage the gills of adult steelhead. Steelhead also require large, woody debris and deep pools in the river, which provide refuge from predators and resting places during storms. Deep pools give steelhead cool water when shallow areas warm up in the summer.

Critical habitat. Critical habitat is designated to include all river reaches and estuarine areas accessible to listed steelhead in coastal river basins from the Santa Maria River to Malibu Creek (inclusive). Also included are adjacent riparian zones. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 3,967 square miles in California. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Los Angeles, San Luis Obispo, Santa Barbara, and Ventura.

4.8 TERRESTRIAL PLANTS

4.8.1 Salt Marsh Bird's-Beak (Endangered)

Status. The salt marsh bird's-beak (*Cordylanthus maritimus* ssp.*maritimus*), an annual semiparasitic herb in the figwort family (Scrophulariaceae), was listed as endangered on September 28, 1978 (43 FR 44812). A recovery plan for this species was approved in 1984 (FWS, 1984b). Critical habitat has not been designated. The main reason for listing this species was habitat loss.

Range. This plant is generally restricted to coastal salt marshes. Although there has been some confusion in the past over the range of this subspecies and the similar Pt. Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*), this plant occurs in salt marshes from Morro Bay in San Luis Obispo County south to San Diego County and Northern Baja California, Mexico. Herbarium records indicate that it was found in at least 10 marshes in California (FWS, 1984b), and in as many as 5 in Baja. The current distribution of this species includes Carpinteria Marsh, Ormond Beach, the Ventura County Game Preserve, Mugu Lagoon, Anaheim Bay, Upper Newport Bay, Sweetwater Marsh, and the Tijuana River estuary (FWS, 1984b). Within the project area, salt marsh bird's-beak is currently known to occur at Ormond Beach and Mugu Lagoon in Ventura County, at Carpinteria Salt Marsh in Santa Barbara County, and at Morro Bay in San Luis Obispo County (CNDDB 2004).

Habitat. The primary habitat for this plant is the upper salt marsh that is inundated by tides on a regular basis, but above areas that receive daily salt flooding. Plants may also occur behind barrier dunes, on dunes, mounds, and occasionally in areas with no tidal influence. The plant forms root connections with other plant species such as salt grass (*Distichlis* sp.), pickleweed (*Salicornia* sp.), and cattail (*Typha latifolia*), which may be especially important for plants growing on drier sites (FWS, 1984b).

Reasons for Listing. Destruction and modification of the coastal marshes is the primary reason for this plant's decline. The plants have been directly affected by a host of man-caused activities, including off-road vehicles, construction equipment, cattle grazing, and flood control levees. Even minor alterations of the marsh that result in permanent changes in the natural tidal dynamics can make previously suitable habitat unsuitable. Changes in tidal inundation have affected plants by: smothering them with increased debris deposited by high tide, encouraging other marsh vegetation which shades out plants, or decreasing germination of seeds by lowering or increasing soil salinity (FWS, 1984b).

Population Status. Population data are not available for most of the salt marsh bird's-beak sites.

4.8.2 California Sea-Blite (Endangered)

Status. The California sea-blite (*Suaeda californica*), a succulent-leaved perennial plant of the goosefoot family (Chenopodiaceae), was listed as endangered on December 15, 1994 (59 FR 64623). A recovery plan is not available for this species, and critical habitat has not been designated. The main reason for listing this species was habitat loss.

Range. Some confusion has occurred over the historical range of this plant. Munz (1959) described the range as extending from San Francisco Bay south to southern Baja California, Mexico. However, Ferren and Whitmore (1983) separated the plant into two species. The plant they separated out, *Suaeda esteroa*, occurs from Santa Barbara County south to Baja. The historical range of the California sea-blite, therefore, includes the San Francisco Bay area and Morro Bay. The only remaining, naturally existing population of this species is along the perimeter of Morro Bay. The distribution of California sea-blite around Morro Bay was mapped in the early 1990s (see 59 FR 64623). On the east side of the bay, colonies occur adjacent to the communities of Morro Bay, Baywood Park, and Cuesta by-the-Sea, although it apparently is absent from the more interior portion of the marshlands created by Chorro Creek runoff. On the west side of the bay, it is found along most of the spit, excepting the northern flank adjacent to the mouth of the bay.

Current re-introduction projects are on-going in Golden Gate National Recreation Area. A small population was re-established in 2003 at the Crissy Field marsh at San Francisco Bay, near Pier 98.

Habitat. California sea-blite is restricted to the coastal marsh habitat of Morro Bay, where it occurs in a very narrow band in the upper intertidal zone. Sea-blite occurs in association with other marsh plants including *Salicornia* sp. (pickleweed), *Distichlis spicata* (saltgrass), *Juncus acutus* (rush), *Jaumea carnosa* (Jaumea), and *Frankenia salina* (Frankenia) and the federally endangered *Cordylanthus maritimus* ssp. *maritimus* (salt marsh birds-beak) (59 FR 64623).

Reasons for Listing. Because the California sea-blite occupies such a narrow band in the intertidal zone, it is threatened by any natural processes or human activities that even slightly alter this habitat. Such threats include: increased sedimentation of Morro Bay, the encroachment of sand on the east side of the spit, and dredging projects within the channel of the bay (59 FR 64623).

Population Status. The sea-blite's colonial habits make it difficult to estimate the population. One estimate places the number of individuals at no more than 500 (see 59 FR 64623).

5.0 POTENTIALLY SIGNIFICANT IMPACT SOURCES

The primary impact-producing activities associated with the proposed project include drilling and production operations with associated support activities. The major impact agents expected from these proposed activities are noise and disturbance, platform discharges, and potential oil spills. The following sections describe the sources and types of these potential impacts.

5.1 NOISE AND DISTURBANCE

The proposed activities associated with the Tranquillon Ridge Unit project, including drilling and transportation, are among the most common sources of man-made, low frequency noise that could affect protected species (and marine mammals in particular). The source level of a sound produced by activities such as these is described as the amount of radiated sound at a particular frequency and distance, usually 1 m from the source, and is commonly expressed in dB re 1 µPa. Much of the following discussion is derived from the detailed review of the sounds produced by offshore activities in Richardson et al. (1995).

5.1.1 Vessel Traffic

Current Levels of Activity. Crew and supply boats are used daily to transport personnel and supplies to platforms offshore southern California. Support vessels for activities in the Santa Barbara Channel and Santa Maria Basin operate out of bases in the Santa Barbara Channel; support vessels traveling to and from the four platforms in San Pedro Bay operate out of Long Beach. During the past decade, support vessels in the Pacific Region, including both crew and supply boats, have averaged approximately 16 trips per week per platform (Bornholdt and Lear, 1995). However, actual vessel traffic in the Region varies among units—as discussed in Section 3.2, the Point Arguello platforms average as few as 6 supply trips per month, while crew and supply boat trips in the eastern Santa Barbara Channel are much more frequent.

The Santa Barbara Channel/Santa Maria Basin Oil Service Vessel Traffic Corridor Program is intended to minimize interactions between oil industry operations and commercial fishing operations. It was developed cooperatively by the two industries through the Joint Oil/Fisheries Liaison Office. In addition to providing transit corridors in and out of area ports, the program routes support traffic along the Channel seaward of an outer boundary line. East of Gaviota, the outer boundary is defined by the 30-fathom line; west of Gaviota, and north of Point Conception as far as Pedernales Point, it follows the 50-fathom line. In the area west of Gaviota, the 50-fathom line is 4 km (2 nm) or more offshore.

Potential Impact Sources. Vessels are the major contributors to overall background noise in the sea (Richardson et al., 1995). Sound levels and frequency characteristics are roughly related to ship size and speed. The dominant sound source is propeller cavitation, although propeller “singing,” propulsion machinery, and other sources (auxiliary, flow noise, wake bubbles) also contribute. Vessel noise is a combination of narrowband tones at specific frequencies and broadband noise. For vessels the approximate size of crew and supply boats, tones dominate up to about 50 Hz. Broadband components may extend up to 100 kHz, but they peak much lower, at 50-150 Hz.

Richardson et al. (1995) give estimated source levels of 156 dB for a 16-m crew boat (with a 90-Hz dominant tone) and 159 dB for a 34-m twin diesel (630 Hz, 1/3 octave). Broadband source levels for small, supply boat-sized ships (55-85 m) are about 170-180 dB. Most of the sound energy produced by vessels of this size is at frequencies below 500 Hz. Many of the larger commercial fishing vessels that operate off southern California fall into this class.

5.1.2 Aircraft

Current Levels of Activity. Offshore southern California, helicopters are a primary means of crew transport on and off platforms, and helicopter traffic is a daily occurrence in the Point Conception area. OCS helicopter traffic in the Pacific Region operates primarily out of Santa Maria, Lompoc, and Santa Barbara airports. During the past decade, helicopters have averaged approximately 3 to 5 trips per week per platform (Bornholdt and Lear, 1995). Most of this traffic is to and from platforms in the western Santa Barbara Channel and Santa Maria Basin.

Beginning in the 1980s, a standard Information to Lessees (ITL) issued in conjunction with OCS lease sales off southern California provided offshore operators with guidelines for protecting marine mammals and birds from aircraft (Bornholdt and Lear, 1995). The ITL stated that,

> "Aircraft should operate to reduce effects of aircraft disturbances on seabird colonies and marine mammals, including migrating gray whales, consistent with aircraft safety, at distances from the coastline and at altitudes for specific areas identified by the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and California Department of Fish and Game (CDFG). A minimum altitude of 1,000 feet is recommended near the Channel Islands Marine Sanctuary to minimize potential disturbances. The CDFG and FWS recommend minimum altitude restrictions over many of the colonies and rookeries."

More recently, the 1,000-foot minimum altitude restriction was extended to air traffic passing the vicinity of the Santa Maria River mouth, to address concerns over possible disturbance of marine bird nesting habitat. Although the original ITL is no longer in force, operators in the southern Santa Maria Basin still comply with these restrictions (P. Schroeder, MMS, pers. comm.).

Potential Impact Sources. Air-to-water transmission of sound is very complex (Richardson et al., 1995). An understanding of underwater sound from any aircraft depends on 1) the receiver depth, and 2) the altitude, aspect, and strength of the source.

The concept of a one-meter sound source means very little when discussing aircraft sound production, and an altitude of 300 m is the usual reference distance (Richardson et al., 1995). The angle of incidence at the water surface is very important—much incident sound is reflected at angles greater than 13 degrees from the vertical. This 26-degree "cone" of sound is defined physically by Snell's Law and influenced by sea conditions. Water depth and bottom conditions also strongly influence the propagation and levels of underwater sound from passing aircraft; propagation is attenuated in shallow water, especially when the bottom is reflective (Richardson et al., 1995).

The rotors are the primary sources of sound from helicopters (Richardson et al., 1995). The rotation rate and the number of blades determine the fundamental frequencies. Fundamental frequencies are usually below 100 Hz, with most dominant tones below 500Hz. These are primarily harmonics of the main and tail rotor blade rates, although other tones associated with engines and other rotating parts may also be present.

Richardson et al. (1995) present an estimated source level for a Bell 212 helicopter of about 150 dB at altitudes of 150-600 m, with the dominant frequency a 22-Hz tone with harmonics. Elsewhere a source level of 165 dB is presented for broadband helicopter noise (frequencies 45-7070 Hz).

Generally, peak received levels occur as the aircraft passes directly overhead and are directly related to altitude and depth. However, when the aircraft is not passing directly overhead, received levels may be stronger at "midwater" depths. Helicopters tend to radiate more sound forward. Duration is variable. For example, a Bell 214 was audible in air for 4 minutes before passing, for 38 seconds at 3-m depth, and for 11 seconds at 18 m.

5.1.3 Offshore Drilling

Current Levels of Activity. As of April 2000, more than 1,200 wells had been drilled in the Pacific OCS Region. This number includes 881 oil and gas development wells drilled from platforms and 326 exploratory wells drilled from a variety of rigs, including mobile offshore drilling units (MODUs), jack-ups, barges, and drill ships. Based on data accrued from 1996 through 1999, slightly less than 2 development wells per month are begun from Region platforms.

Potential Impact Sources. Richardson et al. (1995) cite only a single source of information on the levels of noise produced by platform-based drilling activities. Gales (1982) recorded noise produced by one drilling and three drilling and production platforms off California. The noises produced were so weak that they were nearly undetectable "even alongside the platform" in sea states of Beaufort 3 or better. No source levels were computed, but the strongest received tones were very low frequency, about 5 Hz, at 119-127 dB re 1 μPa. The highest frequencies recorded were at about 1.2 kHz.

5.1.4 Offshore Production

Current Levels of Activity. There currently are 23 offshore platforms in the Pacific OCS Region. Of these, 4 are in the Santa Maria Basin, 15 are in the Santa Barbara Channel, and 4 are in San Pedro Bay.

Potential Impact Sources. Noise produced by metal production platforms is expected to be relatively weak, because a small surface area is actually in contact with the water and because the machinery is placed on decks well above the water line (Richardson et al., 1995). Gales (1982) measured noise from 11 production platforms off California. Sounds recorded from four platforms were very low in frequency, about 4.5-38 Hz measured 9-61 m. Platforms powered by gas turbines produced more tones than platforms with at least partial shore power. Peak recorded sound spectra were between 50-200 or 100-500 Hz.

5.2 EFFLUENT DISCHARGES

Platform discharges with the potential to affect protected species include drilling muds and cuttings, produced waters, and sanitary effluents. All platform effluents are regulated by the requirements of the U.S. EPA's National Pollution Discharge Elimination System (NPDES) General Permit (EPA 2000a and b). The biological assessment prepared for the General Permit evaluates 22 types of discharges resulting from normal OCS oil and gas operations (SAIC, 2000a and b). There are specific permit requirements for five of the discharge types: drilling fluids and cuttings; produced water; well treatment, completion, and workover fluids; deck drainage; and domestic and sanitary waste. The requirements for the remaining discharges are combined. Monitoring is conducted in accordance with 40 CFR Part 136, unless other procedures are specified. Monitoring results are summarized monthly on Discharge Monitoring Report (DMR) forms and reported to the EPA quarterly.

5.2.1 Drilling Fluids

The discharge of drilling muds to be used for the proposed Tranquillon Ridge Unit drilling program will comply with the General Permit requirements. Under the permit, Platform Irene is authorized to discharge up to 30,000 bbs of cuttings and 105,000 bbls of drilling fluid per year. In total, 42,812 bbl of cuttings and 180,737 bbl of drilling fluids are expected to be discharged during the drilling program for the proposed project. It is possible that oil based muds may be used for drilling the longer portions of the wells. Any oil based muds or muds containing additives not approved by EPA, or containing additives in concentrations above EPA limits will be transported ashore for disposal.

The dispersion of drill muds and cuttings depends on the depth of the discharge (shunt depth), the prevailing flow field, and the physical characteristics of the drill muds and the receiving waters (see Attachment D). On Platform Irene, spent drill muds and cuttings would be discharged 150 ft (46 m) below the sea surface. The temperature and density of drill muds generally increase with increasing drilling depth. Even after dilution with seawater at the shale shaker, the discharged material would be a few degrees warmer than ambient seawater temperatures. Because of the shunt depth, most of the heavier muds aggregates are deposited on the seafloor directly below and within 500 m of the discharge point. The heavier rock cuttings are not expected to be transported more than 200 m beyond the discharge point (de Margerie, 1989; MMS, 1996). Approximately 80% of the particulates are removed by these near-field depositional processes (CSA, 1985). Lightweight floccules formed from the remaining suspended particulates would be carried upward toward the sea surface by the buoyant plume of warm water associated with the discharge. They can be carried over four miles from the platform before being deposited on the seafloor (Coats 1994; Pickens 1992; Attachment D).

5.2.2 Produced Water

Produced water from the generated by the Tranquillon Ridge Unit development would also be discharged in accordance with the existing NPDES General Permit. Under the permit, Platform Irene is authorized to discharge up to 55,845,000 bbls of produced water per year, which equates to an average of 50,000 barrels per day. Approximately 1.26 million gallons (40,000 barrels) per day (MGD) of water produced from Point Pedernales and Tranquillon Ridge combined will be shipped from the LOGP to Platform Irene for discharge. A part of the produced water that will be shipped to Platform Irene may still be injected into Point Pedernales reservoir wells, as is currently the operation. Offshore water injection will be conducted as authorized by the MMS.

Initial mixing and dispersion govern the fate of produced water discharged into the marine environment. Initial mixing occurs immediately after discharge. It is driven by the turbulence caused by the momentum of the discharge jet and instability of the buoyant effluent plume as it rises through the water column. EPA’s allowed mixing zone for produced-water discharges (not applied to oil and grease) is the larger of 100 m measured laterally around the discharge point from the sea surface to the sea floor, or to the boundary of the zone of initial dilution as calculated by a plume model. Produced water discharged off the California coast is generally less saline and warmer than ambient seawater. This results in a buoyant discharge plume that aids in the initial mixing of the effluent. Modeling suggests that initial mixing occurs rapidly and results in dilutions of 30- to 100-fold within a few tens of meters from the outfall (Neff 1997). Slower-paced dispersion further reduces the concentration of contaminants as the oceanic flow field transports the produced-water plume. However, for Platform Irene, the produced water salinity and temperature are close to the ambient values, and the plume would be nearly neutrally buoyant at discharge depth. Consequently, it would not receive the additional benefit of buoyancy-induced mixing.

As part of the General Permit requirements, permittees generated a detailed quantitative assessment of potential impacts from produced-water discharges on federally managed fish species from each of the California OCS dischargers, including Platform Irene (MRS 2005). The study focused on the toxicity and bioaccumulation potential of produced-water discharges to the fish populations that reside within the 100-m mixing zone beneath the platforms. These fish populations consist mostly of rockfish that utilize the platform as habitat, rarely venturing far from the protection of the structure. Consequently, contaminant concentrations at locations 100-m from the platform have little bearing on the potential impacts experienced by these fish.

Nevertheless, the quantitative exposure assessment found a general absence of impacts from most of the major produced-water constituents. Many of the produced-water constituents that are normally of concern for the protection of marine organisms were below biological effects levels prior to discharge. Four constituents had end-of-pipe concentrations that were slightly elevated in produced water compared to thresholds of potential effects in finfish. However, because of rapid dispersion, the plume volume containing concentrations of potential biological significance were exceedingly small compared to the volume of habitat contained within the mixing zone. In contrast to the other constituents, the quantitative assessment could not rule out the possibility of potential chronic effects on federally managed finfish due to exposure to undissociated sulfide in produced water discharged at Platform Irene. However, the likelihood of an actual substantive adverse impact on federally managed finfish was thought to be minimal because there were several significant limitations associated with the sulfide assessment, which resulted in an unduly conservative evaluation of finfish exposure.

In particular, the screening study included:

1) an unrealistically low effects threshold for sulfide,
2) a low predicted dilution rate for the original conceptual design of a produced-water diffuser on Platform Irene,
3) high variability among sulfide concentrations initially measured in produced-water samples,
4) contaminant concentrations in historical produced-water samples from Platform Irene that did not reflect potential benefits from future enhanced treatment,
5) no consideration of physicochemical degradation in sulfide introduced into oxygenated seawater, and
6) no consideration of potential finfish avoidance arising from the sulfide astringency.

Currently, produced-water discharges from all the California OCS platforms are being evaluated as part of the reasonable-potential phase of the General Permit. As part of this analysis, contaminant concentrations measured in produced-water samples from individual platforms are being evaluated for their potential to exceed receiving-water limitations at the edge of the 100-m mixing zone. A number of the limitations in Platform Irene's sulfide analysis are being resolved as part of the reasonable-potential analysis. This includes consideration of significantly enhanced dilution resulting from a new diffuser design and a more realistic threshold for sulfide effects.

Depending on the outcome of the reasonable-potential analysis, produced water from Platform Irene could also receive additional treatment to reduce contaminant concentrations prior to discharge. Produced water is not currently discharged from Platform Irene, and, because it is normally re-injected, it receives little or no additional treatment to reduce contaminant concentrations. Before discharge on a regular basis, its quality could be improved by extensive treatment within upgraded treatment facilities both on the platform and within an onshore treatment facility. Upgrades to the onshore treatment facilities have been approved but have yet to be installed. Consequently, the sulfide concentrations historically measured in the Platform-Irene samples are not representative of future marine discharges,

Insofar as limitations in the sulfide effects threshold, an extensive series of bioassay analyses recently established a revised criterion for undissociated sulfide that is applicable to marine organisms near Platform Irene (Weston Solutions Inc. and MRS 2006). The threshold determined in this updated analysis was six-times higher than the EPA National Standard that is currently promulgated in the General Permit. The original criterion was developed using an extremely limited number of dated bioassay studies, conducted primarily on freshwater organisms, or on organisms exposed to sulfides in a complex chemical mixture. Because sulfide toxicity is closely related to the physicochemical properties of water, particularly pH and salinity, the freshwater data can greatly overestimate toxicity.

Thus, even without additional treatment of produced-water, potential impacts to marine organisms around Platform Irene are not likely to be significant. The indeterminacy in potential sulfide impacts that was identified in the original screening study can be largely eliminated through consideration of the increased dilution rate achieved by a redesigned diffuser, and consideration of the higher effects threshold. With a dilution rate comparable to most other California OCS platforms, the computed contaminant concentrations will be well below the sulfide effects threshold within approximately 8 m of the discharge point, and would affect only a small fraction of the receiving-water habitat around Platform Irene. It is highly unlikely that motile marine organisms would encounter this limited area on a regular basis, especially considering that most organisms exhibit a strong avoidance reaction to sulfide (EPA 1976, 1986).

5.3 OIL SPILLS

5.3.1 Oil Spill Risk Assessment

A major environmental concern with offshore oil and gas activities is the potential for oil spills and the resulting effects on biological resources, such as listed species. The largest oil spill in the Pacific OCS Region occurred in 1969, when a well blowout on Platform A off Santa Barbara spilled an estimated 80,000 bbl into the Channel (Van Horn et al., 1988). As discussed in Section 5.3.2, a number of preventive measures have been initiated since that time, including stringent regulations covering OCS operational and environmental safety, a rigorous MMS inspection program in the Pacific Region, continuous evaluation and improvement in OCS facilities' oil spill response, and the development of a highly organized oil spill response structure (Bornholdt and Lear, 1997). No spill of this magnitude has occurred anywhere on the U.S. OCS since 1969, and these measures make the reoccurrence of an event of that magnitude a highly unlikely event.

Table 5.1 lists the hydrocarbon spills that occurred in the Pacific OCS Region from 1969 through 1999. During that period, 843 oil spills were recorded. Obviously, the total volume of oil spilled in the Region is dominated by the Santa Barbara spill—since 1969, these spills have ranged in size from less than 1 bbl to 163 bbl, for a total of slightly less than 830 bbl. For comparison, natural oil seeps at Coal Oil Point in the Santa Barbara Channel are estimated to discharge approximately 100-170 bbl of oil per day (Hornafius et al., 1999).

In the course of normal, day-to-day platform operations, occasional accidental discharges of hydrocarbons may occur. Such accidents are typically limited to discharges of quantities of less than 1 bbl of crude oil. As shown in Table 5.1, 836 spills of less than 50 bbl (99 percent of the total) occurred on the Pacific OCS between 1969 and 1999, resulting in slightly less than 320 bbl of oil being discharged into the ocean. Due to the infrequency and small volumes of these accidental discharges, and their location (generally away from sensitive species), spills of less than 50 bbl are not considered an impact-producing agent for the protected species discussed in this biological evaluation.

Larger oil spills may occur from loss of well control (if wells are free flowing), pipeline breaks, operational errors, or vessel-platform collisions. However, only 5 of the 45 spills of greater than 1 bbl measured 50 bbl or more in volume (Table 5.1); the largest of these was the 163-bbl Platform Irene pipeline spill in September 1997.

Table 5.1 Crude, Diesel, or Other Hydrocarbon Spills Recorded in the MMS's Pacific OCS Region, 1969 Through 1999 (volumes in barrels)

Year	Less than or equal to 1 bbl		Greater than 1 bbl less than 50 bbl		Equal to or more than 50 bbl		Total	
	No	Volume	No	Volume	No	Volume	No	Volume
1969	0		0		2	80,900	2	80,900.0
1970	0		0		0		0	
1971	0		0		0		0	
1972	0		0		0		0	
1973	0		0		0		0	
1974	0		0		0		0	
1975	1	0.1	0		0		1	0.1
1976	3	1.1	1	2	0		4	3.1
1977	11	2.2	1	4	0		12	6.2
1978	4	1.2	0		0		4	1.2
1979	5	1.7	1	2	0		6	3.7
1980	11	4.9	2	7	0		13	11.9
1981	21	6.0	10	75	0		31	81.0
1982	24	3.2	1	3	0		25	6.2
1983	56	7.7	3	6	0		59	13.7
1984	65	4.7	3	36	0		68	40.7
1985	55	9.3	3	9	0		58	18.3
1986	39	5.5	3	12	0		42	17.5
1987	67	7.5	2	11	0		69	18.5
1988	47	3.7	1	2	0		48	5.7
1989	69	4.1	3	8	0		72	12.1
1990	43	3.6	0		1	100	44	103.6
1991	51	5.8	1	10	1	50	53	65.8
1992	39	1.2	0		0		39	1.2
1993	32	0.7	0		0		32	0.7
1994	18	0.4	2	33	1	50	21	83.4
1995	25	0.9	1	1.4	0		26	2.3
1996	39	0.9	1	5	1	150	2341	155.9
1997	20	2.5	0		1	163	21	165.5
1998	29	1.0	0		0		29	1.0
1999	22	0.5	1	10	0		23	10.5
Totals	**796**	**80.4**	**40**	**236.4**	**7**	**81,413.0**	**841**	**81,729.8**

For the purposes of this biological evaluation, MMS has estimated the number of oil spills of this approximate size (50 to 1,000 bbl) that could occur as a result of the proposed action. Based on a larger spill data set from the U.S. OCS (MMS, unpubl. data) and cumulative oil production figures, it was calculated using the method of Anderson and LaBelle (1994) (Attachment F) that a mean of 0.80 spills could occur over the approximately 15-year life of the Tranquillon Ridge project. This number represents oil spill occurrence, not oil spill probability, and is based solely on the oil spill accident rates and oil resource volume estimate. Using the 50-1,000-bbl spill rate of 0.80 and the Poisson distribution (Anderson and LaBelle, 1994), the estimated probability that one or more spills of this size will occur is 55 percent.

An effort also was made to estimate the likely size of such a spill. The MMS's U.S. Oil Spill Database (C. Anderson, unpubl. data) includes Pacific and Gulf of Mexico OCS spills of greater than 1.5 bbl recorded between 1971 and 1999. The database contains platform and pipeline spills, but no barge or tanker spills. Of the 2,125 total spills in the database, 106 are in the range of 50-999 bbl. The mean volume of these spills is 158.6 bbl, and 75 percent (79) are of less than 200 bbl. More than 95 percent (101) are of less than 500 bbl. Given these data and the experience in the Pacific Region over the last 30 years, the most likely spill volume from the Tranquillon Ridge Unit facilities would probably be less than 200 bbl in volume.

MMS also has estimated the number of oil spills of equal to or greater than 1,000 bbl that could occur as a result of the proposed action. The major spill estimate is based on the estimated production of oil over the life of the proposed project, including the subsea pipeline transport of hydrocarbons to shore. Based on the MMS Accident Spill Rates from all U.S. platforms and pipelines (Anderson and LaBelle, 1994; Anderson, 2000, unpubl.), the estimated probability that one or more large spills (≥1,000 bbl) will occur is 17 percent.

Federal regulations concerning oil spill response plans for OCS facilities require operators to calculate worst-case discharge volumes using the criteria specified in 30 CFR §254.47. These include 1) the maximum capacity of all oil storage tanks and flow lines on the facility, 2) the volume of oil calculated to leak from a break in any pipelines connected to the facility, and 3) the daily production volume from an uncontrolled blowout of the highest capacity well associated with the facility. Since these are worst-case estimates, intended to insure that an operator has the capacity to respond to the largest imaginable spills, they are based on unlikely events.

This is particularly true of the estimates for the first and third spill types described above. A catastrophic event would be required to empty all storage tanks and flow lines on the production platform. Similarly, with the implementation of modern blowout prevention equipment, operating procedures, and the MMS inspection program, blowouts have become rare. As discussed above, no blowout resulting in the release of measurable quantities of oil has occurred on the Pacific OCS since the 1969 Santa Barbara spill. In the Gulf of Mexico, with much greater levels of OCS activities, no blowout since 1970 has spilled more than about 60 bbl of oil (C. Anderson, unpubl. data).

Thus, the MMS estimates that the most likely maximum size of a major oil spill from the Tranquillon Ridge Unit development is the maximum volume of oil calculated to be spilled from a break in the Irene to shore oil/emulsion pipeline at the pipeline shoreline location, about 0.25 miles from the shoreline. This is estimated to be 6,718, or approximately 6,700 bbl of oil (MRS 2002 FEIR). However, the most likely scenario, as discussed above, is that one or more oil spills in the 50-1,000-bbl range would occur over the life of the proposed project (with an approximately 55 percent chance of occurrence), and that such a spill would be less than 200 bbl in volume. Regardless, there exists a moderate probability (17 percent) that a spill equal to or greater than 1,000 bbl could occur as a result of the proposed Tranquillon Ridge Unit development activities.

The level of impacts from such spills will depend on many factors, including the type, rate, and volume of oil spilled and the weather and oceanographic conditions at the time of the spill. These parameters would determine the quantity of oil that is dispersed into the water column; the degree of weathering, evaporation, and dispersion of the oil before it contacts a shoreline; the actual amount, concentration, and composition of the oil at the time of shoreline or habitat contact; and a measure of the toxicity of the oil.

Oil Spill Risk Analysis

The analyses described below provide possibilities of oil spill trajectory and landfall or resource impact. They include an OSRA Model calculation and a GNOME analysis that simulates oil movement due to winds, currents, tides, and spreading. The OSRA Model analysis is the traditional MMS method of determining probabilities of oil spill landfall and impacts to resources. It calculates numerous trajectories from a pre-designated launch point by varying the wind over a static, seasonally-averaged ocean current field and applying the deep ocean 3.5-percent wind rule to project the assumed movement of oil over the surface layer of the water. Shoreline segments are partitioned into their USGS Quad maps, and probabilities of oil spill landfall for each shoreline segment are calculated. The probabilities of oil spill intrusion into defined offshore regions are also presented.

GNOME analysis provides a slightly different picture of possible oil spill trajectory by including variables that account for weatherization of released materials, specific ocean current regimes, and meteorological conditions. GNOME was developed by the Hazardous Material Response Division (HAZMAT) of the NOAA OR&R.

Although the GNOME results differ slightly from OSRA model calculations, both analyses provide important insights that help present a more complete picture of what may occur when oil is spilled. Together, these analyses represent the best available information the MMS currently has to offer on possible oil spill trajectories in the Santa Barbara Channel-Santa Maria Basin area.

Oil Spill Risk Assessment (OSRA) Model

In order to determine the areas that might be contacted by proposal-generated oil spills, MMS has generated conditional oil spill probability data. Conditional oil spill probabilities are independent of both the accident spill rates and resource estimates; they are based solely on the MMS Oil Spill Risk Assessment (OSRA) Model simulation trajectories and assume that a spill has occurred. Attachment E describes the OSRA Model and provides graphical depictions of the results of the conditional model runs for southern California. Two launch points were included in the analysis for the proposed Tranquillon Ridge Unit project: Platform Irene, and the Irene-to-shore oil/emulsion pipeline.

The following paragraphs present seasonal synopses of the conditional OSRA Model runs conducted for the Tranquillon Ridge Unit. For each season, the OSRA Model calculated probabilities of contact to shoreline segments and offshore blocks for spills from each of the launch points over 3-, and 10-day periods. The results of each of these conditional model runs are included in Attachment E. Although the OSRA Model can also be used to calculate probabilities over a 30-day period, the effects of weathering on oil make the first 10 days of the oil spill trajectory the most important in a risk analysis and have been focused on here. Additionally, containment measures are generally in place well before 30 days have elapsed. Therefore, a 30-day period was not utilized in the modeling analysis.

Spring (March-May). Based on the spring OSRA Model runs (Attachment E), the probabilities that oil spilled from the Tranquillon Ridge Unit would contact San Miguel and Santa Rosa Islands range from less than 0.1 percent to 13.3 percent by the third day, and increase only slightly thereafter. By day 10, a small chance (less than 0.1 percent) of contact to San Nicolas Island appears. However, the model runs predict a 15.3 percent chance of mainland contact at Point Arguello within 3 days.

Conditional probabilities for offshore blocks also indicate a predominantly south to southeast movement of oil spilled from Tranquillon Ridge Unit (Attachment E). By day 3, contact probabilities of 50 percent or greater are recorded for waters southwest of San Miguel Island. From this point, spreading appears to continue southward, primarily over waters to the west of the Santa Rosa Ridge. Contact probabilities of 50 percent or greater occur in waters to the west of San Nicolas Island by day 10.

Summer (June-August). The OSRA Model runs for summer (Attachment E) indicate an even smaller probability of contact to the northern Channel Islands than in spring. Contact probabilities for San Miguel and Santa Rosa Islands range from less than 0.1 to 1.1 percent by the third day and do not change over the 10-day period. As was the case for spring, a very slight (less than 0.1 percent) probability of contact to San Nicholas Island appears by day 10. Additionally, the model runs predict an 11.9 percent chance of mainland contact at Point Arguello within 3 days.

The summer conditional runs for the offshore blocks show predominantly southward movement, with little probability of contact to areas north of Point Arguello (Attachment E). However, the probability of contact to waters west of San Miguel Island reaches about 60 percent after 3 days. By day 10, a contact probability of about 50 percent is recorded in waters as far south as San Nicolas Island.

Fall (September-November). The fall OSRA Model runs (Attachment E) indicates relatively low probabilities of contact, from less than 0.1 to 1.7 percent, to the western portions of San Miguel Island after 3 days. By day 10, this probability has increased only slightly, up to 1.9 percent. The chance of contact to San Nicolas Island, however, remains very slight, at less than 0.1 percent.

The fall model runs indicate the possibility that an oil spill from the Tranquillon Ridge Unit would contact the mainland shore at, and north of, Point Arguello. There is up to an 8.9 percent probability that the Point Arguello area would be contacted within 3 days. Additionally, low shoreline contact probabilities (around 1 percent) are recorded as far north as Point Sal. These probabilities increase marginally through the full 10-day model period. Very slight (less than 0.1 percent) probabilities of contact to the mainland as far north as Point Buchon appear by day 3, and expand northward by day 10 to include Point Piedras Blancas.

For the offshore blocks, the fall runs indicate movement to both north and south and considerable spreading throughout the 10-day model period (Attachment E). By day 3, low contact probabilities (about 10-20 percent) are recorded offshore as far north as Point Sal; probabilities of contact to waters west of San Miguel Island range up to 30 percent. After 10 days, there is a slight chance (less than 10 percent) of contact as far north as Piedras Blancas. Relatively greater movement to the south results in a contact probability up to 60 percent in areas approximately 10 km south-southwest of San Miguel Island by the end of the 10-day period. However, contact probabilities remain low, at less than 20 percent, in the offshore waters approximately 50 km west of San Nicolas Island.

Winter (December-February). The conditional OSRA Model runs for winter (Attachment E) give probabilities of only 2.5 percent that an oil spill from the Tranquillon Ridge Unit would contact San Miguel Island within 3 days. By the end of the 10-day period, these probabilities increase only slightly, to 3.3 percent. Chances of contact to other Channel Islands also remain slight, reaching 0.8 percent for Santa Rosa Island and less than 0.6 percent for San Nicolas Island, respectively, by day 10.

North of Point Conception, the model runs show probabilities of up to 13.6 percent that the Point Arguello area would be contacted by a spill within 3 days. Thereafter, overall probabilities that a spill would affect the mainland north of Point Conception increase only slightly, to about 14.4 percent. However, slight (less than 1 percent) probabilities of shoreline contact appear almost as far north as Cape San Martin.

At 3 days, the winter runs for the offshore blocks indicate some spreading to the north and northwest, with low probabilities of contact (less than 10 percent) recorded in waters off Morro Bay (Attachment E). Movement to the south appears comparable to that of the fall season, with contact probabilities of about 30 percent observed west of San Miguel Island. By day 10, up to10 percent contact probabilities are seen in offshore waters near Cape San Martin in the north; at the same time, probabilities of contact ranging up to 60 percent occur just west of San Miguel Island.

Oil Spill Risk Information Based on GNOME Modeling
This GNOME modeling analysis is presented along with the MMS OSRA Model results as part of the best available information regarding oil spill risk analysis for the Tranquillon Ridge Unit Project. An expanded version of this analysis, including relevant study methods, and the tables and figures referred to in the analysis presented here are found in Attachment E.

Releases were modeled over 3- and 10-day periods for three locations: Platform Irene, the midpoint of the pipeline, and the pipeline shoreline location about 0.25 miles from the shoreline. Additionally, releases were modeled for three wind directions (northwest, neutral, and southwest) correlated with prevailing ocean current flow regimes (upwelling, convergent, and relaxation).

The proposed project has the potential to beach a maximum of 3,984 bbls of oil, more than double the maximum amount (1,701 bbls) of the current operating scenario. This amount would be associated with a pipeline shoreline release during the upwelling regime and would occur primarily at the Surf location (Attachment E). Worst case impacts associated with a pipeline midpoint release would also occur during an upwelling regime, but would only total about 2,090 bbls. This amount would impact the areas of Surf, Point Arguello and Point Conception. Worst case impacts associated with a release at Platform Irene would total a similar amount, about 2,138 bbls, but would occur during a relaxation regime. This scenario would impact the more northerly areas of Point Purisma, Point Sal, Guadalupe and Pismo Beach.

Landfall contacts generated under the GNOME modeling (for all conditions) suggest that the northernmost extent any release would reach would be off of Point Buchon, and that such northward dispersion would only occur during a relaxation flow regime. The GNOME modeling also provides insight into the behavior of the spill with regard to the release site; a release at the shoreline will predominately impact the mainland from Pt. Sal to Pt. Conception, while releases at the pipeline midpoint or Platform Irene are more likely to make contact with San Miguel and Santa Rosa Islands (Attachment E).

5.3.2 Oil Spill Prevention and Response

Platform Inspections and Drills. The MMS is the federal agency that oversees the safe and environmentally sound exploration and production of oil and gas on the outer continental shelf (OCS). In the Pacific OCS Region, MMS inspectors and engineers visit the offshore platforms 365 days a year to ensure that safety, maintenance, and operational standards are being maintained and to prevent oil spills from occurring. Unannounced, partial production and drilling inspections of every offshore facility in the Region are conducted at least once per month, in addition to thorough annual inspections of each facility. Three or four times a year, the MMS also conducts intensive, multi-day inspections, known as focused facility inspections (FFIs), rotating among the offshore facilities.

In order to test offshore operators' states of readiness and response capabilities, as well as their knowledge and understanding of their individual oil spill response plans (OSRPs), the MMS also conducts frequent oil spill response exercises at OCS facilities. Appropriate federal, state, and local agencies are notified of, and frequently take part in, these exercises. Two types of exercises are conducted: 1) equipment deployment exercises (EDEs), and 2) table-top exercises (TTEs).

EDEs can be minor or major, and the exercises conducted in the Pacific OCS Region are unannounced. A minor EDE requires the successful deployment and operation of primary response equipment at the platform. A major EDE requires the establishment of an onshore incident command center, as well as the successful deployment and operation of primary and, to some degree, secondary response equipment.

Minor EDEs are conducted at least once per year per offshore facility. The MMS also schedules one major drill every year, rotating among the facilities.

A TTE is an exercise of an operator's spill management team response while simulating deployment of response equipment. An intended EDE may become a TTE if for some reason (e.g., weather or damage to equipment) response equipment cannot be deployed without unacceptable risk to personnel and the EDE cannot be rescheduled.

When MMS inspectors conduct drills at the OCS facilities, the operators are judged, in part, by their ability to show containment of the simulated spill within 1 hour and skimming operations within 2 hours. If these guidelines are not met, the MMS inspector can issue an Incident of Non-Compliance (INC) that will indicate how the operator failed in the drill and give them some time to remedy the failure. A retest will be conducted at some later time to ensure that the operator has corrected the fault. During a drill, various records, including training certifications and equipment inspections, are also checked. INCs may also be issued for failure in these areas.

Pipeline Inspection. The Pacific OCS Region also has a rigorous offshore pipeline inspection policy. The policy specifies several types of regular inspections. The operator is required to conduct weekly inspection by boat or aircraft of the ocean surface along the pipeline route for leakage. The records of these inspections must be submitted annually to the MMS.

External and internal inspections of all oil and gas pipelines by a third party are also required in alternating years. Plans for these inspections must be submitted to the MMS at least 30 days before the survey; inspection results must be submitted within 60 days of survey completion. The external inspections, which must be conducted using ROV or side-scan sonar, are intended to identify burial and spanning conditions, protrusions, structural integrity, damage, and corrosion to the pipeline. The internal inspections involve the use of internal survey tools to identify corrosion and/or damage.

If an inspection reveals a potential problem with a pipeline, the MMS requires the operator to develop a remediation plan to address the problem. The plan is submitted to the MMS for review and approval. If the MMS is unsatisfied with the plan, or if an inspection has identified a problem requiring immediate action, the MMS has the authority to shut down the pipeline. This is accomplished by de-rating the pipeline to a lower maximum volume and pressure, by shutting in the pipeline directly, or by suspending the operator's approval to transport OCS oil through the pipeline until the problem is resolved.

MMS regulations state that operators may be required to equip oil pipelines with a metering system to provide a continuous volumetric comparison between the input to the line at the structure(s) and the deliveries onshore. Such a system must include an alarm system and be sensitive enough to detect variations between input and discharge volumes. Alternately, an operator may, with approval from the MMS, install a system capable of detecting leaks in the pipeline. The majority of the oil pipelines in the Pacific OCS Region have continuous volumetric comparison-type leak detection systems. All oil pipeline leak detection systems must be installed and tested to demonstrate indicated design performance levels.

Oil Spill Response. As discussed above, MMS regulations require that each OCS facility have a comprehensive OSRP. Federal regulations (30 CFR Part 254) specify oil-spill response requirements for offshore oil and gas facilities. Operators of oil handling, storage, or transportation facilities must submit a spill-response plan to the MMS to demonstrate their ability to respond quickly and effectively whenever oil is discharged from their facility. Response plans consist of an emergency response action plan, and supporting information that includes an equipment inventory, contractual agreements with subcontractors, a worst-case discharge scenario, a dispersant use plan, an in-situ burning plan, and details on training and drills. Each response plan must be reviewed by the operator at least every 2 years and submitted with modifications to the MMS for review and approval.

Since 1970, oil companies operating in the Santa Barbara Channel and Santa Maria Basin have funded and operated a non-profit oil spill response cooperative called Clean Seas (Clean Seas, 1999). Clean Seas acts as a resource to its member companies by providing an inventory of state-of-the-art oil spill response equipment, trained personnel, training, and expertise in planning and executing response techniques. Clean Seas personnel and equipment are on standby, ready to respond to an oil spill, 24 hours a day, 365 days a year.

Clean Seas' area of responsibility stretches from Point Dume north to approximately Cape San Martin, and includes the northern Channel Islands. To provide spill response coverage in the area, Clean Seas maintains two large Oil Spill Response Vessels (OSRVs), several smaller response vessels, and pre-positioned equipment at strategic locations.

In conjunction with the Ventura County Commercial Fishermen's Association, Clean Seas founded the Fishermen's Oil-spill Response Team (FORT) in 1990. More than 300 area fishermen have been trained to respond to spill situations as members of FORT. FORT vessels have acted in support of Clean Seas' response efforts both in drills and at a number of offshore spills, where they have deployed boom, assisted logistics, and served as wildlife rescue platforms.

The primary oil spill response for the Tranquillon Ridge Unit facilities is provided by Clean Seas' OSRV *Mr. Clean III*. *Mr. Clean III* normally is moored adjacent to Platform Harvest or in Cojo Anchorage near Point Conception. Response time from Cojo Anchorage to Platform Irene is estimated to be approximately two hours. *Mr. Clean III* is equipped with two Lori Five Brush advancing skimmer units, one stationary skimmer, and one DOP 250 Skimmer, plus accessory equipment; 1500 feet of 70-inch Expandi Boom on a hydraulic reel and 1500 feet of 43-inch containment boom; a fast response boom boat, a dispersant application system, an 18-ton crane, 10 bags each of absorbent boom and pads, and an onboard oil storage capacity of 1400 bbl.

Secondary oil spill response from an OSRV would come from *Mr. Clean*, moored outside Santa Barbara harbor along with Clean Seas' oil-recovery barge. *Mr. Clean* could arrive at the Point Pedernales facilities in about 6 to 7 hours. This vessel would be used in the case of a spill that was larger than the primary OSRV could handle.

In addition to the OSRVs, Clean Seas maintains smaller response vessels, including two 32-foot Spill Response Vessels (SRVs), Fast Response Support Boats (FRSB), and miscellaneous small boats. These vessels are based in Santa Barbara Harbor and at Clean Seas' Carpinteria facility. If needed in support of *Mr. Clean III*, they could reach the Tranquillon Ridge facilities in 4 to 5 hours.

Clean Seas also is equipped and prepared to respond to oil spill threats to sensitive shoreline areas within its area of responsibility. Detailed and up-to-date information on sensitive areas and response strategies in the Clean Seas' area is provided in the Northern Sector, Los Angeles/Long Beach Area Contingency Plan prepared by the U.S. Coast Guard and the California Office of Oil Spill Prevention and Response, and in the Clean Seas Regional Response Manual. Based on Clean Seas cascadable agreements, additional levels of oil spill response to the Point Pedernales facilities are provided by Marine Spill Response Corporation (MSRC), and Advanced Cleanup Technology, Inc**.**

The Marine Spill Response Corporation (MSRC) is a nation-wide spill response cooperative, established by the oil industry in the wake of the *Exxon Valdez* spill. Founded in 1990, it is the largest dedicated standby oil spill response organization in the United States. MSRC operates four OSRVs in Southern

California and two in the San Francisco Bay. The OSRVs are approximately 210 feet long, have temporary storage for 4,000 barrels of recovered oil, and have the ability to separate oil and water aboard ship using two oil-water separation systems. To enable the OSRV to sustain cleanup operations, recovered oil is transferred into other vessels or barges. The MSRC's southern California response vessel is the OSRV *California Responder*, which is currently based in Port Hueneme, approximately 8 to 10 hours response time from the Point Pedernales facilities. MRSC also maintains a 32,000 bbl capacity barge at Port Hueneme. Originally, it was intended that the *California Responder* only be deployed in response to oil spills of 1,200 bbl or greater. However, due to the superior operating record and lack of large spills in this region, the *Responder* now responds to smaller spills on an on-call basis.

Advanced Cleanup Technologies, Inc. (ACTI) is a primary contractor for onshore and shoreline cleanup. ACTI has sufficient resources and trained personnel to satisfy all federal and state shoreline response planning requirements. In the event an onshore or shoreline response is required, ACTI personnel and equipment can respond in under a few hours.

The MMS also routinely inspects and can write INCs to the oil spill cooperatives and ACTI.

6.0 IMPACTS TO THREATENED AND ENDANGERED SPECIES

6.1 MARINE MAMMALS

This section provides a general discussion of the potential effects of the identified impact factors, including noise and disturbance, effluent discharges, and oil spills, on marine mammals. The following sections analyze the potential impacts of activities and accidental events associated with the proposed project on threatened and endangered marine mammal species in the project area.

Noise and Disturbance

Aircraft. There have been few systematic studies on the reactions of pinnipeds to aircraft (Richardson et al., 1995). Most documented observations of the reactions of pinnipeds to aircraft noise related to animals hauled out on land. Under these circumstances, recorded reactions range from increased alertness to headlong rushes into the water. In open water, pinnipeds sometimes respond to low-flying aircraft by diving (Richardson et al., 1995; M.O. Pierson, pers. obs.).

There are no data on the received levels at which toothed whales, or odontocetes, react to aircraft (Richardson et al., 1995). Observed reactions include diving, slapping the water with flukes or flippers, and swimming away. Information on the reactions of sperm whales to aircraft has been mixed. Sperm whales have not been observed to exhibit obvious reactions to low-flying helicopters (Richardson et al., 1995). However, sperm whales have been observed to dive immediately in response to a Twin Otter passing 150-230 m overhead (Mullin et al., 1991).

Baleen whales vary in their responses to the approach of aircraft. Richardson et al. (1995; pp. 249-252) review the recorded behavior of several baleen whale species, including bowhead, right, gray, humpback, and minke whales. They conclude that response depends on the whales' activities and situations, with foraging or socializing groups less likely to react to the approach of aircraft than individual animals. Observed responses include hasty dives, turns, and other changes in behavior. To date, there is no evidence that aircraft disturbance has resulted in long-term displacement of baleen whales.

Vessels. In general, seals often show considerable tolerance of vessels. Sea lions, in particular, are known to tolerate close and frequent approaches by boats (Richardson et al., 1995).

Odontocetes also often tolerate vessel traffic, but may react at long distances if confined (e.g., in shallow water) or previously harassed (Richardson et al., 1995). Depending on the circumstances, reactions may vary greatly, even within species. Although the avoidance of vessels by odontocetes has been demonstrated to result in temporary displacement, there is no evidence that long-term or permanent abandonment of areas has occurred. Sperm whales may react to the approach of vessels with course changes and shallow dives (Reeves, 1992), and startle reactions have been observed (Whitehead et al., 1990; Richardson et al., 1995).

There have been specific studies of reactions to vessels by several species of baleen whales, including gray (e.g., Wyrick, 1954; Dahlheim et al., 1984; Jones and Swartz, 1984), humpback (e.g., Bauer and Herman, 1986; Watkins, 1986; Baker and Herman, 1989), bowhead (e.g., Richardson and Malme, 1993), and right whales (e.g., Robinson, 1979; Payne et al., 1983). There is limited information on other species.

Low-level sounds from distant or stationary vessels often seem to be ignored by baleen whales (Richardson et al., 1995). The level of avoidance exhibited appears related to the speed and direction of the approaching vessel. Observed reactions range from slow and inconspicuous avoidance maneuvers to instantaneous and rapid evasive movements. Baleen whales have been observed to travel several kilometers from their original position in response to a straight-line pass by a vessel (Richardson et al., 1995).

Off California, collisions between vessels and whales have occurred frequently. Between 1975 and 1980, twelve collisions occurred off southern California, resulting in the deaths of six gray whales (Patten et al., 1980). Young gray whales, especially, are more likely to be hit by moving vessels (Laist et al. 2001).

A gray whale calf was severely injured offshore Morro Bay, California during installation of a trans-Pacific cable. The injury consisted of a severely cut tail stock and flukes completely severed off the animal. The extent of the injury (severing of the caudal peduncle) was consistent with a propeller strike (Harvey, 2001). Although the carcass of the calf was never recovered, it is unlikely that the injured calf traveled far from the location where it was observed (Harvey, 2001).

Offshore Drilling and Production. As discussed in Section 5.1.3, the sound levels produced by drilling from conventional, bottom-founded platforms are relatively low and are similar to levels generated by production activities (Gales, 1982). Richardson et al. (1995) predict that the radii of audibility for baleen whales for production platform noise would be about 2½ km in nearshore waters and 2 km near the shelf break.

For gray whales off the coast of central California, Malme et al. (1984) recorded a 50-percent response threshold to playbacks at 123 dB re 1 μPa (and about 117 dB re 1 μPa in the 1/3-octave band). This is well within 100 m in both nearshore and shelf-break waters; therefore, the predicted radius of response for grays, and probably other baleen whales as well, would also be less than 100 m. Richardson et al. (1995) predicted similar radii of response for odontocetes and pinnipeds.

Effluent Discharges

The potential effects of OCS platform discharges on marine mammals include 1) direct toxicity (acute or sublethal), through exposure in the waters or ingestion of prey that have bioaccumulated pollutants; and 2) a reduction in prey through direct or indirect mortality or habitat alteration caused by the deposition of muds and cuttings (SAIC, 2000a, b). However, there is no toxicity information on the effects of muds and cuttings and produced-water discharges on marine mammals. Comprehensive reviews by the National Academy of Sciences (1983), the U.S. Environmental Protection Agency (1985), and Neff (1987) do not address the potential effects of routine OCS discharges on these groups of animals (MMS, 1996). Significant impacts from routine OCS discharges have not been associated with marine mammals, because they are highly mobile and capable of avoiding such discharges, and their ranges far exceed the extent of the discharge plumes.

The EPA biological assessment for the proposed reissuance of its general NPDES permit for offshore OCS facilities in southern California waters concludes that direct toxicity to listed marine mammals, or their food base, should be minimal (SAIC, 2000a, b). All such discharges are required to meet NPDES water quality criteria, which were established to protect biological resources outside the mixing zone. Therefore, any contact with OCS discharges likely would be extremely limited. Potential impacts to listed marine mammals would most likely occur through the bioaccumulation of toxins in prey, or through the displacement or reduction of prey species (MMS, 1996; SAIC, 2000a, b). The potential impacts of OCS effluents on individual listed species are discussed below.

Oil Spills

Marine mammals vary in their susceptibility to the effects of oiling (Geraci and St. Aubin, 1990; Williams, 1990; Loughlin, 1994a). Oil may affect marine mammals through various pathways: surface contact, oil inhalation, oil ingestion, and baleen fouling (Geraci and St. Aubin, 1990). Cetaceans risk a number of toxic effects from accidental oil spills at sea (Geraci, 1990). Since cetaceans (like most adult pinnipeds) rely on layers of body fat and vascular control rather than pelage to retain body heat, they are generally resistant to the thermal stresses associated with oil contact. However, exposure to oil can cause damage to skin, mucous, and eye tissues. The membranes of the eyes, mouth, and respiratory tract can be irritated and damaged by light oil fractions and the resulting vapors. If oil compounds are absorbed into the circulatory system, they attack the liver, nervous system, and blood-forming tissues. Oil can collect in baleen plates, temporarily obstructing the flow of water between the plates and thereby reducing feeding efficiency. Reduction of food sources from acute or chronic hydrocarbon pollution could be an indirect effect of oil and gas activities.

It has been suggested that cetaceans could consume damaging quantities of oil while feeding, although Geraci (1990) believes it is unlikely that a whale or dolphin would ingest much floating oil. However, during the *Exxon Valdez* oil spill in 1989, killer whales were not observed to avoid oiled sections of Prince William Sound, and the potential existed for them to consume oil or oiled prey (Matkin et al., 1994). Fourteen whales disappeared from one of the resident pods in 1989-90, and although there was spatial and temporal correlation between the loss of whales and the spill, no clear cause-and-effect relationship was established (Dahlheim and Matkin, 1994). Fin, humpback, and gray whales were observed entering areas of the Sound and nearby waters with oil and swimming and behaving normally; no mortality involving these species was documented (Harvey and Dahlheim, 1994; Loughlin, 1994b; von Ziegesar et al., 1994; Loughlin et al., 1996).

Baleen whales in the vicinity of a spill may ingest oil-contaminated food (especially zooplankters, which actively consume oil particles) (Geraci, 1990). However, since the principal prey of most baleen whales (euphausiids and copepods) have a patchy distribution and a high turnover rate, an oil spill would have to persist over a very large area to have more than a local, temporary effect.

Since oil can destroy the insulating qualities of hair or fur, resulting in hypothermia, marine mammals that depend on hair or fur for insulation are most likely to suffer mortality from exposure (Geraci and St. Aubin, 1990). Among the pinnipeds, fur seals and newborn pups are the most vulnerable to the direct effects of oiling. Frost et al. (1994) estimated that more than 300 harbor seals died in Prince William Sound as a result of the *Exxon Valdez* oil spill and concluded that pup production and survival were also affected. In contrast, although Steller sea lions and their rookeries in the area were exposed to oil, none of the data collected provided conclusive evidence of an effect on their population (Calkins et al., 1994).

Sea otters, which rely almost entirely on maintaining a layer of warm, dry air in their dense underfur as insulation against the cold, are among the most sensitive marine mammals to the effects of oil contamination (Kooyman et al., 1977; Geraci and St. Aubin, 1980; Geraci and Williams, 1990; Williams and Davis, 1995). Even a partial fouling of an otter's fur, equivalent to about 30 percent of the total body surface, can result in death (Kooyman and Costa, 1979). This was clearly demonstrated by the *Exxon Valdez* oil spill (Davis, 1990; Ballachey et al., 1994; Lipscomb et al., 1994). Earlier experimental studies had indicated that sea otters would not avoid oil (Barabash-Nikiforov, 1947; Kenyon, 1969; Williams, 1978; Siniff et al., 1982), and many otters were fouled by oil during the Alaskan spill. Approximately 360 oiled otters were captured and taken to treatment centers over a 4-month period, and more than 1,000 dead sea otters were recovered (Geraci and Williams, 1990; Zimmerman et al., 1994). Ballachey et al. (1994) concluded that several thousand otters died within months of the spill, and that there was evidence of chronic effects occurring for at least 3 years.

The critical factors involved in sea otter mortality in Alaska, as identified by Williams (1990), were: 1) hypothermia, directly due to the decrease in insulation resulting from fouling of the pelage; 2) pulmonary emphysema, which was thought to be due to the inhalation of toxic fumes and was more or less limited to the first 2 weeks; 3) hypoglycemia, which was possibly due to poor gastrointestinal function; and 4) lesions in other organs (liver, heart, spleen, kidney, brain), which were probably due to ingestion of oil, as well as to stress. Williams felt that stress due to the effects of captivity contributed to tissue damage in otters brought into the treatment centers for cleaning, and that pulmonary emphysema was probably the most serious problem, since it was untreatable.

Potential indirect effects on sea otters resulting from an oil spill include a reduction in available food resources due to mortality or unpalatability of prey organisms and the loss of appropriate habitat available to sea otters as kelp forest communities become contaminated (Riedman, 1987).

Impacts of Past and Present OCS Activities

OCS oil and gas activities began off southern California in the late 1960s (Galloway, 1997). Section 5.1 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on biological resources in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995, 1997; MMS, 1996).

Noise and disturbance associated with OCS activities in the Pacific Region have resulted in few documented impacts to marine mammals. Van Horn et al. (1988) concluded that seismic surveys and support vessel traffic had resulted in temporary, localized disturbances to some marine mammals, primarily gray whales. However, despite hypothesizing that increased vessel traffic off southern California might be causing greater numbers of gray whales to migrate farther offshore (Wolman and Rice, 1979; MBC Applied Environmental Services, 1989), the gray whale population does not appear to have been unduly affected by such activity as no alterations have been observed in their migration routes. There is no evidence that increased vessel traffic (of which oil and gas support vessels are a very small part) has resulted in adverse impacts on endangered cetacean populations.

Based on experiences in southern California, the MMS believes that accidental collisions between endangered whales and support vessel traffic are unlikely events. Although large cetaceans have occasionally been struck by freighters or tankers, and sometimes by small recreational boats, no such incidents have been reported with crew or supply boats off California (MMS, unpubl. data). The same is true for southern sea otters.

Pinnipeds are very nimble and considered very unlikely to be struck by vessels. However, the single documented instance of a collision between a marine mammal and a support vessel involved a pinniped—

an adult male elephant seal struck and presumably killed by a supply vessel in the Santa Barbara Channel in June 1999.

The only OCS-related spill in the Pacific Region known to have contacted marine mammals was the 1969 Santa Barbara Channel spill. Although the entire northward migration of California gray whales passed through the Santa Barbara Channel while it was contaminated, Brownell (1971) found no evidence that any cetacean mortality had occurred due to the spill. Similarly, studies of elephant seals and California sea lions contacted by the 1969 spill reported no evidence of pinniped mortality from this event (Brownell and Le Boeuf, 1971; Le Boeuf, 1971). Since 1971, when formal tracking of all OCS spills was initiated, 841 OCS-related oil spills have occurred in the Pacific Region (see Section 5.3.1). However, almost all of these (99 percent) have been very small (less than 50 bbl), although five ranged in size from 50 to 163 bbl. No impacts to marine mammals have been reported from these spills. Although one OCS oil spill, the 1997 Torch spill off Point Pedernales, did contact the shoreline at the southern end of the sea otter range, no otters are known to have been contacted by oil (M.D. McCrary, MMS, pers. comm.).

6.1.1 Blue Whale (Endangered)

As described in Section 3.2, the proposed Tranquillon Ridge Unit drilling operations on Platform Irene would result in an increase in supply boat traffic from the current average of one one-way trip every 3 to 4 days to an average of one one-way trip every 3 days. This traffic would be relatively close to shore and would remain in the established traffic corridors. At the end of the drilling period, vessel traffic would be expected to return to approximately current levels for the duration of the Tranquillon Ridge Unit production activities. Development of the Tranquillon Ridge Unit will almost double the number of daily helicopter flights to Platform Irene (increasing from a current average of 3.2 up to 6.0 one-way flights per day) during drilling. During normal operations, however, although the total annual number of helicopter trips will increase, there would be no daily increase.

There have been few detailed studies of the reactions to vessels by rorqual species other than humpback whales (Richardson et al., 1995). Blue and fin whales summering in the St. Lawrence Estuary have been observed to react most strongly to rapid or erratic approaches by vessels (Edds and McFarlane, 1987). As discussed in Section 6.1 above, blue whales would be likely to react to the close approach of crew or supply boats, and some temporary displacement could occur under these circumstances. However, the increase in surface traffic to and from Platform Irene associated with the proposed project is unlikely to have a detectable effect on blue whales during their summer and fall presence in southern California waters.

Similarly, neither the minor and temporary increases in sound levels produced during the drilling activities on Platform Irene, nor the continuing noises produced by production activities, are likely to affect blue whale movements through the project area waters. Blue whales are frequently sighted from Platform Irene, during the summer and fall months.

Although blue whales do swim past Platform Irene on their way to and from foraging areas in the Santa Barbara Channel, they are unlikely to swim near enough to pass through platform effluent mixing zones. In addition, the zooplankton that form the blue whales primary prey would be unlikely to remain in the vicinity of the platform long enough to bioaccumulate toxins. Based on limited data, the impacts of effluents, particularly muds, cuttings, and produced water, on plankton generally appear to be limited to the several hundred to several thousand meters extent of the discharge plume for the brief period (perhaps several hours) that the organisms are in the plume (Raimondi and Schmitt, 1992; MMS, 1996). This could result in some mortality in the immediate vicinity (tens of meters) of the discharge and perhaps some reduced productivity farther away, to the extent of the plume. However, given their short generation time, on the order of hours or days, populations of plankton over broader areas should remain unaffected. For these reasons, the EPA's biological assessment for Section 7 consultation on the reissuance of their general NPDES permit for OCS facilities (SAIC, 2000a) concluded that blue whales off southern California would not be impacted by OCS platform discharges. Thus, no impacts on blue whales are expected from the effluent discharges associated with the proposed action.

The most likely oil spill scenario for the Tranquillon Ridge development project, based on OCS spill data for California, is that one spill of a volume ranging between 50 and 1,000 bbl could occur during the life of the project (Section 5.3.1). Further, based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. This level of spillage would be unlikely to have a detectable effect on the California blue whale population.

As discussed in Section 5.3, the probability that an oil spill of equal to or greater than 1,000 bbl would occur as a result of the proposed project is about 17 percent. However, if a spill of this size did occur, oil from Tranquillon Ridge would be very likely to contact the waters at the western end of the Santa Barbara Channel. Therefore, if a spill were to occur during summer or fall, when blue whales were in southern California waters to feed, at least part of their local foraging area could be affected (see Section 4.2.1). However, based on experiences from past spills, it is unlikely that any direct blue whale mortality would result from such a spill, and there is no evidence that blue whales would avoid oiled areas. However, blue whales could be temporarily displaced from a portion of their foraging area by the cleanup activities associated with the response to a spill of this size. Such displacement could be a source of physical stress for whales in the affected area and might also increase population congestion in areas unaffected by the spill. These effects would not, in themselves, represent a serious threat to the portion of the California blue whale stock that feeds seasonally in the Southern California Bight.

In conclusion, considering all impact sources, only oil spills are likely to have an effect on blue whales in the project area. However, given the likelihood that a spill occurring as a result of the proposed project would likely be less than 200 bbl in volume, and with the current the oil spill prevention and response capabilities in place, no impacts on blue whales are expected from the proposed Tranquillon Ridge development project.

6.1.2 Fin Whale (Endangered)

As discussed in Section 4.2.2, fin whales are present in greatest numbers off southern California in summer and fall (Dohl et al., 1981, 1983; Barlow, 1995; Forney et al., 1995). Fins are sighted in the Santa Barbara Channel, although they generally occur farther offshore and in waters south of the northern Channel Island chain (Leatherwood et al. 1987; Bonnell and Dailey, 1993; MMS, unpubl. data). They are less common than blue or humpback whales in the project area and, therefore, unlikely to be affected by any of the routine activities associated with the proposed Tranquillon Ridge Unit development.

Similarly, fin whales are unlikely to be affected by an accidental oil spill from Tranquillon Ridge facilities, were one to occur. No impacts to fin whales are expected.

6.1.3 Sei Whale (Endangered)

Due to the low numbers of sei whales estimated to frequent California waters—possibly tens to a few hundreds of animals (Bonnell and Dailey, 1993; Barlow et al., 1997; Reeves et al., 1998b)—neither routine activities nor accidental events associated with the proposed Tranquillon Ridge Unit development project are expected to affect this species. No impacts to sei whales are expected.

6.1.4 Humpback Whale (Endangered)

The reactions of humpback whales to vessels vary considerably. Humpbacks often move away when vessels are within several kilometers, (Baker and Herman, 1989; Baker et al., 1992), but may show little or no reaction when much closer (Richardson et al., 1995). They appear less likely to react overtly when feeding. As discussed for blue whales, humpbacks would be likely to react to the close approach of crew or supply boats, resulting in some temporary displacement and, possibly, disruption of feeding activity. However, the modest increase in surface traffic to and from Platform Irene associated with the proposed project is unlikely to have a detectable effect on humpback whales during their summer and fall presence in southern California waters.

Also, like blue whales, humpbacks are frequently sighted from area platforms during the summer and fall. The sound levels produced by the drilling and production activities associated with the Tranquillon Ridge Unit development project are not expected to affect humpback whales in the project area.

Although humpback whales do occur near Platform Irene, they are unlikely to swim near enough to pass through platform effluent mixing zones. In addition, as was discussed for blue whales, the zooplankton and small schooling fishes that form their primary prey would be unlikely to remain in the vicinity of the platforms long enough to bioaccumulate toxins. For these reasons, the EPA’s biological assessment for Section 7 consultation on the reissuance of their general NPDES permit for OCS facilities (SAIC, 2000a) concluded that humpback whales off southern California would not be impacted by OCS platform discharges. Thus, no impacts on humpback whales are expected from the effluent discharges associated with the proposed action.

However, in Prince William Sound following the 1989 *Exxon Valdez* oil spill, humpbacks were observed feeding in areas that had been heavily oiled, although none were observed feeding in oil (von Ziegesar et al., 1994). The whales did not appear to favor areas that had not been oiled. No humpback whale deaths or strandings were observed in Prince William Sound in 1989-1990 (Loughlin et al., 1996).

As discussed for the blue whale in Section 6.1.1, the one oil spill of about 200 bbl that could occur during the life of the Tranquillon Ridge project is unlikely to affect humpback whales. Additionally, with a probability of occurrence of only 17 percent, the chance of an oil spill of greater than 1,000 bbl is unlikely. However, if a spill of this size were to occur from the Traquillon Ridge Unit offshore facilities during the summer or fall, it would be likely to contact part of the area used for feeding by humpback whales in the Santa Barbara Channel and, to a lesser extent, in the southern Santa Maria Basin (see Section 4.2.4). Such an event would be unlikely to result in any humpback whale mortality, but could result in the temporary displacement of some animals from local foraging areas, primarily as the result of clean-up activities.

In conclusion, considering all impact sources, only oil spills are likely to have an effect on humpback whales in the project area. However, given the likelihood that a spill occurring as a result of the proposed project would be less than 200 bbl in volume, and the oil spill prevention and response capabilities in place, no impacts on humpback whales are expected from the proposed Tranquillon Ridge development project.

6.1.5 Northern Right Whale (Endangered)

Right whales are often approachable by a slowly moving boat, but will move away from a rapidly moving vessel (Watkins, 1986). In waters off the Atlantic coast, ship strikes are a major source of mortality for these slow-moving whales (Kenney and Kraus, 1993). However, as discussed in Section 4.2.5, the right whale population in the North Pacific is very small (NMFS, 1991), and right whales are very rarely seen off southern California (Carretta et al., 1994). Therefore, the probability a northern right whale would be affected by vessel (or helicopter) traffic associated with the proposed Tranquillon Ridge development project is extremely low.

It is also highly unlikely that effluent discharges or oil spills from the offshore Tranquillon Ridge facilities would ever have an effect on right whales. No impacts on the northern right whale from the proposed action are expected.

6.1.6 Sperm Whale (Endangered)

As discussed in Section 4.2.6, sperm whales are a pelagic species with a preference for deep waters (Watkins, 1977; Gosho et al., 1984). Although they are occasionally sighted in the Southern California Bight, they are generally found farther offshore (Dohl et al., 1981, 1983; Bonnell and Dailey, 1993). Thus, sperm whales are unlikely to be present near enough to Platform Irene or traffic corridors to be disturbed by routine activities from these sources.

They also are unlikely to approach near enough to the facilities to be directly affected by effluent discharge plumes. In addition, the squid that comprise their primary prey are deep-water species not known to be abundant near OCS platforms.

Finally, sperm whales do not frequent the areas that potentially could be contacted by an oil spill from the Tranquillon Ridge Unit. No impacts on sperm whales from the proposed action are expected.

6.1.7 Steller Sea Lion (Threatened)

As discussed in Section 4.2.7, Steller sea lions are now uncommon in southern California waters; their southernmost active rookery, Año Nuevo Island, is approximately 400 km north of the project area. They would not be affected by routine activities or discharges associated with the proposed action, and it is very unlikely that any Steller sea lions would come in contact with the one spill of about 200 bbl that could occur during the life of the Tranquillon Ridge Unit development. Therefore, no impacts on Steller sea lions from the proposed project are expected.

6.1.8 Guadalupe Fur Seal (Threatened)

Although a few Guadalupe fur seals appear on the Channel Islands each year (Bonnell and Dailey, 1993; DeLong and Melin, 2000), the Mexico-based population is still quite small (Gallo, 1994). They are almost never sighted at sea off California (Bonnell and Dailey, 1993). As is the case with the Steller sea lion, it is extremely unlikely that any routine activities or accidental oil spills associated with proposed Tranquillon Ridge Unit development would affect more than one or two individuals of this species. As such, no impacts on Guadalupe fur seals are expected from the proposed project.

6.1.9 Southern Sea Otter (Threatened)

Although no direct information is available on the potential impacts of exploratory and development drilling operations on sea otters, Riedman (1983; 1984) did observe sea otter behavior during underwater playbacks of drillship, semi-submersible, and production platform sounds and reported no changes in behavior or use of the area. Most of the otters observed by Riedman (1983) were at least 400 m from the projector; all observed by Riedman (1984) were at least 1.2 km away. Although sea otters at the surface were probably receiving little or no underwater noise, some otters continued to dive and feed below the surface during the playbacks. At 1.2 km, the received sound levels of the strongest sounds were usually at least 10 dB above the ambient noise level (Malme et al., 1983; 1984). Drilling activities associated with the proposed action would occur more than 11 km (7 mi) offshore. California sea otters, except for juvenile males, rarely move more than 2 km offshore (Riedman, 1987; Estes and Jameson, 1988; Ralls et al., 1988), and thus could be expected to be at least 9 km away from the nearest drilling activity. Because of this distance and the evidence from the playback experiments described above, no effects on sea otters from these activities are expected.

No systematic studies have been made of the reaction of sea otters to aircraft and helicopters (Richardson et al., 1995). During aerial surveys of the California sea otter range conducted at an altitude of about 90 m (Bonnell et al., 1983), no reactions to the two-engine survey aircraft were observed. The helicopter trips supporting the Tranquillon Ridge Unit development activities will all be out of the Santa Barbara, Lompoc, and Santa Maria airports and are expected to pass to the south of the main sea otter range. Helicopter traffic is not expected to affect sea otters.

Although sea otters will often allow close approaches by boats, they will sometimes avoid heavily disturbed areas (Richardson et al, 1995). Garshelis and Garshelis (1984) reported that sea otters in southern Alaska tend to avoid areas with frequent boat traffic, but will reoccupy those areas in seasons with less traffic. The vessel traffic corridors between Port Hueneme, the support base, and Platform Irene pass 4 km or more offshore. No effects on sea otters from service vessel traffic are expected.

As discussed in Section 5.3.1, the most likely oil spill scenario for the Tranquillon Ridge development project, based on OCS spill data for California, is that one spill of a volume ranging between 50 and 1,000 bbl could occur during the life of the project. Further, based on the distribution of past spill sizes, it is estimated that such a spill would probably be less than 200 bbl in volume. However, the probability that an oil spill of equal to or greater than 1,000 bbl would occur also exists.

The conditional OSRA Model runs indicate that a spill from the Tranquillon Ridge Unit (Platform Irene and the Irene-to-shore pipeline) during fall or winter has about a 13.6-percent chance of contacting the Point Arguello area within 3 days. Slight (less than 1-percent) chances of contact to mainland areas as far north as Point Piedras Blancas appear over the 10-day model run period. The probability of an oil spill from the Tranquillon Ridge facilities contacting the Point Arguello shoreline increases to 15.3-percent during spring months.

Thus, there is a reasonable chance that a spill of 50-1,000 bbl would contact the shoreline at the southern end of the present southern sea otter range. Predicting the length of coastline affected by an oil spill that comes ashore is extremely difficult due to the complexity of the process, which depends on factors such as nearshore wind patterns and currents, coastal bathymetry, tidal movements, and turbulent flow processes. The OSRA and GNOME modeling both indicate the likelihood that the coastline area from Guadalupe south to Pt. Conception could be impacted in the event of a spill. Thus, there is a reasonable probability of sea otter contacts occurring as a result of a spill associated with the Tranquillon Ridge Project.

Ford and Bonnell (1995), in their analysis of the potential impacts of an *Exxon Valdez*-sized spill on the southern sea otter, concluded that oil spills occurring at the southern end of the otter range present the smallest risk to the population. However, since 1995, southern sea otter range expansion to the south has continued, has increased substantially. During both semiannual surveys (spring and fall) conducted in 2005, close to 200 otters were observed between Pt. Sal and Pt. Conception, comprising 5 and 7% of the total population respectively.

If a spill were to occur, the magnitude of expected sea otter mortality would vary with a number of factors, including the time of year, volume of oil spilled, wind speed and direction, current speed and direction, distance of the spill from shore, volume of oil contacting the shoreline, condition of the oil contacting the shoreline, the success of containment operations, number of animals contacted, and the effectiveness of otter cleaning and rehabilitation.

In its Final Revised Recovery Plan for the Southern Sea Otter (FWS 2003), the FWS makes the assumption that, lacking reliable data on the survivability of oiled sea otters in the wild, all sea otters coming into contact with oil within 21 days of a spill will die. The FWS recognizes that activation of the California Department of Fish and Game's wildlife care facilities and oil spill response protocols would mitigate these impacts to some extent and that this assumption is probably conservative. Rapid and effective oil spill cleanup response (as discussed in Section 5.3.2) would also lessen impacts on otters in the spill area. Nevertheless,it is expected that one 50-1000 bbl spill will occur over the lifetime of the project, and it is estimated that this spill will likely be 200 bbls in size. Given the likelihood a spill making landfall along the mainland coast, there is a reasonable probability of sea otter contacts occurring as a result of a spill. Although the seasonal nature of the otter migration and the oil spill prevention and response capabilities in place, may act to reduce the number of affected otters, due to the increasing number of otters expanding into the project area, moderate impacts to the southern sea otter from the proposed Tranquillon Ridge Unit development project are expected, including mortality in the tens of animals.

6.2 BIRDS

This section provides a general discussion of the potential effects of the identified impact factors, including noise and disturbance, effluent discharges, and oil spills, on birds. The following sections analyze the potential impacts of activities and accidental events associated with the proposed project on threatened and endangered bird species in the project area.

Five threatened or endangered bird species that occur in the general area of concern for the Tranquillon Ridge Unit are considered in this analysis. These are: California brown pelican, California least tern, bald eagle, western snowy plover, and light-footed clapper rail. The only impact-producing agent that could occur from the Tranquillon Ridge Unit and affect these species is an accidental oil spill. Because all drilling activities would occur about 11 km (4 mi) from the nearest land, although additional helicopter flights are proposed, noise and disturbance associated with this project are not expected to have measurable effects on the above species. Platform discharges are not expected to have a measurable effect due to the high degree of dilution that would occur and the fact that bioaccumulation of associated pollutants is not expected (SAIC 2000b; Weston Solutions Inc. and MRS 2006).

Oil spills
Spilled oil may affect birds in several ways: 1) direct contact with floating or beached oil; 2) toxic reactions; 3) damage to bird habitat; and 4) damage to food organisms. Disturbance from cleanup efforts to remove spilled oil may also affect birds. Oil-related mortality is highly dependent on the life histories of the bird species involved. Birds that spend much of their time feeding or resting on the surface of the water are more vulnerable to oil spills (King and Sanger, 1979). Direct contact with even small amounts of oil can be fatal, depending on the species involved. Studies by Dr. Michael Fry (Nero and Associates, 1987) have found that exposure to as little as 3 ml of oil (which amounts to just less than a teaspoon) spread evenly on the wings and breast of Cassin's auklets caused severely matted plumage and was a lethal dose. The principal cause of mortality from oil contact in birds is from feather matting, which destroys the insulating properties of the feathers (Erasmus et al., 1981) and leads to death from hypothermia. Oiling can also result in a loss of buoyancy, which inhibits a bird's ability to rest or sleep

on the water (Hawkes, 1961), and can diminish swimming and flying ability (Clark, 1984). Also, an oiled bird's natural tendency is to preen itself in an attempt to remove oil from the plumage. The acute toxicity of such ingested oil (crude or refined) depends on many factors, including the amount of weathering and amount of oil ingested. Birds that receive lethal doses succumb to a host of physiologic dysfunctions (e.g., inflammation of the digestive tract, liver dysfunction, kidney failure, lipid pneumonia and dehydration) (Hartung and Hunt, 1966). Oil that is ingested as a result of preening or eating contaminated prey can cause abnormalities in reproductive physiology, including adverse effects on egg production (Ainley et al., 1981; Holmes, 1984; Nero and Associates, 1987). In addition, the transfer of oil from adults to eggs can result in reduced hatchability, increased incidence of deformities, and reduced growth rates in young (Patten and Patten, 1977; Stickel and Dieter, 1979). Growth reduction may also be the indirect result of an oiled parent's inability to deliver sufficient food to nestlings (Trivelpiece et al., 1984).

Cleanup efforts to remove spilled oil may have impacts of their own. Oil spill response and cleanup activities may involve intrusion into sensitive areas. Human presence while booming off an area, cleaning oil off beaches, or attempting to capture oiled wildlife for rehabilitation near seabird colonies may cause flushing from nests or temporary abandonment. Additionally, many seabirds react to disturbance by leaving their roosts or nests to go sit on the water somewhere nearby. In other words, disturbance of the colony may have the effect of flushing the birds into oiled water. This potential should be evaluated on a case-by-case basis in the event of a spill, prior to a decision to approach a roost or breeding colony.

Impacts of Past and Present OCS Activities

Section 5.1 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on biological resources in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995, 1997; MMS, 1996).

The level of OCS-related helicopter traffic in the Pacific Region is described in section 5.1. Although helicopter traffic can cause disturbances to birds, especially in largely unpopulated areas (e.g., Alaska), there is no evidence that OCS-related helicopter traffic has affected endangered birds in the Pacific Region (Bornholdt and Lear, 1995). Several international and numerous smaller airports occur along the southern California coast along with several military airports, and air traffic is a constant daily or even hourly occurrence. One of the more sensitive of the endangered birds in southern California might be the California brown pelican. However, air traffic over pelican breeding colonies is restricted to altitudes greater than 1,000 feet. Also, MMS provides OCS lessees with guidelines for protecting birds from aircraft (see section 5.1).

The largest OCS-related oil spill in the Pacific Region was the 1969 Santa Barbara spill, which resulted in the loss of thousands of birds (Straughn, 1971). Since 1971, when formal tracking of all OCS spills was initiated, 841 OCS-related oil spills have occurred in the Pacific Region. However, almost all of these (99 percent) have been very small (less than 50 bbl). No impacts to endangered birds or birds in general have been reported from these very small spills. In addition to these very small spills, five (less than 1 percent) OCS-related spills equal to or larger than 50 bbl have also occurred in the Pacific Region since 1971. These spills ranged in size from 50-163 bbl. Four of these spills did not contact shore, and no impacts to endangered birds or any birds were reported from them. One spill, however, did contact the shoreline and resulted in the mortality of an estimated 635 to 815 birds.

On September 28, 1997, a rupture in the Torch pipeline from Platform Irene to the shoreline occurred releasing an estimated 162 to over 1,242 bbls (26 to 197+ m3) of crude oil (Santa Barbara County 2001). The rupture resulted in the oiling of approximately 40 miles (64 km) of coastline, stretching from the northern end of Minuteman Beach to Boat House in Santa Barbara County. Approximately 100 acres (40 hectares) of sandy beach were disturbed by oiling and cleanup operations. In addition, another 263 acres

(106 hectares) of sandy beach were very lightly oiled (less than or equal to 10 percent oiling by area), but were relatively undisturbed by heavy equipment during cleaning operations (OSPR 1999).

Surveys for dead or live oiled seabirds that were beached were conducted from September 29 to October 5, 1997. Of the 140 birds that were collected during the surveys, 122 were either dead or died after sampling. However, these numbers are extremely conservative. For example, the surveys did not include birds that may have been missed by the surveyors, dead or oiled birds were outside the survey area or did not reach the shoreline, or birds that reached the shoreline in the survey area but were removed by scavengers or predators, such as vultures and coyotes. Ford Consulting (1998) estimated that approximately 353 birds died from oiling that were not recovered during the surveys.

The total number of birds impacted by the Torch spill has therefore been estimated at, a much higher number than that indicated by the survey results. Additionally, although deaths from oiling for the endangered brown pelican and snowy plover were not reported from the spill, Ford Consulting (1998) estimated that 14 brown pelicans and 13 snowy plovers were fouled by oil from the pipeline rupture.

6.2.1 Brown Pelican (Endangered)

Pelicans are at risk from oil spills because they dive into the water to catch their prey, and because they may spend part of the daylight hours on the ocean surface. However, pelicans also spend much of their time resting on land or man-made structures, where they are less vulnerable to oil. Most other seabirds spend as much as 90 percent of their time on the ocean surface, where they are more likely to be contacted by oil. Nevertheless, pelicans have been contacted by oil, and mortality has occurred from oil spills. For example, at least 195 pelicans were estimated to have died during the approximately 10,000-bbl American Trader spill off Huntington Beach, California in 1990 (Gorbics et al., 2000). Additionally, although no deaths were reported, Ford Consulting (1998) estimated that approximately 14 brown pelicans were fouled during the 1997 Torch pipeline spill.

The level of impact of an oil spill on brown pelicans depends on several factors, including the size of the spill, seasonal timing of the spill, and movement of the spill in relation to important pelican use areas. Based on the occurrence of previous oil spills and the amount of oil estimated to be produced from the Tranquillon Ridge Unit, there is a 17 percent probability that a large (>1,000-bbl) oil spill from this project would occur (see Section 5.3.1). A spill of this size has not occurred from OCS operations in southern California since the 1969 Santa Barbara oil spill. Although a large spill from this project is unlikely, smaller spills (<1,000 bbl) can and do occur (see Table 5.1). In the Pacific OCS Region, most (99 percent) of these spills have been very small (<50 bbl). Because of their very small size, these spills are not expected to have an effect on brown pelicans. Since 1971, five (1 percent) small spills of greater than 50 bbls have occurred in the Pacific OCS Region. These five spills ranged from 50 to 163 bbl. Spills in the 50-1,000-bbl range have also occurred in the Gulf of Mexico Region (see Section 5.3.1). Based on both the five spills in the Pacific Region and those in the Gulf, there is a 55 percent chance of a 50-1,000 bbl spill occurring over the life of this project. However, based on the distribution of past spill sizes, it is estimated that such a spill would probably be less than 200 bbl in volume.

There is no indication or evidence that oil spills occur in one season more than another. However, the OSRA Model provides information on where an oil spill might be expected to travel during different seasons while the GNOME Model provides information on where an oil spill might travel under particular oceanographic and meteorologic conditions. The (OSRA) probabilities of oil contacting important pelican use areas if a spill were to occur are shown in Table 6.1.

Table 6.1 indicates that most important brown pelican use areas would not be contacted by an oil spill from the Tranquillon Ridge Unit based on OSRA results. There is a reasonable chance (up to 13.3

percent) that oil from a spill would contact the western shore of San Miguel Island. Brown pelicans have recently re-established a rookery at Prince Island, off the northeastern shore of San Miguel Island. However, contact probabilities with this area are substantially less than those for the western portions of the island. The greatest probability of contact (1.4 percent) with this portion of the island occurs during spring.

There is also a small chance (up to 1.7 percent) that oil would contact the roosting area between Point Sal and Morro Bay during the fall when pelicans are present. If a spill of about 200 bbl were to occur from the Tranquillon Ridge Unit and move northward during the fall when pelicans are present, impacts could occur in this area, including some mortality.

As indicated in Table 6.1, there is also an extremely small chance (0.6 percent) of oil contact during the spring to the offshore area around or near San Nicolas Island after 10 days. However, the very large breeding colonies on Anacapa Island and Santa Barbara Island are not expected to be contacted based on the OSRA results.

Table 6.1 Conditional Probability of Oil Spill Contact with Important Brown Pelican Use Areas

Location and Season	Conditional Probabilities[1]	
	3-Day	10-Day
Anacapa Island		
Winter	0	0
Spring	0	0
Summer	0	0
Fall	0	0
Santa Cruz Island		
Winter	0	0
Spring	0	0
Summer	0	0
Fall	0	0.3
San Miguel Island		
Winter	2.5	3.3
Spring	13.3	14.4
Summer	1.1	1.1
Fall	1.7	1.9
Moro Bay to Point Sal		
Winter	0.3	1.1
Spring	0	0
Summer	0	0
Fall	0.6	1.7

[1]Percent range based on two launch points for the Tranquillon Ridge Unit.

The distance of San Miguel Island from the Tranquillon Ridge Unit (about 120 km or 75 miles), also affords brown pelicans a certain level of protection; Anacapa and Santa Barbara Islands are even more distant. Based on the very low probabilities of contact with pelican breeding colonies in the Southern California Bight and the distance of these colonies from the Tranquillon Ridge Unit, low impacts to pelican colonies are expected.

However, brown pelicans may occur almost anywhere in the Southern California Bight, especially during late summer and fall when pelicans disperse northward from the Mexican colonies. If a spill of approximately 200 bbl were to occur from the Tranquillon Ridge facilities, at least some pelicans might be contacted. Based on OSRA results, an oil spill from this project would most likely move toward the south or west, although some northward movement is also indicated by both OSRA and GNOME data (Attachment E). Pelicans in the immediate vicinity of the project would most likely be affected, although the small San Miguel and Santa Rosa Island roosts could also be contacted. Although dependent on the size of the spill, the number of pelicans affected would probably not exceed 100 birds. However, the impact to roosting pelicans could be exacerbated by cleanup efforts if roost areas become oiled. There is also a reasonable probability that a greater than 1,000-bbl spill could occur (see Section 5.3.1), in which case, the level of mortality could reach several hundred birds.

However, given that a spill occurring as a result of the proposed project would probably be less than 200 bbl in volume, the likelihood that no contact with either Anacapa or Santa Barbara Island will occur, and the oil spill prevention and response capabilities in place, the impacts of an oil spill from the Tranquillon Ridge Unit project on brown pelicans are expected to be very low and limited to the loss of tens of birds.

6.2.2 California Least Tern (Endangered)

Least terns are at risk from an oil spill because they dive into the water to catch their fish prey. They also nest and roost on beaches and mud flats that may be contacted by an oil spill or are in close proximity to the ocean or an estuary. The cleanup process, if not conducted with respect to Federal and State regulations, could exacerbate the effects of an oil spill on least terns.

For the reasons listed in Section 5.3.1, there is a 55-percent chance that one 50-1,000-bbl spill might occur from the Tranquillon Ridge Unit. Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. However, there is also a moderate probability (21.2 percent) that a large (>1,000-bbl) oil spill would occur. If an oil spill were to occur from this project, the probability of oil contacting least tern breeding colonies when the terns are present in California is shown in Table 6.2.

Table 6.2 Conditional Probability of Oil Spill Contact with Least Tern Breeding Colonies During the Breeding Season

Location and Season	Conditional Probabilities[1]	
	3-Day	10-Day
Oceano Dunes		
Spring	0	0
Summer	0	0
Purisima Point		
Spring	0	0
Summer	0	0
Vandenberg AFB		
Spring	15.3	15.3
Summer	11.9	11.9
Coal Oil Point Reserve		
Spring	0	0
Summer	0	0
Santa Clara River		
Spring	0	0
Summer	0	0
Ormond Beach/Pt. Mugu		
Spring	0	0
Summer	0	0

[1]Percent range based on two launch points for the Tranquillon Ridge Unit.

Table 6.2 indicates that, based on OSRA results, only one least tern breeding colony would likely be contacted by an oil spill from the Tranquillon Ridge Unit during the time when the terns are in California (Section 5.3.1). If a spill of about 200 bbl were to occur during the spring or summer and move north and contact the shoreline in the vicinity of Vandenberg AFB, impacts to terns could occur, including some mortality. The severity of these impacts would depend on the size of the spill, the length of shoreline contacted, and the number of terns present in the area. Over the last several years, tern usage of the Vandenberg AFB has declined, although this trend could shift again in time. However, there are currently relatively few terns in this area (only 2 breeding terns in 2006) and colonies are generally widely spaced so impacts would probably be limited to a single colony.

Given that a spill occurring as a result of the proposed project would probably be less than 200 bbl in volume, the likelihood that any oil contact would be limited to the small colonies from Point Sal to Point Conception, relatively small size of the colony in question, and the oil spill prevention and response capabilities in place, impacts to least terns are expected to be very low.

6.2.3 Bald Eagle (Threatened)

Bald eagles would most likely come into contact with oil from feeding on oiled seabirds or marine mammals. Besides ingesting oil-contaminated prey, their plumage could also become oiled.

Due to its small size, the subpopulation of bald eagles reintroduced to the Channel Islands may be more vulnerable to an oil spill. In addition to the efforts begun in 1980 at Santa Catalina Island, recent attempts have focused on the eagle's reintroduction to the northern Channel Islands. Since June 2002, 62 young bald eagles have been released on Santa Cruz Island, and in spring 2006 the first successful hatchings in over 50 years occurred on Santa Cruz Island. Currently, there are between 25 and 40 bald eagles residing on the northern Channel Islands (predominately Santa Cruz).

For the reasons listed in Section 5.3., there is a 55-percent chance that one 50-1,000-bbl spill might occur. There is also a moderate probability (17 percent) that a large (>1,000-bbl) spill would occur from this project. However, based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. If a spill were to occur, both OSRA and GNOME modeling results (see Attachment E) suggest that contact with portions of San Miguel, Santa Rosa, and Santa Cruz Island could occur under certain conditions. However, given that a spill occurring as a result of the proposed project would probably be less than 200 bbl in volume, and the oil spill prevention and response capabilities in place, no impacts to bald eagles are expected from this project.

6.2.4 Western Snowy Plover (Threatened)

Western snowy plovers are vulnerable to oil spills because they are generally restricted to sandy beaches, which can be contacted by spills. The cleanup process, if not conducted with respect to Federal and State regulations, could exacerbate the effects of an oil spill on snowy plovers.

The western snowy plover population has been declining almost since plover surveys were first conducted, and the decline may have increased in recent years. Their small population and sandy beach habitat make snowy plovers more vulnerable to an oil spill. Although, for the reasons listed in Section 5.3 and the brown pelican analysis above, a large (>1,000-bbl) oil spill from the Tranquillon Ridge Unit is unlikely, there is a 27 percent chance of a 50-1,000-bbl spill occurring. Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. If an oil spill were to occur from this project, the probability of oil contacting important snowy plover areas, including critical nesting and wintering habitat, is shown in Table 6.3.

Based on the OSRA results (Table 6.3), there is a moderate probability that one or several important snowy plover areas might be contacted by a spill of about 200 bbl. The snowy plover areas most likely to be contacted if a spill were to occur are Vandenberg AFB, Nipomo Dunes, although areas at San Miguel (SMI) and Santa Rosa Island (SRI) may also be affected. Vandenberg AFB currently acts as a breeding area for more than 10 percent of the plover population (Chris Dellwith FWS 2006 pers. comm.).

Table 6.3 Conditional Probability of Oil Spill Contact with Important Western Snowy Plover Use Areas

Location and Season	Conditional Probabilities[1]	
	3-Day	10-Day
Morro Bay Beaches		
Winter	0	0-0.8
Spring	0	0
Summer	0	0
Fall	0	0-0.3
Pismo Beach/Nipomo Dunes		
Winter	0	0-0.8
Spring	0	0
Summer	0	0
Fall	0	0-0.3
Pt. Sal to Pt. Conception		
Winter	0-13.6	0-14.4
Spring	0-15.3	0-15.3
Summer	0-11.9	0-11.9
Fall	0-8.9	0-9.2
Coastal Beaches		
Winter	0	0
Spring	0	0
Summer	0	0
Fall	0	0
Oxnard Lowlands		
Winter	0	0
Spring	0	0
Summer	0	0
Fall	0	0
San Miguel Island		
Winter	0-2.50	0-3.3
Spring	0.6-13.3	0.6-14.4
Summer	0-1.1	0-1.1
Fall	0-1.7	0-1.9
Santa Rosa Island		
Winter	0	0-0.8
Spring	0-0.8	0-1.1
Summer	0	0
Fall	0	0-0.6

[1]Percent range based on two launch points for the Tranquillon Ridge Unit.

Based on OSRA results, the likelihood of contact with the area between Point Sal and Point Conception, which contains areas designated as critical habitat, ranges up to 15.3 percent during the spring breeding season (Table 6.3). If a spill of about 200 bbl were to contact the shoreline in the vicinity of nesting or wintering snowy plovers in this area, impacts to plovers could occur, including some mortality. The level of impact would depend on the size of the spill, the success of containment efforts, the length of time for the spill to reach the area, and the length of shoreline contacted. Although the outcome of containment efforts cannot be predicted, response at the site of a potential spill should be rapid (see Section 5.3.2). However, there is some risk of contact to this area within three days (Table 6.3). Additionally, impacts to snowy plover could be exacerbated by beach cleanup efforts.

Similarly, other areas, including San Nicolas Island, Pismo/Nipomo Dunes, Morro Bay, and northern San Luis Obispo County, might also be contacted by a spill, but the probabilities are so low (0-1.7 percent, Table 6.3) that contact with these areas is highly unlikely.

Given that a spill occurring as a result of the proposed project would probably be less than 200 bbl in volume, the likelihood of oil contacting various nesting and wintering areas, and the oil spill prevention and response capabilities in place, impacts on snowy plovers would probably be limited to the area between Pt. Sal and Pt. Conception, and San Miguel and Santa Rosa Islands. Impacts to the nesting populations at these locations could include loss of adults, disruption of nesting activity, and abandonment of nesting beaches. However, the island populations make up only a small part of the total population. If, instead, a spill were to contact the area between Point Sal and Point Conception, where numbers are higher, the number of plovers affected could be somewhat higher. However, the overall impact on the species would remain low.

6.2.5 Light-footed Clapper Rail (Endangered)

Light-footed clapper rails are at risk from an oil spill because they are confined to coastal salt marshes that could be contacted by oil. The oil spill cleanup process, if not conducted in accordance with federal and state regulations, could exacerbate the effects of an oil spill on the rail's habitat.

The rail population has remained relatively small for many years, and an increase in the population is probably not likely for several more. Rails are also limited to only a very few marshes, and this, combined with their low population, makes them more vulnerable to an oil spill. For the reasons listed in Section 5.3.1, there is a 55-percent chance that a 50-1,000-bbl spill would occur from the Tranquillon Ridge Unit. Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. There is, however a 17 percent chance of a large (>1,000-bbl) spill occurring.

Further, based on OSRAM results (see Section 5.3.1), no contact with any occupied marsh is expected. There also was no drifter contact with occupied marshes (Attachment E). In the highly unlikely event that a large (>1,000-bbl) oil spill were to occur from this project and approach a salt marsh occupied by rails, these areas are more easily protected than the open coast, which affords the rails a greater degree of safety.

Given that a spill occurring as a result of the proposed project would probably be less than 200 bbl in volume, the likelihood that no contact to an occupied salt marsh will occur, and the oil spill prevention and response capabilities in place, no impacts to light-footed clapper rails are expected from the proposed project.

6.3 REPTILES

This section provides a general discussion of the potential effects of the identified impact factors, including noise and disturbance, effluent discharges, and oil spills, on sea turtles. The following sections analyze the potential impacts of activities and accidental events associated with the proposed project on threatened and endangered sea turtle species in the project area.

Noise and Disturbance
In the Gulf of Mexico, sea turtles are known to be attracted to and feed around offshore platforms (MMS, 1996). Although no systematic studies have been conducted on the effects of manmade noise on sea turtles (MMS, 1996), noise from service-vessel traffic may elicit a startle reaction from marine turtles and produce a temporary sublethal stress (NRC, 1990). Service vessels could also collide with and injure marine turtles at the sea surface. However, sea turtles are estimated to be at the sea surface less than 4% of the time (Byles, 1989; Lohoefener et al., 1990) and are generally infrequent visitors to the area. Although vessel-related injuries have been reported in the Gulf of Mexico, only one has been known to occur in project waters. In 2004, an olive ridley was found stranded on Ellwood Beach near Santa Barbara with a cracked carapace that was consistent with injury from a boat collision. Comparatively, in the Gulf of Mexico, 9% of stranded turtles examined showed signs of vessel injuries (USDOC, 1989).

Although marine turtles could be harmed or killed by project related vessels, collision impacts are considered to be adverse but not significant. Marine turtles are very rare in the project area and collisions with vessel traffic are not expected to occur.

Effluent Discharges
The potential effects of OCS platform discharges on sea turtles include 1) direct toxicity (acute or sublethal), through exposure in the waters or ingestion of prey that have bioaccumulated pollutants; and 2) a reduction in prey through direct or indirect mortality or habitat alteration caused by the deposition of muds and cuttings (SAIC, 2000a, b). However, there is no toxicity information on the effects of muds and cuttings and produced-water discharges on sea turtles. Comprehensive reviews by the National Academy of Sciences (1983), the U.S. Environmental Protection Agency (1985a), and Neff (1987) do not address the potential effects of routine OCS discharges on this group of animals (MMS, 1996).

No significant impacts have been associated with these animals, in part, because they are highly mobile and their range far exceeds the extent of a platform discharge plume. An indirect effect related to the displacement or reduction of food/prey species is more likely (MMS, 1996).

Oil Spills
If a sea turtle comes into direct contact with oil, a number of physiological effects may occur (MMS, 1996). Oil exposure has been observed to adversely affect sea turtle skin tissues, respiration, blood chemistry, and salt gland function. However, test animals exposed to sublethal doses have been observed to recover from oil contact within a month (Lutz, 1985; MMS, 1996).

Oil spills can adversely affect sea turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, disruption of salt gland function, asphyxiation, and displacement from preferred habitats (Lutz and Lutcavage, 1989; Vargo et al., 1986). Sea turtles are known to ingest oil (Gramanetz, 1988); this may occur during feeding (tar balls may be confused with food) or while attempting to clean oil from flippers. Oil ingestion frequently results in blockage of the respiratory system or digestive tract (Vargo et al., 1986). Some fractions of ingested oil may also be retained in the animal's tissues, as was detected in turtles collected after the *Ixtoc* spill in the Gulf of Mexico (Hall et al., 1983).

It is unclear whether adult sea turtles actively avoid spilled oil (MMS, 1996). In some instances, turtles have appeared to avoid oil by increasing dive times and swimming away (Maxwell, 1979; Vargo et al., 1986). Other observers have suggested that sea turtles actually may be attracted to some of the components found in crude oil (Kleerekoper and Bennett, 1976).

Impacts of Past and Present OCS Activities
Section 5.1 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on biological resources in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995, 1997; MMS, 1996).

No impacts on sea turtles from past and present OCS oil and gas activities in the Pacific Region have been identified.

6.3.1 Leatherback Sea Turtle (Endangered)

Although leatherbacks are the most commonly observed sea turtles off the west coast of the U.S. (Dohl et al., 1983; Green et al., 1989; NMFS and FWS, 1998a), densities in southern California waters are very low. Additionally, the presence of leatherbacks off California is seasonal in nature, occurring during late summer and fall. Given their limited, seasonal presence, it is very unlikely that routine activities or accidental oil spills associated with the Tranquillon Ridge Unit development would have a detectable effect on this species. No impacts on leatherback sea turtles from the proposed project are expected.

6.3.2 Green Sea Turtle (Endangered)

Off southern California, green sea turtles are uncommon in waters north of the San Diego area (NMFS and FWS, 1998b) and are rarely seen in the vicinity of the project area (Dohl et al., 1983). No impacts on green sea turtles from the proposed project are expected.

6.3.3 Pacific Ridley Sea Turtle (Endangered)

As discussed in Section 4.4.3, Pacific ridley sea turtles are infrequent visitors to waters north of Mexico and are unlikely to occur in the vicinity of the Tranquillon Ridge Unit project area. No impacts on Pacific ridleys from the proposed project are expected.

6.3.4 Loggerhead Sea Turtle (Threatened)

Like Pacific ridley turtles, loggerhead sea turtles are near the northern limit of their range off southern California and are likely to be infrequent visitors to the Tranquillon Ridge Unit project area (Stebbins, 1966; NMFS and FWS, 1998d). No effects on loggerhead sea turtles from the proposed project are expected.

6.4 MARINE INVERTEBRATES

This section provides a general discussion of the potential effects of the identified impact factors, including noise and disturbance, effluent discharges, and oil spills, on marine invertebrates. The following section analyzes the potential impacts of activities and accidental events associated with the proposed project on the threatened white abalone in the project area.

Noise and Disturbance
No adverse impacts to abalone are expected from the daily helicopter flights, vessel traffic, or drilling and production noise associated with the proposed project.

Effluent Discharges
The drilling muds and cuttings and produced waters of OCS oil and gas facilities could potentially affect abalone through direct toxicity by exposure in the water. The EPA biological assessment for the proposed reissuance of its general NPDES permit for offshore OCS facilities in southern California waters concludes that direct toxicity to listed fish species, or their food base, should be minimal (EPA, 2000a, b). All such discharges are required to meet NPDES water quality criteria, which were established to protect biological resources outside the mixing zone. Significant impacts from routine OCS discharges generally have not been associated with fish or marine invertebrates. For example, a successful mariculture operation previously sold mussels collected from OCS platform legs to local restaurants for over a decade. The mussels consistently passed all FDA criteria for marketing shellfish.

Oil Spills
Oil may affect marine invertebrates through various pathways, including direct contact, ingestion of petroleum contaminated water, and lingering sublethal impacts due to oil becoming sequestered in sediments and persisting in some cases for years in low energy environments (NRC 1985). The level of impacts and the persistence of the oil in the environment will depend on the volume of oil that reaches the habitat and the amount of mixing and weathering the oil has undergone before reaching the habitat. An at-sea oil spill would likely disperse sufficiently prior to any deposition at depth, that it would not impact white abalone habitat.

Impacts of Past and Present OCS Activities
Section 5.1 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on biological resources in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995; MMS, 1996).

No impacts on threatened or endangered marine invertebrates from past and present OCS-related oil and gas activities in the Pacific Region have been reported.

6.4.1 White Abalone (Endangered)

Due to NPDES discharge permit requirements and the rapid dilution of the discharges (Section 5.2), contaminants from effluent discharges associated with OCS activities should not be measurable in the coastal waters and sediments known to harbor white abalone. Thus, no impacts on white abalone are expected from effluent discharges. Although it is unlikely that white abalones exist within the project area since it is north of Point Conception, areas where white abalone or suitable white abalone habitat exist could be affected by a spill from the project area that exhibits a southward trajectory.

The most likely oil spill scenario for the Tranquillon Ridge development project, based on OCS spill data for California, is that one spill of a volume ranging between 50 and 1,000 bbl could occur during the life of the project (Section 5.3). Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume.

Given the oil spill prevention and response capabilities in place, an oil spill of this size would likely weather, mix, and break up to the point where no impacts would occur to white abalone or their habitat. Therefore, no impacts to white abalone or its habitat would be expected from an oil spill associated with the proposed project.

6.5 AMPHIBIANS

This section provides a general discussion of the potential effects of the identified impact factors, including noise and disturbance, effluent discharges, and oil spills, on amphibians. The following section analyzes the potential impacts of activities and accidental events associated with the proposed project on the threatened California red-legged frog in the project area.

Noise and Disturbance

Aircraft. Loud noises such as those produced by a low-flying helicopter would be expected to cause a startle response in frogs. Depending on the frequency of the flights and the altitude of the helicopter, this could disrupt feeding or breeding behavior.

Vessels. No impacts are expected to onshore species.

Offshore Drilling and Production. No impacts are expected to onshore species.

Effluent Discharges

No impacts are expected to onshore species.

Oil Spills

Oil may affect amphibians through various pathways, including direct contact, ingestion of contaminated prey, and lingering sublethal impacts due to oil becoming sequestered in sediments and persisting in some cases for years in low energy environments (NRC 1985). The level of impacts and the persistence of the oil in the environment will depend on the volume of oil that reaches the habitat and the amount of mixing and weathering the oil has undergone before reaching the habitat. An at-sea oil spill would not impact breeding or estivation habitat of red-legged frogs, which is well upstream of the coast.

Impacts of Past and Present OCS Activities

Section 5.1 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on biological resources in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995; MMS, 1996).

No impacts on threatened or endangered amphibians from past and present OCS-related oil and gas activities in the Pacific Region have been reported.

6.5.1 California Red-legged Frog (Threatened)

Helicopter traffic to the platforms that would produce the Tranquillon Ridge Unit currently occurs 3-5 times per week (11 round trips/week annual average), and would increase to 3 round trips per day. It is likely that flights may pass over red-legged frog habitat. Due to the altitude restrictions placed on OCS helicopter flights (Section 5.1.2); however, it is unlikely that these overflights would cause a behavioral effect on red-legged frogs. Thus, no impacts on red-legged frogs are expected from helicopter traffic.

Adult red-legged frogs move down to the brackish coastal lagoons formed seasonally behind sand berms that close the mouths of rivers and streams along the south central coast. Storms or tides may breach these natural berms, at which point the frogs move upstream to freshwater. Due to NPDES discharge permit requirements and the rapid dilution of the discharges (Section 5.2), contaminants from effluent discharges associated with OCS activities should not be measurable in the coastal waters and sediments that enter these lagoons. Thus, no impacts on red-legged frogs are expected from effluent discharges.

There is some risk that an oil spill might reach the coastal lagoons during a high tide or storm when the sand berms have been breached. Red-legged frogs cannot tolerate salinities in excess of 9 ppm and leave the coastal lagoons when seawater breaches the sand berms. Although no direct oil contact with frogs is expected, oil can become sequestered in the sediments and persist until rains flush the sediments from the lagoon. If the sand berms reform and conditions become favorable, some red-legged frogs may return before the contaminated sediments are flushed into the ocean. The level of toxicity would be dependent on the weathering of the oil and the volume of oil that reaches the lagoon.

The most likely oil spill scenario for the Tranquillon Ridge development project, based on OCS spill data for California, is that one spill of a volume ranging between 50 and 1,000 bbl could occur during the life of the project (Section 5.3, p. 3). Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. An oil spill of this size would weather, mix, and break up to the point where only limited tarring would be expected to coastal lagoons in the Point Arguello area. Such a level of spillage would be unlikely to have a detectable effect on the California red-legged frog or the coastal lagoons it uses as seasonal habitat.

However, as discussed in Section 5.3, there is a 17 percent probability that an oil spill of equal to or greater than 1,000 bbl would occur as a result of the proposed project. If a spill of this size did occur, and the sand berms of the coastal lagoons were breached, sublethal impacts to red-legged frogs might occur if the frogs returned before rains flushed the sediments from the lagoons. Oil spill response teams would be expected to boom the mouths of creeks and rivers or enhance the existing berms in the event of a spill thus minimizing the chance of oil reaching the lagoons.

If a spill were to occur between October and March, the OSRA model runs (Section 5.0) predict up to a 15.3-percent probability that the Point Arguello area would be contacted by oil within 3 days. The coastal rivers and streams in the Point Arguello area support populations of red-legged frogs. Tadpoles have been reported in Jalama and Cañada Honda creeks, and adult frogs can be found seasonally in the coastal lagoons of the central California coast. Eggs and tadpoles are not found in the coastal lagoons. As discussed earlier, an oil spill of about 200 bbl that contacted the mainland along the central California coast would be unlikely to result in red-legged frog mortality or sub-lethal effects. However, habitat destruction could result from clean-up efforts. Proper preparation and execution of the oil spill contingency plan should protect these areas during an oil spill response, thus no impacts are expected to red-legged frog habitat.

In conclusion, given the low probability that an oil spill of about 200 bbl would contact seasonal red-legged frog habitat in the coastal lagoons, and the oil spill prevention and response capabilities in place, no impacts to the California red-legged frog or its habitat would be expected from an oil spill associated with the proposed project.

6.6 FISH

This section provides a general discussion of the potential effects of the identified impact factors, including noise and disturbance, effluent discharges, and oil spills, on fish. The following sections analyze the potential impacts of activities and accidental events associated with the proposed project on endangered fish species in the project area.

Noise and Disturbances
Aircraft. No adverse impacts to fish are expected from daily helicopter flights associated with the proposed project.

Vessels. No adverse impacts to fish are expected from vessel traffic associated with the proposed project.

Offshore Drilling and Production. No adverse impacts to fish are expected from offshore drilling and production noise associated with the proposed project.

Effluent Discharges

The drilling muds and cuttings and produced waters of OCS oil and gas facilities could potentially affect fish species through direct toxicity by exposure in the water or ingestion of prey that have bioaccumulated toxins from the discharges. The EPA biological assessment for the proposed reissuance of its general NPDES permit for offshore OCS facilities in southern California waters concludes that direct toxicity to listed fish species, or their food base, should be minimal (EPA, 2000a, b). All such discharges are required to meet NPDES water quality criteria, which were established to protect biological resources outside the mixing zone. Significant impacts from routine OCS discharges generally have not been associated with fish. In fact, Love (1999) suggests that offshore platforms may provide nursery grounds for some species of rockfish. Previously, a successful mariculture operation sold mussels collected from OCS platform legs to local restaurants for over a decade. The mussels consistently passed all FDA criteria for marketing shellfish.

Currently there are eight generic water-based muds that have been approved for use by EPA. EPA does not authorize discharge of oil-based drilling fluids into marine waters. The major toxic constituents of drilling muds are trace metals including arsenic, cadmium, chromium, lead, mercury, and zinc. The toxicity of water-based drilling mud to juvenile lobster and flounder was investigated by Neff et al. (1989). They found that both species accumulated small amounts of barium, but no detectable chromium during 99 days of exposure to sandy sediment heavily contaminated with the settleable fraction of a used water-based lignosulfonate drilling mud. There was some physiological and biochemical evidence of stress in both species, but growth was not significantly affected. The authors concluded that, for the species and life stages tested, there is little evidence for toxicity of water-based drilling mud.

Cuttings are generally not highly toxic, but depending on the subsurface formations being penetrated, they may contain toxic metals, naturally occurring radioactive elements, or petroleum. Cuttings generally do not disperse far from the discharge point, and instead accumulate on the seafloor below the platform. Several thresholds (contaminant concentrations at which ecological and toxicological effects rise to a level of concern) have been proposed for marine sediments. The most widely used thresholds for sediments are the "Effects Range-Low" and "Effects Range-Median" guidelines developed by NOAA (Long and Morgan, 1990; Long, 1992; Long et al., 1995). Effects thresholds were ranked, using laboratory and field tests, and the 90th and 50th percentiles were determined. The 90th percentile (i.e., the contaminant concentration at which 90 percent of the studies found no effect) is referred to as ERL and is considered to be a concentration below which adverse impacts are unlikely. The 50th percentile is referred to as ERM and is interpreted as the concentration at which effects are frequently observed. Neff and Sauer (1996) examined PAH concentrations near four petroleum production platforms in the Gulf of Mexico with large produced water discharges. Although PAH concentrations were 2- to 10-fold above background in sediments at 20 m from discharge points, and were at background by 200 m, the PAH concentrations in sediments were generally below the ERL levels determined by Long et al. (1995).

"Produced water" is the water present in the source petroleum. The major constituents are carboxylic acids and phenols, single-ring aromatics, and polycyclic aromatic hydrocarbons. Acute toxicity correlates strongly with the phenol concentration. The contaminants from produced water are rapidly diluted and removed by volatilization and biodegradation (SAIC, 2000a, b). These findings are consistent with the assessment of essential fish habitat that was prepared for the re-issuance of a NPDES General Permit for offshore oil and gas facilities in southern California (SAIC, 2000c). The overall conclusions of the assessment were that the continued discharge from the 22 platforms offshore California will not adversely affect fish outside the mixing zones. Within the 100-m radius mixing zone, discharges from oil and gas exploration, development, and production may have localized effects on water quality and resident marine organisms, including fish. The assessment further concluded that while there may be effects on fish from certain discharges such as drilling fluids and produced water within the mixing zone near an outfall, these effects should be minor and localized.

As a result of NMFS consultation, the NPDES Genera Permit required a study of the direct lethal, sublethal, and bioaccumulative effects of produced water on federally managed fish species that occupy the mixing zone of produced-water discharges (MRS 2005). That study included site-specific modeling of the dispersion plumes from each platform covered by the permit, including Platform Irene. The study found that fish populations around Platform Irene consist mostly of rockfish that utilize the platform as habitat, rarely venturing far from the protection of the structure. A quantitative exposure assessment found a general absence of impacts from most of the major produced-water constituents. Many of the produced-water constituents that are normally of concern for the protection of marine organisms were below biological effects levels prior to discharge. Four constituents had end-of-pipe concentrations that were slightly elevated in produced water compared to thresholds of potential effects in finfish. However, because the produced-water discharge achieves high dilution almost immediately upon discharge, the plume volume containing concentrations of potential biological significance were exceedingly small compared to the volume of habitat contained within the mixing zone.

In the quantitative assessment, undissociated sulfide was the only constituent in Platform Irene's produced water that could not be eliminated as a source of potential impacts to fish within the mixing zone. However, subsequent research has addressed one of the major deficiencies in the original assessment with regard to sulfide, namely, its toxic threshold in marine organisms (Weston Solutions Inc. and MRS 2006). Analysis of extensive bioassay testing found a sulfide threshold for marine species that was six-times higher than the EPA National Standard currently promulgated in the General Permit. The current standard was based on an extremely limited number of dated bioassay studies, conducted primarily on freshwater organisms, or on organisms exposed to sulfides in a complex chemical mixture. In addition, a new diffuser structure is being designed for Platform Irene that should achieve much higher dilution rates than were considered in the original study. With these changes, computed contaminant concentrations will be well below the sulfide effects threshold within approximately 8 m of the discharge point, and would impact only a small fraction of the receiving-water habitat around Platform Irene. It is highly unlikely that finfish would encounter this limited area on a regular basis, especially considering that they exhibit a strong avoidance reaction to sulfide (EPA 1976, 1986).

Oil Spills

Research shows that hydrocarbons and other constituents of petroleum spills can, in sufficient concentrations, cause adverse impacts to fish (NRC, 1985; GESAMP, 1993). The effects can range from mortality to sublethal effects that inhibit growth, longevity, and reproduction. Benthic macrofaunal communities can be heavily impacted, as well as intertidal communities that provide food and cover for fishes. Although fish can accumulate hydrocarbons from contaminated food, there is no evidence of food web magnification in fish. Fish have the capability to metabolize hydrocarbons and can excrete both metabolites and parent hydrocarbons from the gills and the liver. Nevertheless, oil effects in fish can occur in many ways: histological damage, physiological and metabolic perturbations, and altered reproductive potential (NRC, 1985). Many of these sublethal effects are symptomatic of stress and may be transient and only slightly debilitating. However, all repair or recovery requires energy, and this may ultimately lead to increased vulnerability to disease or to decreased growth and reproductive success.

The egg, early embryonic, and larval-to-juvenile stages of fish seem to be the most sensitive to oil. Damage may not be realized until the fish fails to hatch, dies upon hatching, or exhibits some abnormality as a larva, such as an inability to swim (Malins and Hodgins, 1981). There are several reasons for this vulnerability of early life stages. First, embryos and larvae lack the organs found in adults that can detoxify hydrocarbons. Second, most do not have sufficient mobility to avoid or escape spilled oil. Finally, the egg and larval stages of many species are concentrated at the surface of the water, where they are more likely to be exposed to the most toxic components of an oil slick.

Impacts of Past and Present OCS Activities
Section 5.1 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on biological resources in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995, 1997; MMS, 1996).

No impacts on threatened or endangered fish from past and present OCS-related oil and gas activities in the Pacific Region have been reported.

6.6.1 Tidewater Goby (Endangered)

Tidewater gobies, which are found in shallow coastal lagoons, stream mouths, and shallow areas of bays, would not be impacted by effluent discharges. Over the distance from Platform Irene to the shore, any pollutants discharged would be diluted to background levels.

There is some risk that an oil spill might reach the coastal lagoons during a high tide or storm when the sand berms blocking the stream mouths from the ocean have been breached. Breaches usually occur during the winter and spring months, and tidewater gobies often move upstream out of the lagoons during this period. Although direct oil contact with gobies would be unlikely, oil can become sequestered in the sediments and persist until rains flush the sediments from the lagoon. When the gobies returned, short-term sublethal effects would also be expected, since gobies burrow into and feed in the sediment and rely on macrofaunal and intertidal communities for food and shelter from predators. The level of impacts, however, would be dependent on the volume of oil that reached their habitat and the amount of weathering and mixing the oil had undergone before reaching the habitat.

The most likely oil spill scenario for the Tranquillon Ridge development project, based on OCS spill data for California, is that one spill of a volume ranging between 50 and 1,000 bbl would occur during the life of the project (Section 5.3). Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. An oil spill of this size would weather, mix, and break up to the point where only limited tarring would be expected to coastal lagoons in the Point Arguello area. Such a level of spillage would be unlikely to have a detectable effect on tidewater gobies.

As discussed in Section 5.3, there is a moderate probability, about 17 percent, that an oil spill of equal to or greater than 1,000 bbl would occur as a result of the proposed project. If a spill of this size did occur, and the sand berms of the coastal lagoons were breached, short-term sublethal impacts to tidewater gobies might occur. However, oil spill response teams would be expected to boom the mouths of creeks and rivers or enhance the existing berms in the event of a spill, thus minimizing the chance of oil reaching the lagoons.

Based on OSRA model runs, the greatest threat is to goby populations north of Point Conception from December to May (winter and spring). The modes show that during these months there is a 14.4 to 15.3-percent probability that an oil spill from the Irene-to-shore pipeline would contact the Point Arguello area within 3 days. The probability of contact with Point Arguello diminishes only slightly during summer (11.9 percent) and fall (9.2 percent). Overall the annual probability of an oil spill from a pipeline rupture making contact with Point Arguello within 3 days exceeds 12 percent.

Most goby habitat during fall will be separated from the ocean by sand berms and thus would be protected to some degree. However, tides, heavy surf, or early seasonal rains could breach these barriers. Oil spill response teams would be expected to protect these habitats further with booms and enhancement of the natural berms. During winter months, after rains and storms have breached the natural sand barriers, protection of goby habitat that is within the contact zone of a spill would rely on the speed and effectiveness of the oil spill response team. A spill of about 200 bbl that hit the mainland coast in the Point Arguello area would in all likelihood contact and impact one or two tidewater goby habitats, possibly resulting in some mortality and likely short-term sub-lethal effects. This would depend on the amount spilled and the weathering of the oil.

However, tidewater gobies along the south-central California coast are quite resilient and have a great ability to disperse and re-colonize areas from which they were previously eliminated (FWS News Release, June 24, 1999). Given the moderate probability that an oil spill would contact the mainland, the oil spill prevention and response capabilities in place, and the ability of tidewater gobies to re-colonize their habitat, expected impacts to tidewater gobies from the proposed Tranquillon Ridge project are low.

6.6.2 Steelhead Trout (Endangered)

Direct toxicity from effluent discharges associated with the Tranquillon Ridge development project is unlikely due to discharge requirements and rapid dilution of the discharges. Heavy metals and hydrocarbons are not expected to be accumulated by their prey to toxic levels due to cellular mechanisms for removal of these substances. Thus, no impacts on steelhead trout are expected from effluent discharges.

The critical habitat for steelhead includes all river reaches and estuarine areas accessible to listed steelhead in coastal river basins from the Santa Maria Basin to Malibu Creek. In the Point Arguello area, this would include the Santa Ynez River, San Antonio Creek, the Santa Maria River, and perhaps Jalama and Cañada Honda Creeks. Only winter steelhead occur along the south-central coast. Winter steelhead enter their home streams from November to April to spawn. Juveniles usually migrate to sea in spring.

The most likely oil spill scenario for the Tranquillon Ridge development project, based on OCS spill data for California, is that one spill of a volume ranging between 50 and 1,000 bbl would occur during the life of the project (Section 5.3). Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume. Based on OSRA model runs, the greatest threat is to steelhead populations north of Point Conception from November to April (winter and spring). If a spill from the Irene-to-shore pipeline were to occur during these months, the OSRA model runs (Section 5.3.1) predict up to a 15.3-percent probability of contact with the Point Arguello area within 3 days.

During winter months, after rains and storms have breached the natural sand barriers, protection of steelhead habitat that is within the contact zone of a spill would rely on the speed and effectiveness of the oil spill response team. A spill of about 200 bbl that hit the mainland coast in the Point Arguello area would in all likelihood contact and impact one or two steelhead critical habitats, possibly resulting in some mortality and likely short-term sub-lethal effects. In particular, spills from the pipeline between the shoreline and LOGP could enter the Santa Ynez River, which is designated critical habitat for steelhead. Effects on steelhead would depend on the time of year and size of the spill, and the weathering of the oil.

Impacts would be greatest if the spill occurred during adult or juvenile migration to or from spawning and rearing areas upstream of the project. Although little mortality would be expected from a spill of 200 bbl, sublethal effects causing stress might lead to increased vulnerability to disease and perhaps reduced reproduction to impacted individuals. Migration could also be disrupted. Oil avoidance reactions are well documented in salmon. Adults and juveniles can detect sublethal levels of hydrocarbons (Rice, 1973; Weber et al., 1981) and have been observed actively avoiding contaminated areas (Patten, 1977; Weber et al., 1981). These effects are expected to be short-term due to the weathering and mixing that would occur to the oil before it reached the shore. The high-energy environment of the south-central California coast would further minimize the toxicity and persistence of the oil in the environment. Also, in the event of a spill, oil spill response teams would identify river and stream mouths at risk of oil contact and would immediately boom or build protective berms at the river and stream mouths, which could further disrupt migration. Cleanup efforts could also adversely affect steelhead present through direct mortality or stress from harassment or capture and relocation.

As discussed in Section 5.3, the probability that an oil spill of equal to or greater than 1,000 bbl would occur as a result of the proposed project is about 17 percent. If a spill of this size did occur, and if there were contact with shore in the Point Arguello area during the steelhead trout migration, some mortality and short-term sublethal impacts to steelhead might occur. Oil spill response teams would be expected to boom the mouths of creeks and rivers or enhance the existing berms in the event of a spill, thus minimizing the chance of oil reaching critical habitat. Additionally, although the toxicity and persistence of the oil in the environment would be low due to the weathering and mixing of the oil at sea and the high-energy environment of the south-central coast, moderate mortality levels would still be expected.

In conclusion, oil spills associated with the Tranquillon Ridge development project would be expected to have minor impacts on steelhead trout if a spill were to contact critical habitat (such as the Santa Ynez River) during a period when steelhead are migrating. Due to the openness of the south-central coast and the high-energy environment of the area, a spill of about 200 bbl originating at Platform Irene or along the more offshore portions of the pipeline would likely break into smaller slicks, and some of the oil would disperse into the water column. Thus, concentrated oiling of steelhead habitat would not be expected. However, the Irene-to-shore pipeline comes ashore just north of the Santa Ynez River. Historically, this system supported the largest steelhead run in southern California, and it is currently designated critical habitat for this species. A spill originating near where the pipeline comes ashore would likely result in impacts to this steelhead utilizing the Santa Ynez River, including limited mortality. However, given the moderate probability of a spill from the Tranquillon Ridge Unit area contacting the mainland, and the oil spill prevention and response plans in place, adverse impacts to southern steelhead from the proposed project are likely to be low.

6.7 TERRESTRIAL PLANTS

This section provides a general discussion of the potential effects of the identified impact factors, including noise and disturbance, effluent discharges, and oil spills, on terrestrial plants. The following sections analyze the potential impacts of activities and accidental events associated with the proposed project on endangered plant species in the project area.

There are two threatened or endangered species of plants in the general area of concern for the Tranquillon Ridge Unit project: salt marsh bird’s-beak and California sea-blite. Of the three potential impact sources identified for this project (Section 5.0), only an oil spill could adversely affect these species. Platform discharges and noise and disturbance are not expected to have a measurable effect.

Plant mortality from oil spills can be caused by smothering and toxic reactions to hydrocarbon exposure, especially if oil reaches shore before much of the spill’s lighter fractions have evaporated or dissolved. Generally, oiled marsh vegetation dies, but roots and rhizomes survive when oiling is not too severe (Burns and Teal, 1971). Research has shown that recovery to pre-oiling conditions usually occurs within a few growing seasons, depending on the magnitude of exposure (Holt et al., 1975; Lytle, 1975; Delaune, et al., 1979; Alexander and Webb, 1987).

Impacts of Past and Present OCS Activities
Section 5.1 provides information on current offshore infrastructure and levels and types of activities. Several reviews have been made of the possible cumulative impacts of these activities on biological resources in the region (Van Horn et al., 1988; Bornholdt and Lear, 1995, 1997; MMS, 1996; MMS, 2001).

No impacts on threatened or endangered plants from past and present OCS-related oil and gas activities in the Pacific Region have been reported.

6.7.1 Salt Marsh Bird's-Beak (Endangered)

The Salt marsh bird's-beak was first listed on September 28, 1978. Salt marsh bird's-beak is a diffusely branched annual herb in the figwort family (Scrophulariaceae). The plants are hemiparasitic, sometimes obtaining moisture and nutrients from the roots of their host plants, which are usually perennials. Salt marsh bird's-beak grows in the higher reaches of coastal salt marshes to intertidal and brackish areas influenced by freshwater input. The salt marsh bird's-beak is at risk from an oil spill, because this plant is limited to coastal salt marshes that could be contacted by oil. The cleanup process, if not conducted with respect to Federal and State regulations, could exacerbate the effects of an oil spill on this species and its habitat.

Historically, salt marsh bird's-beak was widespread in coastal salt marshes from Morro Bay in San Luis Obispo County to San Diego County and northern Baja California. Salt marsh bird's-beak is currently limited to a very few (<10) salt marshes along the coast of California and Baja California, Mexico, which makes this species more vulnerable to an oil spill. Within the project area, these marshes include Ormond Beach and Mugu Lagoon in Ventura County, Carpinteria Salt Marsh in Santa Barbara County, and Morro Bay in San Luis Obispo County.

Although, a large (>1,000-bbl) oil spill from the Tranquillon Ridge Unit is not improbable, based on the distribution of past spill sizes, it is estimated that a spill from the Tranquillon Ridge Unit would probably be less than 200 bbl in volume (see Section 5.3.1). However, both OSRA and GNOME modeling results indicate that there is no contact expected for any of the marshes where bird's-beak is known to occur (Attachment E).

If a spill of about 200 bbl were to occur, move north, and contact Morro Bay, impacts to salt marsh bird's-beak could occur. The level of impact would depend on the size of the spill, the success of containment efforts, and the length of time for the spill to reach the bay. Although the outcome of containment efforts cannot be predicted, response at the site of a potential spill should be rapid (see Section 5.3.2). Also, Morro Bay is located more than 80 km (50 mi) north of the Tranquillon Ridge Unit, and responders would have ample time to deploy protective measures in this area. The very nature of the bay itself provides many opportunities for protecting the areas occupied by salt marsh bird's-beak. A greater than 1,000-bbl spill is not expected (see Section 5.3.1), but if one were to occur and reach Morro Bay, containment measures might not be able to prevent some impacts to this species.

Given that a spill occurring as a result of the proposed project would probably be less than 200 bbl in volume, the very low probability of contact with a single occupied marsh (Morro Bay, see Attachment E) located more than 80 km (50 mi) north of the Tranquillon Ridge Unit, and the oil spill prevention and response capabilities in place, no impacts to salt marsh bird's-beak are expected from the development of the Tranquillon Ridge Unit.

6.7.2 California Sea-Blite (Endangered)

California sea-blite is at risk from an oil spill, because, within the project area, this plant is presently limited to a single coastal salt marsh, Morro Bay, which could be contacted by oil. The cleanup process, if not conducted with respect to Federal and State regulations, could exacerbate the effects of an oil spill on this species and its habitat.

Since sea-blite is limited to a single marsh, this plant is highly vulnerable to an oil spill. Although, for the reasons listed in Section 5.3, a large (>1,000-bbl) oil spill from the Tranquillon Ridge Unit is only moderately likely, one 50-1,000-bbl spill might be expected. Based on the distribution of past spill sizes, it is estimated that such a spill probably would be less than 200 bbl in volume (see Section 5.3.1). Based on the OSRA results (Attachment E), there is an extremely small chance of oil contact with Morro Bay during the fall and winter months (<0.1 percent) after 3-10 days. However if a spill of about 200 bbl were to occur, move north, and contact Morro Bay, impacts to sea-blite could occur. The level of impact would depend on the size of the spill, the success of containment efforts, and the length of time for the spill to reach the bay. Although the outcome of containment efforts cannot be predicted, response at the site of a potential spill should be rapid (see Section 5.3.2). Also, Morro Bay is more than 80 km (50 mi) north of the Tranquillon Ridge Unit, and responders would have ample time to deploy protective measures in this area. The very nature of the bay itself provides many opportunities for protecting the areas occupied by sea-blite. However, there is also a 17 percent probability of a greater than 1,000-bbl spill (see Section 5.3.1) occurring. If a spill of this size were to occur and reach Morro Bay, containment measures might not be able to prevent some impacts to this species.

Given that a spill occurring as a result of the proposed project would probably be less than 200 bbl in volume, the fact that only a very slight chance of contact with Morro Bay is estimated, and the oil spill prevention and response capabilities in place, no impacts to California sea-blite from the development of the Tranquillon Ridge Unit are expected.

7.0 CUMULATIVE EFFECTS

7.1 INTRODUCTION

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act. Cumulative effects are usually viewed as those effects that impact the existing environment and remain to become part of the environment. These effects differ from those that may be attributed to past and ongoing actions within the area since they are considered part of the environmental baseline. The primary difference between project specific effects and cumulative effects is the definition of geographical and temporal boundaries.

Section 7.2 describes actions that are reasonably likely to occur and will be considered in the cumulative effects analysis. These actions include activities that could produce impacts on listed species in the project area during the expected life of the Tranquillon Ridge Unit development project (approximately 15 years).

Section 7.3 describes reasonably foreseeable future federal actions that will not be included in the analysis of cumulative effects, since these actions will be considered in separate consultations pursuant to Section 7 of the ESA. Descriptions of these activities are provided as baseline information.

Section 7.4 describes the cumulative effects that may occur to threatened and endangered species as a result of the listed activities.

7.2 ACTIONS REASONABLY LIKELY TO OCCUR

Table 7-1 contains a list of projects in the region likely to occur which could contribute to cumulative effects on threatened or endangered species.

Table 7.1 Relevant Cumulative Projects

Project Name/Applicant	Description/Status
1. LNG Terminal at Platform Grace/Crystal Energy LLC	Offshore LNG Terminal/Pending
2. Carpinteria Field Redevelopment Project/Carone Petroleum Corp. and Pacific Operators Offshore Inc.	Redevelop State Leases PRC-4000, PRC-7911, and PRC 3133/Pending
3. Return to production of State Lease PRC-421/ Venoco	Continuation of offshore oil and gas reserves/Application submitted
4. Ellwood Oil Pipeline Installation and Field Improvements, Venoco	Development of offshore oil and gas reserves/Application submitted
5. Platform Grace Mariculture/Hubbs-SeaWorld Research Institute	Installation and operation of marine agriculture pilot plant/Pending
6. Platform Grace/Venoco	Resume oil production/Anticipated, pending Crystal Energy LLC.

Notes: LNG = liquefied natural gas; NG = natural gas;

Carpinteria Field Redevelopment Project, Carone Petroleum Corporation and Pacific Operators Offshore Inc.:
Carone has applied to the CSLC to develop and produce existing State Oil and Gas Leases PRC-4000, PRC-7911, and PRC-3133 within the Carpinteria Field. Specifically, Carone proposed to drill up to 25 new production or injection wells from Outer Continental Shelf (OCS) Platform Hogan. Oil and gas production from the State Leases would be commingled on Platform Hogan with existing production from the Federal lease and sent via existing pipelines to the La Conchita Facility. After processing, gas and oil are sold to The Gas Company and other third parties at the La Conchita sales meters, and shipped via existing pipelines. A Draft EIR/EIS for this project is currently being prepared.

Paredon Project PRC-3150, Venoco: Venoco applied to the CSLC (application received in February 2005) and to the city of Carpinteria to develop existing State Oil and Gas Lease PRC-3150.1 by conducting extended-reach drilling from an onshore site located within Venoco's existing Carpinteria Oil and Gas Processing Facility (Venoco Carpinteria Facility), in the city of Carpinteria. Venoco estimates that this project could produce up to 10,000 barrels per day (BPD) (1,590 m3/day) of crude oil and 10 MMSCFD (283,169 m3/day) of gas. After processing, oil would enter an existing 16-inch-diameter (41 cm) pipeline to the Rincon Onshore Separation Facility (ROSF) for connection with the existing pipeline system extending to Los Angeles refineries. Processed gas would be delivered via the existing 6-inch-diameter (15 cm) pipeline connection to Southern California Gas Company's existing regional 12-inch-diameter (30 cm) pipeline that passes near the Venoco Carpinteria Facility. The application was found complete in October 2005.

Return to Production of State Lease 421, Venoco: Venoco is proposing to return State Lease PRC-421 to production. The plan for this project was received in May 2004, and it has been reviewed by the Santa Barbara County Energy Division, in consultation with the city of Goleta, as well as by the CSLC. The project includes the removal of old production equipment from oil piers 421-1 and 421-2 (which are California's last remaining surfzone oil piers); repairs to the access road, rock rip-rap wall, and caisson at the end of pier 421-1; installation of a drilling rig and new oil separation and processing equipment on pier 421-2; and reactivation of the oil well on pier 421-2 with a capacity to produce up to 700 BPD (111 m3/d). The oil would be pumped to Line 96 through an existing pipeline and then to the EMT. The existing pipeline between Line 96 and the 421-1 pier would be upgraded. The CSLC, Santa Barbara County, and the city of Goleta provided comments on the proposed plan, including local permitting and policy concerns. The schedule of the project is unknown. The public scoping meeting for this project was held on June 23, 2005.

Ellwood Oil Pipeline Installation and Field Improvements, Venoco: In August 2005, Venoco submitted an application to the CSLC, Santa Barbara County, and the city of Goleta with a number of project components. The project would include drilling of up to 40 new wells on both the existing leases and the proposed project area, decommissioning and abandonment of the Ellwood marine terminal (EMT) and Line 96, replacement of the existing 2-inch (5-cm) utility pipeline and subsea power cable between the EOF and Platform Holly, and discontinuation of marine transportation via barge.

The offshore EMT abandonment process, including pipeline flushing and abandonment, and the removal of mooring equipment, will last approximately 9 weeks. Vessel traffic will follow the prescribed traffic corridors currently used by vessels supporting platform operations. A temporary vessel route and minimal construction work zone will be defined for removal of the offshore components of the EMT.

Oil production is expected to peak at 12,600 BPD (2,003 m3/day) and gas production at 20 MMSCFD (566,337 m3/day) after five years. The application was found incomplete and is being revised. Although the schedule for this project is unknown, if the project is implemented, it would result in the decommissioning and abandonment of the EMT since there would be no further need for barging.

Paredon, Development of State Leases 3150 and 3133, Veneco: Venoco has proposed to develop new oil and gas reserves from their existing Carpinteria Oil and Gas Processing Facility (CPF). The proposed project would consist of drilling up to 35 wells from a drilling pad located within Venoco's CPF to existing offshore State Leases PRC 3150 and 3133, as well as an onshore area east of the City of Carpinteria. Veneco estimates that the proposed project would produce up to 23.5 million bbls of oil and 43 billion cubic feet of gas over the life of the project. The project proposes to use existing pipelines to transport the oil and gas obtained from the leases.

Veneco proposes to drill an exploration well and test production through temporary facilities. If the exploratory well proves the development is commercially viable, then installation of permanent drilling facilities and modifications to the existing CPF would follow to allow for the processing of the new oil and gas production.

7.3 FORESEEABLE FUTURE FEDERAL ACTIONS

LNG Terminal at Platform Grace, Crystal Energy LLC: Clearwater Port would use existing offshore Platform Grace, located approximately 10.5 miles offshore Ventura, to import liquid natural gas (LNG). Reconfiguration of the platform would involve installing an LNG transfer system, a cool down system, six LNG pumps, six LNG vaporizers, and reinstalling and upgrading the platform's power-production capability, while allowing continuing oil and gas production. LNG would be transported by ship to Platform Grace, where it would be converted back into vapor form. A new floating dock would be installed adjacent to the platform to moor LNG vessels during transfer. No additional onsite storage is expected, but if required, Crystal Energy would contract with existing onshore storage facilities. The natural gas would be delivered from the platform to shore in a new, 13-mile (21 km), 32-inch-diameter (81-centimeter [cm]) sub-sea pipeline, using an existing pipeline corridor to minimize disturbance to the marine environment. The natural gas would come onshore by pipeline to a landing at an existing industrial site, the Mandalay Power Generating Station in Oxnard. From the landfall at Mandalay, a new 12-mile (12 km) underground pipeline would tie into an existing 30-inch-diameter (76 cm) Southern California Gas Company (The Gas Company) pipeline at their preferred pipeline tie-in point near Camarillo.

The average anticipated LNG terminal throughput capacity would be 800 million cubic feet per day (MMCFD) (23 million m3/d), with a peak throughput capacity of 1,200 million standard cubic feet per day (MMSCFD) (34 million m3/d).

Crystal Energy filed its application with the United States Coast Guard on January 28, 2004, and the CSLC on February 10, 2004. The application was reviewed by these agencies and was deemed incomplete by both agencies. The proposed terminal is projected by such applications to be operational by early 2007.

Platform Grace Mariculture Project, Hubbs-SeaWorld Research Institute: Development of the Grace Mariculture Project would not require any substantial new equipment on the platform or modification of the existing platform structure. As proposed, the project would include four submerged cages around the platform as well as tanks on the main platform deck for hatchery and nursery operations. The project would utilize the existing platform infrastructure and energy resources at well-below-historical levels and well within the design parameters of the structure. The pilot scale phase of the project is expected to last three years, at the end of which, the project would be reassessed. This project will either be finished or could potentially co-exist with the Crystal Energy LNG Terminal on Platform Grace, by the time the LNG Terminal project is approved and its construction begins.

Return to Production of Platform Grace, Venoco: Venoco has announced plans to resume oil production at Platform Grace (approximately 29 miles [47 km] southeast of the EMT). Venoco has not yet filed an application so the details of the project are not known. However, it is doubtful that returning Platform Grace to production could coexist with the implementation of the Crystal Energy LNG Terminal and the proposed mariculture project.

7.4 CUMULATIVE IMPACTS

Given the relative nearness of the proposed Platform Grace and Platform Holly projects to Platform Irene, and the potential overlap in time of drilling activities at both locations, some potential cumulative impacts might be expected. These are discussed below.

Noise and Disturbance
Platform Irene is about 16 km (10 mi) north of the Rocky Point Unit area. However, the proposed Tranquillon Ridge production is not expected to increase activity levels much above that of current operations. Vessel traffic is expected to increase during drilling operations, but will return to near baseline conditions following the completion of drilling (after year 15).

Platform Holly is farther away, approximately 65 km (40 mi) to the east. The construction and operation activities associated with this project also are expected to be similar to current levels, except for a temporary (6-month) increase in activity during the platform modifications and EMT abandonment.

In conclusion, the various proposed projects in State waters are unlikely to contribute perceptibly to noise and disturbance impacts on listed species in the project area. Nearshore activities associated with removal of the Ellwood marine terminal could be a cause of minor disturbance to sea otters, if present. However, construction would likely be completed before sea otters might be expected to establish a year-round presence along the Santa Barbara Channel coastline west of Goleta.

Effluent Discharges
No effluents are discharged from Platform Holly. Localized increases in effluents associated with drilling and production would be expected from Platform Hogan if the proposed Carone project were approved. Likewise, localized increases in discharges from Platform Grace might accompany its conversion to an LNG terminal, and mariculture site, or its resumption of oil production; however, Irene is far enough from both Platform Hogan and Platform Grace to make any overlap in effects unlikely.

Oil Spills
Production from the various Ellwood projects, and increased production at Platform Holly would increase overall oil spill risk in the Santa Maria Basin by some small amount, which cannot be quantified at this early stage. However the increase in spill risk associated with production from the Ellwood project at Platform Holly would probably be more than balanced by the reduced spill risk due to the removal of the Ellwood marine terminal. Current marine terminal operations involve the transfer of up to 55,000 bbl of oil from onshore tanks via a subsea pipeline to a barge for shipment to refineries in the Los Angeles area. This process, which takes approximately 17 hours, occurs every 5-12 days.

Thus, the overall effect of these two proposed projects would probably be an increased risk of oil contact to threatened and endangered species distributed north of Point Conception. An accidental oil spill associated with the proposed Ellwood, Paredon, and Carone projects would have impacts on threatened and endangered species similar to those described earlier for the proposed Tranquillon Ridge Unit project. However, an oil spill from Platform Irene or its associated pipeline would be more likely to contact those species that occur along the coast of Vandenberg AFB. These species would include the southern sea otter, California brown pelican, California least tern, and western snowy plover.

8.0 LITERATURE CITED

Ainley, D.G., D.W. Anderson, and P.R. Kelly. 1981. Feeding ecology of marine cormorants in southwestern North America. Condor 83:120-131.

Ainley, D.G., and T.J. Lewis. 1974. The history of Farallon Island bird populations, 1854-1972. Condor 76:432-446.

Allen, K.R. 1980. Conservation and management of whales. University of Washington Press, Seattle.

Alexander, S.K., and J.W. Webb. 1987. Relationship of *Spartina alterniflora* growth to sediment oil content following an oil spill. *In*: Proceeding, 1987 oil spill conference, April 6-9, 1987, Baltimore, MD. American Petroleum Institute, Washington, D.C. pp. 445-450.

Anderson, D.W. 1977. Brown pelicans: Population trends at their breeding range periphery. Report to Calif. Dept. Fish and Game, Sacramento, CA. 30 pp.

Anderson, D.W., and I.T. Anderson. 1976. Distribution and status of brown pelicans in the California Current. Amer. Birds 30:3-12.

Anderson, D.W., and F. Gress. 1983. Status of a northern population of California brown pelicans. Condor 85:79-88.

Anderson, D.W., J.R. Jehl, Jr., R.W. Risebrough, L.A. Woods, Jr., L.R. Deweese, and W.G. Edgecomb. 1975. Brown pelicans: Improved reproduction off the southern California coast. Science 190:806-808.

Anderson, C.M., and R.P. LaBelle. 1994. Comparative occurrence rates for offshore oil spills. Spill Science & Technology Bulletin 1(2):131-141.

Antonelis, G.A., Jr., and C.H. Fiscus. 1980. Pinnipeds of the California Current. CalCOFI Reports 21:68-78.

Arthur D. Little, Inc. (ADL). 1984. Point Arguello Field and Gaviota Processing Facility Area Study and Chevron/Texaco Development Plans EIR/EIS (and appendices). Prepared for County of Santa Barbara, Minerals Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development.

Baker, C.S., and L.M. Herman. 1989. Behavioral responses of summering humpback whales to vessel traffic: Experimental and opportunistic observations. NPS-NR-TRS-89-01. Rep. from Kewalo Basin Mar. Mamm. Lab., Univ. Hawaii, Honolulu, for Natl. Park Serv., Anchorage, AK. 50 pp. NTIS PB90-198409.

Baker, C.S., L.M. Herman, A. Perry, W.S. Lawton, J.M. Straley, A.A. Wolman, G.D. Kaufman, H.E. Winn, J.D. Hall, J.M. Reineke, and J. Ostman. 1986. Migratory movement and population structure of humpback whales (*Megaptera novaeangliae*) in the central and eastern North Pacific. Marine Ecology Progress Series Vol. 31:105-119.

Baker, C.S., A. Perry, and G. Vequist. 1988. Humpback whales of Glacier Bay, Alaska. Whalewatcher, Fall 1988:13-17.

Baker, C.S., J.M. Straley, and A. Perry. 1992. Population characteristics of individually identified humpback whales in southeastern Alaska: Summer and fall 1986. Fishery Bulletin 90(3):429-437.

Barabash-Nikiforov, I.I. 1947. The sea otter (*Enhydra lutris* L.)—Biology and economic problems of breeding. Council of Ministers of the RSFSR, Main Administration of Reserves. Published for NSF, Washington, D.C., by Israel Program for Scientific Translations, Jerusalem. 174 pp.

Barlow, J. 1994. Recent information on the status of large whales in California waters. NOAA Technical Memorandum NMFS-SWFSC-203. 27 pp.

Barlow, J. 1995. The abundance of cetaceans in California waters. Part I: Ship surveys in summer and fall of 1991. Fish. Bull. 93:1-14.

Barlow, J., K.A. Forney, P.S. Hill, R.L. Brownell, Jr., J.V. Carretta, D.P. DeMaster, F. Julian, M.S. Lowry, T. Ragen, and R.R. Reeves. 1997. U.S. Pacific Marine Mammal Stock Assessments: 1996. NOAA Technical Memorandum NMFS-SWFSC-248.

Barlow, J., and T. Gerrodette. 1996. Abundance of cetaceans in California waters based on 1991 and 1993 ship surveys. NOAA Tech. Mem. NOAA-TM-NMFS-SWFSC-233.

Barlow, J., and B.L. Taylor. 1998. Preliminary abundance of sperm whales in the northeastern temperate Pacific estimated from a combined visual and acoustic survey. Int. Whal. Commn. Working Paper SC/50/CAWS20. 19 pp.

Barnhart, R. A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)—steelhead. U.S. Fish Wildl. Serv. Biol. Rep. 82. 21 pp.

Bartholomew, G.A. 1967. Seal and sea lion populations of the California Islands. Pp. 229-244 *in*, R.N. Philbrick (ed.), Proceedings of the Symposium on the Biology of the Channel Islands. Santa Barbara Botanic Garden, Santa Barbara, California.

Bartholomew, G.A., and R.A. Boolootian. 1960. Population structure of the pinnipeds of the Channel Islands, California. Journal of Mammalogy 41:366-375.

Battelle. 1991. California OCS phase II monitoring program. Final report to the U.S. Department of Interior, Minerals Management Service, Pacific OCS Region, Camarillo, CA.

Bauer, G.B., and L.M. Herman. 1986. Effects of vessel traffic on the behavior of humpback whales in Hawaii. Rep. from Kewalo Basin Mar. Mamm. Lab., Univ. Hawaii, Honolulu, for Natl. Mar. Fish. Serv., Honolulu, HI. 151 pp.

Behnke, R. J. 1992. Native trout of western North America. Am. Fish. Soc. Monog. 6. American Fisheries Society, Bethesda, MD. 275 pp.

Benson, S.R., K.A. Forney, P.H. Dutton, and S.A. Eckert. 2003. Occurrence of leatherback turtles off the coast of Central California, pp. 27. In: Proceedings of the 22nd Annual Symposium on Sea Turtle Biology and Conservation, 4–7 April 2002, Miami, Florida.

Bent, A.C. 1937. Life histories of North American birds of prey, order Falconiformes, Part I. U.S. National Museum Bulletin No. 167, Washington, D.C. Pp. 321-349.

Bonnell, M.L., and M.D. Dailey. 1993. Marine mammals. *In*: Ecology of the Southern California Bight: A Synthesis and Interpretation, M.D. Dailey, D.J. Reish, and J.W. Anderson (eds.). Berkeley, CA: University of California Press. pp. 604-681,

Bonnell, M.L., B.J. Le Boeuf, M.O. Pierson, D.H. Dettman, G.D. Farrens, and C.B. Heath. 1981. Pinnipeds of the Southern California Bight. Summary Report, 1975-1978, Part I, *In*: Vol. III, Principal Investigator's reports, marine mammal and seabird survey of the Southern California Bight area. NTIS No. PB 81-248-71. 535 pp.

Bonnell, M.L., M.O. Pierson, and G.D. Farrens. 1983. Pinnipeds and sea otters of central and northern California, 1980-1983: status, abundance, and distribution. Final Report to U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region under Contract 14-12-0001-29090. OCS Study MMS 84-0044. 220 pp.

Bonnot, P. 1928. The sea lions of California. California Fish and Game 14:1-16.

Boolootian, R.A. 1961. The distribution of the California sea otter. California Fish and Game 47:287-292.

Bornholdt, M.A., and E.M. Lear (comp.). 1995. Outer Continental Shelf Natural Gas and Oil Program: Cumulative Effects 1987-1991. U.S. Department of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 95-0007.

Bornholdt, M.A., and E.M. Lear (comp.). 1997. Outer Continental Shelf Oil and Natural Gas Program: Cumulative Effects 1992-1994. U.S. Department of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 97-0027.

Braham, H.W. 1984. The status of endangered whales: An overview. Marine Fisheries Review 46:2-6.

Braham, H.W., and D.W. Rice. 1984. The right whale. *In*: J.M. Breiwick and H.W. Braham (eds.), The Status of Endangered Whales. Mar. Fish. Rev. 46:38-44.

Briggs, K.T., W.B. Tyler, D.B. Lewis, and D.R. Carlson. 1987. Bird communities at sea off California; 1975-1983. Cooper Ornithological Society, Studies in Avian Biology No. 11. 74 pp.

Briggs, K.T., W.B. Tyler, D.B. Lewis, and K.F. Dettman. 1983. Seabirds of central and northern California, 1980-1983: status, abundance, and distribution. Center for Marine Studies, University of California, Santa Cruz. Prepared for U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region. Contract #AA551-CT9-33. 246 pp.

Briggs, K.T., D.H. Varoujean, D. Heinemann, and R.G. Ford. 1989. Synthesis of information on seabirds of the eastern North Pacific, with emphasis on the Oregon and Washington OCS area. Section 5. Pp. 1-165, In: Brueggeman, J.J. (ed.). 1989. Oregon and Washington Marine Mammal and Seabird Surveys: Information Synthesis and Hypothesis Formulation. Final Report prepared by Envirosphere Company, Bellevue, WA, and Ecological Consulting Inc., Portland, OR, for the Minerals Management Service, Pacific OCS Region. OCS Study MMS 89-0030. 374 pp.

Brody, A.J., K. Ralls, and D.B. Siniff. 1996. Potential impact of oil spills on California sea otters: Implications of the *Exxon Valdez* spill in Alaska. Marine Mammal Science 12(1):38-53.

Brownell, R.L., Jr. 1971. Whales, dolphins, and oil pollution. Pp. 255-276 *in*: D. Straughn (ed.), Biological and oceanographical survey of the Santa Barbara Channel oil spill 1969-1970.

Brownell, R.L., Jr., and B.J. Le Boeuf. 1971. California sea lion mortality—natural or artifact. Pp. 287-306 *In*: D. Straughn (ed.), Biological and oceanographical survey of the Santa Barbara Channel oil spill 1969-1970.

Brownell, R.L., Jr., K. Ralls, and W.F. Perrin. 1989. The plight of the 'forgotten' whales. Oceanus 32(1):5-13.

Brueggeman, J.J., G.A. Green, R.A. Grotefendt, and D.G. Chapman. 1987. Aerial surveys of endangered cetaceans and other marine mammals in the northwestern Gulf of Alaska and southeastern Bering Sea. Final Report prepared for MMS/NOAA/OCSEAP, Anchorage. Contract No. 85-ABC-00093, Res. Unit 673. 139 pp. plus appendices.

Brueggeman, J.J., T.C. Newby, and R.A. Grotefendt. 1985. Seasonal abundance, distribution, and population characteristics of blue whales reported in the 1917 to 1939 catch records of two Alaska whaling stations. Rep. int. Whal. Commn. 35:405-411

Bryant, H.C. 1915. Sea otters near Point Sur. California Department of Fish and Game 1(3):134-135.

Bryant, P.G., G. Nichols, T.B. Bryant, and K. Miller. 1981. Krill availability and the distribution of humpback whales in southeast Alaska. Journal of Mammalogy 62:427-430.

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (*Oncorhynchus mykiss*) in offshore waters of the North Pacific Ocean. Int. North Pac. Fish. Comm. Bull. 51. 92 pp.

Byrnes, P.E., and W.R. Hood. 1994. First account of Steller sea lion (*Eumetopias jubatus*) predation on a California sea lion (*Zalophus californianus*). Marine Mammal Science 10(3):381-383.

Caffrey, C. 1995. California least tern breeding survey, 1994 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report, 95-3. 49 pp.

Caffrey, C. 1997. California least tern breeding survey, 1995 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report, 97-6. 57 pp.

Caffrey, C. 1998. California least tern breeding survey, 1996 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report, 98-2. 57 pp.

Calambokidis, J. 1995. Blue whales off California. Whalewatcher 29(1):3-7.

Calambokidis, J., and G.H. Steiger. 1995. Population assessment of humpback and blue whales using photo-identification from 1993 surveys off California. Final contract report to Southwest Fisheries Center, La Jolla, CA. 31 pp.

Calambokidis, J., R. Sears, G.H. Steiger, and J. Evenson. 1995. Movement and block structure of blue whales in the eastern North Pacific. Abstr. Proceedings 11th Biennial Conf. Biol. Marine Mamm., Orlando, FL, 14-18 December 1995.

Calambokidis, J., G.H. Steiger, J.C. Cubbage, K.C. Balcomb, C. Ewald, S. Kruse, R. Wells, and R. Sears. 1990. Sightings and movements of blue whales off central California 1986-88 from photo-identification of individuals. Rep. Int. Whal. Commn. Special Issue 12:343-348.

Calambokidis, J., G.H. Steiger, J.R. Evenson, K.R. Flynn, K.C. Balcomb, D.E. Claridge, P. Bloedel, J.M. Straley, C.S. Baker, O. von Ziegesar, M.E. Dahlheim, J.M. Waite, J.D. Darling, G. Ellis, and G.A. Green. 1996. Interchange and isolation of humpback whales off California and other North Pacific feeding grounds. Marine Mammal Science 12(2):215-226.

Caldwell, D.K. 1962. Sea turtles in Baja California waters (with special reference to the Gulf of California), and the description of a new subspecies of northwestern Pacific green turtle. Los Angeles County Museum of Natural History, Contributions in Science 61:3-31.

California Department of Fish and Game (CDFG). 1998. Recent sea otter range expansion. Note to interested parties. Morro Bay, CA.

Calkins, D.G., E.F. Becker, and K.W. Pitcher. 1998. Reduced body size of female Steller sea lions from a declining population in the Gulf of Alaska. Marine Mammal Science 14(2):232-244.

Calkins, D.G., D.C. McAllister, K.W. Pitcher, and G.W. Pendleton. 1999. Steller sea lion status and trend in Southeast Alaska: 1979-1997. Marine Mammal Science 15(2):462-477.

Calkins, D.G., and K.W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. Alaska Department of Fish and Game, Final Report RU243. 128 pp.

Carr, A. 1952. Handbook of turtles: The turtles of the United States, Canada, and Baja California. Ithaca, NY: Cornell University Press. 542 pp.

Carretta, J.V., M.S. Lynn, and C.A. LeDuc. 1994. Right whale (*Eubalaena glacialis*) sighting off San Clemente Island, California. Marine Mammal Science 10(1):101-105.

Carter, H.R., G.J. McChesney, D.L. Jaques, C.S. Strong, M.W. Parker, J.E. Takekawa, D.L. Jory, and D.L. Whitworth. 1992. Breeding populations of seabirds in California, 1989-1991. U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Dixon, California, and San Francisco Bay National Wildlife Refuge Complex, Newark, California. Draft final report to Minerals Management Service, Pacific OCS Region, under Inter-agency Agreement No. 14-12-001-30456. Volumes I and II.

Channel Islands National Park Service(CINPS). 2006. News Release. Santa Barbara Island Closed to Protect Pelicans. Feb 14, 2006. Accessed online at: http://www.nps.gov/chis/parknews/santa-barbara-island-closed-to-protect-pelicans.htm

Chevron U.S.A. Production Company (Chevron). 1997. Oil Spill Contingency and Emergency Response Plan: OCS Platforms Grace, Gail, Harvest, Hermosa & Hidalgo and associated subsea pipelines. Vols. 1 and 2. Chevron U.S.A. Production Company, Ventura Profit Center, Ventura, CA.

CINPS (Channel Islands National Park Service). 1994. Biological assessment for effects of park activities on western snowy plover and California brown pelican at Channel Islands National Park. National Park Service, Channel Islands National Park. 26 pp

Clapham, P.J., and C.A. Mayo. 1987. The attainment of sexual maturity in two female humpback whales. Marine Mammal Science 3(3):279-282

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environ. Pollut. Series A.33:1-22.

Clean Seas. 2000. Clean Seas Regional Resource Manual. Prepared for Clean Seas, Carpinteria, CA, by ENSR Consulting and Engineering, Camarillo, CA. ENSR Document No. 1688- 001-830, March 1994. Revised August 9, 2000.

Coats, D. 1994. Deposition of drilling particulates off Point Conception, CA. Mar. Env. Rev. 37:95-127.

Continental Shelf Associates, Inc. (CSA). 1985. Assessment of the Long-Term Fate and Effective Methods of Mitigation of California Outer Continental Shelf Platform Particulate Discharges. A final report for the U.S. Department of Interior, Minerals Management Service Pacific OCS Region, Los Angeles, CA. Contract No. 14-12-0001-30056. 2 Volumes.

County of Santa Barbara (SBC). 2002. Final Environmental Impact Report Tranquillon Ridge Oil and Gas Development Project LOGP Produced Water Treatment System Project Sisquoc Pipeline Bi-Directional Flow Project. Prepared by Arthur D. Little Inc., Marine Research Specialists, and SAIC. June 2002.

Croll, D.A., B.R. Tershy, R.P. Hewitt, D.A. Demer, P.C. Fiedler, S.E. Smith, W. Armstrong, J.M. Popp, T. Kiekhefer, V.R. Lopez, J. Urban, and D. Gendron. 1998. An integrated approach to the foraging ecology of marine birds and mammals. Deep-Sea Research II 45:1353-1371.

Dahlheim, M.E., H.D. Fisher, and J.D. Schempp. 1984. Sound production by the gray whale and ambient noise levels in Laguna San Ignacio, Baja California Sur, Mexico. Pp. 511-541 *in*: M.L. Jones, S.L. Swartz, and S. Leatherwood (eds.), The gray whale *Eschrichtius robustus*. Academic Press, Orlando, FL.

Dahlheim, M.E., and C.O. Matkin. 1994. Assessment of injuries to Prince William Sound killer whales. Pp. 163-171, *in*, T.R. Loughlin (ed.), Marine mammals and the *Exxon Valdez*. Academic Press, Inc.: San Diego, CA.

Davis, R.W. 1990. Advances in rehabilitating oiled sea otters: the Valdez experience. *In* symposium, "The Effects of Oil on Wildlife," 13th Annual Conference of the International Wildlife Rehabilitation Council, Herndon, Virginia, October 17-18, 1990.

DeGange, A.R., and J.W. Nelson. 1982. Bald eagle predation on nocturnal seabirds. Journal of Field Ornithology 53:407-409.

Delaune, R.D., W.H. Patrick, and R.J. Burch. 1979. Effect of crude oil on a Louisiana *Spartina alternaflora* salt marsh. Environmental Pollution 20:21-31.

DeLong, R.L., and S.R. Melin. 2000. Thirty Years of Pinniped Research at San Miguel Island. Pp. 401-406 *in*: D.R. Browne, K.L. Mitchell, and H.W. Chaney (eds.), Proceedings of the Fifth California Islands Symposium, 29 March to 1 April 1999, Santa Barbara Museum of Natural History, Santa

Barbara, CA. Sponsored by the U.S. Minerals Management Service, Pacific OCS Region, 770 Paseo Camarillo, Camarillo, CA 93010. OCS Study No. 99-0038.

de Margerie, S. 1989. Modeling Drill Cutting Discharges. In: Englehart, F.R., Ray, J.P., and A.H. Gillam, eds. Drilling Wastes. Elsevier Applied Science, New York. pp. 627-646.

Department of Commerce (DOC). 1987. Marine Mammal Protection Act of 1972, Annual Report 1986/87.

Dohl, T.P., R.C. Guess, M.L. Duman, and R.C. Helm. 1983. Cetaceans of central and northern California, 1980-1983: Status, abundance, and distribution. Prepared for U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region. OCS Study MMS 84-0045. 284 pp.

Dohl, T.P., K.S. Norris, R.C. Guess, J.D. Bryant, and M.W. Honig. 1981. Cetacea of the Southern California Bight. Part II of Investigators' reports: Summary of marine mammal and seabird surveys of the Southern California Bight Area, 1975-1978. Prepared for U.S. Department of the Interior, Bureau of Land Management, Pacific OCS Region. NTIS #PB 81-248-189. 414 pp.

Dunstan, T.G., and J.F. Harper. 1975. Food habits of bald eagles in north-central Minnesota. Journal of Wildlife Management 39:140-143.

Dutton, Peter H., A. Frey, R. Leroux, and G. Balazs. 2001. Presentation to the 2nd ASEAN Symposium and Workshop on Sea Turtle Biology and Conservation. Molecular Ecology of Leatherback Turtles in the Pacific. Accessed online at http://www.arbec.com.my/sea-turtles/art27julysept01.htm

Ebert, E.E. 1968. A food-habits study of the southern sea otter, *Enhydra lutris nereis*. California Fish and Game 54:33-42.

Eckert, S.A., K.L. Eckert, P. Ponganis, and G.L. Kooyman. 1989. Diving and foraging behavior of leatherback sea turtles (*Dermochelys coriacea*). Canadian Journal of Zoology 67:2834-2840.

Eckert, Scott A. (1997). Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (Dermochelys coriacea). [Online]. Available http://ecos.fws.gov/recovery_plan/pdf_files/1998/981201d.pdf [21 November 2002].

Edds, P.L., and J.A.F. Macfarlane. 1987. Occurrence and general behavior of balaenopterid cetaceans summering in the St. Lawrence Estuary, Canada. Can. J. Zool. 65(6):1363-1376.

Edelman, W.R., and C.J. Conway. 1998. Clapper rail. *In*: A. Poole and F. Gill eds. Birds of North America No. 340. 32 pp.

Eisenberg, J.F., and J. Frazier. 1983. A leatherback turtle (*Dermochelys coriacea*) feeding in the wild. J. Herpetol. 17:81-82.

Environmental Protection Agency (EPA). 1976. Quality Criteria for Water. US Environ. Protection Agency Rep. PB 263-943.

Environmental Protection Agency (EPA). 1985. Assessment of environmental fates and effects of discharges from offshore oil and gas operations. EPA 440/5-4-85/002. Washington, D.C.

Environmental Protection Agency (EPA). 1986. Quality Criteria for Water. US Environ. Protection Agency Rep. 440/5-86-001.

Environmental Protection Agency (EPA). 2000a. Fact Sheet: Proposed National Pollutant Discharge Elimination System ("NPDES") General Permit No. CAG280000 for Offshore Oil and Gas Exploration, Development and Production Operations off Southern California. July 18, 2000.

Environmental Protection Agency (EPA). 2000b. General NPDES Permit Number CAG280000. Authorization to Discharge under the National Pollutant Discharge Elimination System For Oil And Gas Exploration, Development, And Production Facilities. December 2000.

Erasmus, T., R.M. Randall, and B.M. Randall. 1981. Oil pollution, insulation and body temperatures in the jackass penguin *Spheniseus demerus*. Compendium of Biochemical Physiology 69:169-171.

Ernst, L.H., and R.W. Barbour. 1972. Turtles of the United States. Lexington, KY: University of Kentucky Press. 347 pp.

Estes, J.A. 1980. *Enhydra lutris*. American Society of Mammalogists. Mammalian Species, No. 133. 8 pp.

Estes, J.A., R.J. Jameson, and A.M. Johnson. 1981. Food selection and some foraging tactics of sea otters. *In*: Worldwide Furbearer Conference Proceedings, August 3-11, 1980, Frostburg, MD., D.A. Chapman and D. Pursley (eds.). pp. 606-641.

Fancher, J.M. 1992. Population status and trends of the California least tern. Transactions of the Western Section of the Wildlife Society 28:59-66.

Ferren, W.R., Jr., and S.A. Whitmore. 1983. *Suaeda esteroa* (Chenopodiaceae), a new species from estuaries of southern California and Baja California. Madrono 30:181-190.

Figueroa-C., A-L. 1994. Early lactation and attendance behavior of the Guadalupe fur seal females (*Arctocephalus townsendi*). M.S. thesis, University of California, Santa Cruz. 99 pp.

Fiscus, C.H., and G.A. Baines. 1966. Food and feeding behavior of Steller sea lions. Journal of Mammalogy 47:195-200.

Fish and Wildlife Service (FWS). 1979. Light-footed clapper rail recovery plan. U.S. Fish and Wildlife Service, Portland, OR.

FWS. 1980a. Section 7 Biological Opinion, proposed Outer Continental Shelf oil and gas leasing and exploration activities in the area of California from Point Conception, Santa Barbara County, north to the California/Oregon border (OCS Sale No. 53). Memorandum from Director, USFWS, to Director, BLM, and Director, USGS, dated September 18, 1980.

FWS. 1980b. California least tern recovery plan. U.S. Fish and Wildlife Service, Portland, OR. 58 pp.

FWS. 1981. Section 7 Biological Opinion, proposed Outer Continental Shelf oil and gas leasing and exploration in the Southern California Bight (OCS Sale No. 68). Memorandum from Associate Director, USFWS, to Director, BLM, and Director, USGS, dated April 29, 1981.

FWS. 1982. Southern Sea Otter Recovery Plan. Portland, OR.

FWS. 1983. The California brown pelican recovery plan. Unpublished report, prepared by FWS under contract with F. Gress and D.W. Anderson (University of California, Davis), dated February 3, 1983. 185 pp.

FWS. 1984a. Formal Section 7 Endangered Species consultation on offshore oil and gas development and production in the Point Arguello Field and the Gaviota Processing Facility, Santa Barbara County, California (1-1-84-F-22). To Minerals Management Service, Reston, VA, from U.S. Fish and Wildlife Service, Portland, OR, October 31, 1984.

FWS. 1984b. Salt marsh bird's-beak recovery plan (*Cordylanthus maritimus* subsp. *maritimus*). U.S. Fish and Wildlife Service, Portland, OR. 92 pp.

FWS. 1986. Pacific bald eagle recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 160pp.

FWS. 1995a. Draft Southern Sea Otter Recovery Plan. Ventura, CA.

FWS. 1995b. Seventh and Eighth Annual Report, Southern Sea Otter Translocation to San Nicolas Island, California, August 1993-July 1995. Ventura Endangered Species Recovery Office, Ventura, CA.

FWS 1999a. Fish and Wildlife Service, Pacific Region. June 24, 1999. News Release. http://www.r1.fws.gov/news/9936.htm

FWS 1999b. (Fish and Wildlife Service), Pacific Region. August 3, 1999. News Release. http://www.r1.fws.gov/news/9950.htm

FWS. 2000. Draft Revised Recovery Plan for the Southern Sea Otter (*Enhydra lutris*). Portland, Oregon. 64 pp. + app.

FWS. 2002. Final Recovery Plan for the California Red-Legged Frog (*Rana aurora draytonii*). Portland, Oregon. 64 pp. + app.

FWS. 2003. Final Revised Recovery Plan for the Southern Sea Otter (*Enhydra lutris*). Portland, Oregon. 59 pp. + app.

FWS. 2005. Recovery Plan for the Tidewater Goby (*Eucyclogobius newberryi*). U.S. Fish and Wildlife Service, Portland, Oregon. vi + 199 pp.

FWS. 2006. Designation of Critical Habitat for the California Red-Legged Frog, and Special Rule Exemption Associated With Final Listing for Existing Routine Ranching Activities; Final Rule. 50 CFR Part 17; pg 19244 RIN 1018--AJ16. April 2006.

Fleischer, L.A. 1978. The distribution, abundance, and population characteristics of the Guadalupe fur seal, *Arctocephalus townsendi* (Merriam, 1897). M.S. thesis, University of Washington, Seattle. 93 pp.

Ford, R.G. Consulting Company. 1998. Preliminary bird injury assessment for the Torch/Platform Irene pipeline oil spill, September 1997. Prepared for Office of Spill Prevention and Response, California Department of Fish and Game.

Ford, R.G. 1985. Oil slick sizes and length of coastline affected: A literature survey and statistical analysis. Final report prepared by Ecological Consulting for U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, CA. Contract No. 14-12-0001-30224. MMS OCS Study 85-0105. 34 pp.

Ford, R.G., and M.L. Bonnell. 1987. Analysis of the risk of oil spills to sea otters - methodology. Technical Support Document 3. Volume II, Final Environmental Impact Statement for Translocation of Southern Sea Otters. U.S. Fish and Wildlife Service, Office of Sea Otter Coordination, Sacramento, California. 44 pp.

Forney, K.A., J. Barlow, and J.V. Carretta. 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fishery Bulletin 93:15-26.

Frair, W., R.G. Ackman, and N. Mrsovsky. 1972. Body temperature of *Dermochelys coriacea*: warm turtle from cold water. Science 177:791-793.

Frost, K.J., and L.F. Lowry. 1981. Foods and trophic relationships of cetaceans in the Bering Sea. Pp.825-836 *in*: D.W. Hood and J.A. Calder (eds.), The eastern Bering Sea shelf: Oceanography and resources. Vol. 2, Seattle, University of Washington Press.

Fujino, K. 1960. Immunogenetic and marking approaches to identifying subpopulations of the North Pacific whales. Rep. Int. Whal. Commn. Special Issue 1:1-9.

Gales, R.S. 1982. Effects of noise of offshore oil and gas operations on marine mammals: An introductory assessment. Vols. I and II. Technical Report 844. Prepared for USDOI/MMS. Naval Ocean Systems Center, San Diego, CA.

Gallo-R., J-P. 1994. Factors affecting the population status of the Guadalupe fur seal, *Arctocephalus townsendi* (Merriam, 1897), at Isla de Guadalupe, Baja California, Mexico. Ph.D. diss., University of California, Santa Cruz. 199 pp.

Galloway, J.M. 1997. Santa Barbara-Ventura Basin Province. Pp. 96-115 *in*: C.A. Dunkel and K.A. Piper (eds.), 1995 National Assessment of United States Oil and Gas Resources, Assessment of the Pacific Outer Continental Shelf Region. U.S. Department of Interior, Minerals Management Service, Pacific OCS Region, Camarillo, CA. OCS Report MMS-0019.

Gambell, R. 1985a. Sei whale *Balaenoptera borealis* Lesson, 1828. Pp. 155-170 in: S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, Vol. 3, The sirenians and baleen whales. Academic Press, London.

Gambell, R. 1985b. Fin whale *Balaenoptera physalus* (Linnaeus, 1758). Pp. 171-192 in: S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, Vol. 3, The sirenians and baleen whales. Academic Press, London.

Ganssle, D. 1973. The status of the northern anchovy resource and its management. Unpublished report, California Department of Fish and Game, Marine Resources Technical Report No. 5.

Garcelon, D.L. 1994a. Food habits of the bald eagle on Santa Catalina Island, November 1991-December 1992. A report to the Damage Assessment Office, U.S. Fish and Wildlife Service, Sacramento, California. PPX007 4146. 24 pp.

Garcelon, D.L. 1994b. Effects of organochlorine contaminants on bald eagle reproduction at Santa Catalina Island. Institute for Wildlife Studies, Arcata, California. 16 pp.

Garrett, K., and J. Dunn. 1981. Birds of southern California: status and distribution. Los Angeles Audubon Society, Los Angeles, CA. 408 pp.

Garshelis, D.L., and J.A. Garshelis. 1984. Movement and management of sea otters in Alaska. J. Wildl. Manage. 48:665-678.

Gendron, D., S. Lanham, and M. Carwardine. 1999. North Pacific right whale (*Eubalaena glacialis*) sighting south of Baja California. Aquatic Mammals 25(1):31-34.

Gendron, D., and V. Zavala-Hernàndez. 1995. Blue whales of Baja California: A summary of their distribution and preliminary reproductive data based on photo-identification. Abstr. Proceedings 11th Biennial Conf. Biol. Marine Mamm., Orlando, FL, 14-18 December 1995.

Gentry, R.L. 1970. Social behavior of the Steller sea lion. Ph.D. diss., University of California, Santa Cruz. 113 pp.

Gentry, R.L., and J.H. Johnson. 1981. Predation by sea lions on northern fur seal neonates in Alaska. U.S. Fish and Wildlife Service Report 28. 23 pp.

Geraci, J.R. 1990. Physiologic and toxic effects on cetaceans. Pp. 167-197, *in*: J.R. Geraci and D.J. St. Aubin (eds.), Sea mammals and oil: Confronting the risks. Academic Press, San Diego.

Geraci, J.R., and D.J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals: a review and research recommendations. Marine Fisheries Review 42:1-12.

Geraci, J.R., and D.J. St. Aubin (eds.). 1990. Sea mammals and oil: confronting the risks. Academic Press, San Diego. 282 pp.

Geraci, J.R., and T.D. Williams. 1990. Physiological and toxicological effects on sea otters. Pp. 211-221 *in*: J.R. Geraci, and D.J. St. Aubin (eds.), Sea mammals and oil: Confronting the risks. Academic Press, Inc., San Diego.

Glockner-Ferrari, D.A., and M.J. Ferrari. 1984. Reproduction in humpback whales, *Megaptera novaeangliae*, in Hawaii. Rep. int. Whal. Commn. (Spec. Issue) 6:237-242.

Gorbics, C., P. Kelly, and M. Devany. 2000. Draft: Restoration plan and environmental assessment for seabirds injured by the *American Trader* oil spill. Unpublished draft report, U.S. Fish and Wildlife Service, Carlsbad, CA. 38 pp. plus appendices.

Gosho, M.E., D.W. Rice, and J.M. Breiwick. 1984. The sperm whale, *Physeter macrocephalus*. In, J.M. Breiwick and H.W. Braham (eds.), The status of endangered whales. Mar. Fish. Rev. 46:54-64.

Gramentz, D. 1988. Involvement of loggerhead turtle with the plastic, metal, and hydrocarbon pollution in the central Mediterranean. Marine Pollution Bulletin 19(1):11-13.

Green, G.A., M.L. Bonnell, K.C. Balcomb, D.E. Bowlby, R.A. Grotefendt, and D.G. Chapman. 1989. Synthesis of information on marine mammals of the eastern North Pacific, with emphasis on the Oregon and Washington OCS area. *In*: Information synthesis and hypothesis formulation for Oregon and Washington marine mammal and seabird surveys, J.J. Brueggeman (ed.). Final Report prepared for U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region. Bellevue, WA: Envirosphere Company, and Portland, OR: Ecological Consulting, Inc. OCS Study MMS 89-0030. pp. 1-116.

Green, G.A., J.J. Brueggeman, C.E. Bowlby, R.A. Grotefendt, M.L. Bonnell, and K.C. Balcomb, III. 1991. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. *In*: Oregon and Washington marine mammal and seabird surveys, J.J. Brueggeman (ed.). Final Report prepared for the U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, CA. Bellevue, WA: Ebasco Environmental, and Portland, OR: Ecological Consulting, Inc. OCS Study MMS 91-093. 100 pp.

Green, N.F. 1985. The bald eagle. *In*: Audubon wildlife report 1985. National Audubon Society, New York, New York. Pp. 508-531.

Gress, F. 1970. Reproductive status of the California brown pelican in 1970, with notes on breeding biology and natural history. Calif. Dept. Fish and Game, Wildl. Manage. Br. Admin. Rep. 70-6, Sacramento, CA. 21 pp.

Gress, F. 1992. Nesting survey of brown pelicans on West Anacapa Island, California, 1991. U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Dixon, California. 26 pp.

Grier, J.W. 1980. Modeling approaches to bald eagle population dynamics. Wildlife Society Bulletin 8:316-322.

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27. 617 pp.

GESAMP (Group of Experts on the Scientific Aspects of Marine Pollution). 1993. Impact of oil and related chemicals on the marine environment. Reports and Studies No. 50. International Maritime Organization, London, 180+ix pp.

Grubb, T.G., and R.J. Hensel. 1978. Food habits of nesting bald eagles on Kodiak Island, Alaska. Murrelet 59:70-72.

Guess, R.C. 1982. Occurrence of a Pacific loggerhead turtle, *Caretta caretta gigas* Deraniyagala, in the waters of Santa Cruz Island, California. California Fish and Game 68(2):122-123.

Hall, E.R., and G.B. Schaller. 1964. Tool-using behavior of the California sea otter. Journal of Mammalogy 45:287-298.

Hall, R.J., A.A. Belisle, and L. Sileo. 1983. Residues of petroleum hydrocarbons in tissues of sea turtles exposed to the *Ixtoc 1* oil spill. Journal of Wildlife Disease 19:105-109.

Hanni, K.D., D.J. Long, and L.E. Morgan. 1993. Recent strandings of Guadalupe fur seals (*Arctocephalus townsendi*) from central California. *In*: Abstracts Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, TX, November 11-15, 1993. p. 57.

Hartung, R. and G.S. Hunt. 1966. Toxicity of some oils to waterfowl. J. Wildl. Man. 30:564-570.

Haug, T. 1981. On some reproduction parameters in fin whales *Balaenoptera physalus* (L.) caught off Norway. Rep. Int. Whal. Commn. 31:373-378.

Hawkes, A.L. 1961. A review of the nature and extent of damage caused by oil pollution at sea. Transactions of the North American Wildlife and Natural Resources Conference 26:343-355.

Hayes, M.P., and M.R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylii*): implications for management. *In*: Management of amphibians, reptiles, and small mammals in North America. Eds., R.C. Szaro, K.E. Severson and D.R. Patton. Gen. Tech. Rep. RMn166. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. pp. 144-158.

Hayes, M.P., and Kremples. 1986. Vocal sac variation among frogs of the genus *Rana* from western North America. Copeia 4:927-936.

Hayes, M.P., and M.M. Miyamoto. 1984. Biochemical, behavioral, and body size differences between *Rana aurora aurora* and *Rana aurora draytonii*. Copeia 1018-1022.

Hayes, M.P., and M.R. Tennant. 1985. Diet and feeding behavior of the California rednlegged frog *Rana aurora draytonii* (Ranidae). The Southwestern Naturalist 30: 601-605.

Higgins, L.V., D.P. Costa, A.C. Huntley, and B.J. Le Boeuf. 1988. Behavioral and physiological measurements of maternal investment in the Steller sea lion, *Eumetopias jubatus*. Marine Mammal Science 4(1):44-58.

Hill, P.S., D.P. DeMaster, and R.J. Small. 1997. Alaska marine mammal stock assessments, 1996. NOAA Tech. Memo. NMFS-AFDC-78. 150 pp.

Hogan, C. 1991. Snowy plover and human activities at Damon Point, Washington. May 1 to June 10, 1991. Unpubl. report to Washington Department Wildlife, Olympia, Washington. 10 pp.

Holmes, W.N. 1984. Petroleum pollutants in the marine environment and their possible effects on seabirds. *In*: Reviews in environmental toxicology, Hodgson, I.E., (ed.). Elsevier Science Publishers, Elsevier, NY. pp. 251-317.

Holt, S., N. Rabalais, S. Cornelius, and J.S. Holland. 1975. Effects of an oil spill on salt marshes at Harbor Island, Texas. I. Biology. Conference on assessment of ecological impacts of oil spills. Institute of Biological Sciences, Washington, D.C. pp. 344-353.

Hoover, A.A. 1988. Steller sea lion, *Eumetopias jubatus*. Pp. 159-193 *in*, J.W. Lentfer (ed.), Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations. Marine Mammal Commission, Washington D.C.

Hornafius, J.S., D. Quigley, and B.P. Luyendyk. 1999. The world's most spectacular marine hydrocarbon seeps (Coal Oil Point, Santa Barbara Channel, California): Quantification of emissions. Journal of Geophysical Research 104(C9):20,703-20,711.

Houck, W.J., and J.G. Joseph. 1958. A northern record for the Pacific ridley, *Lepidochelys olivacea*. Copeia 1958(3):219-220.

Hubbs, C.L. 1956. The Guadalupe fur seal still lives! Zoonooz 29(12):6-9.

Hubbs, C.L. 1977. First record of mating of ridley turtles in California, with notes on commensals, characters, and systematics. California Fish and Game 63(4):262-267.

Ingram, T., and D.J. Carter. 1997. Seabird monitoring, Channel Islands National Park, 1991-1992. National Park Service, Channel Islands National Park Technical Report 97-02. 73 pp.

Jacobson, L.D., N.C.H. Lo, S.F. Herrick, Jr., and T. Bishop. 1995. Spawning biomass of the northern anchovy in 1995 and status of the coastal pelagic fishery during 1994. SWFSC Admin. Rep., La Jolla, LJ-95-11. 49 pp.

Jacobson, L.D., N.C.H. Lo, and M. Yaremko. 1997. Status of the northern anchovy (*Engraulis mordax*) stock (central subpopulation) during the 1996-1997 season. SWFSC Admin. Rep., La Jolla, LJ-97-08. 11 pp.

Jameson, R.J. 1983. Evidence of birth of a sea otter on land in central California. California Fish and Game 69(2):122-123.

Jameson, R.J., and J.L. Bodkin. 1986. An incidence of twinning in the sea otter (*Enhydra lutris*). Marine Mammal Science 2(4):305-309.

Jameson, R.J., and A.M. Johnson. 1993. Reproductive characteristics of female sea otters. Marine Mammal Science 9(2):156-167.

Jameson, R.J., and K.W. Kenyon. 1977. Prey of sea lions in the Rogue River, Oregon. Journal of Mammalogy 58(4):672.

Jameson, R.J., K.W. Kenyon, A.M. Johnson, and H.M. Wight. 1982. History and status of translocated sea otter populations in North America. Wildlife Society Bulletin 10:100-107.

Jaques, D.L., and D.W. Anderson. 1987. Conservation implications of habitat use and behavior of wintering brown pelicans (*Pelecanus occidentalis californicus*). Public Service Research and Dissemination Program, University of California, Davis, California. 49 pp.

Jehl, J.R., Jr. 1973. Studies of a declining population of brown pelicans in northwestern Baja California. Condor 75:69-79.

Jennings, M.R. 1988. Natural history and decline of native ranids in California. Proceedings of the conference on California herpetology. eds., H.F. De Lisle, P.R. Brown, B. Kaufman and B.M. McGurty. Southwestern Herpetologists Society.

Jennings, M.R. and M.P. Hayes. 1985. Pre-1900 overharvest of California red-legged frogs (*Rana aurora draytonii*): The inducement for bullfrogs (*Rana catesbeiana*) introduction. Herpetologica 41:94-103.

Jennings, M.R., M.P. Hayes and D.C. Holland. 1993. A petition to the U. S. Fish and Wildlife Service to place the California red-legged frog (*Rana aurora draytonii*) and the western pond turtle (*Clemmys marmorata*) on the list of endangered and threatened wildlife and plants.

Johnson, A.M. 1982. Status of Alaska sea otter populations and developing conflicts with fisheries. Transactions North American Wildlife and Natural Resources Conference 47:293-299.

Johnson, J.H., and A.A. Wolman. 1984. The humpback whale, *Megaptera novaeangliae*. *In*: J.M. Breiwick and H.W. Braham (eds.), The status of endangered whales. Marine Fisheries Review 46:30-37.

Jones, M.L., and S.L. Swartz. 1987. Radio-telemetric study and aerial census of gray whales in the Channel Islands National Marine Sanctuary during the southward migration, January 1986. Draft Final Report prepared for NWAFC/NMFS/NOAA. Contract No. 50-ABNF-6-00067.

Jones, R.E. 1981. Food habits of smaller marine mammals from northern California. Proceedings of the California Academy of Sciences 42(16):409-433.

Kawamura, A. 1980. A review of food of balaenopterid whales. Sci. Rep. Whales Res. Inst. 32:155-197.

Kawamura, A. 1982. Food habits and prey distributions of three rorqual species in the North Pacific Ocean. Sci. Rep. Whales Res. Inst. 34:59-91.

Keane, K. 1998. California least tern breeding survey, 1997 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report. 46 pp.

Keane, K. 2000. Draft Report to the California Department of Fish and Game. California least tern breeding survey, 1998 season.

Keith, J.O., L.A. Woods, Jr., and E.G. Hunt. 1971. Reproductive failure in brown pelicans on the Pacific Coast. Trans. N. Amer. Wildl. And Nat. Res. Conf. 35:56-63.

Kenney, R.D., and S.D. Kraus. 1993. Right whale mortality—A correction and an update. Marine Mammal Science 9(4):445-446.

Kenyon, K.W. 1969. The sea otter in the eastern Pacific Ocean. North American Fauna. No. 68. Bureau of Sport Fisheries and Wildlife. Washington, D.C.: U.S. Government Printing Office. 352 pp.

King, J.G., and G.A. Sanger. 1979. Oil vulnerability index for marine oriented birds. *In*: Conservation of marine birds in northern North America, J.C. Bartoneck and D. Nettleship, (eds.) FWS Wildlife Research Report No. 11. 319 pp.

Kleerekoper, H., and J. Bennett. 1976. Some effects of the water-soluble fraction of Louisiana crude on the locomotor behavior of juvenile green turtles (*Chelonia mydas*) and sea catfish (*Iarius felis*): Preliminary results. Proc. NOAA Symposium on the Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms, November 10-12, 1976, Seattle, WA.

Knowlton, A.R., and S. Kraus. 1989. Calving intervals, rates, and success in North Atlantic right whales. Abstr. Proc. 8th Biennial Conf. Biol. Mar. Mamm., Pacific Grove, CA, December 7-11, 1989.

Kooyman, G.L., and D.P. Costa. 1979. Effects of oiling on temperature regulation in sea otters. Yearly Progress Report. Outer Continental Shelf Energy Assessment Program.

Kooyman, G.L., R.W. Davis, and M.A. Castellini. 1977. Thermal conductance of immersed pinniped and sea otter pelts before and after oiling with Prudhoe Bay crude. Chapter 14 (pp. 151-157) *in*: D.A. Wolfe (ed.), Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems. Pergamon Press, New York.

Larkman, V.E., and R.R. Veit. 1998. Seasonality and abundance of blue whales off southern California. CalCOFI Reports 39:236-239.

Leatherwood, S., and R.R. Reeves. 1986. Porpoises and dolphins. Pp. 110-131 *in*: D. Haley (ed.), Marine mammals of the eastern North Pacific and Arctic waters. Second Edition, Revised. Pacific Search Press.

Leatherwood, S., R.R. Reeves, W.F. Perrin, and W.E. Evans. 1982. Whales, dolphins, and porpoises of the eastern North Pacific and adjacent Arctic waters. A guide to their identification. NOAA Technical Report, NMFS Circular 444. 245 pp.

Leatherwood, S., B.S. Stewart, and P.A. Folkins. 1987. Cetaceans of the Channel Islands National Marine Sanctuary. NOAA, Channel Islands National Marine Sanctuary and NMFS. 66 pp.

Le Boeuf, B.J. 1971. Oil contamination and elephant seal mortality—a "negative" finding. Pp. 277-286 *in*: D. Straughn (ed.), Biological and oceanographical survey of the Santa Barbara Channel oil spill 1969-1970.

Le Boeuf, B.J. 1981. Mammals. Pp. 287-325, *in*, B.J. Le Boeuf and S. Kaza (eds.), The Natural History of Año Nuevo. The Boxwood Press, Pacific Grove, California.

Le Boeuf, B.J., and M.L. Bonnell. 1980. Pinnipeds of the California Islands: abundance and distribution. *In*: The California islands: Proceedings of a multidisciplinary symposium, D.M. Power (ed.). Santa Barbara, CA: Santa Barbara Museum of Natural History. pp. 475-493,

Lehman, P.E. 1994. The birds of Santa Barbara County, California. UCSB Vertebrate Museum, Santa Barbara, California. 338 pp.

Limbaugh, C. 1961. Observations of the California sea otter. Journal of Mammalogy 42:271-273.

Long, E.R. 1992. Ranges in chemical concentrations in sediments associated with adverse biological effects. Mar. Pollut. Bull. 24:38-45.

Long, E.R., and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration, 175 pp. plus appendices.

Long, E.R., D.D. McDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environ. Manag. 19: 81-97.

Loughlin, T.R. (ed.). 1994a. Marine mammals and the *Exxon Valdez*. Academic Press, Inc.: San Diego, CA. 395 pp.

Loughlin, T.R. 1994b. Tissue hydrocarbon levels and the number of cetaceans found dead after the spill. Pp. 359-370, *in*, T.R. Loughlin (ed.), Marine mammals and the *Exxon Valdez*. Academic Press, Inc.: San Diego, CA.

Loughlin, T.R., B.E. Ballachey, and B.A. Wright. 1996. Overview of studies to determine injury caused by the *Exxon Valdez* oil spill to marine mammals. Pp. 798-808 *in*: S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright (eds.), Proceedings of the Exxon Valdez oil spill symposium. American Fisheries Society, Symposium 18.

Loughlin, T.R., D.J. Rugh, and C.H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-80. Journal of Wildlife Management 48:729-740.

Love, M. 1996. Probably more than you want to know about the fishes of the Pacific Coast. Really Big Press, Santa Barbara, CA. 381 pp.

Lutz, P.L. 1985. Effects of oil on marine turtles. *In*: Proc. 1st Atlantic OCS Information Transfer Meeting, Vienna, VA. MMS 85-106.

Lutz, P.L., and M. Lutcavage. 1989. The effects of petroleum on sea turtles: Applicability to Kemp's ridley. Pp. 52-54 *in*: C.W. Caillouet, Jr., and A.M. Landry, Jr. (comp.), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation, and Management. TAMU-SG-89-105.

Lyons, K.J. 1989. Individual variation in diet in the female California sea otter, <u>Enhydra</u> <u>lutris</u>. M.S. thesis, University of California, Santa Cruz. 40 pp.

Lytle, J.S. 1975. Fate and effects of crude oil on an estuarine pond. Proceedings of the conference on prevention and control of oil pollution, San Francisco. pp. 595-600.

Mager, A., Jr. 1984. Status review: Marine turtles. Under jurisdiction of the Endangered Species Act of 1973. U.S. Department of Commerce, NOAA, National Marine Species Service. 64 pp.

Malins, D.C., and H.O. Hodgins. 1981. Petroleum and Marine Fishes: A Review of Uptake, Disposition, and Effects. Environmental Science and Technology, 15(11):1272-1280.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. BBN Rep. No. 5366. Rep. from Bolt, Beranek, and Newman, Inc., Cambridge, Massachusetts, for U.S. Minerals Management Service, Anchorage, Alaska. NTIS PB86-174174.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Phase II: January 1984 migration. BBN Rep. No. 5586. Rep. from Bolt, Beranek, and Newman, Inc., Cambridge, Massachusetts, for U.S. Minerals Management Service, Anchorage, Alaska. NTIS PB86-218377.

Mangels, K.F., and T. Gerrodette. 1994. Report of cetacean sightings during a marine mammal survey in the eastern Pacific Ocean and the Gulf of California aboard the NOAA ships *McArthur* and *David Starr Jordan* July 28 - November 6, 1993. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-221. 88pp.

MRS (Marine Research Specialists). 2002. Tranquillon Ridge Oil and Gas Development Project, Final EIR. Submitted to County of Santa Barbara. June 2002. Volumes 1 and 2.

____. 2005. The Effect of Produced-Water Discharges on Federally Managed Fish Species along the California Outer Continental Shelf. Submitted to: Western States Petroleum Association June 29, 2005.

Márquez, M.R. 1990. Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date. FAO Species Catalog, FAO Fisheries Synopsis 11(25):81 pp.

Marquez, R. 1969. Additional records of the Pacific loggerhead turtle, *Caretta caretta gigas*, from the North Mexican Pacific Coast. Journal of Herpetology 3(1-2):108-110.

Massey, B.W., and J.L. Atwood. 1981. Second-wave nesting of the California least tern: age composition and reproductive success. Auk 98:596-605.

Mate, B.R. 1975. Annual migrations of the sea lions *Eumetopias jubatus* and *Zalophus californianus* along the Oregon coast. Rapp. P.-v. Reun. Cons. int. Mer 169:455-461.

Mate, B.R. 1981. Marine mammals. *In*: Natural history of Oregon coast mammals, C. Maser, B.R. Mate, J.F. Franklin, and C.T. Dyrness. Portland. OR: U.S. Department of Agriculture, Forest Service. General Technical Report PNW-133. pp. 372-457.

Mate, B.R., B.A. Lagerquist, and J. Calambokidis. 1999. Movements of North Pacific blue whales during the feeding season off southern California and their southern fall migration. Marine Mammal Science 15(4):1246-1257.

Matkin, C.O., G.M. Ellis, M.E. Dahlheim, and J. Zeh. 1994. Status of killer whales in Prince William Sound, 1985-1992. Pp. 141-162, *in*, T.R. Loughlin (ed.), Marine mammals and the *Exxon Valdez*. Academic Press, Inc.: San Diego, CA.

Maxwell, J.H. 1979. Anesthesia and surgery. Pp. 127-152 *in*: M. Harless and M. Morlock (eds.), Turtles: Perspectives and research. Wiley Interscience, New York, NY.

MBC Applied Environmental Sciences. 1989. Gray whale monitoring study. Final report prepared for U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region. OCS Study MMS 88-0075. 99 pp. plus app.

McEwan, D., and T. A. Jackson. 1996. Steelhead management plan for California. California Dep. Fish Game. (Available California Department of Fish and Game, Inland Fisheries Division, 1416 Ninth Street, Sacramento, CA 95814.).

McVey, M., K. Hall, P. Trenham, A. Soast, L. Frymier, and A. Hirst. 1993. Wildlife Exposure Factors Handbook, Volume I. U.S. Environmental Protection Agency, Washington D.C., EPA/600/R-93/187a.

Merrick, R.L., T.R. Loughlin, and D.G. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus*, in Alaska, 1956-86. Fishery Bulletin 85(2):351-365.

Miller, D.J. 1974. The sea otter, Enhydra lutris: Its life history, taxonomic status, and some ecological relationships. Marine Resources Leaflet No. 7. The Resources Agency, State of California, Department of Fish and Game. 13 pp.

Minerals Management Service (MMS). 1996. Final Environmental Impact Statement, Outer Continental Shelf Oil & Gas Leasing Program: 1997-2002. U.S. Department of the Interior, Minerals Management Service, Herndon, VA.

Mizroch, S.A., D.W. Rice, and J.M. Breiwick. 1984a. The blue whale, *Balaenoptera musculus*. Mar. Fish. Rev. 46(4):15-19.

Mizroch, S.A., D.W. Rice, and J.M. Breiwick. 1984b. The fin whale, *Balaenoptera physalus*. Mar. Fish. Rev. 46(4):20-24.

Mizroch, S.A., D.W. Rice, and J.M. Breiwick. 1984c. The sei whale, *Balaenoptera borealis*. Mar. Fish. Rev. 46(4):25-29.

Moore, M.M. 1980. Factors influencing the survival of juvenile steelhead rainbow trout (*Salmo gairdnerii gairdnerii*) in the Ventura River. M.S. thesis, Humboldt State Univ., Arcata, CA. 82 pp.

Monterey Bay National Marine Sanctuary (MBNMS). 2002. Ecosystem Observations for the Monterey Bay National Marine Sanctuary: Threatened and Endangered Species, Foraging Ecology of the Leatherback Turtle. http://www.montereybay.noaa.gov/reports/2002/eco/endangered.html

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers, and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study MMS 91-0027. Rep. From the National Marine Fisheries Service, Pascagoula, MS, for the Minerals Management Service, New Orleans, LA. 108 pp.

Munz, P.A. 1959. A California flora. Univ. of Calif. Press, Berkeley.

Nasu, K. 1974. Movement of baleen whales in relation to hydrographic conditions in the northern part of the North Pacific Ocean and the Bering Sea. Pp. 345-361 in: D.W. Hood and E.J. Kelley (eds.), Oceanography of the Bering Sea. Institute of Marine Science, University of Alaska, Fairbanks.

National Academy of Sciences (NAS). 1983. Drilling discharges in the marine environment: Panel on Assessment of Fates and Effects of Drilling Fluids and Cuttings in the Marine Environment. National Academy Press, Washington, D.C.

NAS. 1985. Petroleum in the Marine Environment. Washington, DC: National Academy of Sciences.

National Marine Fisheries Service (NMFS). 1980. Endangered Species Act, Section 7 Consultation—Biological Opinion for proposed Outer Continental Shelf oil and gas Lease Sale No. 53 in the area from Point Conception north to the California/Oregon border and subsequent exploration activities. Prepared for Bureau of Land Management and U.S. Geological Survey, Washington, D.C., by National Marine Fisheries Service, Washington, D.C., September 17, 1980.

NMFS. 1984. Endangered Species Act, Section 7 Consultation—Biological Opinion and Statement regarding Incidental Taking for operations pertaining to the development and production of oil and gas offshore California between Point Arguello and Point Conception. Prepared for the Minerals Management Service, Washington, D.C., by the National Marine Fisheries Service, Washington, D.C., May 31, 1984.

NMFS. 1991a. Recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by Humpback Whale Recovery Team for National Marine Fisheries Service, Silver Spring, MD. 105 pp.

NMFS. 1991b. Recovery plan for the northern right whale (*Eubalaena glacialis*). Prepared by Right Whale Recovery Team for National Marine Fisheries Service, Silver Spring, MD. 86 pp.

NMFS. 1992. Recovery plan for the Steller sea lion (*Eumetopias jubatus*). Prepared by Steller Sea Lion Recovery Team for National Marine Fisheries Service, Silver Spring, MD. 92 pp.

NMFS and FWS (Fish and Wildlife Service). 1998a. Recovery plan for U.S. Pacific population of the leatherback turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, MD. 77 pp.

NMFS and FWS. 1998b. Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle *(Chelonia myda*s). National Marine Fisheries Service, Silver Spring, MD.

NMFS and FWS. 1998c. Recovery plan for the U.S. Pacific populations of the olive ridley turtle (*Lepidochelys olivacea*). National Marine Fisheries Service, Silver Spring, MD.

NMFS and FWS. 1998d. Recovery plan for U.S. Pacific populations of the loggerhead turtle (*Caretta caretta*). National Marine Fisheries Service, Silver Spring, MD.

NMFS. 1999. Our living oceans. Report on the status of U.S. living marine resources, 1999. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-41. 301 pp.

NMFS. 2006. White Abalone Recovery Plan (*Haliotis sorenseni*), DRAFT. National Marine Fisheries Service, Long Beach, CA. November 2, 2006.

NRC (National Research Council). 1985. Oil in the Sea: Inputs, Fates, and Effects. National Academy Press, Washington, DC. 601+xviii pp.

Neff, J.M. 1987. Biological effects of drilling fluids, drill cuttings, and produced water. Pp. 469-538, *in*: D.F. Boesch and N.N. Rabalais (eds.), Long-term environmental effects of offshore oil and gas development. Elsevier Applied Science, New York, NY.

Neff, J.M., R.J. Breteler, and R.S. Carr. 1989. Bioaccumulation, food chain transfer, and biological effects of barium and chromium from drilling muds by flounder (*Pseudopleuronectes americanus*) and lobster (*Homarus americanus*). *In*: F.R. Engelhardt, J.P. Ray, and A.H. Gillam, eds., Drilling Wastes. Elsevier, London. pp. 439-459.

Neff, J.M., and T.C. Sauer. 1996. An ecological risk assessment for polycyclic aromatic hydrocarbons in produced water discharges to the Western Gulf of Mexico. *In*: M. Reed and S. Johnson, eds., Produced Water 2: Environmental Issues and Mitigation Technologies. Plenum, New York, pp.355-366.

Nemoto, T. 1970. Feeding pattern of baleen whales in the oceans. Pp. 241-152 in: J.H. Steele (ed.), Marine food chains. University of California Press, Berkeley.

Nemoto, T., and A. Kawamura. 1977. Characteristics of food habits and distribution of baleen whales with special reference to the abundance of North Pacific sei and Bryde's whales. Rep. Int. Whal. Commn., Special Issue 1:80-87.

Nero and Associates. 1987. Seabird oil toxicity study. Final report to MMS, Pacific OCS Region, Los Angeles, CA.

Nishiwaki, M. 1959. Humpback whales in Ryukyuan waters. Scientific Report of the Whales Research Institute, Tokyo 15:1-15.

Nuevo Energy Company. 2000. Revised Plan of Development and Production, Point Pedernales Field OCS Lease P-0441: Tranquillon Ridge Oil Field Development. Submitted to Minerals Management Service by Nuevo Energy Company, Bakersfield, CA, and Bellwether Exploration Company, Houston, TX. March 2000.

Ohsumi, S., and S. Wada. 1974. Status of whale stocks in the North Pacific, 1972. Rep. Int. Whal. Commn. 24:114-126.

Omura, H. 1958. North Pacific right whales. Scientific Report of the Whales Research Institute, Tokyo. 13:1-52.

Omura, H. 1986. History of right whale catches in the waters around Japan. *In*: R.L. Brownell, Jr., P.B. Best, and J.H. Prescott (eds.), Right whales: Past and present status reports of the IWC. Special Issue No. 10. Cambridge, U.K.

Omura, H., S. Ohsumi, R. Nemoto, K. Nasu, and T. Kasuya. 1969. Black right whales in the North Pacific. Scientific Report of the Whales Research Institute, Tokyo. 21:1-78.

Orr, R.T., and T.C. Poulter. 1967. Some observations on reproduction, growth, and social behavior in the Steller sea lion. Proceedings of the California Academy of Sciences 35(10):193-226.

Ostfeld, R.S. 1982. Foraging strategies and prey switching in the California sea otter. Oecologia 53:170-178.

Page, G.W., F.C. Bidstrup, R.J. Ramer, and L.E. Stenzel. 1986. Distribution of wintering snowy plovers in California and adjacent states. Western Birds 17(4):145-170.

Page, G.W., and L.E. Stenzel (eds.). 1981. The breeding status of the snowy plover in California. Western Birds 12(1):1-40.

Page, G.W., W.E. Stenzel, W.D. Shuford, and C.R. Bruce. 1991. Distribution and abundance of the snowy plover on its western North American breeding grounds. Journal of Field Ornithology 62:245-255.

Page, G.W., J.S. Warriner, J.C. Warriner and R.M. Halbeisen. 1977. Status of the snowy plover on the northern California coast. Part I: Reproductive timing and success. California Department of Fish and Game Nongame Wildlife Investigations, Sacramento, California. 10 pp.

Page, G.W., J.S. Warriner, J.C. Warriner, and P.W.C. Paton. 1995. Snowy Plover (*Charadrius alexandrinus*). In A. Poole and F. Gill, editors, The Birds of North America, No. 154. Academy of Natural Science, Philadelphia, and American Ornithologists' Union, Washington, D.C. 24 pp.

Palacios, E., and L. Alfaro. 1994. Distribution and abundance of breeding snowy plovers on the Pacific coast of Baja California. Journal of Field Ornithology 65:490-497.

Patten, S.M. Jr., and L.R. Patten. 1977. Effects of petroleum exposure on hatchling success and incubation behavior of Gulf of Alaska herring gull group. NOAA, Outer Continental Shelf Environmental Assessment Program.

Payne, R.S., O. Brazier, E.M. Doresy, J.S. Perkins, V.J. Rowntree, and A. Titus. 1983. External features in southern right whales (Eubalaena australis) and their use in identifying individuals. Pp. 371-445 *in*: R.S. Payne (ed.), Communication and behavior of whales. AAAS Sel. Symposium 76. Westview Press, Boulder, CO.

Peterson, R.S., C.L. Hubbs, R.L. Gentry, and R.L. DeLong. 1968. The Guadalupe fur seal: habitat, behavior, population size, and field identification. Journal of Mammalogy 49(4):665-675.

Pierson, M.O. 1987. Breeding behavior of the Guadalupe fur seal, *Arctocephalus townsendi*. *In*: Status, Biology, and Ecology of Fur Seals, J.P. Croxall and R.L. Gentry (eds.). Proceedings of an International Symposium and Workshop, Cambridge, England, 23-27 April 1984. NOAA Technical Report NMFS 51. pp. 83-94.

Pickens, M.K. 1992. The transport and Long-Term Fate of Drilling Muds Discharged in Marine Environments. Ph.D. Dissertation. University of California, Santa Barbara. September 1992.

Pike, G.C., and I.B. MacAskie. 1969. Marine mammals of British Columbia. Bull. Fish. Res. Bd. Canada, No. 171. 54 pp.

Pitcher, K.W. 1981. Prey of the Steller sea lion, *Eumetopias jubatus*, in the Gulf of Alaska. Fishery Bulletin 79(3):467-472.

Pitcher, K.W., and F.H. Fay. 1982. Feeding by Steller sea lions on harbor seals. Murrelet 63:70-71.

Plains Exploration and Production Company (PXP). 2005. Revisions to the Point Pedernales Field DPP Tranquillon Ridge Field, Supporting Information Volume. May 2005

Pritchard, P.C.H. 1971. The leatherback or leathery turtle *Dermochelys coriacea*. IUCN Monograph No. 1. Morges, Switzerland. 39 pp.

Pritchard, P.C.H. 1982. Nesting of the leatherback turtle *Dermochelys coriacea* in Pacific Mexico, with a new estimate of the world population status. Copeia 4:741-747.

Raimondi, P.T., and R.J. Schmitt. 1992. Effects of produced water on settlement of larvae: Field tests using red abalone. Pp. 415-430 *in*: J.P. Ray and F.R. Engelhardt (eds.), Produced water:

Technical/environmental issues and solutions. Environmental Science Research, Vol. 46. Plenum Press, New York.

Ralls, K., T. Eagle, and D.B. Siniff. 1988. Movement patterns and spatial use of California sea otters. Pp. 33-63 *in*: D.B. Siniff and K. Ralls (eds.), Population status of California sea otters. OCS Study MMS 88-0021. Pacific OCS Region, Minerals Management Service, U.S. Department of the Interior. Contract No. 14-12-001-30033.

Ralls, K., and D.B. Siniff. 1990. Time budgets and activity patterns in California sea otters. Journal of Wildlife Management 54(2):251-259.

Reeves, R.R. 1992. Whale responses to anthropogenic sounds: A literature review. Sci. & Res. Ser. 47 New Zealand Dept. Conserv., Wellington. 47 pp.

Reeves, R.R., and R.L. Brownell, Jr. 1982. Baleen whales (*Eubalaena glacialis* and allies). Pp. 415-444 *in*: J.A. Chapman and G.A. Feldhammer (eds.), Wild mammals of North America: Biology, management, and economics. Johns Hopkins University Press, Baltimore.

Reeves, R.R., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber. 1998a. Recovery plan for the blue whale (*Balaenoptera musculus*). Office of Protected Resources, National Marine Fisheries Service, NOAA, Silver Spring, MD. 42 pp.

Reeves, R.R., G.K. Silber, and P.M. Payne. 1998b. Draft recovery plan for the fin whale *Balaenoptera physalus* and sei whale *Balaenoptera borealis*. Office of Protected Resources, National Marine Fisheries Service, NOAA, Silver Spring, MD. 65 pp.

Reilly, S.B., and V.G. Thayer. 1990. Blue whale (*Balaenoptera musculus*) distribution in the eastern tropical Pacific. Marine Mammal Science 6:265-277.

Repenning, C.A., R.S. Peterson, and C.L. Hubbs. 1971. Contributions to the systematics of the southern fur seals, with particular reference to the Juan Fernandez and Guadalupe species. *In*: Antarctic Pinnipedia, W.H. Burt (ed.). Washington, D.C.: Geophysical Union. Antarctic Research Series, Vol. 18. pp. 1-34,

Retfalvi, L. 1970. Food of nesting bald eagles on San Juan Island, Washington. Condor 72:358-361.

Rice, D.W. 1963. Progress report on biological studies of the larger cetaceans in the waters off California. Norsk Hvalfangst-tidende 52:181-187.

Rice, D.W. 1974. Whales and whale research in the eastern North Pacific. *In*: The Whale Problem: A Status Report, W.E. Schevill (ed.). Cambridge, MA: Harvard University Press. pp. 170-195.

Rice, D.W. 1977. Synopsis of biological data on the sei whale and Bryde’s whale in the eastern North Pacific. Rep. Int. Whal. Commn., Special Issue 1:92-97.

Rice, D.W. 1978. The humpback whale in the North Pacific: Distribution, exploitation, and numbers. Pp. 29-44 *in*: K.S. Norris and R.R. Reeves (eds.), Report on a workshop on problems related to humpback whales (*Megaptera novaeangliae*) in Hawaii. Contract Report, Marine Mammal Commission, NTIS PB-280-794.

Rice, D.W. 1986. Blue whale. Pp. 4-45 in: D. Haley (ed.), Marine mammals of eastern North Pacific and Arctic waters. 2nd edition. Pacific Search Press.

Rice, D.W. 1988. Sperm whale *Physeter macrocephalus* (Linnaeus, 1758). Pp. 177-233 in: S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, Vol. 4. Academic Press, London.

Rice, D.W. 1992. The blue whales of the southeastern North Pacific Ocean. Alaska Fisheries Science Center, Quarterly Report, Oct.-Dec., pp. 1-3.

Rice, D.W., A.A. Wolman, B.R. Mate, and J.T. Harvey. 1986. A mass stranding of sperm whales in Oregon: Sex and age composition of the school. Marine Mammal Science 2(1):64-69.

Rice, S.D. 1973. Toxicity and avoidance tests with Prudhoe Bay oil and pink salmon fry. *In*: American Petroleum Institute, Environmental Protection Agency and United States Coast Guard 1973 Joint Conference on Prevention and Control of Oil Spills. American Petroleum Institute, Washington, DC. pp. 667-670.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thompson. 1995. Marine mammals and noise. Academic Press, Inc., San Diego, CA. 576 pp.

Richardson, W.J., and C.I. Malme. 1993. Man-made noise and behavioral responses. Pp. 631-700 *in*: J.J. Burns, J.J. Montague, and C.J. Cowles (eds.), The bowhead whale. Special Publication Number 2, The Society for Marine Mammalogy.

Riedman, M.L. 1983. Studies of the effects of experimentally noise associated with oil and gas exploration and development on sea otters in California. Report by Center for Coastal Marine Studies, University of California, Santa Cruz, for U.S. Department of the Interior, Minerals Management Service, Anchorage, Alaska. NTIS B86-218575.

Riedman, M.L. 1984. Effects of sounds associated with petroleum industry activities on the behavior of sea otters in California. Pp. D-1 to D-12 in, C.I. Malme et al., Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior/Phase II: January 1984 migration. BBN Report 5586 from Bolt, Beranek, & Newman, Inc., Cambridge, Massachusetts, for U.S. Department of the Interior, Minerals Management Service, Anchorage, Alaska. NTIS PB86-218377.

Riedman, M.L. 1987. Summary of information on the biology of the southern sea otter. Technical Support Document 1. Vol. II, Final environmental impact statement: Translocation of southern sea otters. Sacramento, CA: U.S. Fish and Wildlife Service. 69 pp.

Riedman, M.L., and J.A. Estes. 1990. The sea otter (*Enhydra lutris*): behavior, ecology, and natural history. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service. Biological Report 90(14). 126 pp.

Risebrough, R.W., F.C. Sibley, and M.N. Kirven. 1971. Reproductive failure of the brown pelican on Anacapa Island in 1969. Amer. Birds 25:8-9.

Robinson, N.H. 1979. Recent records of southern right whales in New South Wales. Victorian Nat. 96:168-169.

Roffe, T.J., and B.R. Mate. 1984. Abundances and feeding habits of pinnipeds in the Rogue River, Oregon. Journal of Wildlife Management 48(4):1262-1274.

Ross, J.P. 1982. Historical decline of loggerhead, ridley, and leatherback sea turtles. *In*: Biology and conservation of sea turtles, K.A. Bjorndal (ed.). Washington, D.C.: Smithsonian Institution Press. pp. 189-195,

Rotterman, L.M., and T. Simon-Jackson. 1988. Sea otter, *Enhydra lutris*. *In*: Selected marine mammals of Alaska: Species accounts with research and management recommendations, J.W. Lentfer (ed.). Washington, D.C.: Marine Mammal Commission. pp. 237-275

Sandegren, F.E. 1970. Breeding and maternal behavior of the Steller sea lion (*Eumetopias jubata*) in Alaska. M.S. thesis, University of Alaska, College, AK. 138 pp.

Santa Barbara County. 2001. Torch Point Pedernales Project Final Development Plan 94-DP-027. 1998-2000 Condition Effectiveness Review Revised Final Analysis. Prepared by Santa Barbara County Planning & Development Department, Energy Division. January 11.

Scarff, J.E. 1986. Historic and present distribution of the right whale (Eubalaena glacialis) in the eastern North Pacific south of 50°N and east of 180°W. Pp. 43-63, *in*: R.L. Brownell, Jr., P.B. Best, and J.H. Prescott (eds.), Right whales: Past and present status. International Whaling Commission, Cambridge, UK.

Scarff, J.E. 1991. Historic distribution and abundance of the right whale (Eubalaena glacialis) in the North Pacific, Bering Sea, Sea of Okhotsk, and Sea of Japan from the Maury Whale Charts. Rep. int. Whal. Commn. 41:467-489.

Schoenherr, J.R. 1991. Blue whales feeding on high concentrations of euphausiids around Monterey Submarine Canyon. Can. J. Zool. 69:583-594.

Schreiber, R.W., and R.L. DeLong. 1969. Brown pelican status in California. Audubon Field Notes 23:57-59.

Schreiber, R.W., and R.W. Risebrough. 1972. Studies of the brown pelican. Wilson Bull. 84:119-135.

Science Applications International Corporation (SAIC). 2000a. Biological assessment for endangered species in outer continental shelf waters of south and central California for consultation with the National Marine Fisheries Service. Submitted to U.S. Environmental Protection Agency Headquarters, Washington, D.C., and Region 9, San Francisco, CA. Reston, VA, and Santa Barbara, CA. EPA Contract No. 68-C4-0034, WA No. IM-5-30. 35 pp.

SAIC. 2000b. Biological assessment for endangered species in outer continental shelf waters of south and central California for consultation with the United States Fish and Wildlife Service. Submitted to U.S. Environmental Protection Agency Headquarters, Washington, D.C., and Region 9, San Francisco, CA. Reston, VA, and Santa Barbara, CA. EPA Contract No. 68-C4-0034, WA No. IM-5-30. 29 pp.

SAIC. 2000c. Essential Fish Habitat assessment for re-issuance of NPDES general permit for oil and gas production platforms off the California coast. Submitted to U.S. Environmental Protection Agency, Region 9, San Francisco, CA. EPA Contract No. 68-C4-0034, WA No. IM-5-30(P).

Sharpe, P.B., and D.K. Garcelon. 1999. Restoration and management of bald eagles on Santa Catalina Island, California, 1998. Report to the U. S. Fish and Wildlife Service, Sacramento Field Office. Institute for Wildlife Studies, Arcata, CA. 26 pp.

Sherrod, S.H., C.M. White, and F.S.L. Williamson. 1977. Biology of the bald eagle at Amchitka Island, Alaska. Living Bird 15:143-182.

Siniff, D.B., T.D. Williams, A.M. Johnson, and D.L. Garshelis. 1982. Experiments on the response of sea otters, Enhydra lutris, to oil contamination. Biol. Conserv. 2:261-272.

Smith, S.A., and W.J. Houck. 1984. Three species of sea turtles collected from northern California. California Fish and Game 70(1):60-62.

Soothill, E., and R. Soothill. 1982. Wading birds of the world. Blandford Press, Puole and Dorset, England. pp. 232-233.

Spalding, D.J. 1964. Comparative feeding habits of the fur seal, sea lion, and harbour seal on the British Columbia coast. Fisheries Research Board of Canada, Bulletin 146. 52 pp.

Speth, J.W. 1971. The status of coastal wetlands in southern California. Paper presented at annual meeting, Western Section of the Wildlife Society. 19 pp.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin and F.V. Paladino. 1996. Worldwide population decline of Dermochelys coriacea: Are leatherback turtles going extinct? Chelonian Conservation and Biology. 2(2):209-222.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 2000. Leatherbacks face extinction in the Pacific. Nature 405:529-530.

Stafford, K.M., S.L. Nieukirk, and C.G. Fox. 1999. An acoustic link between blue whales in the eastern tropical Pacific and the Northeast Pacific. Marine Mammal Science 15(4):1258-1268.

Stalmaster, M.V. 1987. The bald eagle. Universe Books, New York, New York.

Stebbins, R.C. 1966. A field guide to western reptiles and amphibians. Boston, MA: Houghton Mifflin Co. 279 pp.

Stephenson, M.D. 1977. Sea otter predation on Pismo clams in Monterey Bay. Calif. Fish and Game 63(2):117-120.

Stern, M.A., J.S. McIver, and G.A. Rosenberg. 1990. Investigations of the western snowy plover at the Coos Bay North Spit and adjacent sites in Coos and Curry Counties, Oregon, 1990. Report to Oregon Department Fish and Wildlife Nongame Program. 33 pp.

Stickel, L.F., and M.P. Dieter. 1979. Ecological and physiological/toxicological effects of petroleum on aquatic birds. FWS Biological Services Program. FWS/OBS-70-23.

Stewart, B.S., S.A. Karl, P.K. Yochem, S. Leatherwood, and J.L. Laake. 1987a. Aerial surveys for cetaceans in the former Akutan, Alaska, whaling grounds. Arctic 40:33-42

Stewart, B.S., P.K. Yochem, R.L. DeLong, and G.A. Antonelis, Jr. 1987b. Interactions between Guadalupe fur seals and California sea lions at San Nicolas and San Miguel Islands, California. *In*: Status, Biology, and Ecology of Fur Seals, J.P. Croxall, and R.L. Gentry (eds.). Proceedings of an International Symposium and Workshop, Cambridge, England, 23-27 April 1984. NOAA Technical Report NMFS 51. pp. 103-106.

Storer, T. I. 1925. A synopsis of the amphibia of California. University of California Publications in Zoology 27:1-342.

Straughn, D. 1971. Oil pollution and seabirds. Pp. 307-312 *in*: D. Straughn (ed.), Biological and oceanographical survey of the Santa Barbara Channel oil spill 1969-1970.

Thelander C.G. and M. Crabtree. 1994. Life on the edge: a guide to California's endangered natural resources. Biosystems Books, Santa Cruz, Ca. 550 pp.

Thompson, B.C., J.A. Jackson, J. Burger, L.A. Hill, E.M. Kirsch, and J.L. Atwood. 1997. Least tern (*Sterna antillarum*). *In* A. Poole and F. Gill, editors, The Birds of North America, No. 290. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC. 32 pp.

Tillman, M.F. 1975. Assessment of North Pacific stocks of whales. Marine Fisheries Review 37:1-4.

Tillman, M.F. 1977. Estimates of population size for the North Pacific sei whale. Rep. Int. Whal. Commn., Special Issue 1:98-106.

Titus, R.G., D.C. Erman, and W.N. Snider. In press. History and status of steelhead in California coastal drainages south of San Francisco Bay. Hilgardia.

Tomilin, A. G. 1967. Mammals of the USSR and adjacent countries. Vol. 9: Cetacea (Kitoobraznye). Israeli Program for Scientific Translation, Jerusalem. 717 pp.

Tønnessen, J.N., and A.O. Johnson. 1982. The history of modern whaling. University of California Press, Berkeley. 798 pp.

Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. Zoologica 19:1-50.

Trivelpiece, W.Z., R.G. Bulter, D.S. Miller, and D.R. Peakall. 1984. Reduced survival of chicks of oil-dosed adult leaches storm petrels. Condor 86:81-82.

Vandevere, J.E. 1969. Feeding behavior of the southern sea otter. *In*: Proc. 6th Annual Conf. On Biological Sonar and Diving Mammals. Stanford Res. Inst., Menlo Park, CA.

Van Horn, W., A. Melancon, and J. Sun (eds.). 1988. Outer Continental Shelf Oil and Gas Program: Cumulative Effects. U.S. Department of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 88-0005.

Van Wagenen, R.F., M.S. Foster, and F. Burns. 1981. Sea otter predation on birds near Monterey, California. Journal of Mammalogy 62(2):433-434.

Vargo, S., P. Lutz, D. Odell, E. Van Fleet, and G. Bossert. 1986. Study of the effect of oil on marine turtles. Final report to Minerals Management Service by Florida Institute of Oceanography. Contract No. 14-12-0001-30063.

Venoco, Inc. 2000. Development Plan Application for Full Field Development of the South Ellwood Field. Submitted to the California State Lands Commission and County of Santa Barbara Planning and Development Department, Energy Division. June 2000.

Wada, S. 1976. Indices of abundance of large-sized whales in the 1974 whaling season. Report of the International Whaling Commission 26:382-389.

Wade, L.S. 1975. A sea otter possibly feeding on Pismo clams. Journal of Mammalogy 56(3):720-721.

Walker, P.L., and S. Craig. 1979. Archeological evidence concerning the prehistoric occurrence of sea mammals at Point Bennett, San Miguel Island. California Fish and Game 65(1):50-54.

Warriner, J.S., J.C. Warriner, G.W. Page, and L.E. Stenzel. 1986. Mating system and reproductive success of a small population of polygamous snowy plovers. Wilson Bulletin 98:15-37.

Watkins, W.A. 1977. Acoustic behavior of sperm whales. Oceanus 20:50-58.

Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. Marine Mammal Science 2(4):251-262.

Webb, R.L. 1988. On the Northwest: Commercial whaling in the Pacific Northwest, 1790-1967. University of British Columbia Press, Vancouver. 425 pp.

Weber, D.D., D.J. Maynard, W.D. Gronlaund, and V. Konchun. 1981. Avoidance reactions of migrating adult salmon to petroleum hydrocarbons. Canadian Journal of Fisheries and Aquatic Sciences 38:779-781.

Wendell, F.E., J.A. Ames, and R.A. Hardy. 1984. Pup dependency period and length of reproductive cycle: estimates from observations of tagged sea otters, *Enhydra lutris*, in California. California Fish and Game. 70(2):89-100.

Wendell, F.E., R.A. Hardy, and J.A. Ames. 1985. Assessment of the accidental take of sea otters, *Enhydra lutris*, in gill and trammel nets. Unpubl. Report, Marine Resources Branch, California Department of Fish and Game. 30 pp.

Wendell, F.E., R.A. Hardy, J.A. Ames, and R.T. Burge. 1986. Temporal and spatial patterns in sea otter, *Enhydra lutris*, range expansion and in the loss of Pismo clam fisheries. California Fish and Game 72:197-212.

Westlake, R.L., W.L. Perryman, and K.A. Ono. 1997. Comparison of vertical aerial photographic and ground censuses of Steller sea lions at Año Nuevo Island, July 1990-1993. Marine Mammal Science 13(2):207-218.

Weston Solutions Inc., and Marine Research Specialists (MRS). 2006. Site-Specific Sulfide Criterion for Produced-Water Discharges at Five California OCS Platforms. Submitted to United States Environmental Protection Agency, Region IX (WTR-5) in support of General Permit No. CAG280000. April 25, 2006.

Whitehead, H., J. Gordon, E.A. Mathews, and K.R. Richard. 1990. Obtaining skin samples from living sperm whales. Marine Mammal Science 6(4):316-326.

Wilbur, S.R. 1974. The status of the light-footed clapper rail. American Birds 28:868-870.

Wild, P.W., and J.A. Ames. 1974. A report on the sea otter, *Enhydra lutris* L., in California. Marine Resources Tech. Rep. No. 20. Calif. Dept. Fish and Game. 93 pp.

Wilke, F., and K.W. Kenyon. 1952. Notes on the food of fur seal, sea lion, and harbor porpoise. Journal of Wildlife Management 16:396-397.

Williams, T.D. 1978. Chemical immobilization, baseline hematological parameters, and oil contamination in the sea otter. U.S. Marine Mammal Commission Report No. MMC-77/06. NTIS, Springfield, Virginia.

Williams, T.M. 1990. Evaluating the long term effects of crude oil exposure in sea otters: laboratory and field observations. *In* symposium, "The Effects of Oil on Wildlife," 13th Annual Conference of the International Wildlife Rehabilitation Council, Herndon, Virginia, October 17-18, 1990.

Williams, T.M., and R.W. Davis (eds.). 1995. Emergency care and rehabilitation of oiled sea otters: A guide for oil spills involving fur-bearing marine mammals. University of Alaska Press, Fairbanks, Alaska. 279 pp.

Wilson, D.E., M.A. Bogan, R.L. Brownell, Jr., A.M. Burdin, and M.K. Maminov. 1991. Geographic variation in sea otters, *Enhydra lutris*. Journal of Mammalogy 72(1):22-36.

Wilson, R. A. 1980. Snowy plover nesting ecology on the Oregon coast. M.S. thesis, Oregon State Univ., Corvallis.

Wolman, A.A. 1986. Humpback whale. Pp. 57-63 *in*: D. Haley (ed.), Marine mammals of eastern North Pacific and Arctic waters. Second Edition, Revised. Pacific Search Press.

Wolman, A.A, and D.W. Rice. 1979. Current status of gray whales. Rep. int. Whal. Commn. 29:275-279.

Wright, A. H., and A. A. Wright. 1949. Handbook of frogs and toads of the United States and Canada (third edition). Comstock Publishing Company, Ithaca, NY. 640 pp.

Wyrick, R.F. 1954. Observations on the movements of the Pacific gray whale *Eschrichtius glaucus* (cope.). Journal of Mammalogy 35:596-598.

Yochem, P.K., and S. Leatherwood. 1985. Blue whale *Balaenoptera musculus* (Linnaeus. 1758). Pp. 193-240 in: S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, Vol. 3, The sirenians and baleen whales. Academic Press, London.

Zembal, R., and S.M. Hoffman. 1999. Light-footed clapper rail management and study, 1999. Report to U.S. Fish and Wildlife Service and California Department of Fish and Game. 8 pp.

Zembal, R., B.W. Massey, and J.M. Fancher. 1989. Movements and activity patterns of the light-footed clapper rail. J. Wildl. Manage. 53:39-42.

Zembal, R., S. Hoffman, and J. Konecny. 2006. Status and Distribution of the Light-footed Clapper Rail in California, 2006. Submitted to CDFG and FWS by the Clapper Rail Recovery Fund. June 2006.

Zimmerman, S.T, C.S. Gorbics, and L.F. Lowry. 1994. Response activities. Pp. 23-45, *in*: T.R. Loughlin (ed.), Marine mammals and the *Exxon Valdez*. Academic Press, Inc.: San Diego, CA.

APPENDIX A:

TRANQUILLION RIDGE: LISTING OF FEDERALLY THREATENED AND ENDANGERED SPECIES

Federally Listed Species		
Species	**Status**	**Agency of Oversight**
Marine Mammals		
Blue Whale (E)	Endangered	NMFS
Humpback Whale (E)	Endangered	NMFS
Fin Whale (E)	Endangered	NMFS
Sei Whale (E)	Endangered	NMFS
Northern Right Whale (E)	Endangered	NMFS
Sperm Whale (E)	Endangered	NMFS
Steller Sea Lion (T)	Threatened	NMFS
Guadalupe Fur Seal (T)	Threatened	NMFS
Southern Sea Otter (T)	Threatened	USFWS
Birds		
California Brown Pelican (E)	Endangered	USFWS
California Least Tern (E)	Endangered	USFWS
Light-footed Clapper Rail (E)	Endangered	USFWS
Western Snowy Plover (T)	Threatened	USFWS
Bald Eagle (T)	Threatened	USFWS
Marbled Murrelet (T)	Threatened	USFWS
Reptiles		
Leatherback Sea Turtle (E)	Endangered	NMFS
Green Sea Turtle (E)	Endangered	NMFS
Pacific Ridley Sea Turtle (E)	Endangered	NMFS
Loggerhead Sea Turtle (E)	Endangered	NMFS
Amphibians		
California red-legged Frog (T)	Threatened	USFWS
Invertebrates		
White Abalone (E)	Endangered	NMFS
Fish		
Tidewater Goby (E)	Endangered	USFWS
Steelhead Trout (E)	Endangered	USFWS
Unarmored Threespine Stickleback (E)	Endangered	USFWS
Green Sturgeon (T)	Threatened	USFWS
Terrestrial Plants		
Salt Marsh Bird's-Beak (E)	Endangered	USFWS
California Sea-blite (E)	Endangered	USFWS

PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Supporting Information Volume
Essential Fish Habitat Assessment

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
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May 2008

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1.0 PURPOSE

Under Section 305 (b) (2) of the Magnuson Fishery Conservation and Management Act (16 U.S.C. 1801 *et seq*) as amended by the Sustainable Fisheries Act on October 11, 1996, Federal agencies are required to consult with the Secretary of Commerce on any actions that may adversely affect Essential Fish Habitat (EFH). The Department of Commerce published an interim final rule (50 CFR Part 600) in the Federal Register (December 19, 1997, Volume 62, Number 244) that detailed the procedures under which Federal agencies would fulfill their consultation requirements. As set forth in the regulations, EFH Assessments must include: 1) a description of the proposed action; 2) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species, and associated species by life history stage; 3) the Federal agency's views regarding the effects of the action on EFH; and 4) proposed mitigation if applicable.

Section 600.920 (h) describes the abbreviated consultation process the Minerals Management Service (MMS) is following for the proposed Tranquillon Ridge Unit development project described in the associated biological evaluation (MMS, 2006). The purpose of the abbreviated consultation process is to address specific Federal actions that may adversely affect EFH, but do not have the potential to cause substantial adverse impacts.

2.0 PROJECT DESCRIPTION

The Tranquillon Ridge Unit project is the proposed development and production of the Tranquillon Ridge Unit hydrocarbon reserves located within state waters (<3 miles from shoreline), in the southern Santa Maria Basin. Plains Exploration & Production Company (PXP) is requesting approval to drill up to 17 wells from the adjacent Point Pedernales Field Unit platform Irene (lease OCS-P 0441). Based on current data, PXP has estimated that up to 14 extended-reach wells and an additional 3 utility wells will be needed to develop the Tranquillon Ridge Field. Platform Irene is located immediately to the west of the unit. The development and production of the oil and gas reserves from the Tranquillon Ridge Field will be accomplished by drilling extended reach wells from the Platform Irene using existing well slots, pipelines, equipment and facilities. Only minor modifications to equipment and facilities will be necessary to handle the production under this proposal. In order to accommodate the oil and gas production from the Tranquillon Ridge Field, three existing 600-horsepower (hp) electrical shipping pumps on Platform Irene will be replaced with three 1,250-hp electrical shipping pumps. The Tranquillon Ridge wells will utilize a combination of electrical submersible pumps and gas-lift technology. The only additional equipment for drilling will be two new 1,600-horsepower electric pump for muds handling, as well as some refurbishing of the existing mud system.

All the production from the Tranquillon Ridge Field will be combined with the Point Pedernales Field oil and gas and transported to the Lompoc Oil and Gas Plant (LOGP) in the existing pipelines. From LOGP, the combined oil production from the Tranquillon Ridge Field and the Point Pedernales Field will be transported to the Santa Maria Refinery via pipeline. The combined gas production will either be sold and transported via pipeline or used as fuel at the LOGP.

The proposed drilling program sequence includes rig installation and necessary minor platform modifications (i.e., switch gear and electrical distribution), drilling and tripping operations, setting the well casing, well logging, and well completion and testing. Total well drilling and completion times are anticipated to range between 60 and 120 days (2 to 4 months) per well. PXP's project description anticipates that the first production well would be spudded during the third or fourth quarter of 2008, and that production would begin three to four months thereafter. Overall, drilling activities are projected to take 5 years, with production lasting up to 15 years from the time the first well is drilled.

The discharge of drilling muds to be used for the proposed Tranquillon Ridge Unit drilling program will comply with the National Pollution Discharge Elimination System (NPDES) General Permit currently in force (EPA 2000a, b). Under this discharge permit, Platform Irene is authorized to discharge up to 30,000 bbs of cuttings and 105,000 bbls of drilling fluid per year. In total, approximately 52,300 bbl of cuttings and 140,000 bbls of drilling fluids are expected to be discharged over the course of the 5-year drilling program for the proposed project (assuming all water based muds are used). It is possible that oil based muds may be used for drilling the longer portions of the wells, which would reduce the volume of muds and cuttings that would be discharged to the ocean. Any oil based muds or muds containing additives not approved by EPA, or containing additives in concentrations above EPA limits will be transported ashore for disposal.

Produced water from the proposed project would also be discharged in accordance with the existing NPDES General Permit. Under the permit, Platform Irene is authorized to discharge up to 55,845,000 bbls of produced water per year, which is an average of 50,000 barrels per day. Approximately 1.26 million gallons (40,000 barrels) per day (MGD) of water produced from Point Pedernales and Tranquillon Ridge combined will be shipped from the LOGP to Platform Irene for discharge. A part of the produced water that will be shipped to Platform Irene may still be injected into Point Pedernales reservoir wells, as is currently the operation. Offshore water injection will be conducted as authorized by the MMS.

PXP estimates that production of the Tranquillon Ridge Unit would begin three to four months after the first well is started. Production from the Tranquillon Ridge Field is estimated to peak at around 30,000 bbls/day of oil and 8 mmscfd of gas. With the proposed Tranquillon Ridge Project, overall production from Platform Irene will peak at around 36,000 bbls/day of oil and 10 mmscfd of gas. Under the proposal, production is expected to continue for 15 years from the time the first well is drilled.

The produced liquid from Platform Irene is a combination of crude oil, gas, and water. The gas exists as free gas or is in solution in the oil, and the water exists both as free water and emulsion in the oil. The liquid stream is transferred to the Lompoc Oil and Gas Plant (hereafter LOGP) through the existing 20-inch emulsion pipeline. Oil dehydration and gas processing will take place at the LOGP, as well as shipment of product for sale or further processing by pipeline to various refining destinations or LPG trucks.

A more detailed project description can be found in the Environmental Evaluation document.

3.0 MANAGED SPECIES

The Pacific Fishery Management Council (PFMC) manages over 90 species of fish under four Fishery Management Plans (FMPs): 1) Coastal Pelagics Fishery Management Plan; 2) Pacific Salmon Fishery Management Plan; 3) Pacific Groundfish Fishery Management Plan; and 4) Highly Migratory Species Fishery Management Plan (Table 3.1).

Table 3.1 Species Managed by the Pacific Fisheries Management Council

Coastal Pelagics Fishery Management Plan
- Northern Anchovy
- Pacific Sardine
- Pacific Mackerel
- Jack Mackerel
- Market squid
- Pacific herring
- Pacific saury
- Pacific bonito

Highly Migratory Species Fishery Management Plan
- Thresher shark
- Albacore tuna
- Broadbill swordfish

Pacific Salmon Fishery Management Plan
- Chinook Salmon
- Coho Salmon
- Pink Salmon

Pacific Groundfish Fishery Management Plan
- Butter sole
- Curlfin sole
- Dover sole
- English sole
- Flathead sole
- Petrale sole
- Rex sole
- Rock sole
- Sand sole
- Arrowtooth flounder

Groundfish cont.
- Starry flounder
- Pacific sanddab
- Ratfish
- Finescale codling
- Pacific rattail grenadier
- Leopard shark
- Soupfin shark
- Spiny dogfish
- Big skate
- California skate
- Longnose skate
- Kelp greenling
- Lingcod
- Cabezon
- Pacific cod
- Pacific whiting (hake)
- Sablefish
- Aurora rockfish
- Bank rockfish
- Black rockfish
- Black and Yellow rockfish
- Blackgill rockfish
- Blue rockfish
- Bocaccio
- Bronzespotted rockfish
- Brown rockfish
- Calico rockfish
- California Scorpionfish
- Canary rockfish
- Chilipepper rockfish
- China rockfish
- Copper rockfish
- Cowcod
- Darkblotched rockfish
- Dusky rockfish
- Dark rockfish

Groundfish cont.
- Flag rockfish
- Gopher rockfish
- Grass rockfish
- Greenblotched rockfish
- Greenspotted rockfish
- Greenstriped rockfish
- Harlequin rockfish
- Honeycomb rockfish
- Kelp rockfish
- Longspine thornyhead
- Mexican rockfish
- Olive rockfish
- Pacific ocean perch
- Pink rockfish
- Quillback rockfish
- Redbanded rockfish
- Redstripe rockfish
- Rosethorn rockfish
- Rosy rockfish
- Rougheye rockfish
- Sharpchin rockfish
- Shortbelly rockfish
- Shortraker rockfish
- Shortspine thornyhead
- Silvergray rockfish
- Speckled rockfish
- Splitnose rockfish
- Squarespot rockfish
- Starry rockfish
- Stripetail rockfish
- Tiger rockfish
- Treefish
- Vermilion rockfish
- Widow rockfish
- Yelloweye rockfish
- Yellowmouth rockfish
- Yellowtail rockfish

Of these, slightly over 40 species were identified as regularly present near oil platforms on the southern California OCS. Most of these species were groundfish, dominated by Sebastes (rockfish), which are managed by the Pacific Groundfish Management Plan. The remaining species were Coastal Pelagic Species, namely, Pacific sardine, jack mackerel, and the northern anchovy.

The marine environment offshore Point Pedernales is especially rich in fish species because this area constitutes a transition zone between southern warm-temperate, subtropical waters and northern cold-temperate waters. The area also provides a wide variety of habitats created by many banks, ridges, and deep-sea basins. Nearly all of the species managed by the council can be found within the project area during their life cycle. Therefore, this analysis will be broad in scope and will discuss the effects of the identified impacting sources on a wide range of fish prey and forage, fish habitats, and fish species.

4.0 POTENTIALLY SIGNIFICANT IMPACT SOURCES

Offshore exploration, development, and production of natural gas and oil reserves have been, and continue to be, an important aspect of the U.S. economy. Projections indicate that U.S. demand for oil will increase by 1.3 percent per year between 1995 and 2020 while gas consumption is projected to increase by an average of 1.6 percent during the same time frame (Waisley 1998). As the demand for energy resources continues to grow, striking an appropriate balance between the development of oil and gas resources and adequate protection of the environment becomes harder to achieve.

Three potential impacting sources associated with the routine operations of the proposed Tranquillon Ridge development project have been identified: 1) Noise and disturbance; 2) Effluent discharges; and 3) Oil spills.). A summary description of each impacting source is included in the following section. A detailed description of each of these sources can be found in the Biological Assessment, which is part of the supporting information volume.

5.0 IMPACTS TO EFH

5.1 Noise and Disturbance

There is a long historic record of human awareness that fish produce and use sounds in a wide variety of behaviors (see Moulton 1963). However, studies of fish hearing and sound production (bioacoustics), and the importance of sounds to the lives of fish, were not begun until the early part of the 20th century (Moulton 1963 and Tavolga 1971). The level of investigation into fish hearing and sound production increased considerably in the second half of the 20th century (Zelick et al. 1999; Popper et al. 2003; Ladich and Popper 2004). We now know that fishes, as with most vertebrates, glean a great deal of information about their environment from the general sound field. Whereas visual signals are very important and useful for things near the animal and in the line of sight, substantial information about the unseen part of an animal's world comes from acoustic signals.

Hearing and detection of vibrations are the best-developed senses in most fish, making good use of the efficient propagation of low frequency sound through water. The main sensory organs involved in this process are the lateral-line system, which detects low-frequency (<100 Hz) particle motion in the water contacting the flanks of the fish, and the inner ear, which is sensitive to frequencies of up to 1-3 kHz. The inner ear is thought to be the main sensory organ involved, while the lateral line organ is almost certainly involved in acoustic repulsion when the sound source is close at hand (within a few body lengths of the fish) such as when fish are seen schooling. The inner ear, which lies within the skull of the fish is sensitive to vibration rather than sound pressure. In teleost species (bony fishes) possessing a gas-filled swimbladder, this organ may also act as a transducer that converts sound pressure waves to vibrations, allowing the fish detect sound as well as vibration.

Not surprisingly, sensitivity to sound differs among fish species based on the level of development of their swimbladder and its connection to the inner ear. Species with little or no swim bladder, or one that is not well connected to the ear generally have relatively poor auditory sensitivity (auditory generalists) and usually cannot hear sounds at frequencies above 1 kHz (See Table 5.1). Swim bladders in auditory generalists (e.g. elasmobranchs, flatfish) do not appear to aid significantly in hearing (Popper et al. 2003). In contrast, other fishes have swim bladders that are connected directly to the inner ear (e.g. herring, smelt), which substantially increases their hearing sensitivity (auditory specialists). Most hearing specialists can hear sounds up to around 3 kHz.

Table 5.1 Ambient Ocean Noise Sources in the SB Channel and Fish Auditory Thresholds

Noise Source	Frequency (Hertz)	Pressure (dB re 1 μPA)
Ambient Ocean Noise		
Wind and waves	200–1000	66–95
Precipitation	>500	
Biological (shrimp, fish, mammals)	12–100,000	95–210
Baleen whales	20–20,000	150–190
Platform Operations	~ 5	119–127
Vessel Traffic		
Outboards and small boats	~100–1,000	150–160
Vessels 180 to 280 ft (55 to 85m) in length	<100–500	170–180
Large container ships/supertankers	<100–500	185–200
Helicopter traffic	~<100–500	150-165
Fish Hearing Thresholds		
Hearing generalists	up to ~1,000	–
Hearing specialists	up to ~3,000	–
Lateral line sensitivity	~ ≤100	–

Note: dB re 1 μPa (decibels measured relative to one microPascal) is a measure of underwater sound pressure. 20 dB re 1 μPa is about the hearing threshold, while 140 dB re 1 μPa is the pain threshold. dB re 1 $\mu Pa^2/Hz$ is a measure of sound-pressure density per unit frequency. It is used to describe sounds distributed across broad frequency bands.

Noise sources associated with the proposed Tranquillon Ridge development project may generate sound pressure that can disrupt or damage marine life, including fishes. Additionally, increasing levels of background noise may also have a negative effect on fish. It has been well documented in the mammalian literature that temporary threshold shifts reach an asymptote after a specific duration of noise exposure. However, recent studies have shown that similar shifts occur in fish, with hearing specialists more greatly affected by background noise exposure than hearing generalists (Smith et al 2004).

Four noise and disturbance sources associated with the proposed project have been identified: offshore drilling, and offshore production, vessel traffic, and aircraft traffic. However, the sound levels produced by these sources are unlikely to impact EFH.

Noise associated with conventional drilling platforms is relatively unstudied. Richardson et al. (1995) cite only one example of recorded noise from drilling platforms off the California coast (Gales 1982), which resulted in auditory levels that were nearly undetectable even alongside the platforms. No sound levels were computed, but the strongest received tones were very low frequency, below approximately 5 Hz. Therefore, no impacts to EFH are expected from this source.

Likewise, although development of the Tranquillon Ridge Unit will almost double the number of daily helicopter flights to Platform Irene (increasing from a current average of 3.2 up to 6.0 one-way flights per day) during drilling, during normal operations the total annual number of helicopter trips will increase only slightly and there will be no daily increase. Regardless, aircraft noise is not expected to impact EFH.

The rotors are the primary sources of sound from helicopters (Richardson et al., 1995). The rotation rate and the number of blades determine the fundamental frequencies which are usually below 100 Hz, with most dominant tones below 500Hz (see Table 5.1). Richardson et al. (1995) present an estimated source level for a Bell 212 helicopter of about 150 dB at altitudes of 150-600 m, with the dominant frequency a 22-Hz tone with harmonics. Elsewhere a source level of 165 dB is presented for broadband helicopter noise (frequencies 45-7070 Hz).

Finally, the drilling rig, heavy drilling equipment, rig supplies, and bulk drilling mud and cement materials for the project will be transported to Platform Irene by supply boat from Port Hueneme. Vessels are the major contributors to overall background noise in the sea (Richardson et al., 1995). Sound levels and frequency characteristics are roughly related to ship size and speed. The dominant sound source is propeller cavitation, although propeller "singing," propulsion machinery, and other sources (auxiliary, flow noise, wake bubbles) also contribute. Vessel noise is a combination of narrowband tones at specific frequencies and broadband noise (See Table 5.1). Richardson et al. (1995) give estimated source levels of 156 dB for a 16-m crew boat (with a 90-Hz dominant tone) and 159 dB for a 34-m twin diesel (630 Hz, 1/3 octave). Broadband source levels for small, supply boat-sized ships (55-85 m) are about 170-180 dB. Most of the sound energy produced by vessels of this size is at frequencies below 500 Hz. Many of the larger commercial fishing vessels that operate off southern California fall into this class.

Except during drilling rig installation and removal, vessel traffic to and from Platform Irene is projected to consist of 1 to 2 supply boat trips per month. During drilling rig installation and removal, supply boat trips can increase to a maximum of 1 trip every 3 days. Manpower requirements and boat schedule can vary depending on the workload. Following the drilling activities, supply vessel traffic is expected to return to current baseline levels. Therefore, no adverse effects to EFH are expected from the slight increase in vessel traffic that would occur with the proposed project.

5.2 Effluent Discharges

Under Section 402 of the Clean Water Act, the Environmental Protection Agency (EPA) is authorized to issue National Pollutant Discharge Elimination System (NPDES) permits to regulate the discharges of pollutants to waters of the U.S., the territorial sea, contiguous zone, and ocean. The use of the General Permit streamlines the permitting process for facilities that are not anticipated to significantly affect marine environments. In 2000, EPA prepared an EFH assessment for the re-issuance of a NPDES General Permit for offshore oil and gas facilities in southern California (SAIC, 2000c). The overall conclusions of the EFH assessment were that the continued discharge from the 22 platforms offshore California will not adversely affect EFH outside the mixing zones, described as a 100 m radius from the discharge point. Within the 100 m radius mixing zone, discharges from oil and gas exploration, development, and production may have localized effects on water quality and resident marine organisms, including EFH and fish. The assessment further concluded that while there may be effects on EFH from certain discharges such as drilling fluids and produced water within the mixing zone near an outfall, these effects should be minor overall given the very small area which may be affected relative to the size of the EFH off the Pacific Coast, and the mitigation provided by the various effluent limitations proposed for the permit.

EPA provided a copy of the assessment to the National Marine Fisheries Service (NMFS) to initiate the consultation. As a result of the consultation, the NPDES Genera Permit incorporated a requirement that the permittees conduct a study of the direct lethal, sublethal, and bioaccumulative effects of produced water on federally managed fish species on the Pacific OCS at key life stages that occupy the mixing zone of produced-water discharges. The permit further requires that the permittees model results describing the dilution and dispersion plumes from each point of discharge of produced water (for all platforms covered by the permit) to determine the extent of the area in which federally managed fish species may be adversely affected. The permit also requires the permittees to propose mitigation measures if either of the studies indicates substantial adverse effects to federally managed fish species or EFH occur.

In response, a single comprehensive report was submitted by the permittees (MRS 2005). It provided a detailed quantitative assessment of potential impacts from produced-water discharges on federally managed fish species from each of the California OCS dischargers, including Platform Irene. Although maximum contaminant concentrations beyond the 100-m mixing zone are usually well within NPDES permit limits, the study focused on the toxicity and bioaccumulation potential of produced-water discharges to the fish populations that reside within the 100-m mixing zone beneath the platforms. These fish populations consist mostly of rockfish that utilize the platform as habitat, rarely venturing far from the protection of the structure. Consequently, contaminant concentrations at locations 100-m from the platform have little bearing on the potential impacts experienced by these fish.

Nevertheless, the quantitative exposure assessment found a general absence of impacts from most of the major produced-water constituents. Many of the produced-water constituents that are normally of concern for the protection of marine organisms were below biological effects levels prior to discharge. Four constituents had end-of-pipe concentrations that were slightly elevated in produced water compared to thresholds of potential effects in finfish. However, the produced-water discharges achieve high dilution almost immediately upon discharge. As a result, the plume volumes containing concentrations of potential biological significance were exceedingly small compared to the volume of habitat contained within the mixing zones. In September 2005, EPA concurred with the overall conclusions of the study and forwarded them to NMFS as part of the EFH consultation required by the General Permit. In October 2005, NMFS notified EPA that the study met the intent of the conservation recommendations incorporated in the General Permit and that the EFH consultation was complete.

In contrast to the other constituents, the quantitative assessment could not rule out the possibility of potential chronic effects on federally managed finfish due to exposure to undissociated sulfide in produced water discharged at Platform Irene. However, the likelihood of an actual substantive adverse impact on federally managed finfish was thought to be minimal because there were several significant limitations associated with the sulfide assessment which resulted in an unduly conservative evaluation of finfish exposure.

In particular, the screening study included:

1) an unrealistically low effects threshold for sulfide,
2) a low predicted dilution rate for the original conceptual design of a produced-water diffuser on Platform Irene,
3) high variability among sulfide concentrations initially measured in produced-water samples,

4) contaminant concentrations in historical produced-water samples from Platform Irene that did not reflect potential benefits from future enhanced treatment,
5) no consideration of physicochemical degradation in sulfide introduced into oxygenated seawater, and
6) no consideration of potential finfish avoidance arising from the sulfide astringency.

Currently, produced-water discharges from all the California OCS platforms are being evaluated as part of the reasonable-potential phase of the General Permit. As part of this analysis, contaminant concentrations measured in produced-water samples from individual platforms are being evaluated for their potential to exceed receiving-water limitations at the edge of the 100-m mixing zone. A number of the limitations in Platform Irene's sulfide analysis are being resolved as part of the reasonable-potential analysis. This includes consideration of significantly enhanced dilution resulting from a new diffuser design and a more realistic threshold for sulfide effects.

Depending on the outcome of the reasonable-potential analysis, produced water from Platform Irene could also be treated to reduce contaminant concentrations prior to discharge. Produced water is not currently discharged from Platform Irene, and, because it is normally re-injected, it receives little or no additional treatment to reduce contaminant concentrations. Before discharge on a regular basis, its quality could be significantly improved by extensive treatment within upgraded treatment facilities both on the platform and within an onshore treatment facility. Upgrades to the onshore treatment facilities have been approved but have yet to be installed. Consequently, the sulfide concentrations historically measured in the Platform-Irene samples are not representative of future marine discharges. Also, because there are only a few sulfide measurements overall, the elevated Platform-Irene samples are highly influential in the determination of the median and 95th-percentile concentrations. Both are much higher than would be characteristic of future produced-water discharges.

Insofar as limitations in the sulfide effects threshold, an extensive series of bioassay analyses recently established a revised criterion for undissociated sulfide that is applicable to marine organisms near Platform Irene (Weston Solutions Inc. and MRS 2006). The threshold determined in this updated analysis was six-times higher than the EPA National Standard that is currently promulgated in the General Permit. The original criterion was developed using an extremely limited number of dated bioassay studies, conducted primarily on freshwater organisms, or on organisms exposed to sulfides in a complex chemical mixture. Because sulfide toxicity is closely related to the physicochemical properties of water, particularly pH and salinity, the freshwater data can greatly overestimate toxicity.

Thus, even without additional treatment of produced-water, potential impacts to finfish within the 100-m mixing zone around Platform Irene are not likely to be significant. The indeterminacy in potential sulfide impacts that was identified in the original screening study can be largely eliminated through consideration of the increased dilution rate achieved by a redesigned diffuser, and consideration of the higher effects threshold for finfish. With a dilution rate comparable to most other California OCS platforms, the computed contaminant concentrations will be well below the sulfide effects threshold within approximately 8 m of the discharge point and would impact only a small fraction of the receiving-water habitat around Platform Irene. It is highly unlikely that finfish would encounter this limited area on a regular basis, especially considering that they exhibit a strong avoidance reaction to sulfide (EPA 1976, 1986).

5.3 Oil Spills

Risk Analysis. The following is a summary of the risk analysis associated with the proposed Tranquillon Ridge project. See Appendix B for the complete risk analysis of an oil spill associated with the proposed project.

In the course of normal, day-to-day platform operations, occasional accidental discharges of hydrocarbons may occur. However, such accidents are typically limited to discharges of quantities of less than 1 bbl of crude oil. Between 1969 and 1999, 836 spills of less than 50 bbl (99 percent of the total) occurred on the Pacific OCS, resulting in slightly less than 320 bbl of oil being discharged into the ocean. Due to the infrequency and small volumes of these accidental discharges, and their location (generally away from sensitive species), spills of less than 50 bbl were not considered an impact-producing agent for this evaluation. In contrast to these small spills, larger oil spills may occur from loss of well control (if wells are free flowing), pipeline breaks, operational errors, or vessel-platform collisions. However, only 5 of the 45 spills of greater than 1 bbl measured 50 bbl or more in volume (Table 5.1 in Appendix B); the largest of these was the 163-bbl Platform Irene pipeline spill in September 1997.

On that occasion, a rupture in the Torch pipeline from Platform Irene to the shoreline occurred releasing an estimated 162 to over 1,242 bbls (26 to 197+ m^3) of crude oil (Santa Barbara County 2001). The rupture resulted in the oiling of approximately 40 miles (64 km) of coastline, stretching from the northern end of Minuteman Beach to Boat House in Santa Barbara County. Approximately 100 acres (40 hectares) of sandy beach were disturbed by oiling and cleanup operations. In addition, another 263 acres (106 hectares) of sandy beach were very lightly oiled (less than or equal to 10 percent oiling by area), but were relatively undisturbed by heavy equipment during cleaning operations (OSPR 1999).

The oil spill risk analysis predicts that over the 15-year life of the proposed project there is a 55-percent chance that one or more spills between 50 to 1,000 bbl in size could occur. For the purposes of the Biological Evaluation (MMS 2006), MMS assumed that one spill of greater than 50 bbl could occur over the life of the project. An effort was also made to estimate the likely size of such a spill. The MMS's U.S. Oil Spill Database (C. Anderson, unpubl. data) includes Pacific and Gulf of Mexico OCS spills of greater than 1.5 bbl recorded between 1971 and 1999. The database contains platform and pipeline spills, but no barge or tanker spills. Of the 2,125 total spills in the database, 106 are in the range of 50-999 bbl. The mean volume of these spills is 158.6 bbl, and 65 percent (79) are of less than 200 bbl. More than 95 percent (101) are of less than 500 bbl. Given these data and the experience in the Pacific Region over the last 30 years (Table 5.1 of the Biological Evaluation), MMS expects that such a spill would probably be less than 200 bbl, and almost certainly less than 500 bbl in volume.

MMS also has estimated the number of oil spills of equal to or greater than 1,000 bbl that could occur as a result of the proposed action. The major spill (≥1,000 bbl) estimate is based on the estimated production of oil over the life of the proposed project, including the subsea pipeline transport of hydrocarbons to shore. Based on the MMS Accident Spill Rates from all U.S. platforms and pipelines (Anderson and LaBelle, 1994; Anderson, 2000, unpubl.), the estimated probability that one or more large spills (≥1,000 bbl) will occur over the lifetime of the project is 17 percent.

Federal regulations concerning oil spill response plans for OCS facilities require operators to calculate worst-case discharge volumes using the criteria specified in 30 CFR §254.47. These include 1) the maximum capacity of all oil storage tanks and flow lines on the facility, 2) the volume of oil calculated to leak from a break in any pipelines connected to the facility, and 3) the daily production volume from an uncontrolled blowout of the highest capacity well associated with the facility. Since these are worst-case estimates, intended to insure that an operator has the capacity to respond to the largest imaginable spills, they are based on unlikely events.

This is particularly true of the estimates for the first and third spill types described above. A catastrophic event would be required to empty all storage tanks and flow lines on the production platform. Similarly, with the implementation of modern blowout prevention equipment, operating procedures, and the MMS inspection program, blowouts have become rare. As discussed above, no blowout resulting in the release of measurable quantities of oil has occurred on the Pacific OCS since the 1969 Santa Barbara spill. In the Gulf of Mexico, with much greater levels of OCS activities, no blowout since 1970 has spilled more than about 60 bbl of oil (C. Anderson, unpubl. data).

Thus, the MMS estimates that the most likely maximum size of a major oil spill from the Tranquillon Ridge Unit development is the maximum volume of oil calculated to be spilled from a break in the Irene to shore oil/emulsion pipeline at the pipeline shoreline location, about 0.25 miles from the shoreline. This is estimated to be 6,718, or approximately 6,700 bbl of oil (MRS 2002 FEIR). Although more than double the 2,100 bbl estimated for the 2000 Rocky Point Field development, this figure remains substantially less than the 7,600 bbl calculated for the 1984 Point Arguello Field EIR/EIS (A.D. Little, 1984). The most likely scenario, however, as discussed above, is that one or more oil spills in the 50-1,000-bbl range would occur over the life of the proposed project (with an approximately 55 percent chance of occurrence), and that such a spill or spills would be less than 200 bbl in volume.

Fate and Effects. When an oil spill occurs, many factors determine whether that oil spill will cause heavy, long lasting biological damage; comparatively little damage or no damage; or some intermediate degree of damage. Among these factors are the type, rate, and volume of oil spilled, geographic location, and the weather and oceanographic and meteorological conditions at the time of the spill. These parameters determine the quantity of oil that is dispersed into the water column; the degree of weathering, evaporation, and dispersion of the oil before it contacts a shoreline; the actual amount, concentration, and composition of the oil at the time of shoreline or habitat contact; and a measure of the toxicity of the oil. Additionally, the level of oil spill preparedness, rapidity of response, and the cleanup methods used can also greatly influence the overall impact levels of an oil spill.

A spill of 200 bbl could oil several kilometers of coastline along the south-central California coast. The likely result would be patches of light to heavy tarring of the intertidal zone resulting in localized changes to the community structure. The recovery time for these communities would depend on the environment. High energy rocky coast will be mostly self-cleaned within several months, while low energy lagoons and soft-sediment embayments can retain stranded oil residue for several years. The same impacts would be expected from a 6,700-bbl oil spill, but would be spread over a substantially larger area.

Oil in the marine environment can, in sufficient concentrations, cause adverse impacts to fish (NRC, 1985; GESAMP, 1993). The effects can range from mortality to sublethal effects that inhibit growth, longevity, and reproduction. Benthic macrofaunal communities can be heavily impacted, as well as intertidal communities that provide food and cover for fishes.

The field observations of an oil spill's impacts on the marine environment are taken mostly from very large oil spills that have occurred throughout the world over the past three decades. There is a 55 percent chance that one or more oil spills greater than 50 bbl could occur over the 15 year life of the proposed Tranquillon Ridge development project. In perspective, the *Exxon Valdez* spilled about 36,000 tonnes (~270,000 bbl) of crude oil into Prince William Sound and the *Sea Empress* released 72,000 tonnes (~540,000 bbl) of crude oil off southwest Wales. The *American Trader* spilled about 416,000 gallons (~10,000 bbl) of crude oil offshore Huntington Beach, California. Most recently, in September 1997, a rupture in a 20-inch offshore pipeline emanating from Platform Irene resulted in the discharge of at least

6,846 gallons (163 bbl) of crude oil off the Santa Barbara coast. The spill resulted in the fouling of approximately 17 miles of coastline, and caused impacts to a variety of natural resources, including seabirds, sandy and gravel beach habitats, rocky intertidal shoreline habitats, and use of beaches for human recreation.

Fishes. Fish can be affected directly by oil, either by ingestion of oil or oiled prey, through uptake of dissolved petroleum compounds through the gills and other body epithelia, through effects on fish eggs and larval survival, or through changes in the ecosystem that supports fish. Although fish can accumulate hydrocarbons from contaminated food, there is no evidence of food web magnification. Fish have the capability to metabolize hydrocarbons and can excrete both metabolites and parent hydrocarbons from the gills and the liver (NRC, 1985). Nevertheless, oil effects in fish can occur in many ways: histological damage, physiological and metabolic perturbations, and altered reproductive potential (NRC, 1985). Many of these sublethal effects are symptomatic of stress and may be transient and only slightly debilitating. However, all repair or recovery requires energy, and this may ultimately lead to increased vulnerability to disease or to decreased growth and reproductive success.

The egg, early embryonic, and larval-to-juvenile stages of fish seem to be the most sensitive to oil. Damage may not be realized until the fish fails to hatch, dies upon hatching, or exhibits some abnormality as a larva, such as an inability to swim (Malins and Hodgins, 1981). There are several reasons for this vulnerability of early life stages. First, embryos and larvae lack the organs found in adults that can detoxify hydrocarbons. Second, most do not have sufficient mobility to avoid or escape spilled oil. Finally, the egg and larval stages of many species are concentrated at the surface of the water, where they are more likely to be exposed to the most toxic components of an oil slick.

Although sensitivity is demonstrated in laboratory studies, only in a few instances have adverse effects been observed on fish following major oil spills. Examples include the *Florida* spill off West Falmouth, Massachusetts, and the *Amoco Cadiz* spill off the coast of Brittany. In both cases, sublethal effects on fish were documented. In the *Florida* spill, killifishes from contaminated marshes had a lower rate of lipogenesis than their counterparts from uncontaminated sites (Sabo and Stegeman, 1977). In the *Amoco Cadiz* spill, a large number of histological abnormalities were noted in estuarine flatfish (*Pleuronectes platessa*) (Haensly et al., 1982). However, according to Straughan (1971), there were no indications of fish kills or other evidence of effects on fishes from the Santa Barbara Channel blowout in 1969.

More recently, the *Exxon Valdez* oil spill (~270,000 bbl) provides several examples of how oil affects fish. For the sensitive stages of fish (eggs, larvae, and juveniles) the spill could not have occurred at a worse time. Pacific herring spawned along the shores of Prince William Sound within weeks of the *Exxon Valdez* oil spill in March 1989, resulting in increased egg mortality and larval deformities. Also, fry from pink salmon emerged from their gravel spawning redds and entered the nearshore marine environment during the spill. Site-specific occurrences of instantaneous mortality suggest that a significant reduction in herring larval production occurred because of the oil spill (Brown et al.,1996). Brown et al. (1996) estimated that over 40 percent of the 1989 year-class was affected by *Exxon Valdez* oil at toxic levels. The herring population in Prince William Sound also suffered heavy losses in 1993 due to disease. However, it is not known what role, if any, exposure to oil may have played in the disease outbreak; natural variability and density-dependent effects could not be ruled out as the cause of the small year-class and disease. Despite the reduction in larval production, reduced abundance in the 1989 year-class recruiting as 4-year old adults in 1993 could not be determined because natural processes affecting herring recruitment are poorly understood (Brown et al., 1996).

Pink salmon, Dolly Varden, sockeye salmon, and cutthroat trout exposed to oil from the *Exxon Valdez* spill all showed reduced growth rates the season following the oil spill even though changes in food availability were not detected (Spies, 1996). Pink salmon also showed increased egg mortality in oiled-versus-unoiled streams through the 1993 season (Rice et al., 1996). Exposure to oil was documented by oil in the stomachs of salmon fry, measurements of polynuclear aromatic hydrocarbons (PAH) in salmon fry, and by increases in P450 and bile hydrocarbon metabolites in Dolly Varden (*Salvelinus malva*) (Spies, 1996). Geiger et al. (1996) estimated that 1.9 million adult pink salmon failed to return to Prince William Sound in 1990, primarily because of a lack of growth in the critical nearshore life stage when they entered seawater in spring 1989 during the height of the spill. By 1991, 60,000 wild adult pink salmon failed to return. In perspective, in the years preceding the oil spill, returns of wild pink salmon in Prince William Sound varied from a maximum of 23.5 million fish in 1984 to a minimum of 2.1 million in 1988. The decade preceding the oil spill was a time of very high productivity for pink salmon in the sound, and, given the tremendous natural variation in adult returns, it was impossible to measure directly the extent to which wild salmon returns since 1989 were influenced by the oil spill. Based on intensive studies and mathematical models following the oil spill, researchers determined that wild adult pink salmon returns to the sound's Southwest District in 1991 and 1992 were most likely reduced by a total of 11 percent (EVOSTC, 1999).

In 1990, after the *American Trader* spilled 416,000 gallons (~10,000 bbl) of North Slope crude oil offshore Huntington Beach, California, oil stranded along 22 km of coastline (Gorbics et al., 2000). The natural resource trustees (representatives from USFWS, CDFG, and NOAA) determined that post larval juvenile white sea bass were adversely impacted by the oil. Specifically, 10-15mm juvenile fish were killed by oil when it mixed with drift algae found near the surf line. The drift algae found in this area are the normal habitat for juvenile white sea bass and other croakers during and after the time of the spill (Gorbics et al., 2000).

Despite the fact that laboratory experiments and field observations indicate that fish are susceptible to adverse effects from hydrocarbons, with the exception of the *Exxon Valdez* and *American Trader* oil spills, direct impacts on fishery stocks have rarely been observed following catastrophic spills. This is due in part to the complexities involved with the natural process of recruitment, which produces tremendous natural variations in year-class abundance that bear little relation to the size of the parent stock. Thus, any impacts from catastrophic oiling on fish stocks are probably masked by the natural variations in abundance. Also, massive fish kills during oil spills have not occurred, or if they have it is only in the egg and larval stages found in the surface waters.

An estimated 40 to 50% of the egg biomass of the Pacific herring (*Clupea pallasi*) deposited within Prince William Sound was exposed to oil during developmental stages (Brown et al., 1996). The resulting 1989 year class of herring showed sublethal effects such as premature hatch, low weights, reduced growth, and increased morphologic and genetic abnormalities (Brown et al., 1996). The 1989 year class recruiting as 4-year old adults in 1993 was one of the smallest cohorts observed in Prince William Sound, and it returned to spawn with an adult herring population that was reduced by approximately 75% (Brown et al., 1996).

Adult fish, due to their mobility, may be able to avoid or minimize exposure to spilled oil. However, there is no conclusive evidence that fish will avoid spilled oil (NRC, 1985). One of the worst spills in recent times, the tanker *Sea Empress*, released 72,000 tonnes (~540,000 bbl) of crude oil and 480 tonnes (~4000 bbl) of fuel oil into the sea off Milford Haven waterway in southwest Wales on February 15, 1996. Oil came ashore along 200 km of coastline, much of it in a National Park and an area of international scientific interest. The *Sea Empress* Environmental Evaluation Committee, an independent committee set up by the UK government, reported that "Although tissue concentrations of oil components increased temporarily in some fish species, most fish were only affected to a small degree, if at all, and very few died" (SEEEC 1998). The study found that about 40% of the oil evaporated soon after the spill and around 52% dispersed into the water where it was broken down by microorganisms. Surveys at sea showed that the oil was not deposited in sediments in significant quantities. Between 5% and 7%

(~36,000 bbl) of the oil stranded on shore; however, one year after the spill less than 1% remained on the shore.

Although many factors contribute to the overall impacts realized from an at-sea oil spill, fish are generally not adversely impacted at the population level. Given the high energy and high productivity environment of the Point Pedernales area, the common meteorological and oceanographic conditions, and the oil spill preparedness and response capabilities in place, direct measurable effects to any fish stock abundance from a 200 bbl oil spill off the coast of Point Pedernales, California are unlikely.

Food Web and Habitat. Fish can also be affected indirectly by oil through changes in the ecosystem that supports fish. In simplistic terms, this ecosystem would include all prey species and habitats the fish use during all life stages.

Perhaps the most important food on which all fish rely during their larval and juvenile stages is plankton. In general, the studies to date indicate that zooplankton are more susceptible to effects from oil spills than are phytoplankton. Even if a large number of algal cells were affected during a spill, regeneration time of the cells (9-12 hours), together with the rapid replacement by cells from adjacent waters, probably would obliterate any major impact on a pelagic phytoplankton community (NRC, 1985). After the *Tsesis* spill in the Baltic Sea, there was a decrease in zooplankton in the vicinity of the wreck. The quantity of phytoplankton increased briefly and it was concluded that the change was due to a decrease in the amount consumed by zooplankton. Similar results have been obtained in long-term oiling experiments. Individual organisms in oil spills have been affected in a number of ways: direct mortality (fish eggs, copepods, mixed plankton), external contamination by oil (chorion of fish eggs, cuticles and feeding appendages of crustacea), tissue contamination by aromatic constituents, abnormal development of fish embryos, and altered metabolic rates (Longwell, 1977; Samain et al., 1980). The effects appear to be short-lived and there are seldom prolonged changes in biomass or standing stocks of zooplankters in open water near spills, due largely to their wide distribution and rapid regeneration (Van Horn et al., 1988). During the *Exxon Valdez* spill, Celewycz and Wertheimer (1996) studied the impact of the spill on zooplankton and epibenthic crustaceans, potential prey species of pink salmon. They did not detect any reduction in abundance of either zooplankton or epibenthic crustaceans between oiled and non-oiled locations in either 1989 or 1990.

Intertidal and subtidal macrophytes provide shelter and food for fish and for fish prey species at various life stages along the northern Santa Barbara County coast. The habitats involved here include both high energy rocky shorelines, sand and cobble beaches, and the nearshore subtidal environment. Intertidally, the red alga *Endocladia muricata* and the brown alga *Pelvetia* spp. are species common to the area, as is surf grass (*Phyllospadix spp.)*. Giant kelp, *Macrocystis pyrifera* is common to the nearshore subtidal area. Intertidal macrophytes seem to be more vulnerable to oiling than subtidal macrophytes. Losses of intertidal algal cover have been described after several spills. However, recovery appears to occur quite readily (Topinka and Tucker, 1981), though imbalances in the macrophyte community can persist for years. The proliferation of opportunistic intertidal algal species after a spill is invariably a direct result of the elimination, by the oil, of naturally occurring grazers--limpets and other intertidal herbivores (NRC, 1985). Little evidence exists that kelp is harmed by oil (MMS, 1992).

An oil spill of 200 bbl would probably result in light to heavy tarring of the intertidal zone if oceanographic conditions carried the oil to shore. For comparison, following the Torch spill (163 bbl) at Point Arguello, just north of the Boat House, large amounts of fresh oil and tar were observed on rocks throughout the middle to lower intertidal zone. “Sticky globs of tar were seen on black abalone and seastars. Tar covered the respiratory pores of some abalone. Based on these observations, some mortality may have occurred” (Raimondi et al., 1999, OSPR, 1998). Impacts to intertidal macrophytes would be minimal and patchy over an estimated 10 km or less of shoreline. Raimondi (1998) reported that species abundance at two research sites within the exposure zone of the 163 bbl Irene pipeline spill showed no significant changes that could be attributed to the oil spill. Barnacle abundance at one site decreased in the Fall 1997 and Spring 1998 surveys, however no fresh tar or oil was observed at the site. In Spring 1998 surveys, the same site also showed decreases in mussels and surf grass cover, but these impacts were attributed to the effects of strong El Nino enhanced storms that ravaged the site in January and February of 1998. No measurable impacts would be expected to subtidal macrophytes from a 200 bbl oil spill.

Fluctuations of benthic and intertidal invertebrate populations may affect the fishes that normally feed on them. Considerable work has been done studying the effects of oil on macroinvertebrates. Most susceptible are those species inhabiting the intertidal zone, especially those found in lagoons, embayments, estuaries, marshes, and tidal flats. This risk derives from two factors: high oil concentrations and shallow depth of the water column. Aside from the physiologically toxic effect, intertidal organisms may be entrapped or suffocated by oil. In fact, a major impact of the *Sea Empress* spill was to the intertidal invertebrate community. Heavy limpet mortalities were recorded, and periwinkles and topshells died, though in lesser numbers. Amphipod mortalities were extensive, although substantial recolonization was evident at most sites one year later (SEEEC, 1998). Gorbics et al. (2000) reported that overall mortality of bean clams as a result of the *American Trader* spill (~10,000 bbl of crude oil) in February 1990 was estimated to be 24 percent. Sand crabs showed an increase in the body burden of aliphatic hydrocarbons until June 1990. It can be assumed that the oil from the *American Trader* that stranded along 22 km of coastline near Huntington Beach resulted in a significant increase in the mortality of intertidal invertebrates (Gorbics et al., 2000).

It can take several years for limpet and other mollusc populations to recover completely at heavily impacted sites. A 200-bbl oil spill off Pedernales Point that contacted shore would likely result in mortality to various intertidal macroinvertebrates, including barnacles, limpets, mussels, starfish, anemones, and black abalone. Smothering would be the most common cause of mortality and would be limited to direct contact with weathered tar balls from the oil spill. After the 163 bbl Irene pipeline spill in September 1997, sand crabs within the spill zone showed significant hydrocarbon contamination (J. Dugan, UCSB, pers. com.). Sand crabs are an important component of the diet of several fishes. Though fish can metabolize hydrocarbons they accumulate, this process requires energy and may lead to an increased vulnerability to disease and decreased growth or reproductive success. Since sand crabs were contaminated after the oil spill, one can also assume that other invertebrates such as myssids, amphipods, and polychaetes were also affected.

Coastal and offshore waters and benthic subtidal environments are important habitat for all of the fish species managed by the PFMC (Table 1). The coastal and offshore waters are any areas seaward of the low tide level and include bays, open coastal waters, and the deep ocean. Oil spills in the open ocean do not appear to have as severe an effect on the biota as oil in coastal water or in the shore zone (NRC, 1985). This may be due to the fact that the shore zone and coastal waters are subject to serious effects from chronic pollution and an oil spill in this area is impacting a stressed environment. Benthic subtidal environments may be impacted when oil spilled onto the surface of the water column is transferred to bottom sediments through sorption on clay particles and subsequent sinking, sinking of dead organisms, uptake and packaging as fecal pellets by zooplankton, or direct mixing to the bottom in shallow water. This may impact fish both directly and indirectly. After the *Tsesis* oil spill, herring reproduction was significantly reduced in the spill area. Nellbring et al. (1980) reported that the reduced reproduction was due to a decrease in amphipod populations that graze on fungi growing on the fish eggs, leaving the eggs susceptible to fungal damage. Oiling of the sediments following the *Amoco Cadiz* spill had deleterious effects on plaice and sole, including reduced growth and increased incidence of fin and tail rot (Conan and Friha, 1981). In fact, flatfish may be particularly susceptible, since they spend a considerable amount of time lying on the bottom or even partially buried in the sediments.

Conclusion. An evaluation of the literature reveals that oil spills can cause mortality and sublethal effects on fish at all life stages, their prey, and their habitat. However, whether or not these impacts result in measurable adverse effects on essential fish habitat is more difficult to determine. In 1985, a National Research Council committee found "no irrevocable damage to marine resources on a broad oceanic scale" as a result of oil pollution from either chronic, routine sources or from occasional major spills. At the same time, however, it cautioned that further research is needed before an unequivocal assessment of the environmental impact of oil pollution can be made, particularly as it applies to specific locations and conditions. The size of the oil spills that were analyzed in the NRC study, and on which the above statement was made, ranged from 5,000 tons (~38,000-bbl) spilled from the tanker *Zoe Colocotroni* to 223,000 tons (~1.7 million-bbl) spilled from the tanker *Amoco Cadiz*.

Based on the amount of oil that would be handled from the Tranquillon Ridge Unit reserves, an oil spill risk analysis predicts there is a 55 percent chance that a 50 to 1000-bbl oil spill could occur over the projected 15 year life of the proposed project. As discussed earlier, an effort also was made to estimate the likely size of such a spill. Given the national oil spill data collected from the Gulf of Mexico and Pacific Region OCS programs over the last 30 years, MMS expects that such a spill would probably be less than 200 bbl. However, given the location, normal meteorological and oceanographic conditions, and oil spill response capabilities of the area, minimal adverse effects are expected to EFH from an oil spill this size. Any direct mortalities to fish would probably occur only in the egg and larval stages found in the surface waters in the immediate vicinity of the spill. Depending on the oceanographic conditions at the time of the spill, some oiling of the intertidal zone along the south central California coast or the northern Channel Islands is expected. Under normal conditions for the area, significant mixing and weathering of the oil would evaporate much of the toxic light-end hydrocarbons into the atmosphere, disperse the oil into the water column, and likely break the slick into smaller patches. The weathered tar balls would likely cause some mortality to intertidal macrophytes and invertebrates through smothering. Elevated hydrocarbon levels in nearshore invertebrates would be likely, leading to increased stress and potential decreases in growth and reproduction in fish feeding upon the invertebrates. These effects are expected to be short-term under normal conditions; however, oil may become sequestered in the sediments of low-energy embayments and persist for several years.

In the event of a larger spill, including a ≥1000-bbl oil spill, for which there is a 17 percent probability of occurrence, impacts to EFH would likely be similar to those of a 200 bbl spill. Direct mortalities to fish would still likely be limited to the egg and larval stages found in the nearby surface waters; however, the spatial extent of the spill would likely be much greater and affect a larger area of ocean surface and coastline which could affect more shallow benthic habitats.

6.0 CUMULATIVE IMPACTS

The three impacting sources identified for the proposed project are: noise and disturbance, effluent discharges, and oil spills. Of these three sources, only the increased risk of an oil spill associated with the proposed project would substantially add to, or interact with, effects from related or unrelated actions or projects. This cumulative impact analysis is based on the fact that the proposed project would occur from existing facilities, which were previously evaluated in the Point Arguello Field and Gaviota Processing Facility Area Study and Chevron/Texaco Development Plans EIR/EIS (ADL, 1984) and the ESA Section 7 consultation for Point Arguello (FWS, 1984a; NMFS, 1984). Although the proposed project will fall within the approved level of activity scheduled to occur at platform Irene, and will not add spatially to the impacts caused by effluent discharges, noise and disturbance sources that were scheduled to occur and are covered under permits at platform Irene, it will substantially extend the productive life of the Point Pedernales facilities.

Table 6.1 Cumulative Offshore Energy Projects (Non-federal)

#	Project, Applicant	Description	Status
1	Ellwood Full Field Development, Venoco	Oil and Gas Development Project	Under Review
2	Ellwood Marine Terminal Lease Renewal, Venoco	Oil Transportation	Under Review
3	Resumption of State Lease PRC-421, Venoco	Oil and Gas Development Project	Under Review
4	Carpinteria Field Development, Carone	Oil and Gas Development Project	Under Review
5	Paredon Project, Venoco	Oil and Gas Development Project	Under Review

Table 6.1 has identified five similar non-Federal projects that are reasonably likely to occur and will be considered in the cumulative effects analysis. These actions include activities that could produce impacts on EFH in the project area during the expected life of the Tranquillon Ridge Unit development project (approximately 15 years). These projects include development of State leases from Platform Hogan, the development of the Paredon field, and three proposed options for modification and upgrades to platform Holly and the associated onshore Ellwood facilities. These five proposed projects would slightly increase the risk of an oil spill occurring. All five proposed projects are expected to occur from existing facilities and within the levels of activity planned and analyzed for the facilities. Thus, none of the proposed projects would add to the impacts caused by effluent discharges, and noise and disturbance sources that were scheduled to occur are covered under permits at platforms Grace, or Holly.

Ellwood Full Field Development, Venoco. Platform Holly is located in State waters approximately 4 km (2.4 mi) southwest of Coal Oil Point, in the Santa Barbara Channel. This project would extend the boundaries of State lease PRC 3242.1 eastward, while lease 3120.1 would be extended south to the state water's three-mile limit to facilitate oil and gas extraction from Platform Holly. The project would move gas processing offshore to platform Holly, remove the Ellwood marine terminal, and develop the South Ellwood Field using extended-reach drilling technology from platform Holly. No new or modified subsea pipelines would be constructed. If approved, the project is anticipated to have a peak oil production rate of 12,600 bopd and a peak gas production rate of 20 MMscfd after five years (SBC, 2006a). The project is currently undergoing an environmental review. If approved construction would be expected to begin in 2008 to 2009.

Up to 40 new wells would be drilled using an electric drill rig. Twenty of the wells would be drilled between 2008 and 2015, with approximately two mechanical replacement wells drilled per year thereafter. Platform Holly does not discharge effluents. All fluids and cuttings produced on the platform are disposed of down an offshore well or in an approved onshore disposal site. Additionally, Platform Holly is served by a crew boat that transports personnel and supplies from the Ellwood pier. The proposed project is not expected to alter the current boat traffic load to and from platform Holly. Thus, no cumulative noise and disturbance impacts to EFH are expected from this project.

Removal of the offshore components of the Ellwood marine terminal will involve a small number of vessels working along the shoreline. The removal process, including pipeline flushing and abandonment, and removal of the mooring equipment will last about 9 weeks. Venoco, Inc. will conduct surveys to verify the absence of sensitive marine habitats (hard bottom, eelgrass, kelp, surfgrass) in the offshore work area. Removal of the marine terminal loading line and moorings will be conducted in a manner that avoids potential impacts to these resources, if present.

Development of the South Ellwood Field would cause a slight increase in spill risk. However, the removal of the Ellwood marine terminal would outweigh any spill risk due to the South Ellwood Field development. Current marine terminal operations involve the transfer of up to 55,000-bbl of oil from onshore tanks via a subsea pipeline to a barge for shipment to refineries in the Los Angeles area. This process, which takes approximately 17 hrs, occurs every 5-12 days. The currently proposed Ellwood full field development project would eliminate the risk of an oil spill from the marine terminal.

Ellwood Marine Terminal Lease Renewal, Venoco. Venoco is currently seeking approval from the CSLC for a new Sate Lease (PRC-3904.1) through February 28, 2013. This would allow Venoco to continue operating the existing Ellwood Marine Terminal located offshore the City of Goleta and lands under the ownership of the University of California, Santa Barbara (CSLC 2006). The proposed project does not include the construction of any new facilities or the modifications to existing facilities; however, it does include the potential for increasing the crude oil throughput and transportation from current levels to permitted levels (CSLC, 2006). A draft EIR has been issued for the project and the public review has been completed, the EIR is currently being finalized. This project has the potential to increase the likelihood of an oil spill along the south-central California coast along the barge routes to Los Angeles and San Francisco.

Resumption of State Lease PRC-421, Venoco. In May 2004, Venoco proposed to bring two idle Coastal Zone oil production wells within State Lease PRC-421 back into production. The wells are located in the City of Goleta on two adjacent piers. Pier 421-1 supports an idled water and gas injection well, while Pier 421-2 supports an idled oil production well. Venoco proposes to install new production equipment and reactivate the oil well on Pier 421-2, and reactivate the injection well on Pier 421-1 for disposal of wastewater and natural gas (SBC 2006b). Based upon current projections, the estimated life of the proposed project would be twelve years of oil production; production would be expected to be no more than 700 bopd in the first year, tapering off to approximately 100 bopd by year 12 (CSLC, 2005). The proposed project is currently under review, and would marginally increase the likelihood of an oil spill off the south-central California coast.

Carpinteria Field Development Project, Carone and POOI. This project includes directional drilling from Platform Hogan into existing State Leases PRC-4000, PRC-7911, and PRC-3133. The applicant has proposed to drill up to 25 wells (CSLC, 2006). Estimated peak production from Platform Hogan would increase to approximately 6,000 bopd and 6 MMscfd of gas after the first six years of production, and then would decline. The project would be expected to have a 12 year economic life. The resulting oil and gas production will be sent to La Conchita Facility for processing via the existing pipelines.
This project would result in increased spill risks near the platforms. Oil and gas produced from this project would flow through submerged pipelines to the CPF.

The project has undergone partial environmental analysis. The environmental analysis determined that the structural integrity of Platform Hogan needs to be verified to determine if the platform is capable to support a drilling rig needed to accomplish this project. Therefore, the project is on hold until such determination is completed. If the structural integrity is not adequate, some construction work may be required at Platform Hogan to reinforce the platform's structure. The timing of the project is unknown at this time.

The Paredon Prospect Development, Venoco. This project aims to conduct extended reach drilling from an onshore operations site located at Venoco's existing CPF, located on the coast in the City of Carpinteria, in southern Santa Barbara County. The Proposed project would develop and produce oil and gas from hydrocarbon-bearing reservoirs (the Paredon Prospect) lying primarily offshore of the Carpinteria area in State Leases PRC 3150 and PRC 3133. The Paredon Prospect is estimated to contain recoverable reserves of approximately 23.5 million barrels of oil and 43 billion standard cubic feet of natural gas. Although all of the drilling and construction for this project would occur from the CPF, and land this project has a limited potential to spill oil to the marine environment in the event of a well blow out or frac-out, or in the event of a pipeline break.

Oil and Gas Development. There are a total of 79 OCS oil and gas leases (43 producing leases and 36 non-producing leases) offshore of Southern California. Offshore oil and gas reserves are harvested via the 23 existing oil and gas platforms in Federal waters and 4 platforms in State waters offshore southern California. The cumulative effects of these structures and development activities on the OCS can be found in numerous reports, and environmental documents (MMS 1992, MMS 1995, MMS 1996). The proposed Tranquillon Ridge development project would add substantially to the overall oil spill risk associated with ongoing OCS oil and gas activities in the Pacific Region (MMS, 1996). The proposed Platform Holly/Ellwood, and Paredon projects would add smaller increments to the overall oil spill risk offshore southern California based on their smaller recovery volumes.

Production from these leases is expected to continue for the next five to 20 years. The Minerals Management Service (MMS) currently has no proposals for decommissioning offshore facilities. These leases were acquired between 1968 and 1982 but never developed primarily due to delays by Federal regulators, the State's environmental and safety concerns, in addition to increased power to assess the effects of oil drilling, and various lawsuits. In November 2005 a Federal judge ordered the U.S. government to repay $1.1 billion to the oil and gas companies that hold these leases but have been unable to develop them. The oil and gas companies have said that they will give back the leases once they receive the $1.1 billion settlement and additional related costs.

Other Activities. NMFS (1998a,b) has identified several fishing and non-fishing activities that may cause adverse impacts to EFH along the Pacific Coast. These include dredging and discharge of dredged material, water intake structures, aquaculture, wastewater discharge, oil and hazardous waste spills, coastal development, agricultural runoff, commercial marine resource harvesting, and commercial fishing. Most of these activities occur throughout the California, Oregon, and Washington coastal habitat and all of these activities and impacting agents exist in the southern California coastal zone. As a result, marine water quality has been impacted by municipal, industrial, and agricultural waste discharges and runoff in much of the Southern California Bight (MMS, 1992).

The water quality from the Point Conception area north and offshore the Channel Islands remains good. This area is very productive and is important habitat for many of the species covered under the Coastal Pelagics Fishery Management Plan (FMP), Highly Migratory Species FMP, Pacific Salmon FMP, and the Groundfish FMP. An oil spill would impact the water quality of this habitat. Although only minimal adverse impacts to fish populations and their prey species would be likely result from such an event, EFH in the Southern California Bight is already stressed due to overfishing, and degraded water quality in estuaries south of Point Conception. Degradation of the water quality north of Point Conception due to an oil spill would cause further stress to EFH. However, impacts to water quality from an open ocean spill would be short-term and not expected to last more than several days.

7.0 MITIGATION

The mitigation measures and stipulations for the proposed Tranquillon Ridge Unit development project will not be finalized until the revised Development and Production Plan is approved.

MMS has met the applicable recommended conservation measures for oil and gas production described in Amendment 11 to the Groundfish Fishery Management Plan and in Amendment 8 to the Coastal Pelagics Fishery Management Plan. This includes containment equipment and sufficient supplies to combat spills on-site at Platform Irene. All offshore facilities are covered by oil spill response plans that are revised semi-annually.

Additionally, MMS places mitigation measures and conditions of approval on all OCS activities when appropriate. MMS monitors all lease operations to ensure that industry is in compliance with relevant requirements. This includes conducting scheduled and unscheduled inspections of facilities, and scheduled and unscheduled oil spill drills. The MMS Pacific OCS Region also has a rigorous pipeline inspection program in place. Appendix B describes in detail the oil spill prevention and response programs in place for the Pacific Region and includes a description of MMS Pacific Region's platform inspection and oil spill drill program, pipeline inspection program, and the oil spill response and cleanup capabilities of the area.

8.0 CONCLUSIONS

Under routine operations adverse impacts associated with the proposed project are not expected to EFH identified in the Coastal Pelagics FMP, Highly Migratory Species FMP, Salmon FMP, or the Groundfish FMP. Specifically, the proposed project would occur from existing facilities and will fall within the level of activity already planned to occur at Platform Irene. Thus, the proposed project will not add to the impacts (spatially) caused by effluent discharges and noise and disturbance that were scheduled to occur, were analyzed in prior environmental documents, and are covered under permits at platform Irene. Although the proposed project will extend the productive life of the Point Pedernales facilities, the level of operation will not substantially alter, and, therefore, no temporal impacts to EFH are expected either.

Under upset conditions, the proposed development of the Tranquillon Ridge Unit using extended reach drilling technology may cause minimal to moderate adverse impacts on EFH if an oil spill associated with the project was to occur. It is estimated that there would be a 55 percent chance of one or more oil spills between 50 and 1000 bbl occurring due to the proposed development of the Tranquillon Ridge reserves. However, such a spill would be less than 200 bbl based upon historical data. Minimal adverse impacts to EFH are expected from a spill this size if the spill were to contact land. Given the dynamic environment of the south-central coast, such a spill, while likely having a greater spatial footprint, would still likely result in only minimal to moderate adverse impacts on EFH.

Additionally, ten years ago, extended reach drilling from platform Irene to the Tranquillon Ridge Unit reserves would not have been feasible. The only option available to the leaseholder at that time would have required construction and placement of a new platform structure to develop the Tranquillon Ridge reserves at much greater environmental risk and damage.

9.0 REFERENCES

Anderson, C.M., and R.P. LaBelle. 1994. Comparative occurrence rates for offshore oil spills. Spill Science & Technology Bulletin 1(2):131-141.

Arthur D. Little, Inc. (ADL). 1984. Point Arguello Field and Gaviota Processing Facility Area Study and Chevron/Texaco Development Plans EIR/EIS (and appendices). Prepared for County of Santa Barbara, Minerals Management Service, California State Lands Commission, California Coastal Commission, and California Office of Offshore Development.

Brown, E.D., T.T. Baker, J.E. Hose, R.M. Kocan, G.D. Marty, M.D. McGurk, B.L. Norcross, and J. Short. 1996. Injury to the early life history stages of Pacific herring in Prince William Sound after the *Exxon Valdez* oil spill. *In*: S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright, eds., Proceedings of the *Exxon Valdez* Oil Spill Symposium, American Fisheries Society Symposium 18. Bethesda, Maryland, pp. 448-462.

Celewycz, A.G., and A.C. Wertheimer. 1996. Prey availability to juvenile salmon after the *Exxon Valdez* oil spill. In S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright, eds., Proceddings of the *Exxon Valdez* Oil Spill Symposium, American Fisheries Society Symposium 18. Bethesda, Maryland, pp. 564-577.

Conan, G., and M. Friha. 1981. Effets des pollutions par les hydrocarbures du petrolier *Amoco Cadiz* sur la croissance des soles et des plies dans l'estuaire de l'Aber Benoit, pp. 749-773. In G. Conan et al., eds. *Amoco Cadiz*: Consequences d'une pollution accidentelle par les hydrocarbures. CNEXO, Paris.

United States Environmental Protection Agency (EPA). 1976. Quality Criteria for Water. US Environ. Protection Agency Rep. PB 263-943.

—. 1986. Quality Criteria for Water. US Environ. Protection Agency Rep. 440/5-86-001.

—. 2000a. Fact Sheet: Proposed National Pollutant Discharge Elimination System ("NPDES") General Permit No. CAG280000 for Offshore Oil and Gas Exploration, Development and Production Operations off Southern California. July 18, 2000.

—. 2000b. General NPDES Permit Number CAG280000. Authorization to Discharge under the National Pollutant Discharge Elimination System For Oil And Gas Exploration, Development, And Production Facilities. December 2000.

Exxon Valdez Oil Spill Trustee Council (EVOSTC). March 1999. *Exxon Valdez* Oil Spill Restoration Plan, Update on Injured Resources and Services. Anchorage, Alaska, 28pp.

FWS. 1984. Formal Section 7 Endangered Species consultation on offshore oil and gas development and production in the Point Arguello Field and the Gaviota Processing Facility, Santa Barbara County, California (1-1-84-F-22). To Minerals Management Service, Reston, VA, from U.S. Fish and Wildlife Service, Portland, OR, October 31, 1984.

Ford, R.G. 1985. Oil slick sizes and length of coastline affected: A literature survey and statistical analysis. Final report prepared by Ecological Consulting for U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, CA. Contract No. 14-12-0001-30224. MMS OCS Study 85-0105. 34 pp.

Geiger, H.J., B.G. Bue, S. Sharr, A.C. Wertheimer, and T.M. Willette. 1996. A life history approach to estimating damage to Prince William Sound pink salmon caused by the *Exxon Valdez* oil spill. In S.D. Rice, R.B. Spies, D.A. Wolfe, and B.A. Wright, eds., Proceddings of the *Exxon Valdez* Oil Spill Symposium, American Fisheries Society Symposium 18. Bethesda, Maryland, pp. 487-498.

GESAMP (Group of Experts on the Scientific Aspects of Marine Pollution). 1993. Impact of oil and related chemicals on the marine environment. Reports and Studies No. 50. International Maritime Organization, London, 180+ix pp.

Gorbics, C., P. Kelly, and M. Devany. 2000. Draft Restoration Plan and Environmental Assessment for seabirds injured by the *American Trader* oil spill. USFWS, Carlsbad, California. 38pp.+appendices.

Ladich, F., and Popper, A. N. 2004. "Parallel evolution in fish hearing organs." In Evolution of the Vertebrate Auditory System, edited by G. A. Manley, A. N. Popper, and R. R. Fay (Springer-Verlag, New York), 98-127.

Longwell, A.C. 1977. A genetic look at fish eggs and oil. Oceanus 20:45.

Malins, D.C., and H.O. Hodgins. 1981. Petroleum and Marine Fishes: A Review of Uptake, Disposition, and Effects. Environmental Science and Technology, 15(11):1272-1280.

Marine Research Specialists (MRS). 2005. The Effect of Produced-Water Discharges on Federally Managed Fish Species along the California Outer Continental Shelf. Submitted to: Western States Petroleum Association June 29, 2005.

Minerals Management Service (MMS). 1992. Proposed comprehensive Outer Continental Shelf natural gas and oil resource management program for 1992-1997. Environmental Impact Statement. MMS 92-0004.

MMS. 1995. Outer Continental Shelf natural gas and oil resource management program: Cumulative Effects 1987-1991. MMS 95-0007.

MMS. 1996. Final Environmental Impact Statement, Outer Continental Shelf Oil & Gas Leasing Program: 1997-2002. U.S. Department of the Interior, Minerals Management Service, Herndon, VA.

MMS. 2000. Biological Evaluation of the Proposed Rocky Point Unit Development Project. Pacific OCS Region.

Moulton, J. M. 1963. Acoustic behaviour of fishes. In Acoustic Behaviour of Animals, edited by R.-G. Busnel. Elsevier, Amsterdam. pp. 655-693.

National Marine Fisheries Service (NMFS). 1984. Endangered Species Act, Section 7 Consultation—Biological opinion and statement regarding incidental taking for operations pertaining to the development and production of oil and gas offshore California between Point Arguello and Point Conception. Prepared for the Minerals Management Service, Washington, D.C., by the National Marine Fisheries Service, Washington, D.C., May 31, 1984.

NMFS. 1998a. Essential Fish Habitat, West Coast Groundfish. http://swr.ucsd.edu/hcd/grndfish.pdf. 45pp.

NMFS. 1998b. Essential Fish Habitat, Coastal Pelagic Species. http://swr.ucsd.edu/hcd/cpsefh.pdf. 39pp.

Nellbring, S., S. Hannson, G. Aneer, and L. Weshn. 1980. Impact of oil on local fish fauna, pp. 193-201. In Kineman, Elmgren, and Hannson, eds. The *Tsesis* Oil Spill. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Rockville, Maryland.

NRC (National Research Council). 1985. Oil in the Sea: Inputs, Fates, and Effects. National Academy Press, Washington, DC. 601+xviii pp.

Popper, A.N., Fewtrell, J., Smith, M.E. and McCauley, R.D. 2004. Anthropogenic sound: Effects on the behavior and physiology of fishes. Marine Technology Society Journal, 37(4): 35-40. (1)

Raimondi, P.T. 1998. Monitoring of Rocky Intertidal Resources along the Central and Southern California Mainland, Part II Section 4.0: 1997 Torch Oil Spill. OCS Study MMS 99-0032. 22 pp.

Rice, S.D., R.B. Spies, D.A. Wolfe, and B.A. Wright, eds. 1996. Proceedings of the *Exxon Valdez* Oil Spill Symposium, American Fisheries Society Symposium 18. Bethesda, Maryland.

Samain, J.F., J. Moal, A. Coum, J.R. Le Coz, and J. Y. Daniel. 1980. Effects of the *Amoco Cadiz* oil spill on zooplankton: A new possibility of ecophysiological survey. Helgolander Meeresunters. 33:225-235.

Science Applications International Corporation (SAIC). 2000a. Biological assessment for endangered species in outer continental shelf waters of south and central California for consultation with the National Marine Fisheries Service. Submitted to U.S. Environmental Protection Agency Headquarters, Washington, D.C., and Region 9, San Francisco, CA. Reston, VA, and Santa Barbara, CA. EPA Contract No. 68-C4-0034, WA No. IM-5-30. 35 pp.

SAIC. 2000b. Biological assessment for endangered species in outer continental shelf waters of south and central California for consultation with the United States Fish and Wildlife Service. Submitted to U.S. Environmental Protection Agency Headquarters, Washington, D.C., and Region 9, San Francisco, CA. Reston, VA, and Santa Barbara, CA. EPA Contract No. 68-C4-0034, WA No. IM-5-30. 29 pp.

SAIC. 2000c. Essential Fish Habitat assessment for re-issuance of NPDES general permit for oil and gas production platforms off the California coast. Submitted to U.S. Environmental Protection Agency, Region 9, San Francisco, CA. EPA Contract No. 68-C4-0034, WA No. IM-5-30(P).

SEEEC (*Sea Empress* Environmental Evaluation Committee). 1998. The environmental impact of the *Sea Empress* oil spill. The Stationery Office, UK.

Smith, M.E., Kane, A.S., and Popper, A.N. 2004. Acoustical stress and hearing sensitivity in fishes: Does the linear threshold shift hypothesis hold water? J. Exp. Biol. 207:3591-3602.

Tavolga, W. N. 1976. "Acoustic obstacle detection in the sea catfish (Arius felis)." In Sound Reception in Fish, edited by A. Schuijf, and A. D. Hawkins. Elsevier, Amsterdam, pp. 185-204.

Topinka, J.A., and L.R. Tucker. 1981. Long-term oil contamination of fucoid macroalgae following the *Amoco Cadiz* oil spill. *In*: Conan et al., eds., *Amoco Cadiz*: Consequences dune pollution accidentelle par les hydrocarbures. CNEXO, Paris. pp. 393-404.

Van Horn, W., A. Melancon, and J. Sun (eds.). 1988. Outer Continental Shelf Oil and Gas Program: Cumulative Effects. U.S. Department of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 88-0005.

Weston Solutions Inc., and Marine Research Specialists (MRS). 2006. Site-Specific Sulfide Criterion for Produced-Water Discharges at Five California OCS Platforms. Submitted to United States

Environmental Protection Agency, Region IX (WTR-5) in support of General Permit No. CAG280000. April 25, 2006.

Whiting Petroleum Corporation. 2000. Rocky Point Unit Development, Volume 2 – Environmental Evaluation. Submitted to Minerals Management Service, Pacific OCS Region. July 14, 2000. 113 pp. + attachments.

Zelick, R., Mann, D., and Popper, A. N. 1999. "Acoustic communication in fishes and frogs." In Comparative Hearing: Fish and Amphibians, edited by R. R. Fay and A. N. Popper, Springer-Verlag, New York, pp. 363-411.

PXP

Plains Exploration & Production Company

Revisions to the Point Pedernales Field DPP
Tranquillon Ridge Field

Supporting Information Volume
Coastal Zone Consistency Analysis and Findings

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Plains Exploration & Production Company

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COASTAL ZONE CONSISTENCY ANALYSIS AND FINDINGS FOR THE DEVELOPMENT OF THE TRANQUILLON RIDGE FIELD

The oil and gas reserves from the Tranquillon Ridge Field will be developed from the existing Point Pedernales platform—Platform Irene. The only modifications that would be required would be the replacement of three 600-hp electrical shipping pumps with three 1,250-hp electrical shipping pumps; possible installation of submersible pumps on some of the new wells; and installation of a 1,600-hp electric pump for muds handling. Electrical transformer and switchgear upgrades will be ongoing.

All of the wells will be directionally drilled using existing well slots on the platforms. Drilling of the Tranquillon Ridge wells is expected to last five years with production lasting 15 years.

Plains Exploration & Production Company (PXP), operator of the Point Pedernales project, is proposing to drill development wells from Platform Irene. The proposal is to drill a maximum of seventeen wells (14 producing and 3 injection wells). However, it should be noted that the number of wells needed to develop the reserves on the Tranquillon Ridge Field will not be known until the first few development wells have been completed, placed on production, and evaluated.

All the production from the Tranquillon Ridge Field will be combined with the Point Pedernales Field oil and gas and transported to the Lompoc Oil and Gas Plant (LOGP) in the existing pipelines. From LOGP, the combined oil production from the Tranquillon Ridge Field and the Point Pedernales Field will be transported to the Santa Maria Refinery via pipeline. The combined gas production will either be sold and transported via pipeline or used as fuel at the LOGP.

In brief, the development and production of oil and gas reserves from the Tranquillon Ridge Field will be accomplished by drilling extended reach wells from the existing Platform Irene using existing wells slots, pipelines, equipment and facilities. The total number of wells drilled for the Point Pedernales Field and the Tranquillon Ridge Field will be less than the number of wells originally anticipated and approved for the Point Pedernales Field alone.

The proposed development activities for the Tranquillon Ridge Field, which are described in detail in the Revisions to the Point Pedernales Field Development and Production Plan (DPP) and the Supporting Information Volume, are consistent with the policies of the California Coastal Management Program. The proposed activities will be conducted in a manner to ensure conformity with that program. The development of the Tranquillon Ridge Field will use existing onshore and offshore facilities. This will ensure minimum impact on the environment while producing a needed domestic energy source. Each of the applicable California Coastal Zone Management Plan policies, as set forth in the California Coastal Act, are hereinafter stated and evaluated relative to the development activities proposed for the Tranquillon Ridge Field.

Based upon the evaluation included in this document, along with the information presented in the DPP revision document and the supporting information, the proposed development activities complies with the State of California's approved coastal management program and will be conducted in a manner consistent with such program.

Section 30211-PUBLIC ACCESS

Development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization, including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation.

Assessment
Development of the Tranquillon Ridge Field will not involve the construction of any new onshore or offshore facilities that would interfere with the public's right of access to the sea. The drilling and operational phases of the project would increase local road traffic but would not change the Level of Service (LOS) of any roadways. None of the trucking activities to Port Hueneme will interfere with the public's right of access to the sea.

Finding
The proposed project would not provide new public access, nor will it interfere with existing access. The proposed project is consistent with this section of the Coastal Act because the project will not interfere with the public's right to access.

Section 30230-MARINE RESOURCES; MAINTANANCE, and 30231-BIOLOGICAL PRODUCTIVITY; WASTE WATER

30230. Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economical significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

30231. The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface waterflow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.

Assessment
The entire Santa Barbara Channel and Santa Maria Basin area contains a large number of important marine resources. The Marine Biology Section of the October 2006 Tranquillon Ridge EIR describes in detail the seabirds, marine mammals, fish resources, and other flora and fauna of the area.

The development of the Tranquillon Ridge Field will not require any new offshore structures or facilities. The development will occur from the existing Point Pedernales Platform (Platform Irene). This Platform has had a moderate biological impact, creating additional habitat and a localized increase in the number of fish and other marine organisms. The marine resources that have been documented at Platform Irene is discussed in the Marine Biology Section of the October 2006 Tranquillon Ridge EIR. The presence of Platform Irene has resulted in increased fish production and this effect is considered to be beneficial.

The development of the Tranquillon Ridge Field will not result in any increase in sanitary waste discharges or brine from the desalinization unit. Both of these discharges are subject to and comply with the existing EPA NPDES permit conditions. All discharge points on the Outer Continental Shelf are located further than 3,280 feet (1,000 m) seaward of the State 3-mile (5 km) boundary and will not affect the water quality or biological productivity of the State's waters.

The development of the Tranquillon Ridge Field may result in additional produced water discharges at Platform Irene. Currently produced water from Platform Irene is reinjected into the onshore Lompoc Oil Field and the offshore Point Pedernales Field. However, Platform Irene holds a valid NPDES permit that allows for the ocean discharge of produced water. In the future, produced water could be ocean discharged from Platform Irene in accordance with their existing NPDES permit. The volume of produced water associated with the Tranquillon Ridge Field will be no greater than the volume of produced water currently being produced by production from the Point Pedernales Field. The peak produced water production from the Point Pedernales Field is projected to be approximately 85,000 bbls per day. With the development of the Tranquillon Ridge Field the projected peak produced water production from Platform Irene is not expected to exceed 85,000 bbls per day. With the proposed project a maximum of 40,000 bbls per day of produced water would be returned to Platform Irene for injection or ocean disposal.

If the produced water is discharged from the Platform Irene, it would only be expected to create a minor, localized impact in the vicinity of the discharge point by increasing the concentration of such constituents as suspended solids/turbidity, oxygen demand, oil and grease, and trace metals. Any concentration of materials above normal background levels is diluted rapidly by waves and currents. All produced water discharges are subject to and comply with the existing NPDES permit requirements.

The October 2006 Tranquillon Ridge EIR presents the result of produced water modeling, which shows that the NPDES permit discharge limits are met within 20 meters of the discharge point, and that there would be a 50 fold dilution at 100-meters. Based upon the modeling results, the addition of the produced water from the Tranquillon Ridge Field is not expected to change the localized area of impact, which is in the vicinity of the discharge point.

All solid wastes generated aboard the platform, with the exception of washed drill cuttings and drilling muds, will be collected and disposed of at appropriate onshore facilities in accordance with EPA and local disposal permit conditions.

Oil contaminated solids, spent oils, solvents, etc. will be containerized, transported onshore and disposed of in an appropriate disposal site or as specified in the local disposal permit. Produced water, along with any other drainage water containing oil, will be shipped ashore with the oil/water emulsion for processing at the LOGP.

The U.S. EPA and the MMS strictly regulate discharges into the marine environment, including the discharge of drilling muds and cuttings. The ocean disposal of oil contaminated waste is prohibited. The proposed surface locations for the wells (Platform Irene) are beyond 3,280 feet (1,000 m) of State waters; according to a policy established by the Commission in 1980, discharges of drilling muds and cuttings from operations conducted more than 3,280 feet (1,000 m) from the State's 3-mile (5 km) boundary do not affect the coastal zone.

A discussion of the impacts of washed mud and cuttings disposal is included in the October 2006 Tranquillon Ridge EIR. In summary, there is much documentation that supports the fact that most water based drilling muds (the type anticipated for this project) are relatively nontoxic to marine organisms. The discharges of washed muds and cuttings will not result in any long-term adverse impacts to the biological productivity of communities within the area of discharge or nearby vicinity, with the exception of the burial of benthic organisms in the immediate area of discharge; however, the areas subject to burial should experience only short-term impacts.

The effects of drilling mud and drill cuttings discharged at the Point Arguello Platforms on neighboring hard-bottom epifauna were studied in detail during the comprehensive California Monitoring Program (CAMP) Phases II and III, which lasted from 1986 to 1995. The final conclusion provided in the Phase III report was that platform discharges have not caused changes to nearby hard-bottom communities. Equal numbers of positive and negative effects were indicated for dominant taxa, and there was no consistent pattern of response for a single taxon over the three habitat types (deep high and low relief, and shallow low relief). Statistical tests concluded that the cumulative distribution of responses could have been due to chance alone. Based on the results of CAMP Phases II and III, adverse impacts to hard-bottom epibiota as a result of drilling mud and drill cuttings discharges from the proposed development of the Tranquillon Ridge Field are not expected to occur.

The release of drilling muds and cuttings will produce a displacement of sediment and localized turbidity in the vicinity of the platform. The sediment effects are physical in nature, as only "clean" cuttings and drilling muds are to be discharged into the surrounding waters in accordance with existing NPDES permits.

The literature indicates that while marine mammals hear man-made noises and sounds generated by vessels, there is no indication that they are affected deleteriously by the noise (Richardson *et al*., 1995). Because noise and vessel sounds generated from this project are highly localized and short-term in nature, adverse impacts to marine mammals from noise are not expected. The literature indicates that some species such as dolphins may be attracted to vessels, but the majority will maintain distances of 100-200 m. As described in the October 2006 Tranquillon Ridge EIR, supply vessels, although unlikely, may collide with marine mammals.

Richardson et al. (1995) cite only a single source of information on the levels of noise produced by platform-based drilling activities. Gales (1982) recorded noise produced by one drilling and three drilling and production platforms offshore California. The noise produced was so weak that they were nearly undetectable even along side the platform in sea states of Beaufort 3 or better. No sound levels were computed, but the strongest received tones were very low frequency, about 5 Hz, at 119-127 dB re 1μPa. The highest frequency recorded was about 1.2 Hz. Richardson et al. (1995) predicted that the radii of audibility for baleen whales for production platform noise would be about 2.5 km in nearshore waters and 2 km near the shelf break (MMS 2000).

For gray whales of the coast of central California, Malme et al. (1984) recorded a 50-percent response threshold to playback at 123 dB re 1μPa. This is well within 100m in both the nearshore and shelf-break waters. Therefore, the predicted radius of response for gray whales, and most likely other baleen whales, would also be less then 100m. Richardson predicted similar radii of response for odontocetes and pinnipeds (MMS 2000). As such, noise impacts to marine mammals would be limited to within 100m of the platform.

Finding

The proposed activities are consistent with the enumerated policies for the following reasons:

1. Compliance with MMS regulations (prohibiting ocean dumping of muds containing toxic compounds), EPA and State NPDES permit requirements.

2. The effects of drill cuttings disposal are limited to: 1) localized smothering of less mobile elements of the benthic epifauna and infauna at the base of the drilling platforms and on the lower portions of the structures, and attendant reduction of available food to animals at higher trophic levels; and 2) a temporary increase in water turbidity and consequent reduction of light for plant photosynthesis. Based upon the marine surveys that have been conducted around Platform Irene, the discharge of the cuttings associated with the drilling of the Point Pedernales Unit wells does not appear to have affected the marine life. The discharge of drilling muds at the platform site will not affect marine resources and productivity within coastal State waters.

3. Currently the produced water from Platform Irene is reinjected into the onshore Lompoc Oil Field and offshore into the Point Pedernales Field. In the future, the produced water, separated from the crude oil, could be sent to water treatment facilities for oil removal at the LOGP. Treatment would consist of a skim tank for removal of oil and suspended solids by gravity separation. The water would then be passed through flotation cells to remove suspended oil. The clean water would then be returned to the platform and discharged to the ocean. The oil concentration in the clean discharged water would meet EPA issued NPDES requirements.

Section 30232-OIL AND HAZARDOUS SUBSTANCE SPILLS

Protection against the spillage of crude oil, gas, petroleum products, or hazardous substances shall be provided in relation to any development or transportation of such materials. Effective containment and cleanup facilities and procedures shall be provided for accidental spills that do occur.

Assessment

The development of the Tranquillon Ridge Field will result in a slight increase in the risk of an oil spill originating in Federal and State waters and onshore locations over what exists today for the Point Pedernales Field production. The Risk of Upset/Hazardous Materials section of the October 2006 Tranquillon Ridge EIR provides a discussion of the oil spill risk associated with the proposed development project.

Increased activities offshore would increase the probability of spills. Also, an increase in the oil percentages in the pipeline would increase the amount of oil that could be spilled into the marine environment if a spill occurs. In addition, the longer life associated with Platform Irene and the Platform Irene to LOGP pipeline would increase the probabilities of a spill over the facility lifetime.

The maximum spill volume for the offshore facilities would increase from 2,868 bbls of oil to 6,718 bbls of oil. This increase is due to the increase in the fraction of oil in the emulsion pipeline over the current operations. However, this is well less than the 18,000 bbls that was assumed in the 1985 Point Pedernales EIR/EIS. The 1985 EIR/EIS has a higher maximum spill volume due to higher throughput through the emulsion pipeline and a much higher oil water ratio in the pipeline.

Development of the Tranquillon Ridge Field would result in an increased throughput of oil and would extend the life over which the oil emulsion pipeline would operate. Currently, to reduce the risk of a spill, pipeline inspections and corrosion prevention measures are implemented and a Supervisory Control and Data Acquisition System is in place to monitor the pipeline. In addition, secondary containment basins are located at strategic locations (predominately in the vicinity of the Santa Ynez River) to contain the oil in the event of a spill. An Oil Spill Contingency Plan is also in place to address response to, clean up of, and restoration of, spill affected areas.

Potential spills could be associated with the platform and the on and offshore pipelines. Protection against the spillage of crude oil is a routine part of PXP's operations. An Oil Spill Response Plan for Platform Irene has been developed, and submitted to and approved by the MMS, which describes the measures that will be taken in the event of an oil spill and the personnel and equipment available to implement spill containment and cleanup procedures. The basic procedure for a spill is to immediately ensure personnel safety, stop the pollutant flow, begin the containment and cleanup procedure, and contact designated company personnel and Government agencies. The platform personnel would conduct the initial response activity. For a spill beyond the capability of the platform personnel and equipment, the primary sources of assistance would be the industry-sponsored spill containment cooperative - Clean Seas.

Additional information on the oil spill equipment and response can be found in the Oil Spill Response Plan that has been submitted to and approved by the MMS.

Further, a comprehensive study was conducted on the life expectancy of the project pipelines. The study was presented to and accepted by SBCED and their consulting engineer. It evaluated corrosion monitoring, control programs and maintenance programs. The findings of the study showed that the pipelines have an expected life, assuming no human interventions for repairs, of greater than 200 years. The investigation concluded the present program for corrosion control and monitoring has demonstrated effectiveness in controlling the corrosion penetration rate to less than .239 mils per year (mpy) for the oil line and .23 for the 8" water line and gas line for 2003 and 2004. This is better than industry standards.

The .239 mpy average gives a life expectancy, without pipeline repair or replacement of greater than 200 years for both the onshore and offshore segments of the 20" oil pipeline. The same parameters applied to the 8" water pipeline give a life expectancy of greater than 200 years for both the onshore and offshore segment.

Plains Exploration and Production (PXP) has expanded the corrosion control program and will ensure that the pipelines are maintained within acceptable corrosion penetration rates through their monitoring, corrosion inhibition and cleaning programs. In addition, periodic pipeline integrity reviews including SBCED and their consulting engineer, have been established to ensure the program is being followed.

Finding

The proposed activities are consistent with the policy to protect against oil spills because: 1) all possible protective measures have been taken to prevent accidental spills; and 2) in the unlikely event that an oil spill does occur, all available means will be implemented to mitigate its impacts and to ensure that it does not adversely impact the marine resources of the area.

Section 30234-COMMERCIAL FISHING AND RECREATIONAL BOATING FACILITIES

Facilities serving the commercial fishing and recreational boating industries shall be protected and, where feasible, upgraded. Existing commercial fishing and recreational boating harbor space shall not be reduced unless the demand for those facilities no longer exists or adequate substitute space has been provided. Proposed recreational boating facilities shall, where feasible, be designed and located in such a fashion as not to interfere with the needs of the commercial fishing industry.

Assessment

The drilling phase for development of the Tranquillon Ridge Field will involve vessel movements to and from Platform Irene and Port Hueneme. It is projected that approximately 22 supply boat trips per year above and beyond what is currently required to support the Point

Pedernales operations will be needed to support the drilling operations. The supply boats that will be used are the existing boats that service Platform Irene. Therefore, the development of the Tranquillon Ridge Field will not reduce commercial fishing or recreational boating harbor space at Port Hueneme. No additional supply boat trips above what is required for the Point Pedernales project will be needed once drilling is complete.

Findings
The proposed project will not compete with commercial or recreational vessels for available dock space or ancillary facilities and is therefore consistent with the policy stated above.

Section 30240-ENVIRONMENTALLY SENSITIVE HABITAT AREAS; ADJACENT DEVELOPMENTS

Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.

Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.

Assessment
The proposed development of the Tranquillon Ridge Field will occur from the existing Platform Irene. No new facilities will need to be built to accommodate the production. Platform Irene is not located within or reasonably near any identified environmentally sensitive habitat areas.

The proposed development could impact environmentally sensitive areas such as the Santa Ynez Estuary, Point Sal, and Point Conception in the unlikely event of a major oil spill occurring and reaching the shoreline. The impacts of an oil spill on sensitive biological communities in these areas are discussed in the October 2006 Tranquillon Ridge EIR. The peak oil production from the Platform Irene with the development of the Tranquillon Ridge Field is estimated to be approximately 30,000 bbls per day. This is slightly more than the peak oil production from the Point Pedernales Field, which was around 25,000 bbls per day, but less than the 80,000 bbls per day that was estimated in the 1986 EIR/EIS for the Point Pedernales Field. The Oil Spill Response Plan for the Platform Irene and pipelines defines the sensitive ecological areas within possible oil spill paths (determined from trajectory data) and delineates procedures to protect these areas from contamination.

Normal operation of seafloor pipelines would not impact sensitive habitat areas. Should an accidental spill occur, offshore kelp beds, rocky intertidal habitats and several public beaches could be adversely affected. PXP's Oil Spill Response Plan includes particular reference to these areas to help prevent spill impacts.

Findings
The proposed activities will be conducted so that adverse environmental impacts on important habitat areas will be avoided. The project is consistent with this policy because normal project activities will not impact any environmentally sensitive habitat areas in the general vicinity. Observing the requirements of the MMS, which require that immediate action be taken to minimize the impact on water and marine resources, would mitigate the impact of an oil spill or blowout.

Section 30244-ARCHAEOLOGICAL AND PALEONTOLOGICAL RESOURCES

Where development would adversely impact archaeological or paleontological resources as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required.

Assessment
The development of the Tranquillon Ridge Field involves directional drilling from Platform Irene into California State Lands, using extended-reach technology. No impacts on cultural resources would occur because access to the wells would be entirely through underground approach, several thousand feet below the ocean floor. The development will not require the construction of any new offshore facilities. All offshore oil and gas production will be handled in existing facilities. As such, no activities associated with the proposed development would impact archaeological or paleontological resources.

Finding
The development of the Tranquillon Ridge Field is considered consistent with the enumerated policy because no new structures will be placed offshore, and as such, no offshore anomalies or sites would be affected.

Section 30251- SCENIC AND VISUAL QUALITIES

The scenic and visual qualities of coastal areas shall be considered and protected as resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas. New development in highly scenic areas such as those designated in the California Coastline Preservation and Recreation Plan prepared by the Department of Parks and Recreation and by local government shall be subordinate to the character of its setting.

Assessment
The development of the Tranquillon Ridge Field will not require the construction of any new offshore facilities. The development of the Tranquillon Ridge Field will be done using existing well slots on Platform Irene. As such, no activities associated with the development of the Tranquillon Ridge Field would change the existing scenic and visual qualities of the area.

Finding

The development of the Tranquillon Ridge Field is considered consistent with the enumerated policy because no new structures will be placed offshore, and therefore, there would be no change in the existing scenic and visual qualities of the area.

Section 30253-MINIMIZATION OF ADVERSE IMPACTS

New development shall:

1. Minimize risks to life and property in areas of high geologic, flood and fire hazard.

2. Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.

3. Be consistent with requirements imposed by an air pollution control district or the State Air Resources Control Board as to each particular development.

4. Minimize energy consumption and vehicle miles traveled.

5. Where appropriate, protect special communities and neighborhoods which, because of their unique characteristics are popular visitor destination points for recreational uses.

Assessment

The development of the Tranquillon Ridge Field will not require the construction of any new offshore facilities. The Tranquillon Ridge Field will be developed using existing well slots on Platform Irene. All oil and gas production will be handled in existing facilities. As such, no activities associated with the proposed development would affect areas of high geologic, flood or fire hazard. Since no new facilities are being proposed as part of development of the Tranquillon Ridge Field, there would be no new impacts to geologic stability, or the construction of protective devices that would alter natural landforms along bluffs and cliffs.

The proposed development of the Tranquillon Ridge Field will be covered by the existing Permits to Operate (PTOs) for the Point Pedernales facilities that have been issued by the Santa Barbara County Air Pollution Control District (SBCAPCD). Estimates of the emissions associated with the proposed development are provided in the Air Quality Section of the October 2006 Tranquillon Ridge EIR. All of the emissions associated with the development of the Tranquillon Ridge Field will be offset consistent with SBCAPCD rule and regulations.

Energy consumption will be minimized during the proposed activities by the use electrical power from the PG&E grid, which is supplied to the platform by a power cable. The project itself represents a net production of energy.

As discussed in the Traffic Section of the October 2006 Tranquillon Ridge EIR, the proposed activities will not constitute a major impact to transportation systems in the area or create a substantial increase in vehicle trips per day. The proposed project activities will not disrupt or affect any special communities or neighborhoods.

Finding

The proposed development of the Tranquillon Ridge Field is consistent with the goals and intent of the above policy for the following reasons:

1. Since no new offshore structures will be built as part of the proposed development, no project components will impact high geologic, flood or fire hazards.

2. The proposed development will occur from the existing Platform Irene. The platform structures have been designed to remain stable, even under maximum credible earthquake conditions. The platform has also been designed to withstand extreme oceanographic conditions.

3. The MMS and CSLC drilling rules, the MMS and CSLC approved drilling procedures that will be developed for the proposed wells and implementation of best available safety technology minimize the risk of blowout resulting from communication between a higher pressure strata and a lower pressure strata.

4. The development of the Tranquillon Ridge Field will use the existing pipelines associated with the Point Pedernales Field. These pipelines have been designed to minimize the risk of damage from geologic hazards and to ensure their structural integrity. The onshore pipelines were installed within or near existing right-of-ways and did not require the construction of new protective devices that substantially alter natural landforms along bluffs or cliffs.

5. The development of the Tranquillon Ridge Field will be covered under the existing PTOs for the Point Pedernales facilities that have been issued by the SBCAPCD. Air emissions associated with the proposed development will be offset consistent with SBCAPCD rules and regulations.

6. Energy consumption will be minimized during the proposed activities by use electrical power from the PG&E grid.

7. The Santa Barbara/Ventura Coastal areas provide a number of recreational opportunities that attract tourism to the region. The proposed project will be situated approximately 35 miles from the Channel Islands National Park, which provides a popular visitor destination for limited recreational use. Project activities will occur at a sufficient distance from the park to preclude any adverse impacts during normal activities. Recreational resources along the coastline will not be disrupted since there is no construction activities associated with the proposed project. No long-term effects on recreational opportunities are expected as a result of the development of the Tranquillon Ridge Field since all activities will occur from existing oil and gas development facilities.

Section 30260-INDUSTRIAL DEVELOPMENT; LOCATION OR EXPANSION

Coastal-dependent industrial facilities shall been encouraged to locate or expand within existing sites and shall be permitted reasonable long-term growth where consistent with this division. However, where new or expanded coastal-dependent industrial facilities cannot feasibly be accommodated consistent with other policies of this division, they may nonetheless be permitted in accordance with this section and Sections 30261 and 30262 if: (1) alternative locations are infeasible or more environmentally damaging; (2) to do otherwise would adversely affect the public welfare; and (3) adverse environmental effects are mitigated to the maximum extent feasible.

Assessment
The development of the Tranquillon Ridge Field will not require the construction of any new facilities. The Tranquillon Ridge Field will be developed using existing well slots on Platform Irene. All oil and gas production will be handled in existing facilities with minor modifications. As such, the development of the Tranquillon Ridge Field will not result in and new or expanded industrial development over what exists today.

Finding
The development of the Tranquillon Ridge Field will not result in any new or expanded industrial development over what exists today.

Section 30262-OIL AND GAS DEVELOPMENT

Oil and gas development shall be permitted in accordance with Section 30260, if the following conditions are met:

a. The development is performed safely and consistently with the geologic conditions of the well site.

b. New or expanded facilities related to such development are consolidated, to the maximum extent feasible and legally permissible, unless consolidation will have adverse environmental consequences and will not significantly reduce the number of producing wells, support facilities, or sites required to produce the reservoir economically and with minimal environmental impacts.

c. Environmentally safe and feasible subsea completions are used when drilling platforms or islands would substantially degrade coastal visual qualities unless use of such structures will result in substantially less environmental risk.

d. Platforms or islands will not be sited where a substantial hazard of vessel traffic might result from the facility or related operations, determined in consultation with the USCG and the Army Corps of Engineers.

e. Such development will not cause or contribute to subsidence hazards unless it is determined that adequate measures will be undertaken to prevent damage from such subsidence.

f. With respect to new facilities, all oilfield brines are reinjected into oil producing zones unless the Division of Oil and Gas of the Department of Conservation determines to do so would adversely affect production of the reservoirs and unless injection into other subsurface zones will reduce environmental risks. Exceptions to reinjection will be granted consistent with the Ocean Waters Discharge Plan of the State Water Resources Control Board and where adequate provision is made for the elimination of petroleum odors and water quality problems.

Where appropriate, monitoring programs to record land surface and near-shore ocean floor movements shall be initiated in locations of new large scale fluid extraction on land or near shore before operations begin and shall continue until surface conditions have stabilized. Costs of monitoring and mitigation programs shall be borne by liquid and gas extraction operators.

Assessment

The development of the Tranquillon Ridge Field will not require the construction of any new facilities. The Tranquillon Ridge Field will be developed using existing well slots on Platform Irene. All oil and gas production will be handled in existing facilities with minor modifications. The proposed development of the Tranquillon Ridge Field will be fully integrated into existing oil and gas operating facilities. This represents that maximum possible use of consolidated facilities.

The use of subsea completions has been determined to be an infeasible alternative for the development of the Tranquillon Ridge Field. The use of subsea completions would serve to increase visual impacts because a drilling vessel would be required onsite during the 15 year drilling phase and frequently during the production phase to accomplish well workovers; and testing. The introduction of additional seafloor obstructions over a relatively large area would pose a greater impact to commercial fishermen than that resulting from the proposed use of existing offshore platforms. There is also more environmental risk associated with the use of subsea completions because they are not as accessible to control or service in case of a malfunction. In the case of the proposed project, artificial lift will be required to extract the resource, thus reducing the potential for using subsea completions.

The majority of the produced water is injected onshore at the Lompoc Oil Field with the remaining returned to Platform Irene for offshore injection. For the proposed development activities, a part of the produced water will continue to be transported offshore. This water will either be discharged to the ocean under the NPDES permit or injected offshore in accordance with the MMS authorization. Approximately 40,000 barrels per day (bpd) of water produced from Point Pedernales and Tranquillon Ridge combined will be shipped from the LOGP to Platform Irene for injection or ocean discharge. PXP is authorized to discharge to the ocean from the platform up to 153,000 bpd of water in accordance with the current NPDES permit. A part of the produced water that will be shipped to Platform Irene may still be injected into Point Pedernales reservoir wells, as is currently the operation. Offshore water injection will be conducted as authorized by the MMS.

Finding

The proposed activities are consistent with the enumerated policies for the following reasons:

The development of the Tranquillon Ridge Field will occur from the existing Platform Irene, which was designed and installed to meet all of the safety requirements. No new offshore structures will need to be built for the proposed development.

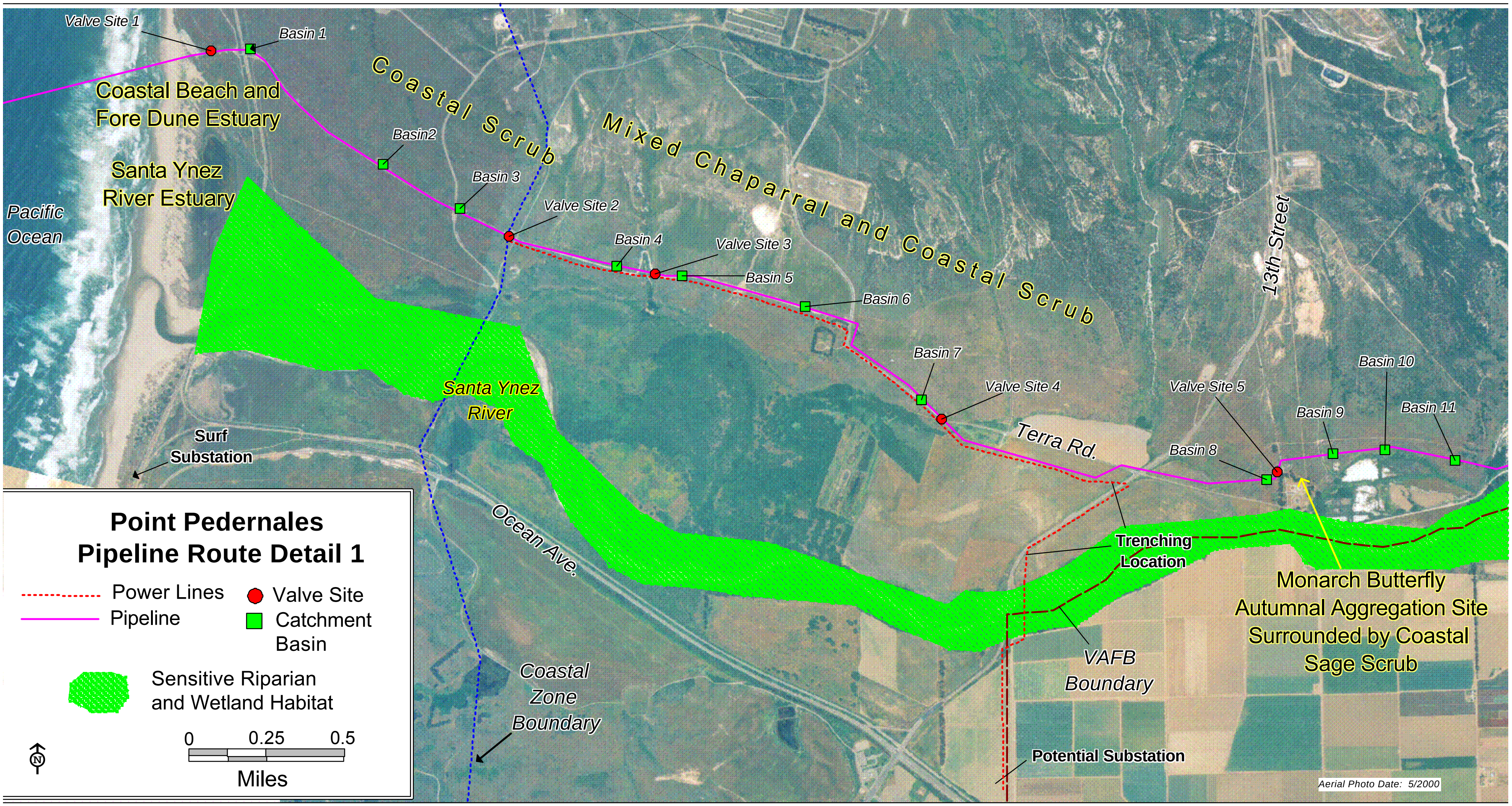
The casing and mud program for the project will use the best available safety technology to minimize the risk of a blowout resulting from communication between a higher pressure strata and a lower pressure strata. All wells will be drilled following MMS and CSLC approved drilling procedures.

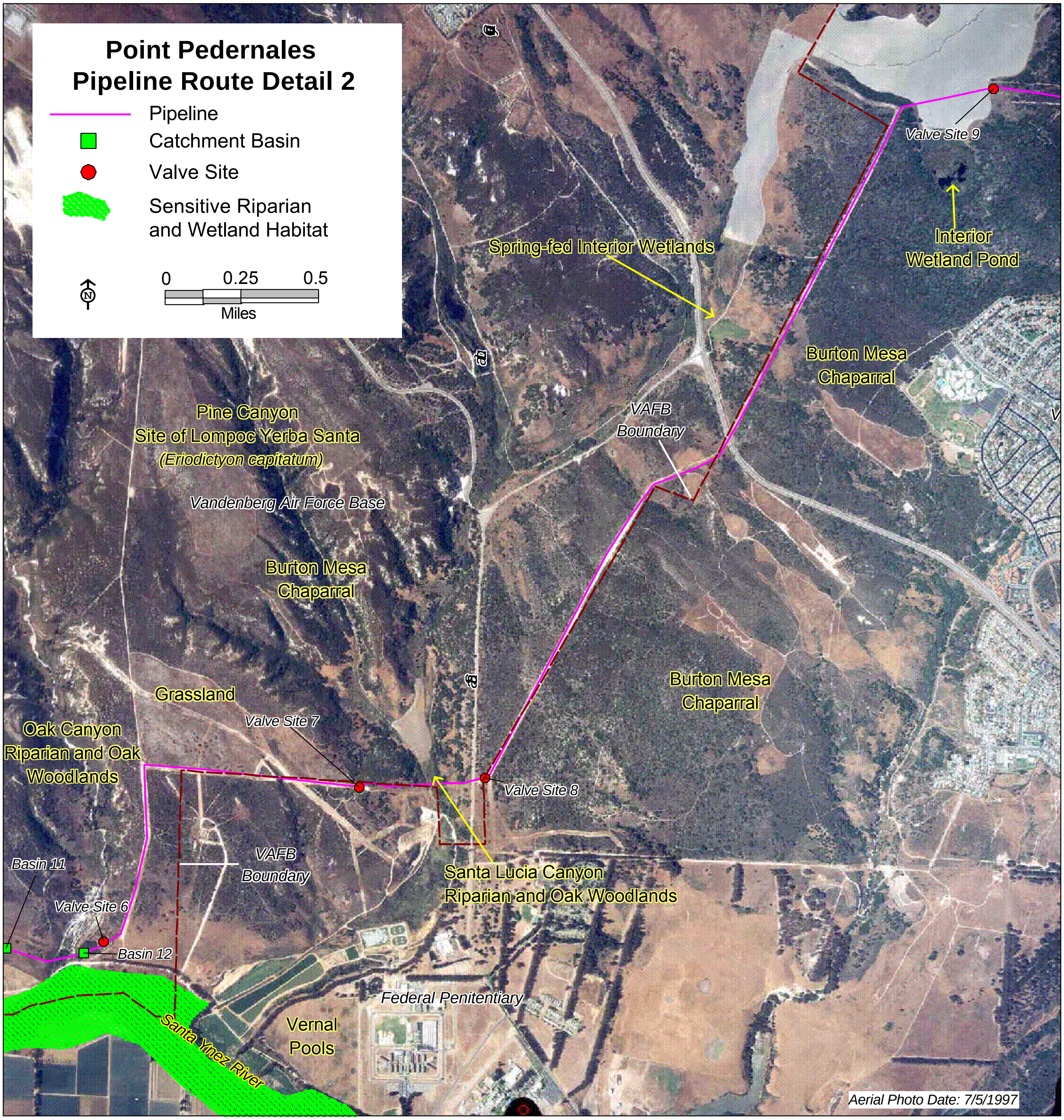
The development of the Tranquillon Ridge Field will utilize existing facilities for the drilling, processing and transportation of the oil and gas production. This represents the maximum possible use of existing facilities.

Platform Irene, which will be used for the development of the Tranquillon Ridge Field, is located sufficiently clear of the northbound shipping lane of the designated VTSS. The platform was sited in accordance with the requirements of the U.S. Army Corps of Engineers and the U.S. Coast Guard.

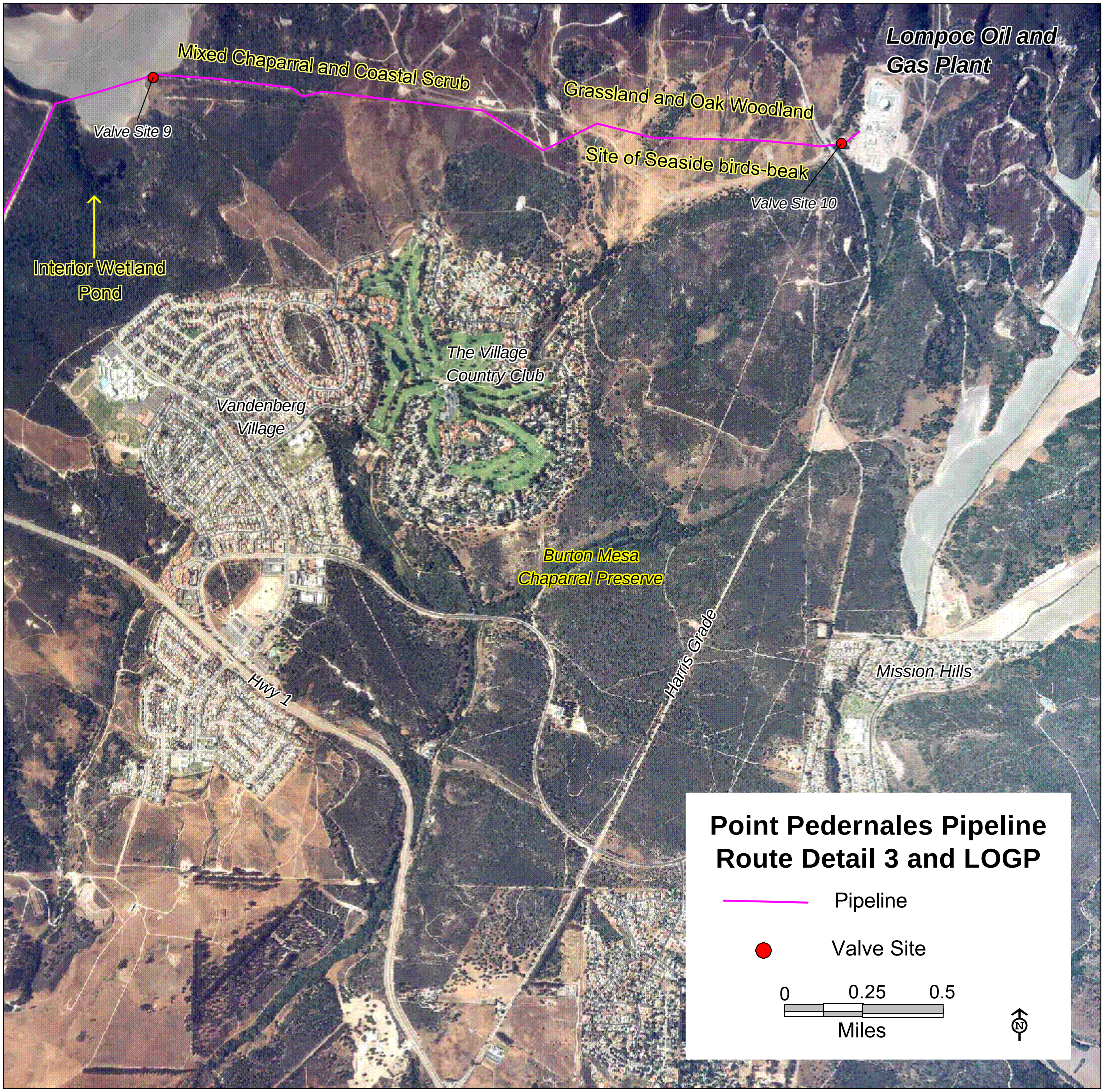
Produced water will either be discharged to the ocean under the NPDES permit or injected onshore, or injected offshore in accordance with the MMS authorization.

Attachment A Point Pedernales/Tranquillon Ridge Pipeline Routes and Facilities


Valve Site 1
Basin 1
Coastal Beach and Fore Dune Estuary
Coastal Scrub
Mixed Chaparral and Coastal Scrub
Basin2
Basin 3
Santa Ynez River Estuary
Pacific Ocean
Valve Site 2
Basin 4
Valve Site 3
Basin 5
Basin 6
13th Street
Basin 7
Valve Site 4
Santa Ynez River
Terra Rd.
Valve Site 5
Basin 10
Basin 9
Basin 11
Basin 8
Surf Substation
Ocean Ave.
Trenching Location
Monarch Butterfly Autumnal Aggregation Site Surrounded by Coastal Sage Scrub
VAFB Boundary
Coastal Zone Boundary
Potential Substation
Aerial Photo Date: 5/2000
Point Pedernales Pipeline Route Detail 1
Power Lines
Pipeline
Valve Site
Catchment Basin
Sensitive Riparian and Wetland Habitat
0
0.25
0.5
Miles
N



Point Pedernales
Pipeline Route Detail 2
Pipeline
Catchment Basin
Valve Site
Sensitive Riparian and Wetland Habitat
N
0
0.25
0.5
Miles
Valve Site 9
Interior Wetland Pond
Spring-fed Interior Wetlands
Burton Mesa Chaparral
VAFB Boundary
Pine Canyon
Site of Lompoc Yerba Santa
(Eriodictyon capitatum)
Vandenberg Air Force Base
Burton Mesa Chaparral
Burton Mesa Chaparral
Grassland
Valve Site 7
Oak Canyon Riparian and Oak Woodlands
Valve Site 8
VAFB Boundary
Basin 11
Valve Site 6
Basin 12
Santa Lucia Canyon Riparian and Oak Woodlands
Federal Penitentiary
Vernal Pools
Santa Ynez River
Aerial Photo Date: 7/5/1997


Lompoc Oil and Gas Plant
Mixed Chaparral and Coastal Scrub
Grassland and Oak Woodland
Valve Site 9
Site of Seaside birds-beak
Valve Site 10
Interior Wetland Pond
The Village Country Club
Vandenberg Village
Burton Mesa Chaparral Preserve
Harris Grade
Hwy 1
Mission Hills
Point Pedernales Pipeline Route Detail 3 and LOGP
Pipeline
Valve Site
0
0.25
0.5
Miles
N

Attachment C Air Emissions Calculations

Attachment C
Table of Contents

Construction Air Emissions Summary - Tranquillon Ridge Project

Emissions Summary - Proposed Project

Location and Construction Activity	Total (Annual) Emissions (tons/year)				
	CO	ROC	NOx	SO_2	PM_{10}
LOGP & Valve St #2	8.03	1.39	19.37	2.00	1.52
LOGP & Valve St #2 - Fugitive dust	-	-	-	-	0.01
Platform Irene	0.08	0.03	0.20	0.02	0.03
Offsite - onshore and offshore	3.14	0.76	2.18	0.05	0.16
Construction Total Emissions	**11.26**	**2.17**	**21.75**	**2.07**	**1.71**
Significance Criteria	**25.0**	**55.0**	**55.0**	**25.0**	**25.0**
Significant?	**No**	**No**	**No**	**No**	**No**

Onsite Construction Equipment Emissions

Proposed Project

Construction Equipment	Number	Daily Usage	Daily Hours	Duration (Days)	Hourly Emissions (lbs/hr)					Peak Daily Emission (lbs/day)					Total (Yearly) Emissions (tons)				
					CO	ROC	NO_x	SO_2	PM_{10}	CO	ROC	NO_x	SO_2	PM_{10}	CO	ROC	NO_x	SO_2	PM_{10}
LOGP and Valve Site 2 Equipment Modifications																			
Backhoe	2	0.8	8	220	1.14	0.46	3.80	0.36	0.34	7.32	2.94	24.32	2.33	2.18	0.81	0.32	2.68	0.26	0.24
Trencher	1	0.8	8	11	0.57	0.23	1.90	0.18	0.17	3.66	1.47	12.16	1.16	1.09	0.02	0.01	0.07	0.01	0.01
A-frame Truck	3	0.5	8	270	5.40	0.57	12.51	1.35	0.78	21.60	2.28	50.04	5.40	3.12	2.92	0.31	6.76	0.73	0.42
Service Truck	2	0.5	8	270	3.60	0.38	8.34	0.90	0.52	14.40	1.52	33.36	3.60	2.08	1.94	0.21	4.50	0.49	0.28
15-ton Crane	2	0.8	8	151	2.34	0.78	5.98	0.52	0.78	14.98	4.99	38.27	3.33	4.99	1.13	0.38	2.89	0.25	0.38
Concrete Truck	2	0.5	8	100	3.60	0.38	8.34	0.90	0.52	14.40	1.52	33.36	3.60	2.08	0.72	0.08	1.67	0.18	0.10
Welding Machine	3	0.5	8	150	1.65	0.30	2.70	0.30	0.30	6.60	1.20	10.80	1.20	1.20	0.50	0.09	0.81	0.09	0.09
Total					**18.31**	**3.10**	**43.57**	**4.52**	**3.41**	**82.96**	**15.93**	**202.31**	**20.62**	**16.74**	**8.03**	**1.39**	**19.37**	**2.00**	**1.52**
Platform Irene Equipment Modifications																			
15-ton Crane	2	0.5	8	15	2.34	0.78	5.98	0.52	0.78	9.36	3.12	23.92	2.08	3.12	0.07	0.02	0.18	0.02	0.02
Welding Machine	1	0.5	8	10	0.55	0.1	0.9	0.1	0.1	2.20	0.40	3.60	0.40	0.40	0.01	0.00	0.02	0.00	0.00
Total					**2.89**	**0.88**	**6.88**	**0.62**	**0.88**	**11.56**	**3.52**	**27.52**	**2.48**	**3.52**	**0.08**	**0.03**	**0.20**	**0.02**	**0.03**

Construction Mobile Emissions (Offsite) - Proposed Project

	Parameters									Peak Day Emissions, lbs/day					Total Emissions, Tons				
Source	**Vehicle Type**	**Include in Peak Hour?**	**Number of Vehicles per Day**	**Load Factor**	**Daily Trips (one way)**	**No. of days**	**Distance One Way (miles)**	**Speed (mph)**	**Time of Trip (min)**	**CO**	**ROC**	**NOx**	**SO2**	**PM10**	**CO**	**ROC**	**NOx**	**SO2**	**PM10**
The LOGP & Valve #2 - Onshore																			
Workers Commuting	Gasoline	1	40	-	80	270	5	25	12	9.35	2.40	0.86	0.05	0.02	1.263	0.324	0.116	0.007	0.002
Truck Travel - Other [a]	Diesel	1	7	-	14	215	25	25	60	10.72	2.32	10.11	0.05	0.74	1.152	0.249	1.087	0.005	0.079
Construction Equipment Delivery [b]	Diesel	0	4	-	8	4	20	25	48	4.90	1.06	4.62	0.02	0.34	0.010	0.002	0.009	0.000	0.001
Construction Equipment Removal	Diesel	0	4	-	8	4	20	25	48	4.90	1.06	4.62	0.02	0.34	0.010	0.002	0.009	0.000	0.001
Construction Materials Delivery [c]	Diesel	1	4	-	8	200	20	25	48	4.90	1.06	4.62	0.02	0.34	0.490	0.106	0.462	0.002	0.034
The Pump Stations - Onshore																			
Workers Commuting	Gasoline	1	21	-	0	98	5	25	12	0.00	0.33	0.00	0.00	0.00	0.000	0.016	0.000	0.000	0.000
Truck Travel - Other [a]	Diesel	1	4	-	0	98	25	25	60	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
Construction Equipment Delivery [b]	Diesel	0	4	-	0	2	20	25	48	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
Construction Equipment Removal	Diesel	0	4	-	0	2	20	25	48	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
Construction Materials Delivery [c]	Diesel	1	4	-	0	15	20	25	48	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
Platform Irene - Offshore																			
Workers Commuting	Gasoline	1	15	-	30	10	10	25	24	5.52	1.37	0.52	0.04	0.01	0.028	0.007	0.003	0.000	0.000
Truck Travel - Material Delivery	Diesel	1	2	-	4	10	25	25	60	3.06	0.66	2.89	0.01	0.21	0.015	0.003	0.014	0.000	0.001
Helicopter (construction) - idle [d]	Gasoline	1	1	-	2	10	-	-	25	9.39	5.38	0.08	0.04	0.05	0.047	0.027	0.000	0.000	0.000
Helicopter (construction) - cruise	Gasoline	1	1	-	2	10	-	-	25	5.86	0.73	7.57	0.73	0.98	0.029	0.000	0.000	0.000	0.000
Supply Boat - main engines [e]	Diesel	1	1	0.65	1	2	-	-	330	54.86	11.77	173.07	19.76	22.42	0.055	0.012	0.173	0.020	0.022
Supply Boat - auxiliary engines [f]	Diesel	1	1	0.50	1	2	-	-	330	42.20	9.06	302.38	15.20	17.25	0.042	0.009	0.302	0.015	0.017
Supply Boat - bow thruster [g]	Diesel	1	1	-	1	2	-	-	60	1.74	0.66	8.09	0.38	0.55	0.002	0.001	0.008	0.000	0.001
Total										***147.6***	***35.7***	***510.2***	***36.3***	***42.6***	***3.14***	***0.76***	***2.18***	***0.05***	***0.16***

Emissions calculations based on EMFAC7G. See Emission Factors spreadsheet

Equipment (backhoes, cranes, etc) assume delivered and removed as 2 separate trips.

Helicopter horse powers 1400

Notes/Assumptions:

a - Includes the following equipment: Service Trucks, A-Frame Trucks, Concrete Trucks

b - Total number of trucks needed to deliver construction equipment
equipment that needs to be delivered does not include various trucks

c - Materials include vessel, eductor, pumps, valves and piping delivery - 20 trucks

d - Helicopter trips originate from Santa Maria Airport and take 50 minutes round-trip on the average (PTO 9106)
idle time is assumed to take 5% of the trip;
construction is assumed that construction would generate 1 additional helicopter round-trip per day

e - Boat power - Main engines = two at 2000 bhp each; Auxiliary engines = two at 245 bhp; Bow thruster = 515 bhp (PTO 9106

Construction Air Emissions - Fugitive Dust Emissions (PM_{10})

Emission factor for travel on unpaved roads based on following inputs		**Assumptions, Comments**	**Data Sources**
surface silt loading in percent	*24*		*Site debris clearing based on CEQA SCAQMD Tables 9-9 and 9-9-f*
mean vehicle speed in mph	*15*		*Graded surface based on SCAQMD Table 9-9*
mean vehicle weight in tons	*2*	Light vehicles only	
mean number of wheels on vehicle	*4*	All vehicles are small	
mean number of rain days per year	*34*		
soil, tons/yd^3	*1.01*		
silt content of soil	*1.5*		

Proposed Project

Activity (at LOGP and Valve Site #2)	Source	Source Units	Number of Days	Emission Factor	Emission Factor, Units	Mitigation Reduction percentage	Peak Day Emissions, lbs/day	Total PM10 Emissions, tons
Site grading	0.34	acres	10	26.4	lbs/acre	0	0.91	0.005
Fill dumping	84	tons	5	0.009	lbs/ton	0	0.15	0.000
Travel on dirt roads - estimate	0.13	vehicle-miles	15	1.43	lbs/vehicle-miles	0	0.01	0.000
Disturbed area	0.52	acres	15	26.4	lbs/acre	0	0.91	0.007
Fill Storage Piles - estimate	0.00	acres	5	6.39	lbs/day/acre	0	0.00	0.000
Total							**1.98**	**0.012**

Average number of vehicles per day	7	**Assumptions: 1) a portion of the pipeline for the Upgraded Water System will be underground**
Travel distance for each vehicle on site, ft	100	**2) a portion of power line will be underground under Vandenberg power line**
Site disturbed area per day, acres/day	*0.03*	**3) to construct transformer station, a 50 x 50 feet area would be cleared**
Total days of excavation/soil disturbance	*12*	
Total fill excavated/delivered, yd^3	*83*	Underground water pipe + underground portion of power line = 250' x 3'x3'

Equipment Emission Factors

Code	Equipment	Hp	Type	Load Factor, %	Emission Factors (lb/hr) CO	ROG	NO_x	SO_2	PM_{10}	Emission Factors (lb/hp-hr) CO	ROG	NO_x	SO_2	PM_{10}	Reference
1	Air Compressor (400 ACFM)	150	Diesel	na	0.675	0.15	1.7	0.143	0.14	-	-	-	-	-	1) for misc. equip
2	Backhoe/Loader (510C)	86	Diesel	na	0.572	0.23	1.9	0.182	0.17	-	-	-	-	-	1) for wheeled loader
3	Concrete Pump Truck (65 CY/hr)	90	Diesel	na	1.8	0.19	4.17	0.45	0.26	-	-	-	-	-	1) for off-highway truck
4	Crane (20 ton)	130	Diesel	100	1.17	0.39	2.99	0.26	0.39	0.009	0.003	0.023	0.002	0.003	2) for cranes
5	Crawler Crane (250 ton)	330	Diesel	100	2.97	0.99	7.59	0.66	0.99	0.009	0.003	0.023	0.002	0.003	2) for cranes
6	Dozer	95	Diesel	100	0.95	0.19	1.995	0.19	0.095	0.010	0.002	0.021	0.002	0.001	2) for rubber tired dozer
7	Dump Truck (16 CY)	250	Diesel	na	1.8	0.19	4.17	0.45	0.26	-	-	-	-	-	1) for off-highway truck
8	Fork Lift (7 ton)	100	Diesel	na	0.52	0.17	1.54	0.143	0.093	-	-	-	-	-	1) for 175 hp fork lift
9	Front End Loader (3 CY)	140	Diesel	na	0.572	0.23	1.9	0.182	0.17	-	-	-	-	-	1) for wheeled loader
10	Grader	150	Diesel	na	1.25	0.27	3.84	0.46	0.41	-	-	-	-	-	1) for scraper
11	Hydro Crane (18 ton)	130	Diesel	100	1.17	0.39	2.99	0.26	0.39	0.009	0.003	0.023	0.002	0.003	2) for cranes
12	Hydro Crane (30 ton)	130	Diesel	100	1.17	0.39	2.99	0.26	0.39	0.009	0.003	0.023	0.002	0.003	2) for cranes
13	Man Lift (40 ft)	32	Diesel	na	0.18	0.053	0.441	0.143	0.031	-	-	-	-	-	1) for 50 hp forklift
14	Man Lift (80 ft)	63	Diesel	na	0.18	0.053	0.441	0.143	0.031	-	-	-	-	-	1) for 50 hp forklift
15	Misc. Equipment	50	Diesel	na	0.675	0.15	1.7	0.143	0.14	-	-	-	-	-	1) for misc. equip
16	Motor Grader	-	Diesel	na	0.151	0.039	0.713	0.086	0.061	-	-	-	-	-	1) for motor grader
17	Pick-up Truck (3/4 ton)	250	Gasoline	na	17.02	0.543	0.412	0.023	0.026	-	-	-	-	-	1) for misc. equip
18	Pumps	20	Diesel	na	0.011	0.002	0.018	0.002	0.002	-	-	-	-	-	2) for pumps
19	Shovel/Breaker	128	Diesel	na	0.675	0.15	1.7	0.143	0.14	-	-	-	-	-	1) for misc. equip
20	Tractor/Trailer (60 ton, 40 ft)	225	Diesel	na	1.8	0.19	4.17	0.45	0.26	-	-	-	-	-	1) for off-highway truck
21	Truck Crane (65 ton)	400	Diesel	na	1.8	0.19	4.17	0.45	0.26	-	-	-	-	-	1) for off-highway truck
22	Vibro Roller	42	Diesel	na	0.3	0.065	0.87	0.067	0.05	-	-	-	-	-	1) for rollers
23	Water Truck (4,000 gal)	200	Diesel	na	1.8	0.19	4.17	0.45	0.26	-	-	-	-	-	1) for off-highway truck
24	Welding Machine	50	Diesel	100	0.55	0.1	0.9	0.1	0.1	0.011	0.002	0.018	0.002	0.002	2) for welders
29	Asphalt Paver	91	Diesel	100	0.637	0.091	2.093	0.182	0.091	0.007	0.001	0.023	0.002	0.001	1) for paving equip (4-strk)
30	Bore/Drill Rig	209	Diesel	100	4.18	0.627	5.016	0.418	0.3135	0.020	0.003	0.024	0.002	0.002	1) bore/drill rig
31	Concrete Saw	56	Diesel	100	1.12	1.344	0.112	0.168	0.056	0.020	0.024	0.002	0.003	0.001	1) concrete saw
32	Tug (EMD 12-645E5)	3000	Diesel	100	0.775	0.351	12.494	0.162	0.684						3)
33	Barge Generator (800 HP)	800	Diesel	100	8.712	1.584	14.256	1.584	0.792						3)
34	Generator sets <50HP	22	Diesel	100	0.242	0.044	0.396	0.044	0.022	0.011	0.002	0.018	0	0.001	1) for generator sets <50 HP

References
1) Emission factors taken from SCAQMD CEQA Air Quality Handbook, Table 9-8-A
2) Emission factors taken from SCAQMD CEQA Air Quality Handbook, Table 9-8-C. Pounds/hour calculated from load factor and hp rating
3) Emission factors from personal communication with Joe Petrini, SBCAPCD

Emission Factors - On Road Mobile Emission Factors from California ARB EMFAC7G

Code	Vehicle Type		NOx Exhaust Emission Factor (g/mile)	NOx Continuous Start EF (g/trip)	CO Exhaust Emission Factor (g/mile)	CO Continuous Start EF (g/trip)	ROG Exhaust Emission Factor (g/mile)	ROG Continuous Start EF (g/trip)	ROG Hot Soak Factor (g/trip)	ROG Diurnal & Resting Losses (g/vehicle-day)	ROG Evap Running Losses, (g/mile)	SO2 Emission Factor (g/mile)	PM10 Emission Factor (g/mile)
101	Gasoline		0.61	1.84	6.09	22.70	0.40	2.44	0.51	7.10	1.03	0.06	0.02
102	Diesel		13.13	0.00	13.92	0.00	3.01	0.00	0.00	0.00	0.00	0.06	0.96

Diurnal & Resting losses vehicle ROG emissions based on a 10 hour day
Based on Calif. ARB EMFAC7G model years 1963 - 1997, enhanced I&M, 75 deg F, 25 MPH
Trip time assumed to be 60 minutes for continuous start emission factors
EMFAC7G was finalized in Oct. 1996

Tranquillon Ridge Development Project - Air Emissions
Operating Emissions Summary

Proposed Project (Tranquillon Ridge Project)

Location and Activity or Equipment	Peak Daily Emission (lbs/day)					Annual Emissions (tons/yr)				
	CO	ROC	NOx	SO_2	PM_{10}	CO	ROC	NOx	SO_2	PM_{10}
LOGP + Valve Site 2 Additional Emissions										
Heater Treaters - 2 additional units	14.13	1.31	20.43	9.60	5.76	2.579	0.238	3.728	1.752	1.051
Additional Truck trips	1.44	0.35	0.14	0.01	0.00	0.075	0.018	0.007	0.001	0.000
Additional fugitive emissions (Valve Site 2)	-	0.06	-	-	-	-	0.011	-	-	-
Platform Irene Additional Emissions										
Emissions from drilling muds	-	1.00	-	-	-	-	0.040	-	-	-
Drilling Equipment	32.06	12.06	88.89	2.22	10.58	1.144	0.430	3.170	0.079	0.377
Helicopter emissions (do not contribute to peak day)	-	-	-	-	-	3.844	1.355	0.019	0.010	0.013
Boat emissions (do not contribute to peak day)	-	-	-	-	-	1.238	0.305	0.305	0.412	0.483
Fugitive emissions	-	39.00	-	-	-	-	7.118	-	-	-
Total Additional Operational Emissions (Project)	**47.64**	**53.78**	**109.46**	**11.84**	**16.35**	**8.88**	**9.52**	**7.23**	**2.25**	**1.92**
Significance Criteria	**n/a**	**55**	**55**	**n/a**	**80**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
Significant?		**Yes**	**Yes**							

Proposed Project Emissions vs Permitted and Current Emissions of Point Pedernales Project

Location and Activity or Equipment	Peak Daily Emission (lbs/day)					Annual Emissions (tons/yr)				
	CO	ROC	NOx	SO_2	PM_{10}	CO	ROC	NOx	SO_2	PM_{10}
LOGP Permitted Equipment - Current (2005)	n/a *	n/a *	n/a *	n/a *	n/a *	0.89	35.86	2.53	0.58	0.61
LOGP Exempt Equipment - Current (Estimate)						0.83	0.42	3.31	0.22	0.22
Platform Permitted Equipment - Current (2005)	n/a *	n/a *	n/a *	n/a *	n/a *	2.66	26.05	12.52	1.04	1.01
Platform Exempt Equipment - Current (Estimate)						4.10	4.27	11.24	0.70	0.68
Total Current						8.48	66.60	29.60	2.54	2.52
Total Additional from Project						8.88	9.52	7.23	2.25	1.92
Total = (Current + Project)						**17.36**	**76.11**	**36.83**	**4.79**	**4.44**

	CO	ROC	NOx	SO_2	PM_{10}
Total Point Pedernales Project ESE (Permitted - PTO 6708 Table 5.4, page 59)	23.76	75.25	74.86	13.73	8.06
Available Offset Credits **	**n/a**	**166.03**	**82.52**	**n/a**	**n/a**

ESE - Entire Source Emissions

ESE includes Permitted Emissions of the entire source at the Potential to Emit, includes Pl. Irene, LOGP, Orcutt Pump Station & Lompoc Oil Field

** Daily emissions are not reported*

*** Offset Credits are required only for NOx and ROC and are in terms of quarterly and annual emissions, and not in terms of daily emissions*

LOGP and Platform Current Emissions are from Operation Data reported to SBCAPCD.

LOGP Operating Equipment Parameters

Equipment Category	Emissions Unit	Equipment Specifications				Usage Data			Peak Load Schedule (hrs)			
Equipment Category	Emissions Unit	Fuel	% S	Size	Units	Capacity	Units	Load	hr	day	qtr	year
Combustion - External	Heater Treater A	NG	0.0080	16	MMBtu/hr	0.140	MMBtu/yr	--	1	24	2190	8760
	Heater Treater B	NG	0.0080	16	MMBtu/hr	0.140	MMBtu/yr	--	1	24	2190	8760
	Heater Treater C	NG	0.0080	16	MMBtu/hr	0.140	MMBtu/yr	--	1	24	2190	8760
	Thermal Oxidizer	NG	0.0080	12	MMBtu/hr	0.105	MMBtu/yr	--	1	24	2190	8760
Flare - combustion	Purge & Pilot	PG	0.0080	45	scfh	0.059	MMBtu/hr	--	1	24	2190	8760
	Planned - continuous	--	--	--	--	--	--	--	--	--	--	--
	Unplanned	SG	0.0796	625	MMBtu/hr	0.959	MMscf/yr	--	--	--	0.25	1
Fugitive emissions	Oil - controlled	--	--	5,778	comp-lp	--	--	--	1	24	2190	8760
	Gas - controlled (valves)	--	--	1,111	comp-lp	--	--	--	1	24	2190	8760
	Gas - controlled (connections)	--	--	6,500	comp-lp	--	--	--	1	24	2190	8760
	Gas - controlled (pumps)	--	--	4	comp-lp	--	--	--	1	24	2190	8760
	Gas - controlled (PRD)	--	--	45	comp-lp	--	--	--	1	24	2190	8760
	Gas - controlled (compressors)	--	--	6	comp-lp	--	--	--	1	24	2190	8760
Oil pipeline (Surf to LOGP)	Oil - controlled (valves)	--	--	222	comp-lp	--	--	--	1	24	2190	8760
	Oil - controlled (connections)	--	--	1	comp-lp	--	--	--	1	24	2190	8760
Gas pipeline (Surf to LOGP)	Gas - controlled (valves)	--	--	89	comp-lp	--	--	--	1	24	2190	8760
	Gas - controlled (connections)	--	--	1	comp-lp	--	--	--	1	24	2190	8760
Oil pipeline (LOGP to OPS)	Oil - controlled (valves)	--	--	17	comp-lp	--	--	--	1	24	2190	8760
	Oil - controlled (connections)	--	--	96	comp-lp	--	--	--	1	24	2190	8760
Pigging Equipment	Oil Pig Receiver	--	--	32	cf	5.0	psig	--	1	24	92	366
	Gas Pig Receiver	--	--	32	cf	5.0	psig	--	1	24	104	417
Sumps	S-800 (Inlet sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-801 (Crude dehydration sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-820 (Water treating sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-830 (Reject Tank sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-840 (Outlet sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-850 (Flotation unit froth sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-860 (Control Building Lab sump	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-870 (Oil surge tank sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-890 (Containment area sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
	S-895 (Amine sump)	--	--	12.50	ft2	--	--	--	1	24	2190	8760
Solvent Usage	Cleaning/degreasing	--	--	various		--	--	--	1	24	2190	8760

Notes: OPS - Orcutt Pump Station

LOGP Equipment Emission Factors - from Part 70 PTO 6708

Equipment Category	Emissions Unit	Emission Factors						Units	
		NOx	ROC	CO	SOx	PM	PM10		
Combustion - External	Heater Treater A	0.0266	0.0017	0.0184	0.0125	0.0075	0.0075	lb/MMBtu	
	Heater Treater B	0.0266	0.0017	0.0184	0.0125	0.0075	0.0075	lb/MMBtu	
	Heater Treater C	0.0266	0.0017	0.0184	0.0125	0.0075	0.0075	lb/MMBtu	
	Thermal Oxidizer	0.0495	0.0043	0.0380	0.0145	0.0110	0.0110	lb/MMBtu	
Flare - combustion	Purge & Pilot	0.0680	0.0027	0.0333	0.1020	0.0048	0.0048	lb/MMBtu	
	Planned	0.0680	0.0027	0.0333	0.1020	0.0048	0.0048	lb/MMBtu	
	Unplanned	0.0680	0.0027	0.0333	0.1020	0.0048	0.0048	lb/MMBtu	
Fugitive emissions (Oil plant)	Oil - controlled	--	0.0304	--	--	--	--	lb/day-clp	
	Oil - uncontrolled	--	0.4020	--	--	--	--	lb/day-clp	
	Gas - controlled (valves)	--	0.0249	--	--	--	--	lb/day-clp	
	Gas - controlled (connections)	--	2.6070	--	--	--	--	lb/day-clp	
	Gas - controlled (pumps)	--	0.6963	--	--	--	--	lb/day-clp	
	Gas - controlled (PRD)	--	--	--	--	--	--	lb/day-clp	
Fugitive emissions (Gas plant	Gas - controlled								
Oil pipeline (Surf to LOGP)	Oil - controlled (valves)	--	0.0304	--	--	--	--	lb/day-clp	
	Oil - controlled (connections)	--	0.0304	--	--	--	--	lb/day-clp	
Gas pipeline (Surf to LOGP)	Gas - controlled (valves)	--	0.4020	--	--	--	--	lb/day-clp	
	Gas - controlled (connections)	--	0.0249	--	--	--	--	lb/day-clp	
Oil pipeline (LOGP to OPS)	Oil - controlled (valves)	--	0.0304	--	--	--	--	lb/day-clp	
	Oil - controlled (connections)	--	0.0304	--	--	--	--	lb/day-clp	
Pigging Equipment	Oil Pig Receiver	--	0.0611	--	--	--	--	lb/acf-event	
	Gas Pig Receiver	--	0.0281	--	--	--	--	lb/acf-event	
Sumps	S-800 (Inlet sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-801 (Crude dehydration sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-820 (Water treating sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-830 (Reject Tank sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-840 (Outlet sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-850 (Flotation unit froth sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-860 (Control Building Lab sum	--	0.0130	--	--	--	--	lb/ft2-day	
	S-870 (Oil surge tank sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-890 (Containment area sump)	--	0.0130	--	--	--	--	lb/ft2-day	
	S-895 (Amine sump)	--	0.0130	--	--	--	--	lb/ft2-day	
Solvent Usage	Cleaning/degreasing	--	various	--	--	--	--	lbs/gal	

LOGP Hourly and Daily Operations Emissions

		NOx		ROC		CO		SOx		PM		PM10	
Equipment Category	**Emissions Unit**	**lbs/hr**	**lbs/day**	**lbs/hr**	**lbs/day**	**lbs/hr**	**lbs/day**	**lbs/hr**	**lbs/day**	**lbs/hr**	**lbs/day**	**lbs/hr**	**lbs/day**
Combustion - External	Heater Treater A	0.43	10.21	0.03	0.65	0.29	7.07	0.20	4.80	0.12	2.88	0.12	2.88
	Heater Treater B	0.43	10.21	0.03	0.65	0.29	7.07	0.20	4.80	0.12	2.88	0.12	2.88
	Heater Treater C	0.43	10.21	0.03	0.65	0.29	7.07	0.20	4.80	0.12	2.88	0.12	2.88
	Thermal Oxidizer	0.59	14.26	0.05	1.24	0.46	10.94	0.17	4.18	0.13	3.17	0.13	3.17
Flare - combustion	Purge & Pilot	0.00	0.10	0.00	0.00	0.00	0.05	0.01	0.14	0.00	0.01	0.00	0.01
	Planned	--	--	--	--	--	--	--	--	--	--	--	--
	Unplanned	--	--	--	--	--	--	--	--	--	--	--	--
Fugitive emissions (Oil plant)	Oil - controlled	--	--	1.46	35.13	--	--	--	--	--	--	--	--
	Oil - uncontrolled	--	--	3.72	89.32	--	--	--	--	--	--	--	--
	Gas - controlled (valves)	--	--	1.35	32.37	--	--	--	--	--	--	--	--
	Gas - controlled (connections)	--	--	0.09	2.09	--	--	--	--	--	--	--	--
	Gas - controlled (pumps)	--	--	0.26	6.27	--	--	--	--	--	--	--	--
	Gas - controlled (PRD)	--	--	0.00	0.00	--	--	--	--	--	--	--	--
Fugitive emissions (Gas plant)	Gas - controlled	--	--	2.14	51.38	--	--	--	--	--	--	--	--
Oil pipeline (Surf to LOGP)	Oil - controlled (valves)	--	--	0.06	1.35	--	--	--	--	--	--	--	--
	Oil - controlled (connections)	--	--	0.00	0.01	--	--	--	--	--	--	--	--
Gas pipeline (Surf to LOGP)	Gas - controlled (valves)	--	--	0.30	7.16	--	--	--	--	--	--	--	--
	Gas - controlled (connections)	--	--	0.00	0.00	--	--	--	--	--	--	--	--
Oil pipeline (LOGP to OPS)	Oil - controlled (valves)	--	--	0.00	0.10	--	--	--	--	--	--	--	--
	Oil - controlled (connections)	--	--	0.02	0.58	--	--	--	--	--	--	--	--
Pigging Equipment *	Oil Pig Receiver	--	--	1.95	1.95	--	--	--	--	--	--	--	--
	Gas Pig Receiver	--	--	0.90	0.90	--	--	--	--	--	--	--	--
Sumps	S-800 (Inlet sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-801 (Crude dehydration sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-820 (Water treating sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-830 (Reject Tank sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-840 (Outlet sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-850 (Flotation unit froth sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-860 (Control Building Lab sum	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-870 (Oil surge tank sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-890 (Containment area sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
	S-895 (Amine sump)	--	--	0.00	0.02	--	--	--	--	--	--	--	--
Solvent Usage	Cleaning/degreasing	--	--	3.95	31.6								
Totals		**1.87**	**45.00**	**16.35**	**263.58**	**1.34**	**32.19**	**0.78**	**18.72**	**0.49**	**11.81**	**0.49**	**11.81**

Source: PTO 6708

LOGP Quarterly and Annual Operations Emissions

		NOx		ROC		CO		SOx		PM		PM10	
Equipment Category	**Emissions Unit**	**TPQ**	**TPY**	**TPQ**	**TPY**	**TPQ**	**TPY**	**TPQ**	**TPY**	**TPQ**	**TPY**	**TPQ**	**TPY**
Combustion - External	Heater Treater A	0.466	1.864	0.030	0.119	0.322	1.289	0.219	0.876	0.131	0.526	0.131	0.526
	Heater Treater B	0.466	1.864	0.030	0.119	0.322	1.289	0.219	0.876	0.131	0.526	0.131	0.526
	Heater Treater C	0.466	1.864	0.030	0.119	0.322	1.289	0.219	0.876	0.131	0.526	0.131	0.526
	Thermal Oxidizer	0.650	2.602	0.057	0.226	0.499	1.997	0.191	0.762	0.145	0.578	0.145	0.578
Flare - combustion	Purge & Pilot	0.004	0.018	0.000	0.001	0.002	0.009	0.007	0.026	0.000	0.001	0.000	0.001
	Planned	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Unplanned	0.009	0.036	0.000	0.001	0.004	0.018	0.013	0.054	0.001	0.003	0.001	0.003
Fugitive emissions (Oil plant)	Oil - controlled	--	--	1.603	6.411	--	--	--	--	--	--	--	--
	Oil - uncontrolled	--	--	4.075	16.302	--	--	--	--	--	--	--	--
	Gas - controlled (valves)	--	--	1.477	5.908	--	--	--	--	--	--	--	--
	Gas - controlled (connections)	--	--	0.095	0.381	--	--	--	--	--	--	--	--
	Gas - controlled (pumps)	--	--	0.286	1.144	--	--	--	--	--	--	--	--
	Gas - controlled (PRD)	--	--	0.000	0.000	--	--	--	--	--	--	--	--
Fugitive emissions (Gas plant)	Gas - controlled	--	--	2.35	9.38	--	--	--	--	--	--	--	--
Oil pipeline (Surf to LOGP)	Oil - controlled (valves)	--	--	0.005	0.020	--	--	--	--	--	--	--	--
	Oil - controlled (connections)	--	--	0.028	0.110	--	--	--	--	--	--	--	--
Gas pipeline (Surf to LOGP)	Gas - controlled (valves)	--	--	0.000	0.000	--	--	--	--	--	--	--	--
	Gas - controlled (connections)	--	--	0.018	0.070	--	--	--	--	--	--	--	--
Oil pipeline (LOGP to OPS)	Oil - controlled (valves)	--	--	0.008	0.030	--	--	--	--	--	--	--	--
	Oil - controlled (connections)	--	--	0.000	0.000	--	--	--	--	--	--	--	--
Pigging Equipment *	Oil Pig Receiver	--	--	0.089	0.357	--	--	--	--	--	--	--	--
	Gas Pig Receiver	--	--	0.047	0.188	--	--	--	--	--	--	--	--
Sumps	S-800 (Inlet sump)	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-801 (Crude dehydration sump	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-820 (Water treating sump)	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-830 (Reject Tank sump)	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-840 (Outlet sump)	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-850 (Flotation unit froth sump	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-860 (Control Building Lab su	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-870 (Oil surge tank sump)	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-890 (Containment area sump	--	--	0.007	0.030	--	--	--	--	--	--	--	--
	S-895 (Amine sump)	--	--	0.007	0.030	--	--	--	--	--	--	--	--
Solvent Usage	Cleaning/degreasing	--	--	0.620	2.480	--	--	--	--	--	--	--	--
Totals		**2.062**	**8.248**	**10.920**	**43.661**	**1.473**	**5.892**	**0.868**	**3.470**	**0.540**	**2.159**	**0.540**	**2.159**

Source: PTO 6708

** - Assumes a maximum of one pigging event eavery day*

Platform Irene Equipment - PTO 9106

Emission Factors

Equipment Category	Description	NOx	ROC	CO	SOx	PM	PM10	Units
		Emission Factors						
Combustion Engines	North Crane	2.446	0.36	0.95	0.20	0.31	0.30	lb/MMBtu
	South Crane	2.471	0.36	0.95	0.20	0.31	0.30	lb/MMBtu
Combustion Flare	Purge & Pilot	0.068	0.12	0.37	0.102	0.02	0.02	lb/MMBtu
	Planned- cont.	0.068	0.12	0.37	0.102	0.02	0.02	lb/MMBtu
	Planned - other	0.068	0.12	0.37	0.102	0.02	0.02	lb/MMBtu
	Unplanned	0.068	0.12	0.37	0.102	0.02	0.02	lb/MMBtu
Fugitive Components	Oil-controlled	-	0.0009	-	-	-	-	lb/day-clp
	Oil-unsafe	-	0.0009	-	-	-	-	lb/day-clp
	Gas-controlled	-	0.0147	-	-	-	-	lb/day-clp
	Gas-unsafe	-	0.0147	-	-	-	-	lb/day-clp
Supply Boat	Main Engines-con	337	16.8	78.3	28.2	33	32	lb/1000 gal
	Main Engines-uncon	561	16.8	78.3	28.2	33	32	lb/1000 gal
	Auxiliary Engines	600	49	129.3	28.2	42.2	40.5	lb/1000 gal
	Bow Thruster	600	49	129.3	28.2	42.2	40.5	lb/1000 gal
	Emergency Response	561	16.8	78.3	28.2	33	32	lb/1000 gal
Pigging Equipment	Oil Pig Launcher	-	0.061	-	-	-	-	lb/acf-evnt
	Gas Pig Launcher	-	0.028	-	-	-	-	lb/acf-evnt
Sumps/Tanks/Separators	Sub-deck Sump #A	-	0.013	-	-	-	-	lb/ft2-day
	Sub-deck Sump #B	-	-	-	-	-	-	lb/ft2-day
	Sub-deck Sump #C	-	-	-	-	-	-	lb/ft2-day
	Wastewater Tank 530	-	-	-	-	-	-	lb/ft2-day
	Wastewater Tank 540	-	-	-	-	-	-	lb/ft2-day
	Roll-off Bins (total of 4)	-	0.097	-	-	-	-	lb/ft2-day
Solvent Usage	Cleaning/Degreasing	-	various	-	-	-	-	lb/gal

Equipment Operation Parameters

Equipment Category	Description	Device Specifications				Usage Data		Load	Peak Load Schedule (hrs)			
		Fuel	%S	Size	Units	Capacity	Units		hr	day	qtr	year
Combustion Engines	North Crane		0.20	210	bhp	7,143	Btu/bhp-hr	-	1	24	730	2920
	South Crane		0.20	197	bhp	7,069	Btu/bhp-hr	-	1	24	730	2920
Combustion Flare	Purge & Pilot		0.0796			0.059	mmBtu/hr	-	1	24	2190	8760
	Planned- cont.		0.0796			3.101	mmscf/yr	-	1	24	0.25	1
	Planned - other		0.0537			1.699	mmscf/yr	-	-	-	0.25	1
	Unplanned		0.2996			20.8	mmscf/yr	-	-	-	0.25	1
Fugitive Components	Oil-controlled			3.859	comp-lp	-	-	-	1	24	2190	8760
	Oil-unsafe			0	comp-lp	-	-	-	1	24	2190	8760
	Gas-controlled			7.11	comp-lp	-	-	-	1	24	2190	8760
	Gas-unsafe			0	comp-lp	-	-	-	1	24	2190	8760
Supply Boat	Main Engines-con		0.20			0.049	gal/bhp-hr	0.65	1	11	275	1100
	Main Engines-uncon		0.20			0.055	gal/bhp-hr	0.65	1	11	28	110
	Auxiliary Engines		0.20			0.055	gal/bhp-hr	0.5	1	11	275	1100
	Bow Thruster		0.20			0.055	gal/bhp-hr	1	1	2	50	200
	Emergency Response		0.20			0.055	gal/bhp-hr	0.65	-	-	32	127
Pigging Equipment	Oil Pig Launcher		-	32	cf	5	psig	-	1	1	13	52
	Gas Pig Launcher		-	5	cf	5	psig	-	1	1	46	182
Sumps/Tanks/Separators	Sub-deck Sump #A		-	6	ft2	-	-	-	1	24	2190	8760
	Sub-deck Sump #B		-	18	ft2	-	-	-	1	24	2190	8760
	Sub-deck Sump #C		-	79	ft2	-	-	-	1	24	2190	8760
	Wastewater Tank 530		-	79	ft2	-	-	-	1	24	2190	8760
	Wastewater Tank 540		-	79	ft2	-	-	-	1	24	2190	8760
	Roll-off Bins (total of 4)		-	60	ft2	-	-	-	1	24	1008	3024
Solvent Usage	Cleaning/Degreasing		-	various	gals	various	-	-	1	24	2190	8760

Platform Irene Operations Emissions - PTO 9106

Hourly and Daily Emissions

Equipment Category	Description	NOx		ROC		CO		SOx		PM		PM10	
		lbs/hr	lbs/day	lbs/hr	lbs/day	lbs/hr	lbs/day	lbs/hr	lbs/day	lbs/hr	lbs/day	lbs/hr	lbs/day
Combustion Engines	North Crane	3.89	93.30	0.57	13.70	1.51	7.80	0.32	7.80	0.49	11.80	0.47	11.40
	South Crane	3.65	87.50	0.53	12.80	1.40	7.20	0.30	7.20	0.46	11.00	0.44	10.50
Combustion Flare	Purge & Pilot	0.00	0.10	0.00	0.01	0.00	0.12	0.01	0.15	0.00	0.00	0.00	0.01
	Planned- cont.	0.03	0.76	0.00	0.06	0.04	0.92	0.05	1.14	0.00	0.08	0.00	0.08
	Planned - other	-	-	-	-	-	-	-	-	-	-	-	-
	Unplanned	-	-	-	-	-	-	-	-	-	-	-	-
Fugitive Components	Oil-controlled	-	-	0.14	3.50	-	-	-	-	-	-	-	-
	Oil-unsafe	-	-	0.00	0.00	-	-	-	-	-	-	-	-
	Gas-controlled	-	-	4.35	104.50	-	-	-	-	-	-	-	-
	Gas-unsafe	-	-	0.00	0.00	-	-	-	-	-	-	-	-
Supply Boat	Main Engines-con	31.47	346.10	2.14	23.50	9.98	109.70	3.59	39.50	4.20	46.20	4.04	44.40
	Main Engines-uncon	80.25	882.70	2.40	26.40	11.20	123.20	4.03	44.30	4.72	51.90	4.53	49.80
	Auxiliary Engines	8.09	88.90	0.66	7.30	1.74	19.20	0.38	4.20	0.57	6.30	0.55	6.00
	Bow Thruster	17.00	34.00	1.39	2.80	3.66	7.30	0.80	1.60	1.19	2.40	1.15	2.30
	Emergency Response	-	-	-	-	-	-	-	-	-	-	-	-
Pigging Equipment	Oil Pig Launcher	-	-	1.95	1.95	-	-	-	-	-	-	-	-
	Gas Pig Launcher	-	-	0.14	0.14	-	-	-	-	-	-	-	-
Sumps/Tanks/Separators	Sub-deck Sump #A	-	-	0.00	0.10	-	-	-	-	-	-	-	-
	Sub-deck Sump #B	-	-	0.01	0.20	-	-	-	-	-	-	-	-
	Sub-deck Sump #C	-	-	0.04	1.00	-	-	-	-	-	-	-	-
	Wastewater Tank 530	-	-	0.04	1.00	-	-	-	-	-	-	-	-
	Wastewater Tank 540	-	-	0.04	1.00	-	-	-	-	-	-	-	-
	Roll-off Bins (total of 4)	-	-	0.97	23.30	-	-	-	-	-	-	-	-
Solvent Usage	Cleaning/Degreasing	-	-	3.95	31.60	-	-	-	-	-	-	-	-
Totals		**95.91**	**1187.40**	**15.82**	**231.40**	**15.89**	**165.70**	**5.09**	**66.40**	**6.24**	**83.50**	**5.99**	**80.10**

Quarterly and Annual Emissions

		tons/qtr	tons/yr	tons/qtr	tons/yr	tons/qtr	tons/yr	tons/qtr	tons/yr	tons/qtr	tons/yr	tons/qtr	tons/yr
Combustion Engines	North Crane	1.42	5.68	0.21	0.84	0.55	2.21	0.12	0.47	0.18	0.72	0.17	0.69
	South Crane	1.33	5.33	0.19	0.78	0.51	2.05	0.11	0.44	0.17	0.67	0.16	0.64
Combustion Flare	Purge & Pilot	0.00	0.02	0.00	0.00	0.01	0.02	0.01	0.03	0.00	0.00	0.00	0.00
	Planned- cont.	0.03	0.14	0.00	0.01	0.04	0.17	0.05	0.21	0.00	0.02	0.00	0.02
	Planned - other	0.02	0.08	0.00	0.01	0.02	0.09	0.03	0.11	0.00	0.01	0.00	0.01
	Unplanned	0.23	0.93	0.02	0.07	0.28	1.13	1.32	5.27	0.03	0.10	0.03	0.10
Fugitive Components	Oil-controlled	-	-	0.16	0.63	-	-	-	-	-	-	-	-
	Oil-unsafe	-	-	0.00	0.00	-	-	-	-	-	-	-	-
	Gas-controlled	-	-	4.77	19.07	-	-	-	-	-	-	-	-
	Gas-unsafe	-	-	0.00	0.00	-	-	-	-	-	-	-	-
Supply Boat	Main Engines-con	4.33	17.31	0.29	1.18	1.37	5.49	0.49	1.97	0.58	2.31	0.55	2.22
	Main Engines-uncon	1.10	4.41	0.03	0.13	0.15	0.62	0.06	0.22	0.06	0.26	0.06	0.25
	Auxiliary Engines	1.11	4.45	0.09	0.36	0.24	0.96	0.05	0.21	0.08	0.31	0.08	0.30
	Bow Thruster	0.42	1.70	0.03	0.14	0.09	0.37	0.02	0.08	0.03	0.12	0.03	0.11
	Emergency Response	1.40	5.61	0.04	0.17	0.20	0.78	0.07	0.28	0.08	0.33	0.08	0.32
Pigging Equipment	Oil Pig Launcher	-	-	0.01	0.10	-	-	-	-	-	-	-	-
	Gas Pig Launcher	-	-	0.00	0.00	-	-	-	-	-	-	-	-
Sumps/Tanks/Separators	Sub-deck Sump #A	-	-	0.00	0.10	-	-	-	-	-	-	-	-
	Sub-deck Sump #B	-	-	0.01	0.04	-	-	-	-	-	-	-	-
	Sub-deck Sump #C	-	-	0.05	0.19	-	-	-	-	-	-	-	-
	Wastewater Tank 530	-	-	0.05	0.19	-	-	-	-	-	-	-	-
	Wastewater Tank 540	-	-	0.05	0.19	-	-	-	-	-	-	-	-
	Roll-off Bins (total of 4)	-	-	0.49	1.47	-	-	-	-	-	-	-	-
Solvent Usage	Cleaning/Degreasing	-	-	0.62	2.47	-	-	-	-	-	-	-	-
Totals		**11.39**	**45.66**	**7.11**	**28.14**	**3.46**	**13.89**	**2.33**	**9.29**	**1.21**	**4.85**	**1.16**	**4.66**

Estimated Permit Exempt Operating Emissions

LOGP

A. Quarterly (Tons/Qtr)						
Equipment Category	NOx	ROC	CO	SOx	PM	PM10
Emergency Production Generators	1.46	0.12	0.32	0.10	0.10	0.10
Emergency Firewater Pump	1.84	0.14	0.40	0.12	0.12	0.12
Surface Coating - Maintenance	--	0.13	--	--	--	--
Trucks	0.00	0.01	0.03	0.00	0.00	0.00
TOTALS (ton/qtr)	**3.30**	**0.40**	**0.75**	**0.22**	**0.22**	**0.22**

B. Annual (Tons/yr)						
Equipment Category	NOx	ROC	CO	SOx	PM	PM10
Emergency Production Generators	1.46	0.12	0.32	0.10	0.10	0.10
Emergency Firewater Pump	1.84	0.14	0.40	0.12	0.12	0.12
Surface Coating - Maintenance	--	0.13	--	--	--	--
Trucks	0.01	0.03	0.11	0.00	0.00	0.00
TOTALS (ton/yr)	**3.31**	**0.42**	**0.83**	**0.22**	**0.22**	**0.22**

Soure: PTO 6708

Plarform Irene

A. Quarterly (Tons/Qtr)						
Equipment Category	NOx	ROC	CO	SOx	PM	PM10
Emergency Drill Generators	5.37	0.44	1.16	0.35	0.38	0.38
Emergency Production Generators	0.73	0.06	0.16	0.05	0.05	0.05
Emergency Firewater Pump	0.92	0.07	0.20	0.06	0.06	0.06
Helicopters	1.06	0.88	0.65	0.06	0.05	0.05
Diesel Storage Tanks	--	0.01	--	--	--	--
Surface Coating - Maintenance	--	0.13	--	--	--	--
TOTALS (ton/qtr)	8.08	1.59	2.17	0.52	0.54	0.54

B. Annual (Tons/yr)						
Equipment Category	NOx	ROC	CO	SOx	PM	PM10
Emergency Drill Generators	5.37	0.44	1.16	0.35	0.38	0.38
Emergency Production Generators	0.73	0.06	0.16	0.05	0.05	0.05
Emergency Firewater Pump	0.92	0.07	0.20	0.06	0.06	0.06
Helicopters	4.22	3.52	2.58	0.24	0.19	0.19
Diesel Storage Tanks	--	0.05	--	--	--	--
Surface Coating - Maintenance	--	0.13	--	--	--	--
TOTALS (ton/yr)	**11.24**	**4.27**	**4.10**	**0.70**	**0.68**	**0.68**

Source: PTO 9106 (October 2000), Table 5.4, page 50

Supply Boat Emission Estimates - Trips due to Drilling Operations at Platform Irene

Table A - Supply Boat Data

Equipment	Fuel %S	Number	Power (bhp)	Total Power	Fuel Usage (gals/bhp-	Load Factor	gals/hr	Maximum Schedule Daily (hours)	Maximum Schedule Quarterly (hours)	Maximum Schedule Annually (hours)	Project Added Schedule Daily (hours)	Project Added Schedule Quarterly (hours)	Project Added Schedule Annually (hours)
Main Engines - con	0.2	2	2,000	4,000	0.049	0.65	127.40	11	275	1100	0	50	200
Main Engines - uncon	0.2	2	2,000	4,000	0.055	0.65	143.00	11	27.5	110	0	5	20
Auxiliary Engines	0.2	2	245	490	0.055	0.5	13.48	11	275	1100	0	50	200
Bow Thruster	0.2	1	515	515	0.055	1.0	28.33	2	50	200	0	9.1	36.4

Source: Data based upon SBCAPCD PTO 9106, Platform Irene

10 % of the time a charter boat is used with main engines that do not utilize low NOx control

During drilling boat trips will be increased to 1 round trip every 3 days

Assumption: boats will not contribute to peak daily emissions

Table B - Supply Boat Emission Factors

Equipment	Emission Factors (lbs/1,000 gals) NO_X	ROC	CO	SO_X	PM	PM_{10}
Main Engines - con	247.0	16.8	78.3	28.2	33.0	32.0
Main Engines - uncon	561.0	16.8	78.3	28.2	33.0	32.0
Auxiliary Engines	600.0	49.0	129.3	28.2	42.2	40.5
Bow Thruster	600.0	49.0	129.3	28.2	42.2	40.5

Source: Data based upon SBCAPCD PTO 9106, Platform Irene

Table C - Current Supply Boat Fuel Use

Quarter	1999	2000	units
1	8,049	12,481	gallons
2	8,839	16,172	gallons
3	11,891	9,506	gallons
4	11,749	24,171	gallons
Total	**40,528**	**62,330**	gallons

Source: SBC APCD reported data

Table D - Estimated Supply Boat Emissions

Emissions	NO_X	ROC	CO	SO_X	PM	PM_{10}
Peak Hourly (lbs/hr)	60.40	4.19	15.38	4.77	5.97	5.77
Peak Daily (lbs/day)	0.00	0.00	0.00	0.00	0.00	0.00
Quarterly (tons/qr)	0.08	0.08	0.31	0.10	0.12	0.12
Annual (tons/yr)	0.31	0.31	1.24	0.41	0.50	0.48

Table E - Maximum Fuel Usage (at Maximum Operating Schedule)

Equipment	gals/hr	gals/day	gals/qr	gals/yr
Main Engines - con	127.4	1,401.4	36,436	145,746
Main Engines - uncon	143.0	1,573.0	40,898	163,592
Auxiliary Engines	13.5	148.2	3,854	15,415
Bow Thruster	28.3	56.7	1,473	5,892
Maximum Total	171	1,623	42,209	168,837

Notes for Table D and E:

Peak Hour emissions is a maximum based on all engines running simultaneously, charter boat is operating

Each boat round trip takes 11 hours: 8hrs cruise, 2hrs maneuver, 1hr idle

Drilling operations based on 2 boat round trips per week, or 1 additional trip/wk compared to current trips

Calculations use the same assumptions as SBCAPCD PTO 9106, Platform Irene

Drilling operations first (worst) year: 90 days/well x 4 wells = 360 days of operation.

Helicopter Emissions During Drilling at Platform Irene - Proposed Project

	Helicopters Operating Parameters						Peak Day Emissions, lbs					Annual Emissions, Tons				
Source	No. per Day	Daily Trips (one way)	No. of days per well*	Wells per year (worst case)	Horse Power	Time of Trip (min)	CO	ROC	NOx	SO2	PM10	CO	ROC	NOx	SO2	PM10
Helicopter - drilling - idle	1	3	90	4	1400	25	13.14	7.53	0.11	0.05	0.07	2.37	1.35	0.02	0.01	0.01
Helicopter - drilling - cruise	1	3	90	4	1400	25	8.21	1.03	10.60	1.03	1.37	1.48	0.00	0.00	0.00	0.00
Total							**21.35**	**8.55**	**10.71**	**1.08**	**1.44**	**3.84**	**1.35**	**0.02**	**0.01**	**0.01**

** - assumes that each well requires 90 days of daily helicopter support; 4 wells are drilled in the worst year.*

Helicopter Emission Factors

Reference	Mode	CO	ROC	NOx	SO_2	PM10	Units
Table 3.2.1-8, EPA 1980	Idle	73.0	41.8	0.6	0.3	0.4	g/hp-hr
Table 3.2.1-8, EPA 1980	Cruise	2.4	0.3	3.1	0.3	0.4	g/hp-hr

Cruise mode is assumed to take 95% of time of the whole trip

Trucks at the LOGP Mobile Emissions - Proposed Project

	Trucks Operating Parameters						Peak Day Emissions, lbs/day					Annual Emissions, Tons/yr				
Number of Vehicles per Day	Daily Trips (one way)	Number of trucks per week	Number of days per year	Distance One Way (miles)	Speed (mph)	Time of Trip (min)	CO	ROC	NOx	SO2	PM10	CO	ROC	NOx	SO2	PM10
Current																
1	2	3	156	50	50	60	1.44	0.34	0.14	0.01	0.00	0.112	0.027	0.011	0.001	0.000
Additional from Project																
1	2	2	104	50	50	60	1.44	0.35	0.14	0.01	0.00	0.075	0.018	0.007	0.001	0.000
Total (Current + Project)	**4**	**5**	**260**				**2.879**	**0.695**	**0.285**	**0.026**	**0.009**	**0.187**	**0.045**	**0.018**	**0.002**	**0.001**

Truck emissions factors - see Emission Factors for Mobile Sources in Construction in this Appendix (page C-8)

Drilling Equipment Emission Estimates - During Drilling at Platform Irene

Table A - Drill Rig Data

Equipment	Quantity	Load (hp)	Fuel	Note
Well Logging Unit	1	100	Diesel	1
Acidizing Pump	1	100	Diesel	2
Cement Pump	1	200	Diesel	3
Slurry Pump (Alternative Injection only)	1	1,000	Diesel	4

Notes to Table A - Estimated Data

1. Well logging unit operates 10 days per month.
2. Acidizing pump is operated 5 days per well, 8 hours/day
3. Cement pump operates 2 days per month, 8 hours per day
4. Slurry Pump operates 8 hrs/day, 55 days per well (Alternative)

Table B - Equipment Emission Factors

Equipment	g/hp-hr					
	NO_X	ROC	CO	SO_X	PM	PM_{10}
Well Logging Unit	8.4	1.14	3.03	0.21	1	1
Acidizing Pump	8.4	1.14	3.03	0.21	1	1
Cement Pump	8.4	1.14	3.03	0.21	1	1
Slurry Pump	8.4	1.14	3.03	0.21	1	1

Diesel I.C. Engines raw factors from AP-42, Table 3.3-1. NOx reduced by 40% to reflect optimum injection timing retard.
SO_2 adjusted for 0.05% sulfur in fuel. HC assumed to be 100% ROC. PM assumed to be 100% PM10.

Table C - Drilling Emissions

Drilling Emissions	NO_X	ROC	CO	SO_2	PM	PM_{10}
Peak Hour, lbs/hr						
Well Logging Unit	1.85	0.25	0.67	0.05	0.22	0.22
Acidizing Pump	1.85	0.25	0.67	0.05	0.22	0.22
Cement Pump	3.70	0.50	1.34	0.09	0.44	0.44
Slurry Pump	18.52	2.51	6.68	0.46	2.20	2.20
Total Hourly Emissions - Project	***7.41***	***1.01***	***2.67***	***0.19***	***0.88***	***0.88***
Total Hourly Emissions - Alternative	***25.93***	***3.52***	***9.35***	***0.65***	***3.09***	***3.09***
Peak Day, lbs/day						
Well Logging Unit	44.45	6.03	16.03	1.11	5.29	5.29
Acidizing Pump	14.82	2.01	5.34	0.37	1.76	1.76
Cement Pump	29.63	4.02	10.69	0.74	3.53	3.53
Slurry Pump	148.15	20.11	53.44	3.70	17.64	17.64
Peak Daily Emissions - Project	***88.89***	***12.06***	***32.06***	***2.22***	***10.58***	***10.58***
Total Daily Emissions - Alternative	***237.04***	***32.17***	***85.50***	***5.93***	***28.22***	***28.22***
tons/qr						
Well Logging Unit	0.67	0.09	0.24	0.02	0.08	0.08
Acidizing Pump	0.04	0.01	0.01	0.00	0.00	0.00
Cement Pump	0.09	0.01	0.03	0.00	0.01	0.01
Slurry Pump	4.07	0.55	1.47	0.10	0.49	0.66
Total Quarterly Emissions - Project	***0.79***	***0.11***	***0.29***	***0.02***	***0.09***	***0.09***
Total Quarterly Emissions - Alternative	***4.87***	***0.66***	***1.76***	***0.12***	***0.58***	***0.76***
First year - tons/yr						
Well Logging Unit	2.67	0.36	0.96	0.07	0.32	0.32
Acidizing Pump	0.15	0.02	0.05	0.00	0.02	0.02
Cement Pump	0.36	0.05	0.13	0.01	0.04	0.04
Slurry Pump	16.30	2.21	5.88	0.41	1.94	2.65
Total Annual Emissions - Project	***3.17***	***0.43***	***1.14***	***0.08***	***0.38***	***0.38***
Total Annual Emissions - Alternative	***19.47***	***2.64***	***7.02***	***0.49***	***2.32***	***3.02***
Every following year - tons/yr						
Well Logging Unit	1.33	0.18	0.48	0.03	0.16	0.16
Acidizing Pump	0.07	0.01	0.03	0.00	0.01	0.01
Cement Pump	0.18	0.02	0.06	0.00	0.02	0.02
Slurry Pump	8.15	1.11	2.94	0.20	0.97	1.32
Total Annual Emissions - Project	***1.59***	***0.22***	***0.57***	***0.04***	***0.19***	***0.19***
Total Annual Emissions - Alternative	***9.73***	***1.32***	***3.51***	***0.24***	***1.16***	***1.51***

Notes to Table C - Assumptions:

Assumes 30 wells drilled at Irene
Assumes one well takes 3 mnths to complete.
Drilling will be spread over 15 years
Assumes in an average year: 2 wells/year.
First year - 4 wells will be drilled
Worst case scenario: 1 well/quarter, 4 wells/year

Estimated Emissions from Mud System (ROC) - Drilling at Platform Irene (Proposed Project)

Assumptions

Volume of gas in drilling mud from one well = 85,000 scf
Density of gas = 0.0056 lbs/scf
Fraction of gas that is reactive organic compounds (ROC) = 20.5%
Density of ROC gas = 0.00115 lbs/scf
Average time required to drill one well = 95 days
Time when gas may be present in mud per well = 20 days
The mud-gas separator and mud degasser removal efficiency = 98%
Mud-gas separator and mud degasser are vented at the top of the derrick
Worst case scenario - 4 wells per year

				ROC Emissions				
Source	**SCF/hr**	**SCF/day**	**% ROC**	**lbs/hr**	**lbs/day**	**lbs/well**	**tons/qrt**	**tons/yr**
Mud-gas Separator/Mud Degasser Vent	174	4165	20.5%	0.041	0.980	19.590	0.010	0.039
Fugitives from Mud Tanks	4	85	20.5%	0.001	0.020	0.400	0.000	0.001
Total	177	4250		0.042	0.999	19.990	0.010	0.040

Estimated Fugitive Emissions from New Wells - Platform Irene (Proposed Project)

Component Type	Quantity	Emission Factor	ROC Emissions			
		lbs/day-clp	lbs/hr	lbs/day	tons/qr	tons/yr
Oil - controlled	2500	0.0009	0.094	2.25	0.103	0.411
Oil - unsafe	0	0.0044	0.000	0.00	0.000	0.000
Gas - controlled	2500	0.0147	1.531	36.75	1.677	6.707
Gas - unsafe	0	0.0736	0.000	0.00	0.000	0.000
Total	5000		1.625	39.00	1.779	7.118

Source: Emission Factors from SBCAPCD PTO 9107, Platform Irene.

Notes: Component counts are estimates only. Actual counts will be developed when wells are installed.
Assumes 20 new Tranquillon Ridge wells operating at one time, 250 leak paths per well.

LOGP Health Screening Assessment based on HAPs Emissions
Current Estimated HAPs Emissions - PTO 6708

					Health Risk Screening						HI - Chronic		HI - Acute	
Type	**Substance**	**ROC Emissions, lb/hr**	**ROC Emissions, lb/day**	**ROC Emissions, lb/yr**	**X/Q Value***	**MET**	**Unit Risk Factor $(um/m^3)^{-1}$**	**MP factor**	**LEA**	**MICR**	**REL**	**HI**	**REL**	**HI**
Hydrocarbon Based														
VOC	Benzene	0.0062	1.49E-01	0.720	13.050	1.000	2.90E-05	1.000	1.000	1.36E-07	7.10E+01	6.62E-05	7.80E+02	6.02E-06
VOC	Toluene	0.0052	1.25E-01	6.060	13.050						2.00E+02		3.70E+04	1.07E-06
VOC	Xylene	0.0020	4.80E-02	2.490	13.050						3.00E+02	5.42E-05	2.20E+03	7.39E-06
VOC	Acetaldehyde	0.0203	4.87E-01	0.630	13.050	1.000	2.70E-06	1.000	1.000	1.11E-08				
VOC	Acrolein	0.0015	3.60E-02	0.340	13.050						2.00E-02	1.11E-01	1.20E-01	1.85E-02
VOC	Butadiene-1,3	0.0104	2.50E-01	0.100	13.050	1.000	1.70E-04	1.000	1.000	1.11E-07				
VOC	Formaldehyde	0.0417	1.00E+00	0.860	13.050	1.000	6.00E-06	1.000	1.000	3.37E-08	3.60E+00	1.56E-03	1.70E+01	3.30E-04
VOC	Methanol	0.0001	2.40E-03	1.050	13.050						6.20E+02		2.80E+03	2.45E-06
VOC	Naphthalene	0.0008	1.92E-02	1.170	13.050						1.40E+01			
Particulate Based														
Other	H_2S	0.0023	5.52E-02	0.500	13.050						4.20E+01	7.77E-05	4.20E+01	7.77E-05
Other	NO_2			16500.000	13.050						4.70E+02	2.29E-01		
Metal	Mercury	0.0001	2.40E-03	0.000	13.050						3.00E-01	0.00E+00	1.80E+00	0.00E+00
Metal	Lead	0.0001	2.40E-03	0.000	13.050	1.000	8.00E-05	1.000	1.000	0.00E+00	1.50E+00			
						Health Risk Screening Results = 2.92E-07					**HI chr = 3.42E-01**		**HI act = 1.89E-02**	

*Notes: * - > 30,000 ft^2 facility*

Maximum Individual Cancer Risk (MICR)

MICR = Q tons x X/Q x MET x URF x MP x LEA

Q - maximum emissions rate (tons/year)
X/Q - Dispersion factor (ug/m3)/(tons/yr)
MET - Meteorological correction factor
URF - Unit Risk Factor (ug/m3)-1
MP - Multipathway factor (if applicable)
LEA - Lifetime exposure adjustment factor

Health Index (HI)

HI = (Q tons x X/Q) / (REL)

REL - reference exposure level (ug/m3)

Greenhouse Gases Operating Emissions Summary - Proposed Project

Location and Activity or Equipment	Annual Emissions (tons/yr)			
	CO2	CH4	NOx	SO2
LOGP + Valve Site #2 Additional Emissions				
Heater Treaters	13,355.5	0.002	3.728	1.752
Additional Truck trips	29.2	0.001	0.007	0.001
Additional fugitive emissions (Valve Site #2)	-	0.044	-	-
Platform Irene Additional Emissions				
Emissions from drilling muds	-	0.160	-	-
Drilling Equipment	182.9	0.023	3.170	0.079
Helicopter emissions	534.3	0.134	0.019	0.010
Boat emissions	1,197.5	0.016	0.305	0.412
Fugitive emissions	-	28.470	-	-
Total Additional Emissions (Project)	15,299.4	28.8	7.2	2.3

References

1. California ARB, 1991. Identification of Volatile Organic Compound Species Profiles.
2. Union Oil Project/Exxon Shamrock Project EIR/EIS Table 4-29
3. Perry's Chemical Engineer's Handbook, 6th edition, McGraw Hill, pp. 9-10 & 9-11.
4. Personal communcation with Lester Truck Rentals Co., Thousand Oaks, CA.
5. Perry's Chemical Engineer's Handbook, 6th edition, McGraw Hill, p. 3-78

Assumptions/Information

CO_2 amount is calculated from fuel combustion reaction stoichiometry
99.5% of carbon in fuel is converted to CO_2 during combustion (estimate)
CH_4 = Total hydrocarbons (THC) - Reactive Organic Compounds (ROC)
For fugitive component emissions: THC = 80% CH_4 + 20% ROC (estimate)
For diesel fuel combustion: THC = 5% CH4 + 95% ROC (Ref. 1)
For gasoline combustion: THC = 9% CH4 + 81% ROC (Ref. 1)
For natural gas combustion: THC = 1% CH4 + 99% ROC (estimate)
Helicopter fuel usage - 124 gal/hr (cruise), 18.7 gal/hr (idle) (Ref. 2)
Carbon content of diesel fuel = 84.7 - 87.3 C% (Ref. 3)
Diesel fuel density = 0.85 - 0.876 g/liter (Ref. 3)
Diesel usage by trucks - 4-5 miles/gallon (Ref. 4)
Drilling equipment diesel usage - 19 gallons/hour (estimate)
Density of CO2 (Ref.5) standard conditions, lbs/cu ft = **0.1235**
Density of CH4 (Ref.5) standard conditions, lbs/cu ft = **0.0448**
Amount of CO2 from gasoline combustion, lbs/gall = **20.0**
Amount of CO2 from diesel combustion, lbs/gall = **22.5**
Amount of CO2 from gas combustion, lbs/lb of CH4 = **2.7**
Stoichiometry: $CH_4 + 2O_2 = CO_2 + 2H_2O$

Attachment D Drilling Mud Dispersion Modeling

Attachment D
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Attachment D Drilling Mud Dispersion Modeling

D.1 Background

This appendix presents the results of far-field dispersion modeling conducted around Platform Irene. The modeling was conducted to determine the spatial extent of drilling mud deposition on the sea floor. Specifically, it determines whether the depositional footprint extends into State waters within the three-mile limit; and if so, whether the particulate concentration is likely to exceed water-quality standards.

Most past field investigations into the fate of drilling wastes have focused on the distribution of drilling solids in surficial sediments close (<0.5 km) to short–term exploration wells (e.g., O'Reilly et al., 1989, Boothe and Presley, 1989; Jenkins et al., 1989; and Neff et al., 1989a). Others have concentrated on heavier drill cuttings that are deposited immediately below platforms (Zingula and Larson, 1977; de Margerie, 1989). In contrast, this investigation examines the lighter fraction of drilling fluid that is carried by ambient currents and initially deposited at mid– and far–field distances (beyond 0.5 and 1.0 km from the source, respectively).

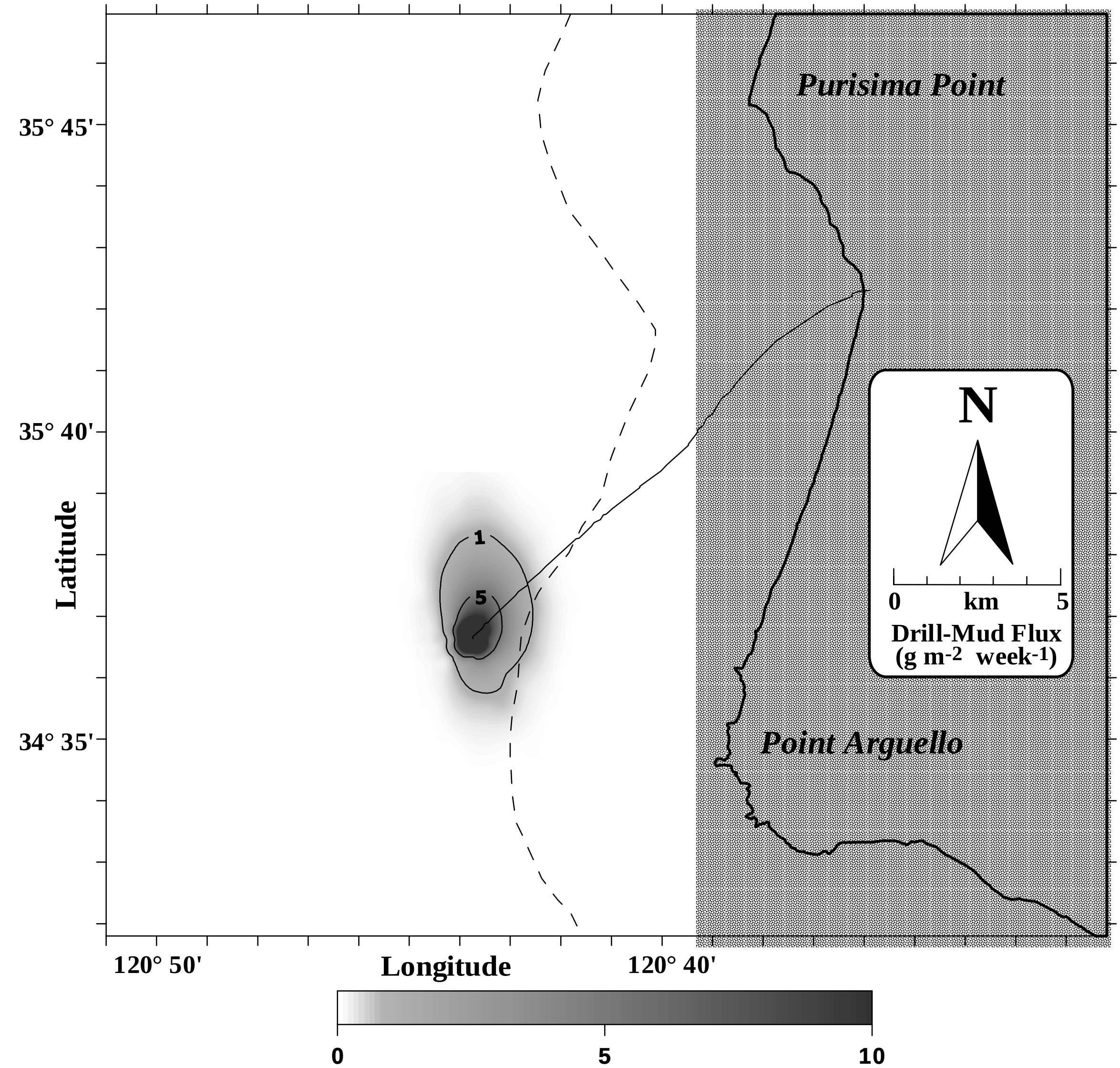
D.2 Model Description

Platform Irene lies six miles west of Point Pedernales in an oceanographically complex region. The mud model applied here was first applied in the same oceanographic regime near Point Arguello (Coats, 1994). The flow field in this region is complicated by the right angle change in the coastline orientation between the Santa Barbara Channel and the Santa Maria Basin (Figure D-1).

Processes that determine the ultimate fate of drilling–derived particulates in the marine environment are also complex. They include initial plume dynamics, passive current transport, wave–current resuspension, chemical weathering, bioturbation, burial, and biological uptake (National Research Council, 1983). Immediately upon discharge, dynamic plume processes dominate the dispersion of drilling particulates. These initial turbulent processes within the plume rapidly mix and dilute suspended particulates as gravitational forces deposit most of the drill cuttings and heavier aggregates of drilling material in the near–field, within about 0.5 km of platforms (Continental Shelf Associates, 1985). Lighter particulate material remains in the water column and is passively advected by ambient currents and deposited over greater distances. After deposition, long–term processes, such as resuspension, serve to further disperse drilling particles and expose benthic epibiota to low concentrations of drilling particles over extended periods.

This study focuses on the process of passive current transport, which initially distributes the particulates over wide areas and exposes benthic organisms to brief episodes of high drilling–particle concentrations within discharge plumes. It was this initial deposition that resulted in the significantly enriched barium signatures observed in sediment traps located at distances beyond 0.5 km from the Platform Hidalgo (Hyland et al., 1994).

Figure D-1 **Predicted Deposition of Drilling Particulates Discharged from Platform Irene**



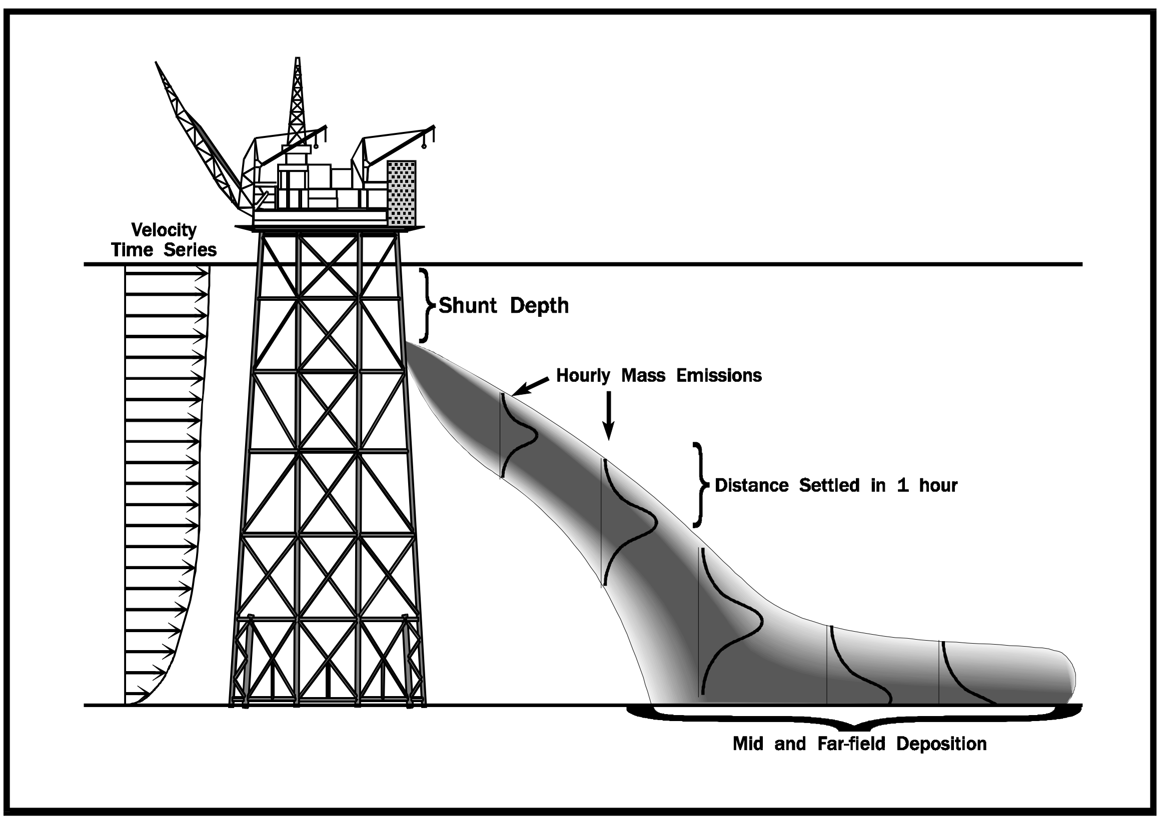
The numerical computation of initial deposition tracks plumes of drilling–fluid discharges as they settle and impinge on the benthos. The model was first applied to investigate mud deposition around Platforms Harvest, Hidalgo, and Hermosa (Coats, 1994). Subsequently, the model was applied to delineate additional discharges from these platforms (SAIC, 1995). Similar particle tracking analyses have been employed to evaluate other aspects of pollutant dispersion in the ocean (van Dam, 1982). Fry and Butman (1991) used a comparable approach to estimate depositional patterns resulting from disposal at the 106–mile dump site off the Atlantic coast.

D.2.1 Trajectory Computation

Although trajectory computations neglect initial plume dynamics and oceanic turbulence, they are capable of generating gross temporal and spatial patterns consistent with direct observations of particulate flux. Their success lies in the ability to integrate cumulative effects from many plumes over long periods. They indicate that, over the long–term, mid– and far–field depositional patterns are primarily controlled by the general circulation and geometry of the discharge sources.

The schematic shown in Figure D-2, illustrates the relationship among the principal parameters of the drilling–mud trajectory computation. For Platform Irene, a uniform hourly mass emission of particulates is computed from the total projected discharge volume over the life of the project. A total volume of 51,500 m^3 of drill mud will be discharged at a rate of 3.5 gpm over the 7.4 years of drilling. Although the daily discharge volume varies substantially, a uniform discharge rate is assumed for this computation. Short–term temporal variability in measured currents provides sufficient stochastic variability in the trajectories of individual plumes so long-term depositional patterns can be accurately represented.

Figure D-2 Schematic of the Depositional Model



The model assumes that about 10% of the discharge is deposited immediately below the platform as cuttings. The heavier coarse mud particulates are deposited in the near field during an initial phase of convective descent and dynamic collapse. These initial phases can be addressed in short–term near-field analyses incorporated in the Offshore Operators Committee model (Continental Shelf Associates, 1985). The depth of the plume of lighter material, remaining suspended at the edge of the zone of initial dilution, is largely determined by the 46-m shunt depth on Platform Irene.

The rate of plume settlement was one of the most sensitive parameters in the initial deposition analysis of open–ocean waste disposal (Fry and Butman, 1991). Fry and Butman's trajectory computations benefited from the results of numerous laboratory studies on the settling rates of sewage particulates. In contrast, only a few comprehensive laboratory investigations of drilling–mud settlement in seawater have been completed (Huang, 1992). Past studies into the behavior of clay–sized particles in seawater have revealed that settling behavior is complicated by their cohesive properties which result in the formation of light–weight aggregates or flocs. Consequently, settling speed is largely dictated by the properties of the flocs rather than the individual particles. For example, Stoke's Law specifies the terminal velocity of an individual spherically–shaped bentonite particle of diameter 0.005 cm and density 4.5 g cm^{-3} to be near 0.5 cm s^{-1}. Burban et al (1990), however, found that settling speed for clay aggregates are as much as 1000 times slower than that predicted by Stoke's law for a solid particle of equivalent size. They also found that the density of flocs, and hence their settling velocity, measurably increased with increasing ambient concentrations of suspended particulates and with increasing fluid shear, with the latter being the most influential.

These effects have been included in a global fate model developed for the Point Conception region by Pickens and Lick (1992). It addresses resuspension of drilling muds after deposition on the seafloor and incorporates settling rates applicable to the much denser flocs formed within high resuspended sediment concentrations generated by highly–sheared benthic flow. They represent settling speeds under a variety of flow conditions by empirically incorporating recent laboratory analyses of drilling–muds by Huang (1992). His work covers a broad range of flow conditions and particle concentrations.

In contrast to resuspension processes, the initial deposition of drilling particles from discharge plumes occurs at relatively low particulate concentrations and in the presence of low fluid shear. The average settling speed of 0.06 cm s^{-1} selected for this study falls well within the range of Huang's empirical results for drilling mud from the Point Conception platforms. He found settling rates as high as 0.1 cm s^{-1} for flocs that reached a steady–state diameter of 0.01 cm within 24 hours of release. The somewhat lower settling rate used in this study represents average conditions. Also, the selection of 0.06 cm s^{-1} is consistent with a diagnostic trajectory computation that was conducted to match sediment-trap flux measured during the MMS California Monitoring Program near Point Conception (Battelle Ocean Sciences, 1991; Coats, 1994). Specifically, the selected settling rate provides particulate accumulations within the 400 km^2 analysis grid that are on the same order as those measured by the traps. Material with a slightly lower settling rate (<0.04 cm s^{-1}) remained in the water column for periods greater than three days and was transported out of the study area before impinging on the seafloor, well away from the sediment traps.

Variation in settling speed about the average 0.06 cm s^{-1} is included to empirically account for a range of particulate sizes. This is modeled with a vertical distribution in the concentration of particulates. As indicated in Figure D-2, the particulate mass associated with each hourly discharge is spread over depth as a Gaussian distribution. This allows continuous deposition of particulates along the plume path. At a given position along the plume trajectory, the fraction of particulates adjacent to the seafloor is deposited within the underlying 1-km^2 grid cell. The amount of deposition within the cell depends upon the vertical spread in particulates and their mean depth as the plume settles with time. The vertical spread is assumed to span three standard deviations from the centroid of the distribution to the seafloor. Initially, this means that the plume is effectively suspended well off the seafloor and the early deposits constitute less than 1% of the total mass in the plume. As the particulate plume settles through the water column, increasingly larger fractions of material adjacent to the seafloor accumulate within underlying grid cells; until the distribution center is deposited. Thereafter, decreasing fractions are deposited within grid cells along the plume trajectory.

The flux of drilling–derived particulates within an individual grid cell is determined from

$$\textbf{\textit{Flux}} = \sum_{\substack{\text{Hourly}\\ \text{Discharges}}} \frac{M \bullet F(\Delta t) \bullet \delta(\vec{X}_{\text{cell}}, \vec{X}_{\text{plume}})}{A \bullet T} \qquad \text{Equation A-1}$$

where $\delta=1$ indicates that the plume at $\vec{X}_{\text{plume}}$ is within the limits of the grid cell at $\vec{X}_{\text{cell}}$, otherwise $\delta=0$; A is the area of individual grid cells (1 km^2); T is the total duration of the seafloor deposition; M is the total particle mass in the plume; and $F(\Delta t)$ is the fraction of mass adjacent to the seafloor Δt hours after discharge or,

$$F(\Delta t) = \frac{1}{\sqrt{2x}} \exp\left[-\frac{9}{2} \bullet \left(1 - \frac{2\Delta t}{t}\right)^2\right]; \; 0 \le \Delta t \le 1 \qquad \text{Equation A-2}$$

where t is the settling time from shunt to seafloor in hours.

The amount of material accumulated within a particular grid cell is determined by the frequency with which plumes encounter that cell (viz. δ=1). Thus, the platform location and the ambient flow field largely dictate the long–term pattern of drilling particle flux. The plume movement is reminiscent of a progressive vector diagram where displacement relative to the release point is determined by temporal integration of current velocity.

D.2.2 Model Verification

The accuracy of the mud deposition model was originally verified during Phase II of the California Monitoring Program (CaMP; Coats, 1994). The verification was conducted near Platforms Harvest, Hermosa, and Hidalgo which are located offshore Point Conception a few miles south of Platform Irene. Subsequently, the model was successfully applied with slight modifications to predict additional discharges from these platforms in Phase III of CaMP (SAIC, 1995). Model verification consisted of comparisons between predicted depositional flux rates with measured drill-mud flux rates within sediment traps deployed around the platforms. Sediment–trap arrays were deployed at distances ranging between 0.5 and 6.5 km from the northernmost platform and the depositional flux of drilling–derived particulates was estimated from elevated barium concentrations in trapped sediments. The maximum flux of drilling solids, near 500 mg m^{-2} day^{-1}, represented less than 2 percent of the total particulate flux into the traps. Furthermore, a substantial portion of these drilling solids originated from the two distant platforms located 3.5 and 6.8 km to the southeast. Particle trajectory computations indicated that ambient current flow carried discharges toward the northwest. Cessation of drilling on the platforms to the southeast accounts for the observed temporal decline in drilling–particulate flux measured near the northernmost platform. Although drilling mud has been discharged at a nearly constant rate over the sampling period, nearby sediment traps recorded lower flux rates when the platforms to south stopped discharging drill mud. This unexpected temporal decline in sediment-trap flux was successfully captured in the depositional model.

D.2.3 Model Input

For the most part, fluctuations in mid–depth current flow at subtidal periods dictate plume trajectories and depositional patterns. In the Platform Irene model, particulates were released 46 m below the sea surface and the discharge plumes required about 0.5 days to transit the remaining 28 m of water column at a mean settling rate of 50 m day^{-1} (0.06 cm s^{-1}). Continuous hourly emissions were tracked until deposition. Consequently, the trajectory computation reflected a climatological summary of subtidal current statistics and depositional patterns disclosed the relative likelihood of plume impingement on benthic communities. Again, this is a fundamental departure from other assessments which include the detailed short–term behavior of individual bulk discharges (e.g., O'Reilly et al., 1989). Similarly, it differs from long–term fate assessments which include resuspension processes (e.g., Pickens and Lick, 1992). Therefore, patterns determined for the trajectory computations are not necessarily synonymous with drilling–particulate distribution in surficial sediments. Nevertheless, performing the trajectory computation on a climatological basis is consistent with measurements provided by sediment traps since they integrate the initial depositional flux of platform–derived particulates over extended periods.

D.2.3.1 Flow Field

Differences in the prevailing mid-depth flow field near Platform Irene are largely responsible for the difference in the mud depositional pattern there. In particular, the depositional pattern around Platform Irene shown in Figure D-1 is skewed to the north along a major axis aligned with the north-south bathymetric trend (Figure 5.6-1). In contrast, the depositional pattern generated by drill-mud discharges from Platforms Harvest, Hermosa, and Hidalgo had a major axis aligned parallel to isobaths that trend toward the northwest at 324°T. The northward skew in the Platform-Irene depositional pattern is also in opposition to the southward transport determined in oil spill trajectory modeling shown in Figure 5.8-1. The difference in patterns results because oil spill trajectories are largely driven by surface processes, namely, southward directed winds and surface currents. At depth, where the drill muds are discharged, the northward-directed Davidson current is largely responsible for net movement of water parcels.

The velocity field at the depth of the plume centroid is interpolated from velocity measured at various current-meter moorings near Platform Irene. Their locations are shown in Figure 5.6-1. They include flow measurements collected at NDBC Buoy 46023 and at moorings deployed during the Santa Barbara Channel – Santa Maria Basin Coastal Circulation Study (SBC-SMB; Hendershott and Winant, 1996). Although the SBC-SMB moorings that are located offshore Point Arguello are closest to Platform Irene, they lie within the different bathymetric regime described above. The mid-shelf SBC-SMB mooring between Point Sal and Purisima Point provides a more suitable flow history for determining the fate of drill-mud discharged from Platform Irene. The mooring is also located near the 100-m isobath, which is comparable to Platform Irene's water depth. While the annual mean surface flow at this mooring is strongly to the south (Hendershott, 2001), the mid-depth prevailing flow carries drilling particulates to the north.

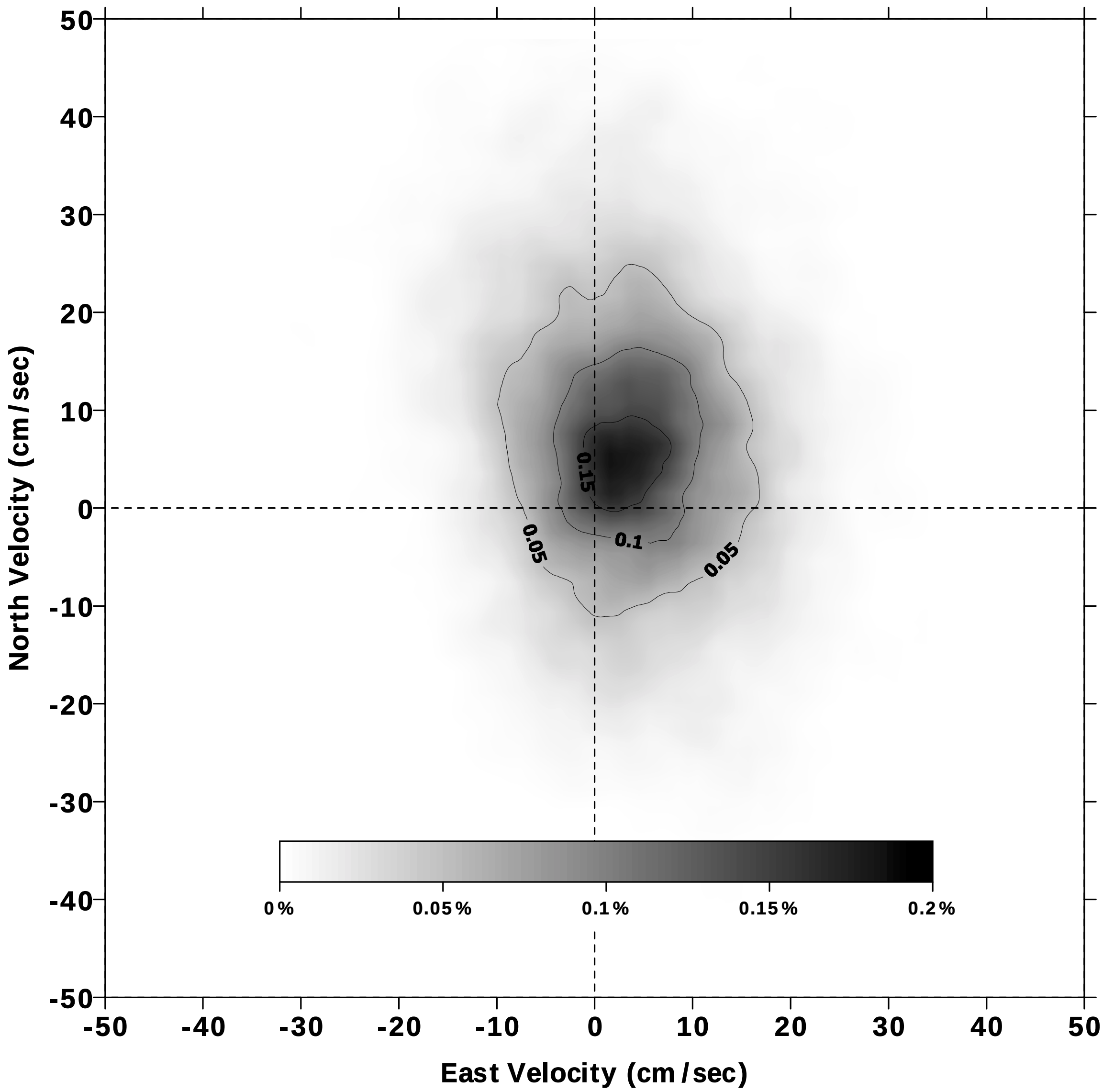
The northward mean flow at depth is evident in flow statistics computed from the 45-m current meter shown in Figure D-3. It shows the probability (%) of observing a particular velocity value within a 1 cm s^{-1} square. For example, the northward mean velocity of (5.2 cm s^{-1}) is almost three times more likely to occur ($P \approx 0.19\%$) than an equivalent speed to the south ($P \approx 0.07\%$). Similarly, cross-shore velocities of the same magnitude are only about half as likely to occur ($P \approx 0.10\%$). The increased likelihood of northward directed flow at mid-depth is largely responsible for the northward elongation of the drill-mud depositional pattern shown in Figure D-1.

D.2.3.2 Mud Discharge

Although the mud dispersion model can process a time-varying mud discharge, a constant discharge was assumed. When the drilling schedule is accurately known, or when mud-log records are available after the fact, the model can combine the mud-discharge time history with the time-varying measured currents to predict drill mud dispersion more accurately. This is particularly useful when the discharge occurs over a brief time; for example, within a single oceanographic season when current flow may depart from the average conditions reflected in Figure D-3. However, the directional drilling that will be used to develop the Tranquillon Ridge Field will occur over many years. Consequently, the discharges are likely to encounter the full range of seasonal variation and the assumption of a uniform discharge rate provides a reasonably accurate depositional pattern.

The model computations are based on a total discharge of 51,500 m^3 over a period of about 7.4 years. The discharge duration was computed assuming 90 days of discharge for each of 30 wells. The discharge volume was estimated from a discharge rate of 3.5 gpm (19 m^3 day^{-1}) over the 7.4 years of discharge. At an average mud density of 1450 kg m^{-3}, the total mass discharged would be about 75,000 metric tons. This discharge mass equals the integral of the flux over the area shown in Figure D-1 multiplied by the discharge duration.

Figure D-3 **Joint Probability Distribution for Current Velocity Measured at 45 m on the Mid-Shelf Point-Sal Mooring from the SBC-SMB Study**



D.3 Model Results

The modeling results shown in Figure D-1 demonstrate that despite the large total discharge, most of the material is deposited close to Platform Irene. Over half of the mud is deposited within the 5-g-m^{-2}-week^{-1} contour, which covers a 9-km^{2} area within about 1.7 km of the Platform. The remaining material is dispersed over wide areas where the flux of particulates is negligible. Over 80% of the mud is deposited within the 1-g-m^{-2}-week^{-1} contour, which covers a 40-km^{2} area within about 3.6 km of the Platform. Less than 0.4% travels farther than 10 km before being deposited on the seafloor.

Based on the depositional pattern, drill mud plumes would rarely extend into State Waters, which are delineated by the dashed line in Figure D-1. This is partially due to the along-shore alignment of the major depositional axis and preferential transport to the north by mid-depth currents as reflected in Figure D-3. Maximum drill mud deposition rates within the small portion of State Waters encompassed by the 1-g-m^{-2}-$week^{-1}$ contour are negligible compared to the deposition rates of ambient particulates. Fallout of detrital and terrigenous material in the upper water column ranges from 4.2 to 17.5 g m^{-2} $week^{-1}$ (Jackson et al., 1989). When sediment resuspension is included, total ambient particulate flux to the seafloor averages 175 g m^{-2} $week^{-1}$ in this region of the continental shelf (Coats, 1994). In the presence of these natural processes, diffuse drill-mud plumes contributing 1g m^{-2} $week^{-1}$ to the seafloor flux would neither tangibly increase water column turbidity nor measurably contaminate seafloor sediments.

D.4 References

Battelle Ocean Sciences. 1991. California OCS Phase II monitoring program: Final Report. Report prepared for the U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, California. Contract No. 14–12–0001–30262. (MMS 91–0083).

Boothe, P.N. and B.J. Presley. 1989. Trends in sediment trace element concentrations around six petroleum drilling platforms in the northwestern Gulf of Mexico. Drilling Wastes. F.R. Engelhardt, J.P. Ray and A.H. Gillam, eds. Elsevier Applied Science, New York, pp. 3–22.

Burban, P.Y., Y.J. Xu, J. McNeil, and W. Lick. 1990. Settling speeds of flocs in fresh water and seawater. J. Geophys. Res., 95, 18213–18220.

Coats, D. 1994. Deposition of drilling particulates off Point Conception, CA. Mar. Env. Rev. 37:95-127.

Continental Shelf Associates, Inc. 1985. Assessment of the long–term fate and effective methods of mitigation of California Outer Continental Shelf platform particulate discharges. Report prepared for the U.S. Department of the Interior, Minerals Management Service, Pacific OCS Region, Los Angeles, CA. Contract No. 14–12–0001–30056. Volume I (MMS 85–0033).

de Margerie, S. 1989. Modeling drill cuttings discharges. Drilling Wastes. F.R. Engelhardt, J.P. Ray and A.H. Gillam, eds. Elsevier Applied Science, New York, pp. 627–646.

Fry, V. A., and B. Butman. 1991. Estimates of the seafloor area impacted by sewage sludge dumped at the 106–mile Site in the Mid–Atlantic Bight. Mar. Environ. Res., 31, 145–160.

Hendershott, M.C. 2001. Observations of Circulation in the Santa Maria Basin. In: Quality Review Board Minutes Of Meeting No. 7, 7-9 March 2000. Analysis and Acquisition of Observations of the Circulation on the California Continental Shelf. University of California, San Diego; Scripps Institution of Oceanography; Center for Coastal Studies, 0209; 9500 Gilman Drive; La Jolla, California 92093-0209. Technical Report Reference No. 01-1 (Published 1 February 2001). Cooperative Agreement No. 14-35-0001-30571. pp 93-120.

Hendershott, M.C. and C. D. Winant. 1996. Surface Circulation in the Santa Barbara Channel. Oceanography 9(2):14-121.

Huang, H. 1992. Transport properties of drilling muds. Ph.D. dissertation, Univ. of Calif., Santa Barbara.

Hyland, J., D. Hardin, M. Steinhauer, D. Coats, R. Green, and J. Neff, 1994. Environmental Impact of Offshore Oil Development on the Outer Continental Shelf and Slope off Point Arguello, California, Marine Environmental Research. Vol. 37(1994): 195-229.

Jackson, G.A., F. Azam, A.F. Carlucci, R.W. Eppley, P.M. Williams, B. Finney, C. Huh, L.F. Small, D.S. Gorsline, B. Hickey, R.A. Jahnke, I.R. Kaplan, M.I. Venkatesan, M.R. Landry, and K.M. Wong. 1989. Elemental cycling and fluxes off southern California. Eos, Trans., Amer. Geophys. Union, 70(10), pp. 146–155.

Jenkins, K.D., S. Howe, B.M. Sanders, and C. Norwood. 1989. Sediment deposition, biological accumulation and subcellular distribution of barium following the drilling of an exploratory well. Drilling Wastes. F.R. Engelhardt, J.P. Ray and A.H. Gillam, eds. Elsevier Applied Science, New York, pp. 587–608.

National Research Council. 1983. Drilling Discharges in the Marine Environment. National Academy Press, Washington, DC., 180 pp.

Neff, J.M., M.H. Bothner, N.J. Maciolek, and J.F. Grassle. 1989a. Impacts of exploratory drilling for oil and gas on the benthic environment of Georges Bank. Mar. Environ. Res., 27, 77–114.

O'Reilly, J.E., T.C. Sauer, R.C. Ayers, M.G. Brandsma, and R. Meek. 1989. Field verification of the OOC Mud Discharge Model. Drilling Wastes. F.R. Engelhardt, J.P. Ray and A.H. Gillam, eds. Elsevier Applied Science, New York, pp. 647–666.

Pickens, M.K. and W. Lick. 1992. The transport and fate of drilling muds. In: Proceedings of the 2nd International Conference of Estuarine and Coastal Modeling. American Society of Civil Engineers, Waterway, Port, Coastal and Ocean Division.

Science Applications International Corporation (SAIC). 1995. Monitoring Assessment of Long-Term Changes in Biological Communities in the Santa Maria Basin: Phase III, Final Report. Report submitted to the U.S. Department of the Interior, Minerals Management Service/National Biological Service, Under Contract No. 14-35-0001-30584. OCS Study MMS 95-0049.

van Dam, G.C. 1982. Models of Dispersion. In: Pollutant Transport and Transfer in the Sea. G. Kullenberg, Ed. Vol. 1. CRC Press, Boca Raton, Fla., Chapter 2.

Zingula, R.P. and D.W. Larson. 1977. Fate of drill cuttings in the marine environment. Ninth Annual Offshore Technology Conference. Paper 3040, pp. 553–556.

Attachment E - Oil Spill Trajectory Modeling

Table of Contents

Attachment E   Oil Spill Trajectory Modeling

E.1   Background

This appendix presents the results of pat drifter and trajectory studies and oil spill modeling conducted for Platform Irene and the Platform Irene to LOGP offshore pipeline. The modeling was conducted to determine the movement and fate of an oil spill occurring at either of these two locations. Two models were examined, the Minerals Management Service (MMS) Oil Spill Risk Analysis (OSRA) and the General National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA) Oil Modeling Environment (GNOME). Each are publicly available models.

E.2   Drifter Studies

The trajectories of drifters released near the project area generally reflect the surface flow patterns measured by long-term current-meter moorings (Crowe and Schwarzlose, 1972; Schwartzlose and Reid, 1972; Chelton, 1987; Winant et al., 1999, see the Section 5.6, Oceanography and Marine Water Quality in this EIR). Namely, northwestward transport is observed throughout much of the year except during strong upwelling events that are most prevalent between April and June. Prevailing winds near Point Arguello are directed to the southeast except during brief, three-to-four-day periods when winter storms disrupt the normal pattern as they pass through the region. Surface currents near the project area are generally directed to the northwest, in opposition to, and uncoupled with the prevailing southeastward winds (Savoie et al., 1991; SAIC, 1995). During the spring and early summer, brief episodes of intensified southward-directed winds result in a reversal of surface currents. For periods of up to a week, near-surface flows turn toward the southeast in opposition to the northwestward current direction that is maintained throughout most of the water column.

The opposing directions of the wind and surface currents near Point Arguello are evident in drifter studies. CalCOFI drifter bottles released north of the Santa Barbara Channel in December 1969 migrated northward at speeds exceeding 15 cm/s. However at other times of the year, drift bottles released near Point Conception were recovered both to the north and to the south near San Diego. For release points near Point Arguello in 1984, many of the CCCCS surface drifters traveled south in response to strong southward directed winds (Chelton, 1987). It was only during a brief period when southward winds weakened in July that the majority of drifters moved northward. However, the CCCCS drifter design is susceptible to a downwind motion of about 0.5% of the wind speed and thus may not accurately represent surface currents alone.

The drifters used in the Santa Barbara Channel to Santa Maria Basin (SMB) coastal circulation study were designed to minimize the influence of wind and wave drift in favor of tracking surface currents over a depth of about 1 m (Davis et al., 1982). As a result, flow statistics derived from the drifters compared well with that of the moored current meters (Dever et al., 1998). Discrepancies in mean flow direction have been ascribed to sampling bias (Dever, 2001b). Beginning in January 1995, many of these drifters were deployed within the Santa Maria Basin, including locations near the Tranquillon Ridge Field. Few of the drifters released near the Point Arguello to Point Conception region beached before exiting the region (Dever et al., 2000; Winant et al., 1999). In a manner consistent with the long-term current meter data collected as part of CaMP, initial offshore movement was followed by northward movement into the SMB in fall and winter. Spring and summer deployments were more likely to show southward flow toward San Miguel Island. Few drifters moved eastward into the Santa Barbara Channel.

The complex interaction between winds and surface currents near Point Conception makes predictions of oil spill trajectories difficult. During much of the year, but especially in the fall and winter, the northwestward surface flow is in direct opposition to the prevailing winds. Certainly these surface currents, as determined by current meters and drifters, have a direct bearing on the fate and effects of potential oil spills resulting from the proposed project. However, winds also influence the spread and trajectory of oil slicks on the sea surface. Empirical data from the open ocean suggests that leading edge of an oil slick would drift at about 3% of the wind speed and oil-following drifters have been evaluated based on their ability to match this “3% rule” (Reed et al., 1988). However, there is no rigorously defensible theoretical basis or empirical data to support the application of this rule in coastal flow regimes.

Drifters deployed during the Santa Barbara Channel to Santa Maria Basin coastal circulation study tended to travel toward the south only about 31% of the time and only about 15% of these intersected the shoreline.

Drifters, with their measurable mass and finite vertical profile below the sea surface, cannot capture the behavior of an oil slick that is typically only a few millimeters thick (Reed et al., 1988). Furthermore, dispersion and weathering affect the spread of oil on the sea surface, and buoys cannot capture the changing slick dynamics across a wide range of winds, waves, and currents. Goodman et al. (1995) and Simecek-Beatty (1994) tested the oil-tracking ability of several drifter designs, including the Davis et al. (1982) design used in the Santa Barbara Channel-SMB coastal circulation study. They found that Davis-type drifters lagged behind simulated oil slicks presumably because they are optimized to track surface currents with minimal influence by winds and waves. In cases where winds opposed surface currents, the Davis-type drifters moved into the prevailing wind and in a direction opposite of the simulated oil slicks made from wood chips. This is similar to the case in the southern SMB where the northward-flowing Davidson current often opposes the prevailing southward-directed winds.

E.3 MMS OSRA Model

The oil-spill risk analyses described in this evaluation were performed using the MMS numerical Oil Spill Risk Analysis (OSRA) model for the Pacific Region. It calculates probabilities of shoreline impact, as well as ocean area impact, after applying a drift equivalent to 3.5% of the prevailing wind velocity in its trajectory computations. Because of the heavy influence of southward-directed winds near Point Conception, the model results indicate that the probability of shoreline impacts along the Channel Islands to the south is far higher than at sites along the central coast to the north. The influence of southward directed winds in the model effectively overcomes the northwestward surface currents observed over part of the year in the field programs. This contrasts with other drifter studies which tend to show travel toward the south only about 31% of the time and only about 15% of these intersect the shoreline (Browne, 2000). In Browne's analysis, northward transport has a slight edge with 32% of the trajectories traveling to the north and contacting the coast about 23% of the time. For more discussion on surface transport and drifters, please see Section 5.6, Oceanography and Marine Water Quality, in this EIR.

The OSRA Model utilizes a seasonally averaged ocean currents for four seasons: winter, spring, summer and fall. The seasonally average current fields are provided by Scripps Institution of Oceanography and are based on several years of current meter and free-floating drifter data. Shoreline segments are divided into their respective quad areas and the probability of impact on each quad is calculated. Weathering factors are not addressed.

The use of the seasonal average ocean currents tends to smooth out the effect of the northward currents which may occur and thereby reduce the northward movement of the trajectories.

The complexity of opposing winds and currents near the project area makes the reconciliation between OSRA model results and drifter observations difficult. Because the applicability of the "3.5% wind rule" in complex coastal flow regimes has not been rigorously quantified, this environmental evaluation also addressed the GNOME model which indicates more northward impacts (see following section) due to its separation of flow regimes.

However, drifters, with their measurable mass and finite vertical profile below the sea surface, cannot capture the behavior of an oil slick that is typically only a few millimeters thick (Reed et al., 1988). Newer style drifters (called "oil following") have been deployed recently and may provide better data when available. Furthermore, dispersion and weathering affects the spread of oil on the sea surface, and buoys cannot capture the changing slick dynamics across a wide range of winds, waves, and currents.

E.4 OSRA Results

The MMS has developed OSRA reports for the Pacific Region OCS, amongst other regions. Because oil spills may occur from activities associated with offshore oil exploration, production, and transportation, the MMS conducts a formal risk assessment to evaluate the risk of oil spill contact from existing and proposed oil and gas operations. Contact is evaluated at each block in a grid encompassing the entire ocean region as well as grids located along the shoreline. Risks are examined for spills from 23 OCS platforms, 11 pipelines, 10 potentially developed units and the transportation routes. The analysis assumes that a spill has occurred and estimates the trajectories of the hypothetical oil spills from potential accident sites to land and ocean segment locations. It then provides conditional probabilities of oil impacting a given area.

The trajectory simulation portion of the MMS OSRA model consists of many hypothetical oil-spill trajectories. The trajectories are the consequence of the integrated action of temporally and spatially varying wind and ocean current fields on the hypothetical oil spills. Collectively, they represent a statistical set of the winds and currents that will occur over the life of the production period. The analysis uses a combination of observed and theoretically computed ocean currents and winds. Most of the ocean currents used were generated by a numerical model. They were supplemented with many direct observations of the currents in the Santa Barbara Channel resulting from deployments of surface drifting buoys. The sea surface winds over the study area were derived from an atmospheric model and from measured winds at buoy, platform, island and land-based wind stations. The studies are conducted for four seasons (winter, spring, summer and fall) when currents and winds are different. More information on the study is available at the MMS web site.

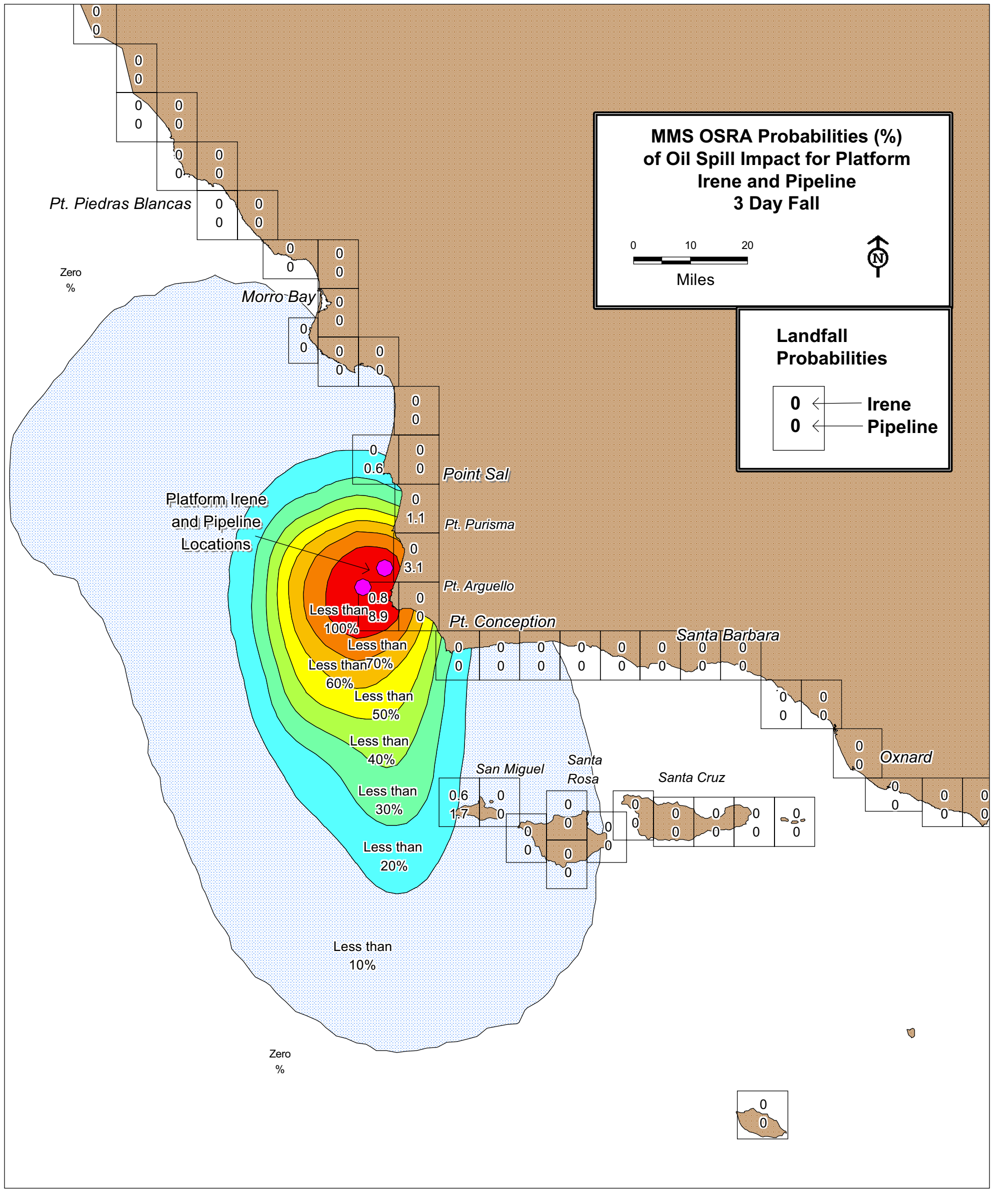
Results of the oil spill trajectory model are presented below for Platform Irene and the Irene oil/emulsion pipeline. This figure shows both the conditional probabilities of oil impacting different locations on the ocean and the conditional probabilities of oil impacting the designated land segments. Conditional probabilities are shown within each land segment block for both Platform Irene and the oil/emulsion pipeline. Ocean impact areas are similar for Platform Irene and the pipeline. Information is presented for all 4 seasons (spring, summer, winter, fall) and for the periods of 3 and 10 days. The 30 day annual average is also shown.

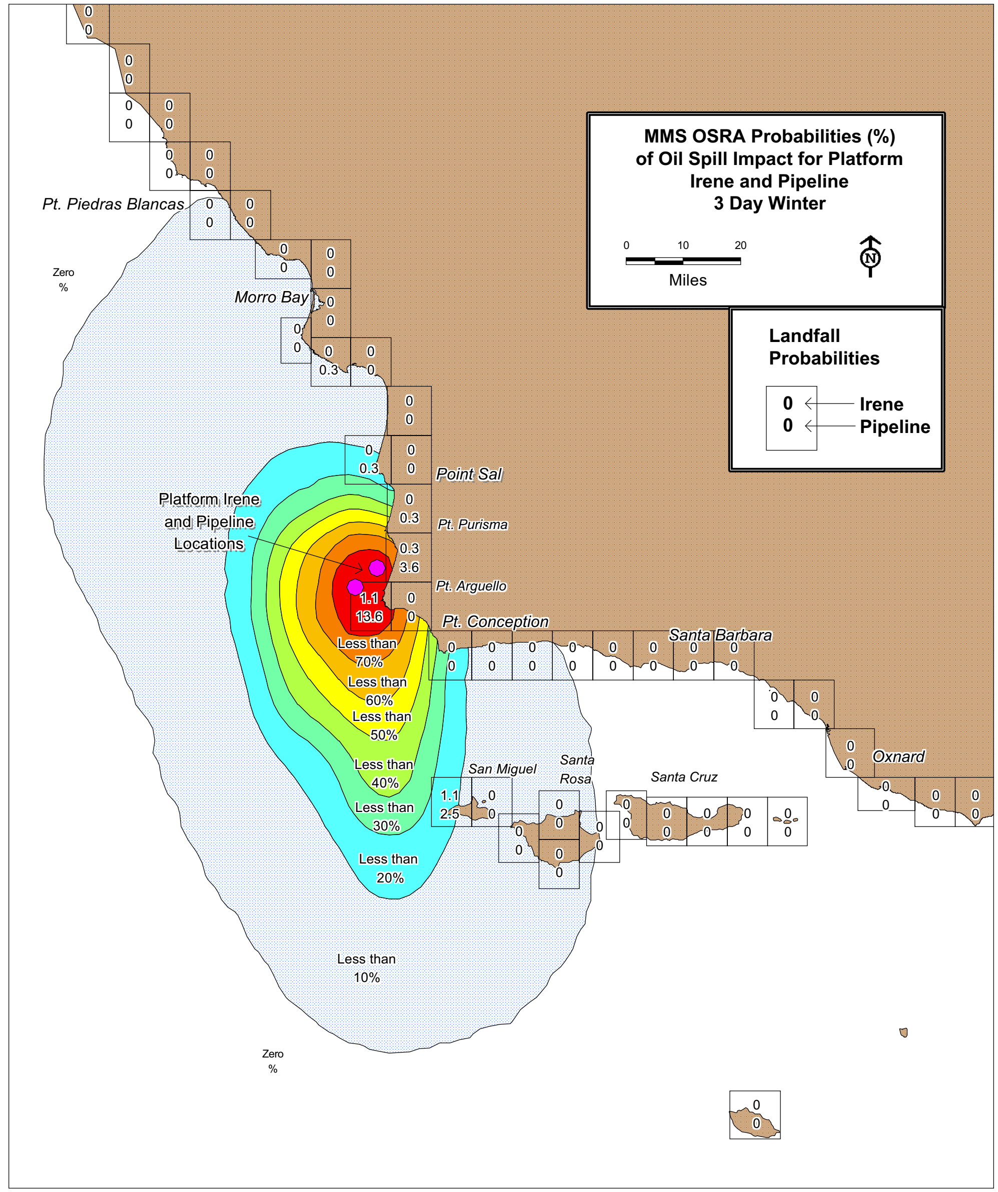
The OSRA trajectory analysis indicates that, generally, an oil spill would travel to the south of the spill, impacting ocean areas beyond the Channel Islands during all seasons. The probability of a northward traveling spill is greater during the winter and fall months with spills potentially reaching as far north as Piedras Blancas. Conditional probabilities of contacting land range up to 15.3% during the springtime for Point Arguello due east of Platform Irene and the pipelines.

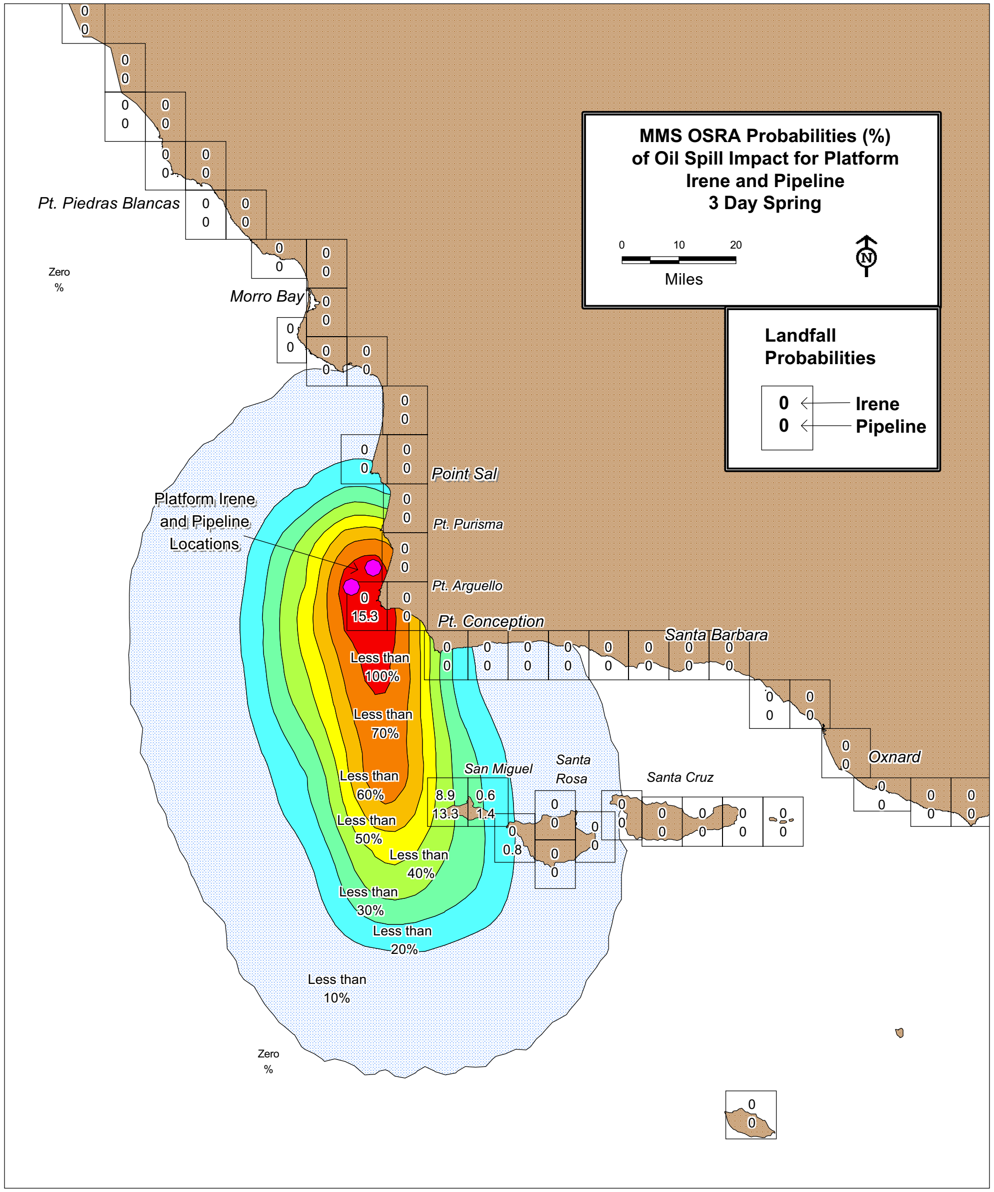
E.5 GNOME Model

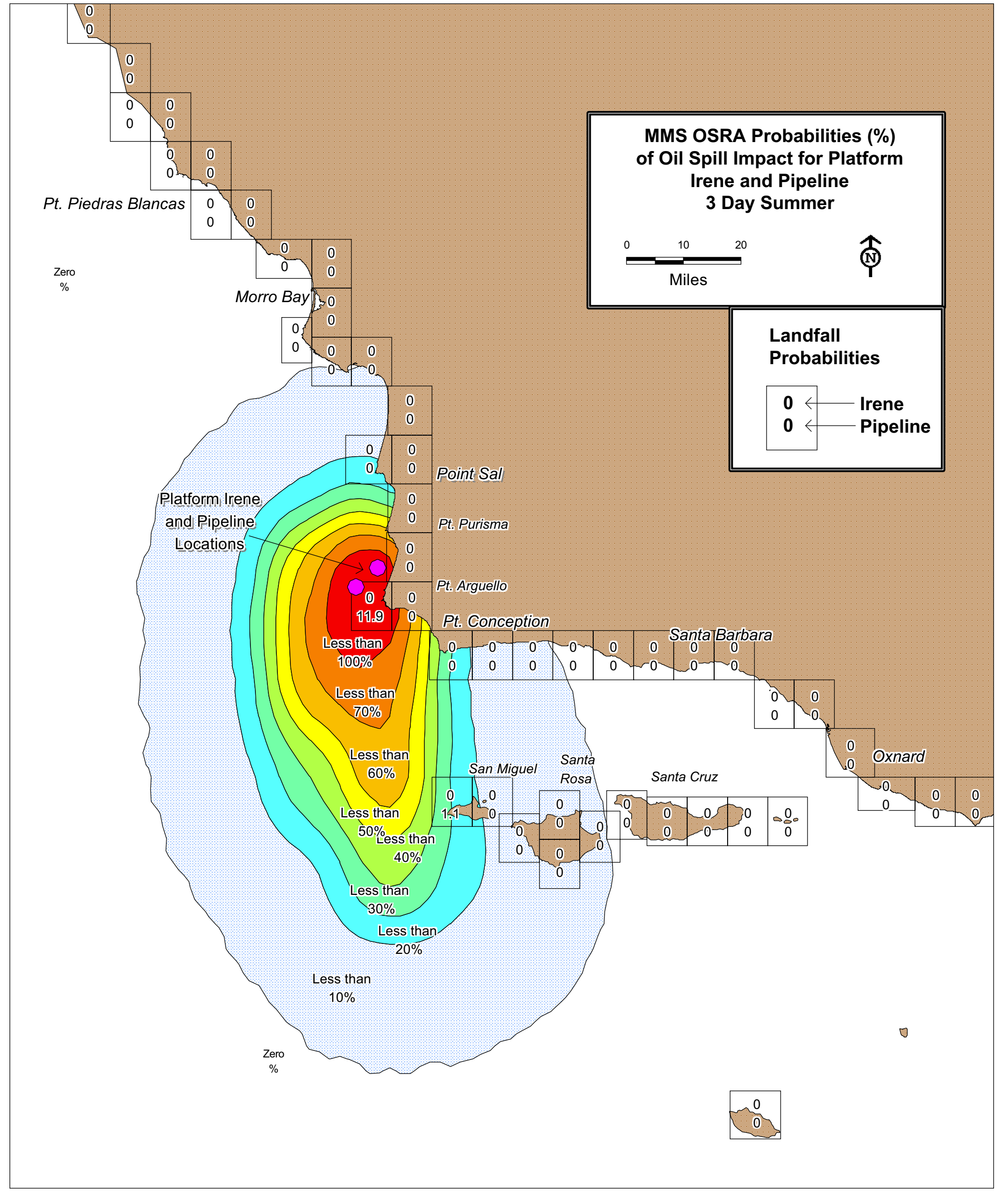
GNOME is a publicly available oil spill trajectory model that simulates oil movement due to winds, currents, tides, and spreading. GNOME was developed by the Hazardous Materials Response Division (HAZMAT) of the NOAA OR&R.

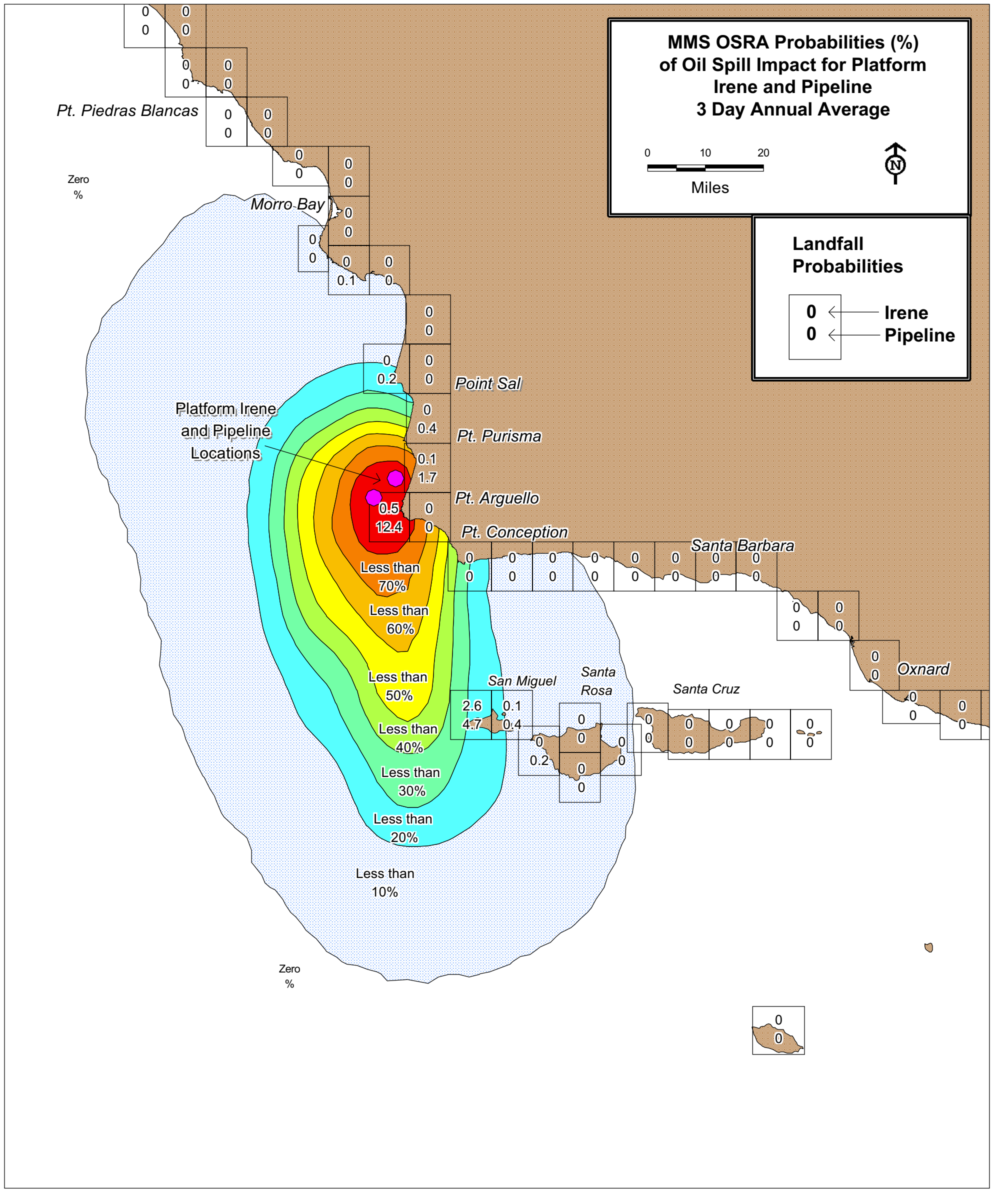
The GNOME Model includes variables that account for weatherization of the released materials as well as a separate set of ocean current regimes for the Santa Barbara Channel and SMB. Wind speed and direction as well as variability can be input to the model. This enables the analysis of specific spill situations with given meteorological conditions.

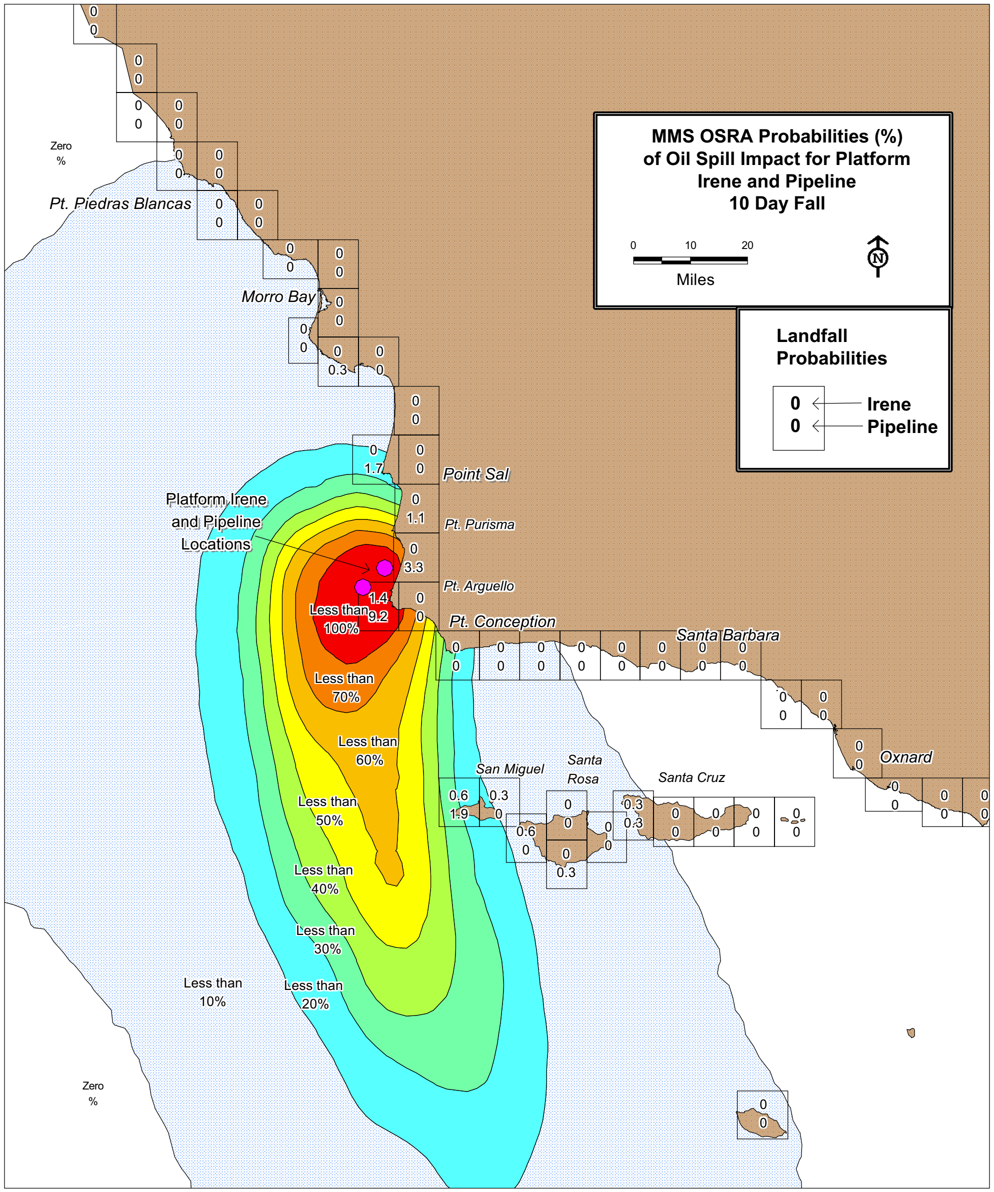

MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Fall
Miles
Landfall
Probabilities
Irene
Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Winter
Miles
Landfall
Probabilities
Irene
Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Spring
Miles
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
15.3
8.9
13.3
0.6
1.4
0.8
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Summer
Miles
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
11.9
1.1
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Annual Average
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Zero
%
Less than
70%
Less than
60%
Less than
50%
Less than
40%
Less than
30%
Less than
20%
Less than
10%
Zero
%



MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Fall
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Zero %
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene and Pipeline Locations
1.4
9.2
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Less than 70%
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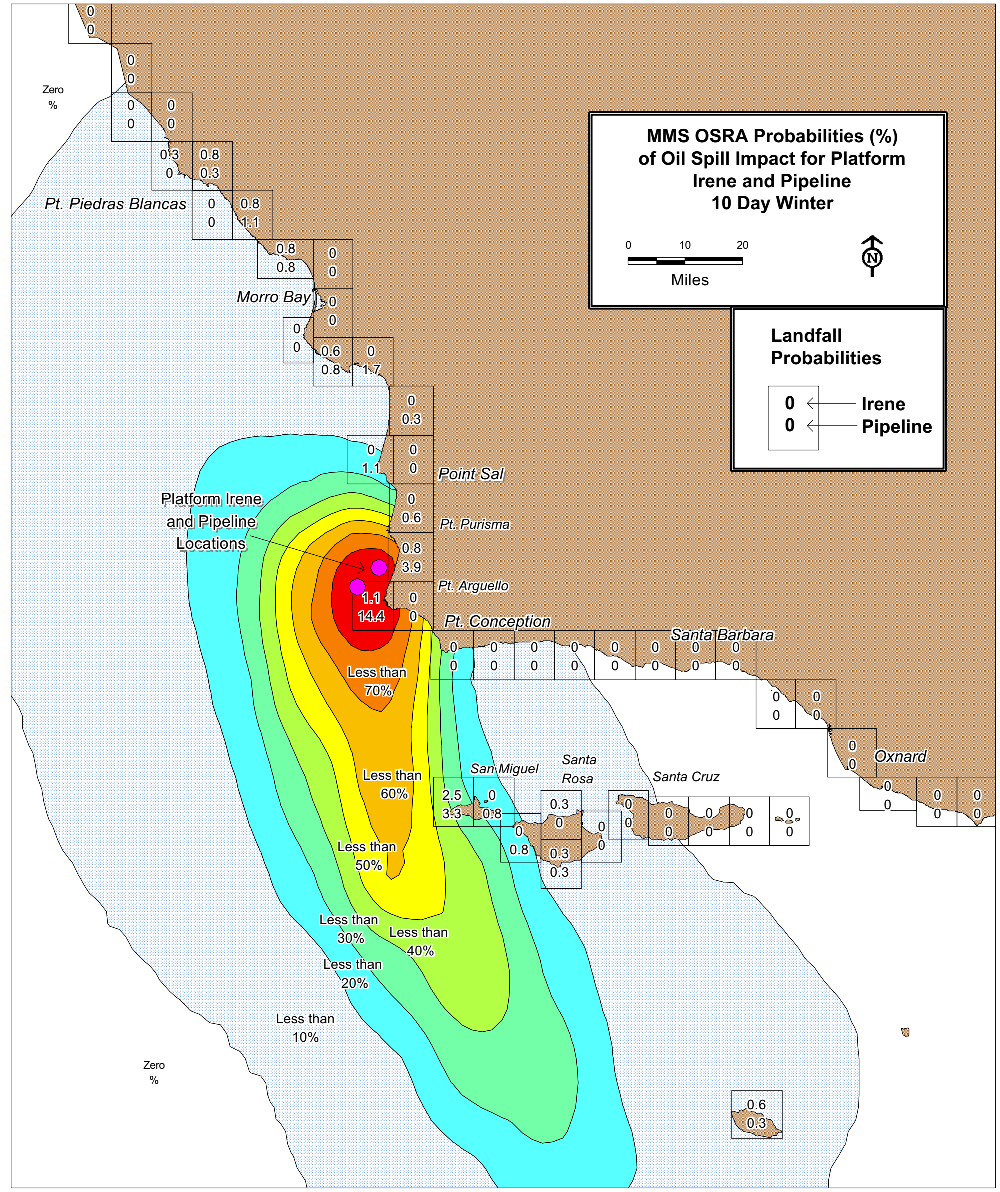
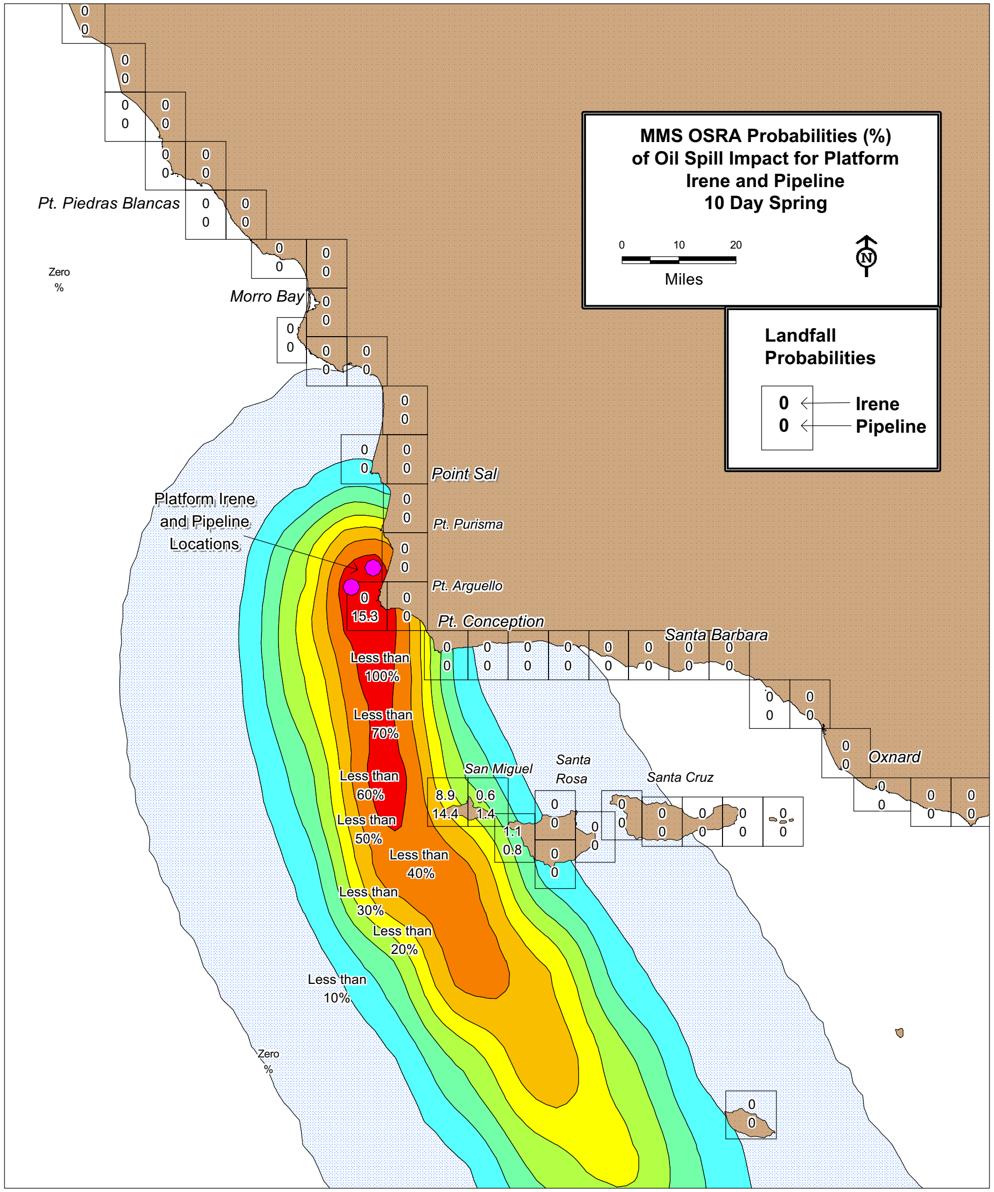
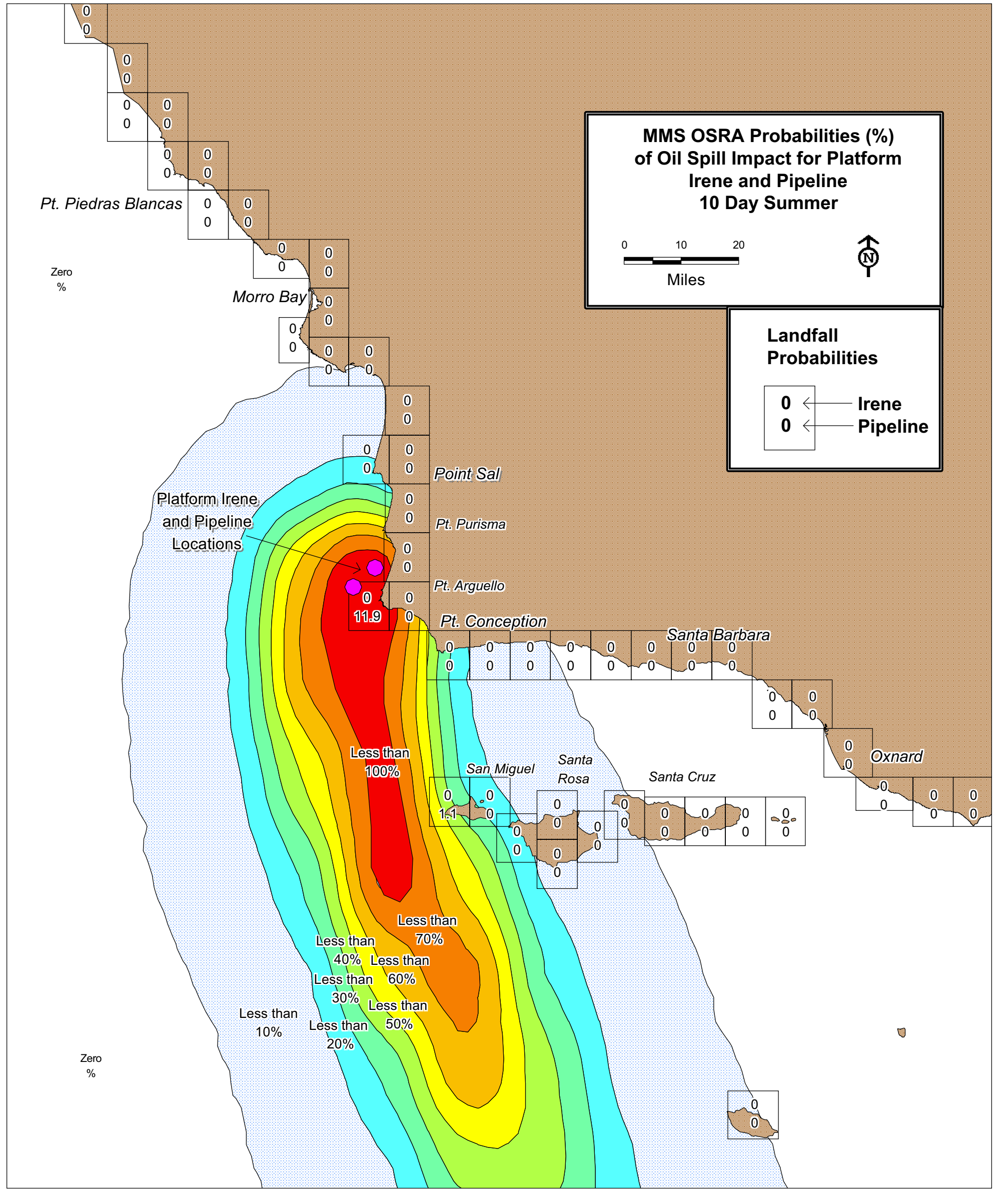
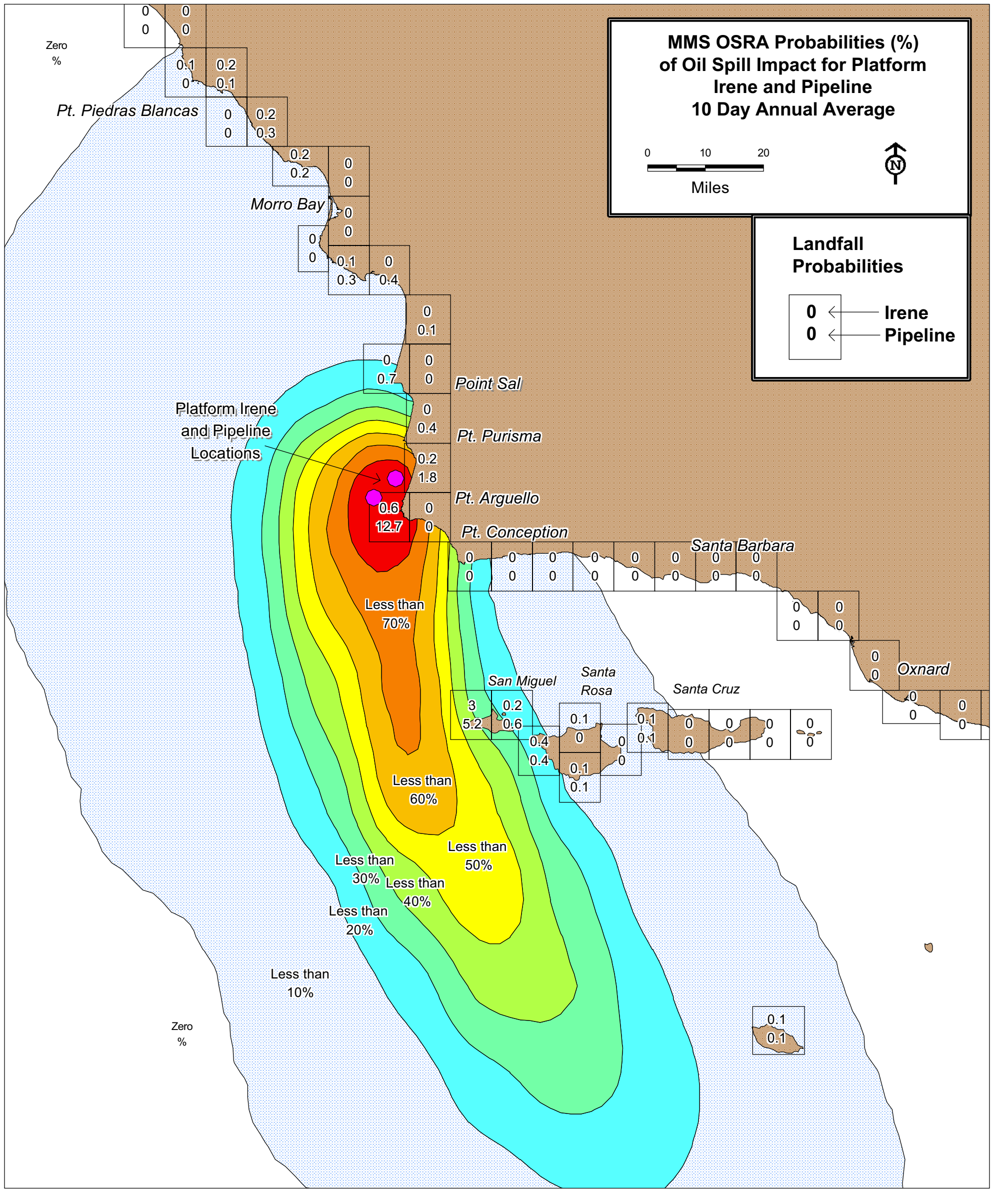
Less than 30%
Less than 20%
Less than 10%
Zero %



MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Winter
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Zero %
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene and Pipeline Locations
1.1
14.4
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Spring
0 10 20
Miles
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa
Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Zero
%
Less than
100%
Less than
70%
Less than
60%
Less than
50%
Less than
40%
Less than
30%
Less than
20%
Less than
10%
15.3
8.9
14.4
0.6
1.4
1.1
0.8

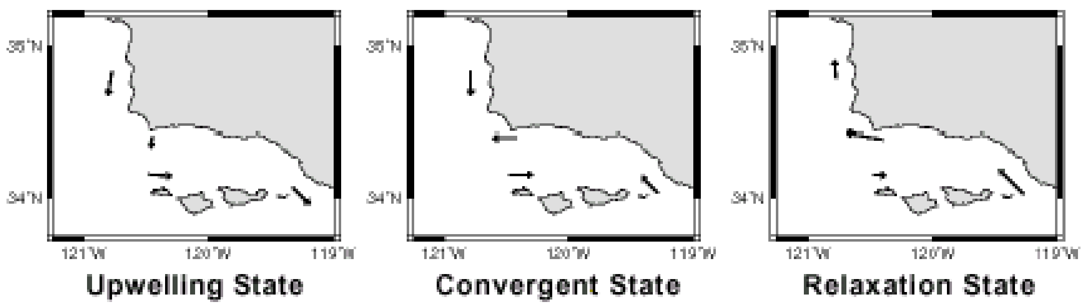

MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Summer
0 10 20
Miles
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa
Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Zero
%
Less than
100%
Less than
70%
Less than
60%
Less than
50%
Less than
40%
Less than
30%
Less than
20%
Less than
10%
11.9
1.1


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Annual Average
0 10 20
Miles
N
Landfall
Probabilities
Irene
Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Zero %
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %

However, in order to assess the probabilities of a specific modeled end result, wind distributions and ocean current time dependant distributions would need to be obtained and many modeling runs conducted for the area.

The GNOME model operates by generating “splots” associated with each spill scenario. The fate of the splots is either to remain on the water, to be beached, to be weathered and disappear or to travel out of the modeling space. The movement of the splots is defined by the ocean current “regime” and the wind influences.

Ocean currents in GNOME are essentially divided into three regimes for the Santa Barbara Channel and the Santa Maria Basin: upwelling, convergent and relaxation. Each of these is shown figuratively below.



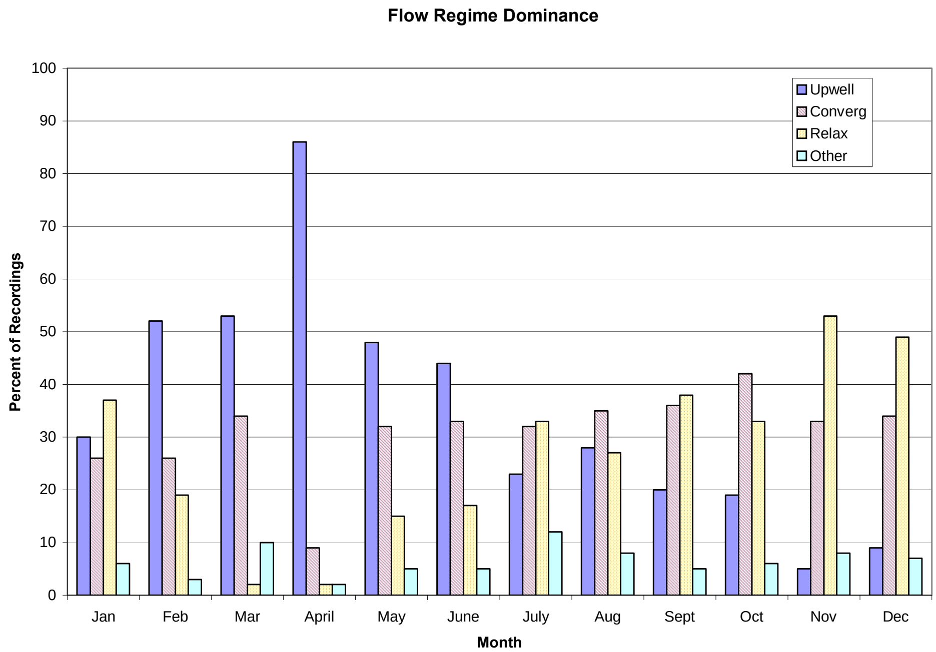
Upwelling
The upwelling state is named for the upwelling of cold (approximately 11°C) subsurface waters near Point Conception that often accompanies this state. The upwelling state occurs primarily in spring, although it has also been observed in other seasons. In terms of the conceptual models of the momentum balance, the upwelling state occurs when strong (>10 m/s), persistent (several days or more), upwelling favorable (equatorward) winds overwhelm any poleward, along-shelf pressure gradient.

Convergent
The convergent state is named for the convergence of southward flow west of Point Arguello with westward flow south of Point Conception. The convergent state occurs primarily in summer, although it has also been observed in other seasons. In terms of the conceptual models of the momentum balance, the convergent state tends to occur when upwelling favorable winds and a strong poleward, along-shelf pressure gradient exist. The most characteristic feature of the resulting flow field is a strong cyclonic recirculation in the western Santa Barbara Channel with about equal strength in the northern and southern limbs of the recirculation.

Relaxation
The relaxation state is named for the time periods when winds off Point Conception “relax” from their usual equatorward direction. The relaxation state occurs primarily in fall and early winter. In terms of the conceptual models of the momentum balance, the relaxation state occurs when poleward, along-shelf pressure gradients overwhelm

upwelling favorable or weak winds. The most characteristic feature of the resulting flow field is a strong westward flow (>50 cm/s) through the Santa Barbara Channel and to the SMB. Flow in the SMB is strongest along the mainland coast

Each of the three ocean current states includes a counter-clockwise circulation pattern in the Santa Barbara Channel. The frequency of occurrence of each flow regime is shown below.



E.6 GNOME Model Results

The GNOME model was run for the same oceanographic and meteorological conditions as were modeled in the MMS Report, Delineation Drilling Activities in Federal Waters Offshore Santa Barbara, California: Draft Environmental Impact Statement, 2001 (MMS 2001-046). These conditions are summarized below:

Current Regime	Meteorological Conditions	Timeframe
Upwelling	8 m/s NW	3 days 10 days
Convergent	7 m/s NW	3 days 10 days
Relaxation	4 m/s NW 4 m/s SW 0 m/s	3 days 10 days

These meteorological conditions are not intended to be all encompassing of the meteorological conditions that could be present during a spill scenario. Although the GNOME model takes ocean currents into account to a large degree, wind effects still have a large influence. Generally, winds originating from the east do not produce beach impacts and were therefore not included.

The model was run for releases at three locations: Platform Irene, the pipeline midpoint, and the pipeline shoreline located about 0.25 miles offshore.

The results of the modeling runs are shown in the following table and the following three figures. All splots for all the modeling runs are shown on each figure.

Flow Regimes
This figure shows the strong influence of the flow regime on the fate of the oil spilled. For the convergent and upwelling scenarios, occurring most frequently during the spring and summer, these two regimes produce oil spills that move in the southern direction impacting Point Arguello, Jalama Beach, Point Conception and San Migual, Santa Rosa and the Santa Cruz Islands. The counter-clockwise currents in the Santa Barbara Channel prevent oil from impacting the Coastline south of Point Conception.

Time Period
Two timeframes were examined in the modeling: 3 days and 10 days. This was conducted in correlation with the MMS study (MMS-2001-046). The model indicated that after 3 days, impacts would range as far south as Point Conception and almost to the Channel Islands. Northward movement after 3 days during relaxation regimes would move as far north as Guadalupe. After 10 days, impacts would reach at least the Channel Islands to the South and Pismo and Avila Beach and Piedras Blancas to the north. These impacts shown are only for a limited set of meteorological conditions.

Release Point
Releases were modeled for three locations: Platform Irene, the midpoint of the pipeline, and the pipeline shoreline location about 0.25 miles from the shoreline. Impacts from spills at Platform Irene were the most far reaching due to their location farther from shore. However, all three release points could impact the Channel Islands.

Wind Direction
Releases were modeled for three wind directions correlated with the ocean current flow regimes. Winds from the south-west were modeled along with the relaxation regimes, winds from the northwest were modeled along with the upwelling and convergent regimes, and neutral winds were modeled with the relaxation regime. The wind direction figure shows the importance of wind direction as south-west winds drove the spilled oil into the coastline between Surf and Pismo Beach. Winds from the north-west moved the oil towards the south impacting Point Arguello, Jalama, Point Conception, and the Channel Islands.

GNOME Modeling Results

					Current Operations					Proposed Operations					
Release Point	Flow Regime	Wind Speed, m/s	Wind Direction	Release Duration, Days	Amount Released, Barre	Amount in Water, barrels	Amount on Beach, barrel	Amount Weathered	Amount off Map	Amount Released, Barre	Amount in Water, barrels	Amount on Beach, barrel	Amount Weathered	Amount off Map	Beach Impacted Areas
Irene	Upwell	8	NW	3	425	261	1	163	0	5020	3087	10	1923	0	PA, PC, J
Irene	Upwell	8	NW	10	425	8	168	195	54	5020	94	1984	2303	638	PA, PC, J, North Side of SM, SR, SC
Irene	Conv.	7	NW	3	425	261	1	163	0	5020	3087	10	1925	0	PA, PC, J
Irene	Conv.	7	NW	10	425	9	103	191	122	5020	106	1217	2256	1441	PA, PC, J, North Side of SM, SR
Irene	Relax.	4	NW	3	425	214	48	163	0	5020	2528	567	1925	0	S, PA
Irene	Relax.	4	NW	10	425	203	25	197	0	5020	2398	295	2327	0	S, PA, J
Irene	Relax.	0	-	3	425	262	1	163	0	5020	3095	5	1925	0	S
Irene	Relax.	0	-	10	425	224	3.4	197	0	5020	2646	40	2327	0	S, PP, PS, G
Irene	Relax.	4	SW	3	425	92	170	163	0	5020	1087	2008	1925	0	S, PP, PS
Irene	Relax.	4	SW	10	425	47	181	197	0	5020	555	2138	2327	0	PP, PS, G, P
PL Mid	Upwell	8	NW	3	1749	82	996	671	0	3671	173	2090	1408	0	S, PA, PC
PL Mid	Upwell	8	NW	10	1749	103	815	802	29	3671	216	1710	1684	60	PA, J, PC, SR, SC
PL Mid	Conv.	7	NW	3	1749	399	679	671	0	3671	838	1425	1408	0	S, PA, J, PC
PL Mid	Conv.	7	NW	10	1749	337	543	815	49	3671	708	1140	1710	104	S, PA, J, PC, SM, SR
PL Mid	Relax.	4	NW	3	1749	428	654	671	0	3671	898	1373	1408	0	S, PA
PL Mid	Relax.	4	NW	10	1749	761	177	811	0	3671	1598	371	1702	0	S, PA, J
PL Mid	Relax.	0	-	3	1749	1066	12	671	0	3671	2237	26	1408	0	S, PP
PL Mid	Relax.	0	-	10	1749	909	25	811	0	3671	1909	52	1702	0	S, PP, PS, G, P
PL Mid	Relax.	4	SW	3	1749	272	807	671	0	3671	570	1693	1408	0	S, PP, PS
PL Mid	Relax.	4	SW	10	1749	267	671	811	0	3671	561	1408	1702	0	S, PP, PS
PL. Shore	Upwell	8	NW	3	2868	69	1701	1098	0	6718	162	3984	2572	0	S
PL. Shore	Upwell	8	NW	10	2868	66	1471	1331	0	6718	155	3446	3118	0	S
PL. Shore	Conv.	7	NW	3	2868	92	1678	1098	0	6718	216	3931	2572	0	S
PL. Shore	Conv.	7	NW	10	2868	258	1279	1331	0	6718	604	2996	3118	0	S, PA, J, PC
PL. Shore	Relax.	4	NW	3	2868	410	1359	1098	0	6718	960	3183	2572	0	S, PA
PL. Shore	Relax.	4	NW	10	2868	619	918	1331	0	6718	1450	2150	3118	0	S, PA
PL. Shore	Relax.	0	-	3	2868	1560	209	1098	0	6718	3654	490	2572	0	S, PA, PP
PL. Shore	Relax.	0	-	10	2868	1494	43	1331	0	6718	3500	101	3118	0	S, PA, PP, PS
PL. Shore	Relax.	4	SW	3	2868	419	1351	1098	0	6718	981	3165	2572	0	S, PP
PL. Shore	Relax.	4	SW	10	2868	399	1139	1331	0	6718	935	2668	3118	0	S, PP, PS

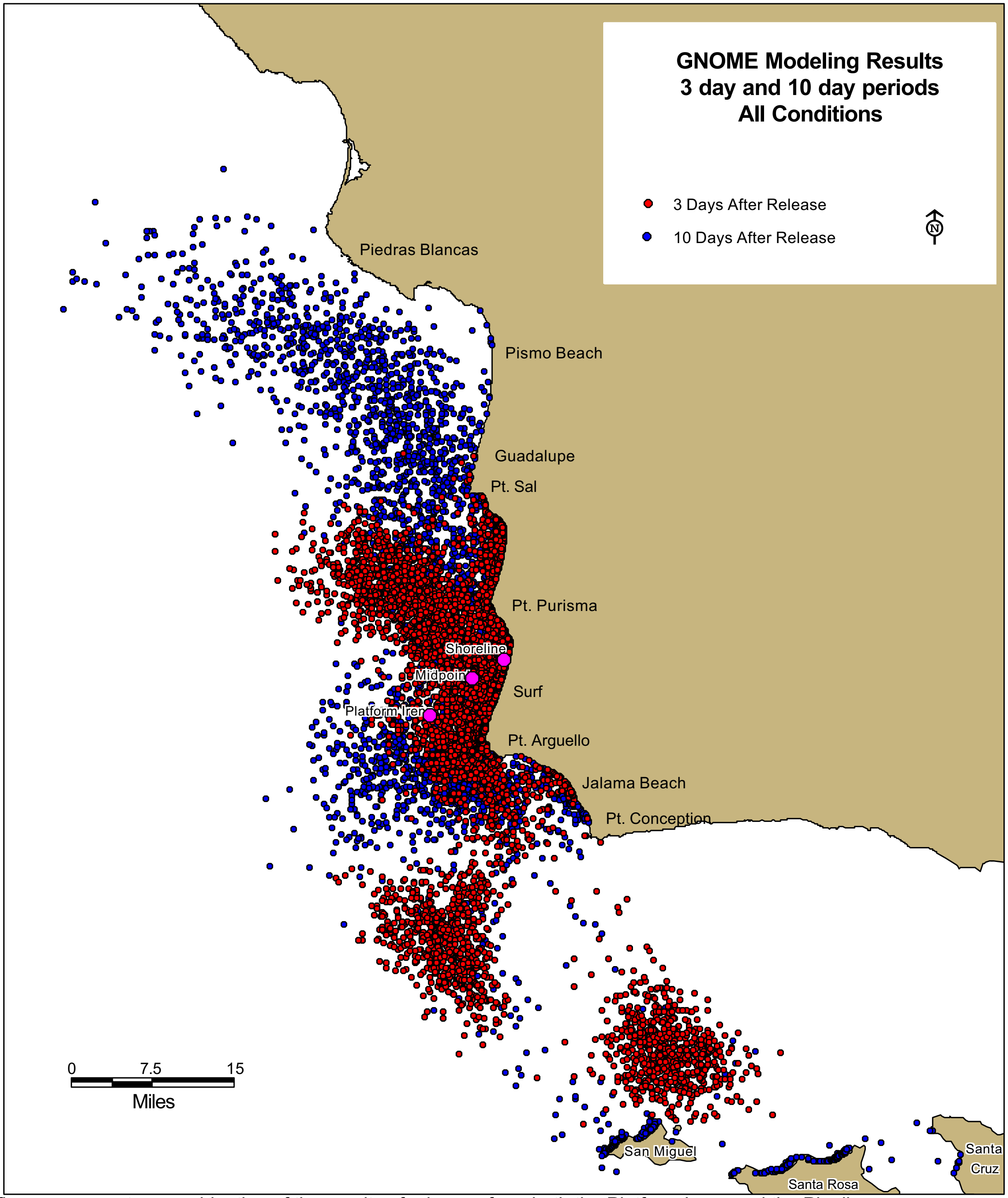
Beach Impacted Areas defined as:

PA - Point Arguello, PC - Point Conception, PP - Point Purisma, PS - Point Sal, S - Surf,
P - Pismo Beach, SM - San Miguel Island, SR - Santa Rosa Island, SC - Santa Cruz Island
J - Jalama, G - Guadalupe

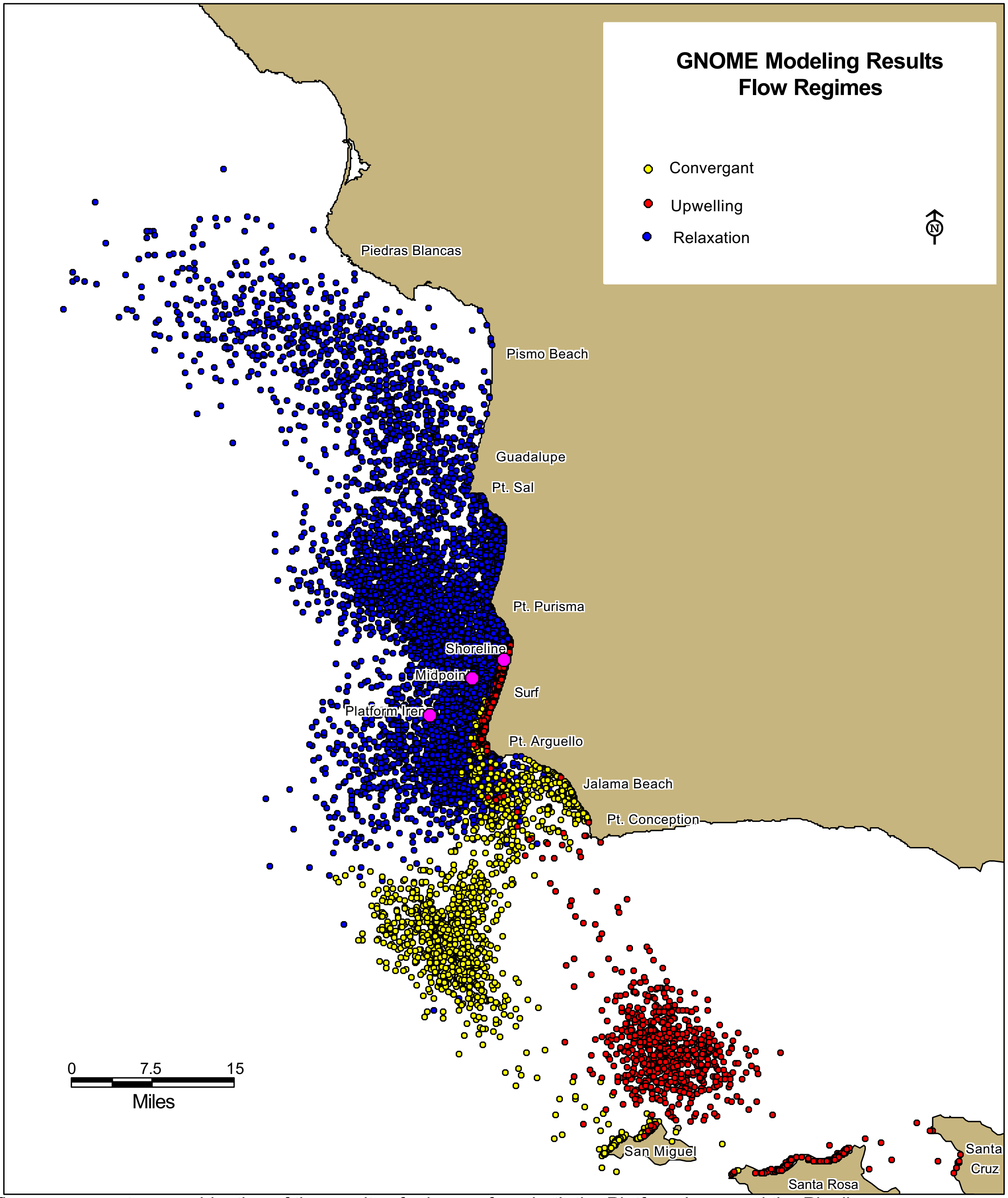
Neutral winds followed the flow regime, in this case relaxation, a moved primarily towards the north impacting the coastline from Point Arguello to north of Piedras Blancas. Wind directions between any of those modeled (such as SSW) would impact areas between the those indicated above.

Operating Scenarios and Impact Levels

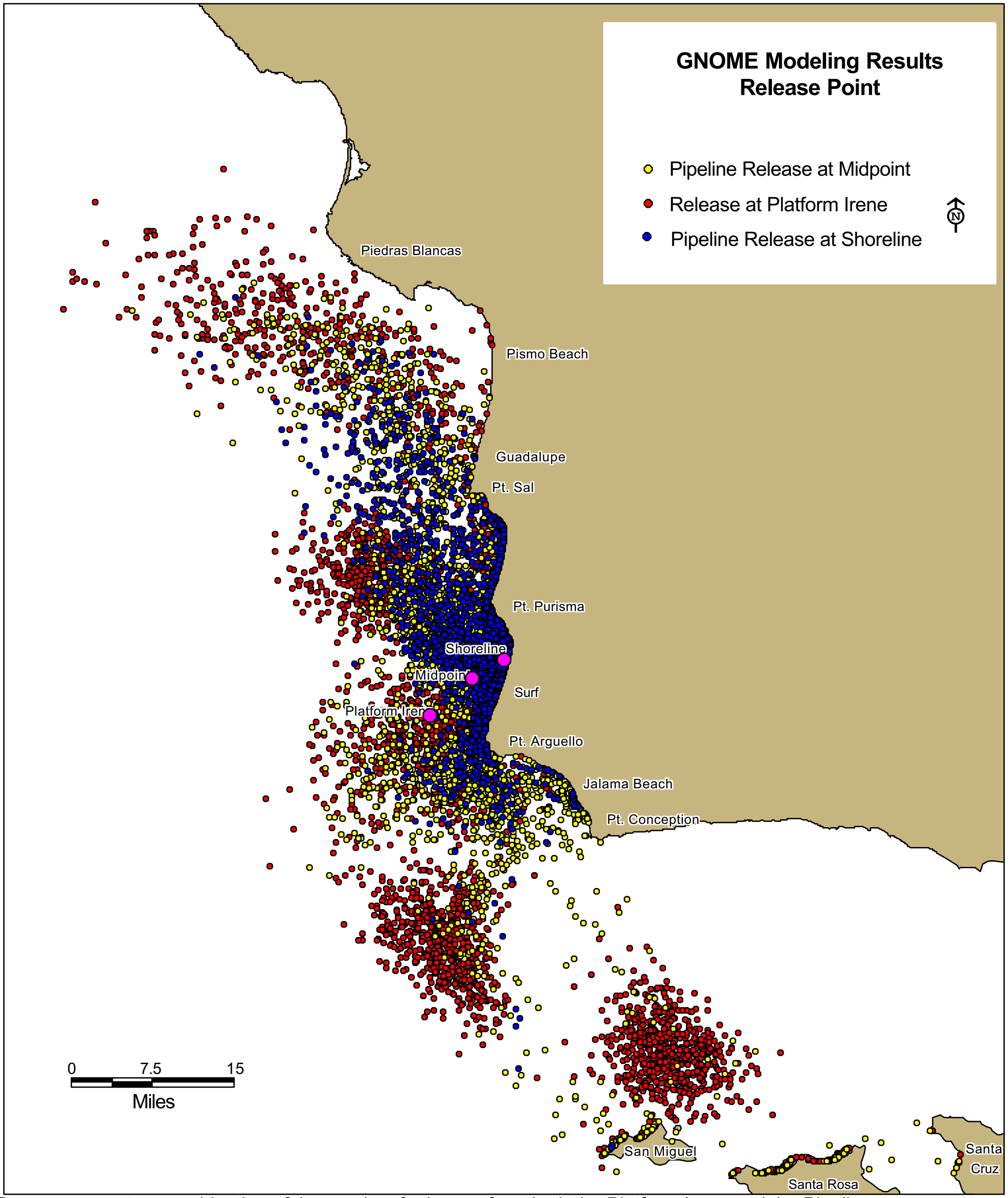
The GNOME Model produces output which allows for quantifying the amount of oil that is either beached, left on the water, weathered or that is outside the scope of the model area. Current operating scenarios have the potential to beach a maximum of about 1701 barrels of oil from current pipeline operations. The proposed project would increase this beached amount to about 3,984 barrels. This maximum amount would be associated with the pipeline shoreline release during the upwelling regime and would occur primarily at the Surf location. Worst case impacts associated with a pipeline midpoint release would occur during an upwelling regime also and would total about 996 barrels and 2090 barrels for current and proposed operations respectively. This amount would impact Surf, Point Arguello and Point Conception. Worst case impacts associated with a release at Platform Irene would occur during a relaxation regime and would total about 181 barrels and 2138 barrels for current and proposed operations respectfully. This amount would impact Point Purisma, Point Sal, Guadalupe and Pismo Beach.



This figure represents a combination of the results of releases from both the Platform Irene and the Pipeline and a range of met and regime conditions using the GNOME NOAA model.



This figure represents a combination of the results of releases from both the Platform Irene and the Pipeline and a range of met and regime conditions using the GNOME NOAA model.



This figure represents a combination of the results of releases from both the Platform Irene and the Pipeline and a range of met and regime conditions using the GNOME NOAA model.

Attachment F Oil Spill Risk Calculations

Offshore Pipeline Spill Volume Estimate
Platform Irene to Beach

	Description	Units	Release at Shoreline: Irene to Shore Current Operations	Release at Shoreline: Irene to Shore Proposed Operations	Release at Pipeline Midpoint: Irene to Shore Current Operations	Release at Pipeline Midpoint: Irene to Shore Proposed Operations
Q	Flow rate of shipping pump	B/D	57000	90000	57000	90000
t	Time to shut down pump and close valve	min	11	11	11	11
%	Oil cut (percent water)	%	87.7	60	87.7	60
V_{pump}	**Discharge volume from time to shut down**	**BBL**	382	413	382	413
P_D	Design pipeline pressure (PSV set point)	psi	1300	1300	1300	1300
D_{ID}	Nominal inside diameter	in	18.75	18.75	18.75	18.75
D_{OD}	Nominal outside diameter	in	20	20	20	20
D_{ID}	Nominal inside diameter	ft	1.563	1.563	1.563	1.563
D_{OD}	Nominal outside diameter	ft	1.667	1.667	1.667	1.667
s	Hoop stress	psi	40300	40300	40300	40300
E	Young's modulus		30000000	30000000	30000000	30000000
D_P	Inside diameter during pumping	ft	1.565	1.565	1.565	1.565
API	API gravity		16	16	16	16
SG	Specific Gravity		0.959	0.959	0.959	0.959
RO_s	Static density of oil	lb/ft^3	59.862	59.862	59.862	59.862
DRO	Difference in oil density due to compressibility from GPSA data book	lb/ft^3	0.1	0.1	0.1	0.1
RO_d	Dynamic density of oil	lb/ft^3	59.96	59.96	59.96	59.96
L	Pipeline length	ft	53328	53328	26664	26664
V_{RO}	**Discharge volume from density change**	**BBL**	27	18	13	9
V_D	**Discharge volume from diameter change**	**BBL**	43	29	21	15
L_1	Length above water line on inlet end	ft	395	395	395	395
L_2	Length above water line on discharge end	ft	315	315	315	315
V_H	**Discharge volume from hydrostatic head**	**BBL**	213	146	213	146
V_P	**Discharge volume from perculation due to density difference between oil and sea water**	**BBL**	**2248**	**7324**	**1124**	**3662**
V_2	**Volume of oil calculated to leak from a rupture of a subsea pipeline**	**BBL**	**2913**	**7929**	**1754**	**4244**

Notes: Assumes 100% of oil in pipeline volume lost due to hydrostatic pressure and buoyancy effects.
Worst case pipeline spill assumed to be located near shore (at highest elevation point of offshore pipeline)

Platform Irene Vessel and Pipeline Release Volumes Estimate

Variable	Description	Units	Current Operations	Proposed Project
Percent Oil			12.3	40
Vessel	V-140			
D	Diameter	ft	8.0	8.0
L	Length	ft	17.0	17.0
h_1	Top of oil layer	ft	8.0	8.0
h_2	Bottom of oil layer	ft	4.0	4.0
%	Oil cut	%	12.3	40.0
V	**Volume of oil**	**BBL**	**9.4**	**30.5**
Vessel	V-150			
D	Diameter	ft	8.0	8.0
L	Length	ft	17.0	17.0
h_1	Top of oil layer	ft	8.0	8.0
h_2	Bottom of oil layer	ft	4.0	4.0
%	Oil cut	%	12.3	40.0
V	**Volume of oil**	**BBL**	**9.4**	**30.5**
Vessel	V-100			
D	Diameter	ft	6.0	6.0
L	Length	ft	13.0	13.0
h_1	Top of oil layer	ft	6.0	6.0
h_2	Bottom of oil layer	ft	3.0	3.0
%	Oil cut	%	12.3	40.0
V	**Volume of oil**	**BBL**	**4.0**	**13.1**
Vessel	V-110			
D	Diameter	ft	6.0	6.0
L	Length	ft	13.0	13.0
h_1	Top of oil layer	ft	6.0	6.0
h_2	Bottom of oil layer	ft	3.0	3.0
%	Oil cut	%	12.3	40.0
V	**Volume of oil**	**BBL**	**4.0**	**13.1**
Vessel	V-120			
D	Diameter	ft	6.0	6.0
L	Length	ft	13.0	13.0
h_1	Top of oil layer	ft	6.0	6.0
h_2	Bottom of oil layer	ft	3.0	3.0
%	Oil cut	%	12.3	40.0
V	**Volume of oil**	**BBL**	**4.0**	**13.1**
Vessel	V-130			
D	Diameter	ft	6.0	6.0
L	Length	ft	13.0	13.0

Platform Irene Vessel and Pipeline Release Volumes Estimate

Variable	Description	Units	Current Operations	Proposed Project
h_1	Top of oil layer	ft	6.0	6.0
h_2	Bottom of oil layer	ft	3.0	3.0
%	Oil cut	%	12.3	40.0
V	**Volume of oil**	**BBL**	**4.0**	**13.1**
Vessel	V-910			
D	Diameter	ft	8.0	8.0
L	Length	ft	11.0	11.0
h_1	Top of oil layer	ft	4.0	4.0
h_2	Bottom of oil layer	ft	0.0	0.0
%	Oil cut	%	75.0	75.0
V	**Volume of oil**	**BBL**	**37.0**	**37.0**
Vessel	T-530/540			
D	Diameter	ft	10.0	10.0
L	Length	ft	10.0	10.0
h_1	Top of oil layer	ft	8.0	8.0
h_2	Bottom of oil layer	ft	0.0	0.0
%	Oil cut	%	75.0	75.0
V	**Volume of oil**	**BBL**	**84.0**	**84.0**
Vessel	V-160			
D	Diameter	ft	10.0	10.0
L	Length	ft	15.0	15.0
h_1	Top of oil layer	ft	9.0	9.0
h_2	Bottom of oil layer	ft	0.0	0.0
%	Oil cut	%	12.3	40.0
V	**Volume of oil**	**BBL**	**15.5**	**50.4**
Piping	**Volume of oil**	**BBL**	**17.1**	**28.5**
V_1	**Volume of oil discharged from vessels and piping**	**BBL**	**188.4**	**313.1**
Diesel Storage	**Volume of Diesel**	**BBL**	**238.0**	**238.0**
VT	**Volume of oil and Diesel discharged from vessels and piping**	**BBL**	**426.4**	**551.1**

Platform Irene Vessel and Pipeline Release Volumes Estimate

Variable	Description	Units	Current Operations	Proposed Project
V vessel	**Largest Vessel Release Volume**	**BBL**	**84.0**	**84.0**

Calculations and equipment based on Torch OSCP, October, 2000. Oil cut percentage correct(
for most recently available data (to 11.9% from 20%)

Tranquillon Ridge Project
Well Blowout Spill Volumes

Case	Platform Irene (bbls/day)	
	Current Operations[a]	Tranquillon Ridge[b]
Oil discharge rate of highest capacity flowing well	0	4,500

a. None of the current wells at Platform Irene are flowing without artifical lift.

b. Tranquillon Ridge wells are expected to flow without artifical lift for about five years.

MMS Oil Spill Risk Calculations: Current Operations
US OCS Spill Historical Spill Data

US OCS Spills	Number of Spills	Median Spill Size (bbls)	Spill Rate (spills per 10^9 bbls)
Spills Between 1 and 50 bbls			
Platforms	154	25	11.1
Pipelines	457	25	33.2
Spills Greater Than 50 bbls			
Platforms	27	159	1.9
Pipelines	80	159	5.8
Spills Greater Than or Equal to 1,000 bbls			
Platforms	11	7,000	0.45
Pipelines	12	5,600	1.35
Spills Greater Than or Equal to 10,000 bbls			
Platforms	4	41,500	0.16
Pipelines	4	17,700	0.44

Source: Comparative Occurrence Rate for Offshore Oil Spills, Anderson and La Belle, MMS.
Source: Delineation Drilling Activities in Federal Water Offshore Santa Barbara County, California, Draft Environemtnal Impact Statement, MMS, 2001-046.
Spills greater than 50 bbls estimated based on MMS, (2001) rate calculated from Table 5.1-1 Appendix 5.1 (50-999 bbls), rate of 0.15 spills/19 billion barrels
Assumed split between platforms and pipelines equal to 1 to 3 as per Anderson et al (25% platforms, 75% pipelines).
Spills between 1 and 50 bbls ratioed up from >50 bbl as per table 5.1.3.1-1 (for Pacific Region only) (47 total spills > 1 bbls, 40 in the 1-50 bbls range)
for a ratio of 40/7 small spills to larger spills
Mean spill size estimated from 159 bbls for 50 - 999 bbls range (as per MMS page 5-18) and mean size for 1 - 49 bbls range of assumed 25 bbls.
Source for >1,000 bbl spills: Comparative Occurrence Rate for Offshore Oil Spills, Anderson and La Belle, MMS.

MMS Calculation of Spill Probabilities for Platform Irene and Irene Pipeline with Pt. Pedernales Production Only

Location	Spill Rate (spills per 10^9 bbls)	Total Oil Production (10^9 bbls)	Duration of Total Oil Production (years)	Estimated Number of Spills During the Duration	Probability of Zero Spills Occurring (P(0))	Probability of One or More Spills Occurring	Rate/yr
Spills Between 1 and 50 bbls							
Platform Irene	11.1	0.0073	10	0.0808	92.2%	7.8%	8.1E-03
Irene Pipeline	33.2	0.0073	10	0.2425	78.5%	21.5%	2.4E-02
Total			10	0.3233	72.4%	27.6%	3.2E-02
Spills Greater Than 50 bbls							
Platform Irene	1.9	0.0073	10	0.0141	98.6%	1.4%	1.4E-03
Irene Pipeline	5.8	0.0073	10	0.0424	95.8%	4.2%	4.2E-03
Total			10	0.0566	94.5%	5.5%	5.7E-03
Spills Greater Than 1000 bbls							
Platform Irene	0.5	0.0073	10	0.0033	99.7%	0.3%	3.3E-04
Irene Pipeline	1.4	0.0073	10	0.0099	99.0%	1.0%	9.9E-04
Total			10	0.0131	98.7%	1.3%	1.3E-03

Notes:
Estimated average rate of oil production over remaining life. 2,000 bpd
Duration of production is for 10 years
Estimated number of spills during the duration=spill rate*total oil production.
Probability(P)=e^-number of spills during production duration.
The probability of one or more spills=1-P.

Calculation of Spill Probabilities for Platform Irene & Pipeline with Pt. Pedernales and Tranquillon Ridge Production

Location	Spill Rate (spills per 10^9 bbls)	Total Oil Production (10^9 bbls)	Duration of Total Oil Production (years)	Estimated Number of Spills During the Duration	Probability of Zero Spills Occurring (P(0))	Probability of One or More Spills Occurring	Rate/yr
Spills Between 1 and 50 bbls							
Platform Irene	11.1	0.1030	15	1.1404	32.0%	68.0%	7.60E-02
Irene Pipeline	33.2	0.1030	15	3.4211	3.3%	96.7%	2.28E-01
Total			15	4.5614	1.0%	99.0%	3.04E-01
Spills Greater Than 50 bbls							
Platform Irene	1.9	0.1030	15	0.1996	81.9%	18.1%	1.33E-02
Irene Pipeline	5.8	0.1030	15	0.5987	55.0%	45.0%	3.99E-02
Total			15	0.7983	45.0%	55.0%	5.32E-02
Spills Greater Than 1000 bbls							
Platform Irene	0.5	0.1030	15	0.0464	95.5%	4.5%	3.09E-03
Irene Pipeline	1.4	0.1030	15	0.1391	87.0%	13.0%	9.27E-03
Total			15	0.1854	83.1%	16.9%	1.24E-02

Notes:
Estimated average rate of oil production over remaining life. 18,840 bpd
Duration of production is for 15 years
Estimated number of spills during the duration=spill rate*total oil production.
Probability(P)=e^-number of spills during production duration.
The probability of one or more spills=1-P.

Tranquillon Ridge Risk Analysis Spreadsheets

Scenarios with Potential to Impact Public Only

LOGP Facility

Scenario	Type	Units	Wind	Impact Distances				Base Frequency, /yr	Conditional Probabilities			Scenario Frequency
				Fatality		Injury						
				Distance, ft	Width, ft	Distance, ft	Width, ft		Event Cond. Prob.	Wind Stab Prob.	Wind Direction Prob.	
Crude tank fire	Thermal	10 kw/m2 fat, 5 kw/m2 injury		650		885		4.00E-05	0.05	1.00	1.00	2.00E-06
Gas/oil separator vessel rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	318	32	740	115	2.00E-05	0.50	0.51	0.15	7.65E-07
Gas/oil separator vessel rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	318	32	740	115	2.00E-05	0.50	0.51	0.85	4.34E-06
Gas/oil separator vessel rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	705	71	1640	120	2.00E-05	0.50	0.49	0.15	7.35E-07
Gas/oil separator vessel rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	705	71	1640	120	2.00E-05	0.50	0.49	0.85	4.17E-06
LPG/NGL Vessel BLEVE	Thermal	80 kJ/m2 fat estimated, 40 kJ/m2 injury		1635		2240		8.00E-07	1.00	1.00	1.00	8.00E-07
LPG/NGL Vessel Explosion	Explosion	3 psi fatality estimated, 0.5 psi injury		470		1880		8.00E-07	0.25	1.00	1.00	2.00E-07
LPG/NGL Tank rupture/release, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	1032	103	2400	1900	2.00E-05	0.50	0.51	0.15	7.65E-07
LPG/NGL Tank rupture/release, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	1032	103	2400	1900	2.00E-05	0.50	0.51	0.85	4.34E-06
LPG/NGL Tank rupture/release, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	1075	108	2500	2000	2.00E-05	0.50	0.49	0.15	7.35E-07
LPG/NGL Tank rupture/release, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	1075	108	2500	2000	2.00E-05	0.50	0.49	0.85	4.17E-06
LPG/NGL tank truck rupture	Explosion	3 psi fatality, 0.5 psi injury		460		1800		4.04E-07	0.25	1.00	1.00	1.53E-05
LPG/NGL tank truck rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	593	59	1380	980	4.04E-07	0.50	0.51	0.15	2.35E-06
LPG/NGL tank truck rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	593	59	1380	980	4.04E-07	0.50	0.51	0.85	1.33E-05
LPG/NGL tank truck rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	538	54	1250	980	4.04E-07	0.50	0.49	0.15	2.26E-06
LPG/NGL tank truck rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	538	54	1250	980	4.04E-07	0.50	0.49	0.85	1.28E-05

IRENE/LOGP Pipeline Segment: Between Valve Station 9 and LOGP closest segments

Scenario	Type	Units	Wind	Impact Distances				Base Frequency, /mile-yr	Conditional Probabilities			Scenario Frequency
				Fatality		Injury						
				Distance, ft	Width, ft	Distance, ft	Width, ft		Event Cond. Prob.	Wind Stab Prob.	Wind Direction Prob.	
Irene/LOGP 8" Pipeline												
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		49		289		4.34E-04	0.25	1.00	1.00	1.03E-04
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		75		92		4.34E-04	0.25	1.00	1.00	1.03E-04
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	172	88	461	159	4.34E-04	0.50	0.51	0.27	2.83E-05
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	172	88	461	159	4.34E-04	0.50	0.51	0.73	7.66E-05
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	112	34	246	58	4.34E-04	0.50	0.49	1.00	1.01E-04
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	400	30	1060	49	4.34E-04	0.50	0.51	1.00	1.05E-04
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	89	23	135	36	4.34E-04	0.50	0.49	1.00	1.01E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		125		751		2.13E-04	0.25	1.00	1.00	5.05E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		217		259		2.13E-04	0.25	1.00	1.00	5.05E-05
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	780	355	2033	660	2.13E-04	0.50	0.51	0.27	1.39E-05
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	780	355	2033	660	2.13E-04	0.50	0.51	0.73	3.76E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	448	137	974	236	2.13E-04	0.50	0.49	1.00	4.94E-05
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	VCE	LFL, 1/2 LFL	F	1066	92	2477	128	2.13E-04	0.50	0.51	0.27	1.39E-05
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	VCE	LFL, 1/2 LFL	F	1066	92	2477	128	2.13E-04	0.50	0.51	0.73	3.76E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	262	79	407	112	2.13E-04	0.50	0.49	1.00	4.94E-05

Segment length 5000 feet

IRENE/LOGP Pipeline Segment: Between VS8 plus VS9 and LOGP farthest segments

Scenario	Type	Units	Wind	Impact Distances				Base Frequency, /mile-yr	Conditional Probabilities			Scenario Frequency
				Fatality		Injury						
				Distance, ft	Width, ft	Distance, ft	Width, ft		Event Cond. Prob.	Wind Stab Prob.	Wind Direction Prob.	
Irene/LOGP 8" Pipeline												
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		49		289		4.34E-04	0.25	1.00	1.00	2.67E-04
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		75		92		4.34E-04	0.25	1.00	1.00	2.67E-04
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	172	88	461	159	4.34E-04	0.50	0.51	0.33	9.00E-05
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	172	88	461	159	4.34E-04	0.50	0.51	0.67	1.83E-04
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	112	34	246	58	4.34E-04	0.50	0.49	1.00	2.62E-04
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	400	30	1060	49	4.34E-04	0.50	0.51	1.00	2.73E-04
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	89	23	135	36	4.34E-04	0.50	0.49	1.00	2.62E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		125		751		2.13E-04	0.25	1.00	1.00	1.31E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		217		259		2.13E-04	0.25	1.00	1.00	1.31E-04
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	780	355	2033	660	2.13E-04	0.50	0.51	0.33	4.42E-05
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	780	355	2033	660	2.13E-04	0.50	0.51	0.67	8.96E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	448	137	974	236	2.13E-04	0.50	0.49	1.00	1.29E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1066	92	2477	128	2.13E-04	0.50	0.51	1.00	1.34E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	262	79	407	112	2.13E-04	0.50	0.49	1.00	1.29E-04

Segment length 13000 feet

Tranquillon Ridge Risk Analysis Spreadsheets
Scenarios with Potential to Impact Public Only

IRENE/LOGP Pipeline Segment: Near Valve Station 7 and Valve Station 8

Scenario	Type	Units	Wind	Impact Distances: Fatality Distance, ft	Impact Distances: Fatality Width, ft	Impact Distances: Injury Distance, ft	Impact Distances: Injury Width, ft	Base Frequency, /mile-yr	Conditional Probabilities: Event Cond. Prob.	Conditional Probabilities: Wind Stab Prob.	Conditional Probabilities: Wind Direction Prob.	Scenario Frequency
Irene/LOGP 8" Pipeline												
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		49		289		4.34E-04	0.25	1.00	1.00	8.23E-05
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		75		92		4.34E-04	0.25	1.00	1.00	8.23E-05
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	172	88	461	159	4.34E-04	0.50	0.51	0.33	2.77E-05
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	172	88	461	159	4.34E-04	0.50	0.51	0.67	5.62E-05
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	112	34	246	58	4.34E-04	0.50	0.49	1.00	8.06E-05
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	400	30	1060	49	4.34E-04	0.50	0.51	1.00	8.39E-05
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	89	23	135	36	4.34E-04	0.50	0.49	1.00	8.06E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		125		751		2.13E-04	0.25	1.00	1.00	4.04E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		217		259		2.13E-04	0.25	1.00	1.00	4.04E-05
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	780	355	2033	660	2.13E-04	0.50	0.51	0.33	1.36E-05
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	780	355	2033	660	2.13E-04	0.50	0.51	0.67	2.76E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	448	137	974	236	2.13E-04	0.50	0.49	1.00	3.96E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1066	92	2477	128	2.13E-04	0.50	0.51	1.00	4.12E-05
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	262	79	407	112	2.13E-04	0.50	0.49	1.00	3.96E-05
Segment length	4000 feet											

IRENE/LOGP Pipeline Segment: Remaining Segments

Scenario	Type	Units	Wind	Impact Distances: Fatality Distance, ft	Impact Distances: Fatality Width, ft	Impact Distances: Injury Distance, ft	Impact Distances: Injury Width, ft	Base Frequency, /mile-yr	Conditional Probabilities: Event Cond. Prob.	Conditional Probabilities: Wind Stab Prob.	Conditional Probabilities: Wind Direction Prob.	Scenario Frequency
Irene/LOGP 8" Pipeline												
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		49		289		4.34E-04	0.25	1.00	1.00	8.72E-04
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		75		92		4.34E-04	0.25	1.00	1.00	8.72E-04
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	F	172	88	461	159	4.34E-04	0.50	0.51	1.00	8.90E-04
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	112	34	246	58	4.34E-04	0.50	0.49	1.00	8.55E-04
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	400	30	1060	49	4.34E-04	0.50	0.51	1.00	8.90E-04
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	89	23	135	36	4.34E-04	0.50	0.49	1.00	8.55E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		125		751		2.13E-04	0.25	1.00	1.00	4.28E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		217		259		2.13E-04	0.25	1.00	1.00	4.28E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	F	780	355	2033	660	2.13E-04	0.50	0.51	1.00	4.37E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	448	137	974	236	2.13E-04	0.50	0.49	1.00	4.19E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1066	92	2477	128	2.13E-04	0.50	0.51	1.00	4.37E-04
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	262	79	407	112	2.13E-04	0.50	0.49	1.00	4.19E-04
Segment length	42416 feet											

Torch Sales Gas Pipeline: rural areas

Scenario	Type	Units	Wind	Fatality: Distance, ft	Fatality: Width, ft	Injury: Distance, ft	Injury: Width, ft	Base Frequency, /mile-yr	Conditional Probabilities: Event Cond. Prob.	Conditional Probabilities: Wind Stab Prob.	Conditional Probabilities: Wind Direction Prob.	Scenario Frequency
Torch Sales Gas 12" Pipeline												
Gas pipeline leak 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		126		138		1.51E-04	0.25	1.00	1.00	2.46E-04
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	F	335	52	600	85	1.51E-04	0.50	0.51	1.00	2.51E-04
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	D	167	16	259	23	1.51E-04	0.50	0.49	1.00	2.41E-04
Gas pipeline rupture, 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		771		791		7.43E-05	0.25	1.00	1.00	1.21E-04
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	F	1761	518	3050	758	7.43E-05	0.50	0.51	1.00	1.24E-04
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	D	928	154	1450	220	7.43E-05	0.50	0.49	1.00	1.19E-04
Segment length	34500 feet											

Torch Sales Gas Pipeline: along Highway 1/135

Scenario	Type	Units	Wind	Fatality: Distance, ft	Fatality: Width, ft	Injury: Distance, ft	Injury: Width, ft	Base Frequency, /mile-yr	Conditional Probabilities: Event Cond. Prob.	Conditional Probabilities: Wind Stab Prob.	Conditional Probabilities: Wind Direction Prob.	Scenario Frequency
Torch Sales Gas 12" Pipeline												
Gas pipeline leak 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		126		138		1.51E-04	0.25	1.00	0.25	8.92E-06
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	F	335	52	600	85	1.51E-04	0.50	0.51	0.25	9.10E-06
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	D	167	16	259	23	1.51E-04	0.50	0.49	0.25	8.74E-06
Gas pipeline rupture, 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		771		791		7.43E-05	0.25	1.00	0.25	4.39E-06
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	F	1761	518	3050	758	7.43E-05	0.50	0.51	0.25	4.48E-06
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	D	928	154	1450	220	7.43E-05	0.50	0.49	0.25	4.31E-06
Segment length	5000 feet											

Tranquillon Ridge Risk Analysis Spreadsheets

Scenarios with Potential to Impact Public Only

Conditional Prob based on CCPS, 50% of releases produce vapor cloud, 25% produce explosion, 25% immediate ignition. Toxic impacts assumed to conservatively be equal to vapor cloud effects.

Fatality Probabilities: 10% at 10 kw/m2 for thermal, 30% within LFL, explosion 50% at 3 psi (assumes 50% of persons indoors), 10% fatalities at ERPG-3 for toxic

Injury Probabilities: 10% at 5 kw/m2 for thermal, 50% within 1/2 LFL, 10% at 0.5 psi and 10% at ERPG-2

Wind Occurrence Based on 1993 SEIR: 50.5% D Stability, 49.5% F stability.

LOGP Harris Grade direction prob. based on 15% of time wind blowing from the NNE, NE, ENE, E, ESE, SE (HS&P met data 1988/89). Remaining 85% of time wind blows towards on rural areas.

Valve 9 to LOGP pipeline urban wind direction prob. based on fraction of time wind is blowing from the NW, NNW, N, NNE. Remaining time wind blows release towards rural only areas.

Valve 8 to Valve 9 pipeline urban wind direction prob. based on NW, WNW, W, WSW

Wind direction prob. for scenarios that do not reach urban areas assigned a value of 1.0 as all other areas are rural in all directions.

Zone rural and Harris Grade or urban fractions based on geometry of ellipses and circles with center area excluded (due to within facility boundaries for LOGP scenarios)

For vapor cloud explosions/fire (VCE) and Toxic impacts, width is equal to 1/2 width of ellipse with ellipse length equal to downwind distance from release point.

For thermal and explosion, downwind distance equal to circle radius with center at release point

For impact distances where numbers are not available, estimated impact distances assumed the following:

- Assumed ratios of length to width for LFL = 0.1
- Assumed ratio of 1/2 LFL to LFL = 0.43
- Assumed thermal 10 kw/m2 to 5 kw/m2 ratio = 0.73
- Assumed 0.5 psi to 3 psi ratio = 0.25

Distance from LOGP to Harris Grade Road (facility boundary), ft	700	feet
Distance between LOGP and Vandenberg Village, feet	4800	feet
Distance from Valve 9 - LOGP pipeline segment to Vandenberg Village =	1800	feet
Distance from Valve 8 - Valve 9 pipeline segment to Vandenberg Village =	2800	feet
Distance from Valve 7 - Valve 8 pipeline segment to Penitentiary Barracks =	2600	feet

Rural population =	1	persons/sq mile
Harris Grade population=	3.48	persons/sq mile (1.74 cars/mile, 2 persons per car)
Rte 1/135 population	24.24	persons/sq mile (12.12 cars/mile, 2 persons per car)
Urban population =	7000	persons/sq mile
Number of Irene-LOGP gas pigging operations per year	12	
Number of LGP trips per year	152	
Facility Life, years	22	
LOGP cumulative scenario frequency, per year	6.90E-05	
LOGP probability, percent	0.15	
Ignition probability per car	0.06	

Ignition sources of cars based on cars per mile with above probability. Ignition probability included in Event Conditional probability

Sales gas, due to being mostly methane, was assumed to not be able to create an explosion due to lack of confinement.

Tranquillon Ridge Risk Analysis Spreadsheets

Scenarios with Potential to Impact Public Only

LOGP Facility

Scenario	Type	Units	Wind	Fatality Zone: Rural Fraction	Fatality Zone: Harris Grade Fraction	Injury Zone: Rural Fraction	Injury Zone: Harris Grade Fraction	Fat. Zone Persons Affected	Inj. Zone Persons Affected	Fatality Prob.	Injury Prob.	Fatalities	Injuries
Crude tank fire	Thermal	10 kw/m2 fat, 5 kw/m2 injury		0.00	0.00	0.32	0.06	0.000	0.045	0.1	0.1	0.000	0.005
Gas/oil separator vessel rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	0.00	0.00	0.00	0.02	0.000	0.000	0.3	0.5	0.000	0.000
Gas/oil separator vessel rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	0.00	0.00	0.02	0.00	0.000	0.000	0.3	0.5	0.000	0.000
Gas/oil separator vessel rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	0.00	0.00	0.00	0.59	0.000	0.011	0.3	0.5	0.000	0.006
Gas/oil separator vessel rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	0.00	0.00	0.59	0.00	0.000	0.003	0.3	0.5	0.000	0.002
LPG/NGL Vessel BLEVE	Thermal	80 kJ/m2 fat estimated, 40 kJ/m2 injury		0.58	0.24	0.60	0.30	0.422	0.937	0.1	0.1	0.042	0.094
LPG/NGL Vessel Explosion	Explosion	3 psi fatality estimated, 0.5 psi injury		0.00	0.00	0.59	0.27	0.000	0.608	0.5	0.1	0.000	0.061
LPG/NGL Tank rupture/release, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	0.00	0.28	0.00	0.76	0.003	0.339	0.3	0.5	0.001	0.169
LPG/NGL Tank rupture/release, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	0.28	0.00	0.76	0.00	0.001	0.097	0.3	0.5	0.000	0.049
LPG/NGL Tank rupture/release, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	0.00	0.31	0.00	0.77	0.004	0.378	0.3	0.5	0.001	0.189
LPG/NGL Tank rupture/release, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	0.31	0.00	0.77	0.00	0.001	0.109	0.3	0.5	0.000	0.054
LPG/NGL tank truck rupture	Explosion	3 psi fatality, 0.5 psi injury		0.00	0.00	0.59	0.26	0.000	0.544	0.5	0.1	0.000	0.054
LPG/NGL tank truck rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	0.00	0.00	0.00	0.49	0.000	0.065	0.3	0.5	0.000	0.033
LPG/NGL tank truck rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	0.00	0.00	0.49	0.00	0.000	0.019	0.3	0.5	0.000	0.009
LPG/NGL tank truck rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	0.00	0.00	0.00	0.42	0.000	0.051	0.3	0.5	0.000	0.025
LPG/NGL tank truck rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	0.00	0.00	0.42	0.00	0.000	0.015	0.3	0.5	0.000	0.007

IRENE/LOGP Pipeline Segment: Between Valve Station 9 and LOGP closest segments

Scenario	Type	Units	Wind	Fatality Rural Fraction	Fatality Urban Fraction	Injury Rural Fraction	Injury Urban Fraction	Fat. Zone Persons Affected	Inj. Zone Persons Affected	Fatality Prob.	Injury Prob.	Fatalities	Injuries
Irene/LOGP 8" Pipeline													
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.000	0.009	0.5	0.1	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.001	0.001	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.000	0.0	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.000	0.002	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.000	0.000	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.000	0.001	0.3	0.5	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.000	0.000	0.3	0.5	0.000	0.000
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.002	0.064	0.5	0.1	0.001	0.006
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.005	0.008	0.1	0.1	0.001	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	0.94	0.06	0.008	16.9	0.1	0.1	0.001	1.69
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.008	0.038	0.1	0.1	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.002	0.006	0.1	0.1	0.000	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	VCE	LFL, 1/2 LFL	F	1.00	0.00	0.78	0.22	0.003	13.9	0.3	0.5	0.001	6.931
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.003	0.009	0.3	0.5	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.001	0.001	0.3	0.5	0.000	0.001
Segment length	5000 feet												

IRENE/LOGP Pipeline Segment: Between VS8 plus VS9 and LOGP farthest segments

Scenario	Type	Units	Wind	Fatality Rural Fraction	Fatality Urban Fraction	Injury Rural Fraction	Injury Urban Fraction	Fat. Zone Persons Affected	Inj. Zone Persons Affected	Fatality Prob.	Injury Prob.	Fatalities	Injuries
Irene/LOGP 8" Pipeline													
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.000	0.009	0.5	0.1	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.001	0.001	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.000	0.002	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.000	0.002	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.000	0.000	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.000	0.001	0.3	0.5	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.000	0.000	0.3	0.5	0.000	0.000
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.002	0.064	0.5	0.1	0.001	0.006
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.005	0.008	0.1	0.1	0.001	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.008	0.0	0.1	0.1	0.001	0.00
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.008	0.038	0.1	0.1	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.002	0.006	0.1	0.1	0.000	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.003	0.009	0.3	0.5	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.001	0.001	0.3	0.5	0.000	0.001
Segment length	13000 feet												

Tranquillon Ridge Risk Analysis Spreadsheets
Scenarios with Potential to Impact Public Only

IRENE/LOGP Pipeline Segment: Near Valve Station 7 and Valve Station 8

Scenario	Type	Units	Wind	Fatality Rural Fraction	Fatality Urban Fraction	Injury Rural Fraction	Injury Urban Fraction	Fat. Zone Persons Affected	Inj. Zone Persons Affected	Fatality Prob.	Injury Prob.	Fatalities	Injuries
Irene/LOGP 8" Pipeline													
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.000	0.009	0.5	0.1	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.001	0.001	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.000	0.002	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.000	0.002	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.000	0.000	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.000	0.001	0.3	0.5	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.000	0.000	0.3	0.5	0.000	0.000
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.002	0.064	0.5	0.1	0.001	0.006
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.005	0.008	0.1	0.1	0.001	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.008	0.0	0.1	0.1	0.001	0.00
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.008	0.038	0.1	0.1	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.002	0.006	0.1	0.1	0.000	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.003	0.009	0.3	0.5	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.001	0.001	0.3	0.5	0.000	0.001

Segment length 4000 feet

IRENE/LOGP Pipeline Segment: Remaining Segments

Scenario	Type	Units	Wind	Fatality Rural Fraction	Fatality Urban Fraction	Injury Rural Fraction	Injury Urban Fraction	Fat. Zone Persons Affected	Inj. Zone Persons Affected	Fatality Prob.	Injury Prob.	Fatalities	Injuries
Irene/LOGP 8" Pipeline													
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.000	0.009	0.5	0.1	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.001	0.001	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.000	0.002	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.000	0.000	0.1	0.1	0.000	0.000
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.000	0.001	0.3	0.5	0.000	0.001
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.000	0.000	0.3	0.5	0.000	0.000
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1.00	0.00	1.00	0.00	0.002	0.064	0.5	0.1	0.001	0.006
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.005	0.008	0.1	0.1	0.001	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	F	1.00	0.00	1.00	0.00	0.008	0.038	0.1	0.1	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1.00	0.00	1.00	0.00	0.002	0.006	0.1	0.1	0.000	0.001
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.003	0.009	0.3	0.5	0.001	0.004
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.001	0.001	0.3	0.5	0.000	0.001

Segment length 42418 feet

Torch Sales Gas Pipeline: rural areas

Scenario	Type	Units	Wind	Fatality Rural Fraction	Fatality Urban Fraction	Injury Rural Fraction	Injury Urban Fraction	Fat. Zone Persons Affected	Inj. Zone Persons Affected	Fatality Prob.	Injury Prob.	Fatalities	Injuries
Torch Sales Gas 12" Pipeline													
Gas pipeline leak 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.002	0.002	0.1	0.1	0.000	0.000
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.000	0.001	0.3	0.5	0.000	0.001
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.000	0.000	0.3	0.5	0.000	0.000
Gas pipeline rupture, 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.067	0.071	0.1	0.1	0.007	0.007
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.028	0.065	0.3	0.5	0.008	0.033
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.004	0.009	0.3	0.5	0.001	0.004

Segment length 34500 feet

Torch Sales Gas Pipeline: along Highway 1/135

Scenario	Type	Units	Wind	Fatality Rural Fraction	Fatality Urban Fraction	Injury Rural Fraction	Injury Urban Fraction	Fat. Zone Persons Affected	Inj. Zone Persons Affected	Fatality Prob.	Injury Prob.	Fatalities	Injuries
Torch Sales Gas 12" Pipeline													
Gas pipeline leak 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	0.043	0.002	0.1	0.1	0.004	0.000
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.012	0.001	0.3	0.5	0.004	0.001
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.002	0.000	0.3	0.5	0.001	0.000
Gas pipeline rupture, 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1.00	0.00	1.00	0.00	1.624	0.071	0.1	0.1	0.162	0.007
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	F	1.00	0.00	1.00	0.00	0.623	0.065	0.3	0.5	0.187	0.033
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	D	1.00	0.00	1.00	0.00	0.098	0.009	0.3	0.5	0.029	0.004

Segment length 5000 feet

Tranquillon Ridge Risk Analysis Spreadsheets

Scenarios with Potential to Impact Public Only

Conditional Prob based on CCPS, 50% of releases produce vapor cloud, 25% produce explosion, 25% immediate ignition. Toxic i
Fatality Probabilities: 10% at 10 kw/m2 for thermal, 30% within LFL, explosion 50% at 3 psi (assumes 50% of persons indoors), 1C
Injury Probabilities: 10% at 5 kw/m2 for thermal, 50% within 1/2 LFL, 10% at 0.5 psi and 10% at ERPG-2
Wind Occurrence Based on 1993 SEIR: 50.5% D Stability, 49.5% F stablity.
LOGP Harris Grade direction prob. based on 15% of time wind blowing from the NNE, NE, ENE, E, ESE, SE (HS&P met data 198
Valve 9 to LOGP pipeline urban wind direction prob. based on fraction of time wind is blowing from the NW, NNW, N, NNE. Remai
Valve 8 to Valve 9 pipeline urban wind direction prob. based on NW, WNW, W, WSW
Wind direction prob. for scenarios that do not reach urban areas assigned a value of 1.0 as all other areas are rural in all direction
Zone rural and Harris Grade or urban fractions based on geometry of ellipses and circles with center area excluded (due to within
For vapor cloud explosions/fire (VCE) and Toxic impacts, width is equal to 1/2 width of ellipse with ellipse length equal to downwin
For thermal and explosion, downwind distance equal to circle radius with center at release point
For impact distances where numbers are not available, estimated impact distances assumed the following:

Assumed ratios of length to width for LFL = 0.1
Assumed ratio of 1/2 LFL to LFL = 0.43
Assumed thermal 10 kw/m2 to 5 kw/m2 ratio = 0.73
Assumed 0.5 psi to 3 psi ratio = 0.25

Distance from LOGP to Harris Grade Road (facility boundary), ft		700
Distance between LOGP and Vandenberg Village, feet		4600
Distance from Valve 9 - LOGP pipeline segment to Vandenberg Village =		1800
Distance from Valve 8 - Valve 9 pipeline segment to Vandenberg Village =		2600
Distance from Valve 7 - Valve 8 pipeline segment to Penitentiary Barracks =		2600
Rural population =	1 persons/sq mile	
Harris Grade population=	3.48 persons/sq mile (1.74 cars/mile, 2 persons per car)	
Rte 1/135 population	24.24 persons/sq mile (12.12 cars/mile, 2 persons per car)	
Urban population =	7000 persons/sq mile	
Number of Irene-LOGP gas pigging operations per year	12	
Number of LGP trips per year	152	
Facility Life, years	22	
LOGP cumulative scenario frequency, per year	6.90E-05	
LOGP probability, percent	0.15	
Ignition probability per car	0.06	

Ignition sources of cars based on cars per mile with above probability. Ignition probability included in Event Conditional probability
Sales gas, due to being mostly methane, was assumed to not be able to create an explosion due to lack of confinement.

Tranquillon Ridge Risk Analysis Spreadsheets
Scenarios with Potential to Impact Public Only

LOGP Facility

Scenario	Type	Units	Wind	Source
Crude tank fire	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1985 EIR, Table 4-13 tank rupture 66,000 barrel spill into dike, Fig 2-15 divided by 4 tanks. Event cond. Prob based on OPS spills at pump station with ignition
Gas/oil separator vessel rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	1985 EIR, table 4-15, Fig 2-14
Gas/oil separator vessel rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	1985 EIR, table 4-15, Fig 2-14
Gas/oil separator vessel rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	1985 EIR, table 4-15, Fig 2-14
Gas/oil separator vessel rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	1985 EIR, table 4-15, Fig 2-14
LPG/NGL Vessel BLEVE	Thermal	80 kJ/m2 fat estimated, 40 kJ/m2 injury		1996 Addendum
LPG/NGL Vessel Explosion	Explosion	3 psi fatality estimated, 0.5 psi injury		1996 Addendum
LPG/NGL Tank rupture/release, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	1985 EIR, table 4-15, 525 bbl propane tank, Fig 2-14
LPG/NGL Tank rupture/release, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	1985 EIR, table 4-15, 525 bbl propane tank, Fig 2-14
LPG/NGL Tank rupture/release, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	1985 EIR, table 4-15, 525 bbl propane tank, Fig 2-14
LPG/NGL Tank rupture/release, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	1985 EIR, table 4-15, 525 bbl propane tank, Fig 2-14
LPG/NGL tank truck rupture	Explosion	3 psi fatality, 0.5 psi injury		1985 EIR, Table 4-17 9,000 gallon rupture, Fig 2-24, base release rate per loading
LPG/NGL tank truck rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	D	1985 EIR, table 4-18 propane release #4, Fig 2-24 base release rate per loading
LPG/NGL tank truck rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	D	1985 EIR, table 4-18 propane release #4, Fig 2-24 base release rate per loading
LPG/NGL tank truck rupture, towards Harris Grade	VCE	LFL estimated, 1/2 LFL	F	1985 EIR, table 4-18 propane release #4, Fig 2-24 base release rate per loading
LPG/NGL tank truck rupture, towards rural areas	VCE	LFL estimated, 1/2 LFL	F	1985 EIR, table 4-18 propane release #4, Fig 2-24 base release rate per loading

IRENE/LOGP Pipeline Segment: Between Valve Station 9 and LOGP closest segments

Scenario	Type	Units	Wind	Source
Irene/LOGP 8" Pipeline				
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 2c, base freq. is per mile year
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 1c
Segment length	5000 feet			

IRENE/LOGP Pipeline Segment: Between VS8 plus VS9 and LOGP farthest segments

Scenario	Type	Units	Wind	Source
Irene/LOGP 8" Pipeline				
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 2c, base freq. is per mile year
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 1c
Segment length	13000 feet			

Tranquillon Ridge Risk Analysis Spreadsheets

Scenarios with Potential to Impact Public Only

IRENE/LOGP Pipeline Segment: Near Valve Station 7 and Valve Station 8

Scenario	Type	Units	Wind	Source
Irene/LOGP 8" Pipeline				
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 2c, base freq. is per mile year
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig, urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig, non-urban	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 1c
Segment length		4000 feet		

IRENE/LOGP Pipeline Segment: Remaining Segments

Scenario	Type	Units	Wind	Source
Irene/LOGP 8" Pipeline				
Gas pipeline leak 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 2c, base freq. is per mile year
Gas pipeline leak 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 2c, updated to 8,000 ppm
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline leak 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 2c
Gas pipeline rupture, 6 mmscfd, 600 psig	Explosion	3 psi fatality, 0.5 psi injury		1993 SEIR, table 5.25, table 5.30 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		1993 SEIR, table 5.25, table 5.28 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	F	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig	Toxic	ERPG-3, ERPG-2	D	1993 SEIR, table 5.25, table 5.26 scenario 1c, updated to 8,000 ppm
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	F	1993 SEIR, table 5.25 table 5.27 scenario 1c
Gas pipeline rupture, 6 mmscfd, 600 psig	VCE	LFL, 1/2 LFL	D	1993 SEIR, table 5.25 table 5.27 scenario 1c
Segment length		42416 feet		

Torch Sales Gas Pipeline: rural areas

Scenario	Type	Units	Wind	Source
Torch Sales Gas 12" Pipeline				
Gas pipeline leak 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	F	Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	D	Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline rupture, 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	F	Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	D	Adapted from PANGL Pipeline consequence modeling, 4/99
Segment length		34500 feet		

Torch Sales Gas Pipeline: along Highway 1/135

Scenario	Type	Units	Wind	Source
Torch Sales Gas 12" Pipeline				
Gas pipeline leak 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	F	Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline leak 800 psig	VCE	LFL, 1/2 LFL	D	Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline rupture, 800 psig	Thermal	10 kw/m2 fat, 5 kw/m2 injury		Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	F	Adapted from PANGL Pipeline consequence modeling, 4/99
Gas pipeline rupture, 800 psig	VCE	LFL, 1/2 LFL	D	Adapted from PANGL Pipeline consequence modeling, 4/99
Segment length		5000 feet		

Tranquillon Ridge Risk Analysis Spreadsheets

Scenarios with Potential to Impact Public Only

Conditional Prob based on CCPS, 50% of releases produce vapor cloud, 25% produce explosion, 25% immediate ignition. Toxic i
Fatality Probabilities: 10% at 10 kw/m2 for thermal, 30% within LFL, explosion 50% at 3 psi (assumes 50% of persons indoors), 1C
Injury Probabilities: 10% at 5 kw/m2 for thermal, 50% within 1/2 LFL, 10% at 0.5 psi and 10% at ERPG-2
Wind Occurrence Based on 1993 SEIR: 50.5% D Stability, 49.5% F stability.
LOGP Harris Grade direction prob. based on 15% of time wind blowing from the NNE, NE, ENE, E, ESE, SE (HS&P met data 198
Valve 9 to LOGP pipeline urban wind direction prob. based on fraction of time wind is blowing from the NW, NNW, N, NNE. Remai
Valve 8 to Valve 9 pipeline urban wind direction prob. based on NW, WNW, W, WSW
Wind direction prob. for scenarios that do not reach urban areas assigned a value of 1.0 as all other areas are rural in all direction
Zone rural and Harris Grade or urban fractions based on geometry of ellipses and circles with center area excluded (due to within
For vapor cloud explosions/fire (VCE) and Toxic impacts, width is equal to 1/2 width of ellipse with ellipse length equal to downwin
For thermal and explosion, downwind distance equal to circle radius with center at release point
For impact distances where numbers are not available, estimated impact distances assumed the following:
Assumed ratios of length to width for LFL = 0.1
Assumed ratio of 1/2 LFL to LFL = 0.43
Assumed thermal 10 kw/m2 to 5 kw/m2 ratio = 0.73
Assumed 0.5 psi to 3 psi ratio = 0.25

Distance from LOGP to Harris Grade Road (facility boundary), ft		700
Distance between LOGP and Vandenberg Village, feet		4600
Distance from Valve 9 - LOGP pipeline segment to Vandenberg Village =		1800
Distance from Valve 8 - Valve 9 pipeline segment to Vandenberg Village =		2600
Distance from Valve 7 - Valve 8 pipeline segment to Penitentiary Barracks =		2600
Rural population =	1	persons/sq mile
Harris Grade population=	3.48	persons/sq mile (1.74 cars/mile, 2 persons per car)
Rte 1/135 population	24.24	persons/sq mile (12.12 cars/mile, 2 persons per car)
Urban population =	7000	persons/sq mile
Number of Irene-LOGP gas pigging operations per year	12	
Number of LGP trips per year	152	
Facility Life, years	22	
LOGP cumulative scenario frequency, per year	6.90E-05	
LOGP probability, percent	0.15	
Ignition probability per car	0.06	

Ignition sources of cars based on cars per mile with above probability. Ignition probability Included in Event Conditional probability
Sales gas, due to being mostly methane, was assumed to not be able to create an explosion due to lack of confinement.

Irene and Offshore Pipeline Failure Rate Calculations: Current Operations Pt. Pedernales Production Only

Summary of Frequency Results

Lifetime	10	years
Average oil production, bpd	2000	bpd over lifetime

Platform Irene Summary		
Scenario	Freq. per year	Lifetime Prob. %
Small Spills		
Irene - Wellhead Area Spill to Ocean - small	1.47E-08	0.0
Irene - Separator Failure Spill to Ocean - small	3.74E-06	0.0
Irene - Pumping and Shipping Spill to Ocean - small	2.38E-04	0.2
Irene - Diesel Fuel Loading - Small spill to Ocean	2.90E-04	0.3
Cumulative Small Spills	5.33E-04	0.5
Large Spills		
Irene - Blowouts	NA	NA
Irene - Wellhead Area Spill to Ocean - large	1.25E-08	0.0
Irene - Separator Failure Spill to Ocean - large	9.60E-05	0.1
Irene - Pumping and Shipping Spill to Ocean - large	2.80E-05	0.0
Irene - External impact	1.00E-05	0.0
Cumulative Large Spills	1.34E-04	0.1
Cumulative All Spills	6.67E-04	0.7

Offshore Emulsion Pipeline Summary		
Scenario	Freq. per year	Lifetime Prob. %
Leaks		
1985 EIR table 2-2, leaks	4.41E-03	4.3
CSFM for this pipeline, leak	3.11E-03	3.1
Ruptures		
1985 EIR table 2-2, ruptures	4.90E-04	0.5
CSFM for this pipeline, rupture	6.82E-04	0.7
OPS all crude lines, spills > 50 bbl	9.17E-03	8.8
MMS pipeline throughput method, 1,000 bbl spill, per year	9.86E-04	1.0

Offshore Emulsion Pipeline and Platform Summary		
Scenario	Freq. per year	Lifetime Prob. %
Leaks and Small Spills	4.94E-03	4.8
Ruptures and Large Spills	6.24E-04	0.6
Any Spill Size	5.57E-03	5.4

Detailed Calculations					
Platform Irene					
Description	*Base rate*	*Units*	*Multiplyer*	*Rate*	*Ref*
Irene - Blowouts				0.00E+00	
Blowout during drilling	3.90E-03	per well drilled	0	0.00E+00	1985 EIR, figure 2-2, 78% wellhead or drill floor (HLID, 1992), assumes wells drilled = 0, multiplyer units of wells/year
Blowout during drilling: below platform	1.10E-03	per well drilled	0	0.00E+00	1985 EIR, figure 2-2, 22% subsea (as per HLID, 1992), assumes wells drilled = 0, multiplyer units of wells/year
Blowout during well workover	5.20E-05	per well	0	0.00E+00	HLID, 1992, 93% wellhead or drill floor assumes workoverers every 7 years
Blowout during well workover: below platform	5.14E-06	per well	0	0.00E+00	HLID, 1992, 9% subsea, assumes workoverers every 7 years
Blowout during production	2.57E-04	per year	0	0.00E+00	1985 EIR, figure 2-2, 78% wellhead or drill floor (HLID, 1992), Assumes no production wells under reserviour pressure
Blowout during production: below platform	7.26E-05	per year	0	0.00E+00	1985 EIR, figure 2-2, 22% subsea (HLID, 1992), Assumes no production wells under reserviour pressure
Oil spill conditional probability	7.40E-02	per demand	1	7.40E-02	1985 EIR, figure 2-2, for blowouts on platform
Irene - Wellhead Area Spill to Ocean - small				1.47E-08	
Irene - Wellhead Area Spill to Ocean - large				1.25E-08	
Number of wellheads	22	number	1	2.20E+01	Current operation
Fittings per well	2	number	1	2.00E+00	1985 EIR, figure 2-3
Break of small fitting	3.00E-04	per year	1	3.00E-04	1985 EIR, figure 2-3
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	1985 EIR, figure 2-3
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	1985 EIR, figure 2-3
Failure of drainage system	1.00E-03	on demand	1	1.00E-03	Estimated, Lees, failure to operate on demand
Hole in 3" diameter pipe	5.26E-06	/m.yr	50	2.63E-04	Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6
Leak at 2" or 3" valve	7.88E-05	/valve.yr	5	3.94E-04	Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6 *Assume 90% of leaks are significant but not catastrophic rupture*
Hole in well head	2.63E-06	/m.yr	2	5.26E-06	Treated as a hole in 8" pipe. Significant leak. Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6
Full bore pipe rupture	2.60E-07	/m.yr	50	1.30E-05	Rupture of pipe. Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6
Full bore 2" or 3" valve rupture	8.76E-06	/valve.yr	5	4.38E-05	Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6 *Assume 10% of leaks are catastrophic rupture*
Well head rupture	9.00E-08	/m.yr	2	1.80E-07	*Treated as a 8" pipe rupture.* Rupture of pipe >150 mm diameter. Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6

Irene and Offshore Pipeline Failure Rate Calculations: Current Operations Pt. Pedernales Production Only

Irene - Separator Failure Spill to Ocean - small				**3.74E-06**	
Irene - Separator Failure Spill to Ocean - large				**9.60E-05**	
Vessel Spontaneous Rupture	3.00E-05	per year	2	6.00E-05	1985 EIR, gross separators only
Vessel Maine impact	8.00E-06	per year	2	1.60E-05	1985 EIR, gross separators only
Vesel Seismic induced rupture	1.00E-05	per year	2	2.00E-05	1985 EIR, gross separators only
Break of small fitting	3.00E-04	per year	10	3.00E-03	See above, number estimated
Hole in 3" diameter pipe	5.26E-06	/m.yr	50	2.63E-04	See above, number estimated
Leak at 2" or 3" valve	7.88E-05	/valve.yr	6	4.73E-04	See above, number estimated
Failure of drainage system	1.00E-03	on demand	1	1.00E-03	Estimated, Lees, failure to operate on demand
Irene - Pumping and Shipping Spill to Ocean - small				**2.38E-04**	
Irene - Pumping and Shipping Spill to Ocean - large				**2.80E-05**	
Vessel Spontaneous Rupture	1.00E-05	per year	1	1.00E-05	1985 EIR, Shipping tank
Vessel Maine impact	8.00E-06	per year	1	8.00E-06	1985 EIR, Shipping tank
Vesel Seismic induced rupture	1.00E-05	per year	1	1.00E-05	1985 EIR, Shipping tank
Break of small fitting	3.00E-04	per year	10	3.00E-03	See above, number estimated
Hole in 3" diameter pipe	5.26E-06	/m.yr	50	2.63E-04	See above, number estimated
Leak at 2" or 3" valve	7.88E-05	/valve.yr	6	4.73E-04	See above, number estimated
Pump leak or ruture	1.70E-02	per year	2	3.40E-02	HLUD, 1992
Pig launcher improper action/mech defect	1.10E-03	per year	1	1.10E-03	1985 EIR, figure 2-7
Pigging operations per year	183	number	1	183	Project description
Failure of drainage system	1.00E-03	on demand	1	1.00E-03	Estimated, Lees, failure to operate on demand
Irene - Diesel Fuel Loading - Small spill to Ocean				**2.90E-04**	
Hose failure	1.10E-02	per year	1	1.10E-02	1985 EIR, figure 2-9
Loadings per year	1.20E+01	per year	1	1.20E+01	1985 EIR, figure 2-9
Check valve failure	2.20E-03	per demand	1	2.20E-03	CCPS, 1989, Failure to check
Irene - External impact				**1.00E-05**	**1985 EIR, Figure 2-10**
Total Large Spill Frequency				**1.34E-04**	
Years Between Spills				7462	
Platform Life, years				10	
Lifetime probability				1.34E-03	
Probability				0.1	
Total Small Spill Frequency				5.33E-04	
Years Between Spills				1877	
Platform Life, years				10	
Lifetime probability				5.33E-03	
Probability				0.5	
TOTAL SPILL TO OCEAN FREQUENCY				**6.67E-04**	
Years Between Spills				1500	
Platform Life, years				10	
Lifetime probability				6.67E-03	
Probability				0.7	
Combined Platform Irene and Pipeline					
Platform Life, years				10	
Small Spills				4.94E-03	
Small Spills Probability				4.8	
Large Spills				6.24E-04	
Large Spills Probability				0.6	

PIPELINE FAILURE RATES				**Freq/yr**	**Probability**
Offshore Emulsion Pipeline - Failure rates, utilize 1985 EIR leak rate				**4.41E-03**	4.3
1985 EIR table 2-2, leaks	4.28E-04	per mile-year	10.3	4.41E-03	4.3
CSFM for this pipeline, leak	3.02E-04	per mile-year	10.3	3.11E-03	3.1
1985 EIR table 2-2, ruptures	4.76E-05	per mile-year	10.3	4.90E-04	0.5
CSFM for this pipeline, rupture	6.62E-05	per mile-year	10.3	6.82E-04	0.7
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	10.3	9.17E-03	8.8
MMS pipeline throughput method, 1,000 bbl spill, per year				9.86E-04	1.0
Offshore Water Return Pipeline - Failure rates, utilize 1985 EIR leak rate				**3.60E-03**	3.5
1985 EIR table 2-2, leaks	3.50E-04	per mile-year	10.3	3.60E-03	3.5
CSFM for this pipeline, all products, leak	5.96E-04	per mile-year	10.3	6.14E-03	6.0
1985 EIR table 2-2, ruptures	3.88E-05	per mile-year	10.3	4.00E-04	0.4
CSFM for this pipeline, all products rupture	1.31E-04	per mile-year	10.3	1.35E-03	1.3
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	10.3	9.17E-03	8.8
MMS pipeline throughput method, 1,000 bbl spill, assumes 10,000 bpd water				4.93E-03	4.8
Onshore Emulsion Pipeline					
CSFM Failure rate - ruptures	6.62E-05	per mile-year	12.2	8.08E-04	
Seismic activity - rupture	4.15E-06	per mile-year	12.2	5.06E-05	
Onshore Emulsion Pipeline Ruptures				**8.59E-04**	0.9
Onshore Emulsion Pipeline Leaks	3.02E-04	per mile-year	12.2	**3.68E-03**	3.6
Onshore Gas Pipeline					
Leak rate, per pipeline mile-year	4.34E-04	per mile-year	12.2	**5.29E-03**	5.2
Rupture rate, per pipeline mile-year	2.13E-04	per mile-year	12.2	**2.60E-03**	2.6
Onshore Water Pipeline					
CSFM Failure rate - ruptures	1.31E-04	per mile-year	12.2	1.60E-03	
Seismic activity - rupture	4.15E-06	per mile-year	12.2	5.06E-05	
Onshore Water Pipeline Ruptures				**1.65E-03**	1.6
Onshore Water Pipeline Leaks	5.96E-04	per mile-year	12.2	**7.27E-03**	7.0
LOGP-Summit Pipeline					
Years Life	30	years			
CSFM Failure rate - ruptures	1.47E-03	per mile-year	27.65	4.07E-02	
Seismic activity - rupture	4.15E-06	per mile-year	27.65	1.15E-04	
Onshore Oil Pipeline Ruptures				**4.09E-02**	70.7
Onshore Oil Pipeline Leaks	6.71E-03	per mile-year	27.65	**1.86E-01**	99.6

Irene and Offshore Pipeline Failure Rate Calculations: Current Operations Pt. Pedernales Production Only

LOGP FACILITIES					
SCADA - failure				1.01E-01	Reference
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	Reliability and Maintainability in Perspective, 3rd Edition, D.J. Smith, 1988, Fail to recognise incorrect status on inspection
Other LOGP Freqeuncies taken directly from the 1985 EIR					

Irene and Offshore Pipeline Failure Rate Calculations: Proposed Operations, Pt. Ped and tranquillon Ridge Production

updated to 15 year lifetime

Summary of Frequency Results

Lifetime	15	years
Average oil production, bpd	18,840	bpd over lifetime

Platform Irene Summary		
Scenario	Freq, per year	Lifetime Prob, %
Small Spills		
Irene - Wellhead Area Spill to Ocean - small	1.47E-08	0.0
Irene - Separator Failure Spill to Ocean - small	3.74E-06	0.0
Irene - Pumping and Shipping Spill to Ocean - small	2.38E-04	0.4
Irene - Diesel Fuel Loading - Small spill to Ocean	2.90E-04	0.4
Cumulative Small Spills	5.33E-04	0.8
Large Spills		
Irene - Blowouts	2.78E-03	4.1
Irene - Wellhead Area Spill to Ocean - large	1.25E-08	0.0
Irene - Separator Failure Spill to Ocean - large	9.60E-05	0.1
Irene - Pumping and Shipping Spill to Ocean - large	2.80E-05	0.0
Irene - External impact	1.00E-05	0.0
Cumulative Large Spills	2.91E-03	4.3
Cumulative All Spills	3.44E-03	5.0

Offshore Emulsion Pipeline Summary		
Scenario	Freq, per year	Lifetime Prob, %
Leaks		
1985 EIR table 2-2, leaks	4.41E-03	6.4
CSFM for this pipeline, leak	3.11E-03	4.6
Ruptures		
1985 EIR table 2-2, ruptures	4.90E-04	0.7
CSFM for this pipeline, rupture	6.82E-04	1.0
OPS all crude lines, spills > 50 bbl	9.17E-03	12.8
MMS pipeline throughput method, 1,000 bbl spill, per year	9.28E-03	13.0

Offshore Emulsion Pipeline and Platform		
Scenario	Freq, per year	Lifetime Prob, %
Leaks and Small Spills	4.94E-03	7.1
Ruptures and Large Spills	3.40E-03	5.0
Any Spill Size	8.34E-03	11.8

Detailed Calculations					
Platform Irene					
DESCRIPTION	**BASE RATE**	**UNITS**	**Multiplyer**	**RATE**	**REFERENCE**
Irene - Blowouts				**2.78E-03**	
Blowout during drilling	3.90E-03	per well drilled	2	7.80E-03	1985 EIR, figure 2-2, 78% wellhead or drill floor (HLID, 1992), assumes wells drilled = 0, multiplyer units of wells/year
Blowout during drilling: below platform	1.10E-03	per well drilled	2	2.20E-03	1985 EIR, figure 2-2, 22% subsea (as per HLID, 1992), assumes wells drilled = 0, multiplyer units of wells/year
Blowout during well workover	5.20E-05	per well	0	0.00E+00	HLID, 1992, 93% wellhead or drill floor assumes workoverers every 7 years
Blowout during well workover: below platform	5.14E-06	per well	0	0.00E+00	HLID, 1992, 9% subsea, assumes workoverers every 7 years
Blowout during production	2.57E-04	per year	0	0.00E+00	1985 EIR, figure 2-2, 78% wellhead or drill floor (HLID, 1992), Assumes no production wells under reserviour pressure
Blowout during production: below platform	7.26E-05	per year	0	0.00E+00	1985 EIR, figure 2-2, 22% subsea (HLID, 1992), Assumes no production wells under reserviour pressure
Oil spill conditional probability	7.40E-02	per demand	1	7.40E-02	1985 EIR, figure 2-2, for blowouts on platform
Irene - Wellhead Area Spill to Ocean - small				**1.47E-08**	
Irene - Wellhead Area Spill to Ocean - large				**1.25E-08**	
Number of wellheads	22	number	1	2.20E+01	Current operation
Fittings per well	2	number	1	2.00E+00	1985 EIR, figure 2-3
Break of small fitting	3.00E-04	per year	1	3.00E-04	1985 EIR, figure 2-3
Failure to close sub surface valve	1.00E-02	per year	1	1.00E-02	1985 EIR, figure 2-3
Failure to close surface safety valve	1.00E-03	per year	1	1.00E-03	1985 EIR, figure 2-3
Failure of drainage system	1.00E-03	on demand	1	1.00E-03	Estimated, Lees, failure to operate on demand
Hole in 3" diameter pipe	5.26E-06	/m.yr	50	2.63E-04	Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6
Leak at 2" or 3" valve	7.88E-05	/valve.yr	5	3.94E-04	Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6. *Assume 90% of leaks are significant but not catastrophic rupture.*
Hole in well head	2.63E-06	/m.yr	2	5.26E-06	Treated as a hole in 8" pipe. Significant leak. Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6
Full bore pipe rupture	2.60E-07	/m.yr	50	1.30E-05	Rupture of pipe. Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6
Full bore 2" or 3" valve rupture	8.76E-06	/valve.yr	5	4.38E-05	Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6. *Assume 10% of leaks are catastrophic rupture*
Well head rupture	9.00E-08	/m.yr	2	1.80E-07	*Treated as a 8" pipe rupture.* Rupture of pipe >150 mm diameter. Risk Analysis Report to the Rijnmond Public Authority, D.Reidel Publishing Co., 1981 ISBN 90-277-1393-6
Irene - Separator Failure Spill to Ocean - small				**3.74E-06**	
Irene - Separator Failure Spill to Ocean - large				**9.60E-05**	
Vessel Spontaneous Rupture	3.00E-05	per year	2	6.00E-05	1985 EIR, gross separators only
Vessel Maine impact	8.00E-06	per year	2	1.60E-05	1985 EIR, gross separators only
Vesel Seismic induced rupture	1.00E-05	per year	2	2.00E-05	1985 EIR, gross separators only
Break of small fitting	3.00E-04	per year	10	3.00E-03	See above, number estimated
Hole in 3" diameter pipe	5.26E-06	/m.yr	50	2.63E-04	See above, number estimated
Leak at 2" or 3" valve	7.88E-05	/valve.yr	6	4.73E-04	See above, number estimated
Failure of drainage system	1.00E-03	on demand	1	1.00E-03	Estimated, Lees, failure to operate on demand
Irene - Pumping and Shipping Spill to Ocean - small				**2.38E-04**	
Irene - Pumping and Shipping Spill to Ocean - large				**2.80E-05**	
Vessel Spontaneous Rupture	1.00E-05	per year	1	1.00E-05	1985 EIR, Shipping tank
Vessel Maine impact	8.00E-06	per year	1	8.00E-06	1985 EIR, Shipping tank

Irene and Offshore Pipeline Failure Rate Calculations: Proposed Operations, Pt. Ped and tranquillon Ridge Production

updated to 15 year lifetime

Vesel Seismic induced rupture	1.00E-05	per year	1	1.00E-05	1985 EIR, Shipping tank
Break of small fitting	3.00E-04	per year	10	3.00E-03	See above, number estimated
Hole in 3" diameter pipe	5.26E-06	/m.yr	50	2.63E-04	See above, number estimated
Leak at 2" or 3" valve	7.88E-05	/valve.yr	6	4.73E-04	See above, number estimated
Pump leak or ruture	1.70E-02	per year	2	3.40E-02	HLUD, 1992
Pig launcher improper action/mech defect	1.10E-03	per year	1	1.10E-03	1985 EIR, figure 2-7
Pigging operations per year	183	number	1	183	Project description
Failure of drainage system	1.00E-03	on demand	1	1.00E-03	Estimated, Lees, failure to operate on demand
Irene - Diesel Fuel Loading - Small spill to Ocean				**2.90E-04**	
Hose failure	1.10E-02	per year	1	1.10E-02	1985 EIR, figure 2-9
Loadings per year	1.20E+01	per year	1	1.20E+01	1985 EIR, figure 2-9
Check valve failure	2.20E-03	per demand	1	2.20E-03	CCPS, 1989, Failure to check
Irene - External impact				**1.00E-05**	**1985 EIR, Figure 2-10**
Total Large Spill Frequency				**2.91E-03**	
Years Between Spills				343	
Platform Life, years				15	
Lifetime probability				4.37E-02	
Probability				4.3	
Total Small Spill Frequency				**5.33E-04**	
Years Between Spills				1877	
Platform Life, years				15	
Lifetime probability				7.99E-03	
Probability				0.8	
TOTAL SPILL TO OCEAN FREQUENCY				**3.44E-03**	
Years Between Spills				290	
Platform Life, years				15	
Lifetime probability				5.17E-02	
Probability				5.0	
Combined Platform Irene and Pipeline					
Platform Life, years				15	
Small Spills				4.94E-03	7.1
Large Spills				3.40E-03	5.0

PIPELINE FAILURE RATES				**Freq/yr**	**Probability**
Offshore Emulsion Pipeline - Failure rates, utilize 1985 EIR leak rate				**4.41E-03**	6.4
1985 EIR table 2-2, leaks	4.28E-04	per mile-year	10.3	4.41E-03	6.4
CSFM for this pipeline, leak	3.02E-04	per mile-year	10.3	3.11E-03	4.6
1985 EIR table 2-2, ruptures	4.76E-05	per mile-year	10.3	4.90E-04	0.7
CSFM for this pipeline, rupture	6.62E-05	per mile-year	10.3	6.82E-04	1.0
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	10.3	9.17E-03	12.8
MMS pipeline throughput method, 1,000 bbl spill, per year				9.28E-03	13.0
Offshore Water Return Pipeline - Failure rates, utilize 1985 EIR leak rate				**3.60E-03**	5.3
1985 EIR table 2-2, leaks	3.50E-04	per mile-year	10.3	3.60E-03	5.3
CSFM for this pipeline, all products, leak	3.36E-04	per mile-year	10.3	3.46E-03	5.1
1985 EIR table 2-2, ruptures	3.88E-05	per mile-year	10.3	4.00E-04	0.6
CSFM for this pipeline, all products rupture	7.38E-05	per mile-year	10.3	7.60E-04	1.1
OPS all crude lines, spills > 50 bbl	8.90E-04	per mile-year	10.3	9.17E-03	12.8
MMS pipeline throughput method, 1,000 bbl spill, assumes 10,000 bpd water				4.93E-03	7.1
Onshore Emulsion Pipeline					
CSFM Failure rate - ruptures	6.62E-05	per mile-year	12.2	8.08E-04	1.2
Seismic activity - rupture	4.15E-06	per mile-year	12.2	5.06E-05	0.1
Valve Station 2 Pump Failure - leak	3.10E-01	per year			99.0
Valve Station 2 Pump Failure - rupture	3.10E-03	per year			4.5
CSFM failure rate - Leaks	3.02E-04	per mile-year	12.2	3.68E-03	5.4
Onshore Emulsion Pipeline Ruptures				**3.96E-03**	5.8
Onshore Emulsion Pipeline Leaks				**3.14E-01**	99.1
Onshore Gas Pipeline					
Leak rate, per pipeline mile-year	4.34E-04	per mile-year	12.2	5.29E-03	7.6
Rupture rate, per pipeline mile-year	2.13E-04	per mile-year	12.2	2.60E-03	3.8
Onshore Water Pipeline					
CSFM Failure rate - ruptures	7.38E-05	per mile-year	12.2	9.00E-04	
Seismic activity - rupture	4.15E-06	per mile-year	12.2	5.06E-05	
Onshore Water Pipeline Ruptures				9.51E-04	1.4
Onshore Water Pipeline Leaks	**3.36E-04**	**per mile-year**	**12.2**	**4.10E-03**	6.0
LOGP-Summit Pipeline					
Years Life	30	years			
CSFM Failure rate - ruptures	1.28E-03	per mile-year	26	3.33E-02	
Seismic activity - rupture	4.15E-06	per mile-year	26	1.08E-04	
Onshore Water Pipeline Ruptures				3.34E-02	63.3
Onshore Water Pipeline Leaks	5.83E-03	per mile-year	26	1.52E-01	98.9

LOGP FACILITIES					
SCADA - failure				**1.01E-01**	
Phone line failure	2.28E-04	demand	1	2.28E-04	Estimated 8 hours per year down time
Pump shutdown failure	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure to stop on demand
Actuated valve failure	1.00E-03	on demand	1	1.00E-03	Lees, failure to operate on demand
Pressure Switch	1.00E-04	on demand	1	1.00E-04	Rijnonmd, failure on demand
Operator Restarts system, override SCADA	1.00E-01	on demand	1	1.00E-01	Reliability and Maintainability in Perspective, 3rd Edition, D.J. Smith, 1988, Fail to recognise incorrect status on inspection

Attachment G – Estimated Mud Composition for an Average Well (Platform Irene)

Attachment G - Estimated Drilling Mud Composition (Average Well)

Water Based Mud

INTERVAL (FT)	PRODUCTS	PACKAGE		UNITS sx	TOTAL Pounds
0 - 800' 1,800 bbl Starting Volume 1,400 bbl of mud build for interval	DUROGEL	50	lb/sx	990	49,500
	Soda Ash	50	lb/sx	42	2,100
	Sodium Bicarbonate	50	lb/sx	30	1,500
	MI-BAR	100	lb/sx	200	20,000
800' - 7,500' 800 bbl Starting Volume 12,713 bbl of mud build for interval	SP-101	50	lb/sx	500	25000
	Soda Ash	50	lb/sx	700	35000
	POLYPAC	50	lb/sx	100	50000
	Drilzone	55	gal	20	8000
	Duovis	25	lb/sx	80	2000
	Asphasol Supreme	50	lb/sx	200	10000
	Tanathin	50	lb/sx	40	2000
	Salt	80	lb/sx	500	40000
	M-I GEL	100	lb/sx	1500	150000
	Lube 167	55	gal	10	4000
	Sodium Bicarbonate	50	lb/sx	100	5000
	MI-BAR	100	lb/sx	2000	200000
15,200' - 19,000' 1,200 bbl Starting Volume 2,949 bbl of mud build for interval	FLO-VIS NT	25	lb/sx	250	6250
	Lube 167	55	gal	40	16000
	Salt	80	lb/sx	800	64000
	GREEN-CIDE G	55	gal	20	8000
	SAFECARB 20	50	lb/sx	500	25000
	SAFECARB 40	50	lb/sx	500	25000
	DUALFLO	50	lb/sx	350	17500

Estimated Drilling Mud Composition (Average Well)
Mineral Oil Based Mud

INTERVAL (FT)	PRODUCTS	PACKAGE		UNITS sx	TOTAL Pounds
7,500' – 15,200'	VG PLUS	50	lb/sx	540	27000
	LIME	50	lb/sx	1,100	55000
1,800 bbl Starting Volume	VERSA-MUL	55	gal	80	32000
6,743 bbl of mud build for interval	VERSA-COAT	55	gal	96	38400
	VG Supreme	50	lb/sx	80	4000
	M-I BAR	100	lb/sx	3,300	330000
	Calcium Chloride	80	lb/sx	3,300	264000
15,200' - 19,000'	VG PLUS	50	lb/sx	230	11500
	LIME	50	lb/sx	462	23100
1,200 bbl Starting Volume	VERSA-MUL	55	gal	35	14000
2,837 bbl of mud build for interval	VERSA-COAT	55	gal	40	16000
	VG Supreme	50	lb/sx	30	1500
	M-I BAR	100	lb/sx	1,400	140000

Attachment H – Typical Well Control Equipment

Attachment H – Typical Well Control Equipment

Well control equipment will provide for prevention, detection and control of undesired formation fluid entry into the wellbore. Described below is typical well control equipment.

A 20-3/4" diverter BOP system will be used as described in the following section. The diverter, BOP stack, and choke manifold will be designed in accordance with API RP 53 "Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells".

I. Typical Blowout Prevention Equipment

1. 20-3/4" Diverter Blowout Prevention System

A. Hydril 20-3/4" FSS MSP 2,000 psi with 2 each 12" 900 (12" bore) flanged outlets to flow selector.

B. Diverter Valves
Four (4) each SS 12" x 3000-lb knife valves hydraulic actuated with hose and valving.

C. 12" pipe and fittings to divert flow away from rig in two directions, in compliance with MMS rules. All flanges to be 12" ANSI 300

2. 21-1/4" BOP

A. Annular BOP (flanged)

Hydril, MSP, 21-1/4" 2,000 psi WP, with H_2S trim

B. Single Gate (Hub)

One (1) Hydril, 20-3/4 3,000 psi WP, with H_2S trim.

C. Double Gate (flanged)

One (1) Hydril, 20-3/4 3,000 psi WP , with H_2S trim

D. Drilling Spool (flanged)

One (1) 20-3/4" 3,000 psi, top and bottom flanged side outlet

E. Rams
   1. As needed for tubular program

F. One (1) 20-3/4" 3,000 psi riser spool, approximately 27' long, flange x flange, with API stamp.

3. BOP Stack Handling System

A. One (1) each overhead crane system capable of picking either stack up while landing casing.

B. One (1) BOP platform which is capable of stumping up both the 13-5/8" stack and the 20" stack simultaneously for moving or other activity.

C. BOP work platform to facilitate ram changes, nipple up and nipple down. Platform height can be moved up and down easily.

4. Typical Kill and Choke Lines System

A. Kill line valves to consist of two (2) 3-1/6" 10,000 psi, McEvoy type E gate valve, with one valve being manually operated and one being hydraulically activated.

B. Kill line is 3-1/6" 5,000 psi Coflexquip Hose 30' which comes off the standpipe manifold, all connections flanged.

C. Choke valves to consist of two (2) 4-1/6" 10,000 psi, McEvoy type E gate valve, one (1) valve being manually operated and one (1) being hydraulically activated.

D. Choke line is 4-1/6" 5,000 psi Coflexquip hose 30', which connects from choke line valves to floor mounted choke manifold. All hose connections flanged.

5. Typical Degasser Vessel and Vent Line

A. Primary degasser built as per drawing, specifications.

B. Primary degasser vent line to be 10", extends to crown.

C. Straight through vent line 4", connects into degasser vent and proceeds to crown.

6. Blowout Preventer Control System

NL Koomey Model T40280-3S blowout preventer control unit with 375 gallon volume tank, main energy provided by a 40 HP electric motor driven triplex plunger pump rate at 20.2 GPM at 3,000 psi charging twenty-eight (28) each 11-gallon bladder-type separate accumulator bottles. Second energy charging system consists of Model FA-42 air pumps rated at a combined volume of 23 GPM at 1,200 psi, or 12 GPM at 3,000 psi. Above two energy systems BACKED UP by 12 - 220 cubic feet nitrogen bottles connected to the manifold system. All above system controlled by a Model SU2KB7S"S" series manifold with eight (8) manual control stations at the unit.

A. Includes two (2) Model MGBK7EH electrically operated remote control panel with two manifold pressure gauges and nine push button controls with lights. One (1) mounted on rig floor, one (1) mounted in pipe rack module.

Controls for:

One (1) annular BOP with pressure regulator control to decrease or increase annular pressure.

Three (3) gates BOP.

One (1) kill line HCR valve.
One (1) choke line HCR valve.
One (1) diverter flow selector valve.

B. BOP mounted in subbase module such that 1" coflexip, hoses can remain connected when skidding the rig and picking the stack up.

7. Upper Kelly Cocks

Two (2) each. One for top drive, one for conventional kelly drilling Hydril kelly guard, 10,000 psi W.P.

8. Lower Kelly Cocks and D.P. Floor Valve

A. One (1) for Varco Top Drive 4 ½ IF
B. One (1) for conventional drilling 4 ½ IF
C. Two (2) for floor valve-one (1) 4 ½ IF, one (1) 3 ½ IF
D. All to be Hydril Kelly Guard, 10,000 psi W.P.

9. Inside BOP

One (1) Flocon inside BOP 4 ½ IF
One (1) Flocon inside BOP 3 ½ IF

10. BOP Test Pump

Triton Model 3075 triplex plunger pump rated at 5000 psi working pressure at 6 GPM, driven by a top-mount 20 HP electric motor complete with make-up tank, adjustable relief pressure bypass valve, system gauges with four each 50-ft of 3/8" 5000 psi working pressure test hose with snap-type couplers. This unit is also designed to act as a low volume wash-down pump. Included with the unit are two each NGC 200-2 cleaning lances.

Figure 1 Example Class IV BOPE Installation, API Arrangement RSRRA or RSRdA