In the Matter of

CHEVRON U.S.A. INC.

APPELLANT'S EXHIBIT 2

Platform Gail Environmental Report

MINERALS MANAGEMENT SERVICE
PACIFIC OCS REGION
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FIELD OPERATIONS
LOS ANGELES

OIL SPILL RISK AND TRAJECTORY ANALYSIS
BIOLOGICAL INFORMATION DOCUMENT
SUPPORTING TECHNICAL STUDY
PROPOSED PLATFORM GAIL
FOR CHEVRON U.S.A., INC.

December 20, 1985

Dames & Moore

33.37/1-COVER

Dames & Moore

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December 20, 1985

Chevron U.S.A. Inc.
6001 Bollinger Canyon Road
San Ramon, California 94583

Attention: Ms. Cynthia Norris

Ladies and Gentlemen:

Oil Spill Risk and Trajectory Analysis
Biological Information Document Supporting
Technical Study
Proposed Platform Gail
For Chevron U.S.A. Inc.

Transmitted with this letter is our report addressing the results of oil spill risk and trajectory analyses conducted in accordance with your instructions. This report is intended to provide information useful to Chevron in your compilation of a biological information document to be submitted to the U.S. Minerals Management Service as input to the Section 7 Consultation process.

It has been a pleasure to conduct these investigations for Chevron U.S.A. Inc. If you have any questions concerning the content of this report, please contact us.

Sincerely,

DAMES & MOORE

Dean Hargis

Dean Hargis
Associate

PDH/sjm
33.37/1-ltr

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1.0 INTRODUCTION

In response to a request from the U.S. Minerals Management Service, Chevron asked Dames & Moore to conduct an investigation of the probability of oil spills associated with the Platform Gail project, and the potential for spill contact with identified sensitive resources and shoreline segments. The scope of our investigations was developed by Chevron in consultation with the U.S. Minerals Management Service. It includes:

(1) Computation of oil spill probabilities for different spill size categories;

(2) Seasonal spill trajectory simulations for 3, 10, and 30-day simulation periods;

(3) Combined analysis of oil spill occurrence and oil spill trajectory simulations; and

(4) Evaluation of results in relation to sensitive resource "targets" identified by Chevron and the MMS in addition to shoreline segments.

This analysis was accomplished using the Dames & Moore oil spill trajectory model (a two-dimensional model similar to the MMS model) for 3 and 10 day trajectories, and the MMS Lease Sale 80 results for the 30-day trajectories. The area encompassed by this study extends from Oceanside at the south to the Santa Maria River at the north. The discussion to follow describes the study data inputs, analytical methods, and results.

2.0 BACKGROUND AND METHODS

2.1 SPILL CONTINGENCY PLANNING AND FATE OF SPILLED OIL

Oil spill prevention and contingency planning is an integral element of every OCS development project. This is partly a result of the legal requirements of the Minerals Management Service (MMS) and other agencies and partly a reflection of prudent business practice. The Platform Gail Project oil spill contingency and containment plans are included in a detailed Oil Spill Contingency Plan. This plan is on file with the MMS and describes the procedures that would be implemented in the event of a spill, including: reporting and notification procedures; response decision guidelines and checklists; the organization and responsibilities of Chevron's onsite and corporate response teams; containment equipment and procedures appropriate to the volume and location of the spill and the nature of the resources potentially affected; inventories of equipment and personnel available through industry oil spill cooperatives (e.g., Clean Seas) and government agencies; and related topics. Planned prevention measures include a platform deck drainage system designed to contain spilled oil, disposal of drill cuttings and other solids in accordance with an NPDES permit, conformance with OCS Order No. 7 (Pollution Prevention and Control), regular equipment inspections, and response crew training. Containment procedures detailed in Chevron's Oil Spill Contingency Plan include methods for quickly determining whether or not on-board containment capabilities are sufficient and precise instructions for small or large spill containment.

Oil spill response capabilities presently available cannot eliminate all risk of impacts should a spill occur, but do provide a means of reducing impacts on specific areas of concern by partial cleanup or dispersant application. In cases where cleanup or dispersion is not feasible, diversion of an oil slick may allow protection of specific sensitive locations. The biological impacts on specific resources associated with an oil spill originating from Platform Gail or its associated pipeline system are not evaluated in this investigation. This report presents an analysis of the probability that a spill will occur, and an assessment of the slick's likely physical movement and resulting oil slick centroid impact locations.

Factors which influence oil dispersion in the marine environment include spill volumes, the physical and chemical properties of the oil, meteorological conditions (primarily wind speed and direction), oceanographic conditions (principally current speed and direction), and biological processes. Current analytical methods for predicting oil spill dispersion are limited by their ability to take these factors into account and by the availability of input data.

Oil released in the ocean will generally rise to the surface, where it will tend to spread into a thin film under the influence of gravity and surface tension (Fay, 1971). Oils of light viscosity tend to spread more rapidly than heavier oils, and warm air and water temperatures promote rapid spreading. A small spill can cover a relatively large area if it is allowed to spread. Spreading occurs simultaneously with slick transport and weathering. Working together with transport, it increases the total area that a spill may affect. However, by increasing the surface area of a slick, spreading makes the oil more susceptible to weathering and degradation.

Advection, or drift, is driven primarily by the action of winds, waves, and surface currents. When the driving forces do not vary across the surface of a slick (e.g., the wind field is uniform), advection is relatively independent of spill volume and spreading. Published experimental results (Van Dorn, 1953; Stewart et al., 1974; Oceanographic Institute of Washington, 1977) indicate that an oil slick moves in the direction of the wind at about 3 percent of the wind speed in the absence of surface currents.

Oil slicks are weathered by processes such as evaporation, dissolution, emulsification, and sedimentation, which reduce the slick to a smaller volume of generally higher-viscosity material. Petroleum components are removed from the marine environment by evaporation, photochemical oxidation, and chemical and microbial degradation (Lee, 1980).

Evaporation is the most important initial process affecting an oil slick (Wheeler, 1978). Hydrocarbon evaporation rates depend on the physical properties of the oil, the exposed surface area, temperature, wind velocity, sea state, and the intensity of solar radiation (Fallah and Stark, 1976). Because vapor pressures of hydrocarbons tend to decrease with increasing molecular weight (Rossini et al., 1953), an oil slick tends to become depleted of the light, low-boiling-point fractions over time, resulting in a heavier, aromatic-rich slick composition. Up to 50 percent of an oil spill volume may be evaporated within the first 24 hours (Rostad, 1976). Evaporation and dissolution combined can remove over 90 percent of the hydrocarbons lighter than C10 within several hours (McAuliffe, 1966).

Dissolution is a process of mass transfer of hydrocarbons from floating or suspended oil into the water column. Its rate and extent are influenced by the physcial properties of the oil, extent of spreading, water temperature, turbulence, and degree of dispersion. Spreading, turbulence, and dispersion enhance dissolution by increasing the oil surface exposed to the water. The most volatile hydrocarbons, such as benzene and toluene, are the most soluble in water and are removed first. As these low-boiling-point fractions are removed, the density and viscosity of the remaining oil increases, thereby inhibiting the spreading and molecular diffusion of the remaining components.

Dispersion involves the incorporation of small globules of oil into the water column to form an oil-in-water emulsion. The process is enhanced by turbulence and heavy seas, and by the presence in the oil of surfactants (oil components with hydrophilic groups). Surfactants are present in many petroleum products, and may be formed from other compounds during the life of a slick by photochemical degradation (Lee, 1980). The increased oil surface area caused by dispersion increases the rates of dissolution and biodegradation. High dissolved hydrocarbon concentrations may exist for a short time in the water column following the initial dispersion process in an oil spill. The dispersion process may continue for up to a year, after which time other processes such as biodegradation and sedimentation play an increasingly important role.

Emulsification is the process by which water-in-oil emulsion is formed (as contrasted with the oil-in-water emulsion formed by dispersion). Water-in-oil emulsions have the appearance of viscous creams or floating coherent semi-solid lumps. The rate of emulsification depends on the oil composition and sea state.

The process is enhanced by turbulence and the presence of emulsifying agents in the asphaltene fraction of crude oil (Mackay et al., 1973).

Emulsification inhibits the degradation and weathering of petroleum products by limiting the area of degradable surfaces. The water contained in the emulsion is not sufficient to provide the required oxygen and nutrients for these processes (Gibbs, 1975). High water and/or asphaltene content increases the density and viscosity of the emulsions which, in conjunction with detrital or biogenic skeletal material, can cause the emulsions to sink.

Sedimentation of petroleum occurs when the specific gravity of the petroleum or petroleum conglomerates becomes greater than that of seawater (approximately 1.025 g/cm3). The processes that are dominant in the formation of high specific gravity compounds are adhesion of oil distribution and composition. Petroleum consuming microbes are commonly more abundant in chronically polluted waters than in nonpolluted waters (Seki et al., 1974; Tagger et al., 1976). Bacteria, yeast, filamentous fungi, and algae that are known to degrade hydrocarbons have discontinuous geographic distributions, do not all attack the same oil components, and may occur both in the water column and interstitially in sediments. Therefore, biodegradative processes are strongly dependent on the available assemblages of organisms in the spill area, the composition of the oil spilled, and the physical processes that affects its distribution and composition.

Autooxidation is the process by which hydrocarbons are oxidized in the water column. The extent and products of oxidation vary considerably and are dependent on the properties and composition of the oil, water temperature, solar radiation, the abundance of various inorganic compounds in the water and oil, and the degree of diffusion and spreading of the oil mass. The oxidation process increases the solubility of certain oil constituents, thereby enhancing dispersion and emulsification.

Prediction of the extent of the autooxidation process is difficult. Calculation of autooxidation rates is complicated by the large number of controlling variables and a multiplicity of reaction pathways.

The residue of weathered crude oil is a viscous material composed largely of asphaltenes. These may compose as much as 20 percent of the original crude oil (Butler, 1975) and are resistant to further degradation: their lifetimes may range from several months to a year (Lee, 1980; Butler, 1975).

Few assessments of the long-term fate and effects of marine oil spills have been reported. Most previous studies conducted to determine the effects on marine organisms were confined to estuaries; few data are available considering effects in open ocean areas. Based on published reports (e.g., Barszcz et al., 1978; Cucci and Epifanio, 1979; Laughlin et al., 1978; North et al., 1964; and Sanders et al., 1981), the degree of recovery of polluted water varied greatly. Recovery apparently depended on flushing of the area, the type of sediments present, and the degree of isolation of affected marine organisms. The time period for recovery varied from a few months to several years. Additional subtle effects may persist beyond the period of apparent recovery; however, little is known about these possible long-term effects.

2.2 RISK OF OIL SPILL OCCURRENCE

2.2.1 Assumptions

Certain assumptions must be made in order to estimate the probability of a future oil spill associated with the Platform Gail Project. As discussed below, the use of the following assumptions is expected to lead to an overestimation of the potential oil spill risk. However, without these assumptions, an oil spill risk analysis could not be performed.

1. Past spill experience is a reliable indicator of future spill experience.
2. The underlying causes of oil spills will be the same in the future as they have been in the past.
3. True (intrinsic) oil spill occurrence rates will not be affected by improvements in spill prevention technology or more stringent regulatory requirements imposed on OCS operators.
4. Causes of oil spills in the western Santa Barbara Channel OCS would be the same as for other U.S. offshore areas and regions of the world where historical oil spill occurrence rates have been determined (e.g., the Gulf of Mexico OCS).

Assumption 1: Past spill experience is a reliable indicator of future spill experience.

This assumption can only be tested statistically and only after the fact. However, the assumption must be made in order to utilize historical data to estimate the risk of future spills.

Figure 2-1 is a curve derived from data of Nakassis (1982) which shows statistically estimated U.S. offshore oil production spill rates (spills per billion barrels of production) for each of the years 1964 through 1979. It can be seen that inferred spill rates declined dramatically over time during this period. However, using an average spill rate based on 1964-1966 data to estimate the risk of spillage in 1979 would have resulted in a predicted number of spills more than 12 times higher than that estimated by Nakassis (1982) for 1979. Most of the spill rates employed in the Platform Gail risk assessment study are based upon Gulf of Mexico historical spill rates for the years 1973 through 1975 (refer to Section 2.2.2). Inspection of Figure 2-1 reveals that 1973-1975 corresponds to the "flat" portion of the curve. However, the average spill occurrence rate for these years is still almost 50 percent higher than the rate which is inferred to have occurred during 1979. If the decline in spill rates were to continue, oil spill risk estimates based on past accident experience will infer more spills than will actually occur.

Assumption 2: The underlying causes of oil spills will be the same in the future as they have been in the past.

As long as human error and equipment malfunctions continue to occur, the underlying causes of oil spills (although not necessarily their rates) should be the same in the future as they have been in the past. There has been sufficient offshore oil experience that any kind of incident that could potentially cause a spill is likely to have occurred at least once. If not, the incident is probably too infrequent to be significant.

Assumption 3: Parametric (true or intrinsic) oil spill occurrence rates will not be affected by improvements in spill prevention technology or more stringent regulatory requirements imposed on OCS operators.

This assumption says that the "true" rate of oil spills (an unknown quantity which can only be estimated from historical data) will remain constant over time despite any efforts by industry and regulators to reduce the rate. If this were the case, there would be no justification for regulating the offshore petroleum industry. However, as regulations are made more stringent and new oil spill prevention technology is introduced, it is not unreasonable to expect that there will be a reduction in the parametric oil spill occurrence rate and a corresponding reduction in the number of oil spills. Because we do not have sufficient data to accurately determine the degree to which the parametric spill rate has been changed by these improvements, historical data have been used in this analysis without consideration of the effect of improved technology and regulation. This is expected to result in a conservative overestimate of the actual spill risk associated with new offshore structures.

Assumption 4: Causes of oil spills in the western Santa Barbara Channel OCS would be the same as for other U.S. offshore areas and regions of the world where historical oil spill occurrence rates have been determined (e.g., the Gulf of Mexico OCS).

Similar to Assumption 1, this is a pragmatic assumption that allows the performance of an oil spill risk analysis. There are major differences between the Gulf of Mexico and Santa Barbara Channel OCS offshore environments that should have an effect on the risk of spillage--hurricanes in the Gulf being a prime example.

The Gulf of Mexico OCS is acknowledged by most oil spill risk analysts to be a "riskier" environment than the Santa Barbara Channel OCS because of harsher sea and weather conditions and significantly greater vessel traffic. Use of

Gulf of Mexico statistics may result in an over-prediction of spill probabilities. However, until such time as sufficient operating data are available for the Pacific OCS region, Gulf of Mexico data are the only data available.

2.2.2 Spill Probability Calculations

The computations for this oil spill risk analysis assume that oil spills occur as a Poisson process. This means that (1) spills are assumed to occur randomly and independent of one another; and, (2) the probability that an oil spill will occur during any given time interval is proportional to the amount of exposure in that interval. The equation that describes a Poisson process is:

$$P\ (n,\lambda) = \frac{\lambda^{n}\ e^{-\lambda}}{n!}$$

where: $P(n,\lambda)$ = the probability of occurrence of exactly n events (n = 0, 1, 2, 3,...etc.) given a statistical expectation of events,

λ = the statistically expected number of events (also called mathematical expectation),

n = the number of events (0, 1, 2, 3,...etc.)

n! = (n)(n-1)(n-2)...(1), and

e = 2.718.

The parameter in the Poisson equation represents the average or statistically expected number of occurrences for a very large number of samples. It is the mean (and also the variance) of the distribution and is constant for a particular calculation. The statistically expected number of occurrences (λ) is not a prediction of the number of events that will actually occur. Rather, the statistically expected number of occurrences is used to determine the probability of occurrence of 0, 1, 2, 3, or some other number of events. Solution of the Poisson equation gives this probability. Hayes and Winkler (1971) provide a detailed discussion of the properties of the Poisson distribution.

Use of the Poisson equation to develop probabilities of n oil spills requires estimating λ. This requires correlating the historical number of oil spill occurrences with some descriptive measure of exposure such as hydrocarbon production volume or platform-years of operation. The value obtained is termed the <u>exposure variable</u>. Dividing the historical number of spills by the historical exposure yields an estimate of the parametric (true or intrinsic) spill rate. The rate is then multiplied by the estimated exposure for the project whose spill risk is being evaluated to yield the required value of λ. Ideally, the exposure variable selected in estimating a parametric spill rate should bear a direct functional relationship to the underlying cause of a spill (Beyer and Painter, 1977). However, historical data necessary to define such variables commonly are not available and less direct exposure variables often must be utilized.

Also necessary for the assessment of oil spill risk is the frequency distribution of spill sizes. These can differ significantly depending on the spill source. Statistical methods have been developed to analyze historical oil spill data and produce estimates of the probability that the volume of a spill from a given source will exceed a particular volume. Published oil spill volume distribution functions have been used to estimate the statistically expected number of spills exceeding 1000 and 10,000 bbl.

The steps involved in estimating future oil spill risk for the Platform Gail Project are summarized below.

1. Historical spill data are compiled on the number and size of spills from different sources.

2. Exposure variables are determined for each project element potentially capable of spilling oil.

3. Historical spill data and exposure variables are used to estimate an historical spill rate for a particular type of spill.

4. Frequency distributions for spills $\geq$1,000 and $\geq$10,000 bbl are developed from historical data. These distributions are used to provide an estimate of the proportion of all spills that are greater than a given volume.

5. Historical spill rates and frequency distributions are correlated to give the statistically expected number of spills of a given size.

6. The statistically expected number of spills (λ) of a given size are input to the Poisson equation to provide an estimate of the probability that n spills of that size will occur over the operating lifetime of the project element in question.

2.2.3 Spill Calculation Data Inputs

Historical data concerning oil spill occurrences were used to develop spill occurrence rates and frequency distributions for various spill sizes. For the Platform Gail Project, spill occurrence rates and frequency distributions for blowouts, non-blowout platform spills, and offshore pipeline spills were derived from a study by Stewart and Kennedy (1978). This report is considered to be one of the more authoritative studies of oil spill risks currently available. The USCG Pollution Incidence Reporting System (PIRS) and MMS (then USGS) Event File data for the years 1973 through 1975 served as the primary data sources for the study. Stewart and Kennedy created a modified subset of these data through extensive manual checking and cross-referencing of the original data to delete erroneous entries and ensure the accuracy of the information used to develop spill rates. They obtained supporting information for their study from Martingale's Master Vessel File, the American Bureau of Shipping Register, the MMS (then USGS) Platform File, and numerous other files maintained by the U.S. Army Corps of Engineers, the Maritime Administration, the U.S. Coast Guard, and the U.S. Census Bureau.

2.2.3.1 Blowouts

An historical rate of blowout spills has been derived by Stewart and Kennedy (1978) based on data from the MMS (USGS) Event File covering the period 1964 to 1975. "Well-years" was used as the exposure variable. This implies that the more wells that are drilled and the longer they produce, the greater the probability of a blowout spill. This is intuitively correct in light of the fact that most blowouts resulting in oil spillage are due to non-drilling operations (Danenberger, 1976 and 1980).

Stewart and Kennedy (1978) derived a cumulative probability density function for the volume distribution of blowout spills. This density function was used to estimate the proportion of spills in each given size class. The following table gives the probability that a blowout spill will exceed 1000 and 10,000 bbl in size.

Volume Distribution of Blowout Spills[a]

Spill Volume, bbl	Probability of a Blowout Spill in this Size Class
≥1000	0.577
≥10,000	0.302

---

[a] Estimates based on Table B.3 of Stewart and Kennedy (1978).

One important observation relative to blowout spills is that between the years 1971 and 1978, the total spillage attributable to OCS blowouts was less than 1000 bbl (Danenberger, 1980). This amount is substantially less than would be predicted by the above model. The reduced blowout spill volume experienced during the past decade may well reflect the availability of improved equipment and training.

2.2.3.2 Non-Blowout Platform Spills

Platform oil spillage can also occur as a result of non-blowout events. These spills are evaluated separately from blowout spills because the historical occurrence rates and volume distributions of non-blowout platform spills and blowouts are markedly different.

Historical data pertaining to offshore platform-related spills have been summarized by Stewart and Kennedy (1978). Their tabulation was derived from data in the MMS (USGS) Event File for the years 1973 to 1975. The number of Gulf of Mexico production platforms experiencing one or more production-related spills declined almost continuously between 1971 and 1975, ranging from a high of 174 in 1971 to a low of 38 in 1974 (Danenberger, 1976). Although this reduction could be attributable to normal statistical variation (i.e., chance), Danenberger (1976) considers it to at least partially reflect the better equipment and more stringent regulations imposed on OCS operators. If the latter is the case, the spill rates derived above should be conservative for present day operations.

An oil spill size frequency distribution associated with platform operational spills was derived by Stewart and Kennedy (1978). The probabilities of a platform operational spill exceeding 1000 and 10,000 bbl based on Stewart and Kennedy's data are given below.

Volume Distribution of Platform Operational Spills[a]

Spill Volume, bbl	Probability of a Non-blowout Platform Spill in this Size Class
$\geq$ 1,000	< 0.001
$\geq$ 10,000	< 0.001

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[a] Estimates based on Table B.4 of Stewart and Kennedy (1978).

2.2.3.3 Offshore Pipelines

Historical data on oil spills from offshore pipelines are presented in Stewart and Kennedy (1978). Their spill rate utilizes "pipeline mile-years" as the exposure variable. Based on information in the MMS (USGS) Event File and the MMS Pipeline Management System's Segment Specific Pipeline List for the period 1973 through 1975, Stewart and Kennedy (1978) evaluated the occurrence rates and distribution of oil spill sizes associated with offshore pipelines. They used this information to develop a cumulative probability density function. Based on this work, the probability that an offshore pipeline spill will exceed 1000 and 10,000 bbl is summarized below.

Volume Distribution of Offshore Pipeline Spills[a]

Spill Volume, bbl	Probability of an Offshore Pipeline Spill in this Size Class
≥1,000	0.002
≥10,000	<0.001

---

[a] Estimates based on Table B.5 of Stewart and Kennedy (1978).

2.3 OIL SPILL TRAJECTORY MODELING

2.3.1 Oil Spill Model Description

The trajectory model employs a vectoral addition of wind and current forces to drive the centroid of a two-dimensional surface oil slick. Second-order forces such as waves and wind wave-current interaction, which may tend to slow the progress of a slick are not considered. Physiochemical processes such as those described in Section 2.1 (evaporation, sinking, dissolution, emulsification, etc.) which generally reduce the volume of a slick are also not considered. The results of the analysis conducted are expected to yield conservatively high results with respect to shoreline segment centroid impact probabilities.

The trajectory model was used to simulate the movement of the centroid of an oil spill over 3-day and 10-day periods. Physical factors considered predominant driving forces in the model are winds, geostrophic currents, and tidal currents. The effects of wind on marine oil slicks is incompletely understood (Stolzenbach et al., 1977). Published experimental results (Van Dorn, 1953; Stewart et al., 1974; and Oceanographic Institute of Washington, 1977) indicate that the centroid of an oil slick moves in the direction of the wind at about 3 percent of the wind velocity in the absence of surface currents. In the absence of wind, slicks tend to move in the direction of the net surface current (the combination of the geostrophic and tidal currents).

In the oil spill trajectory model, the slick centroid is calculated to move at the same instantaneous velocity as the vectoral sum of the underlying surface currents, plus 3 percent of the wind velocity vector. The instantaneous centroidal velocity vector is determined by:

$$U_{oil} = U_{tidal} + U_{geostrophic} + 0.03\ U_{wind}$$

The oil spill trajectory model employs a grid system superimposed over the study area. An approximate 3-mile square grid system was used for the Platform Gail analysis, roughly corresponding to offshore oil and gas lease block boundaries. This grid system is the basis for input of wind and current data. The definitions of shoreline impact locations are also based on this grid.

Because factors influencing slick movement are highly variable, the trajectory model uses a Monte Carlo technique to select combinations of wind and current forces acting on a slick at a particular time, and to simulate changes in these forces. By using observational data concerning the frequency of occurrence of different wind and current conditions (obtained from synoptic charts, field measurements, and satellite imagery) and applying the Monte Carlo selection technique over a sequence of timesteps (each 20 minutes over periods of 3 days and 10 days), the model simulations represent potential oil slick centroid trajectories. A total of 200 model runs were conducted for each month of the year to approximate the variety of trajectories that could be expected under variable weather conditions. Monthly results were combined to develop approximate seasonal trajectory predictions. The results of these runs were used to calculate the percentages of predicted contact of individual shoreline segments.

2.3.2 Wind and Current Data Inputs

A fourteen-year long record of daily surface wind observations and interpretations from synoptic charts were used to classify winds into general wind regimes, some with a characteristic diurnal variation. The observed frequency of occurrence of each wind regime and a transition matrix (based on the observed frequency of transitions from one specific wind type to another) was determined for input to the model. Each wind regime is discussed briefly below and illustrated on Figures 2-2 through 2-15.

For modeling purposes, surface currents in the project region are divided into two components: a geostropohic surface current and a tidally induced surface current. During each trajectory simulation, the net geostrophic surface current component is assumed to remain constant in time and the tidal current component is phased according to a simulated tidal cycle.

2.3.2.1 Winds

The most prevalent wind pattern in the Platform Gail project region is one of northwest winds, modified nearshore by local topography and the land-sea breeze phenomenon. Several other wind flow regimes are relatively common in the region. To quantify these flow regimes for use in the oil spill trajectory model, a 14-year record of daily weather conditions and events was categorized. Additional references used in categorizing these flow regimes included de Violini (1974) and DeMarrais et al. (1965). Four basic meterological types, some with multiple subtypes, were distinguished for the region. These types are:

Meteorological Types	Subtype
Seabreeze	Summer A (Channel)/ Summer (Southern)
	Summer B (Channel)/ Summer(Southern)
	Winter
Northwester	Local Gradient
	Entire Region
Southeaster	Frontal Passage
	Santa Barbara Channel Only
Northeaster/Santa Ana	Entire Region
	Eastern Channel/Northern (Southern California Region)

Each of these flow regimes exhibits unique spatial and temporal characteristics as discussed below. Vector plots of the wind patterns associated with these types, by time of day, are shown on Figures 2-2 through 2-15.

Sea Breeze Regime

The sea breeze wind regime may be divided into two relatively distinct summer subtypes in the Santa Barbara Channel. They have been labeled the Summer A and Summer B conditions for convenience. The Summer A condition is the more common, occurring more than 50 percent of the time. The Summer B condition occurs less than 20 percent of the time. Summer sea breeze conditions in the Southern California region are more uniform, and are characterized by a single subtype in this modeling analysis.

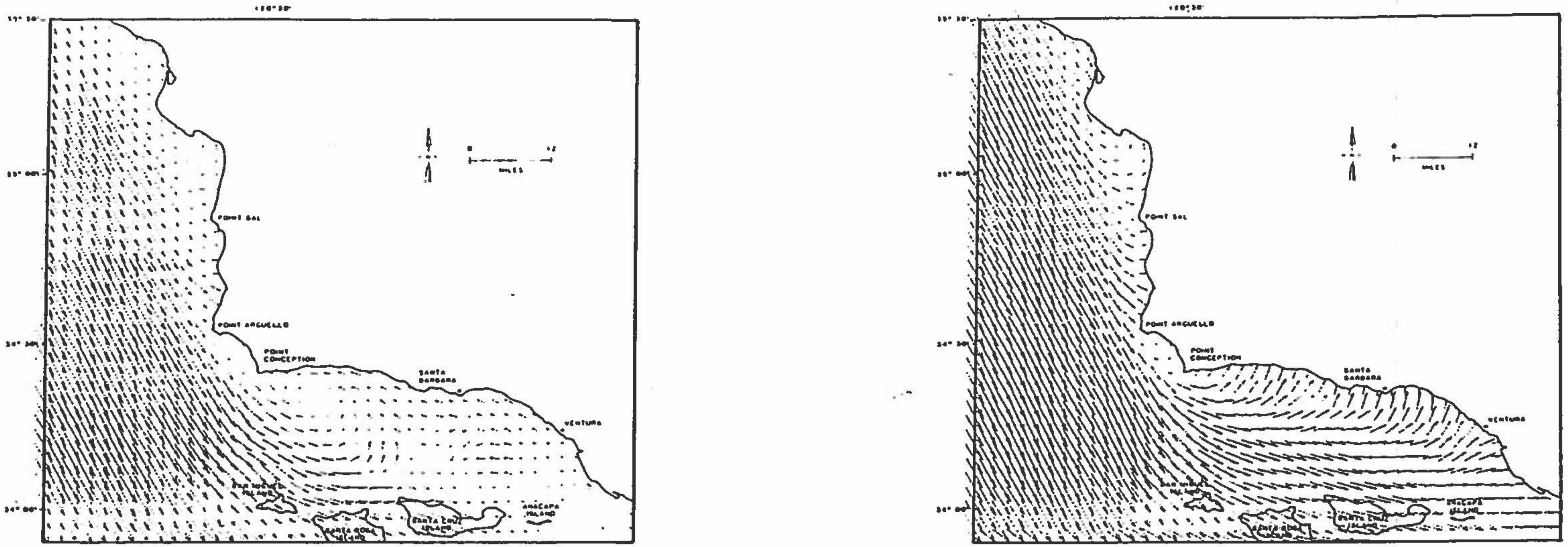
Santa Barbara Channel - Summer A: The sea breeze or stratus flow regime is the most common during the spring and summer seasons and is generally characterized by coastal fog and stratus clouds. Winds in the outer region typically remain northwesterly throughout the day at speeds of 15 knots (8 m/s). During the early morning, coastal winds are light and from the west to southwest (Figure 2-2). By mid-morning, the coastal sea breeze begins to set in, increasing coastal winds to 10 to 12 knots (5-6 m/s) (Figure 2-2). Winds in the region of Point Conception increase to 20 knots (10 m/s). The wind direction remains relatively constant throughout the afternoon, but the wind speed generally decreases by late afternoon particularly in the Point Conception area. At night, the offshore wind pattern is influenced by land breezes from coastal areas (Figure 2-2).

The Summer A regime is prevalent in the Santa Barbara Channel/Santa Maria Basin region 50 to 60 percent of the time in the spring and summer months. The average persistence of this regime is 4 to 6 days, but it may persist for as long as 20 days before being interrupted by another weather pattern.

Santa Barbara Channel - Summer B: The Summer B regime is typified by light offshore northwesterly winds (8 knots; 4.3 m/s) and a much greater coastal influence. The mid-day and afternoon winds (Figure 2-3) approach the coast from the southwest at 8 knots (4.3 m/s). The evening, night and early morning coastal winds run approximately parallel to shore in a northerly direction (Figure 2-3).

The Summer B regime occurs 10 to 20 percent of the time in the spring and summer months. This condition has an average persistence of 10 to 20 percent during the spring and summer months.

Summer (Southern California): The sea breeze or stratus flow regime is the most common during the summer season and is generally characterized by coastal fog and stratus clouds. Winds in the area typically remain westerly to northwesterly throughout the day. At night and during early morning, coastal winds are light and from the southwest to southeast (Figure 2-4). By early afternoon, winds along this portion of the California coastline are from the west to southwest, depending on location, and exhibit average speeds of about 10 knots (f m/s) (Figure 2-4). The wind direction remains relatively constant throughout the afternoon. At night, the offshore wind pattern becomes more westerly as shown in Figure 2-4.

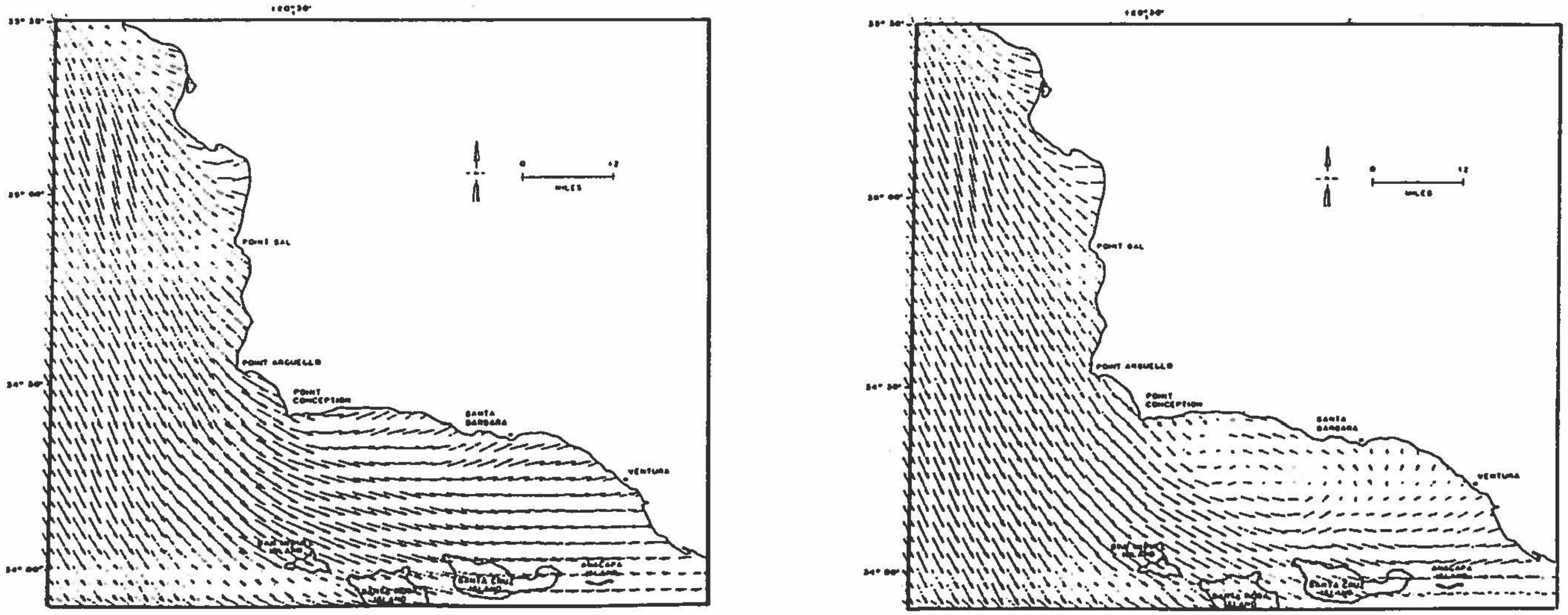


SEA BREEZE SUMMER SANTA MARIA +
SANTA BARBARA 0200 - 0800 HRS.

→ 12 KNOTS

SEA BREEZE SUMMER ,"A" 1000 HRS

→ 12 KNOTS



SEA BREEZE SUMMER "A" 1400 HRS

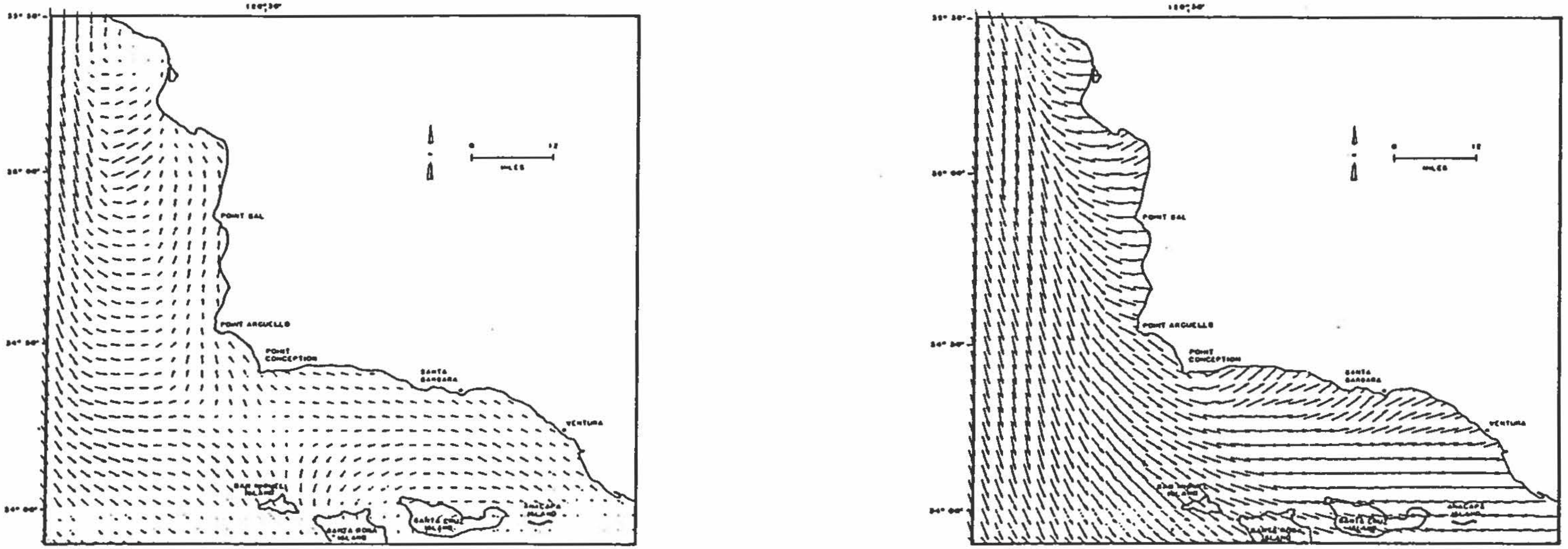
→ 20 KNOTS

SEA BREEZE SUMMER "A" 2100 HRS

→ 20 KNOTS

FIGURE 2-2

SANTA BARBARA CHANNEL
SUMMER A SEABREEZE
WIND REGIME



SEA BREEZE SUMMER "B" 2000 - 0800 HRS

SEA BREEZE SUMMER "B" 1400 HRS

FIGURE 2-3

SANTA BARBARA CHANNEL
SUMMER B SEABREEZE
WIND REGIME

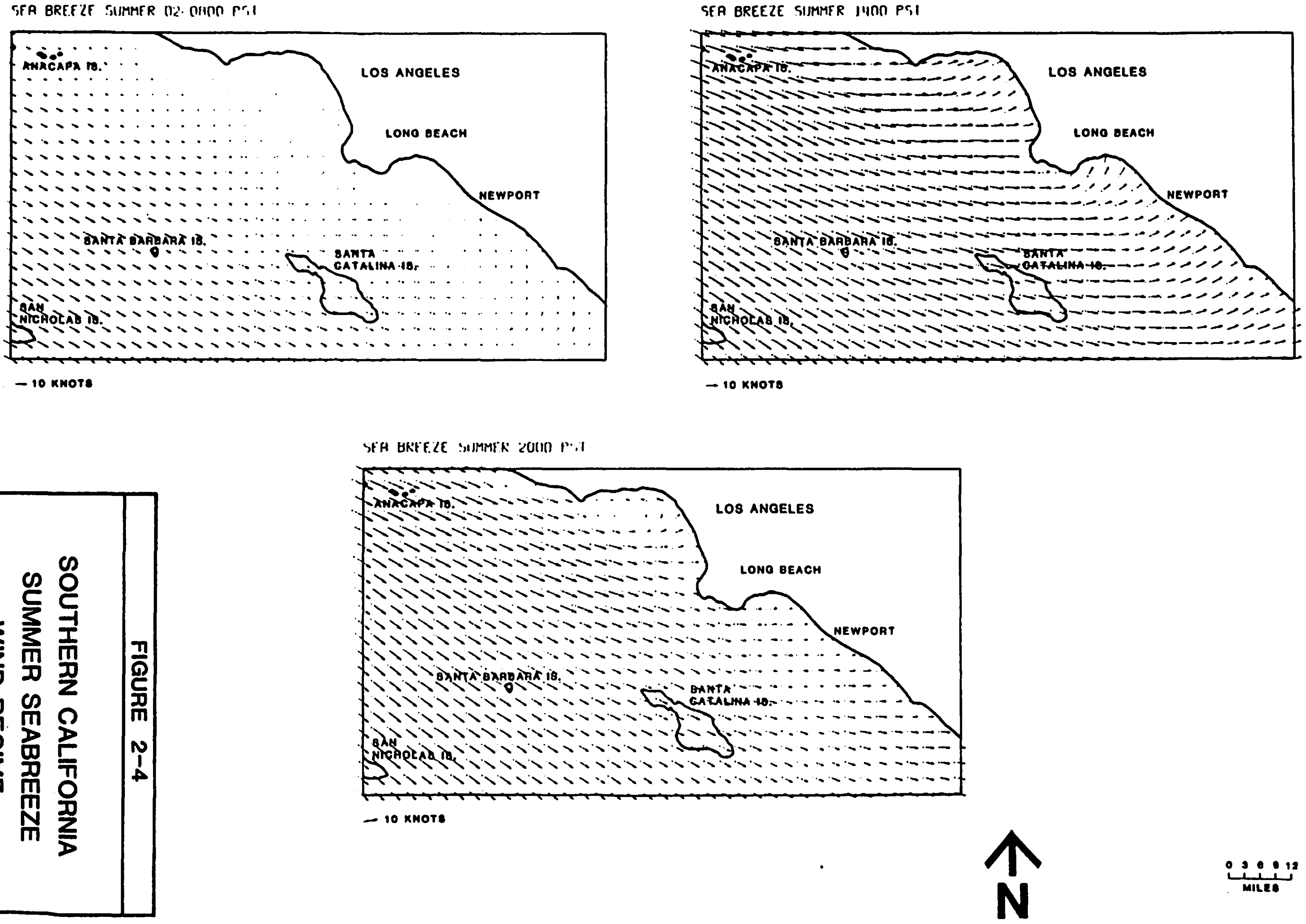


FIGURE 2-4

SOUTHERN CALIFORNIA
SUMMER SEABREEZE
WIND REGIME

Dames & Moore

The sea breeze regime is prevalent offshore of Southern California more than 50 percent of the time during the summer months. The average persistence of this regime is 4 to 6 days, but it may persist for as long as 20 days before being interrupted by another weather pattern.

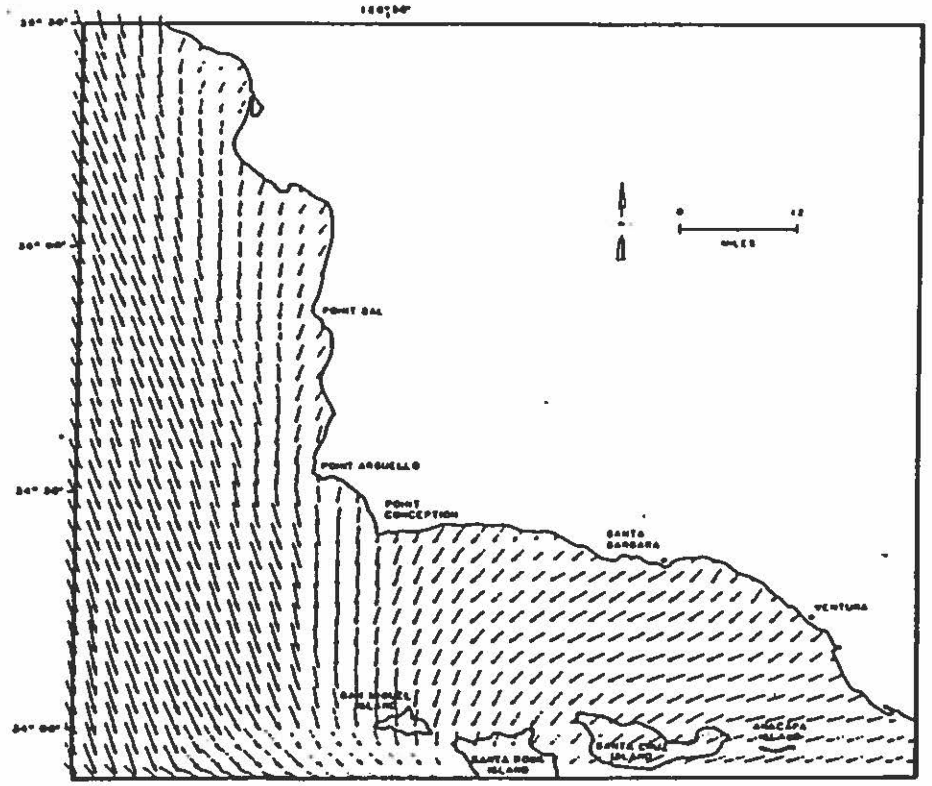
Winter: Wind patterns in winter are more variable than in summer. The most common pattern is the land-sea breeze regime, a seasonal variation of the summer stratus regime. The major sea breeze is weaker and the land breeze stronger during winter. A typical representation of this regime during the daytime is shown on Figure 2-5 and 2-6. After sunset, the land breeze dominates, causing the wind to shift to the northeast in nearshore areas (Figures 2-5 and 2-6). Wind speeds throughout the day range from about 4 to 12 knots (2 to 6 m/s).

This flow regime occurs betwen 50 to 60 percent of the time during fall and winter. It typically persists for 3 to 6 days but may last for as long as 25 days.

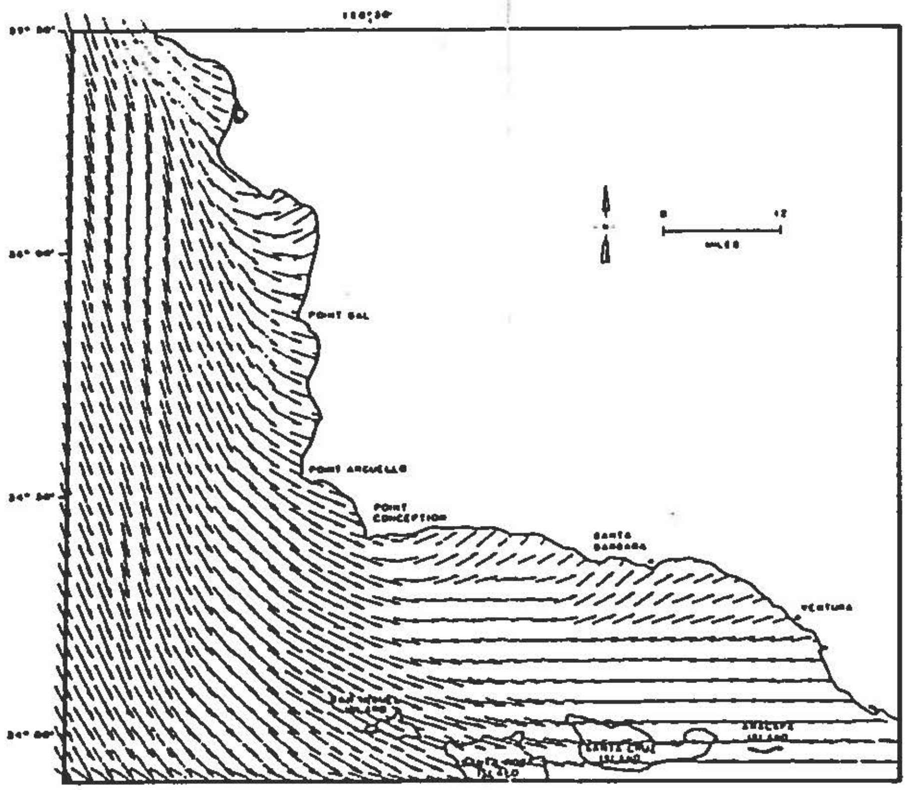
Northwester Wind Regime

Local Northwest Gradient: The northwester meteorological type is often marked by strong northwesterly winds in the outer Santa Barbara Channel which become stronger in the vicinity of Point Conception due to a pressure system situated over Point Conception (Figures 2-7 and 2-8). Strong northwest winds offshore Anacapa and Santa Catalina Islands are also associated with this wind type. The northeastern part of the Channel and near shore areas in Southern California typically experience much lighter winds, often with a return eddy flow near the coast. The strength of the northwest wind is variable, as is the distance to which it progresses eastward during the day.

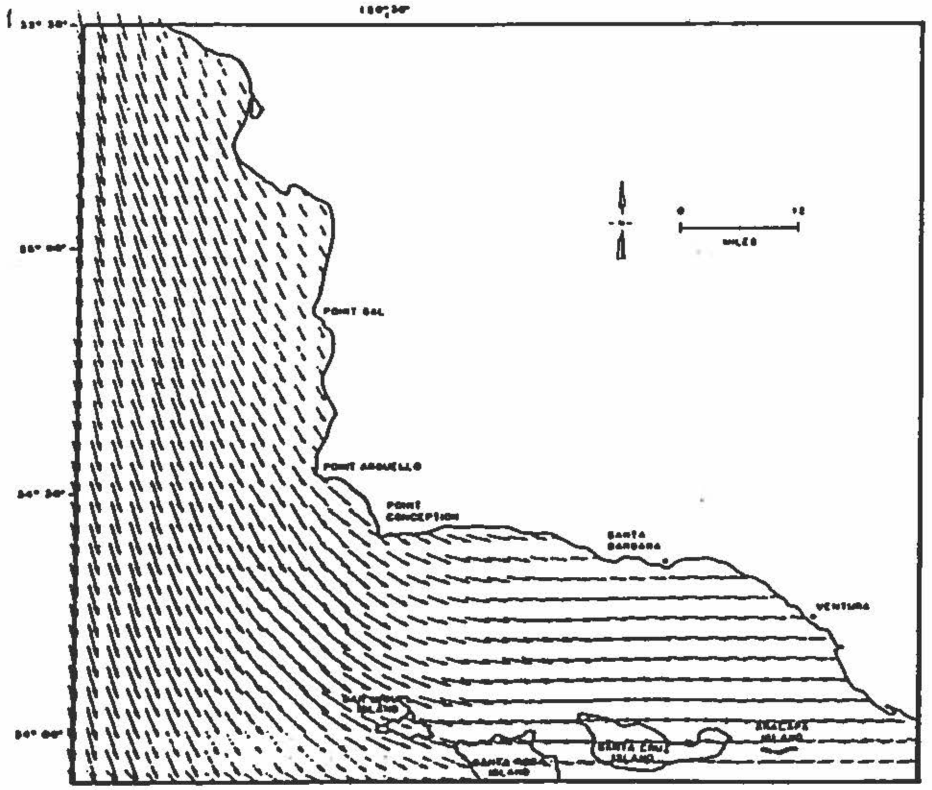
The local northwest gradient flow regime occurs between 20 and 30 percent of the time during the summer months and 10 to 15 percent of the time in the winter. The average duration in summer is 2 to 3 days with a maximum duration of 10 days. The average duration in the winter is 1 to 2 days with a maximum of 8 days.



SEA BREEZE WINTER 0200 - 0800 HRS — 20 KNOTS



SEA BREEZE WINTER 1400 HRS — 20 KNOTS



SEA BREEZE WINTER 2000 HRS — 20 KNOTS

FIGURE 2-5

SANTA BARBARA CHANNEL
WINTER SEABREEZE
WIND REGIME

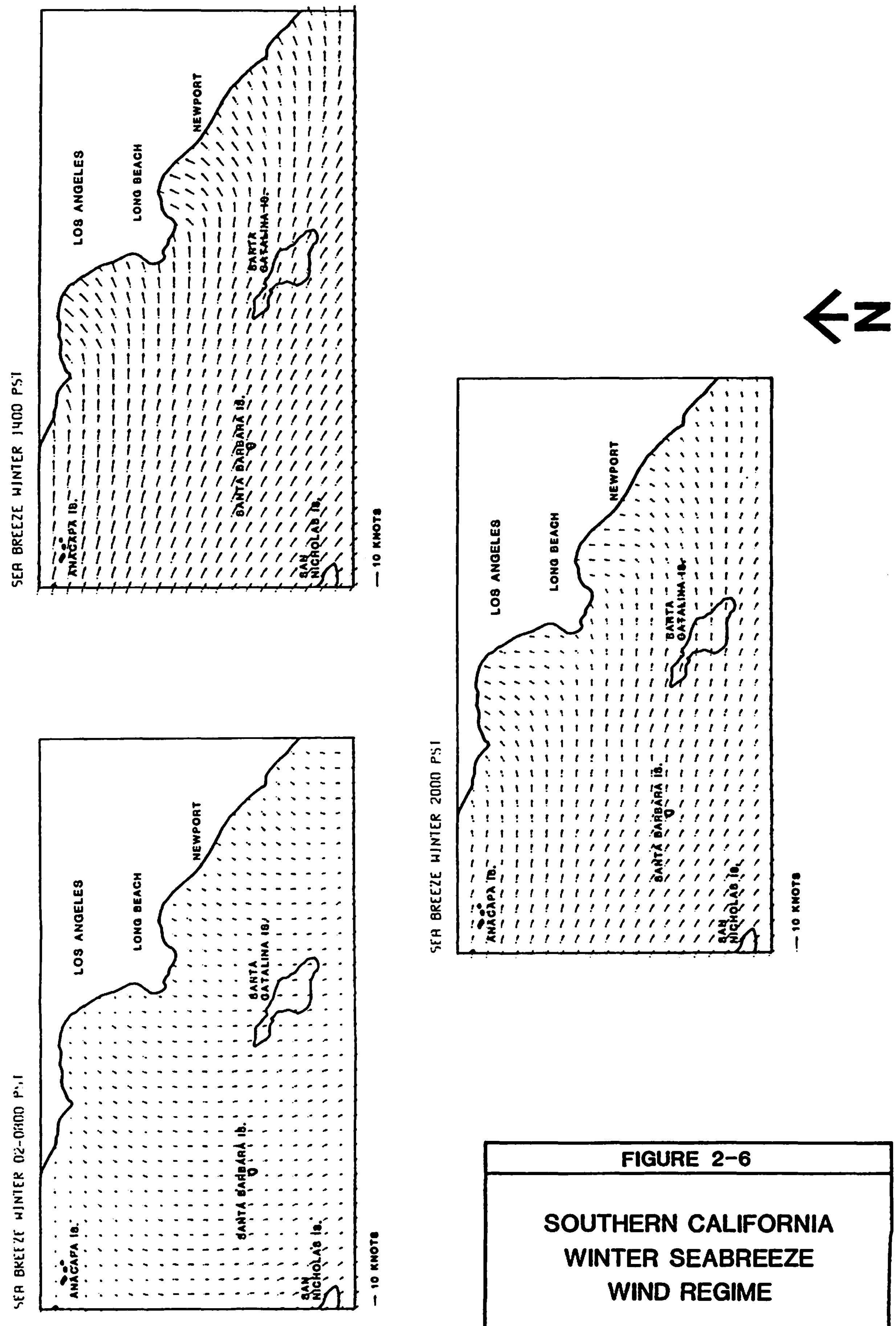
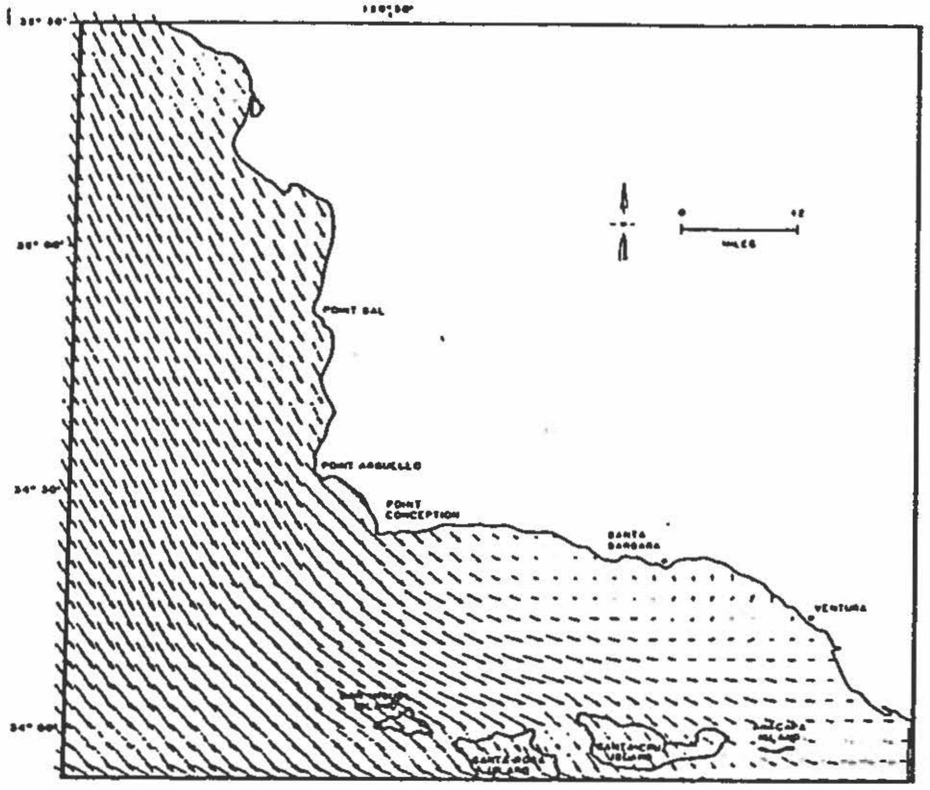


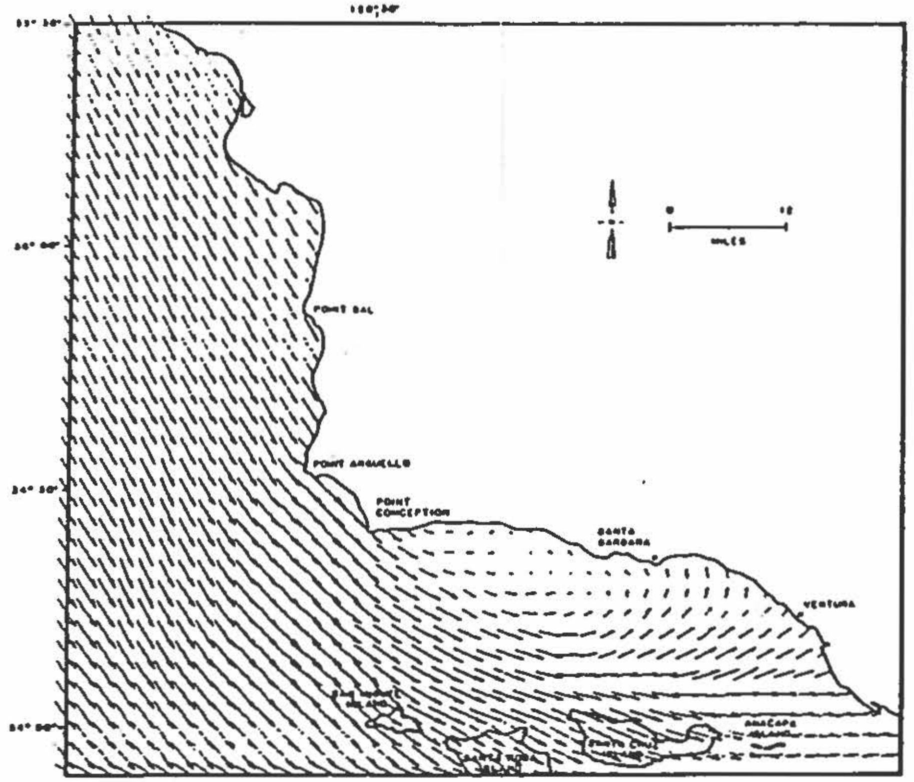
FIGURE 2-6

SOUTHERN CALIFORNIA
WINTER SEABREEZE
WIND REGIME

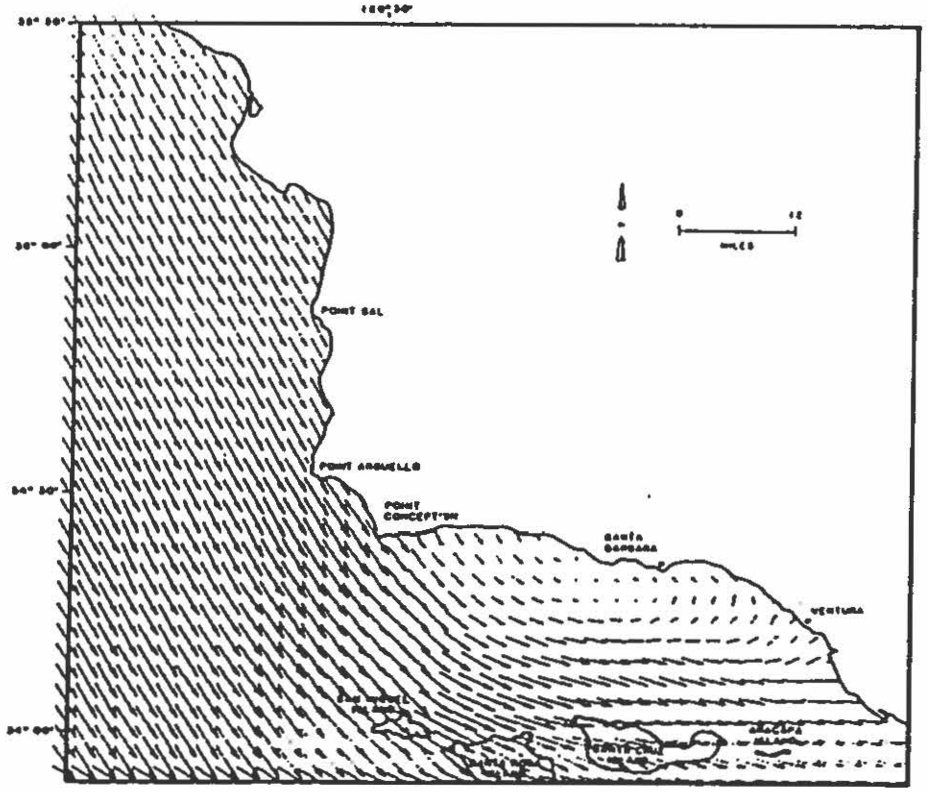
Dames & Moore



LOCAL NW GRADIENT 0800 HRS



LOCAL,NW GRADIENT 1400 HRS



LOCAL NW GRADIENT 2000 - 0200 HRS

FIGURE 2-7

SANTA BARBARA CHANNEL
LOCAL NORTHWEST GRADIENT
WIND REGIME

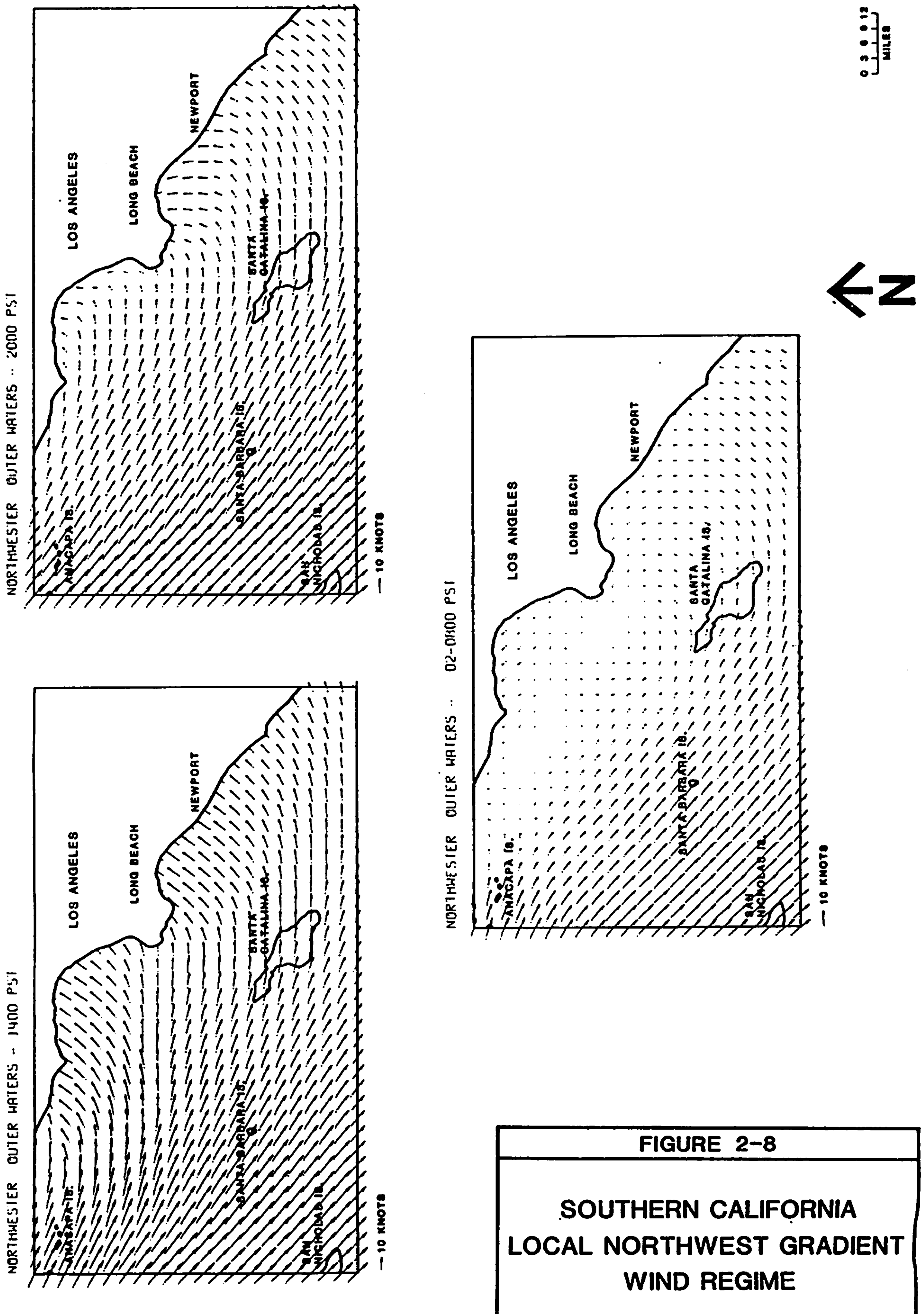


FIGURE 2-8

SOUTHERN CALIFORNIA
LOCAL NORTHWEST GRADIENT
WIND REGIME

Dames & Moore

Entire Region: This flow regime is marked by strong winds throughout the Santa Barbara Channel and Southern California regions (Figures 2-9 and 2-10). To qualify as this type, a minimum wind speed of 20 knots (10 m/s) must occur for several hours at some time during the day (usually in the afternoon). The wind direction varies from west to northwest, with less frequent winds from northwest to north.

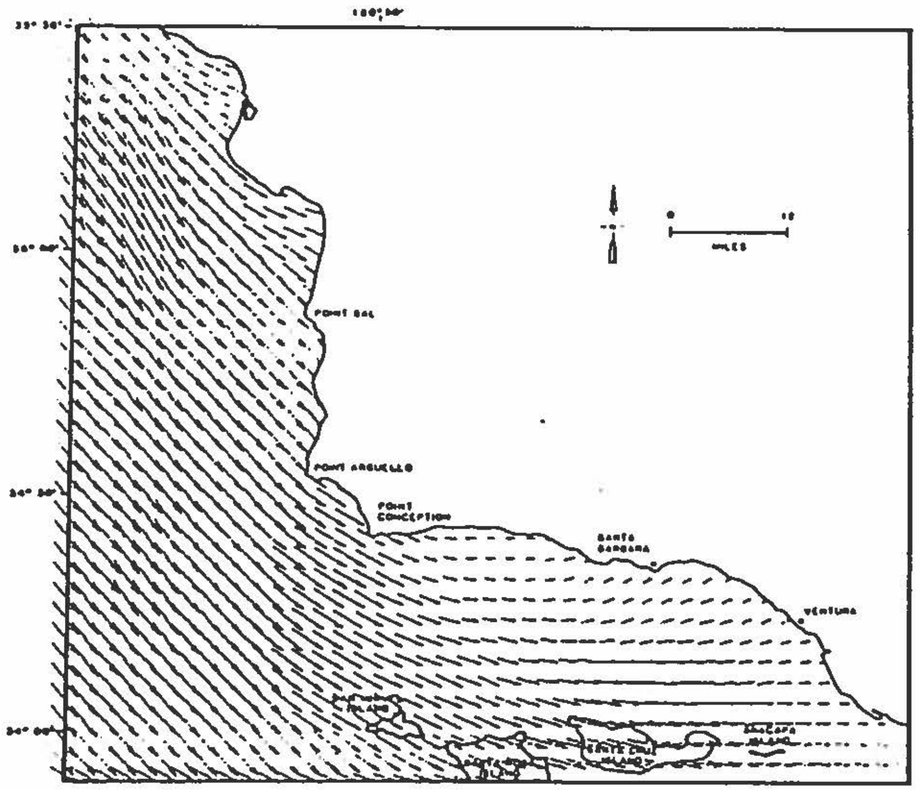
This flow regime occurs most frequently during the winter and spring (10 to 20 percent of the time). Its average duration is about 1 day and its maximum duration is about 3 days. This condition occurs 10 to 15 percent of the time during the summer-fall months.

Southeaster

Frontal Passage: Southeasters that influence the project region are associated with migrating low pressure systems and a frontal passage. The strongest winds may occur long before the frontal passage and extend over a considerable period of time. Conversely, they may occur over a short duration and be confined largely to the frontal zone. The diurnal influence is minimal, being offset by the large-scale synoptic features. However, frontal passages do have a peak frequency of occurrence during the early morning hours and a secondary peak in the evening.

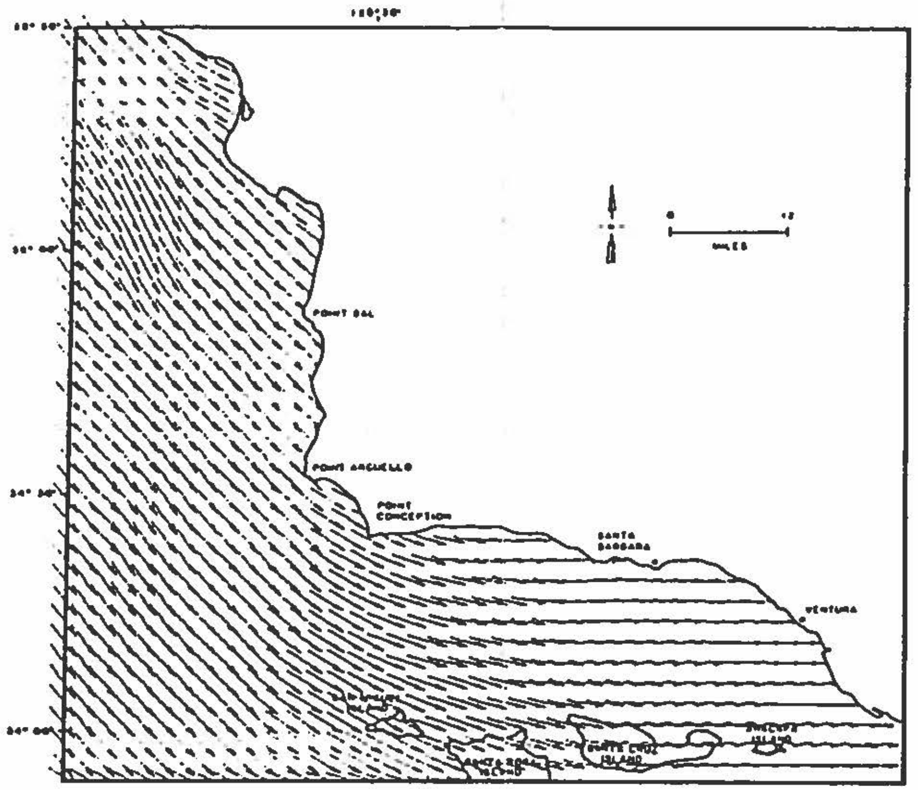
A typical frontal passage scenario affecting the Point Conception area is shown on Figure 2-11. Figure 2-12 illustrates a frontal passage in Southern California. The vector plots show a southerly wind setting in initially over the entire region, followed by increasing wind speeds and a southward shift of the area of influence. After the frontal passage, light, west to southwest winds occur for about 12 to 24 hours, followed thereafter by a northwester or calm conditions.

The duration of the southeaster is dependent on the speed of the migrating pressure system, but is generally about 2 days. The frequency of occurrence of the southeast regime is generally in the range of 10 to 20 percent in the Santa Barbara Channel, and 5 to 15 percent in Southern California from November to



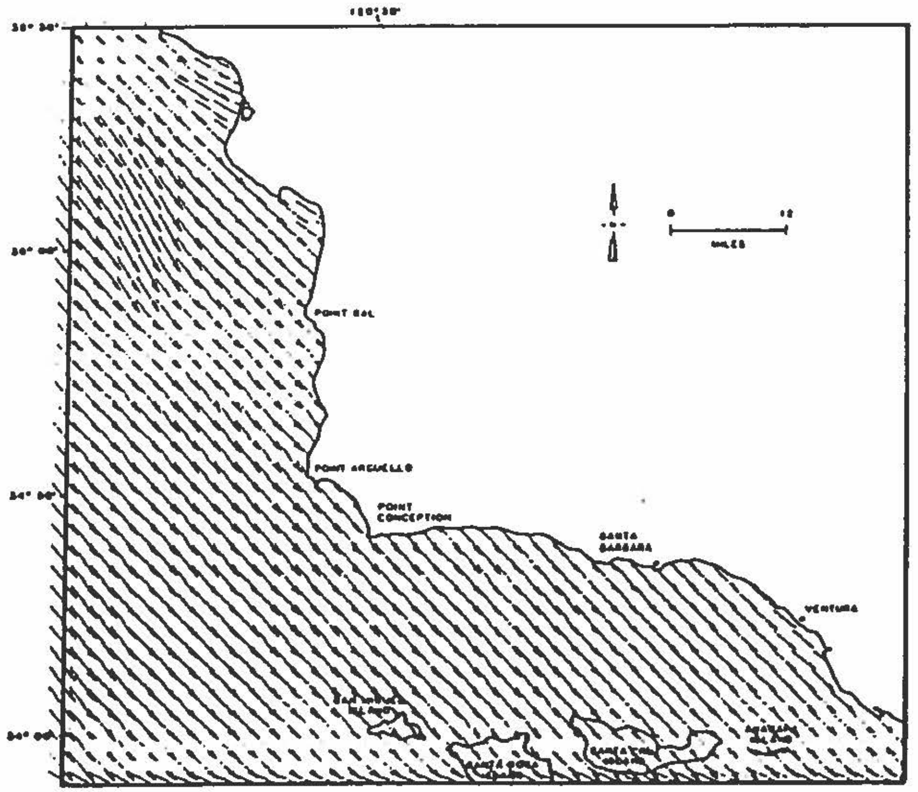
NORTHWESTER 0200 - 0800 HRS

→ 30 KNOTS



NORTHWESTER 1400 HRS

→ 30 KNOTS



NORTHWESTER 2000 HRS

→ 30 KNOTS

FIGURE 2-9

SANTA BARBARA CHANNEL
NORTHWESTER
(ENTIRE REGION)
WIND REGIME

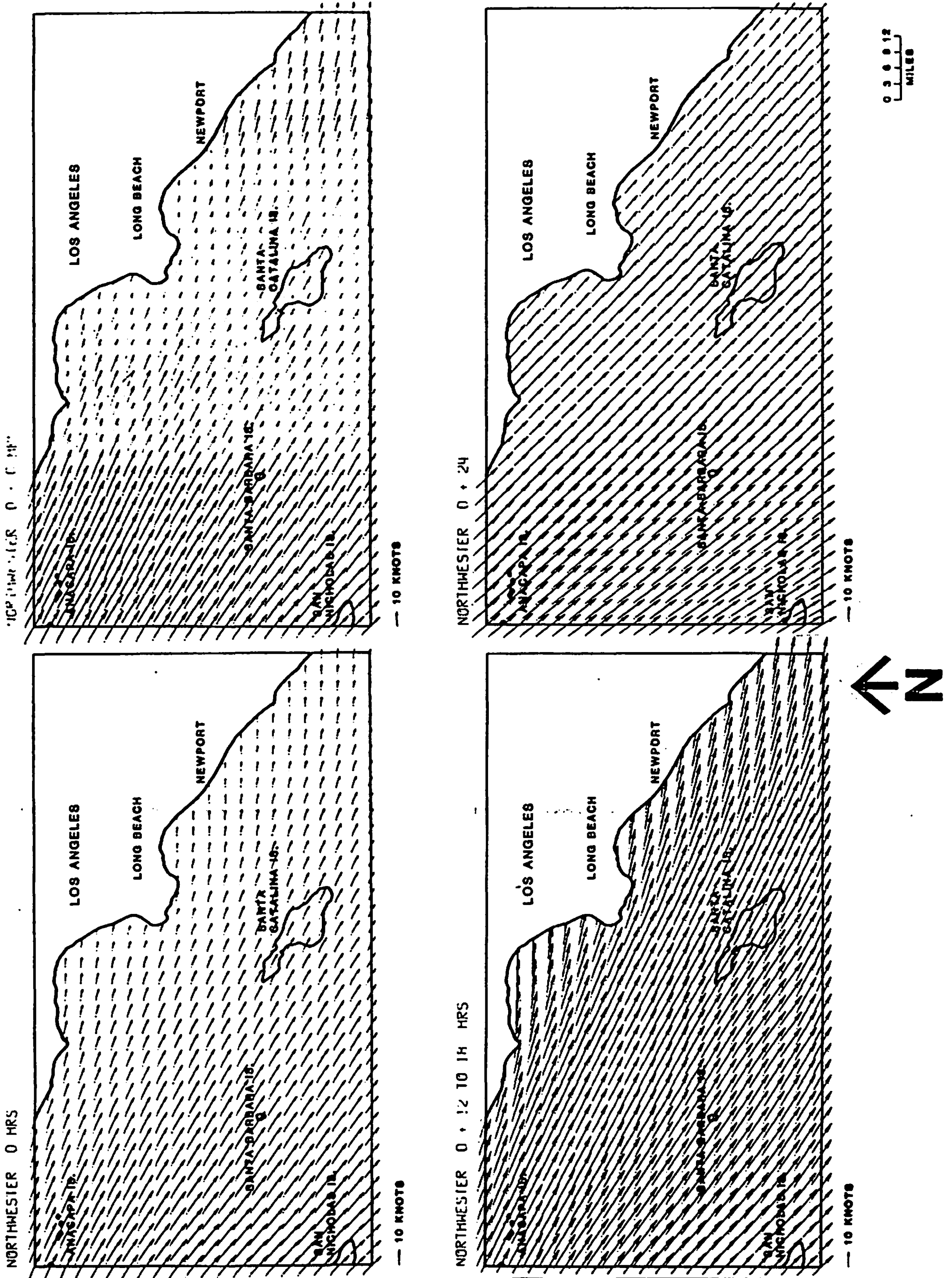
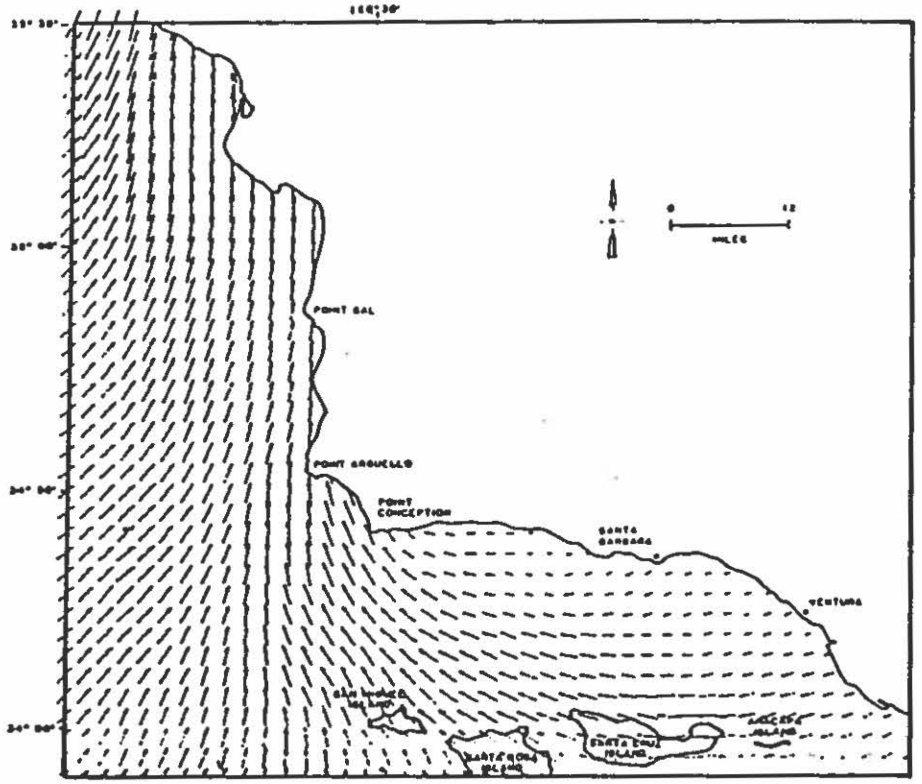


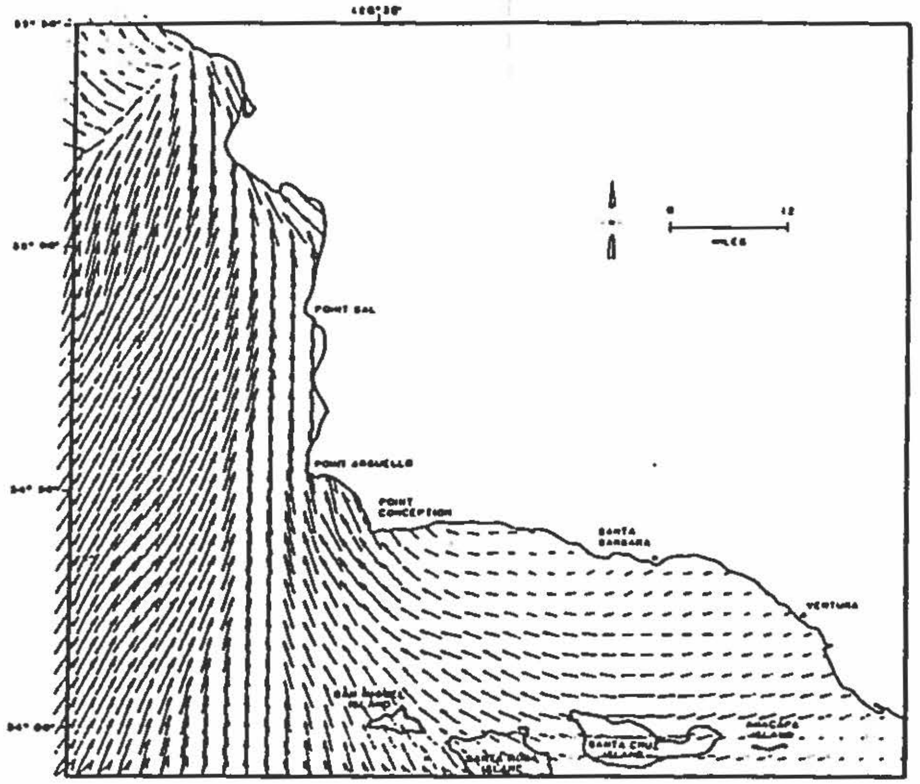
FIGURE 2-10

SOUTHERN CALIFORNIA
NORTHWESTER
(ENTIRE REGION)
WIND REGIME

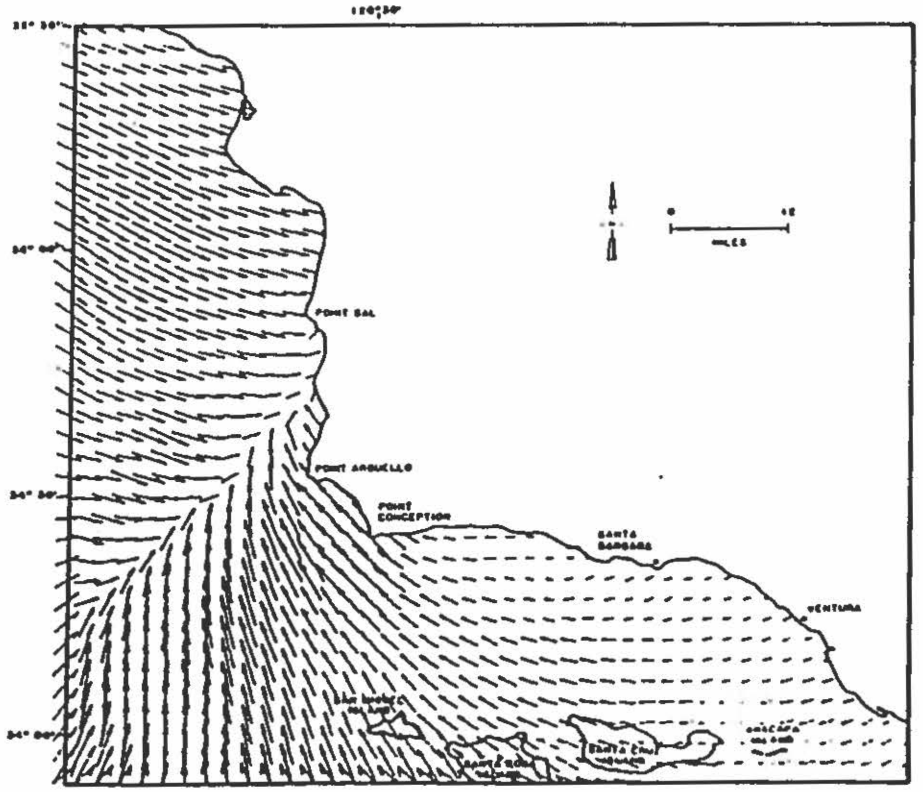
Dames & Moore



FRONTAL PASSAGE 0000 HRS. —— 60 KNOTS



FRONTAL PASSAGE 0000 + 0600 HRS. —— 60 KNOTS



FRONTAL PASSAGE 0600 + 0800 HRS. —— 60 KNOTS

FIGURE 2-11

SANTA BARBARA CHANNEL
SOUTHEASTER/FRONTAL PASSAGE
WIND REGIME

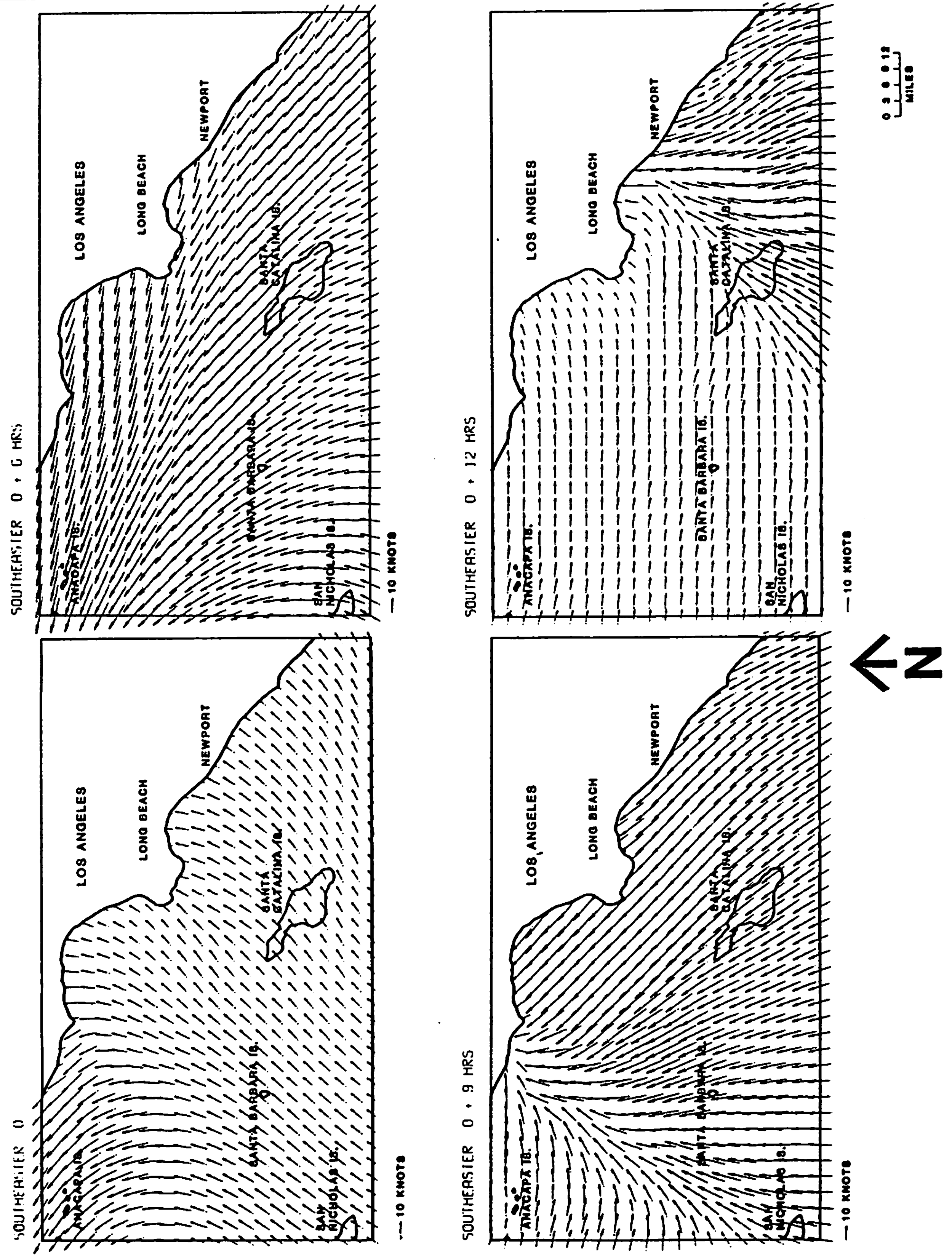


FIGURE 2-12

SOUTHERN CALIFORNIA
SOUTHEASTER
FRONTAL PASSAGE
WIND REGIME

Dames & Moore

April. These conditions are rare during the other months of the year (less than 3 percent).

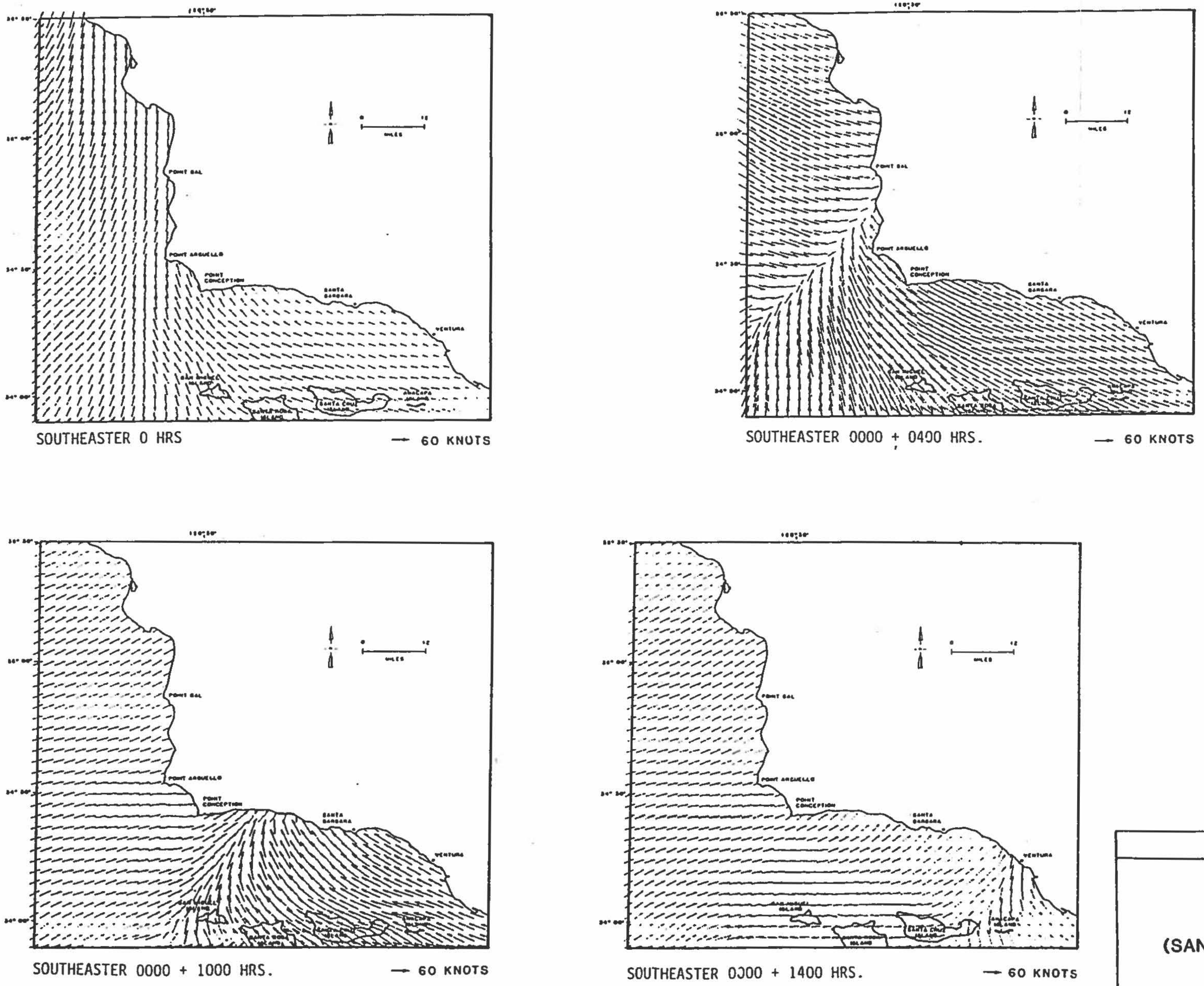
Santa Barbara Channel: Southeast winds are often associated with migratory low pressure systems prior to the frontal passage, particularly in the Santa Barbara Channel region. This regime occurs between 1 and 5 percent of the time from November to April, and rarely during the other months. Wind speeds attained in the Point Conception area as a consequence of this regime usually range between 15 and 20 knots (8 to 10 m/s)(Figure 2-13).

This flow regime may result from a storm that has no effect on the eastern Santa Barbara Channel or from a front that eventually moves eastward, accompanied by southeast winds. The average duration is 1 day in the winter, with a maximum duration of about 3 days.

Northeaster/Santa Ana

The northeaster flow regime (Figures 2-14 and 2-15) is a winter condition occuring from 5 to 10 percent of the time between November and February. The flow regime is marked by strong (15 to 20 knots; 8 to 10 m/s) southward flows during the night and early morning hours. During the afternoon and evening, the nearshore flows moderate to 10 knots (5 m/s), while the offshore flows remain constant at 20 knots (10 m/s). The average persistence of this regime is 1 day, except during January when the average persistence is 2 days.

The Santa Ana is a dry, offshore wind associated with high pressure over the western states. It usually establishes itself between about 0300 and 0900 hours as a northeast wind in the Oxnard area confined to the southeastern end of the Santa Barbara Channel and along the Channel Islands. It often remains throughout the day, although a westerly sea breeze sometimes appears in the afternoon hours during weak to moderate Santa Ana conditions. Wind speeds may reach 28 knots (14 m/s) or more during the morning hours in the offshore area betweeen Oxnard and Anacapa Island. During the afternoon hours, when the northeast winds are countered by the westerly sea breeze, speeds of about 14 knots (7 m/s) are not uncommon in this area (Figure 2-14).



SOUTHEASTER 0 HRS

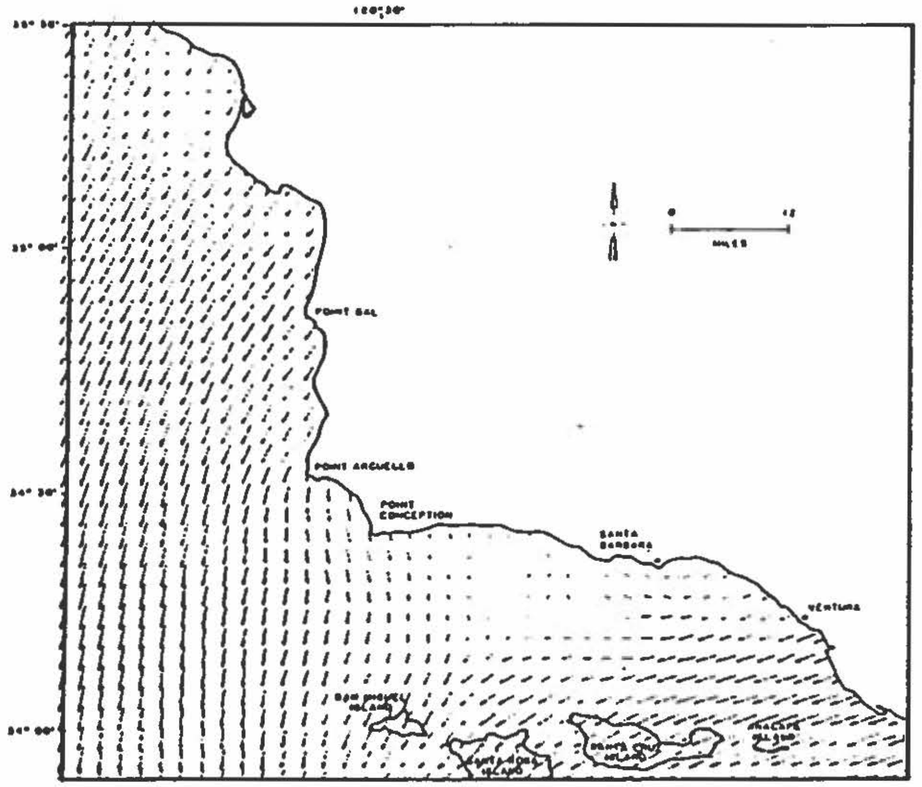
SOUTHEASTER 0000 + 0400 HRS.

SOUTHEASTER 0000 + 1000 HRS.

SOUTHEASTER 0000 + 1400 HRS.

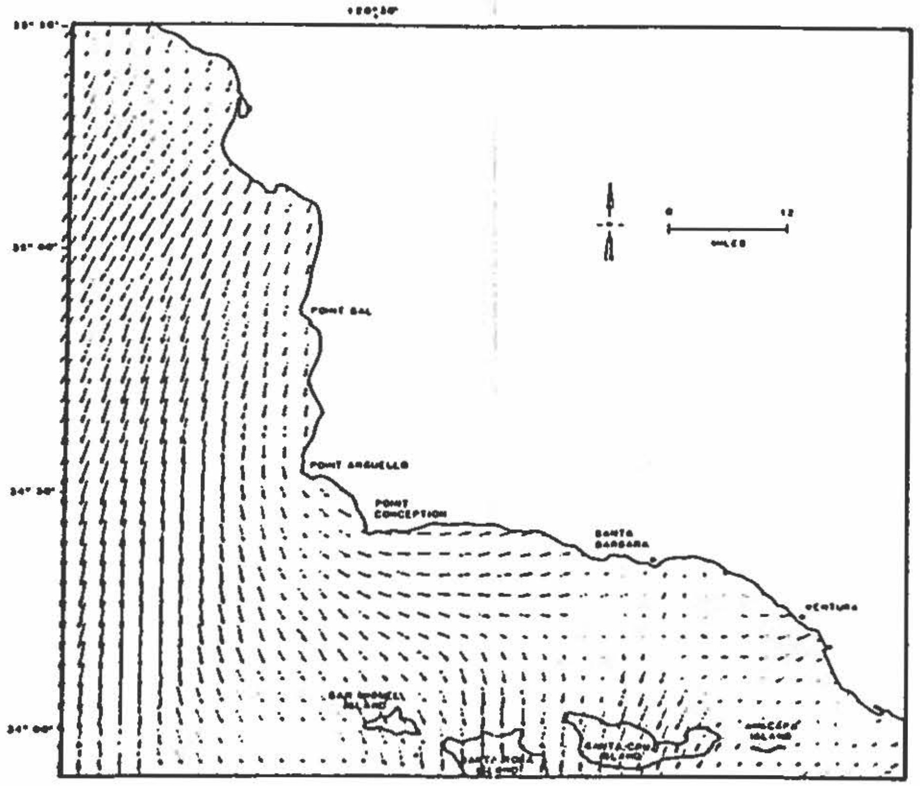
FIGURE 2-13

SOUTHEASTER
(SANTA BARBARA CHANNEL)
WIND REGIME



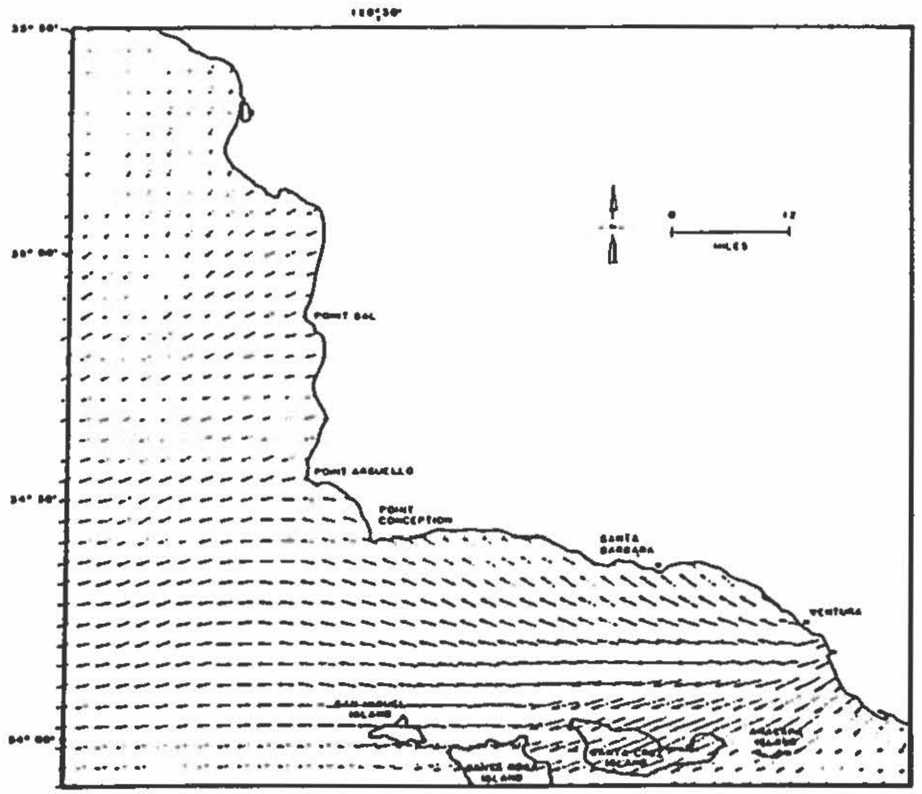
NORTHEASTER 0200 - 0800 HRS

→ 60 KNOTS



NORTHEASTER 1400 HRS

→ 60 KNOTS



SANTA ANA

→ 60 KNOTS

FIGURE 2-14

SANTA BARBARA CHANNEL
NORTHEASTER / SANTA ANA
WIND REGIMES

Santa Anas typically do not extend into the western part of the Channel. However, on rare occasions a severe Santa Ana with winds reaching 50 to 60 knots (26 to 31 m/s) in the eastern Channel will occur. Usually, the duration of such an event is 2 days, with Santa Ana winds in the western Channel/Point Conception area only occurring on the second day.

2.3.2.2 Currents

Water movement in the coastal region can be considered the resultant of a number of forces. These include geostrophic forces that produce large-scale surface currents, tidal forces which result in oscillatory motions, and wave forces which drive longshore currents. The relative magnitude (and hence importance) of these forces varies over time and with distance from the shoreline. Wave forces dominate the longshore currents within the surf zone, but they have negligible influence in deep water. Hence, wave-induced currents are an important consideration in a nearshore oil spill model but can be ignored in an offshore mode. Geostrophic forces are damped in shallow waters, but tend to dominate all other oceanic forces far offshore. Tidal forces mainly influence the nearshore regions. The types and characteristics of currents produced by geostrophic and tidal forces are discussed in the following paragraphs.

Surface Currents

The surface currents in the Santa Barbara Channel area form a complex pattern of large scale horizontal circulations and eddies, all of which are subject to seasonal and meteorological effects. The determining influence in the region is the southward-flowing California Current, part of the Pacific Ocean geostrophic current system. As the current passes the eastward break in the coastline at Point Conception, a permanent counterclockwise eddy, the Southern California Counter Current, is induced. The current usually flows northward through the Santa Babara Channel (Dailey et al., 1974; Wyllie, 1966). Seasonal variations in meteorology modify the current pattern.

Pirie et al. (1975) have identified three periods of current patterns from LANDSAT and NASA high altitude aircraft photographs. The Oceanic Period, occurring from July to November, corresponds to the situation described in the preceding paragraph. During the so-called Davidson Period from November to mid-February, the normally submerged Davidson Current rises as the California Current weakens. This produces a more northward flow along the entire coast. In between the above two periods, strong winds dominate over the geostrophic effects. The surface wind shear induces vertical circulation yielding the name of the Upwelling Period. Pirie et al. (1975) show current patterns typifying these three periods for the entire California coast.

Weighted drift card data of Kolpack (1971) reflect predominantly the Oceanic Period, although the Upwelling Period pattern can also be seen. There is no indication in Kolpack (1971) of the Davidson Period as seen by Pirie et al. (1975). However, Schwartzlose (1963) shows an unusually strong northward flow for November, 1957. Jones (1971) also indicates the occurrence of the Davidson Period in his geostrophic flow condition diagrams. It is possible that this condition does not occur every year due to its dependence on the weakening of the California Current.

Considering the sources and reliability of surface current data presently available for offshore Point Conception, surface current patterns of Pirie et al. (1975) and Kolpack (1971) were selected for use with the oil spill trajectory model.

Little information is available regarding the speeds of the current in the Santa Barbara Channel. The unusually strong current reported by Schwartzlose (1963) had a maximum velocity of approximately 0.5 to 0.9 knot (0.26 to 0.46 m/s). The City of Oxnard (1980) and Cooke (1981) indicate surface current speeds of 0.3 knot (0.15 m/s) at mid-Channel, dropping to 0.2 knot (0.1 m/s) nearer the shoreline. In calm conditions, current velocities typically an order of magnitude smaller can be expected.

Comprehensive surface current data for the entire project region are not readily available. However Williams et al. (1981) produced a series of seasonal maps showing mean surface current sectors on a regular grid for application in-pollutant spill trajectory models. Inputs to the preparation of these maps include currents derived from shipdrift, geostrophic currents, wind drift currents derived from mean wind stress, currents from surface drifters, and current meter data.

Upon examination of these data sets, Williams et al. (1981) concluded that they showed an insufficient number of observations existed for any one data set to prepare reliable circulation charts on a monthly basis. Therefore, Williams et al. (1981) combined the data according to the distinct circulation seasons, after Skogsburg (1936), as follows: the Davidson Current Period, December-January; the Upwelling Period, May-June-July; and, the Oceanic Period, September-October. As input to this trajectory model, the monthly surface currents provided by Williams et al. (1981) for the above-mentioned months were used.

Tidal Currents

The tidal current is generated by the rising and falling action of the tide. In general, the tidal range and accompanying tidal current have a maximum amplitude at the coastline and decrease progressively seaward. The flow pattern used to represent this behavior consists of an elliptical tidal current cycle rotating clockwise in which the current flows upcoast during flood tide and downcoast during ebb tide.

In the Santa Barbara Channel offshore region the tides are predominately semi-diurnal with the tide peak moving in a westerly and northwesterly direction along the coast (Dailey et al., 1974; NOAA, 1978; City of Oxnard, 1980). This induces an elliptical tidal current which moves shoreward and upcoast during the incoming flood tide and offshore and downcoast during ebb tide. The current velocities are maximum during the mid-tide period with zero velocities at high and low water.

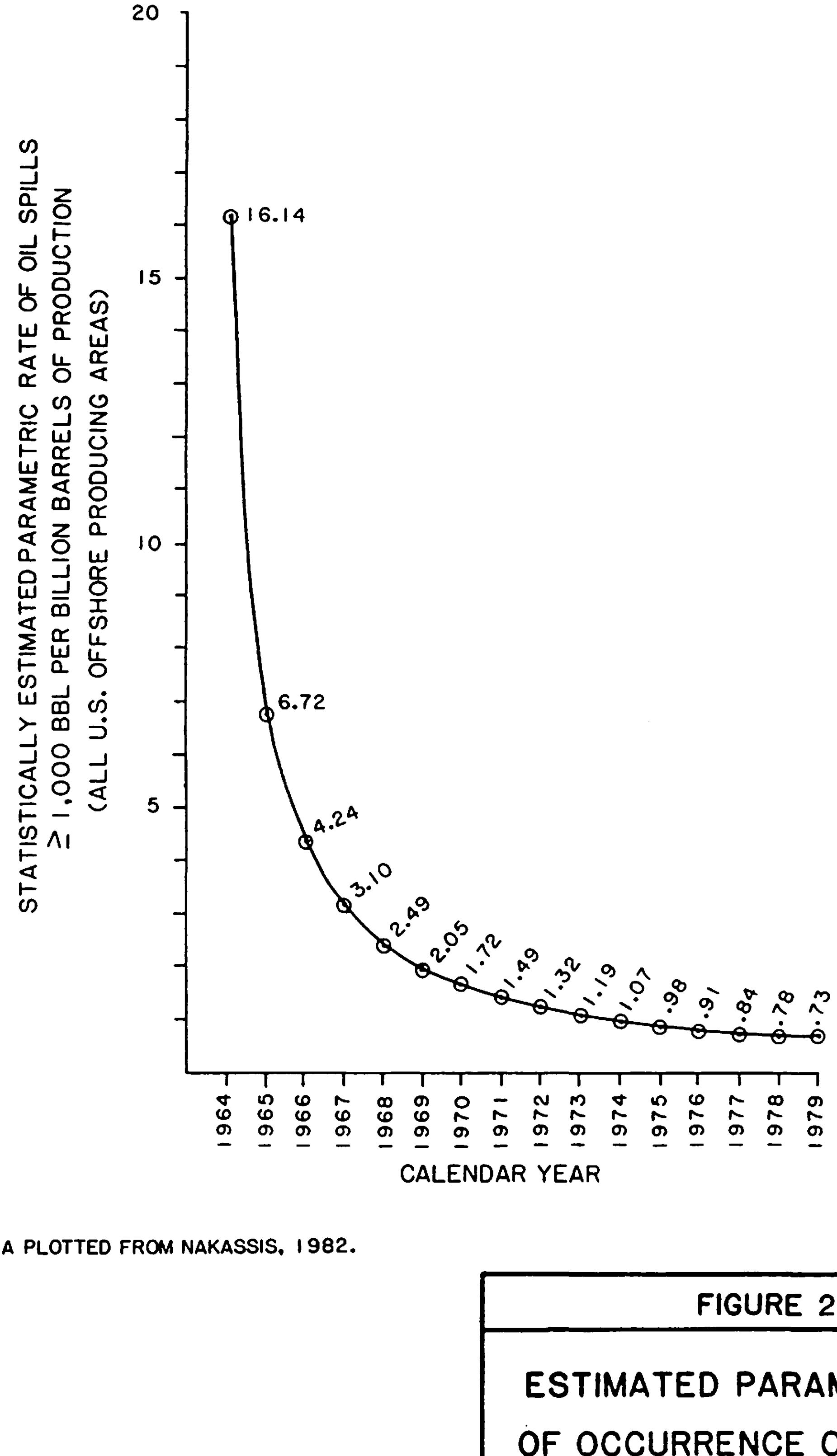
An average maximum tidal current of 0.5 knot (0.26 m/s) occurs during the mid-tide period (City of Oxnard, 1980). The current is assumed to have this value for water depths from the shoreline to 90 feet (27m). Current velocities are then assumed to decrease linearly to a value of zero at the edge of the shelf break (300 feet; 91 m).

2.4 THIRTY-DAY OIL SPILL TRAJECTORIES

Thirty-day oil spill trajectories originating from the Platform Gail site were assumed to be represented by the trajectories reported for leasing area E-24 in the February 1984 Southern California Lease Offering Oil Spill Risk Analysis POCS Technical Paper No. 83-9 (Minerals Management Service, 1983). The analysis presented in that paper is based on a computer simulation of spill trajectories which follows mathematical procedure equivalent to the Dames & Moore oil spill model. The MMS model accommodates the longer simulation period by using a slighty coarser modeling grid and longer time intervals between trajectory recalculations to account for changes in wind and current velocities. Because simulations of such an extended duration are subject to a high level of uncertainty associated with the limitations of available input data, these accommodations are considered appropriate.

2.5 CUMULATIVE OIL SPILL OCCURRENCE PROBABILITIES

Presently available discussions of cumulative oil spill risks are qualitative in nature, and do not present an accounting of total spill risk exposure associated with the offshore oil and gas activities over the lifetime of the Platform Gail project. Although some rough estimates of cumulative spill rate expected values are presented in a recent report prepared for the MMS (Arthur D. Little, 1985), that report does not present a detailed analysis of cumulative spill risk exposure and acknowledges that "this analysis is mostly qualitative by necessity." Information presented in Table 6.0-2 of that study can be used to estimate the cumulative risk of oil spillage over the ten-year period from 1986 through 1995, however. The cumulative risk of platform oil spillage over this period is calculated in this study using the Minerals Management Service production rate spill exposure statistic (presented in Minerals Management Service, 1983) applied to the total production estimated for the Santa Barbara Channel and Santa Maria Basin. The incremental contribution to this risk associated with Platform Gail was determined by a comparison of cumulative risks with and without Platform Gail. The computation of spill risk assumed that oil spill occurrence may be estimated using the Poisson equation presented in Section 2.2.2.



DATA PLOTTED FROM NAKASSIS, 1982.

FIGURE 2-1

ESTIMATED PARAMETRIC RATE OF OCCURRENCE OF OIL SPILLS LARGER THAN 1,000 BARRELS BY YEAR, 1964 THROUGH 1979

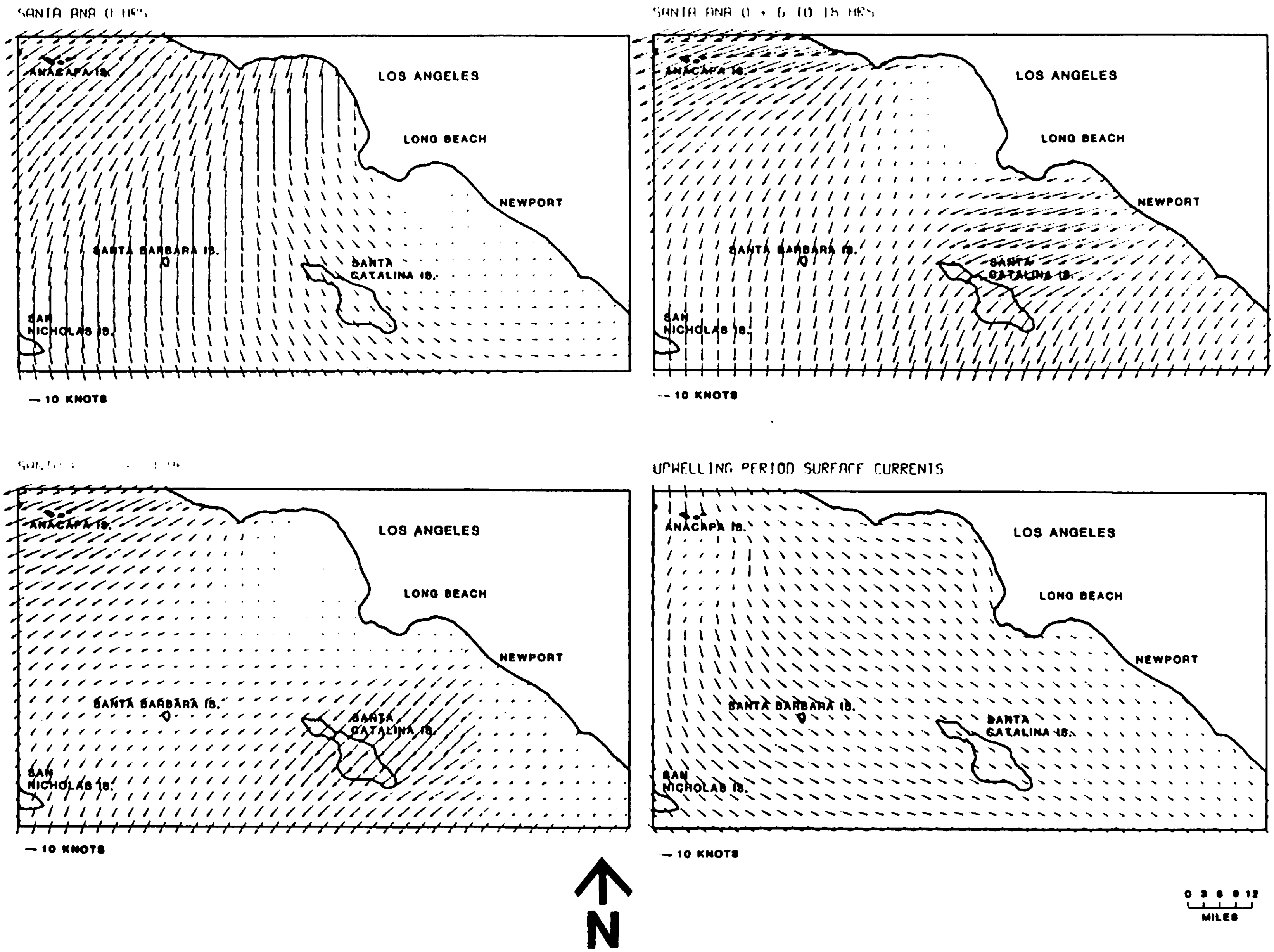


FIGURE 2-15

SOUTHERN CALIFORNIA
SANTA ANA
WIND REGIME

Dames & Moore

3.0 RESULTS

3.1 COMPUTED RISK OF OIL SPILL OCCURRENCE

The estimated oil spill risk exposure associated with Platform Gail and the subsea pipeline connecting it to the Platform Grace is detailed in Table 3-1. These estimates were combined with historical spill rates using the computational procedure described in Section 2.2 to determine the estimated number of oil spills associated with the Platform Gail project and the probability of oil spills of various sizes over the entire project lifetime. As shown in Table 3-2, the statistically expected number of spills over 1000 barrels is 0.074, or essentially zero since a fraction of a spill cannot occur. Table 3-3 presents the probability of spill occurrence for different spill-size categories, and indicates a 6 percent chance of one or more spills greater than 1000 barrels and a 3 percent chance of one or more spills greater than 10,000 barrels originating from Platform Gail. As indicated on Table 3-3, the probability of one or more large spills (greater than 1000 barrels) is approximately 1 percent.

3.2 OIL SPILL TRAJECTORY SIMULATIONS

The movement of an oil spill originating from Platform Gail as simulated is described in Sections 2.3 and 2.4. Because the area encompassed by this study was large (extending from Oceanside and San Clemente Island on the south to the Santa Maria River at the north), two modeling grids were employed in this analysis. The regional scope of the spill trajectory simulations and boundaries of the modeling grids used are illustrated on Figure 3-1. The Santa Barbara Channel/Santa Maria Basin modeling grid cells are detailed in Figure 3-2. Figure 3-3 details the Southern California model grid cells. to facilitate the usefulness of this study to interpret impacts on resources of special interest, "target" locations were also indentified within the area of study. These locations are listed in Table 3-4 and illustrated on Figure 3-4. Oil spill "hits" on target resources were interpreted as occurring if any of the grid cells occupied by a target were contacted during the simulation period. Because most of the shoreline and target contacts occurred close to the Platform Gail location within 10 days, graphic illustrations of spill contacts in the eastern Santa Barbara Channel area were prepared to facilitate the review of 3-day and 10-day modeling results. The area encompassed by these illustrations and the locations of principal Platform Gail project elements are shown on Figure 3-5.

3.2.1 3-Day Trajectory Results

The results of the 3-day oil spill trajectory simulations are presented in Tables 3-5 through 3-28 and Figures 3-6 through 3-9. These results include:

(1) The conditional probabilities of spill contact (the probability of contact assuming that a spill will occur) at specific shoreline segments;

(2) Total probability that an oil spill greater than 1000 barrels will occur and will contact specific shoreline segments;

(3) Total probability that an oil spill between 1000 and 10,000 barrels will occur and will contact specific shoreline segments;

(4) Total probability that an oil spill greater than 10,000 barrels will occur and will contact specific shoreline segments;

(5) Conditional probabilities of spill contact at specific sensitive resource targets; and,

(6) Total probabilities that an oil spill greater than 1000 barrels will occur and will contact specific sensitive resource targets.

As indicated by the results presented, the locations most likely to be affected within 3 days by a spill originating from Platform Gail are relatively close to the platform site. The mainland coast from Ventura to Ormond Beach is the most commonly contacted shoreline segment in the 3-day analysis during all seasons of the year. The minimum time to impact in this area was calcualted as low as 15 hours in some cases. Most of the spill trajectories reach shore within 3 days during the spring and summer months, but over 75% do not make a shoreline contact within 3 days during the fall and winter.

3.2.2 10-Day Trajectory Results

The results of the 10-day oil spill trajectories are presented in Tables 3-29 through 3-52 and Figures 3-10 through 3-13. The results presented are analogous to those presented for the 3-day trajectory simulations, but addressing the 10-day results. Although some trajectories are transported much farther from the platform location over the 10-day simulation period, the most common area of contact is still the area from Ventura to Ormond Beach. Shoreline contacts from Ventura to Santa Barbara increase during all seasons, but are particularly pronounced during the fall season. Very few spill simulations did not contact land within the 10-day simulation period. The number of trajectories which did not make contact within 10-days ranged from zero percent (summer) to 20.7 percent (winter and spring).

3.3 30-DAY SPILL TRAJECTORY ESTIMATES

Oil spill trajectories and resulting shoreline and sensitive resource target contacts were estimated using the conditional probability results for launch site E-24 in the Pacific OCS Technical Paper 83-9 (Minerals Management Service, 1983). Becuase the MMS analysis uses a coarser modeling grid, these results cannot be transformed into probabilities addressing the same shoreline segments and sensitive resource "targets" as presented for the 3-day and 10-day trajectories. The shoreline segments and sensitive resource locations referred to in Tables 3-53 and 3-54 correspond to those locations referenced in the MMS study. The results presented address probabilities over an entire year-long period because no seasonal results were reported by the MMS for launch site E-24 in the technical paper.

3.4 CUMULATIVE OIL SPILL RISK

Oil production rate estimates for all southern California offshore development over the expected production life of Platform Gail are not readily available. Arthur D. Little, 1985 presents a projection of crude oil production over the period 1986 through 1995, however. This period encompasses the period of maximum production associated with Platform Gail, and the Arthur D. Little data may be used to evaluate Platform Gail's contribution to cumulative oil spill risk. Spill rate estimates presented by the Minerals Management Service (1983) were used in this analysis, and the computation of pipeline spills assumes that all oil produced between 1986 and 1995 will be transported to shore by pipeline. As the results in Tables 3-55 and 3-56 indicate, the cumulative probability of spill occurrence between 1986 through 1995 is quite large, and the overall probability of spill occurrence is affected to a very minor degree by the exclusion of the Platform Gail contribution to spill risk.

TABLE 3-1

OIL SPILL RISK EXPOSURE PARAMETERS
PLATFORM GAIL AND PROPOSED SUBSEA PIPELINE

Project Element	Spill Type or Cause	Estimated Oil Spill Risk Exposure
Platform Gail	Blowouts	800 well-years
	Operational/Break-in period	10 platform-years
	Operational/Post Break-in	22 platform-years
Offshore Pipeline	Leak or rupture	192 mile-years

TABLE 3-2

STATISTICALLY EXPECTED NUMBER OF SPILLS (λ) PLATFORM GAIL AND ASSOCIATED PIPELINE

	Volume (barrels)	
	>1000	>10,000
Platform Gail	0.066	0.035
Pipeline	0.008	0.000
TOTAL	0.074	0.035

TABLE 3-3

PROBABILITY OF SPILL OCCURRENCE*
PLATFORM GAIL AND ASSOCIATED PIPELINE

	Platform Gail	Pipeline	Total
>1000 BBL			
P_0	0.94	0.99	0.93
P_1	0.06	0.01	0.07
P_{2+}	0.00	0.00	0.00
>10,000 BBL			
P_0	0.97	1.00	0.97
P_1	0.03	0.00	0.03
P_{2+}	0.00	0.00	0.00

---

* P_0 = Probability of zero spills.
P_1 = Probability of exactly one spill.
P_{2+} = Probability of two or more spills.
All values are rounded to the nearest hundreth.

TABLE 3-4

ENDANGERED AND THREATENED SPECIES
TARGET LOCATIONS FOR RISK ANALYSIS
PLATFORM GAIL

Location	Species[1]
Nearshore Mainland	
1. Santa Maria River mouth	LT
2. Point Sal to Santa Maria River	SO
3. San Antonio Creek mouth	LT
4. Purisima Point	LT
5. Santa Ynez River mouth	LT
6. Point Conception to Point Arguello	SO
6. Point Conception	PF
7. Jalama Beach	LT
8. Government Point/Cojo Bay	LT
9. Goleta Slough	CR, BB?
10. Carpinteria Marsh	CR, BB
11. Ventura River mouth	BB?
12. Santa Clara River mouth	LT, BB
13. Ventura to Point Mugu	BP
14. McGrath State Beach	BB?
15. Ormond Beach	LT, BB
16. Mugu Lagoon/Point Mugu	CR
17. Ventura County Game Preserve	BB
18. Venice Beach	LT
19. Playa del Ray	LT
Islands	
20. Point Bennet, San Miguel Island	NFS, GFS
21. Prince Island, off San Miguel Island	BP
22. San Miguel Island	GW, NGS
23. Santa Rosa Island	GW
24. Scoprion Rock, off Santa Cruz Island	BP
25. Santa Cruz Island	G
26. West Anacapa Island, north shore	BP
27. Anacapa Islands	GW
28. San Nicholas Island	GFS
29. Sutil Island, off Santa Barbara Island	BP
30. Santa Barbara Island	GFS
31. San Clemente Island	GFS
32. Catalina Island	BE, GW, PG
Offshore Locations	
33. Santa Barbara Channel	GW

---

[1] Key to symbols: BB = salt marsh bird's beak; BE = bald eagle; CR = light-footed clapper rail; GFS = Guadalupe fur seal; GW = gray whale, LT = California least tern; NFS = northern fur seal, PF = peregrine falcon; SO = southern sea otter.

TABLE 3-5

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
3-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
28, 2	0.67	11.9
29, 2	1.0	10.6
30, 2	1.0	31.7
31, 2	2.5	22.2
32, 2	0.67	22.2
35, 2	0.33	39.5
36, 2	0.33	27.2
27, 2	0.83	12.3
41, 4	0.67	29.5
42, 4	0.17	54.8
39, 5	7.0	16.7
40, 5	0.5	33.6
39, 6	4.0	20.7
38, 7	1.17	27.1
37, 8	0.5	44.7
36, 9	0.17	71.
35, 10	0.33	47.6
29, 11	0.17	43.6
30, 11	1.17	40.9
31, 12	0.17	55.7
33, 11	0.17	60.4

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-6

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
3-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 2	0.17	49.9
31, 2	0.17	22.0
36, 2	0.17	50.4
43, 3	1.0	44.5
41, 4	5.83	27.6
39, 5	17.5	15.9
40, 5	1.0	36.0
39, 6	11.5	24.4
38, 7	19.6	41.9
37, 8	20.8	27.1
36, 9	0.83	42.8
29, 11	0.5	42.8
33, 11	0.33	53.6
14, 20**	0.33	70.2

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-7

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
3-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.67	30.5
39, 5	10.8	17.7
40, 5	0.33	38.0
39, 6	14.8	29.4
38, 7	13.2	40.9
37, 8	25.2	56.1
36, 9	0.17	61.0
29, 11	0.17	39.5
30, 11	0.33	45.3

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-8

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
3-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
31, 2	0.5	23.3
32, 2	0.17	36.9
43, 3	0.17	45.3
41, 4	0.67	28.7
39, 5	4.2	19.2
39, 6	6.0	30.5
38, 7	4.0	42.1
37, 8	2.33	47.5
36, 9	0.5	53.2
29 11	0.5	40.0
30 11	0.33	40.4

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-9

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
28, 2	0.05	11.9
29, 2	0.07	10.6
30, 2	0.07	31.7
31, 2	0.18	22.2
32, 2	0.05	22.2
35, 2	0.02	39.5
36, 2	0.02	27.2
27, 2	0.06	12.3
41, 4	0.05	29.5
42, 4	0.01	54.8
39, 5	0.49	16.7
40, 5	0.04	33.6
39, 6	0.28	20.7
38, 7	0.08	27.1
37, 8	0.04	44.7
36, 9	0.01	71.
35, 10	0.02	47.6
29, 11	0.01	43.6
30, 11	0.08	40.9
31, 12	0.01	55.7
33, 11	0.01	60.4

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-10

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
28, 2	0.03	11.9
29, 2	0.04	10.6
30, 2	0.04	31.7
31, 2	0.10	22.2
32, 2	0.03	22.2
35, 2	0.01	39.5
36, 2	0.01	27.2
27, 2	0.03	12.3
41, 4	0.03	29.5
42, 4	0.01	54.8
39, 5	0.28	16.7
40, 5	0.02	33.6
39, 6	0.16	20.7
38, 7	0.05	27.1
37, 8	0.02	44.7
36, 9	0.01	71.
35, 10	0.01	47.6
29, 11	0.01	43.6
30, 11	0.05	40.9
31, 12	0.01	55.7
33, 11	0.01	60.4

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-11

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
28, 2	0.02	11.9
29, 2	0.03	10.6
30, 2	0.03	31.7
31, 2	0.08	22.2
32, 2	0.02	22.2
35, 2	0.01	39.5
36, 2	0.01	27.2
27, 2	0.02	12.3
41, 4	0.02	29.5
42, 4	0.01	54.8
39, 5	0.21	16.7
40, 5	0.02	33.6
39, 6	0.12	20.7
38, 7	0.04	27.1
37, 8	0.02	44.7
36, 9	0.01	71.
35, 10	0.01	47.6
29, 11	0.01	43.6
30, 11	0.04	40.9
31, 12	0.01	55.7
33, 11	0.01	60.[illegible]

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-12

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 2	0.01	49.9
31, 2	0.01	22.0
36, 2	0.01	50.4
43, 3	0.07	44.5
41, 4	0.41	27.6
39, 5	1.23	15.9
40, 5	0.07	36.0
39, 6	0.81	24.4
38, 7	1.37	41.9
37, 8	1.46	27.1
36, 9	0.06	42.8
29, 11	0.04	42.8
33, 11	0.02	53.6
14, 20**	0.02	70.2

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-13

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 2	0.01	49.9
31, 2	0.01	22.0
36, 2	0.01	50.4
43, 3	0.04	44.5
41, 4	0.23	27.6
39, 5	0.7	15.9
40, 5	0.04	36.0
39, 6	0.46	24.4
38, 7	0.78	41.9
37, 8	0.83	27.1
36, 9	0.03	42.8
29, 11	0.02	42.8
33, 11	0.01	53.6
14, 20**	0.01	70.2

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-14

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 2	0.01	49.9
31, 2	0.01	22.0
36, 2	0.01	50.4
43, 3	0.03	44.5
41, 4	0.17	27.6
39, 5	0.53	15.9
40, 5	0.03	36.0
39, 6	0.35	24.4
38, 7	0.59	41.9
37, 8	0.62	27.1
36, 9	0.02	42.8
29, 11	0.02	42.8
33, 11	0.01	53.6
14, 20**	0.01	70.2

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-15

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.05	30.5
39, 5	0.76	17.7
40, 5	0.02	38.0
39, 6	1.04	29.4
38, 7	0.92	40.9
37, 8	1.76	56.1
36, 9	0.01	61.0
29, 11	0.01	39.5
30, 11	0.02	45.3

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-16

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.03	30.5
39, 5	0.43	17.7
40, 5	0.01	38.0
39, 6	0.59	29.4
38, 7	0.53	40.9
37, 8	1.01	56.1
36, 9	0.01	61.0
29, 11	0.01	39.5
30, 11	0.01	45.3

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-17

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.02	30.5
39, 5	0.32	17.7
40, 5	0.01	38.0
39, 6	0.44	29.4
38, 7	0.40	40.9
37, 8	0.76	56.1
36, 9	0.01	61.0
29, 11	0.01	39.5
30, 11	0.01	45.3

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-18

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
31, 2	0.04	23.3
32, 2	0.01	36.9
43, 3	0.01	45.3
41, 4	0.05	28.7
39, 5	0.29	19.2
39, 6	0.42	30.5
38, 7	0.28	42.1
37, 8	0.16	47.5
36, 9	0.04	53.2
29 11	0.04	40.0
30 11	0.02	40.4

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-19

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
31, 2	0.02	23.3
32, 2	0.01	36.9
43, 3	0.01	45.3
41, 4	0.03	28.7
39, 5	0.17	19.2
39, 6	0.24	30.5
38, 7	0.16	42.1
37, 8	0.09	47.5
36, 9	0.02	53.2
29 11	0.02	40.0
30 11	0.01	40.4

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-20

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >10,000 BARRELS
3-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
31, 2	0.02	23.3
32, 2	0.01	36.9
43, 3	0.01	45.3
41, 4	0.02	28.7
39, 5	0.13	19.2
39, 6	0.18	30.5
38, 7	0.12	42.1
37, 8	0.07	47.5
36, 9	0.02	53.2
29 11	0.02	40.0
30 11	0.01	40.4

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-21

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
3-DAY TRAJECTORY SIMULATION
WINTER SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0.17
Ventura River mouth	0.50
Santa Clara River mouth	0.50
Ventura to Point Mugu	13.84
McGrath State Beach	4.00
Ormond Beach	7.00
Mugu Lagoon/Point Mugu	0.67
Ventura County Game Preserve	0.67
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0.67
Santa Cruz Island	0.67
West Anacapa Island, north shore	0.33
Anacapa Islands	0.66
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-22

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
3-DAY TRAJECTORY SIMULATION
SPRING SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0.33
Ventura River mouth	20.80
Santa Clara River mouth	20.80
Ventura to Point Mugu	76.23
McGrath State Beach	11.50
Ormond Beach	17.50
Mugu Lagoon/Point Mugu	5.83
Ventura County Game Preserve	5.83
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0.34
West Anacapa Island, north shore	0
Anacapa Islands	0.17
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-23

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
3-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0
Ventura River mouth	25.20
Santa Clara River mouth	25.20
Ventura to Point Mugu	65.00
McGrath State Beach	14.80
Ormond Beach	10.80
Mugu Lagoon/Point Mugu	0.67
Ventura County Game Preserve	0.67
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-24

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
3-DAY TRAJECTORY SIMULATION
FALL SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0
Ventura River mouth	0
Santa Clara River mouth	0
Ventura to Point Mugu	17.20
McGrath State Beach	6.00
Ormond Beach	4.20
Mugu Lagoon/Point Mugu	0.67
Ventura County Game Preserve	0.67
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0.17
Santa Cruz Island	0.67
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-25

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
FALL SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0
Ventura River mouth	0.01
Santa Clara River mouth	0.04
Ventura to Point Mugu	0.04
McGrath State Beach	0.97
Ormond Beach	0.28
Mugu Lagoon/Point Mugu	0.49
Ventura County Game Preserve	0.05
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0.05
Santa Cruz Island	0.47
West Anacapa Island, north shore	0.02
Anacapa Islands	0.05
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-26

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
SPRING SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0.02
Ventura River mouth	1.46
Santa Clara River mouth	1.46
Ventura to Point Mugu	5.34
McGrath State Beach	0.81
Ormond Beach	1.23
Mugu Lagoon/Point Mugu	0.41
Ventura County Game Preserve	0.01
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0.02
West Anacapa Island, north shore	0
Anacapa Islands	0.01
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-27

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0
Ventura River mouth	1.76
Santa Clara River mouth	1.76
Ventura to Point Mugu	4.55
McGrath State Beach	1.04
Ormond Beach	0.76
Mugu Lagoon/Point Mugu	0.05
Ventura County Game Preserve	0.01
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-28

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
3-DAY TRAJECTORY SIMULATION
FALL SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0
Ventura River mouth	0.16
Santa Clara River mouth	0.16
Ventura to Point Mugu	1.20
McGrath State Beach	0.42
Ormond Beach	0.29
Mugu Lagoon/Point Mugu	0.05
Ventura County Game Preserve	0.05
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0.01
Santa Cruz Island	0.05
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-29

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
10-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.17	49.6
28, 2	0.67	12.1
29, 2	0.67	10.7
30, 2	1.17	26.5
31, 2	3.17	22.6
32, 2	1.33	20.0
35, 2	0.67	18.3
36, 2	0.5	27.2
17, 3	0.17	196.0
18, 3	0.17	65.7
26, 3	0.5	149.0
27, 3	2.33	12.3
15, 4	0.17	167.0
41, 4	1.50	28.4
42, 4	0.17	53.5
39, 5	7.0	14.9
40, 5	0.5	32.4
39, 6	8.3	24.3
38, 7	20.67	26.0
37, 8	11.33	28.0
36, 9	4.83	47.5
35, 10	2.0	47.1
29, 11	2.17	40.6
30, 11	5.33	41.0
33, 11	0.83	58.0
34, 11	0.8	124.0
25, 12	0.33	121.0
26, 12	1.0	134.0
27, 12	0.33	147.0
31, 12	0.50	55.7
21, 13	0.17	117.0
12, 20**	0.17	166.7

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-30

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
10-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.17	31.4
43, 3	0.33	44.6
41, 4	4.50	27.7
42, 4	0.33	70.7
39, 5	17.67	16.0
40, 5	0.67	36.0
39, 6	14.0	25.1
38, 7	17.37	43.8
37, 8	33.67	26.1
36, 9	1.67	52.4
35, 10	2.17	57.3
29, 11	0.67	39.8
30, 11	0.33	44.8
33, 11	1.17	60.4
34, 11	1.0	115.2
32, 12	0.33	86.5
23, 13	0.17	150.0
23, 15**	0.17	141.0
14, 20**	0.17	64.2

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-31

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
10-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.82	27.8
39, 5	9.67	120.9
40, 5	0.17	42.3
39, 6	16.17	29.2
38, 7	9.00	41.2
37, 8	51.17	55.6
36, 9	3.33	70.1
35 10	4.5	86.9
29, 11	0.17	54.6
33 11	3.00	83.9
34, 11	1.83	106.2
14, 20**	0.17	78.3

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-32

CONDITIONAL PROBABILITY OF SHORELINE CONTACT*
10-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**		Prob. (%)	Min. Time to Shoreline (hrs)
28	2	0.17	84.4
31	2	1.83	21.7
32	2	0.67	19.3
35	2	0.67	71.1
43	3	0.67	45.6
41	4	0.83	29.9
39	5	3.33	19.0
39	6	7.0	29.4
38	7	11.17	41.7
37	8	28.0	58.4
36	9	6.67	59.6
35	10	4.83	85.5
29	11	3.50	40.0
30	11	2.17	41.5
33	11	10.67	68.3
34	11	3.33	86.1
25	12	0.33	175.8
26	12	1.0	158.4
27	12	0.67	148.9
31	12	0.83	117.4
32	12	1.67	125.1
21	13	0.17	200.8
22	13	0.33	194.0
23	13	0.17	233.0

---

* Conditional probabilities reflect the probability of a shoreline contact within the specified grid cell assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-33

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.01	49.6
28, 2	0.05	12.1
29, 2	0.05	10.7
30, 2	0.08	26.5
31, 2	0.22	22.6
32, 2	0.09	20.0
35, 2	0.05	18.3
36, 2	0.04	27.2
17, 3	0.01	196.0
18, 3	0.01	65.7
26, 3	0.04	149.0
27, 3	0.16	12.3
15, 4	0.01	167.0
41, 4	0.11	28.4
42, 4	0.01	53.5
39, 5	0.49	14.9
40, 5	0.04	32.4
39, 6	0.58	24.3
38, 7	1.45	26.0
37, 8	0.79	28.0
36, 9	0.34	47.5
35, 10	0.14	47.1
29, 11	0.15	40.6
30, 11	0.37	41.0
33, 11	0.06	58.0
34, 11	0.04	124.0
25, 12	0.03	121.0
26, 12	0.07	134.0
27, 12	0.03	147.0
31, 12	0.04	55.7
21, 13	0.01	117.0
12, 20**	0.01	166.7

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-34

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
10-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.01	49.6
28, 2	0.03	12.1
29, 2	0.03	10.7
30, 2	0.05	26.5
31, 2	0.13	22.6
32, 2	0.05	20.0
35, 2	0.03	18.3
36, 2	0.02	27.2
17, 3	0.01	196.0
18, 3	0.01	65.7
26, 3	0.02	149.0
27, 3	0.09	12.3
15, 4	0.01	167.0
41, 4	0.06	28.4
42, 4	0.01	53.5
39, 5	0.28	14.9
40, 5	0.02	32.4
39, 6	0.33	24.3
38, 7	0.83	26.0
37, 8	0.45	28.0
36, 9	0.19	47.5
35, 10	0.08	47.1
29, 11	0.09	40.6
30, 11	0.21	41.0
33, 11	0.03	58.0
34, 11	0.02	124.0
25, 12	0.01	121.0
26, 12	0.04	134.0
27, 12	0.01	147.0
31, 12	0.02	55.7
21, 13	0.01	117.0
12, 20**	0.01	166.7

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-35

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >10,000 BARRELS
10-DAY TRAJECTORY SIMULATION
WINTER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.01	49.6
28, 2	0.02	12.1
29, 2	0.02	10.7
30, 2	0.03	26.5
31, 2	0.10	22.6
32, 2	0.04	20.0
35, 2	0.02	18.3
36, 2	0.02	27.2
17, 3	0.01	196.0
18, 3	0.01	65.7
26, 3	0.02	149.0
27, 3	0.07	12.3
15, 4	0.01	167.0
41, 4	0.05	28.4
42, 4	0.01	53.5
39, 5	0.21	14.9
40, 5	0.02	32.4
39, 6	0.25	24.3
38, 7	0.62	26.0
37, 8	0.34	28.0
36, 9	0.14	47.5
35, 10	0.06	47.1
29, 11	0.07	40.6
30, 11	0.16	41.0
33, 11	0.02	58.0
34, 11	0.02	124.0
25, 12	0.01	121.0
26, 12	0.03	134.0
27, 12	0.01	147.0
31, 12	0.02	55.7
21, 13	0.01	117.0
12, 20**	0.01	166.7

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-36

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.01	31.4
43, 3	0.02	44.6
41, 4	0.32	27.7
42, 4	0.02	70.7
39, 5	1.24	16.0
40, 5	0.05	36.0
39, 6	0.98	25.1
38, 7	1.22	43.8
37, 8	2.36	26.1
36, 9	0.12	52.4
35, 10	0.15	57.3
29, 11	0.05	39.8
30, 11	0.02	44.8
33, 11	0.08	60.4
34, 11	0.07	115.2
32, 12	0.02	86.5
23, 13	0.01	150.0
23, 15**	0.01	141.0
14, 20**	0.01	64.2

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-37

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
10-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.01	31.4
43, 3	0.01	44.6
41, 4	0.18	27.7
42, 4	0.01	70.7
39, 5	0.71	16.0
40, 5	0.03	36.0
39, 6	0.56	25.1
38, 7	0.69	43.8
37, 8	1.35	26.1
36, 9	0.07	52.4
35, 10	0.09	57.3
29, 11	0.03	39.8
30, 11	0.01	44.8
33, 11	0.05	60.4
34, 11	0.04	115.2
32, 12	0.01	86.5
23, 13	0.01	150.0
23, 15**	0.01	141.0
14, 20**	0.01	64.2

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-38

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
SPRING SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
29, 1	0.01	31.4
43, 3	0.01	44.6
41, 4	0.14	27.7
42, 4	0.01	70.7
39, 5	0.53	16.0
40, 5	0.02	36.0
39, 6	0.42	25.1
38, 7	0.52	43.8
37, 8	1.01	26.1
36, 9	0.05	52.4
35, 10	0.07	57.3
29, 11	0.02	39.8
30, 11	0.01	44.8
33, 11	0.05	60.4
34, 11	0.03	115.2
32, 12	0.01	86.5
23, 13	0.01	150.0
23, 15**	0.01	141.0
14, 20**	0.01	64.2

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-39

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.06	27.8
39, 5	0.68	120.9
40, 5	0.01	42.3
39, 6	1.13	29.2
38, 7	0.63	41.2
37, 8	3.58	55.6
36, 9	0.23	70.1
35 10	0.32	86.9
29, 11	0.01	54.6
33 11	0.21	83.9
34, 11	0.13	106.2
14, 20**	0.01	78.3

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-40

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
10-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.03	27.8
39, 5	0.39	120.9
40, 5	0.01	42.3
39, 6	0.65	29.2
38, 7	0.36	41.2
37, 8	2.05	55.6
36, 9	0.13	70.1
35 10	0.18	86.9
29, 11	0.01	54.6
33 11	0.12	83.9
34, 11	0.07	106.2
14, 20**	0.01	78.3

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-41

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >10,000 BARRELS
10-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Cell Number**	Prob. (%)	Min. Time to Shoreline (hrs)
41, 4	0.02	27.8
39, 5	0.29	120.9
40, 5	0.01	42.3
39, 6	0.49	29.2
38, 7	0.27	41.2
37, 8	1.54	55.6
36, 9	0.10	70.1
35 10	0.14	86.9
29, 11	0.01	54.6
33 11	0.09	83.9
34, 11	0.05	106.2
14, 20**	0.01	78.3

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-42

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**		Prob. (%)	Min. Time to Shoreline (hrs)
28	2	0.01	84.4
31	2	0.13	21.7
32	2	0.05	19.3
35	2	0.05	71.1
43	3	0.05	45.6
41	4	0.06	29.9
39	5	0.23	19.0
39	6	0.49	29.4
38	7	0.78	41.7
37	8	1.96	58.4
36	9	0.47	59.6
35	10	0.34	85.5
29	11	0.25	40.0
30	11	0.15	41.5
33	11	0.75	68.3
34	11	0.23	86.1
25	12	0.02	175.8
26	12	0.07	158.4
27	12	0.05	148.9
31	12	0.06	117.4
32	12	0.12	125.1
21	13	0.01	200.8
22	13	0.02	194.0
23	13	0.01	233.0

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-43

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS 1000 TO 10,000 BARRELS
10-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**		Prob. (%)	Min. Time to Shoreline (hrs)
28	2	0.01	84.4
31	2	0.07	21.7
32	2	0.03	19.3
35	2	0.03	71.1
43	3	0.03	45.6
41	4	0.03	29.9
39	5	0.13	19.0
39	6	0.28	29.4
38	7	0.45	41.7
37	8	1.12	58.4
36	9	0.27	59.6
35	10	0.19	85.5
29	11	0.14	40.0
30	11	0.09	41.5
33	11	0.43	68.3
34	11	0.13	86.1
25	12	0.01	175.8
26	12	0.04	158.4
27	12	0.03	148.9
31	12	0.03	117.4
32	12	0.07	125.1
21	13	0.01	200.8
22	13	0.01	194.0
23	13	0.01	233.0

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-44

TOTAL PROBABILITY OF SHORELINE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
FALL SEASON

Cell Number**		Prob. (%)	Min. Time to Shoreline (hrs)
28	2	0.01	84.4
31	2	0.05	21.7
32	2	0.02	19.3
35	2	0.02	71.1
43	3	0.02	45.6
41	4	0.02	29.9
39	5	0.10	19.0
39	6	0.21	29.4
38	7	0.34	41.7
37	8	0.84	58.4
36	9	0.20	59.6
35	10	0.14	85.5
29	11	0.11	40.0
30	11	0.07	41.5
33	11	0.32	68.3
34	11	0.10	86.1
25	12	0.01	175.8
26	12	0.03	158.4
27	12	0.02	148.9
31	12	0.02	117.4
32	12	0.05	125.1
21	13	0.01	200.8
22	13	0.01	194.0
23	13	0.01	233.0

---

* Total probabilities reflect the combined that one or more spills of the specified size will occur, and will contact a specified grid cell within the simulation time period. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

** All grid cells are located in the Santa Barbara Channel/Santa Maria Basin modeling grid unless they are followed by a double asterisk (**).

TABLE 3-45

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
10-DAY TRAJECTORY SIMULATION
WINTER SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0.33
Carpinteria Marsh	0.83
Ventura River mouth	11.33
Santa Clara River mouth	11.33
Ventura to Point Mugu	49.30
McGrath State Beach	8.30
Ormond Beach	7.00
Mugu Lagoon/Point Mugu	1.50
Ventura County Game Preserve	1.50
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0.17
Santa Rosa Island	0.34
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	1.33
West Anacapa Island, north shore	10.01
Anacapa Islands	0.67
San Nicholas Island	1.17
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-46

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
10-DAY TRAJECTORY SIMULATION
SPRING SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	1.17
Ventura River mouth	33.67
Santa Clara River mouth	33.67
Ventura to Point Mugu	87.88
McGrath State Beach	14.00
Ormond Beach	17.67
Mugu Lagoon/Point Mugu	4.50
Ventura County Game Preserve	4.50
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0.17
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-47

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
10-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0
Ventura River mouth	51.17
Santa Clara River mouth	51.17
Ventura to Point Mugu	87.01
McGrath State Beach	16.17
Ormond Beach	9.67
Mugu Lagoon/Point Mugu	0.83
Ventura County Game Preserve	0.83
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-48

CONDITIONAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
10-DAY TRAJECTORY SIMULATION
FALL SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0.67
Carpinteria Marsh	10.67
Ventura River mouth	28.00
Santa Clara River mouth	28.00
Ventura to Point Mugu	50.33
McGrath State Beach	7.00
Ormond Beach	3.33
Mugu Lagoon/Point Mugu	0.83
Ventura County Game Preserve	0.83
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0.67
Santa Cruz Island	2.67
West Anacapa Island, north shore	0.67
Anacapa Islands	0.67
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	100

---

* Conditional probabilities reflect the probability of a shoreline contact within the designated resource area assuming that an uncontrolled spill of unspecified size will occur. This analysis also assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-49

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
WINTER SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0.02
Carpinteria Marsh	0.06
Ventura River mouth	0.79
Santa Clara River mouth	0.79
Ventura to Point Mugu	3.45
McGrath State Beach	0.58
Ormond Beach	0.49
Mugu Lagoon/Point Mugu	0.11
Ventura County Game Preserve	0.11
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	0
Prince Island, off San Miguel Island	0.01
San Miguel Island	0.02
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0.09
Santa Cruz Island	0.70
West Anacapa Island, north shore	0.05
Anacapa Islands	0.08
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-50

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
SPRING SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0.08
Ventura River mouth	2.36
Santa Clara River mouth	2.36
Ventura to Point Mugu	6.15
McGrath State Beach	0.98
Ormond Beach	1.24
Mugu Lagoon/Point Mugu	0.32
Ventura County Game Preserve	0.32
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	0
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0.01
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-51

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
SUMMER SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0
Carpinteria Marsh	0
Ventura River mouth	3.58
Santa Clara River mouth	3.58
Ventura to Point Mugu	6.09
McGrath State Beach	1.13
Ormond Beach	0.68
Mugu Lagoon/Point Mugu	0.06
Ventura County Game Preserve	0.06
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	0
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0
Santa Cruz Island	0
West Anacapa Island, north shore	0
Anacapa Islands	0
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-52

TOTAL PROBABILITY OF SENSITIVE RESOURCE CONTACT*
SPILLS >1000 BARRELS
10-DAY TRAJECTORY SIMULATION
FALL SEASON

Location	Probability (%)
Nearshore Mainland	
Santa Maria River mouth	0
San Antonio Creek mouth	0
Purisima Point	0
Santa Ynez River mouth	0
Point Conception to Point Arguello	0
Point Conception	0
Jalama Beach	0
Government Point/Cojo Bay	0
Goleta Slough	0.05
Carpinteria Marsh	0.75
Ventura River mouth	1.96
Santa Clara River mouth	1.96
Ventura to Point Mugu	3.52
McGrath State Beach	0.49
Ormond Beach	0.23
Mugu Lagoon/Point Mugu	0.06
Ventura County Game Preserve	0.06
Venice Beach	0
Playa del Rey	0
Islands	
Point Bennet, San Miguel Island	0
Prince Island, off San Miguel Island	0
San Miguel Island	0
Santa Rosa Island	0
Scorpion Rock, off Santa Cruz Island	0.05
Santa Cruz Island	0.19
West Anacapa Island, north shore	0.05
Anacapa Islands	0.05
San Nicholas Island	0
Sutil Island, off Santa Barbara Island	0
Santa Barbara Island	0
San Clemente Island	0
Catalina Island	0
Offshore Locations	
Santa Barbara Channel	7.00

---

* Total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified resource within the simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

33.37/1-T3-52

TABLE 3-53

PROBABILITY OF SHORELINE CONTACT
30-DAY TRAJECTORY SIMULATION*
MMS LAUNCH SITE E-24
ENTIRE YEAR

Land Segment	Conditional Probability (spillage assumed)	Total probability (%) (spills >1000 barrels)
9	n	n
10	n	n
11	n	n
12	n	n
13	n	n
14	n	n
15	1	0.1
16	26	1.8
17	50	3.5
18	1	0.1
19	[illegible]	n
21	n	n
23	9	0.6
28	n	n
31	n	n

---

* Reference: Minerals Management Service, 1983
n = negligible, less than 0.5% (conditional) and less than 0.05% (total).
Conditional probabilities assume that an uncontrolled spill will occur; total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified land segment within the specified simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-54

PROBABILITY OF SENSITIVE RESOURCE CONTACT
30-DAY TRAJECTORY SIMULATION*
MMS LAUNCH SITE E-24
ENTIRE YEAR

Location	Conditional Probability (spillage assumed)	Total probability (%) (spills >1000 barrels)
N. Channel Islands	34	2.4
S. Channel Island	1	0.1
Channel Islands	34	2.4
N. Sea Otter Range	n	n
S. Sea Otter Range	n	n
Sea Otter Range	n	n
Santa Monica Bay	n	n
San Nicholas Island	n	n
Begg Rock	n	n
N. Anacapa island	21	1.5
San Miguel Island	n	n
Least Tern Colony 1	8	0.6
Least Tern Colony 2	n	n
Least Tern Colony 3	n	n
Least Tern Colony 4	n	n
N. Offshore Feeding	1	0.1
S. Offshore Feeding	n	n
Anacapa Island	21	1.5
Santa Barbara Island	n	n
Coronados Islands	n	n
Guadalupe Island	n	n
Farallon Islands	n	n
Baja Islands	n	n
Coastal Feed Area 1	3	0.2
Coastal Feed Area 2	99	6.9
Coastal Feed Area 3	2	0.1
Coastal Feed Area 4	n	n
Coastal Feed Area 5	n	n
Coastal Feed Area 6	n	n
Coastal Feed Area 7	n	n

---

* Reference: Minerals Management Service, 1983.
n = negligible, less than 0.5% (conditional), and less than 0.05% (total)
Conditional probabilities assume that an uncontrolled spill will occur; total probabilities reflect the combined probability that one or more spills of the specified size will occur, and will contact the specified land segment within the specified simulation time period. This analysis assumes that spill volume will not be reduced by natural processes and that no spill response efforts (such as dispersion, containment and recovery, or diversion) will be conducted.

TABLE 3-55

CUMULATIVE PROBABILITY OF OIL SPILL OCCURRENCE
1986 THROUGH 1995
SANTA BARBARA CHANNEL AND SANTA MARIA BASIN
WITH AND WITHOUT PLATFORM GAIL
SPILLS >1000 BARRELS

1 or more

Scenario	Total Production (Billion barrels)	Platform Spills		Pipeline Spills		Total Spills	
		Probability (%)	Expected Value (λ)	Probability (%)	Expected Value (λ)	Probability (%)	Expected Value (λ)
Platform Gail Included	1.497	77.6	1.497	90.9	2.395	98.0	3.892
Without Platform Gail	1.459	76.8	1.459	90.3	2.334	97.7	3.793

λ - ~~No of~~ Statistically expected Value -

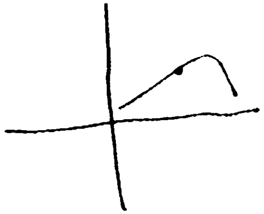


TABLE 3-56

CUMULATIVE PROBABILITY OF OIL SPILL OCCURRENCE
1986 THROUGH 1995
SANTA BARBARA CHANNEL AND SANTA MARIA BASIN
WITH AND WITHOUT PLATFORM GAIL
SPILLS >10,000 BARRELS

Scenario	Total Production (Billion barrels)	Platform Spills		Pipeline Spills		Total Spills	
		Probability (%)	Expected Value ( )	Probability (%)	Expected Value ( )	Probability (%)	Expected Value ( )
Platform Gail Included	1.497	48.3	0.659	63.3	1.003	81.0	1.662
Without Platform Gail	1.459	47.4	0.642	62.4	0.978	80.2	1.6200

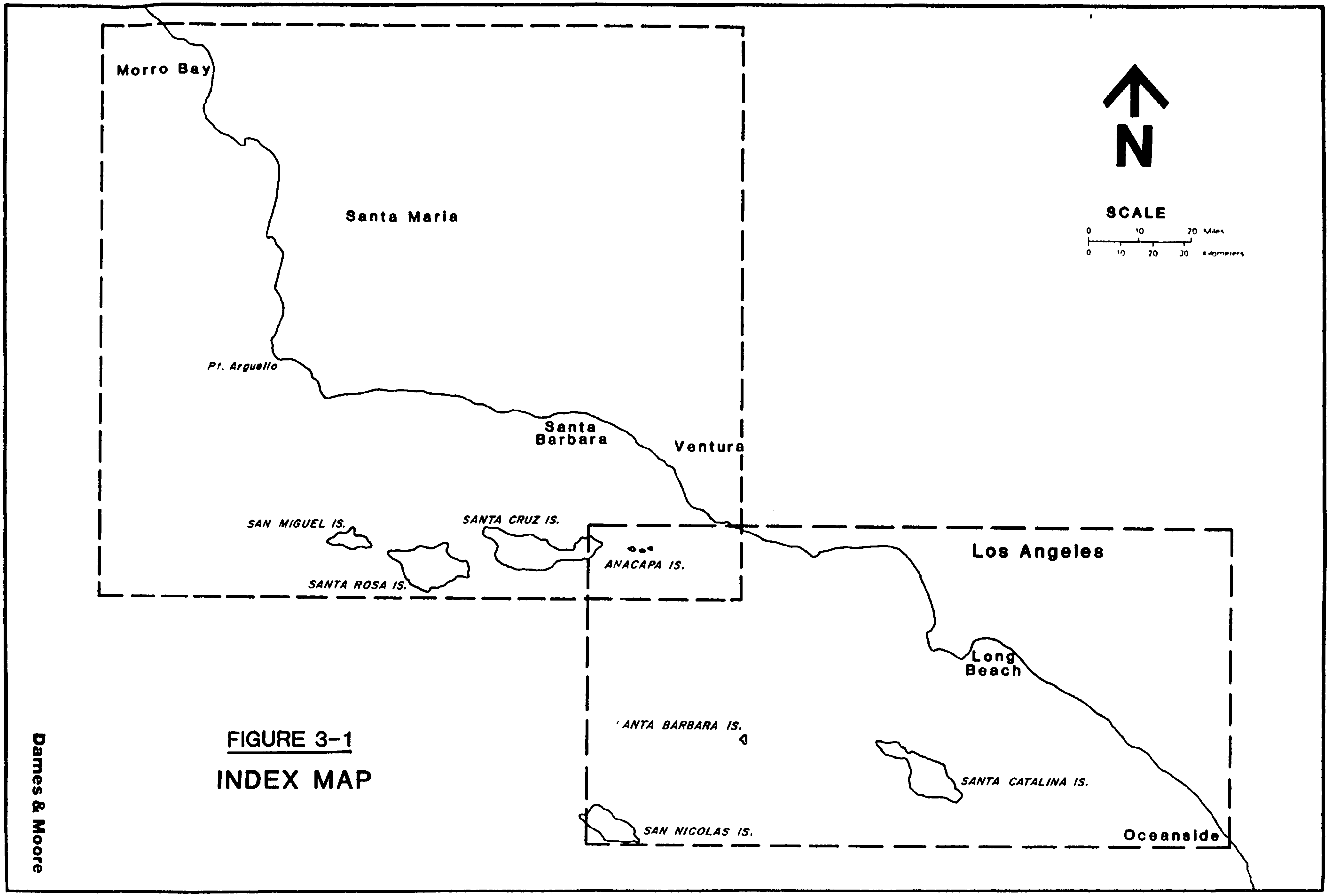


FIGURE 3-1

INDEX MAP

Dames & Moore

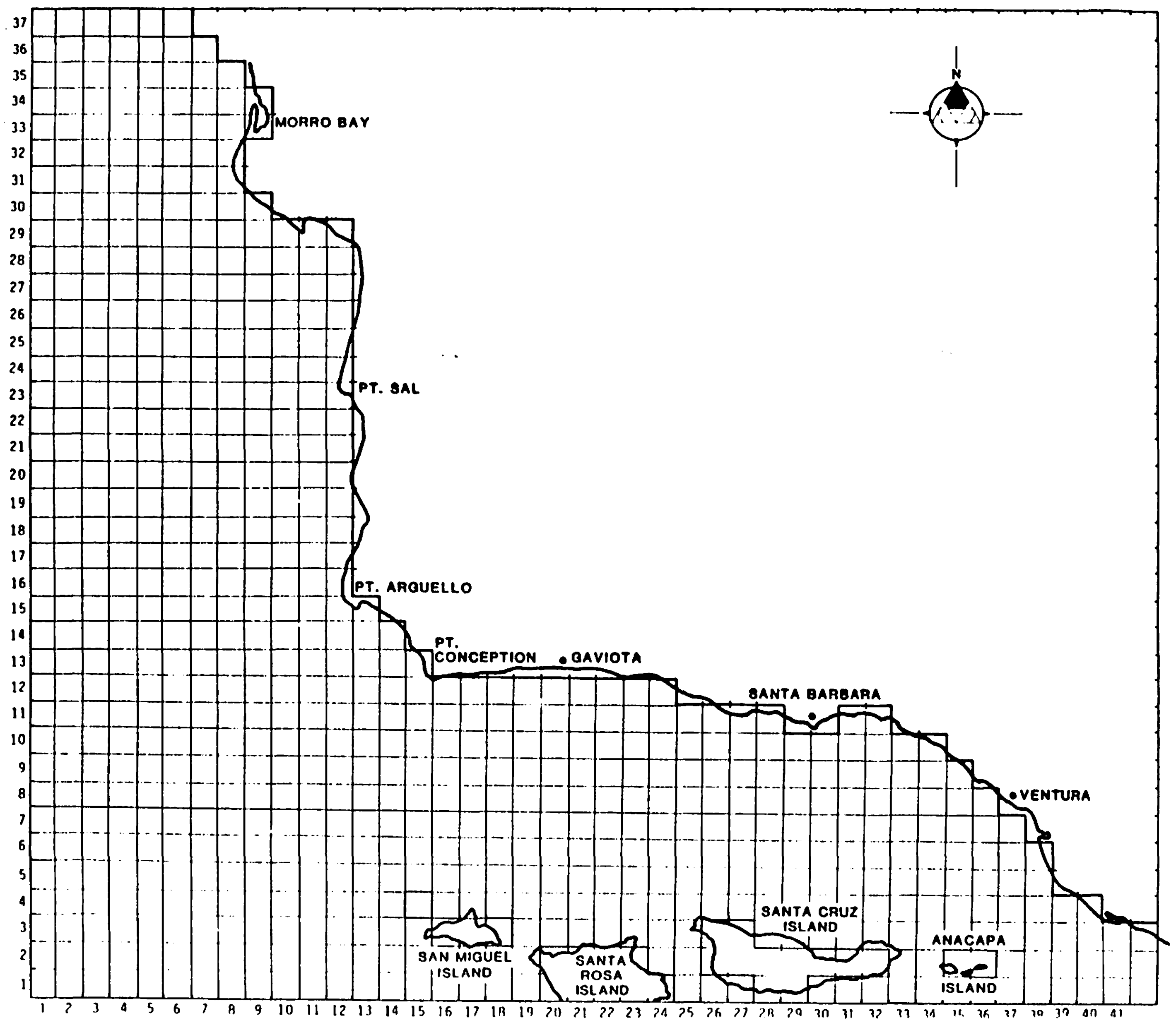
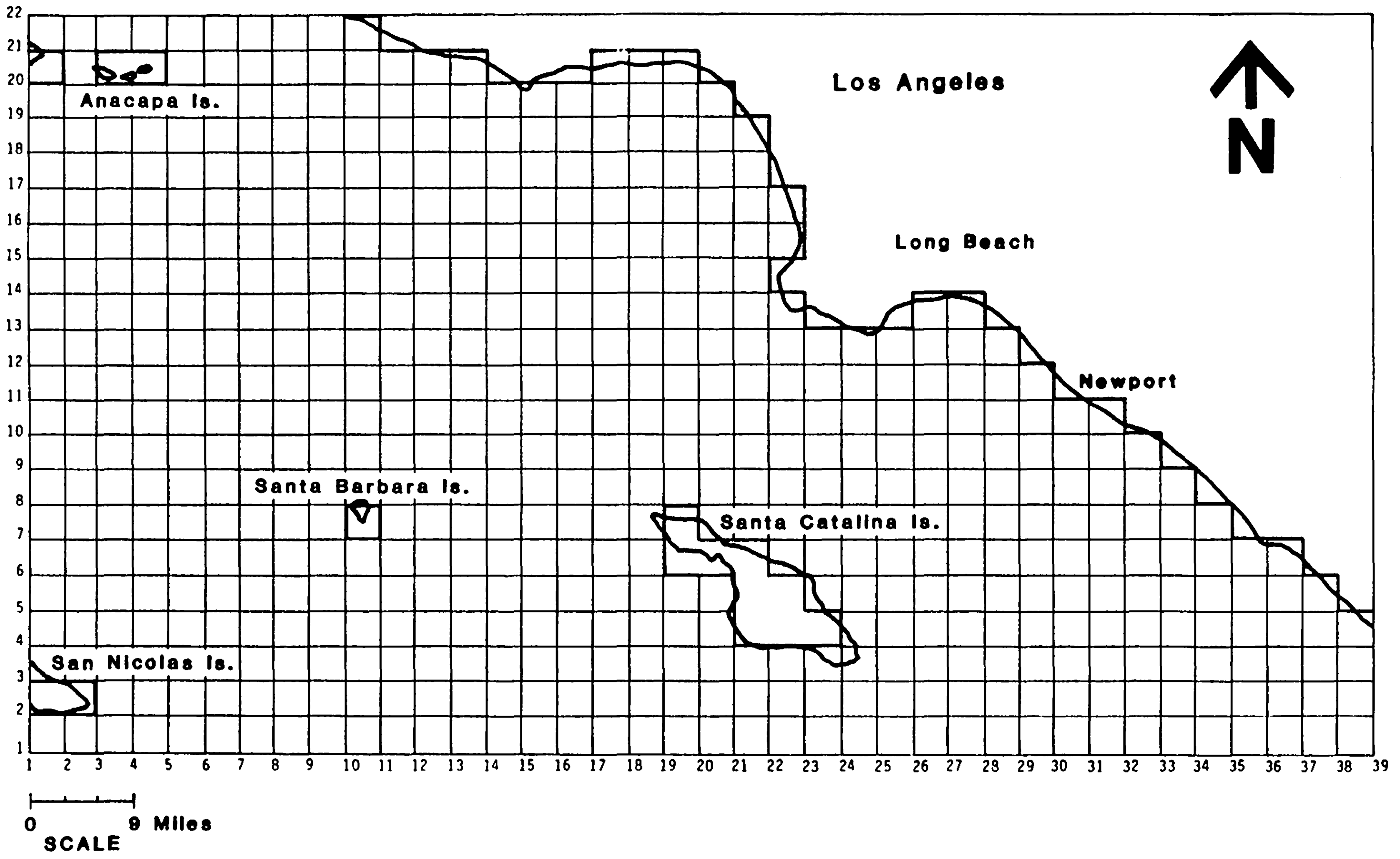


FIGURE 3-2

OIL SPILL TRAJECTORY MODEL DOMAIN SHOWING GRID CELL NUMBERS SANTA BARBARA CHANNEL REGION



OIL SPILL TRAJECTORY MODEL DOMAIN SHOWING GRID CELL NUMBERS –"SOUTHERN CALIFORNIA REGION"

FIGURE 3-3

Dames & Moore

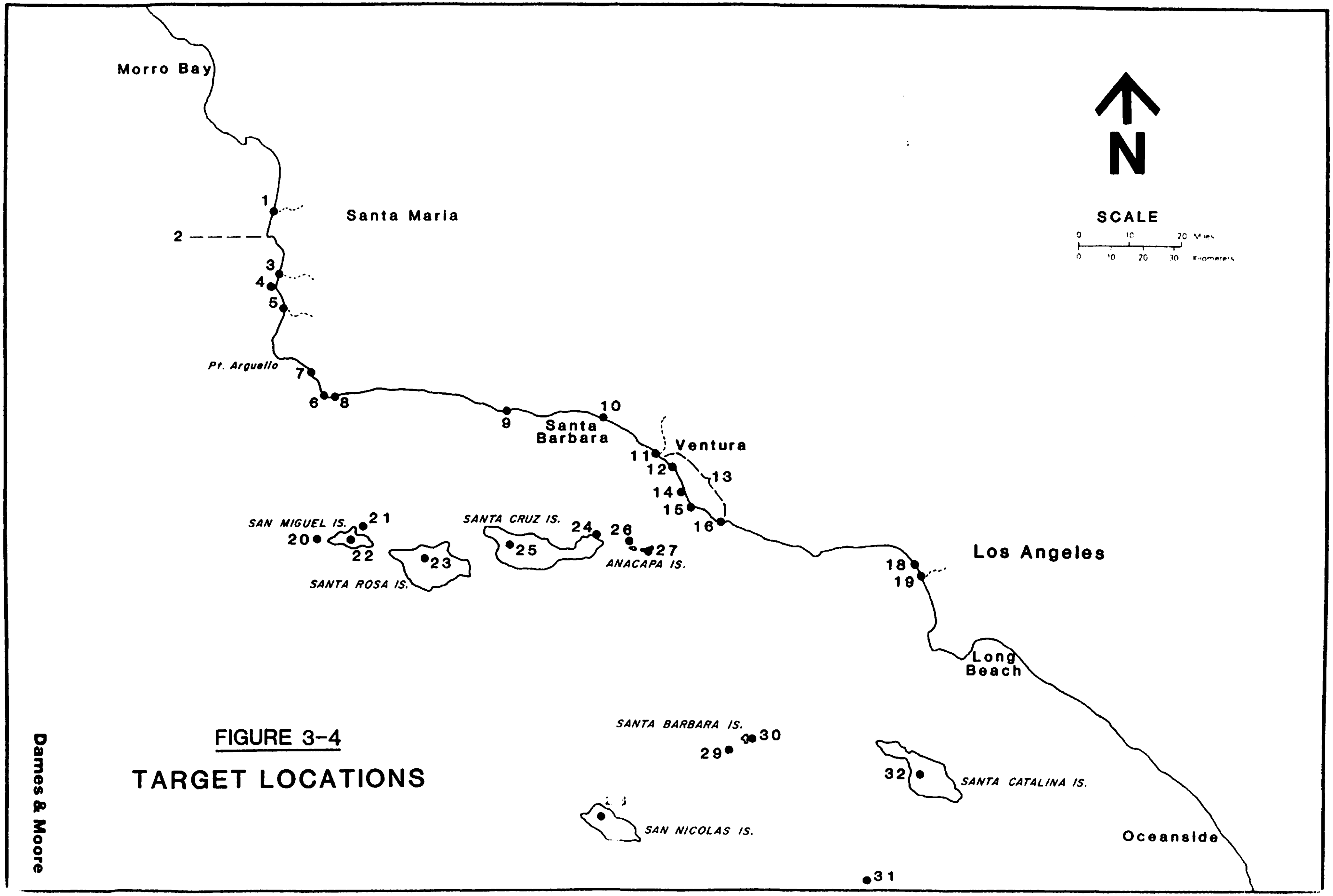


FIGURE 3-4

TARGET LOCATIONS

Dames & Moore

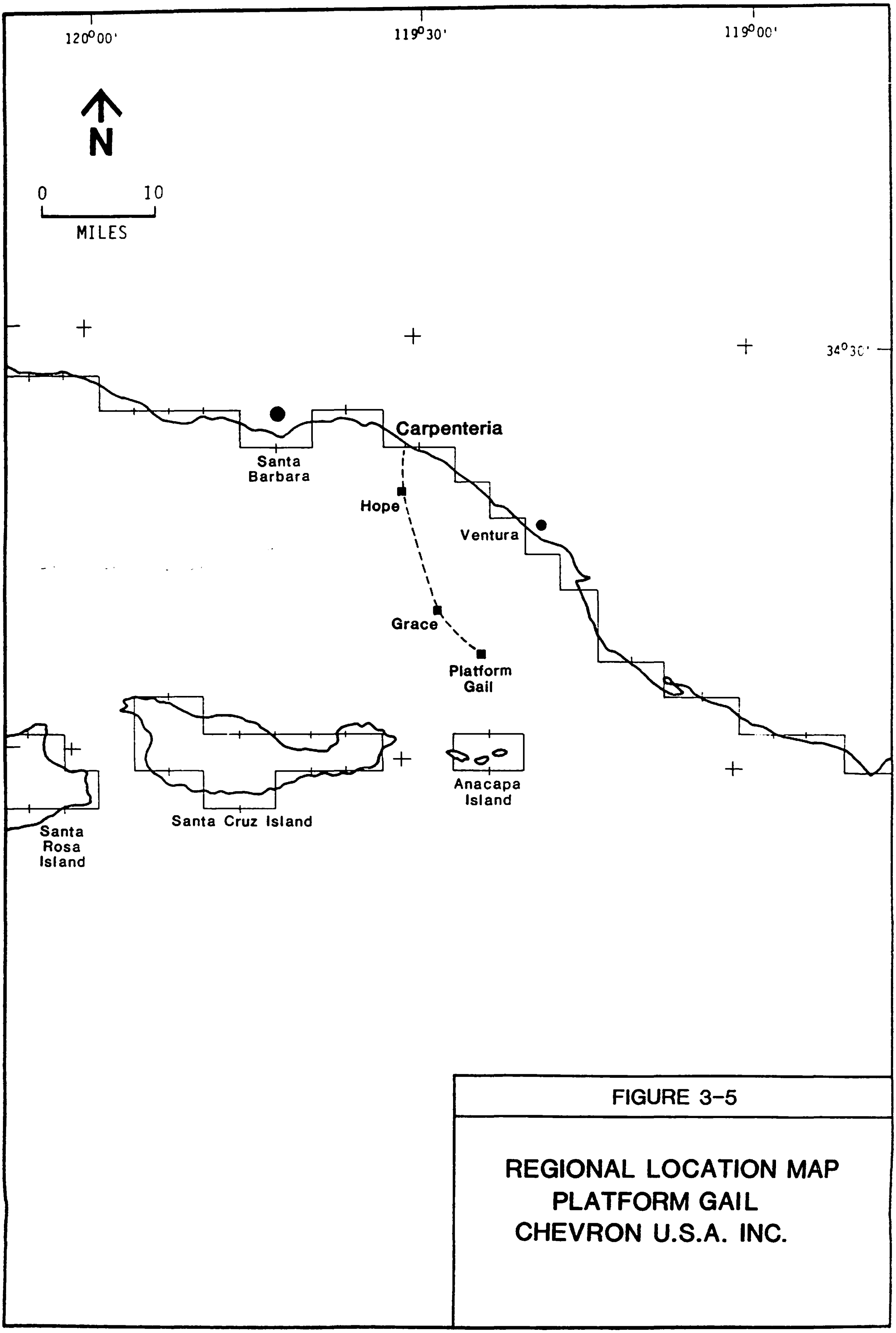


FIGURE 3-5

REGIONAL LOCATION MAP
PLATFORM GAIL
CHEVRON U.S.A. INC.

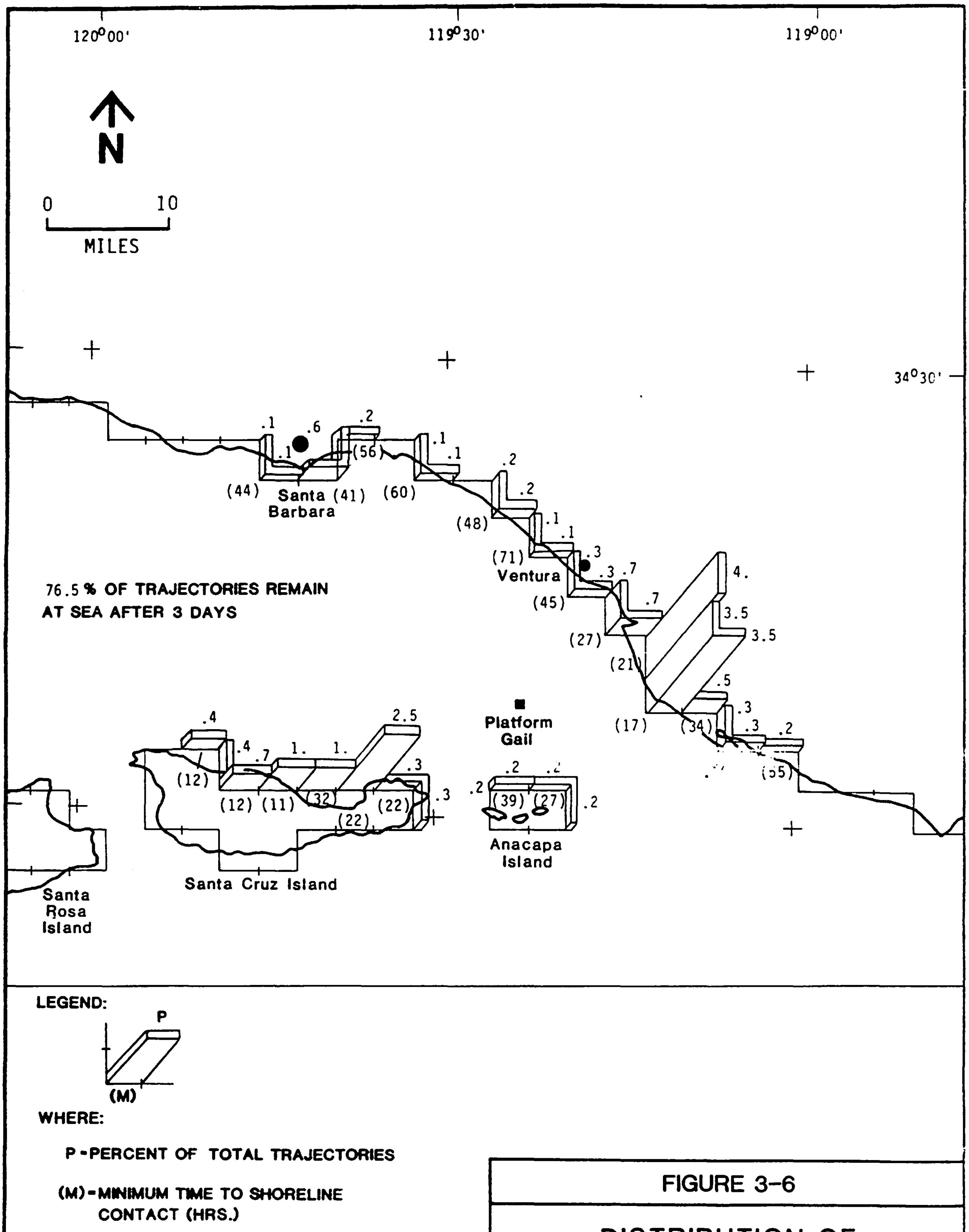
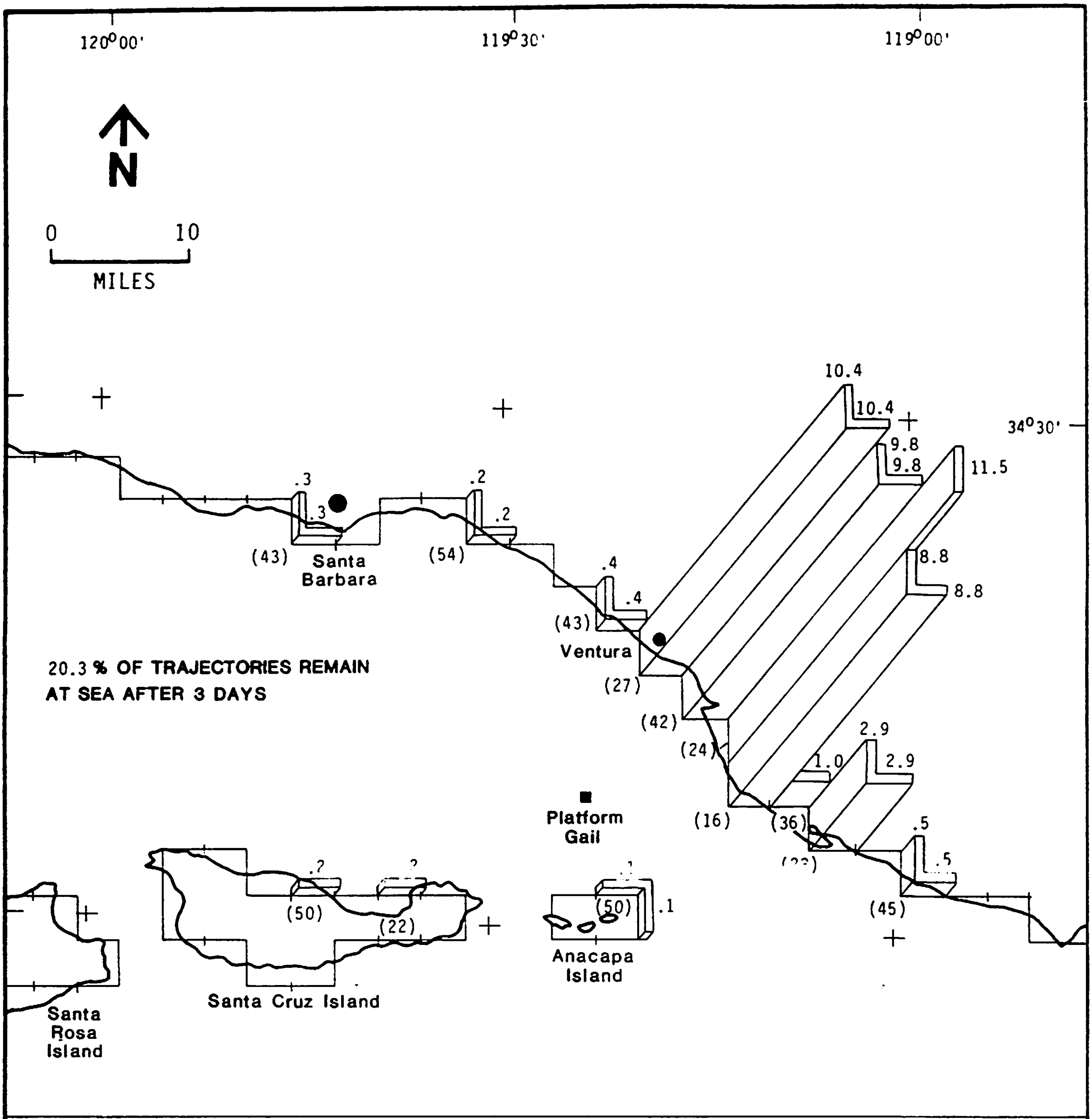
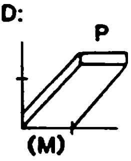


FIGURE 3-6

DISTRIBUTION OF
SHORELINE CONTACTS
PLATFORM GAIL
3 - DAY ANALYSIS
DECEMBER TO FEBRUARY



LEGEND:



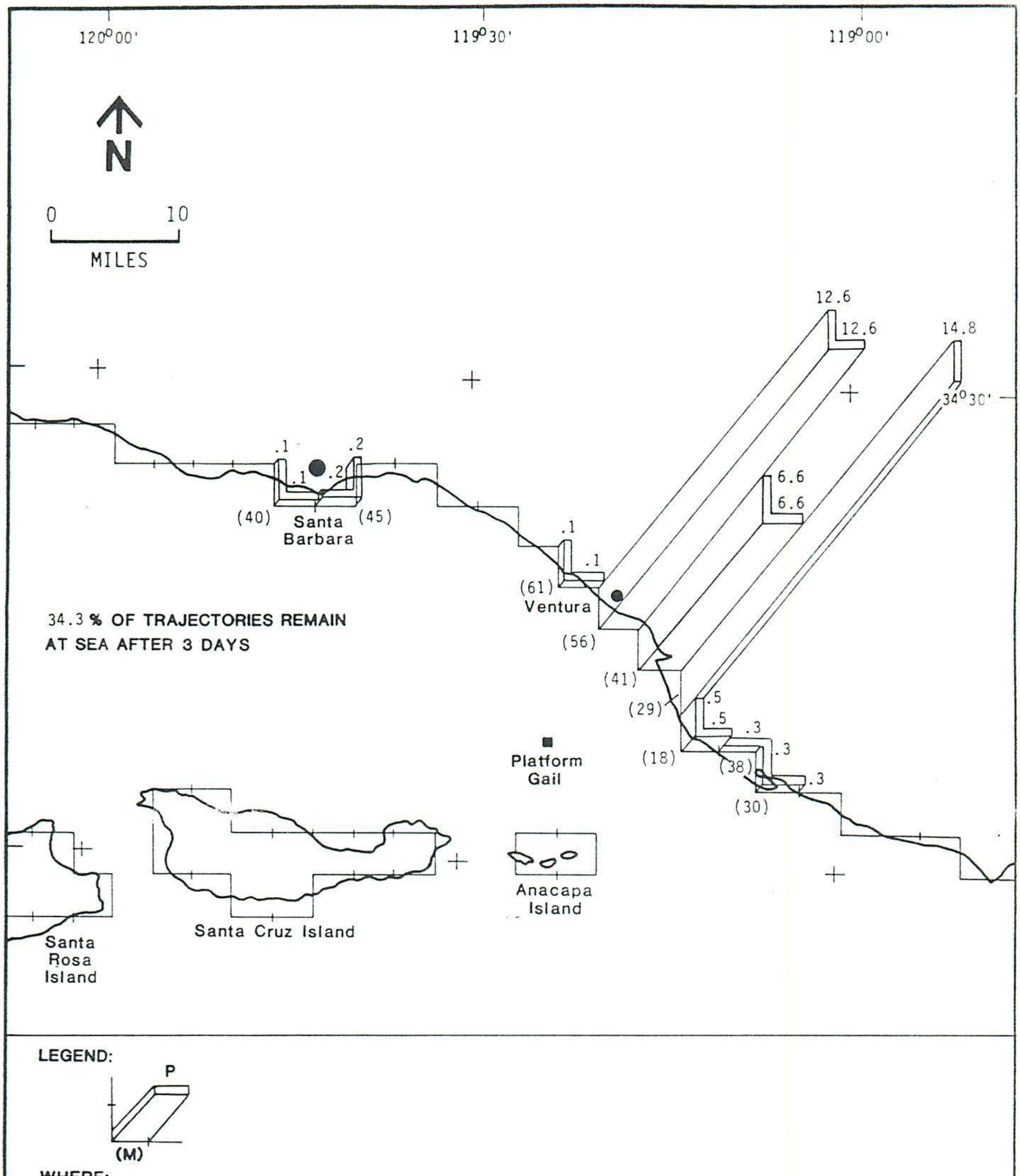
WHERE:

P - PERCENT OF TOTAL TRAJECTORIES

(M) - MINIMUM TIME TO SHORELINE CONTACT (HRS.)

FIGURE 3-7

DISTRIBUTION OF SHORELINE CONTACTS PLATFORM GAIL 3 - DAY ANALYSIS MARCH TO MAY



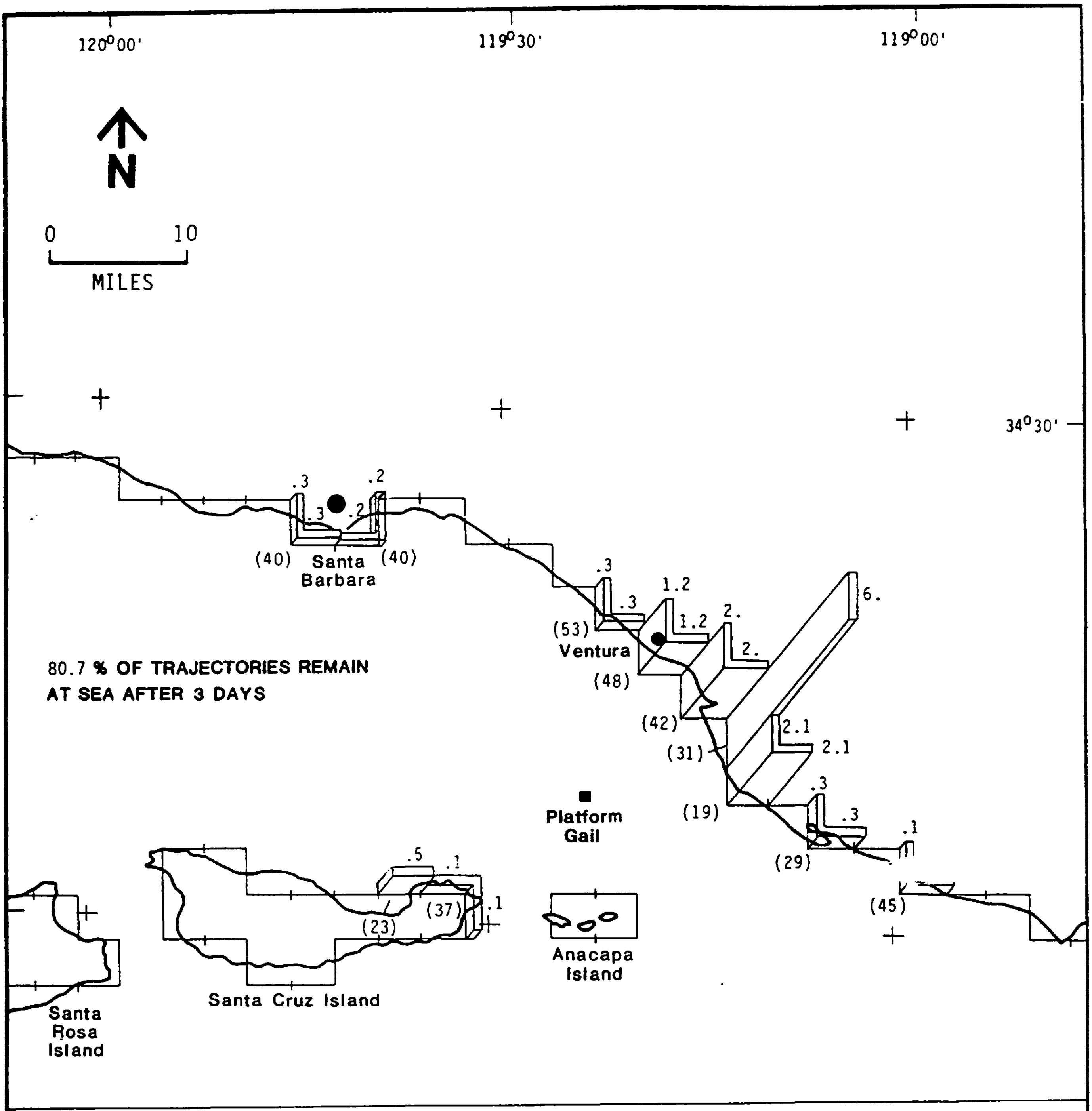
WHERE:

P - PERCENT OF TOTAL TRAJECTORIES

(M) - MINIMUM TIME TO SHORELINE CONTACT (HRS.)

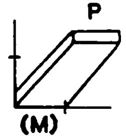
FIGURE 3-8

DISTRIBUTION OF SHORELINE CONTACTS PLATFORM GAIL 3 - DAY ANALYSIS JUNE TO AUGUST



80.7 % OF TRAJECTORIES REMAIN AT SEA AFTER 3 DAYS

LEGEND:



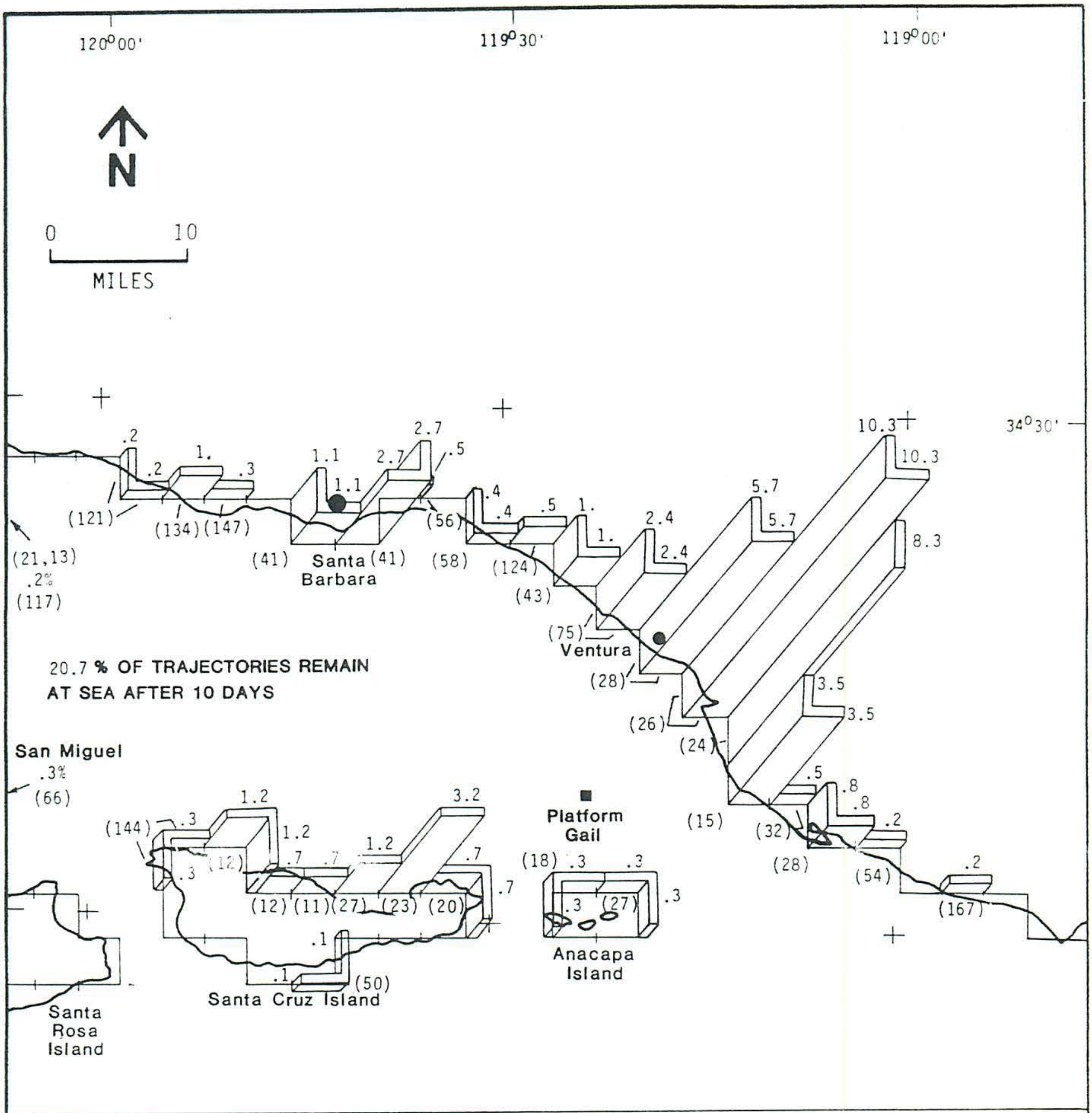
WHERE:

P-PERCENT OF TOTAL TRAJECTORIES

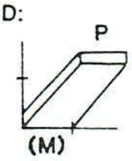
(M)-MINIMUM TIME TO SHORELINE CONTACT (HRS.)

FIGURE 3-9

DISTRIBUTION OF SHORELINE CONTACTS PLATFORM GAIL 3 - DAY ANALYSIS SEPTEMBER TO NOVEMBER



LEGEND:



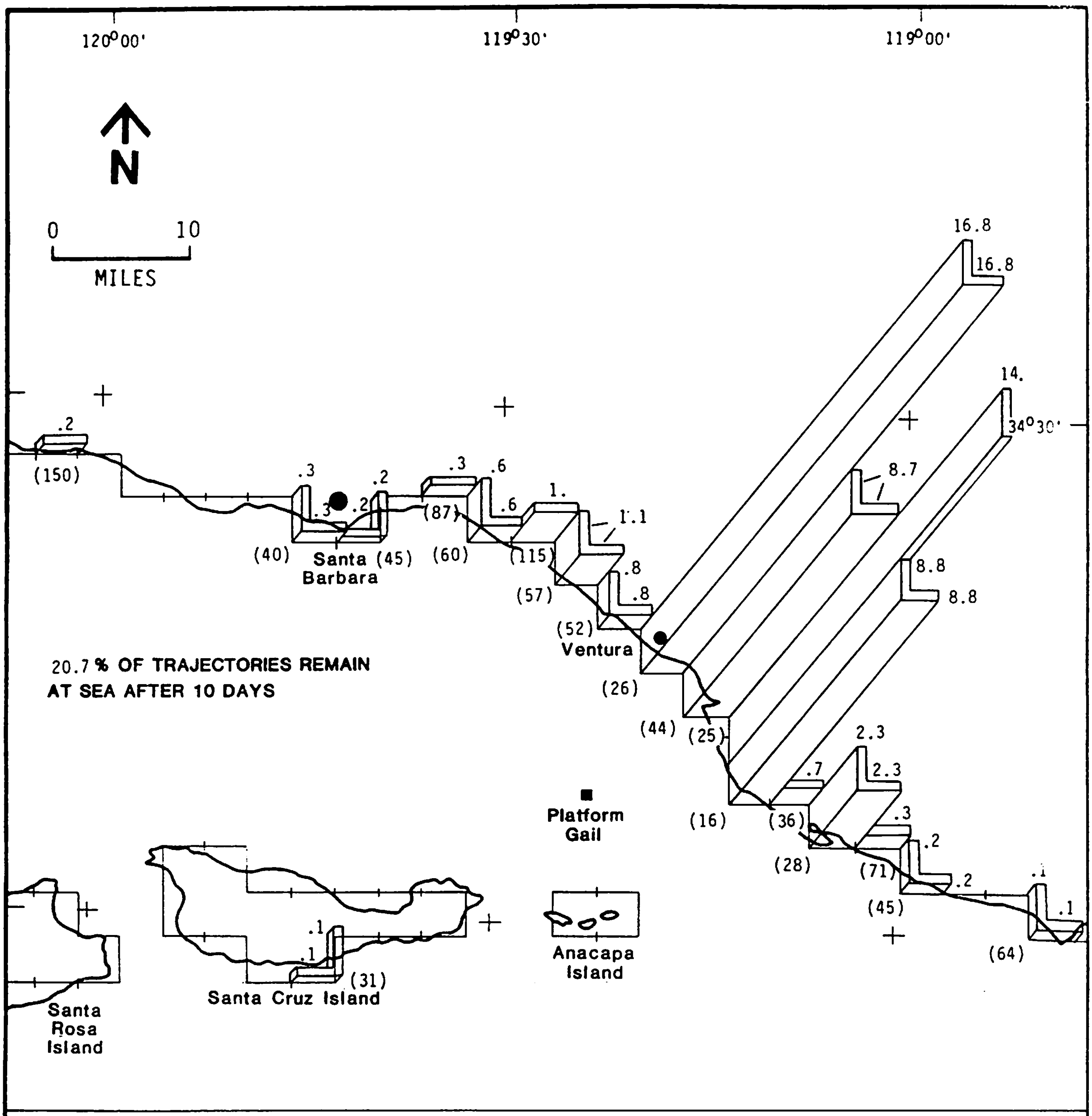
WHERE:

P - PERCENT OF TOTAL TRAJECTORIES

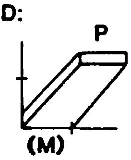
(M) - MINIMUM TIME TO SHORELINE
CONTACT (HRS.)

FIGURE 3-10

DISTRIBUTION OF
SHORELINE CONTACTS
PLATFORM GAIL
10 - DAY ANALYSIS
DECEMBER TO FEBRUARY



LEGEND:



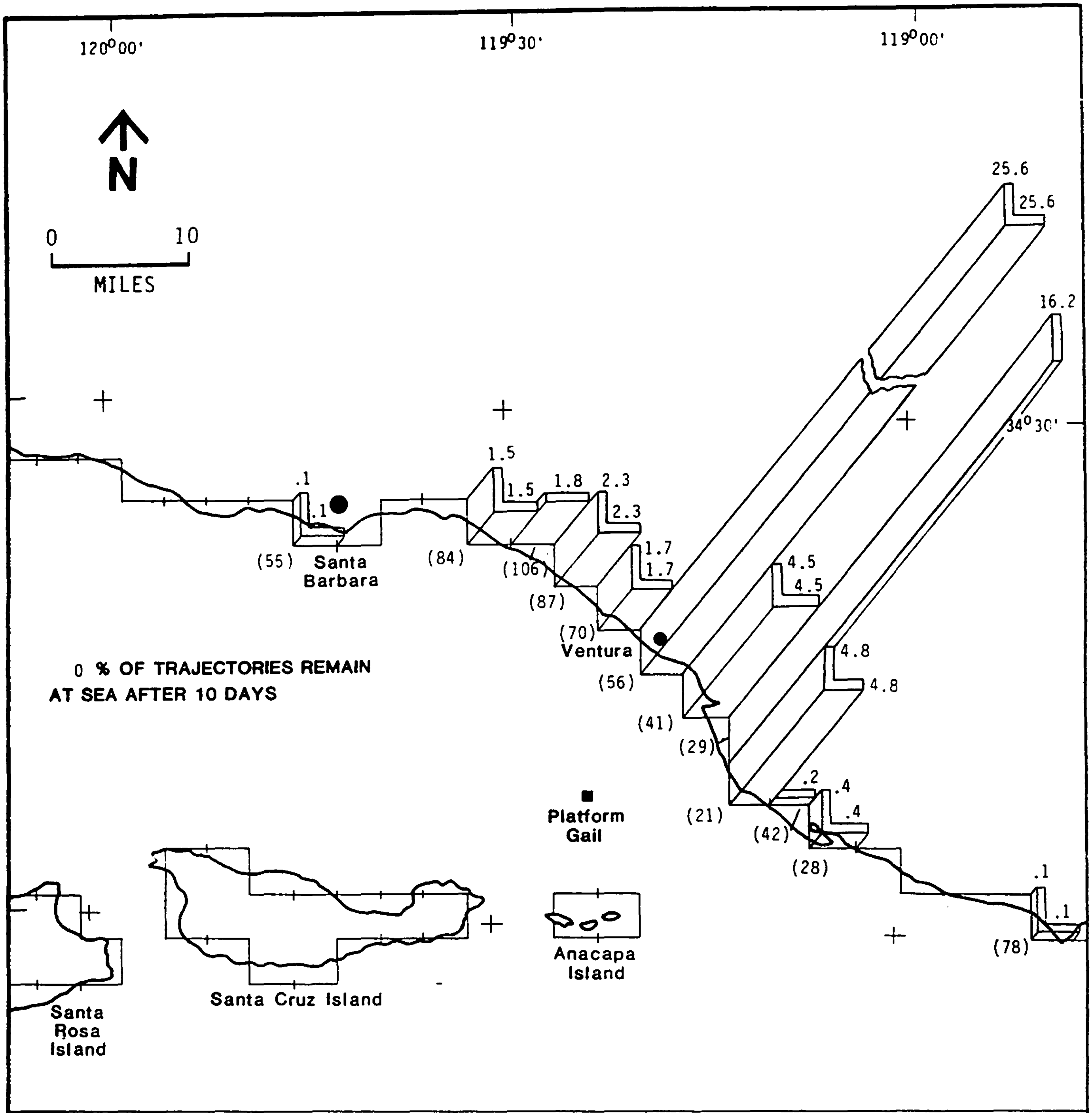
WHERE:

P - PERCENT OF TOTAL TRAJECTORIES

(M) - MINIMUM TIME TO SHORELINE CONTACT (HRS.)

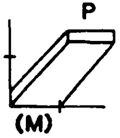
FIGURE 3-11

DISTRIBUTION OF SHORELINE CONTACTS PLATFORM GAIL 10 - DAY ANALYSIS MARCH TO MAY



0 % OF TRAJECTORIES REMAIN AT SEA AFTER 10 DAYS

LEGEND:



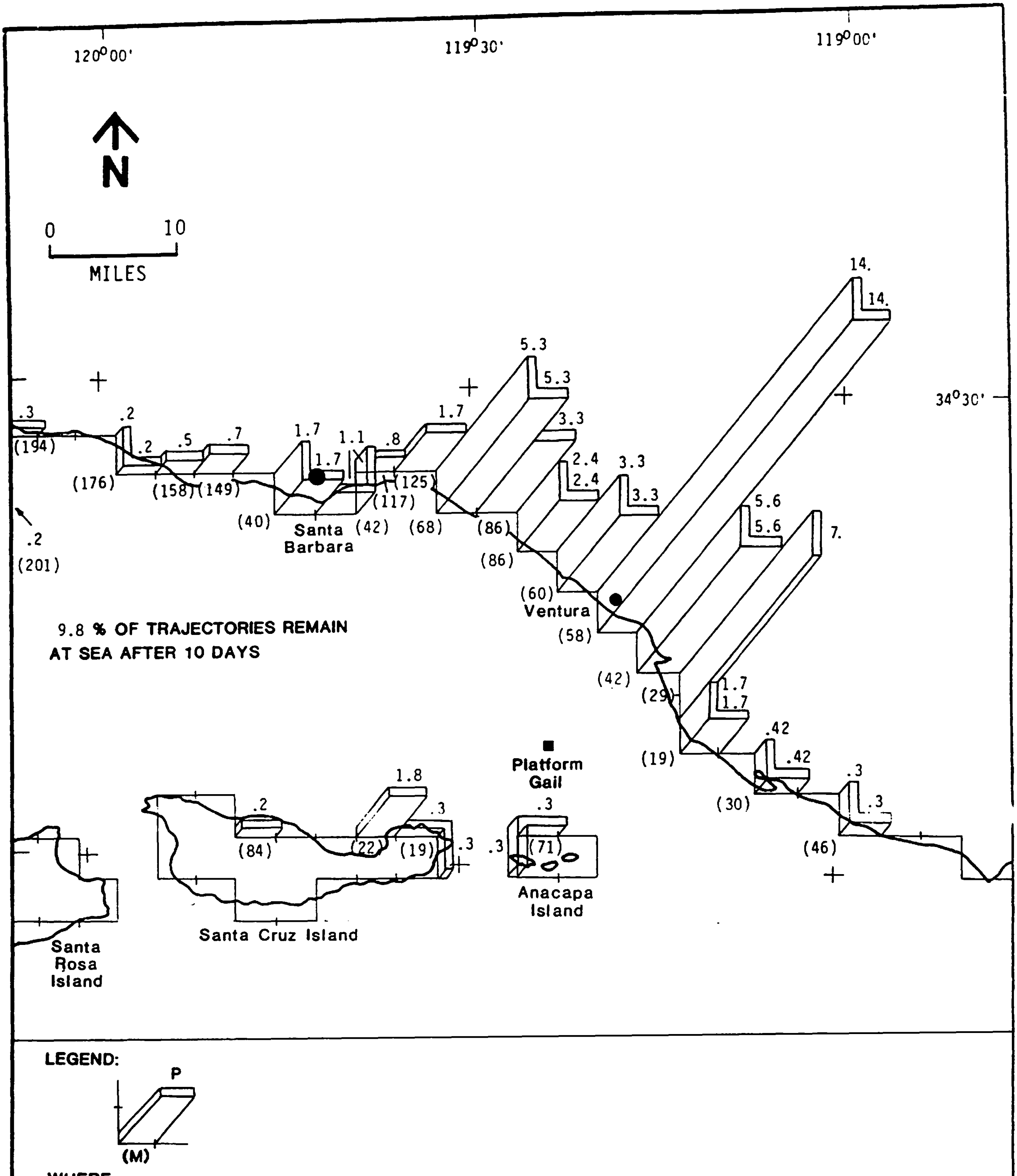
WHERE:

P - PERCENT OF TOTAL TRAJECTORIES

(M) - MINIMUM TIME TO SHORELINE CONTACT (HRS.)

FIGURE 3-12

DISTRIBUTION OF SHORELINE CONTACTS
PLATFORM GAIL
10 - DAY ANALYSIS
JUNE TO AUGUST



WHERE:

P - PERCENT OF TOTAL TRAJECTORIES

(M) - MINIMUM TIME TO SHORELINE CONTACT (HRS.)

FIGURE 3-13

DISTRIBUTION OF SHORELINE CONTACTS PLATFORM GAIL 10 - DAY ANALYSIS SEPTEMBER TO NOVEMBER

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Chevron U.S.A. Inc.

Environmental Report: Platform Gail and Associated Pipelines (Supplement to Santa Clara Unit)

SUPPLEMENT TO SANTA CLARA UNIT
ENVIRONMENTAL REPORT
FOR
PLATFORM GAIL AND SUBSEA PIPELINES

Prepared for:

Chevron U.S.A. Inc.

Prepared by:

WESTEC Services, Inc.
2151 Alessandro Drive, Suite 120
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Project No. 35063

January 1986

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APPENDIX

SECTION 1

TITLE PAGE

1.1 **Project Name:** Supplement to Santa Clara Unit Environmental Report for Platform Gail and Subsea Pipelines.

1.2 **Area Name:** Santa Clara Unit, Offshore California.

1.3 **Initial Block Number and Field:** Sockeye Field.

Lease	Tract	Block
OCS P 0205	P4 (1968)-353	46N-60W 34°07'30"N/119°24'01"W

1.4 **Lessee or Operator:** Chevron U.S.A. Inc. (hereinafter called "Chevron") is the operator of OCS Lease P 0205. (Exxon has a 50 percent interest only in the south half of the south half of the lease and has no ownership interest in Platform Gail.)

1.5 **Platform Name:** Gail.

1.6 **Date of Environmental Preparation:** January 1986.

1.7 **Address Inquiries To:**

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Concord, California 94524
Phone Number: (415) 680-3333

1.8 **Previous ERs, EAs, or EISs:**

1. Department of the Interior, Bureau of Land Management, 1979. Proposed 1979 Outer Continental Shelf Oil and Gas Lease Sale Offshore Southern California, OCS Sale No. 48. Final Environmental Impact Statement.

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SECTION 2

DESCRIPTION OF THE PROPOSED ACTION

2.1 LESSEE AND OPERATOR

Lessee: Chevron U.S.A. Inc.

Operator: Chevron U.S.A. Inc.

2.2 LEASE NUMBER AND LOCATION

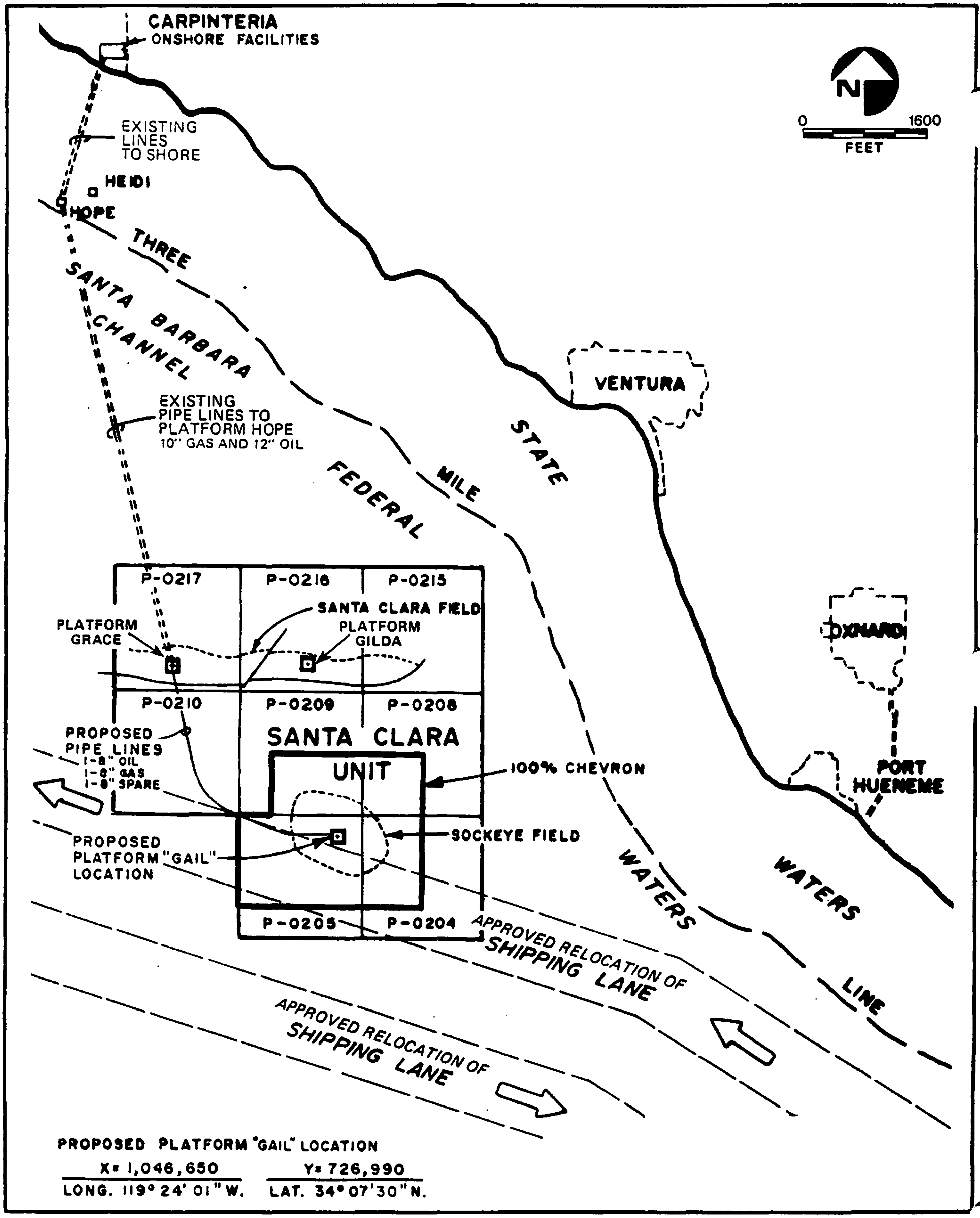
The northern boundary of Lease OCS P 0205, the third lease proposed for development in the Santa Clara Unit, is located approximately 24 statute miles (38.6 km) southeast of Santa Barbara and 11 statute miles (17.7 km) southwest of Ventura. The nearest mainland shore is 10.3 statute miles (16.5 km) to the west southwest just north of Port Hueneme. Lease OCS P 0205 and the 7 additional leases (P 0204, P 0208, P 0209, P 0210, P 0215, P 0216, P 0217) composing the Santa Clara Unit were part of OCS Lease Sale P4 (1968). All leases are shown on Figure 2.2-1. Chevron obtained lease P 0205 in April of 1968.

2.3 OBJECTIVES OF THE PROPOSED ACTION

The objective of the proposed development, as described in the Development and Production Plan (DPP), is to recover and process hydrocarbon resources from the Sockeye Field. Further, the intent of the program is to minimize environmental impact through consolidation and participation in an existing transportation network.

2.4 PROJECT OVERVIEW

Chevron proposes to install a 36-slot drilling and production platform to be named Gail on Lease OCS P 0205 in 739 feet (225 m) of water during the third quarter of 1986. The first oil production is planned for mid 1987. Oil production from Platform Gail is projected to peak in 1990 at 13,300 barrels of oil per day (BOPD). Gas production is projected to peak in 1998 at 20.2 million standard cubic feet per day (MMSCFD). Separation of gas, oil and free water will occur at the platform utilizing three-phase separators and electrostatic coalescers. The produced water will be treated to meet the current general Environmental Protection Agency-National Pollutant Discharge Elimination System (EPA-NPDES) permit requirements and subsequently will be discharged into the ocean. Dry oil and gas will be transported by separate new subsea pipelines to Platform Grace. In addition there will also be a spare pipeline. The oil and gas will then be commingled with Grace production and sent through existing pipelines to shore via Platform Hope.



Chevron's Platform "Gail" Sockeye Field, Santa Clara Unit
Santa Barbara, California

FIGURE 2.2-1

Gas from Platform Gail will be transported via Platforms Grace and Hope to the Carpinteria facility. Any hydrogen sulfide (H_2S) and carbon dioxide (CO_2) present will be removed by the Stretford unit on Platform Grace. The unit is designed to produce up to 3.2 tons of sulfur per day by removing H_2S from the produced gas to produce "sweet" gas. At Carpinteria, Southern California Gas (SCG) will purchase the gas and distribute it through an existing pipeline system.

2.5 PLATFORM DESCRIPTION

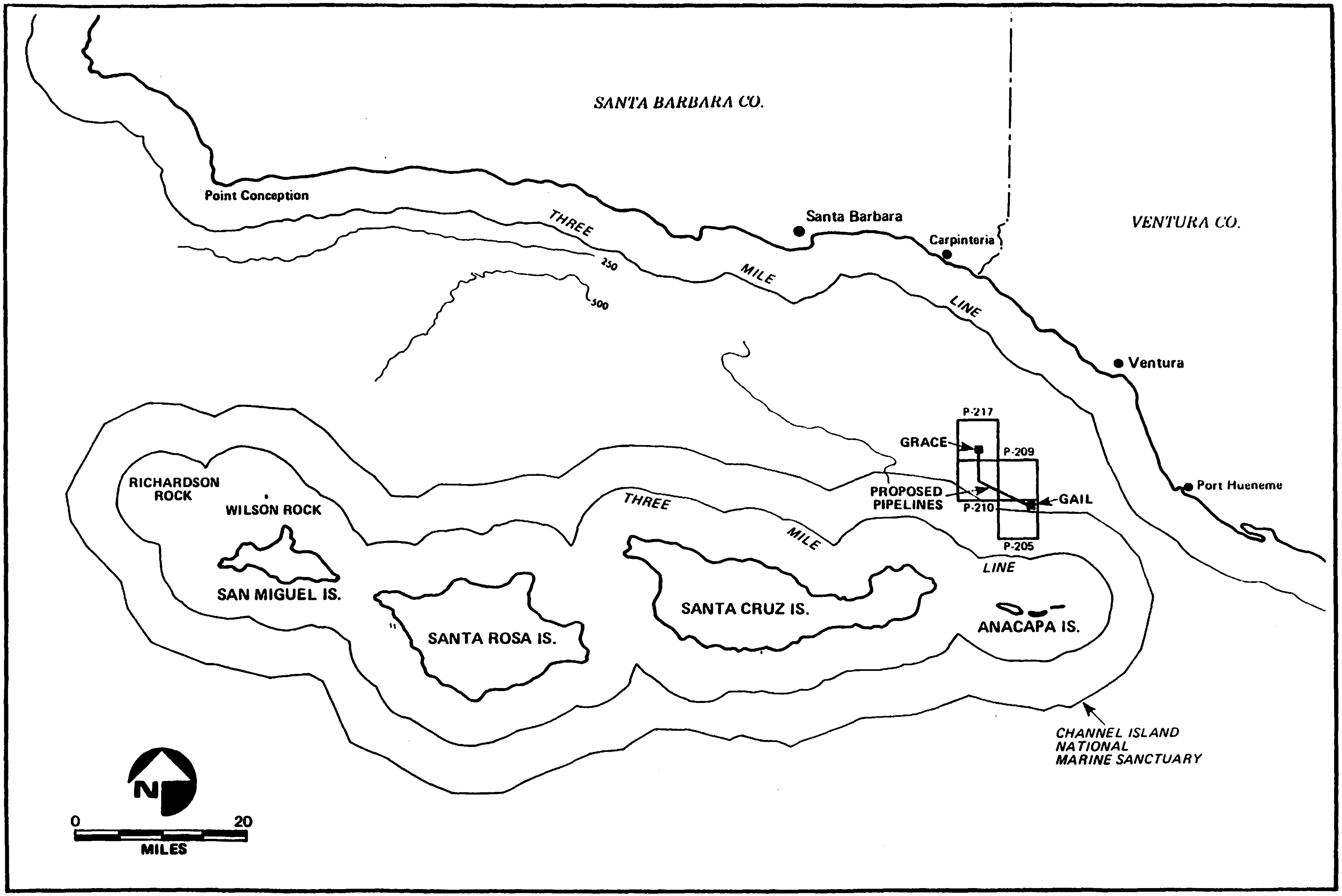
2.5.1 Platform Locations

Chevron's Platform Gail will be a continuously manned, drilling and production platform in the offshore Santa Barbara Channel. Coordinates for the proposed location are:

Lambert (Grid Zone 6)	UTM 11	Latitude/ Longitude	Loran C
X = 1,046,650 E	X = 278641.2	34°07'30"N/	MW = 16577.1289
Y = 726,990N	Y = 3778431.8	119°24'01"W	MX = 28034.8934
			MY = 41422.8477

The platform will be located in approximately 739 feet (225 m) of water on the Outer Continental Shelf (Lease OCS P 0205), approximately 9 nautical miles (14 km) west/southwest of Port Hueneme and approximately 6.5 nautical miles (10.5 km) from the east end of Anacapa Island. The Channel Islands National Park Boundary abuts the southern lease boundary. The platform site in relationship to the lease and prominent onshore areas is shown in Figure 2.5-1. As shown, the proposed platform will be located approximately 0.67 nautical miles (1.3 km) from the approved relocated Vessel Traffic Separation Scheme (VTSS) leading from the Santa Barbara Channel. The modification of lanes has received approval by the Coast Guard and the International Maritime Organization (IMO) and is scheduled for implementation on February 1, 1985.

Three federal platforms are operating in the project area. The closest federal OCS developments to proposed Platform Gail are Platform Gilda (Union) located approximately 3.6 nautical miles (5.7 km) to the north and Platform Grace (Chevron) approximately 4.7 nautical miles (7.6 km) to the northwest. Platform Gina is located 6 nautical miles (9.9 km) easterly of proposed Platform Gail. The nearest platform in state waters is Heidi which is located 14.2 nautical miles (22.9 km) north/northwest of Gail.



Project Location

FIGURE 2.5-1

2.5.2 Platform Construction Data

The platform structure will be designed in compliance with the Minerals Management Service (MMS) OCS Order No. 8, API RP 2A "Recommended Practices for Planning, Designing and Constructing Offshore Platforms," and applicable American Institute of Steel Construction (AISC) guidelines. The structure will be designed for the most severe loads that might occur during launch, installation and during operations, and to safely withstand loads caused by severe storm waves or the level of earthquake groundshaking appropriate for the seismic region. The design of Platform Gail will be performed by Brown and Root and verified by a Certified Agent according to OCS Order No. 8. A comprehensive detailing of design criteria, cathodic protection, site conditions, design analyses, and structural design will be provided as part of the Verification Document. Due to the preliminary stages of the platform design, the following discussion is a conceptual description of the proposed platform.

Platform Gail will be a conventional eight-leg steel jacket structure supported on the seafloor by pilings driven through the legs of the jacket and then welded and grouted on the jacket. There will also be 12 skirt piles which will be grouted to the skirt pile sleeves. The jacket will support a three-level deck including well conductors. The proposed platform will contain drilling/production and utility facilities, quarters, a heliport, and provisions for docking of crew and supply boats. The deck structure will provide space and load carrying capacity for one drilling rig. General arrangement plans of the decks are shown in the Development and Production Plan (DPP).

Fabrication and installation of the platform will follow conventional procedures for such structures. Installation of the platform and commissioning of the facilities will require 4 to 6 months. Major marine equipment required for installation of the platform will include a derrick barge, the jacket launch barge, cargo barges, tug boats, supply boats, and crewboats.

General Installation procedures for the platform are as follows:

Fabrication - The principal components of the platform; the jacket, pilings, and deck modules, will be fabricated and assembled in onshore yards. Sites for construction and assembly will be determined when contracts are awarded.

Jacket Tow and Launch - Upon completion of fabrication, the jacket structure will be loaded onto a transportation/launch barge and secured for tow. The jacket will be towed from its fabrication site to the installation site where it will be launched from its transport barge and floated horizontally in the water.

Jacket Upending - Following launch, the jacket will be towed to its installation site and upended by the flooding of selected leg and skirt pile sleeve compartments. Final positioning will be made with the derrick barge and further flooding will set the jacket on the sea floor.

Anchoring - Installation of the platform will require the use of a moored construction barge. Mooring points will generally be spaced in a circle (5000 foot radius (515 m)) around the platform.

Pile and Conductor Installation - The main piles will be installed through the jacket legs in approximately 100-foot (30 m) long welded segments. The skirt piles will be installed through pile sleeves and upon reaching the mudline driven to their design penetration with the aid of a retrievable follower. Both the main and skirt piles will be grouted to the jacket structure. The well conductors will be installed with the drilling rig at the time each well is spudded.

Deck Setting - Deck units will first be set and welded to the jacket top for support of the modules. The topsides, composed of two decks (east and west) and four modules with production equipment pre-installed, will be transported by barge from their assembly sites to the offshore installation site. The modules will be lifted by the derrick barge, set on top of the decks and welded into place. The flare boom and other miscellaneous components will then be attached to the deck structure.

Hookup and Commissioning - Following setting of decks and modules, offshore crews will make structural, piping, electrical, and instrumentation interconnections between decks and modules and will test and commission all systems.

Platform Removal - Upon reservoir depletion, the platform will be removed in compliance with MMS regulations.

2.5.3 Drilling Facilities

Platform Gail will have slots for a maximum of 36 wells. Chevron presently plans to drill 25 wells during the first development phase. During the second development phase, an additional 9 wells may be drilled. Development (both phases) drilling is planned to span approximately 6 years, and require approximately 2 months per well. A typical drilling program is outlined in the DPP.

The drilling rig will be a land-type rig modified for offshore application. All drilling equipment and services will be handled on a contract basis. Subsequent to development drilling, a workover rig may be brought on board to service the producing wells. Refer to the DPP for further information regarding the drilling operations and procedures and schematic drawings of the platform equipment.

2.5.4 Production and Separation Process Facilities

The crude oil produced will originate from geological zones having different API gravities, viscosities and sulfur contents. Normally, the Lower Topanga/Sespe oil will be kept separate from the Upper Topanga/Monterey oil until after dehydration is completed. Three-phase separators are planned for primary oil/gas/free-water separation followed by electrostatic coalescers for dehydration. Wells will be manifolded to isolate individual wells for testing and gauging while the remaining wells are directed to the "pool" separators. The wet-oil stream to the separators will be heated with hot oil to approximately 150°F for free-water removal. The resulting oil emulsion will then flow to the electrostatic coalescers operating at 50 pounds per square inch-gauge (psig) up to 250°F. The oil will then be stabilized in a twelve tray stripping column for removal of hydrogen sulfide (H_2S) and shipped to Platform Grace.

Three identical test separators and heaters will be used. Each well will be tested at least once per month to facilitate reservoir evaluation. A well cleanup separator will be used for the initial unloading of well production to remove mud, water and drilling fluid.

Produced gas from the three-phase production and test separators and the coalescers will be compressed to pipeline shipping pressure by three 50 percent capacity electric motor-driven reciprocating compressors. Low pressure gas will be recovered from platform equipment and compressed along with casing gas. The recovered gas will be commingled with gas from separation facilities and compressed prior to dehydration and shipment to shore. Each stage of compression will be equipped with suction scrubbers, various unloaders and clearance pockets to handle varying production rates. Dehydration facilities will be provided on the platform to avoid water condensation and hydrate or corrosion problems in the gas pipeline. All oil and gas leaving the platform will be metered.

Produced water resulting from the oil separation process on the platform will be treated and discharged to the ocean through a disposal caisson. This water is discharged primarily from the two production separators with a smaller volume discharged from the test separators and coalescers. To meet the requirements of 40 CFR 435, Effluent Limitations for Offshore, Subcategory of the Oil and Gas Extraction Point Source Category, the water will be treated by passing it through a corrugated plate interceptor followed by a flotation cell to remove suspended oil from the water. The anticipated oil content of the discharge will be less than the average value of 72 parts per million (ppm) allowed by the Environmental Protection Agency (EPA). Oil and solids resulting from this treatment process will be recycled into the oil stream. All discharges will be in accordance with the General National Pollutant Discharge Elimination System (NPDES) Permit. Process flow diagrams for Platform Gail are shown in Section 6 of the DPP.

Electrical power will be generated at 4160 volts (V) by three 3150 kilowatt (kW) turbine generators, one of which will be a standby unit. Gas will be the primary fuel for the turbines with diesel as an alternate fuel. Gas will be sent from Platform Grace to fuel the turbines until Platform Gail produces sufficient gas on its own. The main gas compressors will operate at 4000 V. Stepdown transformers and motor control centers will operate general process and utility loads at 480 V.

Although not required by Department of Interior (DOI) regulations, Chevron will use demineralized water injection on Platform Gail to reduce air emissions from the combustion gas turbines. At an injection rate of between 0.5 and 1 pound of water per pound of fuel injected, it is expected that a 70 percent reduction in NO_x emissions will occur.

Emergency power for the production facilities will be supplied by an 850 kW diesel powered generator. This unit will provide electric power under emergency conditions for critical services such as blowout prevention (BOP) accumulators, lights, air pressurizing systems and sump pumps. The diesel generator will have an air starter and a separate air reservoir tank. Other diesel fuel users will include the intermittent use of the cranes, diesel fire water pump, the drilling contractor's logging unit, the drilling standby generator and bulk storage air compressor. Diesel is also the backup fuel for the main power generators.

Initial gas production on Platform Gail is expected to be sweet. However, when development of the upper zones occur, the gas will be sour (i.e., contain hydrogen sulfide). Facilities will be provided on Gail to sweeten sufficient gas to satisfy the fuel gas needs of the platform.

Two 1200 gallon per hour capacity desalination units (one standby) will produce fresh water from sea water for the potable and demineralized water systems. The system will keep the potable water system and mixed bed demineralizer supplied with 5 ppm total dissolved solids (TDS) water, while any surplus will go to fresh water storage. Water from the vapor desalination unit will enter a mixed bed cartridge type demineralizer where the total dissolved solids will be reduced from 5 parts per million (ppm) to less than 0.5 ppm. A demineralized water holding tank will be located between the demineralizer and the turbine generators.

Cogeneration will be used on the platform. Process heating will be provided by a circulated heating medium system. The heat source for the heating media will be waste heat recovered from the turbine drivers on the electrical generators. The system consists of circulating pumps and a heating fluid expansion tank.

All drainage from the decks will be collected. The drain water together with any entrained oil, will be fed to a corrugated plate separator where oil will be separated and returned to a hydrocarbon drain tank. This oil is then pumped into the oil processing system or into a holding tank. Clean water from the corrugated plate interceptor will be discharged to the ocean through a disposal caisson. All decks will be of solid steel plate and have a 6 inch (15 cm) minimum high curb around the perimeter to prevent any runoff into the ocean. Spray shields will be included where necessary to prevent liquid hydrocarbon spray from reaching the ocean.

2.5.5 Summary of Drilling Equipment to be Used and General Layout

In summary, the primary drilling platform equipment consists of the following:

- One land type cantilever mast, 152 feet minimum (46 m) high with 12,000 foot (3658 m) drilling and 1 million pound hook-load capacities. The derrick will be designed in accordance with API standard 4 D for free standing masts.
- Draw works - 1500 hp, electrically powered.
- Rotary table - 1500 hp, electrically powered.
- The swivel and traveling block will be of 500 + ton load-rated capacity to match the derricks.
- Mud system: Each rig will be equipped with two mud pumps (1000 hp each), one desander (75 hp), desilter (75 hp), lightning mixers (5 hp), and shale shaker (3 hp).
- Degasser - 1 at 30 hp.
- The drill pipe will be 5 inch (12.7 cm), Grade E and G.
- Electric cementing units - 2 at 1000 hp each.
- Casing - Casing setting depths and cementing will be in accordance with MMS Order No. 2. A complete description of the casing program is provided in the DPP (Section 5.3.1).

2.5.6 Support Facilities, Monitoring and Safety Systems

2.5.6.1 Hydraulic Control System

A hydraulic pressure system will be provided for downhole subsurface safety control valves. The system will include pneumatic-powered pumps, reservoir tanks, filters and a distribution system. This is a closed-loop system with spent fluid returning to a pump suction reservoir.

2.5.6.2 Control and Monitoring Systems

The general process and associated equipment will be monitored by a computer in a central control room. All control of the facilities is local to the equipment. The computer contains the logic for start-up and shut-down of the facilities.

In the event that local process controls are unable to maintain the process within prescribed operating limits, alarms will be triggered in the control room to warn the operator of impending upset conditions. These alarms will cause a process alarm to sound and an alarm message to flash indicating the nature of the trouble.

Should the operator fail to correct an alarm condition before it reaches the unsafe limits, the following safety equipment is provided to protect the process equipment:

- High/Low Pressure Sensors (Shutdowns)
- High/Low Temperature Sensors (Shutdowns)
- High/Low Liquid Level Sensors (Shutdowns)
- Pressure Safety Valves (Relief)
- High/Low Flow Sensors (Shutdown)
- Automatic Emergency Shutdown (ESD) System
- Manual Emergency Shutdown (ESD) System
- Surface and Subsurface Well Safety Valves
- Equipment Isolation Shutdown Valves (SDVs)

This safety shutdown equipment is applied in accordance with MMS Pacific Region OCS Order No. 5, OCS Order No. 9 and API Recommended Practice RP-14C.

2.5.6.3 Personnel Quarters

Personnel quarters will be sized for normal drilling and production activities. Facilities include sleeping accommodations for 72 persons with restrooms, locker rooms, wash rooms, a galley, a medical room and recreation/training room. The quarters building will be designed to minimize transmission of vibration and noise. A heliport will be situated on top of the quarters building.

2.5.6.4 Safety Systems

Safety systems are broadly classified as those devices and practices which safeguard life and limb, the environment, resources, and equipment. They relate specifically to good design practices, personnel training and operational and emergency modes. Typical of such systems are, fire prevention and detection, emergency power generation, navigational aids, pipeline leak detection, gas detection, control and monitoring of critical operations with emergency shutdowns, emergency alarms, corrosion control, and personnel evacuation. The platform will be equipped with radio and telephone communication to the mainland to ensure appropriate emergency coordination.

Safety features proposed for Platform Gail include the following:

2.5.6.5 Fire Suppression

a. Two electric submersible fire pumps to provide firewater (1500 gpm) at 100 psi residual pressure to the platform's deluge system, hose reels, and fire monitors. Each pump will start automatically by a signal from its low pressure switch on the firewater header.

b. One standby diesel-powered right angle drive vertical turbine fire pump to provide firewater (3000 gpm minimum) at 100 psi residual pressure to the platform's deluge system, fire monitors, and hose reels. The pump will start automatically by a signal from a low pressure switch on the firewater header. The pressure setting will be lower than that of the two electric fire pump start settings.

c. Two 50 gpm (maximum) centrifugal jockey water pumps (one operating, one standby) to maintain the firewater header at 150 psi. The pumps will get their suction from the cooling water header and will prevent automatic starting of the main fire pumps due to system leaks or small firewater demands.

d. Adequate 1-1/2 inch to 1-1/4 inch hard rubber hose reels to provide water/foam coverage at any point on the platform with two 100 foot hoses.

e. Deluge system with automatic area controls capable of wetting critical deck areas not occupied by major equipment with water density of not less than 0.25 gpm/ft^2. The system will also protect the wellhead area and process equipment with the following design densities:

1. Wellhead, 0.50 gpm, S.A. (gallons per minute, Surface Area)
2. Oil shipping pumps, 0.25 gpm, S.A.
3. Oil/diesel vessels and exchangers, 0.25 gpm, S.A. of upper half if vessel normally 50 percent full.
4. Oil/diesel pumps, 0.25 gpm, S.A., 0.50 gpm, S.A. for packing areas.
5. Gas compressors, 0.25 gpm, S.A., 0.50 gpm, S.A. for packing areas.
6. Gas compression vessels and exchangers, 0.25 gpm, S.A.
7. Pig launcher/receiver, 0.25 gpm, S.A.
8. Sump deck, 0.25 gpm, S.A.
9. Miscellaneous hydrocarbon equipment, 0.25 gpm, S.A.
10. Structural protection, 0.10 gpm, S.A. flare boom only.

f. Two 500 gpm fire monitors on the main deck to cover the BOP stack and the upper well bay area. One 250 gpm fire monitor will be on the upper deck.

g. Portable fire extinguishers of the appropriate size and class for the anticipated hazard will be provided and located to permit coverage of the entire platform, deck areas and buildings. Different types used are dry chemical, CO_2, and Halon.

h. Automatic Halon 1301 flooding protection system will be located in each turbine generator enclosure.

i. Manual fire alarm pull stations will be located in the generator room, quarters building, and production area buildings.

j. Firehose connections at the boat landing (for fire boat use) will be piped to the platform distribution system.

k. Fire hydrant riser and connections will be located at all stair landings.

l. Automatic dry chemical spray units will be located over stove and grill in the quarters building.

The following is a brief description of the fire detection and alarm system components:

a. Flame sensors: These will signal a local controller which will signal the platform Modicon programmable controller. An audible alarm is then initiated. An ESD condition with zone deluge will commence unless overridden by the operators.

b. Fusible plugs will initiate the same events as the flame sensors.

c. Visual sighting: Personnel can initiate shutdown and suppression activities from the main control room or fusible plug panels and ESD stations.

d. Thermal rate-of-rise detectors: These will signal the Modicon programmable controller, initiate an audible alarm, and shutdown building ventilation.

e. Turbine enclosure flame and rate-of-rise detectors: These will signal a local controller which will signal the Modicon programmable controller. An audible alarm is then initiated which will start the Halon flooding system, start the diesel generator, and will shut off the turbine fuel supply.

f. Ultraviolet flame detectors.

2.5.6.6 H_2S and SO_2 Contingency Plan

Appendix 7 of the Oil Spill and Emergency Contingency Plan for Platform Gail contains a detailed emergency plan with safety procedures to be employed for facilities which may be exposed to hazardous levels of hydrogen sulfide.

2.5.6.7 Navigation Aids

Navigation aids for Platform Gail include the following components:

a. Four lights, one on each platform corner consisting of 255 millimeter (mm) lenses which are visible for 5 nautical miles (8 km).

b. Fog signal with 2 nautical mile (3 km) audible range.

c. Aviation warning lights on the drilling derrick.

Platform Gail will be equipped as a Class A structure per 33 CFR Part 67.20. Platform color will be a painted white. The use of a United States Coast Guard approved Automatic Radar Plotting Aid (ARPA) unit to be installed on the platform is being considered. This radar unit will include an anti-collison system which would alert operations if a vessel is on a collision course with the Platform. The radar unit will monitor in an east to southwest direction (Section 4.7).

2.5.6.8 Blowout Prevention Equipment

Blowout prevention equipment (BOPE) systems will be used as required by Chevron Drilling Practices, OCS Orders and field rules. This equipment will be hydraulically operated and remote controlled. The DPP (Section 5.3.4) provides additional detail on the system.

2.5.6.9 Deck Drainage/Sump System

Platform Gail will have two separate drainage systems for handling of deck drainage. Drainage from the upper decks, drip pans in the rig substructure and the rig floor will gravitate to a waste tank located on the lower deck. Drainage from the lower deck areas will drain to a sump tank below the lower deck, from which the liquids will be pumped into the waste tank. Oily waste water from the waste tank will be sent to the production train for treating. Washed cuttings and oil free sediments from the waste tank will gravitate to the disposal pile for discharge to the ocean.

2.5.6.10 Safety and Escape Equipment

The escape system provided on Platform Gail will include life jackets and 3 survival capsules accommodating 36 persons each. Injured personnel will travel directly from Platform Gail via helicopter to a helipad at St. John's Hospital. Helicopter flight time from Platform Gail to St. John's Hospital (Oxnard) is approximately 15 minutes, allowing injured personnel to be quickly brought ashore.

2.5.6.11 Environmental Monitoring Systems

Platform Gail will be outfitted with the following environmental monitoring systems:

1. Meteorological monitoring station, which measures and records on magnetic tape, wind speed, wind direction, deviation in wind direction, and ambient temperature.
2. Wave staff that measures wave length, height and tide. This will be connected to the computer system for data storage.
3. Current meter.
4. Seismic monitors.

2.6 DESCRIPTION OF PROPOSED TRAVEL MODES AND ROUTES; FREQUENCY FOR MOVING SUPPLIES AND PERSONNEL TO AND FROM OFFSHORE ACTIVITY SITES

It is currently planned that during the construction phase, supply boats and support vessels will depart and arrive at Port Hueneme while crewboats will operate from the Carpinteria Pier. During the drilling phase, both the drilling contractor's crewboats and supply vessels will depart and arrive at Port Hueneme. During the production phase, crewboats and supply vessels will originate from the Carpinteria Pier. Aircraft (helicopters) will use the Ventura County Airport at Oxnard. Aircraft will use the shortest route consistent with U.S. Coast Guard recommended practices and FAA requirements.

All support vessels will use a traffic lane set up by the Santa Barbara Channel Oil Service Vessel Traffic Corridor Program established between the petroleum and fisheries industries (Figure 2.6-1). The vessel corridor program is the product of negotiations between the oil industry and the commercial fishing industry at the Joint Oil/Fisheries Committee. It is intended to reduce inter-industry conflicts occurring in the Santa Barbara Channel while minimizing changes to currently existing operations where possible.

The traffic corridor program is set up for an initial 6 month review period. Periodically, the Joint Committee will review the effectiveness and compliance with the program for possible amendments. Future exploratory and production platform service vessel routes can thus be added to the program as necessary.

These vessel traffic corridors are not meant to supercede existing Coast Guard regulations regarding traffic safety, nor existing traffic separation lanes in the Santa Barbara Channel. They also are not meant to apply in marine emergency situations.

2.6.1 Surface Support Vessels

During the construction/installation phase of Platform Gail and the subsea pipelines, one supply boat will travel to the project area from Port Hueneme once per day. A crewboat will travel to the platform site from the Carpinteria Pier an average of twice per day (2 round trips) during platform installation and twice per day for subsea pipeline installation. Helicopter transportation will be provided twice per day during platform installation and twice per day during subsea pipeline installation.

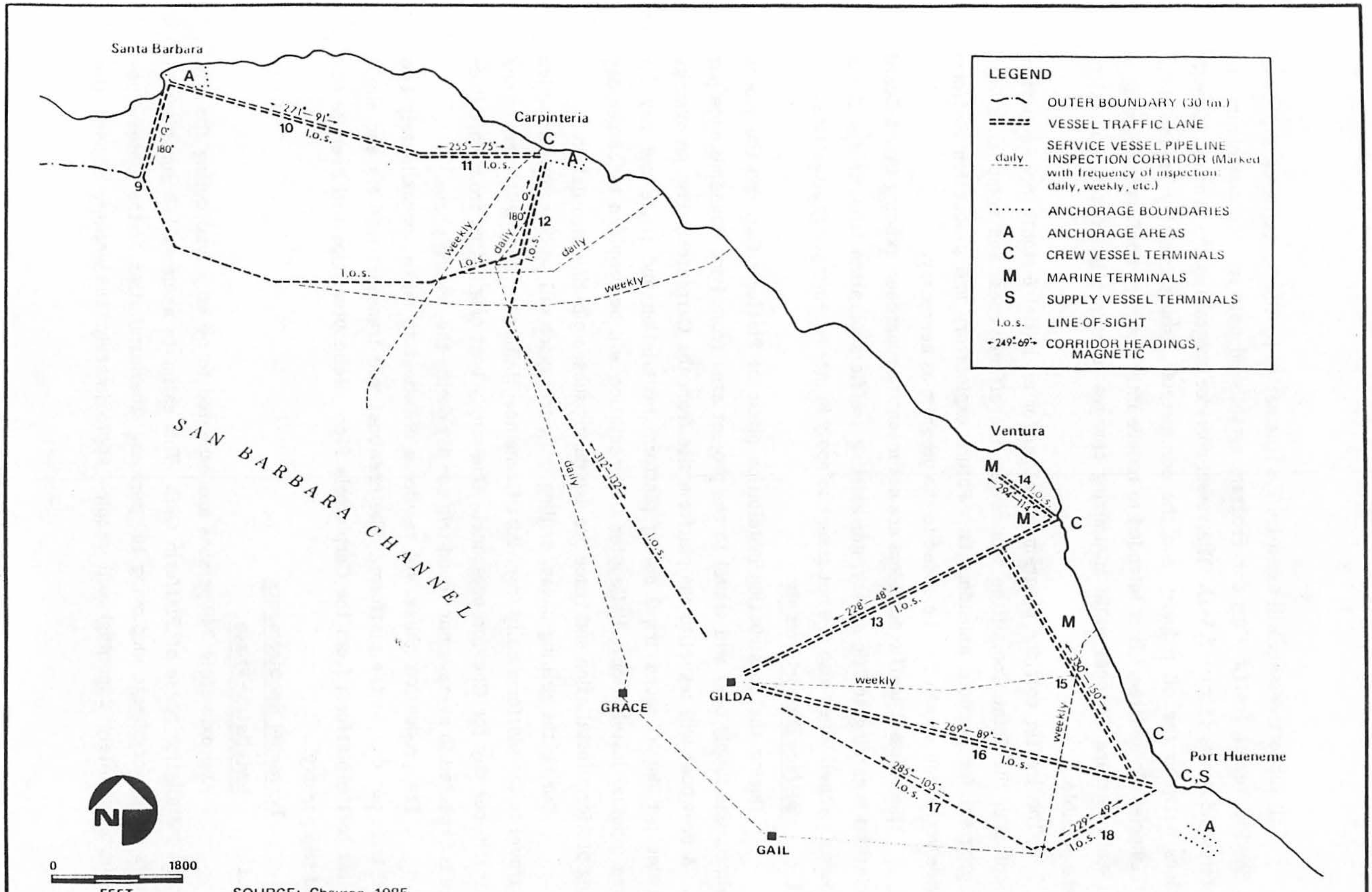
During the drilling phase, drilling crew transport will be by crewboat which will travel to the platform daily from Port Hueneme. Helicopter trips will average one round trip per day for Chevron personnel. One supply boat originating from Port Hueneme is expected to average one round trip per day during the drilling phase.

The production phase will require a crewboat to make approximately two round trips per day to the platform. The crewboat will transport workers and small supplies to the platform from the Carpinteria Pier. Helicopter trips will average one round trip per day.

2.6.2 Personnel Requirements

2.6.2.1 Installation Phase

Approximately 240 persons are expected to be employed during the 4 to 6 month installation phase of Platform Gail. This estimate assumes 140 construction workers and 1 work barge employing 100 persons. The installation of the subsea pipelines (approximately 2 months) will require approximately 100 workers aboard the



SOURCE: Chevron, 1985

Offshore Oil Service Vessel Traffic Corridor Program

FIGURE 2.6-1

WESTEC Services, Inc.

subsea pipeline lay barge. Total project personnel offshore could reach a maximum of 340 persons if all project components are constructed concurrently.

2.6.2.2 Operations Phase

During the 8 year development drilling period, the maximum crew aboard the platform at any one time is expected to be 70 persons, divided into approximately 40 contract drilling personnel, 15 company production personnel, 15 service persons and visitors.

During development drilling, crews will be scheduled for a 7-day work week, 12 hours per day. Drilling crews are expected to contain 35 persons for both the day shifts (18) and night shifts (17). The drilling personnel will be quartered on the platform. The service personnel will be contract welders, electricians, instrument technicians, etc. who will be onboard the platform for one or more days, depending on the task to be completed. Transportation to the platform will be provided by a crewboat.

The crew requirement during the production phase following the completion of development drilling consists of 20 company operating personnel, 12 contract drilling persons involved in well workover operations, and five support-service employees (welders, electricians, etc.). The production personnel will work a 7-day work period (12 hours per day) followed by 7 days off. The service contractors will be onboard as needed for variable lengths of time. Additional persons from local service companies will be required during periodic repairs.

2.7 PIPELINE SYSTEM

2.7.1 Introduction

Three submarine pipelines, each nominally 8.625 inches in diameter (22 cm), will be installed between Platforms Gail and Grace. One will take oil to Platform Grace, one will transport gas to or from Grace and one will be a spare. The crude oil and gas will then enter an existing pipeline system at Grace and be shipped to Platform Hope and ultimately onshore at Chevron's Carpinteria treating facility where the gas will be processed. The dehydrated oil from Platform Gail will not require any additional treatment onshore. The oil is transferred to an existing dry-oil line and then transported to Chevron's El Segundo Refinery in Los Angeles. Following gas processing, gas will be sold to Southern California Gas (SCG).

2.7.2 Pipeline Routes

The proposed route of the three pipelines is shown in Figure 2.2-1, Section 2.1. It is composed of three segments only one of which is new:

a. Offshore (6 miles [9.6 km]) - from Platform Gail to Platform Grace. The subsea lines will be laid within a 1-mile corridor. These lines are the only new pipelines required.

b. Offshore (11.8 miles [19 km]) - from Platform Grace to Platform Hope. These lines are installed.

c. Offshore (approximately 2.8 miles [4.4 km]) - from Platform Hope to Carpinteria Gas Plant. These lines are installed.

2.7.3 Pipeline Design Basis

2.7.3.1 Offshore Pipelines (Platform Gail to Platform Grace)

The proposed offshore pipelines will be designed to ensure that they can be safely installed and operated in an environmentally acceptable manner. Specific design data will be supplied in compliance with MMS OCS Order No. 9.

Design/Operating Conditions

Maximum design pressure will in part be determined by the wall thickness required to withstand laying stress. The minimum design pressures of the oil, spare and gas pipelines to shore will be ANSI 600, ANSI 600 and ANSI 300, respectively. The oil line size will be sufficient to transport up to 15,100 barrels per day (BPD) of crude oil. The gas pipeline will be sized to have a capacity of 25.2 MMSCFD.

Temperature of crude in the oil pipeline is expected to range from 47° to 130°F. The gas line will have a temperature range of 45° to 90°F. The pipeline will be designed to accommodate thermal effects without damage.

Mechanical Design

Pipeline material specifications will be developed to satisfy requirements of both operating and installation modes. Pipelines will be designed to resist recurring environmental loads resulting from steady-state and wave-induced currents, and seismic activity. The magnitude and direction of loads will be determined through in-ocean data measurements and review of existing relevant data.

Construction

Construction equipment, methods and procedures will be selected to ensure that pipelines are not overstressed during installation. Pipeline installation will be by the conventional pipelay barge and stinger method. Refer to the DPP (Section 7) for details on the construction technique.

Prior to construction, all pipe and coatings will be inspected for defects. Pipeline welding procedures and welders will be prequalified. During construction, all girth welds will be radiographically inspected per applicable codes. Full time qualified inspectors will monitor all phases of construction. Pipelines will be gauged and pressure tested with inhibited water to 1.50 times the ANSI flange design pressure. Test water containing inhibitors will be treated in accordance with applicable regulations prior to ocean disposal at Platform Grace or Gail. Some retained water will remain in pipelines until production begins.

2.7.4 Pipeline Operations

2.7.4.1 Offshore Pipelines (Platform Gail to Platform Grace)

Platform Gail's volumetric comparison oil leak detection system is comprised of a computer system that will perform a volumetric balance in 1-minute intervals. Obtaining a volumetric balance entails the comparing of all volumes which have entered a pipeline segment to the volumes which have left the segment. All pipeline volumes will be temperature compensated to 60°F and adjusted by the appropriate meter factor. Additionally, the pipeline inventory will be corrected for changes due to pressure fluctations. A volumetric meter will be installed at the exit from Gail and at the entry to Grace on both the oil line and the spare line. Volumetric meters already exist on the oil line exit point from Grace and at the oil line entry point to Carpinteria.

The volumetric balance is checked at seven different leak levels over different time periods spanning from 1 minute to monthly. If an excessive imbalance occurs, an alarm will be sounded. This volumetric balance system enables the detection and alarm of leaks as small as 0.1 barrel per minute in a 20-minute period and 100 barrels over a 30-day period. Also, if a leak of two barrels or more occurs in a 1-minute interval, the system will alarm. The leak detection system will be designed in accordance with MMS OCS Order No. 9.

2.8 ONSHORE PROCESSING FACILITY

2.8.1 Gas Plant Processing

The Carpinteria plant site encompasses approximately 26 acres (10.5 ha) and contains facilities for oil and gas processing and distribution. Over the life of the plant, it has processed gas from several fields in the area.

The Summerland field was the first to be developed and is located within state waters. This is a Chevron joint venture, called Standard-Humble-Summerland-State or SHSS which began development circa 1959. Wet gas and oil are separated offshore and shipped separately to Carpinteria where liquids are extracted from the gas and the oil dehydrated.

The Carpinteria field was the second to be developed and is also on a state lease. This was the second Chevron joint venture, known as Standard-ARCO-Carpinteria-State or SACS and was started circa 1966. Wet gas and oil production follows the same process steps as SHSS gas and oil.

The most recent field gas to be processed in the plant is part of the Santa Clara Unit, located in federal waters. The producing platform, Platform Grace, (installed in 1979) sends dehydrated oil and wet gas ashore via separate pipelines. The wet gas is comingled with SACS gas production at Platform Hope before going ashore. Platform Grace oil flows to Platform Hope where it is transported ashore via a converted gas lift pipeline.

Gas production from both state leases (SHSS and SACS) is sweet, and Platform Grace currently removes H_2S prior to shipping its gas ashore. At the gas plant, wet gas is compressed, commingled, dried and cooled to remove hydrocarbon liquids in a low temperature separator (LTS) plant. The dry gas leaving the LTS plant is used for plant fuel or sold to Southern California Gas (SCG). Recovered liquids are fractionated into propane, mixed butanes, and natural gasoline. The natural gasoline is blended and sold with the crude. Propane is sold to Van Gas Distributors and butane to Chevron Liquids and Gas Group for distribution.

In order to develop the Sockeye field, Chevron plans to install Platform Gail during 1986. Produced crude oil will be degassed and dehydrated on the platform before shipment to shore via a new pipeline to Platform Grace. Platform Gail's crude will be commingled with crude from Platform Grace.

Produced sweet gas on Platform Gail will be dehydrated and compressed before entering a new pipeline to Platform Grace. Sockeye gas will commingle with Santa Clara gas and later be comingled with SACS gas before going ashore. Sour gas produced from Platform Gail will be treated at Platform Grace to remove any H_2S utilizing the existing Stretford unit prior to final treatment at Carpinteria. When the zones with sour gas are drilled, samples will be taken and analyzed. These future results will become the design basis for the future processing facilities at Carpinteria.

2.8.1.1 Safety Systems

The Carpinteria plant presently has a variety of safety systems including:

- Pressure relief valves
- Hydrocarbon monitor in the engine room
- Infrared "fire eye" detectors
- High/low alarms for pressure and temperature

2.8.2 Crude Oil Processing

2.8.2.1 Oil Dehydration

As noted earlier, dewatering of the crude will take place on Platform Gail. Free water will be removed from the oil in two parallel/three phase separators. Two parallel electrostatic coalescers will reduce the water content to less than 1 percent. One train will process the Lower Topanga/Sespe oil and the other will be processing the Upper Topanga/Monterey oil. Piping will be provided to commingle the production prior to dehydration to maximize production during shut-down of either coalescers. Oil from the coalescers will be gas stripped to release the H_2S in the crude to 20 ppm or less.

Dry oil from the crude stripper will be pumped from a dry oil surge tank through a lease automatic custody transfer (LACT) meter and via a 8.625-inch (22 cm) O.D. (outside diameter) subsea pipeline to Chevron's Platform Grace. There it will be commingled with Grace's oil and be pumped to shore via Chevron's existing subsea pipeline, then enter an existing pipeline to the Los Angeles area. No additional onshore treatment at Carpinteria is required.

2.9 APPROXIMATE TIME FRAMES FOR CONDUCTING ACTIVITIES

The estimated time frame for this project is shown in Figure 2.9-1, Preliminary Schedule. Each task is shown in sequence. The total estimated time to complete the project is 3.5 years.

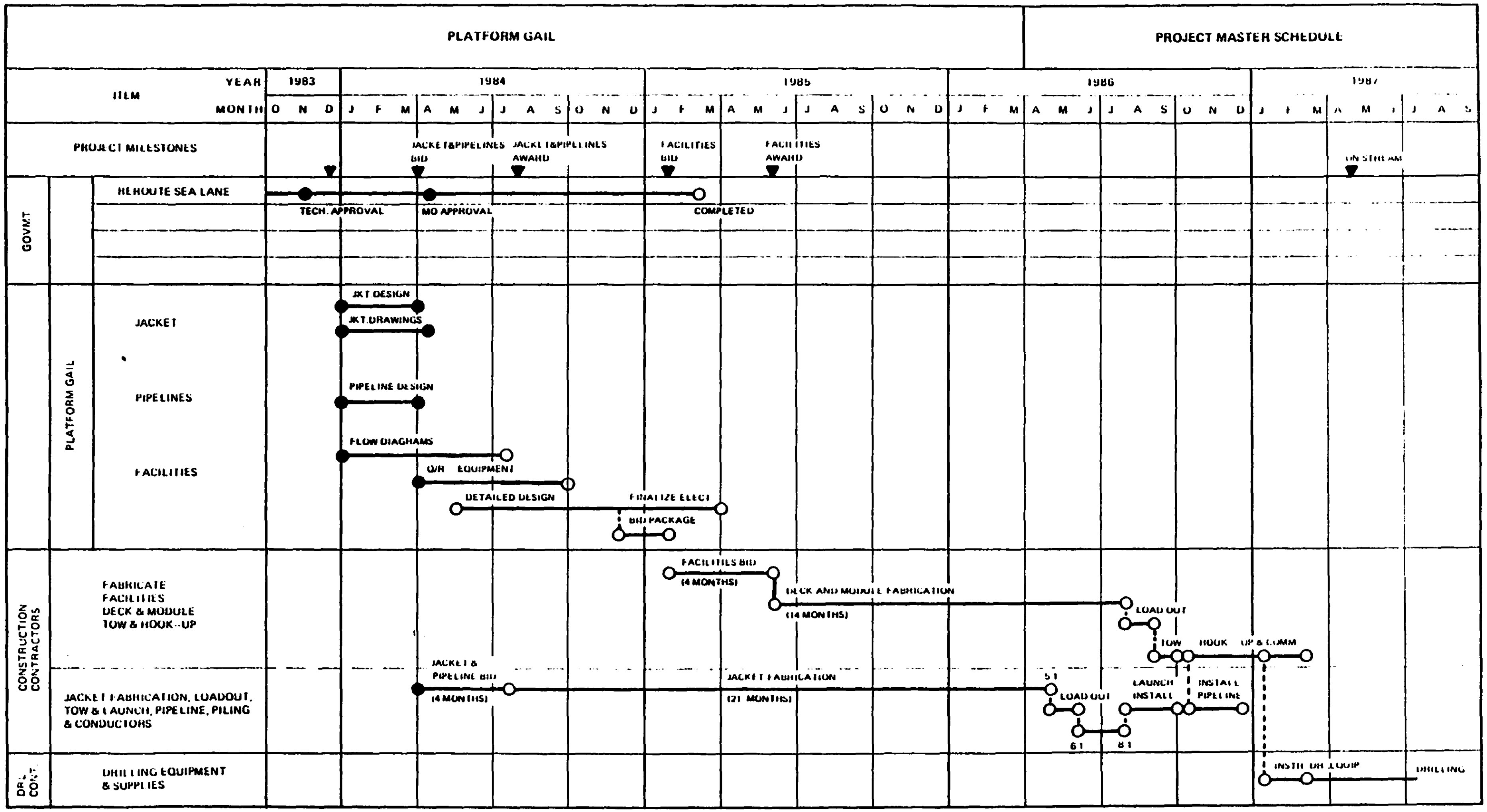
The construction phase for Platform Gail and its ancillary pipelines will encompass the phases as shown in Figure 2.9-1 and highlighted below.

- Final engineering design of the platform and offshore pipelines.
- Fabrication of the platform jacket and processing facilities for proposed Platform Gail as described in the DPP.
- Jacket and module installation (including drilling rig).
- Installation of the subsea pipelines to Platform Grace.

2.10 DISCUSSION OF THE USE OF THE OIL SPILL CONTINGENCY PLAN

It is the policy of Chevron U.S.A. Inc. to execute all necessary and appropriate actions to avoid, contain, cleanup, and dispose of any oil or oily waste that may result from drilling and production operations associated with Platform Gail. Chevron and its contractors will conduct all activities safely and efficiently to prevent the accidental discharge of pollutants.

In the event that a spill does occur, including sheens on the water surface, procedures for reporting and activating spill response measures are described in the Oil



Preliminary Schedule - Platform Gail Project

FIGURE 2.9-1

Spill and Emergency Contingency Plan, Platform Gail - Platform Grace, Santa Clara Unit, submitted to the MMS in accordance with OCS Order No. 7, Pollution Prevention and Control. This plan describes in detail the notification procedures for contacting appropriate government agencies; designation of the spill response teams; description of specific containment and cleanup procedures; equipment inventories; and the locally and regionally available oil spill cooperatives, manpower and service contractors providing specialized cleanup equipment and expertise. The plan also details the procedures for limiting, ceasing, continuing or curtailing critical operations under defined hazardous conditions. An H_2S Plan is also included in the Plan as Appendix 7.

2.10.1 Description of Oil Pollution Prevention Procedures

Prevention of oil spills during drilling and production operations will be performed through full compliance by Chevron and its drilling contractor in accordance with the requirements of OCS Orders No. 2 and 7. Order No. 2 establishes casing and casing-cement requirements; blowout prevention equipment specifications; mud program, testing and control requirements; and a mandatory program for the supervision and surveillance of activities and the training of personnel. Order No. 7 establishes requirements for liquid and solid waste disposal; personnel training and drills for pollution prevention; and pollution inspections and reports.

The primary system used to prevent oil pollution is composed of a properly designed mud and casing program, and a diverter/blowout prevention system, both of which are described in detail in the DPP (Section 3.5). While drilling each well, a pressure integrity test conforming to OCS Order No. 2, paragraph 3.6, will be performed prior to drilling out the cement plug at the conductor, surface, and intermediate casing shoes. All zones which contain oil, gas or fresh water will be fully protected by casing and/or cement as specified in Order No. 2, paragraphs 3.1 through 3.5. Equipment which meets or exceeds the standards set in OCS Order No. 2 will be used. Platform Gail will be equipped with a safety control system designed to shut in all producing wells in case of an emergency. Platform equipment such as pressure relief valves, fire fighting systems, deck drainage collection systems, and well flow control devices have been designed to minimize and prevent accidental spillage of oil and other pollutants.

2.10.2 Personnel Involved in the Implementation of the Contingency Plans

The Oil Spill and Emergency Contingency Plan for Platform Gail - Platform Grace, Santa Clara Unit will utilize two related response teams to make up the overall Oil Spill Response Organization. The first level response, intiated by the Immediate

Response Team, is organized to make maximum use of the persons and equipment located on Platform Gail, the boats at Platform Grace and Carpinteria Pier, and the skimmer on Platform Grace. The team is trained to provide immediate containment and control capabilities for minor spills generally considered to be less than 400 gallons (10 bbl). The team will also initiate control actions for large or uncontained spills regardless of their source.

If it is apparent that the spill cannot be completely controlled by onboard resources, the Major Spill Response Team will be activated. This team will oversee and direct the containment and cleanup operation to ensure that correct procedures are followed and that adequate measures are taken to protect human health and the environment. The Major Spill Response team will also coordinate with Clean Seas (CS) and any other oil spill cooperatives or government response teams that might be involved.

The organizational structure of the Chevron oil spill response teams along with the names and phone numbers for the primary and alternate persons filling each position are outlined in the Oil Spill and Emergency Contingency Plan for Platform Gail - Platform Grace, Santa Clara Unit.

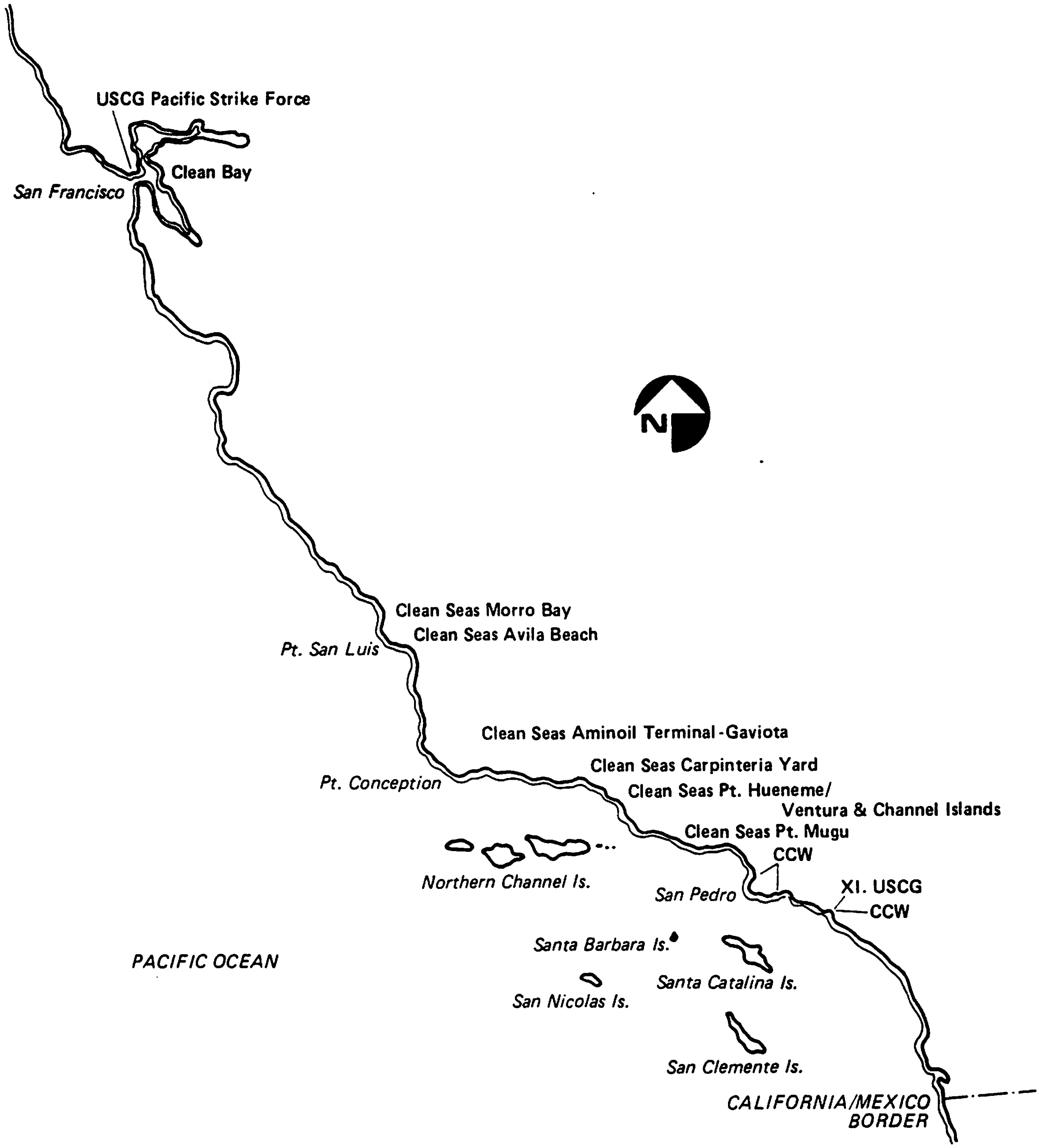
2.10.2.1 Personnel Training

All Chevron platform personnel, spill response teams and contract drilling personnel will receive training in the operation, maintenance and deployment of the containment/cleanup equipment applicable to their function. Instruction will be provided in the proper procedures for requesting the use of chemical collecting agents and dispersants. Scheduled training drills will be conducted to maintain crew proficiency and will include full deployment of all offshore containment and cleanup equipment with the exception of chemical application.

2.10.2.2 Oil Spill Cooperatives

If an oil spill occurs that is beyond the capabilities of onsite personnel and equipment, Chevron will request assistance from Clean Seas, the regional oil spill cooperative responsible for containment and cleanup operations from Cape San Martin to Point Dume.

Clean Seas maintains a large inventory of oil spill cleanup equipment stationed at various locations along the coast (Figure 2.10-1.) A significant portion of the available equipment is stored in mobile "semi-trailer" vans which are located at strategic points or can be moved to appropriate locations as required. Clean Seas main storage yard is located in Carpinteria. Clean Seas currently operates two open ocean oil spill response vessels. Mr. Clean I is based in Santa Barbara and can be onsite at



SOURCE: Clean Seas, 1984.

Locations of Oil Spill Recovery Equipment

FIGURE 2.10-1

Table 2.10-1

OIL SPILL RESPONSE EQUIPMENT CARRIED ON CLEAN SEAS RESPONSE VESSELS

Mr. Clean I	Mr. Clean II
(1) 136' x 36' Dedicated Response Vessel equipped with the following:	(1) 130' x 30' Dedicated Response Vessel equipped with the following:
2 ODI Sections (advancing mode skimmer)	2 ODI Sections (advancing mode skimmer)
1 ODI 750 gpm Pump System for above	1 ODI 750 gpm Pump System for above
1 Vikoma Seapack (with 1600 ft of inflatable boom)	1 Walosep W-3 Skimmer
2000 ft of 43" Expandi Boom on a 10 ft powered reel	2000 ft of 14" x 24" Goodyear Boom
2500 ft of 36" Goodyear Boom	1 Vikoma Seapack (with 1600 ft of inflatable boom)
1 12 Ton Pedestal Crane	2000 ft of 4300 Expandi Boom
1 Komara Skimmer	1 100-bbl Onboard Oil/Water Separation System
1 Dracone Storage Bag, 3 Kepner Storage Bags	4 Kepner Storage Bags
1 Dispersant Spray Unit	1 14-ft Skiff with outboard
1 16-ft Outboard Skiff	1 32-ft Boom Boat with (2) 175 hp motors
1 32-ft Boom Boat with (2) 175/hp motors	1 Dispersant Spray Unit
1 100-bbl Onboard Oil/Water Separation System	1 14-Ton Pedestal Crane
1 Walosep W-3 Skimmer	

Platform Gail in approximately 3 hours. Mr. Clean II is stationed in Port San Luis, San Luis Obispo County. Fully equipped with oil spill containment and recovery equipment, the vessels also contain an oil and water separation tank for processing and storage of recovered oil (Table 2.10-1.) Procedures for requesting Clean Seas equipment are described in the Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace.

Should a spill exceed the capabilities of Clean Seas, additional equipment may be acquired from other cooperatives such as Clean Coastal Waters (Long Beach) and Clean Bay (San Francisco Bay).

2.10.3 Description of Containment and Cleanup Activities

Once a spill has been detected and the source located, Chevron's onsite foreman will initiate the level of response required and establish contact with Chevron management, Clean Seas and appropriate governmental agencies such as the U.S. Coast Guard, Minerals Management Service, and the California Office of Emergency Services.

Responses to minor spills, and initial responses to major spills will be conducted using the equipment at Platform Gail, Platform Grace and at the Carpinteria Pier. Supplementary response equipment for all spills will be provided by Clean Seas as needed.

A preliminary list of the spill equipment that will be used on a spill from Platform Gail or Platform Grace is provided below. The equipment inventory and location for Clean Seas and other spill cooperatives and service contractors operating in the Santa Barbara Channel is contained in the Chevron's Oil Spill and Emergency Contingency Plan.

Platform Gail (proposed)

- 1-750-foot Whittaker Expandi Boom 4300 series or equivalent
- 1-1/2 boxes - (1500 pieces) 3M Sorbent Pads (18 by 18 inches) or equivalent

Platform Grace (existing)

- 1 - 750-foot Whittaker Expandi 4300 Boom or equivalent
- 1 - Walosep W-1 Skimmer
- 240 foot - 3M Sorbent Boom or equivalent
- 1 box - (1000 pieces) 3M Sorbent Pads (18 by 18 inches) or equivalent

Crewboat Stationed at Platform Grace (proposed)

- 1 - 750-foot Whittaker Expandi 4300 Boom
- 1 box - (1000 pieces) 3M Sorbent Pads (18 by 18 inches) or equivalent

- 240 foot - 3M Sorbent Boom or equivalent
- 1 - 1200 gal. floating storage bag for recovered oil

Crewboat Stationed at Carpinteria Pier (proposed)

- 1 - 750-foot Whittaker Expandi 4300 Boom or equivalent
- 1 box - (1000 pieces) 3M Sorbent Pads (18 by 18 inches) or equivalent
- 240 foot - 3M Sorbent Boom or equivalent
- 1 - 1200 gal. floating storage bag for recovered oil

The approximate time required to deploy the spill containment equipment at Platform Gail is approximately 30 minutes under normal conditions. Estimated response time for Clean Seas, Mr. Clean I is approximately 3 hours.

Once the oil is on the water, the initial containment effort will involve deploying a spill boom to encircle the slick thus providing a physical barrier to prevent further spreading. After the spill has been contained the oil will be mechanically removed by Platform Grace's Walosep skimmer or a skimmer from Clean Seas.

If weather or high seas conditions prevent the safe implementation of a spill boom and skimmer, or if the slick is moving towards an environmentally sensitive area, Chevron may elect to initiate the dispersant request process through the Federal On-Scene Coordinator (OSC). A dispersant will be used only after permission is given by the Federal OSC.

A discussion of containment and cleanup procedures for various open ocean and shoreline conditions and detailed information concerning dispersants and their use, relative to this project, are presented in the Oil Spill and Emergency Contingency Plan, Platform Gail-Platform Grace, Santa Clara Unit which accompanies this Environmental Report.

2.10.4 Relationship to Regional Contingency Plans

In addition to individual oil and gas operator contingency plans and regional cooperatives, the following Federal and State contingency plans are also in effect in the project area, as required by legislative mandate.

- National Oil and Hazardous Substances Pollution Contingency Plan
- Region IX Multi-Agency Oil and Hazardous Materials Pollution Contingency Plan
- California Oil Spill Contingency Plan and State Interagency Oil Spill Committee

2.11 SOLID, LIQUID AND GASEOUS WASTES

Discharges of wastes and pollutants into the marine environment fall into two categories: (1) gaseous pollutants and (2) solid and liquid wastes.

In accordance with the provisions of the Federal Water Pollution Control Act, as amended (33 USC 1251 et. seq.), the U.S. EPA regulates the discharge of liquid and solid wastes into federal waters. Upon notification to the EPA of Chevron's intention to operate under the General National Pollutant Discharge Elimination System (NPDES) permit issued by EPA Region IX on December 8, 1983, Chevron will be allowed to discharge from Platform Gail. The permit sets forth effluent limitations, standards and other conditions for discharges from oil and gas facilities. The general permit covers discharges from oil and gas exploration and development platforms for the tracts leased in OCS Lease Sale 35, 48, 68, 1966 and 1968 areas and portions of the Santa Maria Basin (Lease Sale 53). The Platform Gail lease was acquired from Lease Sale P4 (1968). In August 1984, the EPA announced a schedule for the reissuance of the general NPDES permit authorizing discharges from offshore oil and gas facilities in Federal waters by November 30, 1984. However, this schedule has changed. A representative of the EPA's Water Quality Permits Section has indicated the following tentative schedule for the reissuance of the general permit:

Public notice of public hearing and proposal of new general permit	late January 1985
Public hearing	late February 1985
Close of comment period	mid-March 1985
Reissuance of permit	late April 1985

Source: Chevron, 1985

Any platform wastes that might be considered harmful to the environment will be disposed of onshore in an acceptable manner at a government approved disposal site. Disposal of hydrocarbons or questionable substances is adequately addressed in MMS Order No. 7, Pacific Region, effective January 1, 1980. Chevron's disposal practices will be consistent with that order. Wastes generated from platform operations are discussed below and shown in Tables 2.11-2 and 2.11-3.

Table 2.11-2

SOLID AND LIQUID WASTE GENERATION DRILLING PHASE

Disposable Waste	Treatment	Disposal Method	Disposal Frequency	Disposal Rate
Drill cuttings	Wash to remove oil and grease	Discharge to ocean	Continuously when actually drilling	1330 gal/day
Clean drilling mud	None necessary	Discharge to ocean	Daily (average)	0-420 gal/day
Completion fluid	None necessary	Discharge to ocean	Once per well, mostly in one day	0-280 gal/day
Contaminated drilling mud	None necessary	Transport to shore and disposal at an approved site	Variable, as needed	0-20 bbl/day
Cooling water	None necessary	Discharge to ocean	Continuous	4400 gpm outfall (maximum)
Deck drainage	Skim to remove oil and grease	Discharge water to ocean; deliver oil into flotation units	Daily discharge/shore transport as needed	2000-3000 gal/day
Domestic waste and sanitary sewage (maximum)	Electro-catalytic unit	Discharge to ocean	Daily (average)	7000 gal/day
Desalinization brine	None necessary	Discharge to ocean	Daily (average)	72,000 gal/day
General refuse	None necessary	Store in appropriate containers and haul to shore	Weekly	4000 lb/wk

Table 2.11-3

SOLID AND LIQUID WASTE GENERATION PRODUCTION PHASE

Disposable Waste	Treatment	Disposal Method	Disposal Frequency	Disposal Rate
Drill cuttings	Wash to remove oil and grease	Discharge to ocean	Infrequent (associated with redrills or milling)	0-300 ft^3/day
Clean drilling mud	None necessary	Discharge to ocean	Infrequent (associated with redrills)	0-400 bbl/day
Completion fluid	None necessary	Discharge to ocean	As needed - used for pressure control during workovers, milling, etc.	0-180 bbl/day
Contaminated drilling mud	None necessary	Transport to shore and disposal at an approved site	Infrequent, as needed	0-20 bbl/day
Cooling water	None necessary	Discharge to ocean	Continuous	4400 gpm outfall (maximum)
Deck drainage	Skim to remove oil and grease	Discharge water into ocean, deliver oil into production system	Daily discharge/shore transport as needed	0-250 gal/day
Sanitary sewage	Electro-catalytic unit	Discharge to ocean	Daily	3700-7000 gpd
Desalinization brine	None necessary	Discharge to ocean	Daily	0-67,000 gpd
Produced water	Treat to remove oil and grease	Discharge to ocean	Daily	0-11,200 bbl/day
General refuse	None necessary	Store in appropriate containers and haul to shore	Weekly	1000 lb/wk

2.11.1 Sewage and Domestic Waste

Sewage generated on the platform will be processed in an electrocatalytic treatment unit prior to being discharged into the ocean. It is estimated that the total treated volume will be 7000 gallons (167 bbl) per day when the platform is fully occupied with personnel. The domestic waste is the result of operating a 24-hour kitchen, showers and washing machines. Once the drilling phase is completed this volume will decrease significantly.

2.11.2 Deck Drainage and Washdown Drainage

To prevent spills of oil or other pollutants from reaching the ocean, the platform will be equipped with drainage collection systems in all areas where spills are likely to occur. Drainage from the drill floor and other deck areas will be processed in either flotation units or gravity separation units such that it will comply with NPDES permit requirements prior to ocean discharge.

It is estimated that 2000 to 3000 gallons (48 to 71 bbl) per day of deck drainage and washwater will be discharged into the ocean waters. Oily waste will be separated from the water, mud and other materials as required by the NPDES permit, and retained in waste tanks for transport to shore and disposal at an EPA approved Class II-I onshore site.

2.11.3 Drill Cuttings, Sand and Silt From Desander and Silt Separator, Drilling Muds, Excess Cement Slurries, Trap Overflow, and Drainage From Tanks

Drilling fluids are used during development drilling to lift and transport drill cuttings from the bottom of the hole to the surface; to control formation pore pressures; to maintain borehole stability; to protect productive formations; to protect against corrosion; and to cool and lubricate the drill bit and drill string. The mud is pumped down the drill string (drill pipe and drill collars) during drilling and exits at the bit. It then returns via the annulus, is recovered, and treated for recirculation. The mud flows out of the mud return line to a vibrating screen called a "shale shaker", then into the surface mud tank. The drilled cuttings (composed of shattered and pulverized sediment and underlying rock) are physically screened out of the mud by the shaker, washed and discharged overboard in accordance with the NPDES permit.

Drilling solids which are too fine to be separated by screening are removed by gravity separation and centrifugal devices (desanders and desilters). Drill cuttings containing oil will be collected on the platform and transported to shore for disposal at an approved site at Casmalia.

The cuttings wash water will be processed along with other water streams containing oil to the extent that upon discharge to the ocean it will contain no more oil than that mandated by EPA (72 ppm instantaneous average).

Platform Gail will use one drilling rig. Each well is expected to produce approximately 2852 bbls of cuttings. The estimated net volume of excess treated drilling mud is 900 bbl/well and the estimated volume of completion fluid is 600 bbl/well. These numbers are based on drilling experience from Platform Grace. Total volumes of discharge expected over the 8-year drilling program are 97,000 bbls of treated drill cuttings, 30,600 bbls of treated drilling mud and 20,400 bbls of completion fluid. Normally, muds are not disposed of until drilling is complete and, as required by OCS Order No. 7, they are free from oil if discharged.

2.11.4 Brine Concentrate

Operation of the desalinization units will create a brine waste water discharge estimated to be 15 to 20 percent more saline than sea water. The maximum quantity of brine concentrate discharged will be less than 1.1 bbl per minute.

2.11.5 Cooling Water

Cooling sea water will be discharged from the platform into a 54 inch (137 cm) caisson. The caisson outlet is 240 feet (73 m) below mean lower low water (MLLW). The design flow rate and temperature of the water discharge are 4400 gpm and 78°F.

2.11.6 Produced Water

Produced water resulting from the oil dehydration process on the platform will be discharged to the ocean through a disposal caisson approximately 240 feet (72 m) below the ocean surface. To meet the requirements of 40 CFR 435, Effluent Limitations for Offshore, Subcategory of the Oil and Gas Extraction Point Source category, the water will be treated by passing it through a corrugated plate interceptor followed by a flotation cell to remove suspended oil from the water. It is expected that this volume could reach a daily maximum of 11,200 barrels per day after the year 2000.

2.11.7 Cement Slurry/Washdown

Cement slurry and cementing washdown water will be discharged to the ocean without further treatment. Excess cement slurry volumes are expected to be minimal. Cement washdown water discharge will also be minimal. These discharges will not be continuous and will take place only when well casing is being cemented.

2.11.8 Gaseous Wastes

These wastes primarily relate to emissions from internal combustion engines, and emergency flaring. Information on the nature and quantity of emissions, the characteristics and operating frequency of significant emission sources associated with the platform and pipelines, and the calculations associated with the air quality analysis requirements of the DOI is provided in Appendix A. Tables in Section 4.3 provide a summary of these emissions.

2.12 MAPS AND DIAGRAMS OF PROJECT LAYOUT

The location of the proposed platform area is shown in Figures 2.2-1 and 2.5-1. Details on Platform Gail can be found in the Development and Production Plan.

2.13 CERTIFICATION OF COASTAL ZONE CONSISTENCY

The federal Coastal Zone Management Act of 1972 (CZMA) establishes the authority of coastal states to review federal actions (including federally licensed and permitted activities described in OCS plans) affecting land or water uses in the state's coastal zone where the state's coastal management program has been approved by the Secretary of Commerce (CZMA, Section 307(c)(3)(B)). As part of the permit process, applicants for federal permits or approvals must certify that the permitted activity would be consistent with the state coastal management program. The California Coastal Commission must concur with the applicant's consistency certification before activities that could affect land or water uses in the California Coastal Zone are approved.

The proposed installation, drilling and production activities associated with the Platform Gail project could affect land and water uses in the Coastal Zone in a variety of ways. In some cases, these effects are related to onshore activities required to support OCS development, such as increased supply and personnel related traffic in coastal access corridors. In other cases, they could be associated with potential effects at the platform itself, such as the discharge of drilling muds to the ocean floor. Although some potential effects have been identified, the magnitude of anticipated impacts will be minimized by Chevron's incorporation of appropriate mitigation measures.

The proposed activities described in detail in this Environmental Report and the DPP for the installation and operation of Platform Gail on lease OCS P 0205 as part of the Santa Clara Unit development, and the associated subsea pipelines 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 Sockeye Field project has been designed with consolidated offshore facilities to 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 such activities.

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

The construction and drilling phases of the proposed project will contribute to a minimal increase in vehicle and truck traffic in the areas of Carpinteria Pier, Ventura County Airport and Port Hueneme in association with personnel and equipment transport. Activities involve the installation of one new offshore platform and offshore pipelines from proposed Platform Gail to Platform Grace in federal waters.

FINDING

The proposed project would not provide new public access opportunities, nor will it substantially interfere with existing access. Construction traffic activities may create minor temporary access limitations at Port Hueneme or the Carpinteria Pier. However, adequate public access currently exists in the vicinity of these areas.

The proposed project is consistent with this section of the Coastal Act as construction effects will be of limited duration and will not substantially interfere with the public's right to access to the sea.

Sections 30230, 30231, PROTECTION OF THE MARINE ENVIRONMENT

> 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 area contains an abundance of important marine resources. Section 3.6 of this report describes in detail the seabirds, marine mammals, fish resources, and other flora and fauna of the area.

Offshore construction activities will be in relatively close proximity (approximately 0.6 nautical miles [1.3 km]) from the boundary of the Channel Islands National Marine Sanctuary surrounding Anacapa Island and its sensitive biological resources. It is sufficiently removed from the mainland to generally minimize impacts on marine sanctuaries, rocky intertidal and significant estuarine habitats. The construction of the platform will occur during the seasonal cetacean migration period.

The primary activities during installation and operation of the pipeline and platform that may affect marine resources in the project vicinity are summarized below.

Construction of the platform and offshore pipelines will increase suspended solids in the general area of construction. This condition is temporary and will occur intermittently over an approximate span of 6 months, involving the following activities:

a. Installation of platform pilings.

b. Relocation of work barge anchors.

c. Placement of subsea pipelines and lay barge anchors.

Localized turbidity would have short-term minor effects upon flora, fauna and bottom-dwelling biota. The water depth and currents in the project area ensure maximum dilution and rapid settling of the suspended plume.

Long-term localized changes in bottom habitat where the platform structure is placed will have a moderate biological impact, creating additional habitat and a localized increase in the number of fish and other marine organisms present. The presence of platform structures result in increased fish production and this effect is considered to be beneficial.

Possible conflicts with commercial fishing are the platform placement which restricts surface and subsurface fishing activities and potential fishing gear losses associated with industrial debris and anchor scars. Chevron's commitment to use pipelines with minimum surface obstructions and to quickly reimburse fishermen for equipment losses resulting from their facilities will effectively mitigate the majority of impacts associated with this development. The loss of a fishing area is more difficult to mitigate, particularly this area, since the primary fishing species are pelagic (mackerel and anchovies) which are not distributed in the same manner as benthic (habitat dependent) species. Catch tonnage in the area of the platform is highly variable due to a variety of factors and the impact of the platform placement is difficult to assess in terms of loss (or gain) to the fishing.

Chevron will inform local commercial fishermen of the schedule and location of construction activities. Locations will be identified on a bathymetric chart using Loran-C coordinates to assist fishermen in identifying the area.

All associated discharges from platform operations, such as hydrostatic test water, sanitary waste and brine from the desalinization unit, are subject to and will comply with the EPA NPDES permit conditions. These discharges could result in temporary, localized turbidity and water quality changes, and are expected to have negligible adverse effects. All discharge points on the Outer Continental Shelf are located further than 3280 feet (1000 m) seaward of the State 3-mile (5 km) boundary as well as outside the 6 mile (9.6 km) limit of the Channel Island's National Marine Sanctuary and will not affect the water quality or biological productivity of the

State's waters. Any concentration of materials above normal background levels will be diluted rapidly by waves and currents.

All solid wastes generated aboard the platform, with the exception of washed drill cuttings, drilling muds and washed produced sand, 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 processed in a flotation unit on the platform to remove free oil and suspended solids such that it will meet existing federal permit requirements (72 ppm maximum oil concentration) prior to discharge to the ocean. Deck drainage from rain runoff and washdown will be processed in either flotation units or gravity separation units such that it will comply with general NPDES permit requirements prior to discharge to the ocean.

The U.S. Environmental Protection Agency 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 well locations are beyond 3280 feet (1000 m) of state waters, and according to a policy established by the Commission in 1980, discharges of drilling muds and cuttings from operations conducted more than 3280 feet (1000 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 Section 4.6 of this Environmental Report. 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 from Platform Gail 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 potential burial of some types of benthic organisms in the immediate area of discharge; however, the areas subject to burial should experience only short-term impacts. Most motile benthic organisms can migrate through deposited material.

The release of drilling muds and cuttings will produce a disturbance of the sediments and localized turbidity in the vicinity of the platform. The sediment effects are physical in nature, as only cleaned cuttings, formation sands and drilling muds are to be dumped into the surrounding waters. Both epifaunal and infaunal benthic communities will be locally affected to some degree. Reduced water clarity associated with mud discharges is expected to have little, if any, impact on phytoplankton productivity because these discharges would be localized and occur below the photic zone. The normal functions and interactions of local benthic communities will be temporarily disturbed by the deposition of sediments from drilling and construction. However, the disposal of cuttings and mud has no significant impact on pelagic fauna.

There is no evidence that cetaceans, pinnipeds, or seabirds are adversely impacted by routine drilling or production operations.

FINDING

The proposed activities are consistent with the enumerated policies for the following reasons:

1. Compliance with MMS regulations (particularly OCS Order No. 7, prohibiting ocean dumping of muds containing toxic compounds) and EPA NPDES permit requirements.
2. Construction of the platform and pipelines will have a short-term, insignificant impact upon localized flora, fauna and bottom-dwelling biota, thereby preserving the overall marine resources in the project area.
3. The platform and pipelines will provide additional habitat for fish and other marine organisms, thereby enhancing the marine environment.
4. 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 minor reduction of available food to animals at higher trophic levels; 2) a temporary increase in water turbidity and consequent reduction of light for plant photosynthesis; and 3) possible interference of recolonization in the cutting mound if

textural differences exist between the deposit and adjacent natural sediments. The discharge of drilling muds at the platform site will not affect marine resources and productivity within coastal state waters.

5. The produced water, separated from the crude oil, will be sent to water treatment facilities for oil removal at both Platform Gail and onshore facilities. The produced water cleanup facility allows the produced water to be discharged to the ocean. Treatment prior to disposal will consist of a skim tank for removal of oil and suspended solids by gravity separation. The water will then be passed through a flotation cell to remove suspended oil. The treated water (meeting the NPDES requirements) will then be discharged to the ocean.

Section 30232, PROTECTION AGAINST 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 proposed project would increase the risk of an oil spill originating in federal waters. Potential spills could be associated with the platform, and offshore pipelines and marine vessel casualties. Protection against the spillage of crude oil will be a routine part of Chevron's operations.

To protect the environment in the unlikely event of an oil spill, and pursuant to OCS Order No. 7, Chevron is submitting to the MMS with the DPP a detailed Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace, Santa Clara Unit. The contingency plan specifically outlines the immediate response and postspill procedures to be followed, notifications to all appropriate governmental agencies, and the deployment of personnel and equipment.

Inter-platform equipment is designed to handle spills up to 420 gallons (10 bbl). Should a larger spill occur, the equipment listed in Section 2.10.3 of the Project Description will be deployed as a first-response effort to control the spill until the assistance of local oil spill cooperatives is obtained, if necessary. Chevron is a member of Clean Seas, the regional oil spill cooperative responsible for containment and cleanup operations in the Santa Barbara Channel. Clean Seas' vessel Mr. Clean I has a response time of 3 hours from the Santa Barbara Harbor. Assistance may be acquired from other cooperatives in the area, including Clean Coastal Waters (Long Beach) and Clean Bay (San Francisco Bay).

The responsible Chevron onsite representative will request the assistance of the spill cooperative should a need arise. As a participant in Clean Seas, Chevron can draw upon spill equipment from their inventories as needed. Chevron can also acquire spill equipment from its refinery at El Segundo as well as from other oil companies operating in or near the Santa Barbara Channel. Response to a spill is immediate, and any additional equipment and manpower can be deployed to the platform site from the Santa Barbara/Ventura area within 1 to 3 hours for any spill in excess of 420 gallons (10 bbl). The curbs fitted onto the platform decks and the drainage system will provide additional protection against any small oil spillage that might occur on the platform.

To protect against the occurrence of a blowout, Platform Gail will be fully equipped with blowout preventer (BOP) equipment, as specified in the OCS Order No. 2, and will observe safe drilling practices in compliance with all applicable OCS orders and USGS regulations.

To protect against the occurrence of an oil spill due to pipeline or vessel rupture, Chevron will equip the platform with the current state-of-the-art safety technology as required in OCS Order No. 5 and OCS Order No. 9. Spill volumes will be minimized through pressure and flow monitors.

Fuel transportation and fuel transfer operations are controlled by the MMS anti-pollution regulations (CFR Title 33, Parts 154 and 156). The contractor that will be supplying diesel fuel to the platform will comply with these regulations.

The pipelines from Platform Gail to Platform Grace will be protected from over-pressure by means of a pressure switch set to automatically shut down the pumps when a predetermined pressure is exceeded. The oil pipeline is monitored in two ways to detect leaks and limit the amount of oil spilled in the event of a leak. Very large leaks (i.e., pipeline rupture) will be detected by a low pressure sensor on the pipeline exit from the platform. In the event that this sensor detects an abnormally low pressure caused by a pipeline break, all oil shipping pumps will be automatically stopped. A volumetric leak detection system is intended to detect leaks smaller than a rupture.

The procedures for preventing and reacting to oil spills are described in detail in Chevron's Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace, Santa Clara Unit. The oil spill containment procedures and equipment identified therein provide the maximum feasible mitigation of oil spill risks. Chevron's emphasis on the rapid protection of sensitive coastal areas in its spill contingency plan will help reduce potential impacts should a spill originate from a nearshore location.

FINDING

The proposed activities are consistent with the policy to protect against oil spills because: 1) all possible protective measures will be 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. Because Chevron has placed special emphasis on spill prevention and contingency planning, the proposed project is consistent with this section of the Coastal Act.

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 construction, drilling and production phases of the proposed project involve vessel movements within the channel to and from the Carpinteria Pier and Port Hueneme. The proposed project is not expected to reduce commercial fishing or recreational boating harbor space at any such facilities within the channel. The proposed installation of the platform has the potential to restrict purse seine fishing activity in the areas around the platform. Other types of commercial fishing should not be significantly affected.

FINDING

The proposed project will not compete with commercial or recreational vessels for available dock space or ancillary facilities at Port Hueneme and is therefore consistent with the policy stated above.

The site of the proposed platform is in an area of moderate to high purse seining activity particularly for anchovies, with adjacent shallower areas used for mackeral fishing. Due to the immobility of the fishing vessel while the net is set and the winds and currents in the area, some area of restrictions for purse seine fishermen around the platform will result. The area affected cannot be absolutely determined due to the variability in the physical environment but could be from 2 to 10 square miles depending upon current speeds and wind. The loss of that specific area may not be significant to the fishing, but would incrementally add restrictions to local fishing activity.

Anchovies and mackeral are pelagic species and as such are not always found in the same location, therefore, it is difficult to assess the overall impact of the platform on commercial fishing activity. Chevron will work with local fishing groups to reduce any potential impacts to commercial fishing. All support vessels will use a traffic lane set up by the Santa Barbara Channel Oil Service Vessel Traffic Corridor Program (refer to Section 2.6). Thus, the project is consistent with this Coastal Act policy.

Section 30240, ENVIRONMENTALLY SENSITIVE HABITAT AREAS

> Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on such resources shall be allowed within such 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 such areas, and shall be compatible with the continuance of such habitat areas.

ASSESSMENT

The proposed activities could impact environmentally sensitive areas such as the Channel Islands, and particularly Anacapa Island in the unlikely event of a major oil spill occurring and reaching the island shoreline. The impacts of an oil spill on sensitive biological communities in these areas are discussed in Section 4.6 of this report. The Oil Spill and Emergency Contingency Plan for Platform Gail - Platform Grace 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. Chevron's Oil Spill and Emergency Contingency plan includes particular reference to these sensitive areas.

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 significantly impact any environmentally sensitive habitat areas in the general vicinity, and the impact of an oil spill or blowout would be mitigated by observing the requirements of OCS Order No. 7, requiring that immediate action be taken to minimize the impact on water and marine resources.

Section 30244, PROTECTION OF 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

Notices to Leases (NTL) 77-3, "Minimum Cultural Survey Requirements, OCS Exploratory Drilling," requires that a cultural resource survey be conducted prior to approval of OCS drilling operations in less than

394 feet (120 m) of water. Platform Gail will be located in approximately 739 feet (225 m) of water, and is therefore exempt from this requirement.

A marine cultural resources survey was conducted along the pipeline route in water depths less than 394 feet (225 m) to determine the location of potential archaeological sites and artifacts in accordance with (NTL) 77-3 (Woodward-Clyde Consultants, 1981). Side-scan sonar data provided a cultural resource survey of the pipeline route (Woodward-Clyde) which indicates no anomalies along the survey route that could be interpreted as possible shipwrecks. All other anomalies were assessed as linear features (cables or anchor drag marks), existing pipelines, or low relief targets (possible scattered outcrops). For further information, refer to Appendix E in Woodward-Clyde Consultants, 1981.

FINDING

Based on the results of the cultural resource assessment, no archaeological sites or artifacts are expected to be encountered or affected by the proposed activities. Therefore, the proposed activities are considered consistent with this section of the Coastal Act.

Section 30251, COASTAL VISUAL RESOURCES AND SPECIAL COMMUNITIES

> 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.
>
> New development shall, where appropriate, protect special communities and neighborhoods which because of their unique characteristics, are popular visitor destination points for recreation uses.

ASSESSMENT

The installation of Platform Gail and associated offshore construction activities are potentially visible from Ormond Beach County Park, and by beach users along the Ventura shoreline and passengers on the Amtrack rail line. Visual intrusive effects will be limited by the short-term nature of construction activities. Visual intrusion of Platform Gail during drilling and production will be limited as the platform's appearance would not be unique on the horizon line due to the presence of other platform structures in the immediate area. The visual instrusion is of minor significance because of the platform's distance from shore (9 nautical miles [14 km] at its closest point), and frequent fog and haze limitations on visibility.

Installation of the pipelines will also have a temporary short-term adverse effect on coastal views. Visual impacts are essentially mitigated by the short-term duration of the activity.

FINDING

The proposed project will not adversely affect or interfere with views of the ocean or coastal areas. The offshore platform will appear diminutive in scale from shoreline viewing locations and generally will not be visible due to its distance from shore (9 nautical miles [14 km] to the nearest shoreline location), and the presence of fog and haze offshore during much of the year. The project is considered to be in conformance with the above stated policy.

Section 30253, HAZARD AND ENERGY CONSERVATION CRITERIA

> 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

Sections 1) and 2) are applicable to the design and construction of the new platform and seafloor pipelines.

Based on detailed site surveys by Woodward-Clyde Consultants, 1981, there are no faults passing through the platform site or pipeline area. Active faults in the general region could generate seismic groundshaking at the project site. The "strength" level design earthquake would have a peak ground acceleration of 22 percent of gravity and a 270-year recurrence interval. The "extreme" level design earthquake would result in peak accelerations of 0.55 g in rock or stiff sand and 0.35 g at the mudline in the project area. This event has a return period of over 4000 years.

In addition to local seismic conditions, the proposed drilling program presents potential hazards due to slope stability and shallow gas. Compliance with geotechnical and structural engineering design criteria dictated by good construction practice and/or required by regulatory agencies will assure that potential impacts are mitigated. For further information refer to Sections 3.1 and 4.1 of this ER.

Subsection 3) is not applicable as the State Air Resources Board and the local APCD do not have jurisdiction over activities on the federal OCS.

The proposed activities will generate gaseous emissions containing hydrocarbons, CO, SO_2, NO_x and particulates. The total offshore emissions fall considerably below the MMS exemption level provided in 30 CFR Part 250. Further discussion of air quality emissions and requirements is provided in Section 4.3.

The proposed project will comply with all Clean Air Act and DOI requirements and will receive all necessary permits and approvals prior to operation. The project will incorporate several control technologies including water injection on gas turbines to reduce NO_x, diesel engines tuned for low NO_x emissions, fugitive emissions program and smokeless flare burners to minimize the level of hydrocarbon and nitrogen oxide emissions to the atmosphere.

Subsection 4) is generally applicable to employee transit, particularly during relatively high levels of activity (such as construction and drilling phases).

Energy consumption will be minimized during the proposed activities by the use of recycled waste heat from the turbine generators for oil treatment and utilization of treated produced gas generated from the platform to help supply normal operating fuel requirements for the platform. The project itself represents a net production of energy. As discussed in Section 3.7 of this report, project 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 project is consistent with the goals and intent of the above policy for the following reasons:

1. Based on the known submarine geology, earthquake recurrence intervals, and best available safety technology, the structure will be designed in accordance with the latest edition of OCS Order No. 8 for the most severe loads that might occur during launch and installation, and during operations, to safely withstand the potential earthquake groundshaking identified for the region. Complete details on site conditions, design criteria, platform analyses, fabrication and installation will be provided as part of the Verification Documentation required for OCS Order No. 8, as reviewed by the MMS.
2. The platform structure will remain stable under "strength" level earthquake conditions, and will have adequate energy absorption capacity to prevent structural failure under an "extreme" level earthquake. The design will also incorporate the ability of the platform to withstand extreme oceanographic conditions.

3. OCS Order No. 2 and implementation of best available safety technology will minimize the risk of blowout resulting from possible shallow gas.
4. The proposed platform and pipelines will be designed to minimize the risk of damage from geologic hazards, including unstable slopes, and to ensure structural integrity.
5. The proposed activities will comply with all Clean Air Act and DOI established regulations, 30 CFR Part 250, concerning air emissions from offshore oil and gas operations.
6. Energy consumption will be minimized during the proposed activities by use of recycled waste heat and processed gas.
7. The Santa Barbara/Ventura Coastal areas provide a number of recreational opportunities which attract tourism to the region. The proposed project will be situated approximately 6.5 nautical miles (10.5 km) from Anacapa Island, 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 significantly disrupted as a result of project construction activities and no long-term effects on recreational opportunities are expected.

Section 30260, LOCATING INDUSTRIAL DEVELOPMENT

> 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 Section 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

All components of the proposed project are coastal dependent, requiring a location on or adjacent to the ocean to be able to function. The proposed platform site is located in an existing developed field where offshore oil and gas extraction and production facilities in the channel are a common use.

FINDING

The location of the platform is dictated by technical constraints and relocation is considered infeasible due to the location of the Vessel Traffic Separation Scheme and the Channel Islands National Marine Sanctuary boundary which abuts the southern lease boundary. Pipeline routing follows the most direct technically feasible alignment that provides for avoidance of sensitive marine habitats and geologic hazards. Chevron intends to use its existing gas plant at Carpinteria and existing pipeline network to Los Angeles for Platform Gail production.

Because domestic production of oil is considered to be in the national interest and is important to the State and local economy, the implementation of the proposed project is in the public's interest.

Chevron's incorporation of development standards and other mitigation measures as part of the proposed project effectively mitigates potentially adverse environmental effects to the maximum extent possible. As described above, the Platform Gail project meets the requirements of Section 30260 and is, therefore, consistent with the Coastal Act.

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 to 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 nearshore 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

With respect to subsection a), all project phases are generally applicable. Subsection b) is generally applicable to the subsea pipelines. Subsection c) is applicable to the new drilling production platform. Subsection d) is applicable to the siting of the platform. Subsection e) is applicable to fluid extraction during the production phase. Subsection f) is applicable to the disposal of produced brines.

The proposed platform will be located in the most suitable site in terms of the least impact on the environment and greatest advantage for oil production. The proposed location of Platform Gail is very critical to maximize oil recoveries and at the same time avoid mechanical problems in drilling, completing and producing highly deviated hole wells. After careful consideration, it was decided that the optimum platform location was at Lambert coordinates X = 1,046,650E, Y = 726,990N within Lease OCS P 0205. A platform at this location will maximize oil recoveries from the main oil accumulation as well as be located outside of the Channel Islands National Marine Sanctuary. Also, most of the potential reserves in the smaller accumulations can be developed from this location.

FINDING

The proposed activities are consistent with the enumerated policies for the following reasons:

1. All of the geological data available from former studies and the geophysical survey for Platform Gail have been extensively evaluated by Chevron in order to determine the safest, most effective platform structure design. Design, fabrication, and installation will all be performed in accordance with the latest edition of OCS Order No. 8. Prior to the approval of the proposed platform, the detailed shallow hazards and geophysical survey report will be reviewed according to the MMS Verification Program (OCS Order No. 5) to ensure that the development is performed safely.
2. OCS Order No. 2 regulating casing and mud programs and implementation of best available safety technology minimize the risk of a blowout resulting from communication between

a higher pressure strata and a lower pressure strata. In addition, Chevron has extensive experience drilling and operating in the offshore environment. If experience dictates, steps in addition to those required per the MMS will be taken to insure the safety of the personnel and protection against a major oil spill.

3. The platform location and design includes the most effective feasible consolidation of multiple-wells drilled from one surface location. Pipelines will be consolidated and Chevron will use its existing facility site at Carpinteria to process production from Platform Gail.
4. The platform will be sited in accordance with the requirements of the U.S. Army Corps of Engineers and the U.S. Coast Guard. The proposed Platform is located approximately 0.6 nautical miles (1.1 km) from the Vessel Transportation Separation Scheme (VTSS). Potential hazards to navigation are further reduced by compliance with Class I Private Aids to Navigation for Artificial Islands and Fixed Structures (USCG-4143).
5. Produced water will be discharged in accordance with the EPA General NPDES Permit. The proposed project is consistent with this Coastal Act requirement.

2.14 COMPLIANCE WITH OCS ORDERS AND REGULATIONS

Submittal of this Environmental Report (Development/Production) and the accompanying Development and Production Plan for the Sockeye Field and discoveries of the proposed Platform Gail complies with the regulations in 30 CFR 250.34, OCS Order No. 2, and NTL 80-2 "Minimum Requirements for Environmental Reports," dated March 20, 1980. Other measures in compliance with these regulations include:

1. Certification of Consistency with California's Coastal Management Plan.
2. The platform will be marked in accordance with OCS Order No. 1, Paragraph 1. Measures to comply with OCS Order No. 2 include filing of applications for permits to drill (also follows NTL 80-2), submittal of evidence of fitness of drilling unit with operational limitations and anticipated conditions, including safety, firefighting, and pollution

equipment, completion and submittal of a Shallow Geological Hazard Survey and Report (conforms in detail with NTL 80-2). The following activities will conform to MMS requirements: well casing and cementing program including testing; directional surveys; blowout preventers, testing programs and drills; mud program and monitoring; and supervision, surveillance and training of drilling personnel. A Critical Operations and Curtailment Plan is included in the Oil Spill and Emergency Contingency Plan for Platform Gail submitted to the MMS concurrently with this Environmental Report.

3. Each well will be plugged and abandoned in compliance with OCS Order No. 3.

4. OCS Order No. 4, Determination of Well Producability, requires all production tests to be witnessed by an authorized representative of the MMS. To comply with this order, the MMS office will be notified as required. In complying with OCS Order No. 5, Chevron shall install and operate the Best Available Safety Technology aboard the Platform.

5. The wellhead completions performed on Platform Gail will meet the requirements of OCS Order No. 6. Solid and liquid disposal and discharge from the facility will comply with OCS Order No. 7. The measures which will be taken include reporting of drilling mud components, disposal of excess mud and drill cuttings under EPA permitting procedures, curbs, gutters, and drains to collect all contaminated deck drainage (also regulated by the U.S. Coast Guard), containers and similar solid waste material transported ashore for disposal, personnel instruction, training and drills, pollution inspection and reports, oil spill contingency plan on file, pollution control equipment, and materials maintained on board the vessel or standby boat.

6. Per OCS Order No. 8, Chevron will obtain design verification for all platform facilities through a MMS-approved third party Verification Agent.

7. The design of the pipeline will be in accordance with the provisions of OCS Order No. 9, which includes approved leak detection devices, high-low pressure monitoring and shut-in equipment.

8. OCS Order No. 10, Twin Core Holes, does not apply to this project.

9. Chevron will comply with OCS Order No. 11. This includes proposing a maximum efficient rate from the reservoir(s) encountered during the drilling program within 45 days of first production from that reservoir. The operator will provide maximum production rate information as required and follow the testing and completion procedures outlined.

10. The operator will mark documents available for public inspection per OCS Order No. 12.

In addition to the above, Chevron will obtain U.S. Army Corps of Engineers' approval of the platform location.

2.15 NEARBY PENDING ACTIONS

Two production platforms are presently installed in the Santa Clara Unit; Chevron's Platform Grace is located on OCS P 0217, and Union's Platform Gilda is situated on OCS Lease P 0216 north of OCS P 0205.

Other actions pending near Lease P 0205 include the following:

Operator	Activity	Lease
Chevron (pending)	Exploratory drilling, possible development if drilling results are successful.	PRC 3150 PRC 3184
Chevron (current)	Exploratory drilling.	OCS P0210

2.16 MEANS FOR TRANSPORTING OIL AND GAS TO SHORE

As discussed in Section 2.7, Pipeline System, three submarine pipelines (oil, gas, spare) will be installed between Platforms Gail and Grace. From Grace the oil and gas will enter an existing pipeline system to Platform Hope in state waters. From Platform Hope the oil and gas will also enter an existing pipeline system to the Carpinteria Gas Plant. Oil will not require any additional treatment at Carpinteria and thus, will be transferred to an existing pipeline system to the Los Angeles Area. Gas will be treated on Platform Grace and transported to Carpinteria, then sold (Section 2.8.)

2.17 MONITORING SYSTEMS

Onboard monitoring systems are described in the DPP (Section 6) and in Section 2.5.6 of the ER. Many agencies currently regulate or have authority over specific activities and particular natural resources. No single authority has responsibility for monitoring the entire system. The operators who will be conducting activities in the

OCS Region will be maintaining close surveillance during all drilling/production activities. As an element of MMS supervision, extensive cooperation will be maintained with the U.S. Coast Guard, National Marine Fisheries Service and EPA.

2.18 ENVIRONMENTAL PROTECTION MEASURES

This section presents measures that Chevron has incorporated into the Platform Gail project to reduce potential impacts and ensure that the project is implemented in an environmentally sound manner. As Chevron proceeds with final engineering design, additional environmental protection measures will be incorporated into the project plans as appropriate.

1. All applicable codes and regulations will be complied with.
2. All required permits, certificates, licenses, and approvals will be obtained and complied with.
3. Chevron will continue to conduct inhouse training programs to develop safe working practices for its employees.
4. All Platform Gail project activities will be scheduled to encompass the minimum time period consistent with efficient resource extraction.
5. Offshore and onshore transportation will be consolidated with those of other operations to the extent possible to minimize the amount of new facilities.
6. Consumptive use of fresh water will be reduced to the extent practicable.
7. To the extent possible, fresh water requirements will be met using desalination units on vessels (during installation) and the platform (hookup, drilling, and production) to minimize the effect on regional fresh water supplies.
8. Geotechnical and structural engineering studies have been conducted to ensure proper design of the platform and pipelines. Final engineering will incorporate the findings and recommendations of the geotechnical and engineering studies and reports.
9. All natural gas-fired turbines on the platform will be equipped with water injection systems to reduce NO_x emissions.
10. Some of the natural gas-fired turbines will be equipped with waste heat recovery units to reduce fuel consumption and the need for fired heaters. Fuel efficiency was a key factor in selecting turbines for power generation and gas compression.

11. Crew and supply boat trips will be scheduled to minimize the total number of vessel movements. All vessels will follow a predetermined vessel route (Section 2.6.).
12. All workers will be encouraged to participate in car and van pools.
13. The subsea pipelines will be installed in a corridor selected to minimize the total area to be disturbed within the constraints imposed by geologic conditions and safety, risk, and technical factors.
14. No oil-contaminated drill cuttings or drilling muds will be discharged to the ocean; they will be hauled to shore for disposal at an approved site.
15. All platform deck drainage will be treated to remove oily contaminants; all oil-contaminated solid wastes would be disposed of at an approved onshore site (probably Casmalia).
16. In the event of an accidental oil spill, appropriate actions will be taken as outlined in Chevron Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace, Santa Clara Unit. Spilled fluids will be retrieved, any affected wildlife will be rehabilitated, and affected habitats will be restored to the extent feasible.
17. Drill cuttings and drilling mud discharges will be made at a predetermined depth to minimize effects on the marine biota of the euphotic zone.
18. The subsea pipelines will be designed and installed in a manner intended to minimize the potential for fishing gear to be damaged.
19. Existing onshore support facilities at Port Hueneme, Chevron Pier, and Ventura County Airport will be used to avoid proliferation of such facilities.
20. To the maximum extent feasible and consistent with good business practice, materials and services expenditures will be made locally to maximize beneficial economic effects.
21. Oil and gas well casing designs, mud programs, and detailed drilling procedures have been developed to maximize well control and safety; and minimize the possibility of an oil spill due to loss of well control.
22. A fugitive emissions inspection program will be implemented.
23. A flare system will be in place to prevent accidental hydrocarbon emissions.

2.19 CUMULATIVE DEVELOPMENTS

The proposed action is one part of ongoing oil exploration and development activities offshore and onshore of Ventura and Santa Barbara counties. In addition, major non-oil related projects are planned, that will have a significant impact on the natural resources of the affected communities. Examples of major non-oil related activities include:

- Expansion of activities at Vandenberg AFB.
- Santa Barbara cross-town freeway project.
- Major residential and commercial land development projects occuring at various locations in Santa Barbara and Ventura counties.
- Expansion of the Santa Barbara Airport.
- Port of Port Hueneme Master Plan expansion.

These various ongoing and planned oil and non-oil related projects, also referred to as cumulative projects, can have impacts on resources and services which are cumulatively significant, though the proposed action's share of the impact is only a minor increment of the total (Platform Gail is but one of up to 15 planned platforms in the Santa Barbara Channel) and is largely insignificant by itself. Recent analyses of cumulative impacts within the greater Santa Barbara Channel area are contained in the MMS Lease Sale 80 document (U.S. Department of the Interior, 1983) and in the Point Arguello Development Plan EIR/EIS (A.D. Little, 1984).

The proposed project will be operative for an approximate 30-year period commencing in mid-1987, with peak oil production occurring in 1990 and peak gas production in 1998. Peak oil production from cumulative projects in 1990 was recently forecast to be 459 thousand BPD (using the scenario that assumes Santa Ynez unit production is not constrained by transportation capacity [A.D. Little, 1984]). Peak gas production in 1995 (no figures are available for 1998) was projected to be 305 MMSCFD (A.D. Little, 1984). These figures do not include very recent applications or prospective projects including, leasing and development activities on up to five state leases (SLC Quitclaim Lease Project) commencing in the late 1990s and Shell California Production Inc.'s PRC 2920 Hercules Development Project for 30,000 BPD of oil and 100 MMSCFD of gas, commencing by 1990. Conversely, while the above scenario for cumulative oil development is reasonably foreseeable and planned, it is likely that the individual projects will be started over a longer time frame than indicated and it is probable that not all identified projects will be constructed. The delays in project implementation are due to a number of factors including the timing of State lease sales in the Point Conception to Point Arguello area and protracted local agency development plan processing requirements. Another possible cause of delay for projects in State waters is that fewer and fewer air emissions offsets will be available to satisfy local air pollution control district permitting requirements.

Cumulative impacts of the project are assessed by environmental topic in each subsection of Section 4, Environmental Consequences of the Proposed Action and Recommended Mitigation Measures. The focus of the analysis is to identify the effects of a cumulative nature that would increase the significance of the stated project impacts and to address the mitigation measures Chevron has proposed to minimize these impacts.

SECTION 3
DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 GEOLOGY, SOILS AND GEOLOGIC HAZARDS

Geologic elements of the environment that could affect or be affected by the proposed Platform Gail and subsea pipeline project are described below. Included are descriptions of regional and site-specific physiography and bathymetry, geology, soils, geologic hazards, and groundwater hydrology.

3.1.1 Data Base

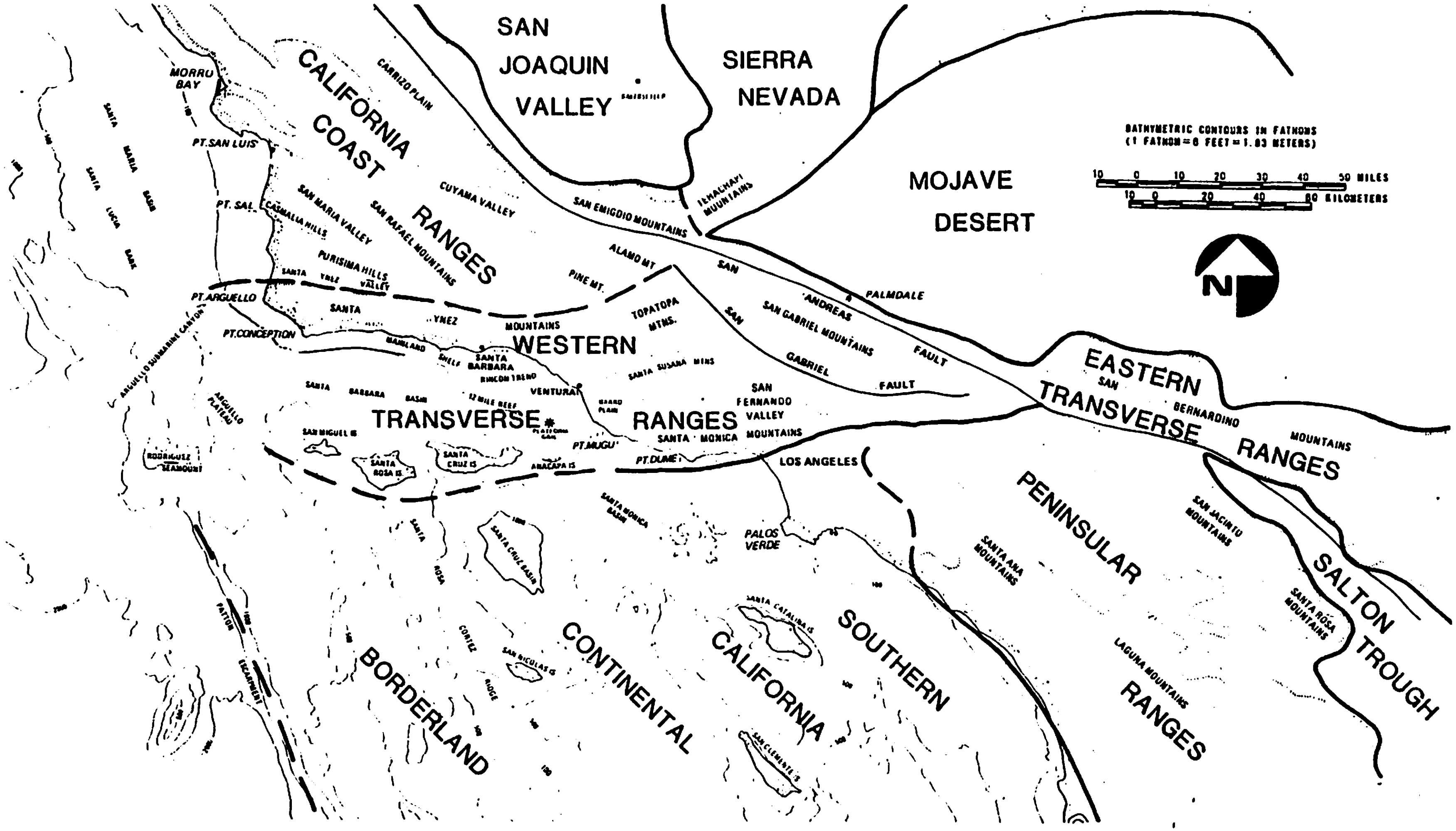
Information related to the regional and local geologic aspects of the proposed project area are available from a number of reports and studies. Environmental Statements covering federal oil and gas leasing activities in the region have been prepared and published by the U.S. Geological Survey (1976) and the U.S. Bureau of Land Management (1979). In addition, several environmental reports addressing exploratory drilling projects and earlier oil and gas development in the Santa Clara Unit are available (see Chevron, 1976, 1980 and 1981; and Woodward-Clyde, 1978). A number of detailed geophysical, geohazards and geotechnical investigations have prepared for both the Santa Clara Unit in general and the proposed Platform Gail and subsea pipeline project in particular. These include earlier studies by Aquatronics International (1974) and General Oceanographics (1978), and later investigations by Dames and Moore (1981) and Woodward-Clyde (1981a and b). Chevron's (1984) Development and Production Plan for Platform Gail and the associated subsea pipelines also contains pertinent geologic baseline data.

3.1.2 Physiography and Bathymetry

3.1.2.1 Regional Setting

The proposed project lies in the western portion of the Transverse Ranges physiographic province (Figure 3.1-1). This province is an east-west trending feature which, as its name suggests, has a topographic and structural grain oriented transverse to the northwest-trending Coast Ranges and Peninsular Ranges to the north and south, respectively. The Transverse Ranges consist of high, relatively steep mountains and lower, broad hills that are flanked or separated by narrow to moderately broad valleys. The province is characterized by major topographic contrasts and includes the highest peaks in southern California.

The Transverse Ranges extend from offshore of the Point Conception-Point Arguello area to the eastern end of the Little San Bernardino Mountains in the



SOURCE: AFTER JAHNS (1954)

Major Physiographic Provinces and Features in Southern California

FIGURE 3.1-1

Mojave Desert. The inland or eastern end of the province is generally placed at the eastern edge of the Eagle Mountains, about 37 miles (60 m) west of the Colorado River (Bailey and Jahns, 1954). The province is about 50 miles (80 km) wide in the site area as measured between the Santa Ynez Mountains and the southern edge of the Channel Islands.

The following discussion emphasizes the physiographic character of the Western Transverse Ranges, in which the proposed platform and pipeline facilities are located. The Eastern and Western Transverse Ranges, as shown in Figure 3.1-1, are separated along a line roughly defined by the San Gabriel fault. East of this fault is predominantly igneous and metamorphic terrain, while to the west are primarily sedimentary rocks.

The Western Transverse Ranges are divisible into several subprovinces. As shown on Figure 3.1-1, the proposed project lies wholly within one of these: the Santa Barbara Basin. The Santa Barbara Basin is an offshore extension of the Ventura Basin and forms a major portion of the Western Transverse Ranges. It is rimmed by the mainland shelf which lies between sea level and about the 350 to 400 feet (100 to 200 m) isobath. This inner shelf is about 5 to 6 miles (8 to 9 km) wide in the Point Conception region, narrows to about 3 miles (5 km) in the Gaviota area, broadens to about 11 miles (18 km) between Santa Barbara and Ventura, then again narrows to less than 2 miles (3 km) wide offshore of the Santa Monica Mountains.

The eastern portion of the mainland shelf is separated from the Channel Islands insular shelf by a narrow strait between the Santa Monica Mountains and Anacapa Island. The maximum depth of this southern outlet of the Basin is about 820 feet (250 m). The insular shelf surrounding the Channel Islands is generally less than 5 miles (8 km) wide, except south of Santa Rosa Island and northwest of San Miguel Island where it is 8 miles (13 km) and 11 miles (18 km) wide, respectively.

The maximum depth of the Santa Barbara Basin is about 625 feet (2050 m) in the west central portion north of Santa Rosa Island. The basin shallows to 1512 feet (461 m) at the western sill between Point Conception and San Miguel Island. The seafloor of the channel has two major positive physiographic (bathymetric) features which, in typical Transverse Range fashion, are oriented in an east-west direction. These are the Rincon Trend and the 12-Mile Reef (see Figure 3.1-1). Both of these bathymetric features reflect structural folds at depth.

3.1.2.2 Project Area Bathymetry

The platform and subsea pipeline project area lie on the lower portion of the slope separating the mainland shelf from the Santa Barbara Channel basin (see Figure 3.1-2). The break between the mainland shelf and slope in this area occurs at a water depth of 400 feet (122 m) approximately 8000 feet (2440 m) northeast of the platform site. About 1 mile (1.6 km) to the southwest is the floor of the Santa Barbara Channel, which lies at depths in excess of 780 feet (240 m) in the project area.

Average slopes near the platform and pipeline site range in steepness from less than 1 percent on the mainland shelf and in the basin of the Santa Barbara Channel to 5 percent on the slope. In general, the steeper slopes in the study area are found north and east of the platform site, where sea-floor gradients as steep as 14 percent occur locally. As shown by the closed contours on Figure 3.1-2, the central and eastern portions of the study area are characterized by an irregular, hummocky physiography.

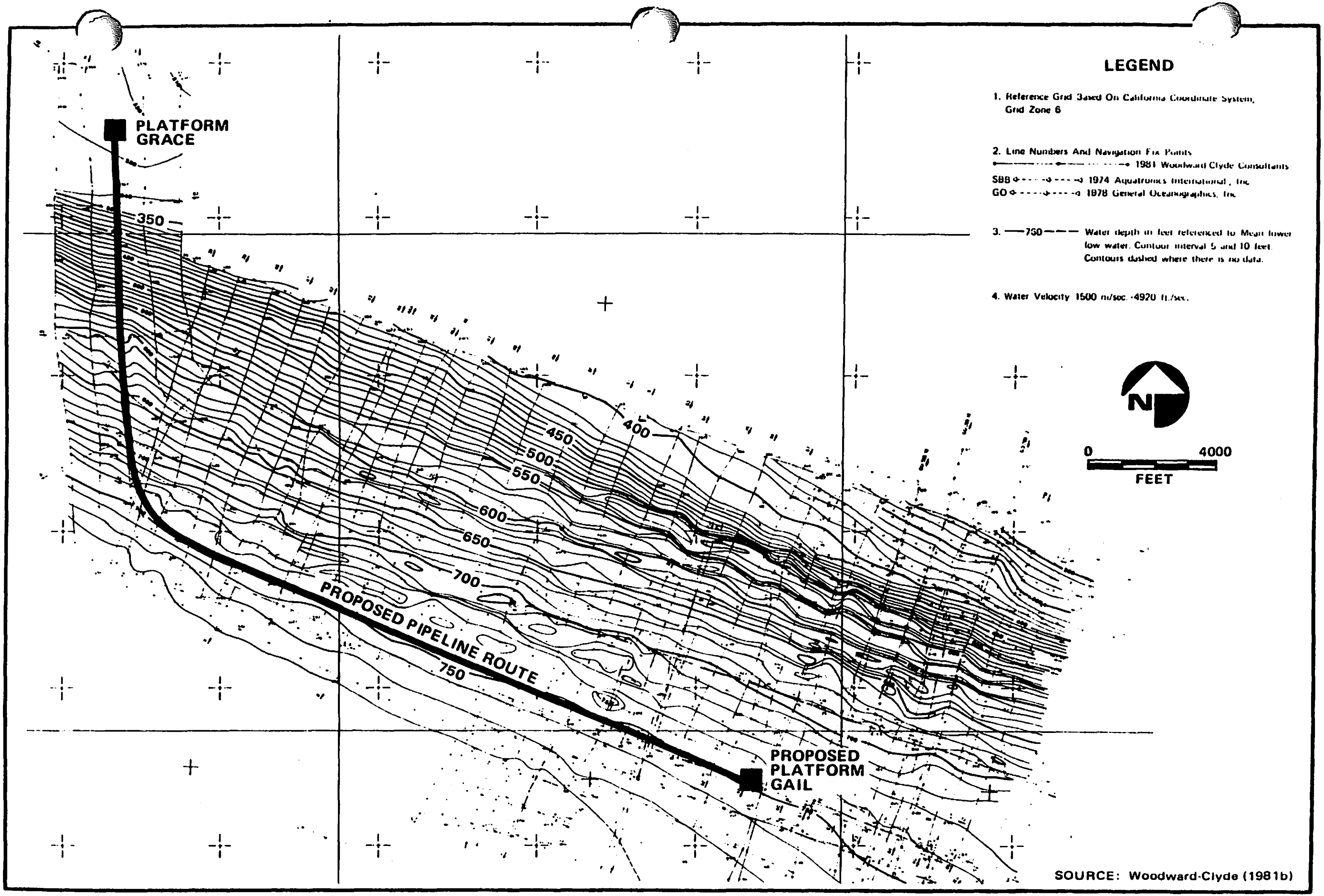
Platform Site

The water depth at the proposed Platform Gail site is approximately 744 ± 5 feet (226 ± 1.5 m) according to the Woodward-Clyde (1981b) geophysical survey report (see Figure 3.1-2). A more detailed bathymetric survey by John E. Chance and Associates (1981) for platform design revealed that the water depth at this location is 739 feet (225 m). The seafloor slopes to the southwest at a gradient of about 1.7 percent and is smooth and continuous in the proposed platform area.

Pipeline Route

The proposed subsea pipeline route extends approximately 21,000 feet (6400 m) in a west-northwesterly direction from the Platform Gail site, then turns north for about 12,000 feet (3660 m) to Platform Grace. As shown in Figure 3.1-2, the segment west from the Platform Gail site generally follows the 750 foot isobath, and lies in water ranging in depth from approximately 740 to 755 feet (225 to 230 m). This segment lies south of the irregular, hummocky seafloor that characterizes the central portion of the study area. Along this part of the pipeline route the seafloor is generally smooth and slopes to the southwest at 1.5 to 2 percent.

The north-trending segment of the pipeline corridor extends upslope at about a 3.5 to 4 percent grade to Platform Grace. The seafloor in this segment ranges in depth from about 750 feet (229 m) at the south end to 318 feet (97 m) at Platform Grace.



SOURCE: Woodward-Clyde (1981b)

Bathymetry in the Area of the Proposed Platform and Pipeline Corridor

FIGURE 3.1-2

3.1.3 Geology

3.1.3.1 Regional Geologic Setting

Geologic History

The geologic history of the Santa Barbara Channel region can be traced back over 100 million years. It is characterized by recurrent periods of tectonic activity followed by periods of relative quiescence (Vedder et al., 1969). Franciscan rocks, which form the basement for most of the region, are pre-Cretaceous in age and consist of altered, deep-water marine sediments and igneous intrusions. During early Cretaceous time, marine shales and thin sandstones were deposited on what may have been the ancestral outer continental shelf and slope. The middle Cretaceous record is obscure because, due to erosion or lack of deposition, strata of this age are missing in the region.

Throughout most of late Cretaceous time, regional subsidence permitted the sea to transgress the region, and a thick succession of shale, siltstone, sandstone, and conglomerate was deposited. This deposition was followed by several episodes of uplift and erosion over much of the area during latest Cretaceous and earliest Tertiary time, but preservation of isolated remnants of Paleocene strata in the southern part of the region indicate that deposition continued at least locally.

Subsidence was again evident in Eocene time, resulting in the deposition of a marine sequence of algal limestone, shale and claystone, arkosic sandstone, claystone, and sandstone and claystone. Major tectonic activity occurred during the Oligocene, when uplift occurred north of the present site of the Santa Ynez Mountains, causing the sea to withdraw westward and southward with concurrent deposition of shallow-water marine and terrestrial sediments.

During the early Miocene, a new episode of subsidence, widespread transgression of the sea, and deposition of marine sediments began. As the sea advanced northward across the broad, sinking land surface, shallow-water marine sandstone was deposited. As the area continued to subside and the water deepened, these sandstone beds were covered and overlapped by fine-grained shale and siltstone. This was also a time of extensive volcanic activity throughout California. Volcanic centers within the area currently occupied by the Western Transverse Ranges were found in the western Santa Ynez Mountains, the Santa Monica Mountains and the Channel Islands.

The axial portion of the proto-Santa Barbara Channel subsided rapidly during the late Miocene and early Pliocene, causing some sediments to be deposited in water as deep as 4000 feet (1200 m). Restriction of the area into an enclosed basin began during the early Pliocene as the north and later the south margins of the region were elevated above sea level. Structural deformation continued throughout the late Pliocene over the entire area. Intensity of deformation differed from place to place and resulted in thick localized Pliocene deposits of extremely varied nature and origin. Restriction of the basin and sedimentation continued into the early Pleistocene.

Many of the structural and geomorphic features present in the Santa Barbara Channel today were slowly growing throughout much of the Pliocene epoch to the degree that they affected sedimentation. However, the major north-south compressional tectonism that created the present structural and geomorphic form of the region did not take place until the middle Pleistocene.

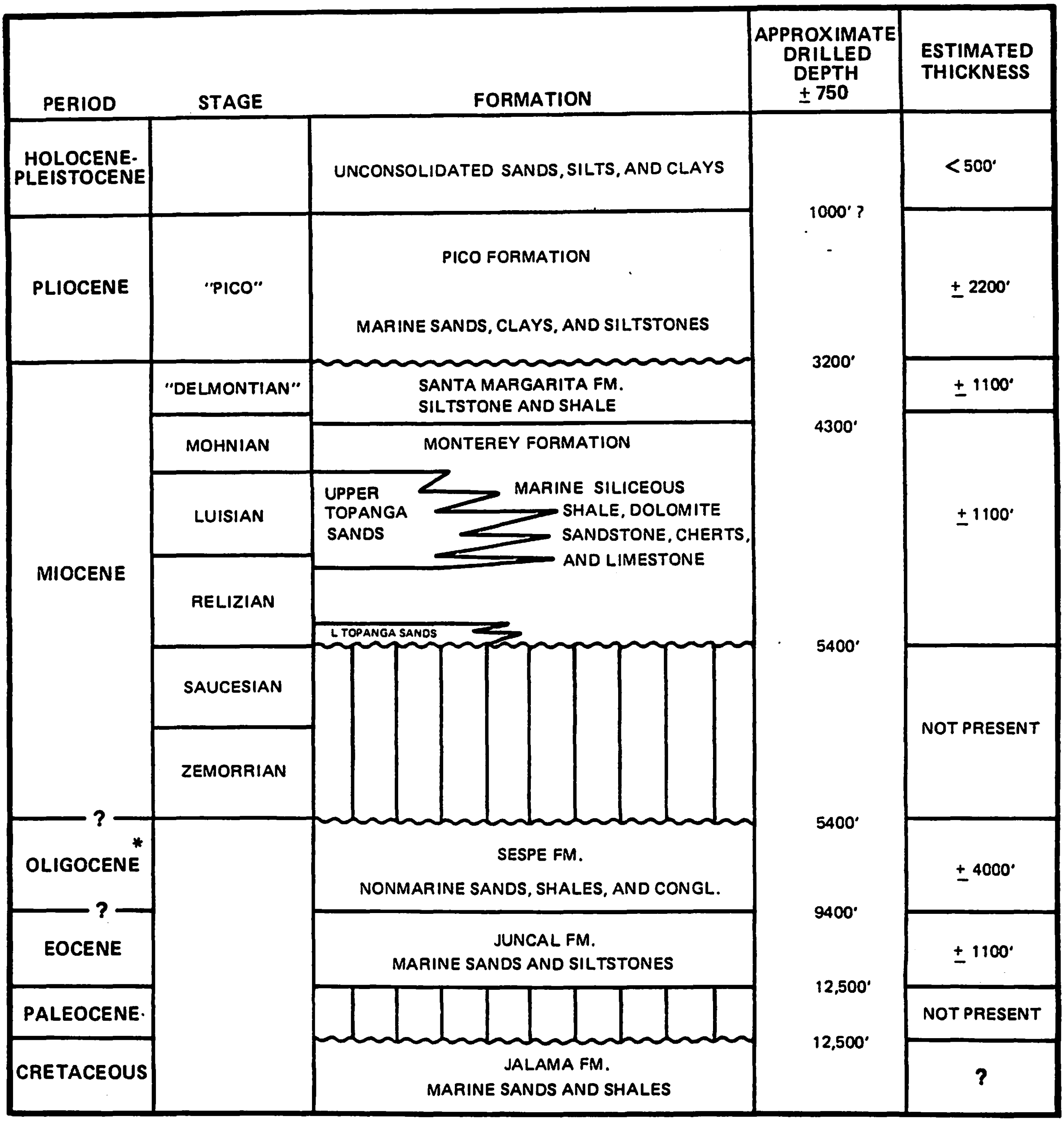
The nature and distribution of Pleistocene deposits indicate the dominant geologic processes at work during this time were tectonism and glacioeustatic sea level fluctuations. In the onshore portions of the region, deposits of Pleistocene age consist primarily of regressive marine sediments and nonmarine colluvial deposits which mantle the elevated, wave-cut coastal terrace. Offshore, Pleistocene deposits are extremely variable in thickness and lithology because of the different modes and rates of deposition on the continental shelf and slope. Local differential movements along with minor faulting characterize the Holocene Epoch.

Stratigraphy

Exploratory well drilling in the eastern Santa Barbara Channel indicates that the region is underlain by sedimentary strata over 12,000 feet (3660 m) thick and ranging in age from Cretaceous to Holocene. A stratigraphic column illustrating the sequence of sedimentary rocks in the area is provided in Figure 3.1-3. The formation thicknesses shown in this figure change considerably across the project area due to variations in depositional processes and the presence of unconformities. Four major unconformities have been noted in the area: at the base of the Paleocene, at the base of the Miocene (the "Sespe unconformity"), at the base of the Pliocene, and beneath the Pleistocene deposits.

Geologic Structure

Geologic structures are defined as the folds and faults that result from the tectonic deformation of rock units. Within the broad area shown in Figure 3.1-4, two dominant structural trends are recognized. The first is the northwest-southeast oriented trend characterized by the San Andreas fault. This feature, which shows right-lateral strike-slip separation, extends from the Coast Ranges physiographic province on the north obliquely across the Transverse Ranges to the eastern boundary of the Peninsular Ranges.



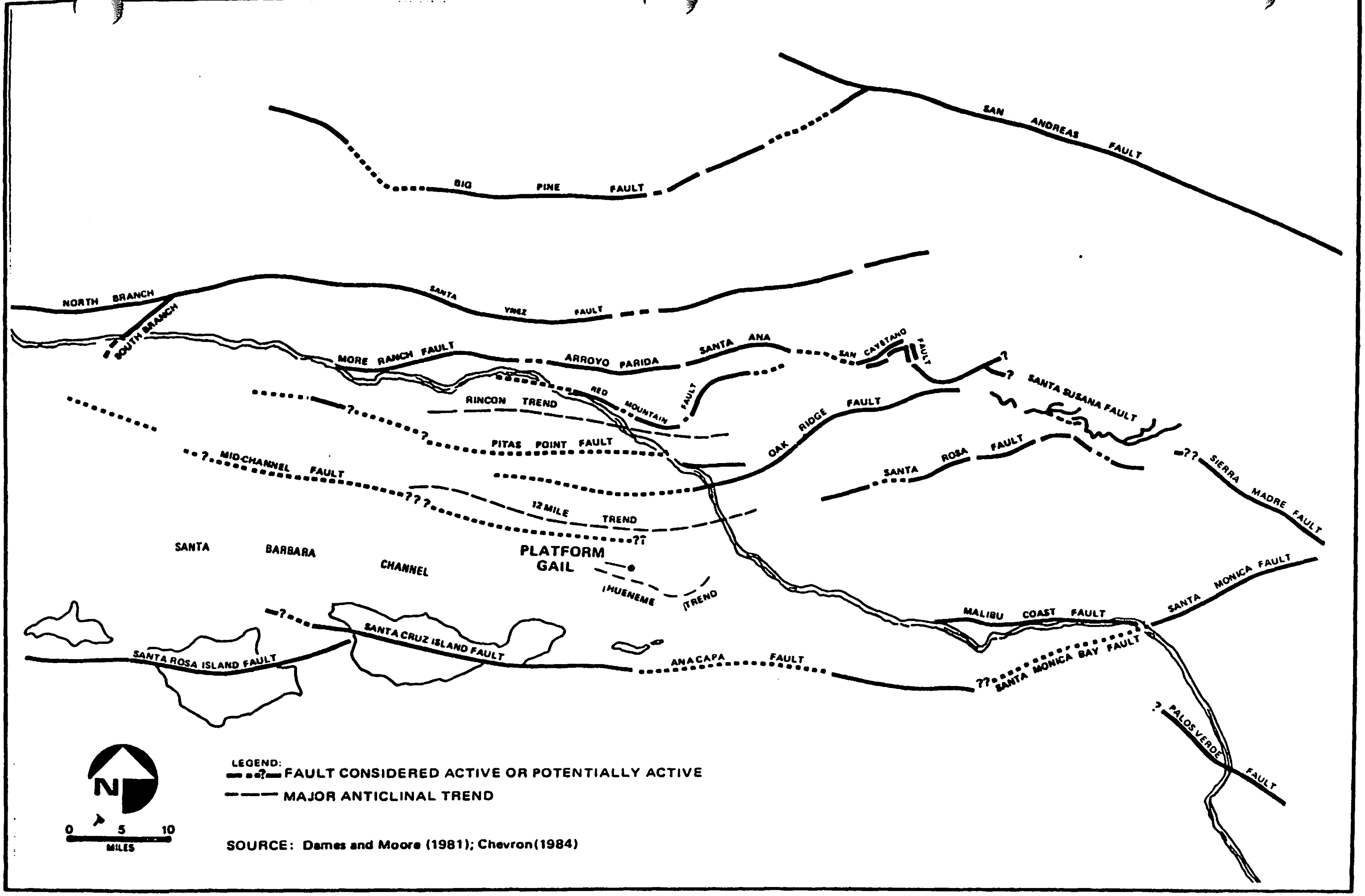
PERIOD	STAGE	FORMATION	APPROXIMATE DRILLED DEPTH ± 750	ESTIMATED THICKNESS
HOLOCENE-PLEISTOCENE		UNCONSOLIDATED SANDS, SILTS, AND CLAYS		< 500'
PLIOCENE	"PICO"	PICO FORMATION MARINE SANDS, CLAYS, AND SILTSTONES	1000' ?	± 2200'
MIOCENE	"DELMONTIAN"	SANTA MARGARITA FM. SILTSTONE AND SHALE	3200'	± 1100'
	MOHNIAN	MONTEREY FORMATION	4300'	± 1100'
	LUISIAN	UPPER TOPANGA SANDS MARINE SILICEOUS SHALE, DOLOMITE SANDSTONE, CHERTS, AND LIMESTONE		
	RELIZIAN	L TOPANGA SANDS		
	SAUCESIAN		5400'	NOT PRESENT
	ZEMORRIAN			
? OLIGOCENE* ?		SESPE FM. NONMARINE SANDS, SHALES, AND CONGL.	5400'	± 4000'
EOCENE		JUNCAL FM. MARINE SANDS AND SILTSTONES	9400'	± 1100'
PALEOCENE			12,500'	NOT PRESENT
CRETACEOUS		JALAMA FM. MARINE SANDS AND SHALES	12,500'	?

*RECENT PALEONTOLOGIC WORK PLACES THE OLIGOCENE IN THE ZEMORRIAN STAGE. THE SESPE FORMATION WOULD THEN BE CONSIDERED EOCENE IN AGE.

SOURCE: Chevron(1984)

Stratigraphic Column for Platform Gail Project Region

FIGURE 3.1-3



SOURCE: Dames and Moore (1981); Chevron(1984)

Generalized Geologic Structure Map

FIGURE 3.1-4

The second structural trend is the east-west oriented folds and faults typical of the Transverse Ranges. Faults in this system are characterized by left-lateral and high angle reverse components of movement.

Significant structural features in the proposed project region are illustrated in Figure 3.1-4. The anticlinal trends shown are structural traps that have been responsible for much of the on- and offshore hydrocarbon production in this area. The faults shown, with the exception of the Mid-Channel Fault, are of significance as they are potential sources of seismic activity, as discussed in detail in Section 3.1.3.5.

3.1.3.2 Project Area Geology

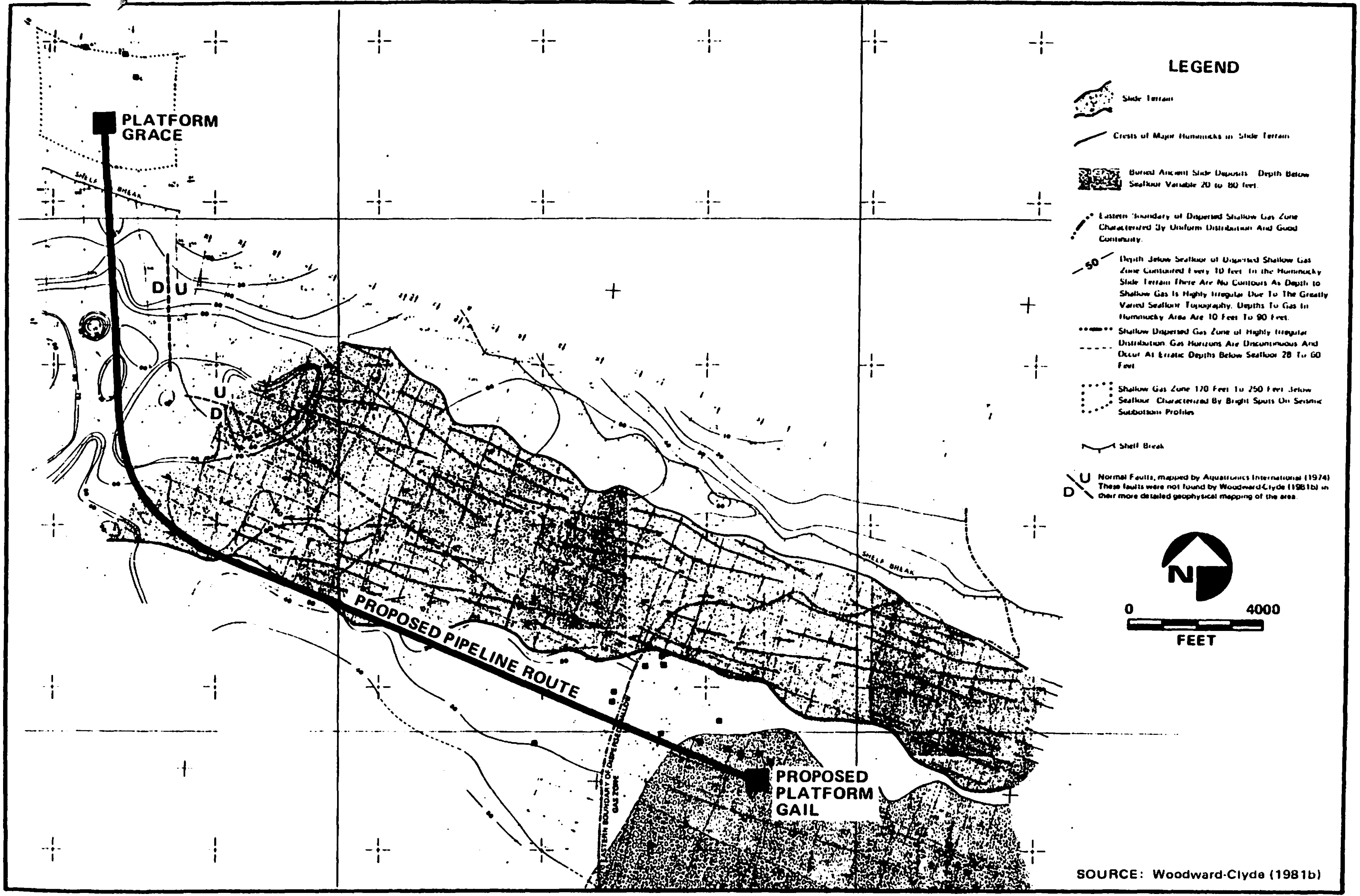
Stratigraphy (Figure 3.1-3)

Surficial sediments in the project area consist of silty clays of Holocene age. These Holocene materials overlie marine Pleistocene and Pliocene sediments which consist locally of interbedded silts, clays and sands. All of these sediments unconformably overlie the upper Miocene Santa Margarita Formation, which consists of shales and silts. The Santa Margarita in turn overlies the siliceous Miocene Monterey Shale and the associated Upper Topanga Sands. The Monterey Shale and Topanga Sands are two of the major hydrocarbon reservoirs in this field. The Lower Topanga Sands at the base of this unit are underlain by an unconformity in which Lower Miocene rocks are missing. Beneath this unconformity is the Oligocene Sespe Formation, consisting of nonmarine sands, shales, and conglomerates. Sespe rocks constitute the third major petroleum reservoir in the field. The Sespe overlies the Eocene Juncal Formation of marine sands and siltstones. The Juncal Formation unconformably overlies the Upper Cretaceous Jalama Formation, consisting of marine sands and shales.

Geologic Structure

The thick sequence of Tertiary-age and older sedimentary rocks beneath the platform and subsea pipeline project area has been folded into an anticline which is bounded on the north and southwest by south-dipping reverse faults (Chevron, 1984). The limbs of this anticline dip gently away from the east-west trending axis of the fold at angles of 3° to 15° from the horizontal.

Near-surface sediments at the shelf edge and slope in the project area consist of a steeply-dipping sequence of foreset beds unconformably overlying an erosional surface of undetermined age (Woodward-Clyde, 1981b). The basinward frontal slope of these beds has in the past apparently become steep enough to be unstable. The result is an extensive area of slide terrain just north of the proposed platform site and pipeline route (see Figure 3.1-5). This slide terrain coincides with the area of irregular, hummocky seafloor described in Section 3.1.2.2 and shown in Figure 3.1-2.



SOURCE: Woodward-Clyde (1981b)

Geological Hazards in the Project Area

FIGURE 3.1-5

Also shown in Figure 3.1-5 is a buried ancient slide deposit in the area of proposed Platform Gail. The slide plane beneath this buried slide deposit appears to be the same as that which underlies the more youthful slide terrain directly to the north and west (Woodward-Clyde, 1981b). However, the portion below the buried slide deposit is considered inactive and probably corresponds to an unconformity surface. The depth of the buried slide deposit beneath the seafloor is variable, and ranges from approximately 20 to 80 feet (6 to 24 m).

Geophysical survey data indicate no apparent faulting in the project area shallow enough to be detected by the high resolution sparker and Uniboom subbottom profiling systems used. If there are undetected faults in the area, it appears that they have not displaced upper Quaternary to Holocene sediments (Woodward-Clyde, 1981b). Two inactive normal faults, as shown in Figure 3.1-5, were reported in the project area by Aquatronics (1974). The youngest of these features predates the Upper Pliocene-age strata in the vicinity. More detailed geophysical mapping of the project area by Woodward-Clyde (1981b) failed to confirm the presence of these faults.

3.1.4 Soils

Subsurface soil conditions at the proposed Platform Gail site were studied in detail by Woodward-Clyde (1981a), who identified four individual horizons or strata. Stratum I extends from the seafloor to a depth of 20 m (65 feet) and consists of soft to stiff, gray to dark gray silty clay. Beneath this are interbedded dense dark gray silty and clayey sand, very stiff to hard silt and sandy clay, and dense silty clay (Stratum II). This second stratum extends from 65 to 410 feet (20 to 125 m) beneath the seafloor.

Stratum III is found at depths of 410 to 475 feet (125 to 145 m) below the seafloor, and consists of very stiff to hard dark gray sandy clay. Interbedded, dense dark gray silty and clayey sand and sandy clay comprise Stratum IV. These sediments extend from a depth of 425 feet (145 m) to more than 500 feet (150 m), the maximum depth explored.

Soil conditions are generally uniform along the proposed pipeline route from the Platform Gail site west approximately 15,000 feet (4570 m). They consist of a surface layer of silty sand to sandy silt about 1 to 1.5 feet (0.3 to 0.5 m) thick, underlain by clays of medium to low plasticity. These clays are very soft to medium stiff in consistency, with undrained shear strengths ranging between about 200 and 800 psf. Soils along the pipeline route near Platform Grace consist of silty sands to sandy silts to the maximum depth sampled 2 to 3 feet (0.6 to 1 m).

Detailed descriptions of the geotechnical and engineering properties of soils in the platform and pipeline area are provided in the geological and geophysical study reports prepared by Woodward-Clyde (1981a and b).

3.1.5 Geologic Hazards

3.1.5.1 Surface Fault Rupture

As discussed previously and illustrated in Figure 3.1-5, two faults were reported to exist in the platform and subsea pipeline project area by Aquatronics (1974). The largest of these features trends in a northwest-southeast direction about 2000 feet (610 m) north of the proposed pipeline route, and the other lies approximately 1500 feet (460 m) east of the north-south trending segment of the pipeline. Neither of these faults nor any other evidence of faulting were detected in the geophysical survey records from the more detailed Woodward-Clyde (1981b) investigation. The youngest faulting reported in the project area by Aquatronics is older than late Pliocene, indicating that these faults, if they exist, are inactive. In addition, it is concluded by Woodward-Clyde (1981b) that if there are any undetected faults in the project area they have apparently not displaced Quaternary or Holocene strata, and would thus be considered inactive. Hazards due to rupture of the seafloor from fault movement therefore do not appear to be significant.

3.1.5.2 Seismic Groundshaking

The eastern Santa Barbara Channel is within a tectonically and seismically active region, as is virtually all of Southern California. Known faults representing potentially significance sources of seismic activity (except the Mid-Channel fault, which is aseismic) are shown in Figure 3.1-4. These faults, their closest approach to the project site, their lengths, the inferred recency of activity, and the limiting magnitude for earthquakes generated by each fault are listed in Table 3.1-1. This table shows only faults which are known to have been active during and after the late Pleistocene.

The limiting magnitudes shown in Table 3.1-1 are estimated based on geologic and tectonic considerations, including historic seismicity. These estimates are derived primarily from empirical relationships between the length of inferred surface displacement, generally considered to be 20 to 50 percent of total fault length, and earthquake magnitude (Mark and Bonilla, 1977; Slemmons, 1977).

To determine the expected levels of seismic groundshaking at the proposed platform site, a probabilistic analysis technique based on the geology, seismic history and tectonics of the region was used (Dames and Moore, 1981). Necessary inputs to this method include: 1) a seismotectonic source model; 2) the seismic activity

Table 3.1-1

SIGNIFICANT FAULTS IN THE PLATFORM GAIL PROJECT REGION

Fault (See Figure 3.1-4)	Approximate Closest Distance to Site (miles/km)	Approximate Length (miles/km)	Recency of Activity*	Limiting Magnitude
San Andreas	53/85	680/1,100	H	8.25
Santa Cruz Island—Anacapa	11/17	40/64	Q	7.0
Santa Ynez	25/41	99/160	Ho	7.5
Big Pine	37/60	43/70	H?	7.0
Oak Ridge	7.5/12	30/49	Ho	6.5
Red Mountain	14/23	13/21	Ho	6.5
San Cayetano—More Ranch	19/31	65/105	Ho?	7.0
Santa Monica	37/60	54/87	H	7.0
Santa Rosa—Santa Susana	20/32	34/55	Q	6.75
Santa Rosa Island	29/47	20/32	Q	7.0
Pitas Point	11/18	33/53	Ho	6.75
Palos Verdes	55/88	81/130	Ho	7.0

---

*H = Historic
Ho = Holocene
Q = Quaternary

Source: Dames and Moore (1981)

rate and the distribution between large and small seismic events in the region; 3) a distance-attenuation relationship for mean peak ground motions in rock; and 4) a consideration of local effects on design accelerations based on soil borings from the platform site.

Two levels of predicted seismic ground motion at the Platform Gail site were determined by Dames and Moore (1981). The first is a lower level ground acceleration, referred to as the "strength" level, which corresponds to the effects of an earthquake that has a reasonable likelihood of not being exceeded during the life of the proposed structure. The second is an upper, or "extreme", level which corresponds to a rare, intense earthquake.

Based on the above, Dames and Moore has recommended a strength level peak horizontal ground acceleration of 22 percent of gravity (0.22 g) at the Platform Gail mudline. This event has a return period of 270 years. The expected ground motions from an extreme event would result in peak accelerations of 0.55 g in rock or stiff sand, or 0.35 g at the mudline in the project area. Such an event would have a return period of nearly 4000 years.

3.1.5.3 Soil Liquefaction

Based on estimated peak horizontal accelerations and the duration of shaking for the strength level and extreme level earthquakes and the properties of soils at the project site, the potential for seismic-induced soil liquefaction is considered to be negligible (Woodward-Clyde, 1981a).

3.1.5.4 Induced Seismicity

Seismic events induced by the subsurface injection of fluids have been reported several places in the world (for example, at the Rocky Mountain Arsenal near Denver (Evans, 1966; Healy et al., 1968); at the Rangely Oilfield, Colorado (Rayleigh, 1976); at Matsushiro, Japan (Ohtake, 1974); and in the Attica-Dale area, New York (Fletcher and Sykes, 1977). In each case, increases in reservoir pore pressure were found to be the triggering mechanism.

As currently planned, oil and gas production from Platform Gail will not require the maintenance of reservoir pressure through gas or water injection. The potential for inducing seismicity by this means is thus eliminated. Should operating experience later dictate that reinjection is required, either to maintain reservoir pressure or for wastewater disposal, injection and subsurface pressures will be monitored. Studies at the Rangely Oilfield indicate a threshold injection pressure well in excess of reservoir pressure is necessary to trigger earthquakes. Maintaining injection pressure below this threshold will avoid causing any changes in seismicity.

3.1.5.5 Subsidence

Subsidence of the land surface can be caused by a number of activities: groundwater withdrawal, oil and gas withdrawal, hydrocompaction, and oxidation of peat deposits (Alfors et al., 1973). In the case of oil and gas withdrawal there are a number of contributing factors, but the main factor is a reduction of pore-fluid pressure which allows the overburden to compact the fluid-depleted reservoir rock. As discussed by Allen (1973), it appears that the geologic structural style of the reservoir beds has an influence on the occurrence of subsidence through its ability to resist deflection by the overlying beds. Anticlinal folds, such as those beneath the Platform Gail site, function much as an arch in resisting downward deformation. Unrelieved tectonic stresses also affect the resistance of structure to deformation. The likelihood of subsidence is reduced if associated faulting is high angle or reverse indicating compressive stress.

Surface subsidence is not expected to be a problem in the Platform Gail project area for the following reasons: 1) the region has been under compression since early Pleistocene time; 2) the geologic structure beneath the site is in the form of an anticline, or supporting arch; and 3) the oil producing strata are at depths of more than 1100 m (3500 feet) beneath the seafloor, such that the folded overburden will provide additional support.

3.1.5.6 Slope Stability

The area shown as slide terrain in Figure 3.1-5 and the sediments perched immediately above it represent a potential geological hazard to be considered in siting and design of both the platform and pipeline. The discussion in Section 3.1.3.2 described the slide terrain and the individual hummocky features.

Slopes are dynamic geomorphic features. The style and magnitude of failure depend on a number of factors, including shear strength of the sediments, the degree of slope, pore water pressure, and the sedimentation rate. Although gravity is the driving force, slope failure may be triggered by earthquake activity, storm wave induced pressures, or human-induced disturbances.

Overall, the slide terrain in the study area appears to have failed in a predominantly translational style. At the upper end of the slope, blocks of sediment appear to have broken off at headwall scarps with some rotation of the block. The blocks then moved downslope along a dip-slope failure surface. As the blocks moved downslope, they appear to become somewhat smaller in size. Possibly, shear caused by frictional drag is responsible for the deterioration of the blocks.

The general character of the slide terrain implies that recent sliding was not catastrophic. The blocks maintained their internal coherency and appear to have moved gradually downslope. The buried slide deposits in the platform area, however, seem to have been formed by more rapid downslope movement. They appear internally jumbled and incoherent in nature on geophysical records.

An analysis of slope stability under dynamic loading at the proposed platform site and along the pipeline corridor was conducted by Woodward-Clyde (1981a). The analysis indicates that earthquake-induced permanent ground displacements of about 15 inches (38 cm) and 40 inches (102 cm) could be expected for the strength level and extreme level seismic events, respectively, along the slope directly north of the platform site and pipeline route. The estimated permanent displacement in the platform area should be negligible for the strength level event and about 0.5 inches (1.3 cm) for the extreme level earthquake.

3.1.5.7 Settlement

Based on the anticipated maximum pipeline loading and the bearing capacity of seafloor soils along the proposed pipeline route, significant settlement of the pipeline into underlying soils is not anticipated (Woodward-Clyde, 1981b). Maximum pipeline penetration into the seafloor is expected to be less than the pipeline radius.

3.1.5.8 Erosion

Erosional processes in the offshore environment consist of the removal of soils by current scouring. The clayey silts and silty clays in the platform and pipeline areas, are not considered to be susceptible to scour. If, as indicated by shallow sediment sampling in the platform vicinity, a silty sand surficial layer is present, some scouring could develop. This would be restricted to the thickness of the sandy layer (12 to 18 inches), and should not represent a significant hazard (Woodward-Clyde, 1981a).

3.1.5.9 Turbidity Currents

There was no evidence in either the soil samples or the high-resolution geophysical records of turbidity current activity in the project area (Woodward-Clyde, 1981a,b). X-rays of soil boring cores showed regular bedding and not the chaotic structure that would be expected in turbidity current deposits. Also, turbidity currents are usually associated with submarine canyons and fans, neither of which is present locally. Thus, turbidity currents do not appear to constitute a hazard to the proposed project.

3.1.5.10 Shallow Gas

Shallow dispersed gas horizons were found beneath the central and western portions of the proposed pipeline route (see Figure 3.1-5). Geochemical testing of sediment cores from this area indicates the gas is mostly methane derived from leakage of petrogenic gases from the underlying hydrocarbon reservoir. Large quantities of gas were found to be present in the bubble phase, implying the gas is predominantly dissolved in pore waters.

No shallow gas was found in the area of proposed Platform Gail. The sediments beneath Platform Grace appear to contain gas in greater concentrations and at greater depths than in other parts of the survey area. The surface extent of this gassy region is also shown in Figure 3.1-5.

3.1.6 Groundwater Hydrology

Electric logs from wells drilled in the project area and water quality measurements from geotechnical investigation borings revealed pore waters with total dissolved solids concentrations ranging from 5000 to 25,000 mg/l (Chevron, 1984). Such waters are not potable and do not constitute a significant groundwater resource.

3.2 METEOROLOGY

The major climatic influences on the Santa Barbara Channel area are the Pacific High, a semi-permanent pressure system which generally lies over the ocean to the west; migratory cyclonic storms, which yield most of the annual rainfall; and the Pacific Ocean, which provides a moderating influence on ambient temperatures. The net effect of the above factors is a mild climate with little severe weather, and with rainfall concentrated in the winter months.

3.2.1 Large-Scale Weather

The Pacific High is a strong and persistent anticyclone which lies off the Pacific coast, and which shifts northward or southward as a result of seasonal changes or the presence of cyclonic storms. In its usual position to the west of southern California, the High produces an elevated temperature inversion (due to large-scale subsidence) and northwesterly winds in the study area. Advection of cool, humid marine air onshore causes frequent fog and low clouds near the coast, particularly during night and morning hours and during warmer months.

Migratory cyclonic storms periodically affect the area, notably during the October-April period. Depending upon the relative strength of a storm, the Pacific High may either deflect such storms northward, or weaken and shift southward. In the latter case, the storms can produce periods of cloudiness, strong winds, and precipitation in the area. The number of days of such activity varies widely from year to year. Hence, the annual precipitation displays a large degree of variation, ranging from less than 10 inches (3.9 cm) to more than 40 (16 cm). The long-term average annual total is about 17 inches (6.7 cm) near the coast.

Storm conditions are usually followed by periods of clear skies, cool temperatures, and gusty westerly winds as frontal systems move eastward. Such movement is likely to be accompanied by strengthening of high pressure over inland areas far to the northeast (eastern California and Nevada). These conditions can produce the warm, dry easterly winds, commonly known as Santa Anas, which can be quite strong near coastal canyons and valleys. Such winds can occur at any time of the year, but are most common from late summer through early winter.

Another major wind regime occurs in advance of winter storms. Pre-frontal southeasters typically persist for less than 12 hours, but occasionally continue nonstop for several days. Wind speeds, which are generally less than 25 knots, can at times exceed 50 knots, causing widespread damage along the coastline.

Although most of the precipitation in the area is produced by mid-latitude storms from the North Pacific, tropical moisture can also produce clouds and rainfall. Three major types of such activity occur: upper-air moisture from the southwest, the so-called "subtropical jet"; moisture from the southeast, generated in the Gulf of Mexico or the Gulf of California; and tropical storms off the west coast of Mexico, which sometimes move northward toward southern California. Tropical air masses influence the area infrequently, chiefly during August and September.

3.2.2 Temperatures

In general, daily and annual temperature variation in the area is minimal. Near the coast such variation is particularly low, with greater ranges occurring in inland areas. In January, daily maximum and minimum temperatures near the coast average about 64°F (18°C) and 42°F (5°C), respectively. Corresponding July values are 71°F (22°C) and 55°F (13°C). Extreme temperatures observed in the Carpinteria area range from the low 100s (40°C) to the mid-20s (-5°C).

3.2.3 Inversions and Stability

A temperature inversion occurs when cool air lies below warmer air aloft. The result is a stable condition in which air tends to remain stratified, vertical mixing is reduced, and pollutants generated at the surface tend to remain trapped in the lower levels of the atmosphere. Inversions in the Carpinteria area are caused primarily by the combined effects of the cool marine air near the surface and subsidence from the Pacific High described earlier. The daytime mixing heights are shown in Table 3.2-1.

Table 3.2-1

MEAN MIXING HEIGHTS OVER LOCAL ONSHORE AREAS (feet/meters)

	Winter	Spring	Summer	Fall
Morning	1600/488	2600/792	1700/792	1700/518
Afternoon	2200/671	3000/914	2000/610	2000/610

Source: Holzworth, 1972

Atmospheric stability is a measure of the mixing ability of the atmosphere and, therefore, the ability to disperse pollutants. Greater turbulence and mixing are possible as the atmosphere becomes less stable, and thus pollutant dispersion becomes greater. In general, more stable conditions are associated with low wind speeds and restricted mixing heights, such as during inversion conditions.

The most common stability classification scheme was developed several decades ago by Pasquill and later modified by Gifford. The so-called Pasquill-Gifford classes range from A (very unstable) to F (very stable). Class D, neutral, approximates the mean thermal mixing of the atmosphere. Table 3.2-2 lists monthly and annual frequencies of stability classes at the Santa Barbara Airport, as reported by Dames and Moore (1975). As is evident from the table, unstable (A and B) conditions occur most frequently during the warmer months, although they are relatively infrequent throughout the year. E (stable) periods show no obvious annual pattern, but F conditions are most frequent in winter, when sea-surface and ground temperatures are coolest.

Due to the influence of the cool sea surface waters, the stability in the vicinity of proposed Platform Gail is somewhat different than those shown in Table 3.2-2. Unstable (A, B, and C) conditions, caused by ground-level heating, would be a great deal less frequent near the platform than onshore. Winter stable (F) conditions would also be less frequent, due to the moderating influence of the ocean; in fact, annual variation in the frequence of F stability would probably be quite small due to the minimal change in sea surface temperature during the year (43°F (6°C)).

Table 3.2-2

MONTHLY AND ANNUAL FREQUENCIES (%) OF STABILITY CLASSES AT THE SANTA BARBARA AIRPORT (1960-64)

Month	Stability Class A	B	C	D	E	F
January	0.05	6.8	13.4	25.6	7.0	47.1
February	0.7	7.4	14.3	32.5	9.4	35.7
March	0.4	7.7	13.0	36.7	9.9	32.3
April	0.9	10.4	16.3	33.7	9.1	29.5
May	1.0	9.7	18.2	33.4	10.1	27.7
June	1.0	9.5	15.4	47.2	6.2	20.6
July	0.6	12.7	18.9	36.5	9.2	22.1
August	0.3	10.7	17.3	36.8	9.4	25.5
September	0.3	7.6	17.0	38.1	7.6	29.4
October	0.1	6.4	15.5	36.5	7.8	33.7
November	0.1	4.6	13.4	35.2	8.8	37.8
December	0.0	5.1	15.1	25.6	6.5	47.7
Annual	0.5	8.2	15.7	34.8	8.4	32.4

Source: Dames & Moore (1975)

3.2.4 Local Winds

Although winds in the Carpinteria area reflect large-scale atmospheric patterns, terrain features exert a major influence on winds observed at any given location. Among the more important terrain factors which affect local circulation are:

- **Santa Ynez Mountains.** The Santa Ynez is an east-west oriented range which averages about 3000 feet (914 m) (MSL) in height. To the north of the mountains, the land is exposed to the predominant northwest winds during a majority of the days of the year; as a result, those areas tend to be relatively windy during much of the year. South of the Santa Ynez, however, lie in a "wind shadow" under those same conditions; airflow is diverted around or over the mountains. Thus, the Channel exhibits different wind characteristics during northwest flow than areas north of the mountains. Wind speeds are often somewhat lower, and the typical wind direction is west-southwest through west-northwest.
- **Oxnard Plain.** The coastline of Ventura County is dominated by coastal mountains (the Coast Range on the northern extreme and the Santa Monica Mountains, on the northern and southern extremes, separated by the broad Oxnard Plain. Low-level air flow throughout the day tends to parallel the east-west orientation of the Plain and the interior valleys (notably the Santa Clara Valley). At night, winds are predominantly offshore (easterly), while the prevailing daytime direction is westerly. When winds in the Channel is likely to continue toward the Oxnard Plain. When more northwesterly conditions occur, however, air parcels tend to be diverted to the south of the Santa Monica Mountains and toward the Los Angeles area.

Very little reliable wind data are available for the eastern Santa Barbara Channel. One of the few existing data sets is for Platform Grace, located only a few miles from the site of Gail, where winds have been measured since 1980. Unfortunately, due to the placement of the monitoring stations on the platform, the data are unreliable.

As an alternative to the offshore data, wind data collected at Point Mugu Naval Air Station, located at the southern edge of the Oxnard Plain, are reported. Table 3.2-3 shows mean wind speed and direction recorded at Point Mugu at 3-hour intervals for each of the four seasons of the year. As is evident, onshore (210-300 degree) winds are common during daytime hours, and more persistent in spring and summer. Nighttime flow is generally northeast (offshore), and more persistent in fall and winter. Although wind conditions in the Channel are somewhat different than those shown in the table, overall similarities are probably close. Wind direction differences would be the major difference between the onshore and offshore sites, due to the effects of nearby terrain at Point Mugu. The southwest and northeast winds which are common at Point Mugu would tend to be more nearly westerly and easterly in the Channel, in the absence of nearby terrain influences.

Table 3.2-3

MEAN WIND SPEED AND DIRECTION (degrees/mph)
AT POINT MUGU NAVAL AIR STATION, 1962-77

Season	1011	0400	0700	1000	1300	1600	1900	2200
Spring	323/1	007/1	013/2	230/4	250/8	264/9	279/5	297/2
Summer	calm	029/1	013/1	235/5	252/8	267/8	287/4	291/1
Fall	036/2	032/2	031/2	210/1	248/5	269/6	320/2	002/2
Winter	033/4	036/4	038/4	052/4	230/2	279/3	001/2	022/3

Reference: National Climatic Center, 1979.

3.3 AIR QUALITY

3.3.1 Air Quality Standards

Ambient air quality standards for the various criteria pollutants, including both California and Federal versions, are listed in Table 3.3-1. Primary Federal standards have been promulgated to protect the public health, with an adequate margin of safety, and must be achieved by each state by 1982 (or by 1987 with waiver). Secondary standards represent the levels necessary to protect the public from any known or anticipated health implications; these must be achieved with a "reasonable" length of time after a State Implementation Plan has been approved by EPA. Short-term Federal standards are not to be exceeded more than once per year; California standards are never to be equaled or exceeded.

3.3.2 Existing Air Quality in the Study Area

Table 3.3-2 lists air quality monitoring stations currently operated in western Ventura and southern Santa Barbara counties (including the Channel Islands) by either local agency or by the California Air Resources Board (CARB). Santa Barbara

Table 3.3-1

AIR QUALITY STANDARDS

POLLUTANT	AVERAGING TIME	CALIFORNIA STANDARDS		NATIONAL STANDARDS		
		CONCENTRATION	METHOD	PRIMARY	SECONDARY	METHOD
OXIDANT	1 HOUR	0.10 ppm (200 ug/m^3)	ULTRAVIOLET PHOTOMETRY	–	–	–
OZONE	1 HOUR	–	–	240 ug/m^3 (0.12 ppm)	SAME AS PRIMARY STANDARDS	CHEMILUMINESCENT METHOD
CARBON MONOXIDE	8 HOUR	9 ppm (10 mg/m^3)	NON-DISPERSIVE INFRARED SPECTROSCOPY	10 mg/m^3 (9 ppm)	SAME AS PRIMARY STANDARDS	NON-DISPERSIVE INFRARED SPECTROSCOPY
	1 HOUR	20 ppm (23 mg/m^3)		40 mg/m^3 (35 ppm)		
NITROGEN DIOXIDE	ANNUAL AVERAGE	–	SALTZMAN METHOD	100 ug/m^3 (0.05 ppm)	SAME AS PRIMARY STANDARDS	GAS PHASE CHEMILUMINESCENCE
	1 HOUR	0.25 ppm (470 ug/m^3)		–		
SULFUR DIOXIDE	ANNUAL AVERAGE	–	CONDUCTIMETRIC METHOD	80 ug/m^3 (0.03 ppm)	–	PARAOSANILINE METHOD
	24 HOUR	0.05 ppm (131 ug/m^3)		365 ug/m^3 (0.14 ppm)	--	
	3 HOUR	–		–	1300 ug/m^3 (0.5 ppm)	
	1 HOUR	0.5 ppm (1310 ug/m^3)		–	–	
SUSPENDED PARTICULATE MATTER	ANNUAL GEOMETRIC MEAN	60 ug/m^3)	HIGH VOLUME SAMPLING	75 ug/m^3	60 ug/m^3	HIGH VOLUME SAMPLING
	24 HOUR	100 ug/m^3)		260 ug/m^3	150 ug/m^3	
SULFATES	24 HOUR	25 ug/m^3)	AIHL METHOD NO. 61	–	–	–
LEAD	30 DAY AVERAGE	1.5 ug/m^3)	AIHL METHOD NO. 54	–	–	–
	CALENDAR QUARTER	–	–	1.5 ug/m^3	1.5 ug/m^3	ATOMIC ABSORPTION
HYDROGEN SULFIDE	1 HOUR	0.03 ppm (42 ug/m^3)	CADMIUM HYDROXIDE STRACTAN METHOD	–	–	–
VINYL CHLORIDE (CHLOROETHENE)	24 HOUR	0.010 ppm (26 ug/m^3)	GAS CHROMATOGRAPHY	–	–	–
ETHYLENE	8 HOUR	0.1 ppm	–	–	–	–
	1 HOUR	0.5 ppm				
VISIBILITY REDUCING PARTICLES	ONE OBSERVATION	IN SUFFICIENT AMOUNT TO REDUCE THE PREVAILING VISIBILITY TO LESS THAN 10 MILES WHEN THE RELATIVE HUMIDITY IS LESS THAN 70%		–	–	–

ppm - PARTS PER MILLION

ug/m^3 - MICROGRAMS PER CUBIC METER

mg/m^3 - MILLIGRAMS PER CUBIC METER

WF 0074

Table 3.3-2

AIR QUALITY MONITORING STATIONS IN THE STUDY AREA

County	Location	Agency	Parameters
Santa Barbara	El Capitan	SBAPCD	TSP, O_3, SO_2, THC, SO_4
	Goleta	SBAPCD	TSP, CO, O_3, SO_2, NO, NO_2, NO_x
	Carpinteria	SBAPCD	TSP
	Santa Barbara	CARB	TSP, SO_2, CO, O_3, THC, NO, NO_2, NO_x
Ventura	Ventura	VCAPCD	TSP, O_3
	Port Hueneme	VCAPCD	O_3
	El Rio	VCAPCD	TSP, O_3
	Ojai	VCAPCD	TSP, O_3
	Anacapa Island	VCAPCD	First year of operation 1984. Data capture is less than 50 percent. 1985 will be the first official data generated by station.

Table 3.3-3

MAXIMUM 1-HR AVERAGE OZONE CONCENTRATIONS (ppm) OBSERVED SINCE 1979 IN THE AREA

Location	1979	1980	1981	1982
El Capitan	0.14	0.12	0.11	0.15
Goleta	0.21	0.19	0.18	0.14
Santa Barbara	0.17	0.16	0.24	0.10
Ventura	N/A	0.13	0.15	
Port Hueneme	0.19	0.13	N/A	
El Rio	0.23	0.13	0.16	
Ojai	0.18	0.18	0.20	

County is currently in attainment of all standards except the 1-hour ozone, 8-hour CO, and 24-hour and annual TSP standards. There is little information on the air quality of the Channel Islands. A station is located on Anacapa Island with the first year of operation in 1984. However, data captured was less than 50 percent. The first official data collection year will be 1985. Discussions of the characteristics of individual pollutants appear below.

3.3.2.1 Ozone (O_3)

Ozone is a secondary air pollutant, formed in the atmosphere by a series of chemical reactions involving sunlight, nitrogen oxides, (NO_x), and organic compounds. O_3 is the pollutant of most concern in Southern California due to widespread violations and difficulties in control.

Table 3.3-3 shows maximum 1-hour O_3 observed at monitoring stations in the area since 1979. As can be seen, O_3 concentrations in excess of the Federal standard have been observed consistently each year.

3.3.2.2 Nitrogen Dioxide (NO_2)

Although no violation of the NO_2 standard has ever occurred in the area, it is of concern to regulatory agencies primarily because it is considered a percursor to ozone; and future emissions of nitrogen oxides in the area are expected to increase compared with current levels. The maximum 1 hour observed concentrations from 1980 through 1983 have been approximately one half of the Federal standard.

NO_2 is a secondary pollutant, formed (primarily) in the atmosphere from oxidation of nitric oxide (NO).

3.3.2.3 Sulfur Dioxide (SO_2)

Concentrations of SO_2 measured in the area have never approached any of the applicable ambient standards. The highest 1-hour value measured in recent years was 0.08 ppm at the State Street monitor, a reading well below the California standard of 0.50 ppm. Similarly, 24-hour and annual average concentrations have been far below applicable standards.

3.3.2.4 Carbon Monoxide (CO)

Carbon monoxide is a toxic gas produced primarily from internal combustion engines. A primary pollutant, CO is emitted directly into the atmosphere; thus, concentrations are highest in the vicinity of major CO sources, such as in areas of heavy traffic activity.

Violations of the Federal 8-hour CO standard have been recorded on several occasions at the State Street monitor. The 1-hour standard, however, has not been equaled or exceeded. Table 3.3-4 lists annual maximum 1- and 8-hour CO concentrations recorded in the area, while Table 3.3-5 is a summary of days/periods above the 8-hour standard.

3.3.2.5 Total Suspended Particulate (TSP)

Suspended particles in the atmosphere can be of either natural or anthropogenic origin, and either primary or chemically-formed. Additionally, TSP can include solids (dust, soot, smoke) or liquid material (mists, sprays, or droplets).

Table 3.3-6 lists TSP concentrations recorded at stations in the study area since 1979. None of the sites has experienced a violation of the Federal annual geometric mean (75 $\mu g/m^3$) or 24-hour standard (260 $\mu g/m^3$). However, each station has exceeded the more stringent California standards (60 and 100 $\mu g/m^3$, respectively). It should be noted that the region south of Los Padres National Forest in Ventura County is nonattainment for the TSP federal standards.

Due to the broad nature of the TSP category, observed concentrations may be due to such benign substances as blowing dust or salt spray. However, suspended sulfate (SO_4), a component of TSP, has been recognized for its possible adverse health effects; in 1976, California established an ambient standard of 25 $\mu g/m^3$ (24-hour average) for SO_4.

Table 3.3-7 lists observed sulfate concentrations at the Santa Barbara monitor since 1979. During that period, only one 24-hour sample had SO_4 concentrations in excess of the State standard.

3.4 WATER QUALITY/OCEANOGRAPHY

3.4.1 Regional Oceanography

The project area is within the general Southern California Bight. Located in the eastern end of the Santa Barbara Channel, it is somewhat removed from the complex physical conditions found in the western channel and Point Conception. The general oceanographic characteristics of the Southern California Coastal Region have been described in a variety of reports (MMS, 1982, 1983; Allan Hancock, 1965; SCCWRP, 1973; SAI, 1983). The following information describing the physical and chemical oceanographic conditions in the project area is largely drawn from the review documents.

3.4.2 Currents

Most areas of the Bight are influenced by a common oceanic current pattern which affects local oceanographic conditions. The Bight area is bounded by the eastern edge of the California current and includes the open embayment extending from Point

Table 3.3-4

MAXIMUM 1-HR AND 8-HR CARBON MONOXIDE (CO) CONCENTRATIONS (ppm) IN THE AREA

Location	1979	1980	1981	1982
Santa Barbara				
1-hr.	13.0	18.0	15.0	14.0
8-hr.	10.6	13.3	8.7	8.3
Goleta				
1-hr.	------- Not operating -------			6.0
8-hr.				2.8

Table 3.3-5

DAYS/PERIODS IN EXCESS OF 8-HR FEDERAL CO STANDARD

Location	1979	1980	1981	1982
Santa Barbara	7/7	6/6	0/0	0/0
Goleta	------- Not operating -------			0/0

Table 3.3-6

TOTAL SUSPENDED PARTICULATE (TSP) CONCENTRATIONS RECORDED IN THE STUDY AREA ($\mu g/m^3$)

Location	1979	1980	1981	1982
Santa Barbara				
Geom. Mean	64.5	67.3	67.6	57.7
Highest	156	161	139	119
Goleta				
Geom. Mean	44.6	50.4	54.3	40.9
Highest	105	105	107	94
Carpinteria				
Geom. Mean	41.5	59.0	60.1	44.4
Highest	125	146	123	78
El Rio				
Geom. Mean	N/A	6.25	N/A	
Highest	N/A	216	144	
Ojai				
Geom. Mean	67.1	64.9	N/A	
Highest	131	154	N/A	

Table 3.3-7

SULFATE (SO_4) CONCENTRATIONS ($\mu g/m^3$) OBSERVED AT THE SANTA BARBARA MONITOR

Average Period	1979	1980	1981	1982
Geom. Mean	5.7	6.2	6.2	5.0
Highest	18.2	29.3	12.7	14.2
2nd High	13.4	16.7	10.6	12.9

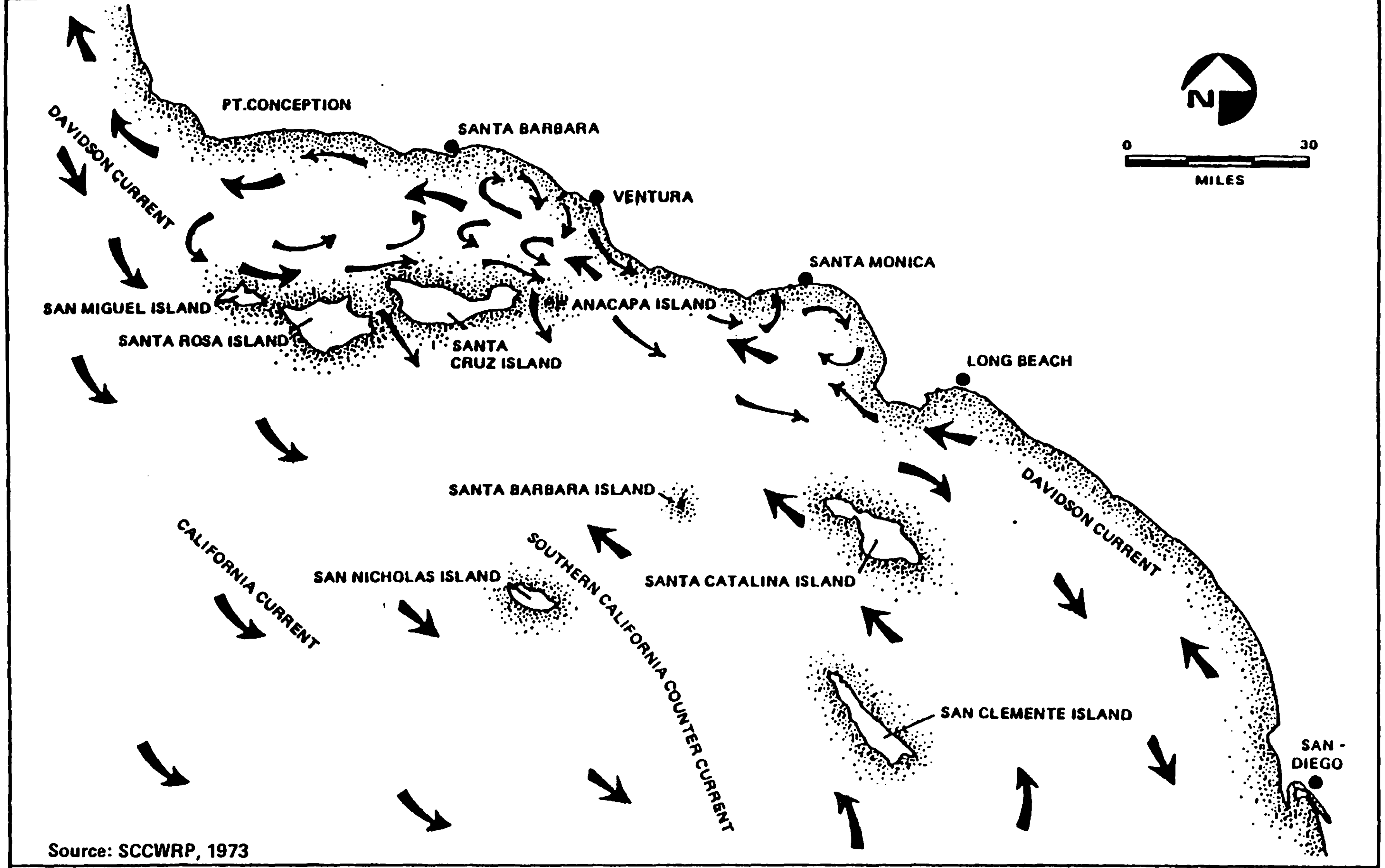
Conception to Caco Colnett in Baja California, Mexico. Oceanographic conditions within the Bight are highly variable as a result of locally induced current and water circulation patterns influenced by natural and artificial structures.

Estimates indicate that water moving around the Channel Islands within the Southern California Bight is replaced about three to four times per year (Jones, 1971). Inshore waters are estimated to turnover at a rate of no greater than once per year (Fay, 1971) and represents a somewhat closed physical and chemical system. The low turnover rate is of importance in understanding the factors contributing to marine productivity and the effects that man's activities can have on this ecosystem.

The project site is located in the Santa Barbara Channel and is generally considered to be in an area of complex coastal currents. The currents are complex because local water movements are the result of the action and interaction of a number of small-to-oceanic-scale forces along the rough fluid boundary formed by the Pacific Coast east of Point Conception. The overall pattern of circulation within the Southern California Bight is primarily a result of the interaction of the California Current system with locally generated wind-drift currents and tidal currents.

The two major currents within the Southern California Bight are the California Current and the Southern California Countercurrent. The California Current is part of the general clockwise pattern of surface water circulation in the northern Pacific ocean. The current flows southeast along the California coast. Within the Southern California Bight, the California Current lies outside of the 5000-foot (1524 m) depth contour. Offshore of northern Baja California, the main portion of the California Current turns landward and divides into two branches. One branch continues southward, while the other branch, the Southern California Countercurrent, turns northward and flows through the Channel Islands inshore of the California Current. Major currents are shown in Figure 3.4-1.

East of the Southern California Countercurrent, the current again turns southeast, forming an eddy which flows along the coast. This flow is associated with the dynamic topography established under the influence of winds along the coast and consequently seaward movement of surface water. The Southern California Eddy, a nearly permanent feature of the flow pattern, is seasonal in character. The Eddy is usually well developed in summer and autumn and weak (and occasionally absent) in winter and spring. The Davidson current tends to dominate in the winter, flowing NW along the coast and around Point Conception. Data pertaining to the small *scale*, horizontal eddy structures, which are important in describing lateral mixing as well as



Source: SCCWRP, 1973

Surface Circulation Within the Southern California Bight

FIGURE 3.4-1

in determining the residence time of a parcel of water in the Bight is limited (Pirie, et al., 1974).

Circulation surface in coastal waters is dominated to a large extent by prevailing wind patterns (Hickey, 1979; Williams et al., 1980). Considerable variability exists on various time and spatial scales driven by the variations in the wind forcing as well as the inherent variability of the flow itself (Bernstein et al., 1977, Owen, 1980).

Currents in the Santa Barbara basin are of generally low velocity (5-10 cm/sec) and are highly dependent upon flow between basins to the north and south (Emery, 1960). The flow direction in the basin is dependent upon the driving current and will be toward the NW during the Davidson Current period (winter) and SE during the Southern California Countercurrent period (majority of the year). Flow velocities and directions will be slightly affected by tides.

On occasion, episodic currents can affect the waters of the Southern California Bight. One example is the "El Nino". El Nino is an episodic event of longer time scale. Every 2 to 6 years the surface water of the east equatorial Pacific Ocean becomes up to 7-8°F (5°C) warmer than the mean, usually accompanied by an increased intensity of the SE Trade Winds. Equatorial flow changes direction to eastward, the thermocline deepens along the coast of Central America, and abnormally warm water occurs northward as far as the project area. The event lasts for about 1 year but occasionally terminates shortly after initiating. It has occurred most recently in 1957, 1965, 1972, 1976 and 1982-3. Observations and measurements of the 1982-3 El Nino event are discussed by Halpern et al., 1983.

3.4.2.1 Wind-driven Currents

The movement of the surface layer of the ocean is controlled by wind drag upon the sea surface and often differs from the underlying pattern established by the regional currents. The wind generates waves and modifies their surface orbits into a cycloidal elongation resulting in a net transport downwind.

Coriolis forces deflects the resulting drift to the right and eddy viscosity extends the motion to deeper water. Estimates of the amount of deflection range from none to 100°. Surface turbulence and the gustiness of the wind tend to obscure this effect and make reliable measurement difficult.

The speed of wind drift is predicted by theory and observed to be from 2 percent to 5 percent of the wind speed measured 33 feet (10 m) above the sea surface. The depth to virtually no wind-induced drift is dependent upon the duration of the wind (MMS, 1982).

Upon cessation of the wind the surface water continues to move because of its inertia. Coriolis deflection causes the inertial drift to describe an elliptical path with a period of 21.5 hours, the half pendulum day at the latitude of the project region. Long-term measurements of wind drift tend to exhibit this effect as well as wind gust effects (A.D. Little, 1984).

Surface drifters, drift cards and drogues have been used to measure surface currents in and near the project region. An extensive compilation of the trajectories inferred from such studies are presented in MMS, 1982.

One effect of wind generated waves is upwelling. Upwelling is a consequence of wind drift as well as the dynamics of the regional circulation pattern. It is a return flow response to the offshore transport of surface water and to the lateral pressure gradient maintained by geostrophic flow.

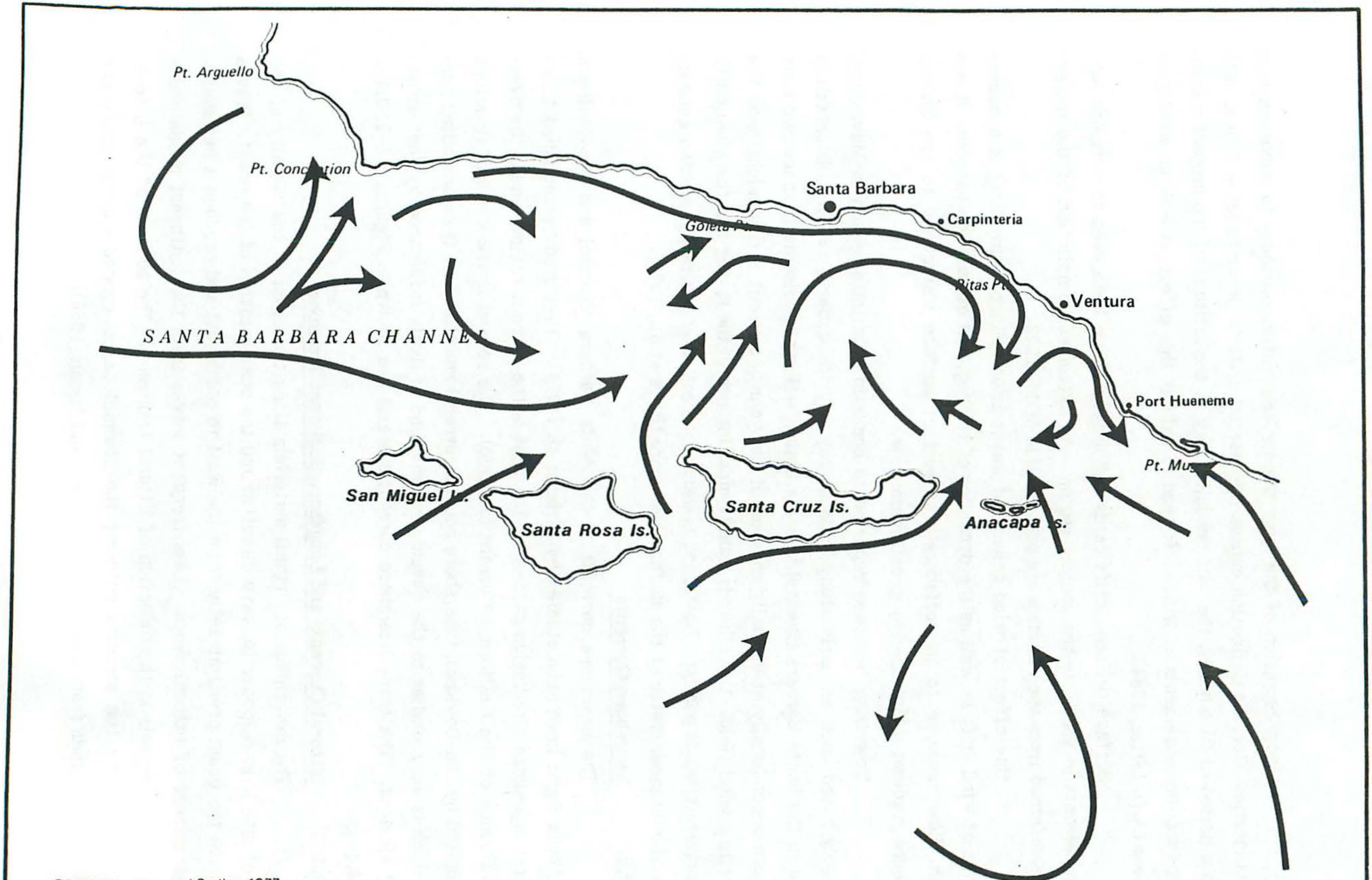
Upwelling has been reported to occur in a definite season in May, June, and July based upon an early study in Monterey Bay (Skogsberg, 1936). Observations made in the Santa Barbara Channel indicate that upwelling is episodic in space and time and can occur locally at virtually anytime of the year because it is dependent upon the prevailing wind field. Upwelling is usually most intense in the spring months when north to northwest winds persist. Upwelling is usually detected by the rather sudden appearance of cold clear water at the surface nearshore (Pirie et al., 1974).

3.4.2.2 Nearshore Currents

The nearshore currents in the Santa Barbara Channel and the Southern California Bight have been studied by Pirie et al. (1974). That study established three general nearshore circulation patterns. The first is the current regime under the overall influence of the California Current (oceanic). The second is the current structure dominated by the Davidson (nearshore countercurrent) and the third is an upwelling period which is very similar to the oceanic regime, and is likely influenced by that structural element. The three nearshore current systems are shown in Figures 3.4-2, 3.4-3 and 3.4-4.

3.4.2.3 Littoral Currents and Longshore Sediment Transport

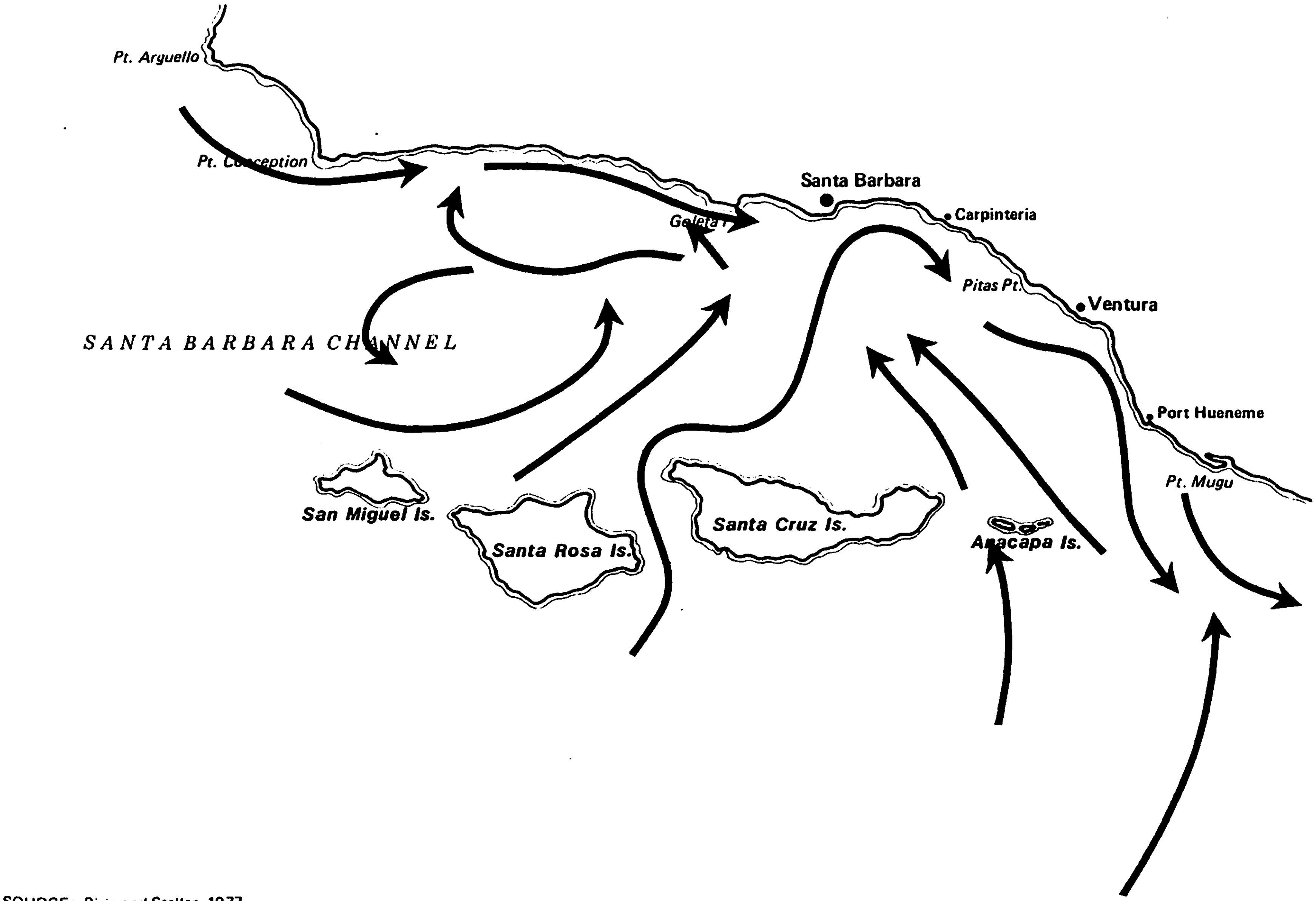
The movement of littoral materials along the coast in the vicinity of the project site is in response to wave direction and the configuration of the coast. Waves approach the coast predominantly from the west to northwest and produce a net southerly transport of littoral sands. Less frequent waves from the southeast cause occasional local reversals in the direction of littoral transport. The sources of the littoral materials include the streams entering the channel basin, eroded coastal rocks and sediment, and sands from coastal dunes (Bowan and Inman, 1966).



SOURCE: Pirie and Steller, 1977

Santa Barbara Channel Currents — Upwelling Period

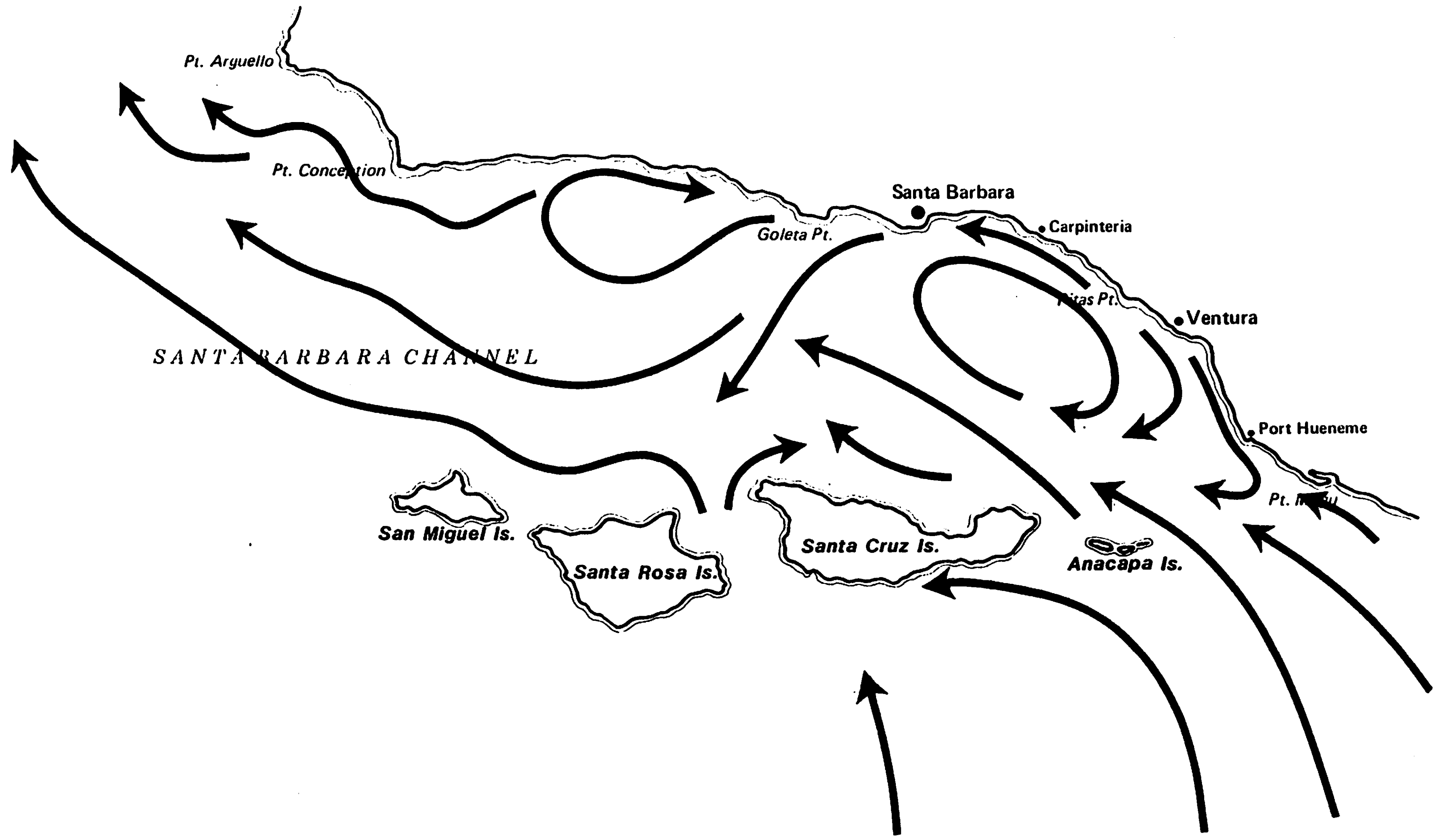
FIGURE 3.4-2



SOURCE: Pirie and Steller, 1977

Santa Barbara Channel Currents – Oceanic Period

FIGURE 3.4-3



SOURCE: Pirie and Steller, 1977

Santa Barbara Channel Currents — Davidson Period

FIGURE 3.4-4

The rate of littoral transport in the region is a subject of controversy. Estimates of the net transport southward around the Conception Headlands range from none (Pollard, 1979) to 180,000 cu yd/yr (Jen et al., 1976). The littoral materials are supplied to the sea as discrete events during flood stage of the streams in the region and when cliffs and bluffs undergo erosion typically by the virtually instantaneous collapse of a localized part of a vertical backshore. Minor quantities of material is added to the littoral zone by aeolian transport from alluvial deposits onshore.

3.4.2.4 Tides and Tidal Currents

The tides in the project region are of the mixed type having a diurnal inequality in the semidiurnal variation of sea level. Semidiurnal tide amplitudes vary on a fortnightly basis between neap (minimum range) and spring (maximum range) conditions. The yearly extreme tides occurs during the spring and winter solstices. At Santa Barbara, the mean tidal range is 3.7 feet (1.1 m) but the mean diurnal range is 5.3 feet (1.6 m). The tide wave which accompanies the rise and fall is progressive and approaches the coast from the southeast. Any tidal currents generated by flooding tides should flow toward the northwest with ebbing flows toward the southeast. Tidal currents are generally unevenly distributed due to shoreline and bottom topography and can vary from 0 to 13 feet per minute (Leipper, 1955).

3.4.3 Sea States

3.4.3.1 Waves

Ocean waves are primarily the result of wind and storms. Less frequently, waves are generated by geologic activity such as earthquakes, volcanic activity, and submarine landslides. Tidal action produces another form of wave. Waves which grow in height under the influence of wind are referred to as wind waves or seas, and the area over which they are generated is termed the fetch. Once the wind waves move out of the fetch area and continue on without additional energy input, they are referred to as swell. In southern California, wind waves are predominantly from the northwest (prevailing winds), and swells may occur from any seaward direction. Wave height and direction may be the result of several different wave trains moving through the area.

Sea surface waves range in length from fractions of an inch (capillary waves) to hundreds of miles (tides and tsunamis). Most of the wave energy transmitted on the sea surface appears in the form of wind-generated waves with periods ranging from approximately 5 to 15 seconds.

Propagation of surface waves over water depth less than about one-fourth the wavelength is inhibited by the friction or wave-breaking effects caused by the waves moving over or breaking onto the bottom. According to the State Water Quality Control Board (Allan Hancock, 1965), nearly all of the southern California Coast is protected, to some degree, from swells generated outside the coastal area by the offshore islands. Certain portions of the coast are exposed to essentially unlimited fetches from the west and south, but no location is exposed to swell from all possible seaward directions. The project site lies in an area that is protected from incoming surface wave energy in all but westerly and southeasterly directions. Local wave generation is also limited because the surrounding topography reduces the length of wind fetch.

Along the coast from Santa Barbara to Point Dume, most significant swells arrive from 260° and from 160° to 190° True. Even in areas which are exposed to long fetches, swells with periods greater than 10 seconds are altered, at least in direction, by refraction over banks and around the offshore islands.

The protection offered by offshore islands is generally so complete that significant waves over the shelf are mainly formed in the local area. The restricted fetches allow only the development of low waves with short wave lengths and periods. Larger waves (to 6 or 8 feet (1.8-2.4 m)) are formed during frontal crossings, but have short wave lengths and periods due to the limited fetch. It is only when gale winds of greater than 35 knots (64.8 km/hr) blow from the west that high waves are formed in the local region and travel over the shelf.

During the 1983 winter storms, the primary direction of wave flow was from the south and southeast. Waves in excess of 12 to 15 feet (4 to 5 m) were observed (Scripps Institute of Oceanography, NORPAC Data Center). South facing coastlines experienced shorebreak in the range of 15-20 feet (4 to 6 m) and were extensively damaged.

3.4.3.2 <u>Tsunamis</u>

Tsunamis are surface gravity waves generated primarily by submarine earthquakes or volcanic eruptions. They are a finite series of waves that travel in a concentric pattern from the source of disturbance. Generally they are long-period waves (from 5 minutes to several hours), low in height (a few feet or less) and may travel at speeds well over 400 knots (740 km/hr). On the open sea or in deep water, they usually go unnoticed by ships and platforms. However, as the wave moves to shallow water, it is modified by coastal and bottom configurations and increases in height and shortens in length eventually breaking against the coast. The damage associated with tsunamis often occurs in the form of rapidly rising water levels or bores rather than breaking waves.

Use of the term "tidal wave" to denote the seismic wave is misleading because of the allusion to astronomical tide, which is a surface gravity wave of a larger wavelength. Though the longer and higher astronomically driven tide waves possess far more energy and inundate larger areas of land than do tsunamis, they are not as destructive. Tides may flood an area regularly and predictably, while tsunamis occur rarely and without warning.

According to the Coast Pilot #7 (1968), the coast of California is not generally subject to waves of the magnitude which strike the Hawaiian Islands and other Pacific areas, although widespread damage to shipping and to waterfront areas occurs occasionally. For example, much of the damage to the Los Angeles area from the 1960 Chilean tsunamis was caused by rapid currents and the swift rise and fall of the water level, which broke mooring lines and set docks and ships adrift. Tsunamis are not considered a hazard to the proposed platform as it will be located in a water depth in excess of 730 feet (223 m).

3.4.4 Water Quality

3.4.4.1 Temperature

The temperature of the seawater in the vicinity of the project site is controlled by the advective processes that move water into the area and by solar warming and evaporative processes. Temperature is of major importance as a seawater characteristic influencing density, biological productivity, and the dispersion properties of the water mass. An area of rapid temperature change (0.1°C per meter) is referred to as a thermocline. Thermoclines are created by increases in surface water temperature, thus decreasing surface density. A strong thermocline results in vertical stratification that may inhibit natural physio-chemical and biological vertical exchange, and may also affect dispersion and settling of suspended materials.

During the summer months (July, August, and September), inshore waters are generally warm, and a well defined thermocline exists. In late summer, colder northern water carried by the California Current is moved inshore via the Southern California Countercurrent. Part of the current flows north toward Point Conception, and the remainder reverses direction and moves southward along the coast. The surface waters become cooler due to wind-induced mixing with colder deeper waters, and the thermocline gradually disappears. During the winter, storms maintain this mixing. In the spring, an upwelling of colder subsurface water occurs. This colder water also chills the air over the water surface creating fog during the months of April, May, and June. Summer heat then gradually warms the inshore waters to complete the cycle.

Stratification of water along the southern California mainland shelf is principally the result of temperature differences with depth. In summer the temperature change from surface to 200 feet (60 m) may be 15° to 20°F (8° to 11°C). Summer thermoclines are generally observed between 30 and 50 feet (9 to 15 m) and may show a temperature decrease as much as 5° to 8°F (3° to 4°C). In winter the temperature difference from surface to 200 feet (60 m) may be as small as 1 to 2°F (0.6 to 1.2°C). Upwelling tends to decrease the depth of the thermocline.

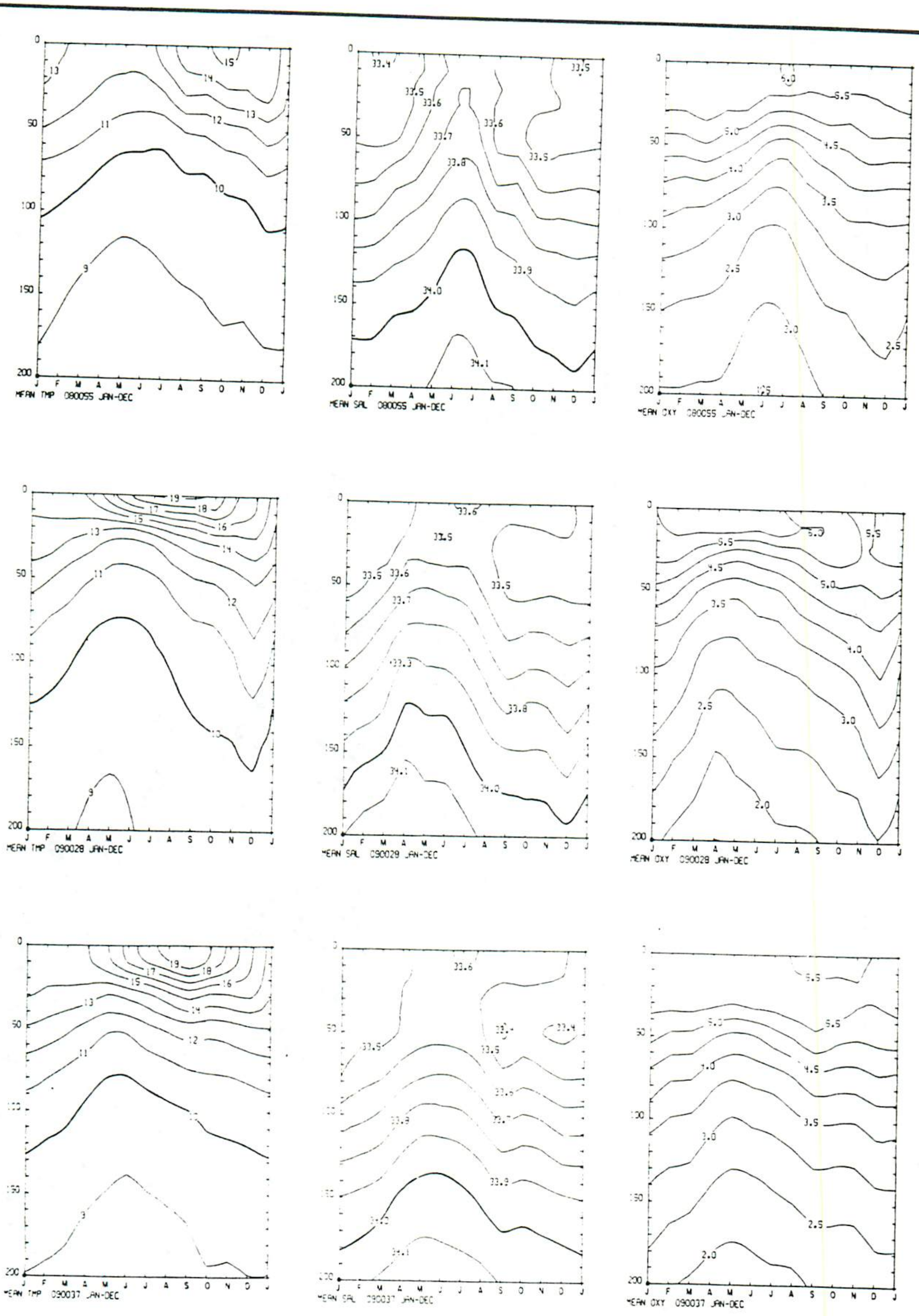
Figure 3.4-5 shows long-term temperature profiles for two nearshore (80055, 90028) and one offshore (90037) CalCOFI grid location for data taken from 1950 to 1965. The sampling stations are shown in Figure 3.4-6. It is not expected that sea temperatures will vary significantly from these figures. Short-term anomalies such as the thermal incursion which occurred along the southern California coast in 1982 and 1983 are infrequent phenomena and should not be considered to have long-term impacts on the aquatic system. Figure 3.4-7 shows the bottom temperatures of the basins in the southern California Bight and includes direction of bottom current flows between basins. Figure 3.4-8 describes the relationship between temperature and depth in the open ocean and for the basins within the Bight.

3.4.4.2 Salinity

Salinity, as a measure of the concentration of dissolved salts in seawater, is relatively constant throughout the open ocean. However, it can vary in coastal waters, primarily because of the inputs of freshwater from land or because of upwelling (SCCRWP, 1973). Salinity typically increases with depth, although generally remaining uniform in the open ocean, with concentrations varying between 33.4 and 34 parts per thousand (ppt) (Eber, 1977). Water in the site area is often isohaline below a depth of 50 feet (15 m) with the effects of dilution and evaporation detectable only in the surface 50 feet (15 m). During summer, a salinity inversion develops near the surface due to evaporation, however, the density stratification is usually sufficient to preserve water column stability, and the increase is only slight. The average annual salinity for three CalCOFI grid sites in the project area is shown in Figure 3.4-5.

3.4.4.3 Oxygen

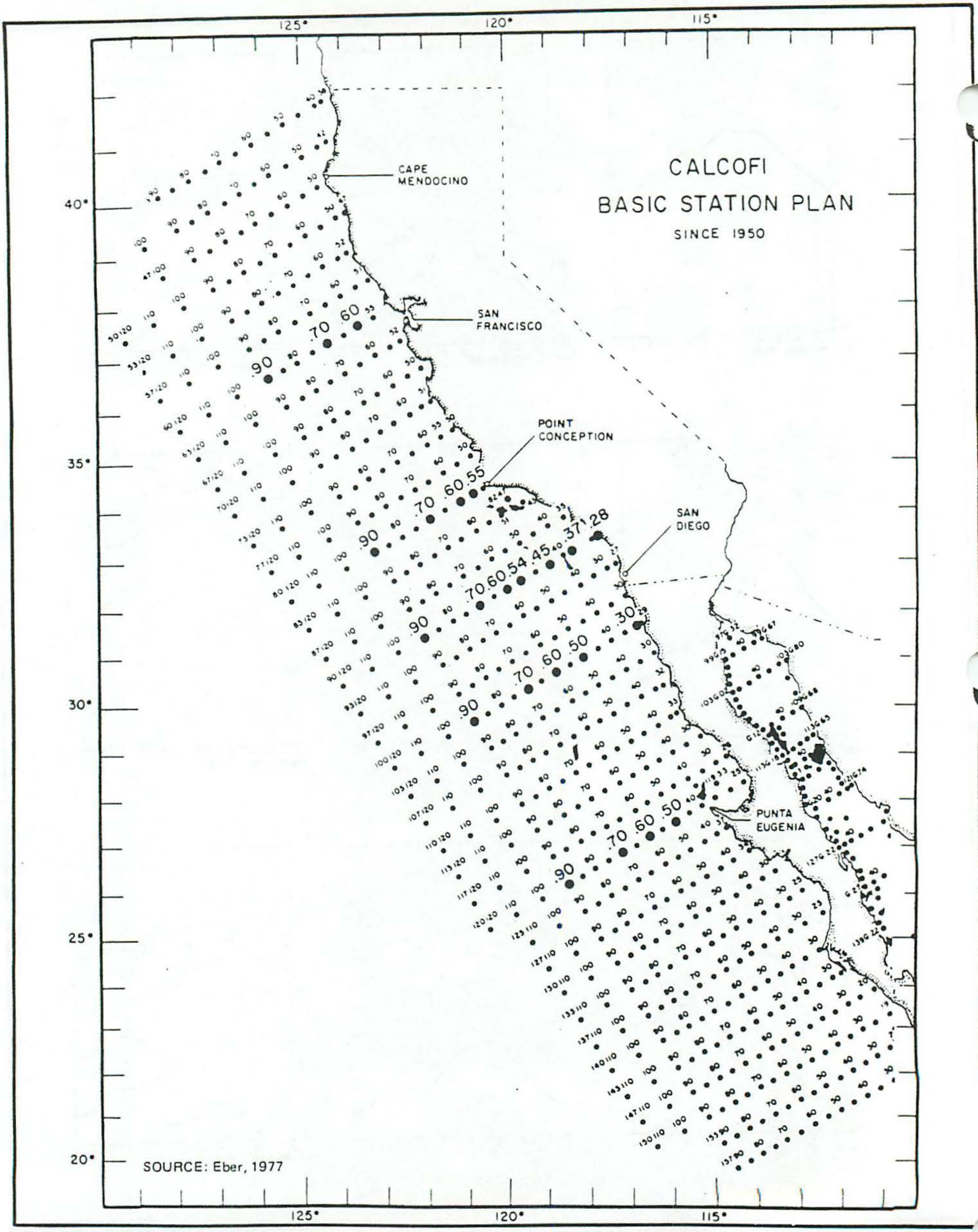
The Southern California Coastal Water Research Project (SCCWRP, 1975) reports that surface waters are usually saturated or supersaturated with dissolved



SOURCE: Eber, 1977

Temperature, Salinity and Oxygen Measurements – Yearly Averages at 2 Nearshore and 1 Offshore CalCOFI Stations

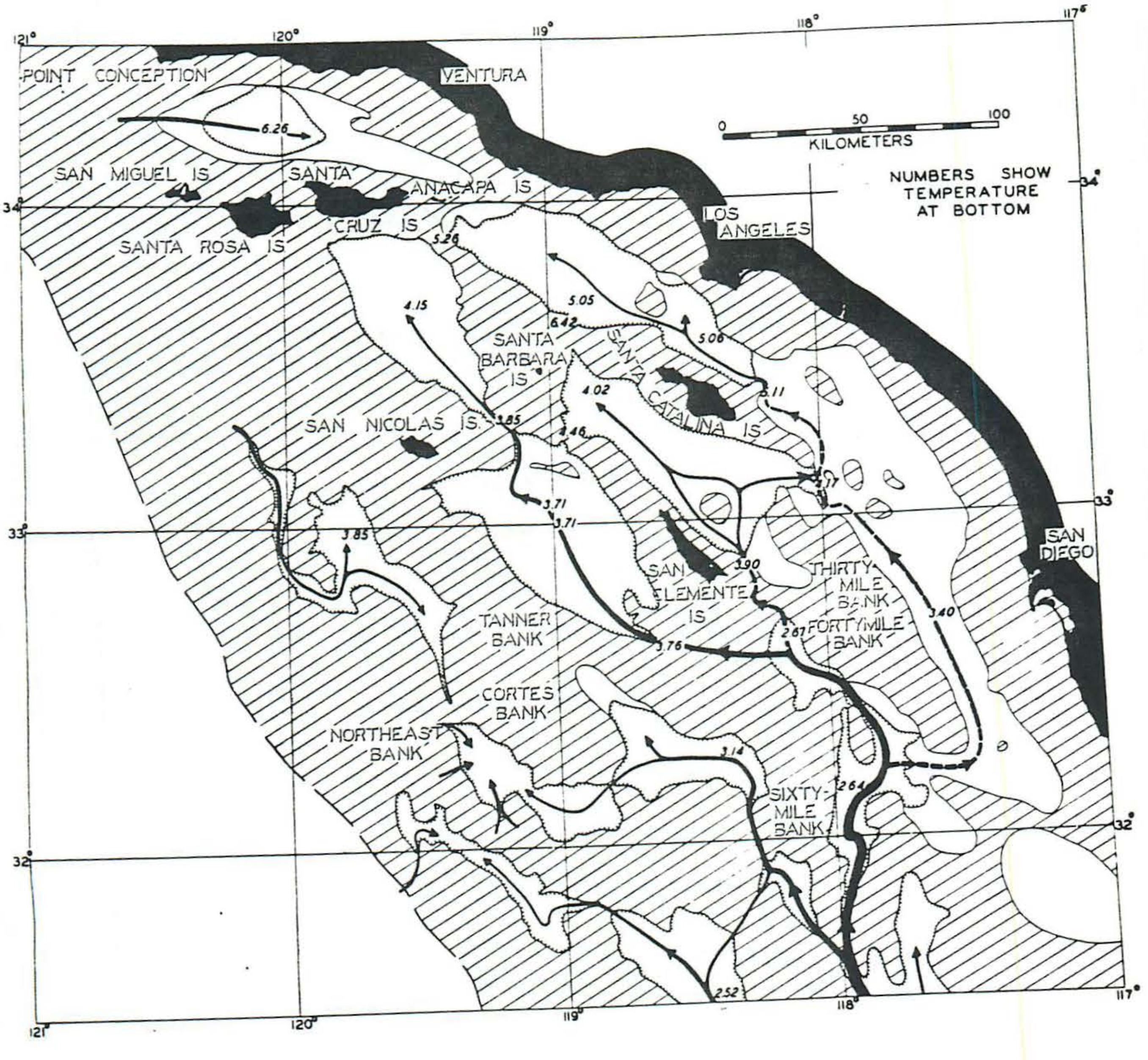
FIGURE 3.4-5



SOURCE: Eber, 1977

CalCOFI Basic Station Plan

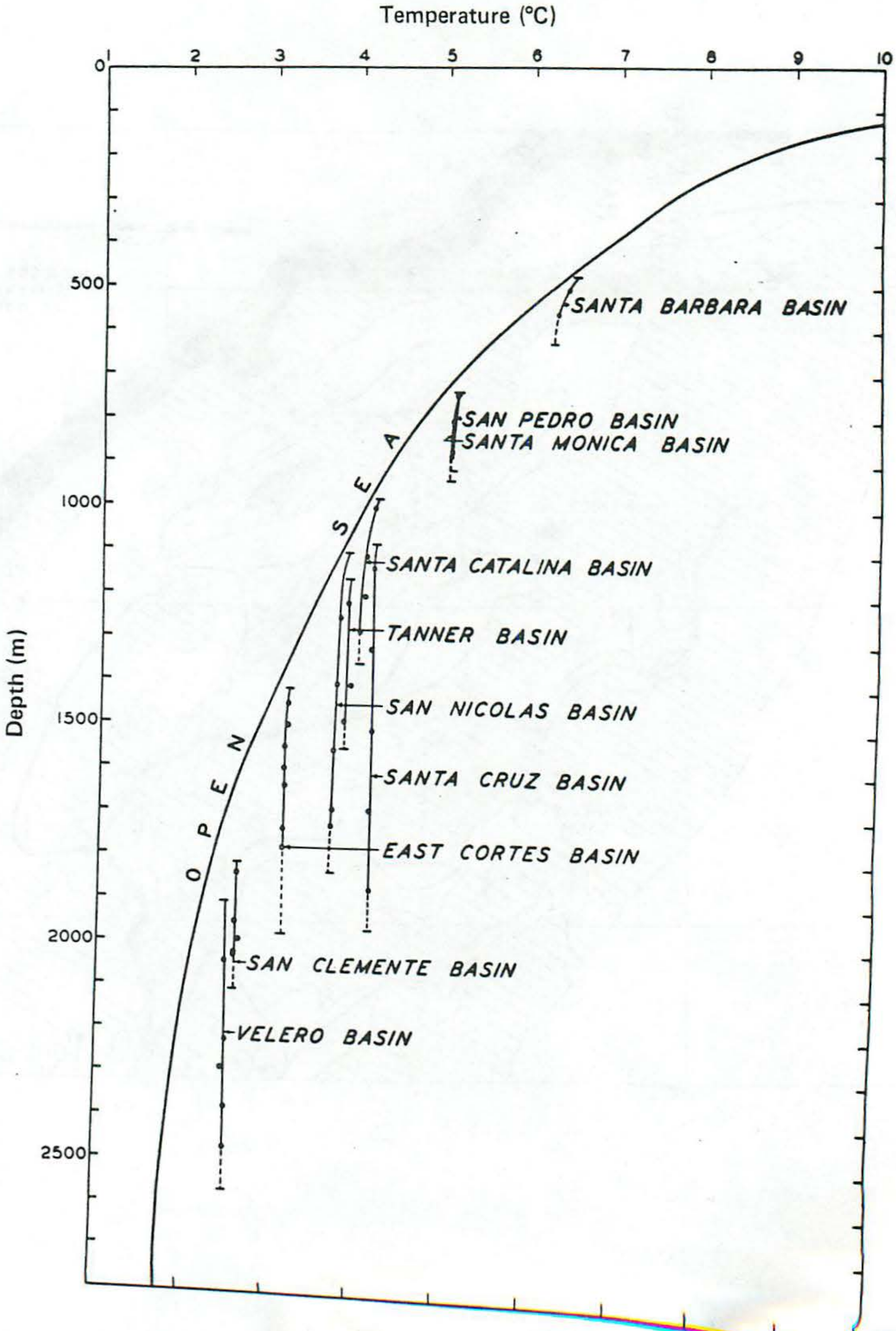
FIGURE 3.4-6



SOURCE: Redrawn from Emery, 1960.

FIGURE 3.4-7

tom Temperatures of Basins in the Southern California Bight



Temperature — Depth Relationship in Open Ocean and Southern California Ba

SOURCE: Redrawn fr

oxygen on the mainland shelf with the highest concentrations occurring during the summer months when oxygen saturation may reach as high as 140 percent of saturation. Coastal water concentrations of dissolved oxygen are more variable than those offshore, reaching as high as 10 to 14 mg/l. Highest concentrations are characteristic of nutrient-rich water which maintain phytoplankton populations releasing oxygen during photosynthesis. Dissolved oxygen may be depleted by respiration from marine organisms and chemical and/or biochemical oxygen demand.

Concentrations of dissolved oxygen are a function of photosynthetic processes, respiration, atmospheric exchange of gases, ocean temperature, salinity, currents, density, and wind-mixing. There is little horizontal variation of dissolved oxygen but there are large vertical variations. Dissolved oxygen concentrations are greatest in spring and summer because of photosynthesis; they also vary with depth because photosynthesis occurs mainly in the upper strata of the ocean. Concentrations generally decrease with depth; however, values below 200 feet (60 m) of depth usually do not fall below 4 mg/l in shelf waters, which is about 50 percent of saturation and adequate to support marine life. Figure 3.4-9 shows the oxygen curve for open ocean waters with depth, and includes the oxygen minimums for deep basin waters including the Santa Barbara Basin.

Data from long-term oceanographic studies conducted under the auspices of CalCOFI shows a similar condition (Figure 3.4-5). Oxygen levels drop rapidly below 100 m, to below 2.0 ppm dissolved oxygen. Organisms living in the deeper waters have adapted physiologically to the interactive effects of temperature, pressure, oxygen and salinity and live quite satisfactorily.

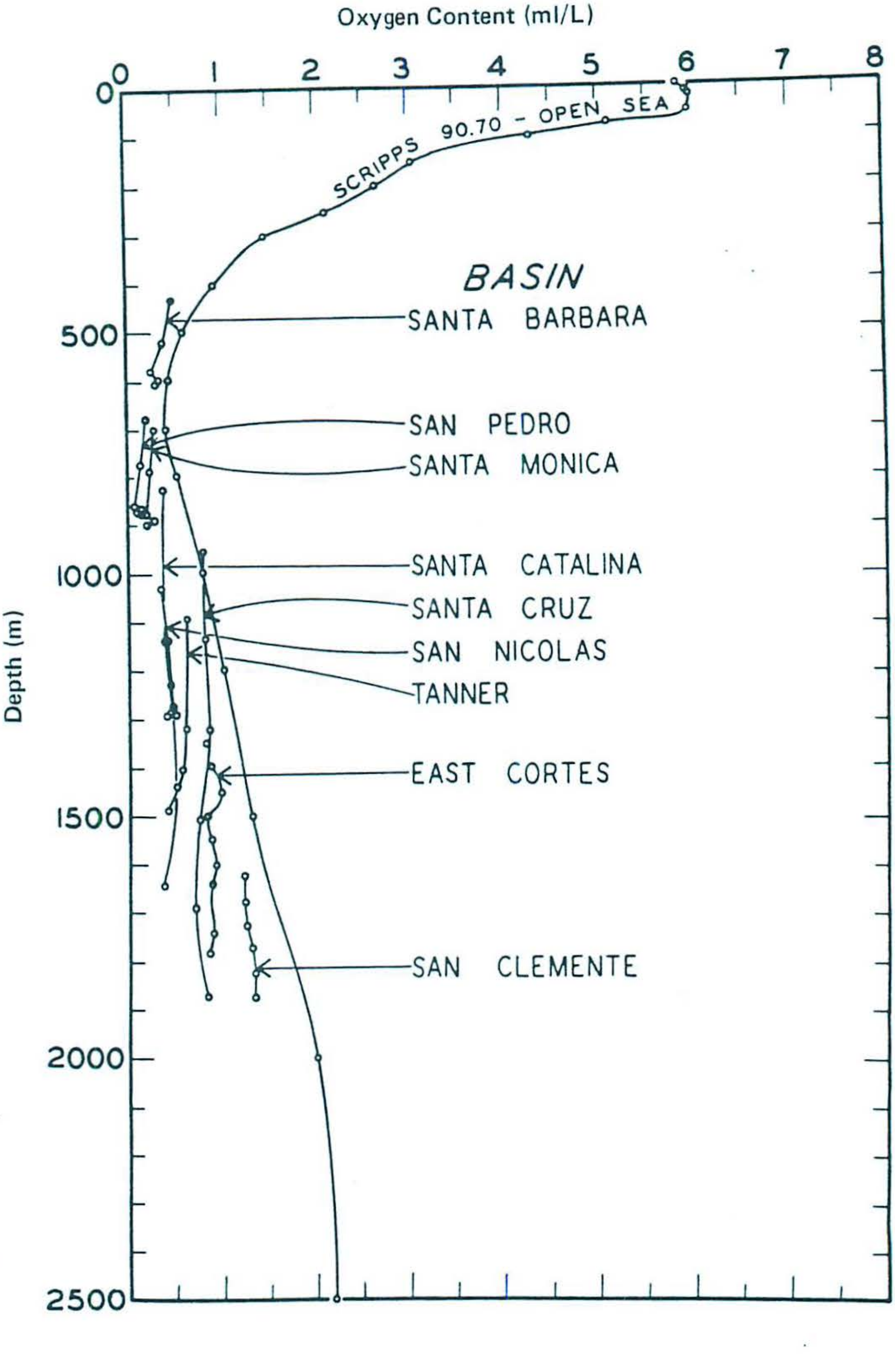
3.4.5 Water Quality Parameters

A number of physical and chemical characteristics are used to define the term water quality. Three of these characteristics: temperature, salinity and oxygen, have been discussed previously.

3.4.5.1 Transparency/Turbidity

Light is a major factor in the growth of phytoplankton and the growth and reproduction of attached marine plants. It is also affects the diurnal vertical migration of zooplankton and some fishes. The transparency of water, which determines the depth to which light will penetrate, is of concern in considering many biological processes.

Turbidity, the reduction of water transparency created by the presence of suspended solids, is most commonly measured as the percent transmittance (%T) of



SOURCE: Redrawn from Emery, 1960.

FIGURE 3.4-9

Oxygen – Depth Relationship in Open Ocean and Southern California Basins white light through 1 m of water. Naturally occurring contributors to turbidity offshore include high plankton concentrations (usually in surface waters), fine particles of suspended sediments from storm water and river runoff, or resuspended bottom material from wave action and upwelling.

Transparency is lower in the spring than in the fall, particularly in the vicinity of the alluvial land plains along the coastline south of Santa Barbara. A band of low transparency water within a mile or so of the beach is characteristic of the southern California Coast (Allan Hancock Foundation, 1965).

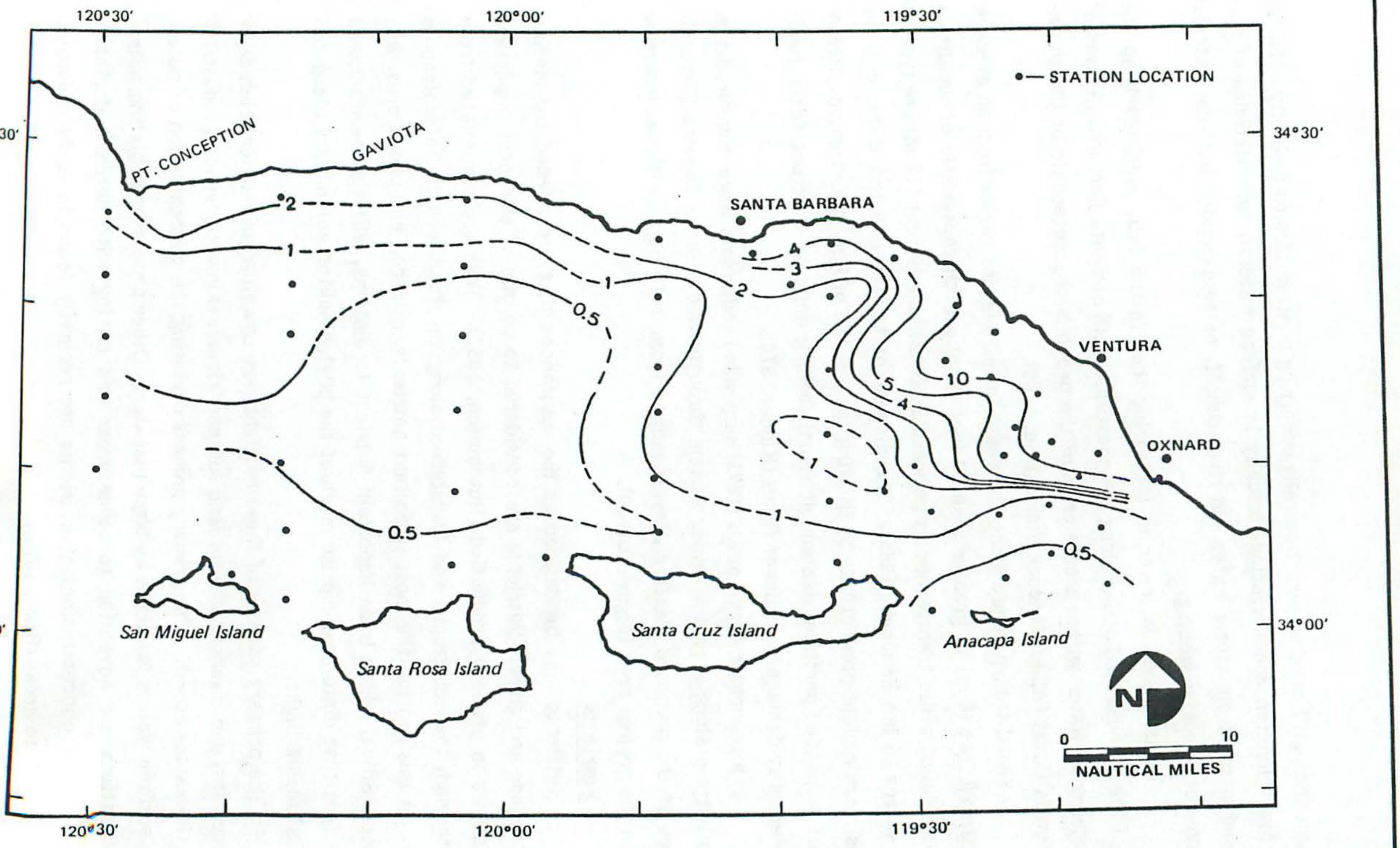
Visual transparency along the coast for all seasons varies from an average of less than 20 feet (6 m) to greater than 50 feet (6 m) are characteristic of localities off allivual plains, while transparencies between 20 (6 m) and 40 feet (12 m) are typical of rocky shores (Allan Hancock, 1965). The amount of turbidity in the water column influences marine plant productivity by limiting the amount of light penetration. Heavy amounts of suspended particles can inhibit visual feeding animals, obstruct filter feeders, or potentially damage the gills of fishes (Kinne, 1970).

In a report by Drake et al. (1971) suspended sediments were measured 1 m above the bottom along a grid sampling system throughout the Santa Barbara Channel. In the area of the proposed platform, levels ranged from 2-10 μg/l, with very narrow isopleths in the project area (Figure 3.4-10).

3.4.5.2 Nutrients

Nutrients may be defined as the substances that are needed for marine life to reproduce and grow. Nutrients are considered to be one of the most important limiting factors in primary production (Hutchinson, 1957). They are assimilated from seawater through the autotrophs and transferred along the food web to heterotrophic organisms. In this section the most important nutrients, nitrogen and phosphorus, will be discussed. Silica, which is an important nutrient to diatoms, will also be discussed due to the fact that diatoms comprise much of the phytoplankton community along the Southern California Bight.

The primary sources of these nutrients are upwelling of nutrient rich deep waters, aductions, and discharges from land sources (rivers, rainwater runoff, industrial and domestic wastewaters). The primary process depleting the concentration of nutrients in the surface waters is uptake by phytoplankton. Other processes depleting nutrient concentrations are advection to other areas and mixing with nutrient depleted water masses. Low concentrations of nutrients are normally found in surface waters except in local source areas (BLM, 1975).



SOURCE: Drake et al., 1971

Suspended Sediment (mg/liter) One Meter Above the Bottom in August 1969

FIGURE 3.4-10

Nitrogen and phosphorus represent the two elements generally found to be limiting in natural ecosystems; however, nitrogen is considered to be the more important of the two. In the open ocean, it has been commonly observed that total nitrogen and total phosphorus are found in a relatively constant ratio of about 15 atoms of nitrogen to 1 atom of phosphorus (Redfield, 1958). This relationship is not nearly so constant in coastal waters, which are affected by higher rates of organic production and are subject to influences from land-based nutrient sources. Ryther and Dunstan (1971) suggest that since phosphate is normally present in concentrations twice that of nitrogen in the coastal marine environment, nitrogen must be the critical limiting factor.

Phosphorus exists in a great number of forms, the most prevalent of which is the phosphate group ($PO_4^=$). The slightly soluble inorganic phosphorus of the earth's crust is a relatively unlimited reservoir which slowly leaches into aquatic systems through the weathering of rock. These soluble orthophosphates are quickly assimilated by phytoplankton and transformed into particulate organic phosphorus. Dissolved inorganic phosphorus compounds are released into solution by excretion or decomposition and are transformed into particulate organic phosphorus, or, through degradation, are converted back into inorganic orthosphosphates. As in nitrogenous forms, some of the organic products result in refractory compounds, unavailable for biological use, and become part of the sediments.

In the Southern California Bight, average nitrate and phosphate concentrations in the surface water, 0 to 50 feet (0-15 m) are always low (NO_3 = <5 μg/l; PO_4 - 4P = <0.5 μg/l). From a depth of 50 to approximately 330 feet (15-100 m) concentrations increase rather rapidly (NO_3 - N = 8 - 12 μg/l and PO_4 - P = 1 - 2 μg/l). Below 330 feet (100 m) of depth, the concentrations increase steadily, but at slower rates than near the surface. Below 740 feet (225 m) of depth, nitrate concentrations are consistently greater than 20 μg/l and phosphate greater than 2 μg/l.

Nutrient concentrations in the surface waters vary with season near the coast due to spring upwelling and runoff from storms. Concentrations of both nitrate and phosphate are higher during the spring than in other seasons. This seasonal change is less evident farther from shore and is not evident below 330 feet (100 m) of depth. Concentrations measured at equal depths throughout the Bight are usually similar, which indicate that the horizontal distribution of nutrients is fairly uniform. Some differences are expected in the surface water due to local differences in runoff and upwelling characteristics. The depth at which concentrations of at least 30 μg/l

NO_3 - N are continually available apears to be 1000 feet (300 m) or more. The distribution of both phosphate and nitrate concentrations were observed to be the same (Oceanographic Services, Inc., 1978).

Silica concentrations are relatively uniform in surface waters, with low values occurring in the fall and winter. The differences in concentrations between surface waters and waters at 300 feet (90 m) of depth appear to be the greatest during April, May, and June, when the upwelling of deep water is greatest. Silica concentrations at the surface range from approximately 200 µg/l to 800 µg/l. Mean silica concentrations show fairly consistent patterns, increasing with depth. Silica concentrations at 300 feet (90 m) range from 800 µg/l to 2250 µg/l (SCCWRP, 1973).

3.4.5.3 Trace Metals

Trace metals (such as cadmium, copper, zinc, mercury, and lead) are normal constitutents of sea water and sedimentary material. In the Southern California Bight, trace metals within the water column and sediments are derived from natural sources (weathering of pre-existing rock material) and man-induced sources.

Metals can exist in the waters in ionic form, associated with particulates, organically bound, or as chemical complexes. Chemical and biological processes shift the equilibria between these states. Total trace metal concentrations and the state of trace material in coastal waters can be expected to vary significantly from those in offshore waters. Similarly, concentrations in surface waters and in deep ocean waters differ significantly. Other factors, such as heavy rains, storm runoff to coastal waters, upwelling of subsurface water, or changes in plankton population can also alter metals concentration.

The levels of metals in the waters of the Southern California Bight, even in the vicinity of river discharges and wastewater outfalls, are within ranges reported for seawater in various areas around the world (SCCWRP, 1975). Trace metal concentrations measured in southern California Bight (Bruland, 1983) are presented in Table 3.4-1.

Table 3.4-1

CONCENTRATION (μg/l) OF DISSOLVED TRACE METALS IN SEAWATER (Bruland, 1983)

Chemical	Mean	Range
Barium	13	4 - 21
Cadmium	0.08	0.001 - 0.1
Chromium	0.2	0.1 - 0.3
Copper	0.25	0.03 - 0.38
Nickel	0.5	0.1 - 0.7
Lead	0.002	0.001 - 0.004
Vanadium	1.5	1 - 2
Zinc	0.4	0.003 - 0.6

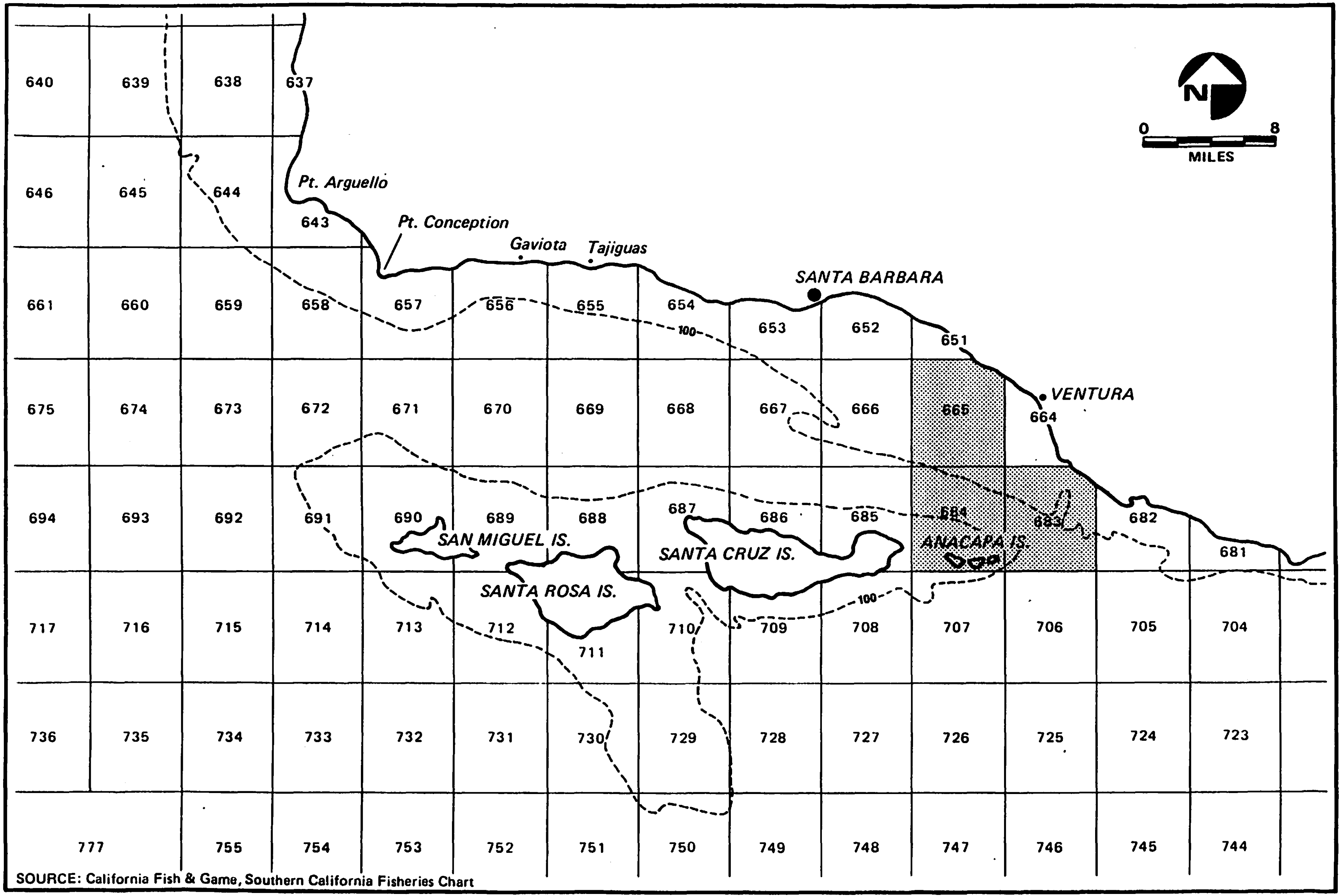
3.5 OTHER USES OF THE PROJECT AREA

3.5.1 Commercial and Sport Fisheries

As pointed out by Horn (1974), almost all of the commercial and sport fishes landed in southern California are either pelagic species that are taken by a variety of methods or inshore predatory species that are taken by selective hook-and-line fishing. In contrast to central and northern California, where bottom trawling accounts for much of the fish landed, only an insignificant fraction of the total commercial catch in southern California is taken by trawling. In Fish and Game District 19 (Santa Barbara-Ventura County line to the Mexican border), the possession of trawl nets is governed by terms of a permit issued by the California Department of Fish and Game.

The Platform Gail project lies within California Department of Fish and Game Fish Block 684 (100 square miles) (Figure 3.5-1). The historical commercial catch in pounds landed for that fish block as well as 683 and 665 is given in Table 3.5-1. All three blocks are dominated by the purse seine fishery for mackerals, anchovies and bonito. Other major fisheries include the California halibut, English sole, various species of shark, various species of rockfish, lobster and shrimp and sea urchins.

The primary fishing area for anchovies is generally in the mid-channel area over deep water, while mackeral tend to be associated with the shallow waters adjacent to the Channel Islands. The purse seine fishery in the project area uses fishing vessels in the range of 40-120 tons.



SOURCE: California Fish & Game, Southern California Fisheries Chart

Fish Blocks in the Project Area

FIGURE 3.5-1

Table 3.5-1

COMMERCIAL FISH LANDINGS FROM BLOCKS 665, 683 and 684 in 1977 and 1981

	665		683		684	
	1977	1981	1977	1981	1977	1981
Tuna, yellowfin	—	4,260	—	—	—	—
Bonito, Pacific	—	1,475	—	318,973	—	255,322
Yellowtail	—	12	—	700	—	—
Mackeral, unspecified	—	103,800	00	00	00	462
Mackeral, Pacific	—	621,876	236,238	1,737,265	357,908	6,322,688
Mackeral, jack	434	154,144	1,759,682	540,492	10,907,432	2,947,409
Butterfish, Pacific	—	13,248	—	7,367	567	160
Swordfish	—	1,280	952	4,263	915	4,223
Sardine, Pacific	—	—	—	—	—	37
Anchovy, northern	10,730,200	2,642,486	1,685,500	1,390,784	1,854,800	139,500
Barracuda, California	180	11,394	—	79	—	75
Sheephead, California	182	428	—	150	—	246
Shark, unspecified	2,241	6,386	702	882	918	5,307
Shark, bonito	—	503	27	897	—	2,602
Shark, spiny dogfish	47,925	—	—	—	—	641
Shark, leopard	32	290	—	81	442	9,271
Shark, common thresher	1,830	3,806	—	12,570	411	2,059
Shark, smooth hammerhead	—	112	—	—	—	—
Shark, soupfin	214	960	—	1,947	—	—
Shark, Pacific Angel	—	2,344	—	3,721	—	7,631
Shark, blue	987	—	—	1,101	—	—
Ray, Pacific electric	—	51	—	—	—	—
Skate, unspecified	137	444	92	281	—	259
Sable fish	276	—	1,585	—	—	—
Lingcod	27	—	10	658	—	258
Sole, unspecified	99	29	12	68	—	—
Sole, English	10,150	214	3,791	173	—	746
Sole, rex	—	—	152	7	—	190
Sole, petrale	179	131	1,602	17	—	—
Sole, Dover	—	—	94	—	—	—
Halibut, California	54,676	47,121	5,959	10,880	675	15,014
Sanddab	266	73	—	—	—	2
Flounder, unspecified	212	—	—	—	—	—
Turbot	107	—	—	—	—	—
Rockfish, cowcod	—	129	—	1,929	—	873
Rockfish, vermilion	—	—	—	32	—	—
Rockfish, unspecified	1,094	3,072	42,992	13,672	4,362	29,593
Rockfish, black	—	—	—	—	—	13
Rockfish, bocaccio	2,486	—	666	906	392	—
Rockfish, chilipepper	—	—	264	21	—	—
Rockfish, yellowtail	21	—	—	—	—	—
Cabezon	29	—	—	—	—	—
Thornyhead	263	—	—	—	—	—

Table 3.5-1

COMMERCIAL FISH LANDINGS FROM BLOCKS 665, 683 and 684 in 1977 and 1981 (Continued)

	665		683		684	
	1977	1981	1977	1981	1977	1981
Rockfish, gopher	—	—	197	—	—	—
Rockfish, yelloweye	1,128	—	2,301	2,138	1,182	682
Bass, giant sea	10	334	—	57	—	186
Salmon, chinook	—	—	—	—	24	—
Seabass, white	175	5,001	—	116	—	458
Grouper	—	—	—	—	—	2,129
Croaker, white	2,364	38,394	—	23,088	—	2,093
Hake, Pacific	—	—	—	—	—	—
Surfperch, unspecified	—	343	—	73	—	295
Abalone	10	—	—	—	6	—
Abalone, black	—	—	—	—	1,767	1,000
Abalone, red	4,544	—	—	—	2,652	825
Abalone, green	8	—	—	—	10	94
Abalone, pink	6.032	—	—	—	8,313	1,690
Abalone, white	—	—	—	—	1,415	—
Abalone, threaded	35	—	—	—	—	—
Squid, market	—	—	—	114	72,000	98,540
Octopus	—	—	—	13	—	—
Urchin, sea	8,220	—	—	36,660	184,530	74,005
Crab, Dungeness	—	—	201	—	—	—
Crab, rock	16,901	3,997	202	5,436	—	7,443
Crab, spider	502	—	—	—	—	—
Prawn, ridgeback	216	930	—	—	—	—
Shrimp, unspecified	—	1,859	—	—	—	—
Prawn, spot	—	189	—	280	—	—
Lobster, California spiny	100	2,474	—	189	3,778	12,238
Fish, unspecified	39,586	—	—	1,305	—	264
TOTAL LANDINGS	10,934,078	3,673,587	3,743,254	4,119,374	13,404,499	9,864,532

Note: All landings are in pounds

Source: California Department of Fish and Game, Fisheries Statistics Group

Mr. John Tasso of Universal Packers in Ventura and Mr. Larry Bozanich of the Fishermens' Coop provided the following description of fishing activity. In the mid channel area, between Ventura and Anacapa Island, anchovies are taken using purse seines (300-400 fathoms long by 40-50 fathoms deep). The mesh in the nets is smaller than mackeral seines. Once the nets are in the water the fishing vessel stops and begins the pursing of the net. During the net hauling, the boat and net may drift 2 to 4 miles (3.2 to 6.4 km) with the current. Normal currents in the fishing area are southeasterly and northwesterly.

When fishing mackeral, slightly larger mesh nets are used in shallower water. The fishermen prefer to set the 40-50 fathom (240-300 foot) nets so the rings are on the bottom. This limits the escapement of the mackeral. This also restricts the fishing to waters shallower than 300 feet (91 m). Over sand bottoms, full width nets are used; while in rocky bottom areas, the fishermen shorten the depth of the net to 20 fathoms (120 feet) to keep from fouling nets on the rocks.

At the present time the quota on anchovies is 60,000 tons in California. The season is open from September to January, closed in February and March, open again from April through June; and closed in July and August. The present quota on Pacific mackeral is 16,000 tons, considered by most fishermen to be highly restrictive (J. Tasso, personal communication).

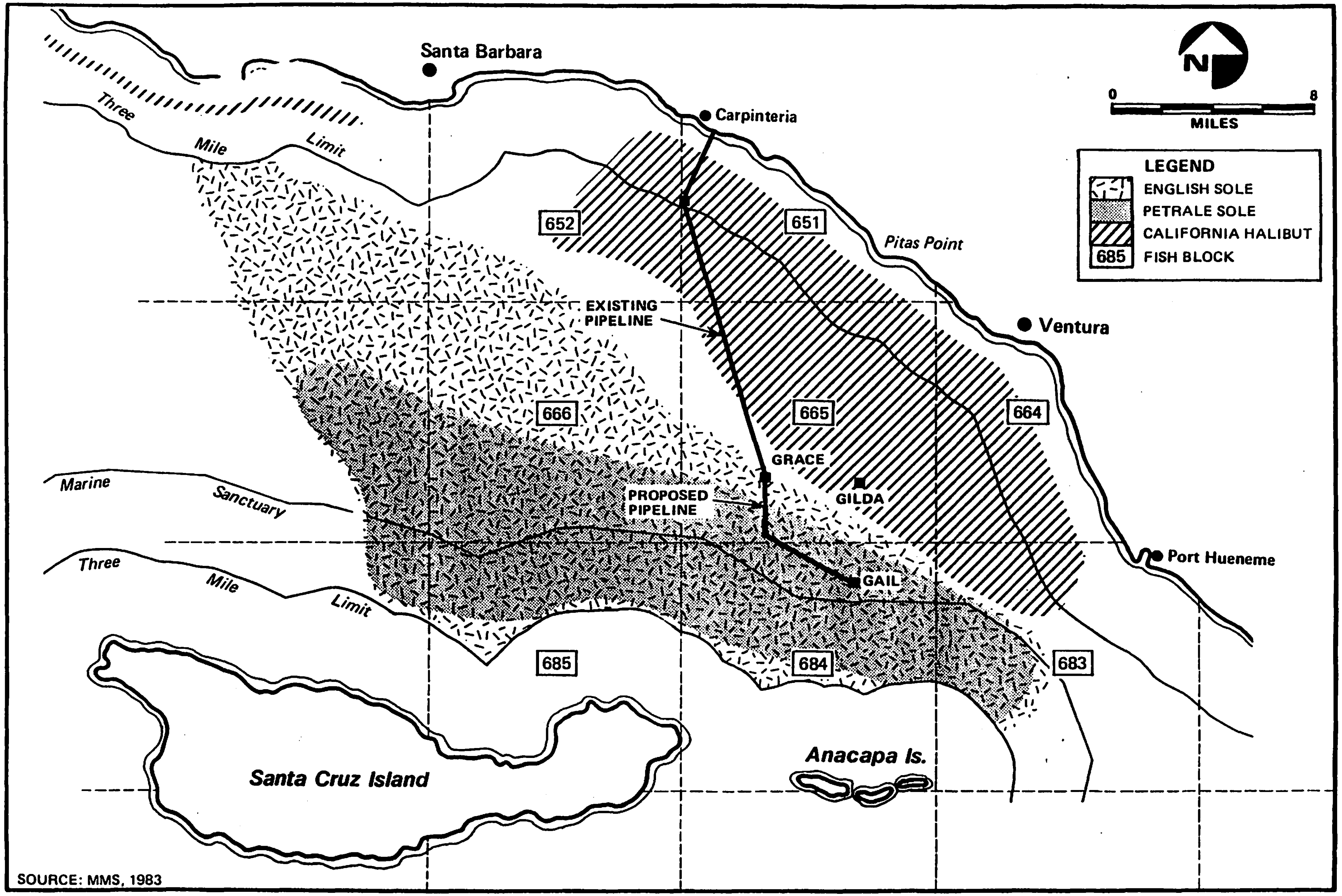
Some of the other major fisheries in these blocks include trawling for rockfish and flatfish. A significant California halibut trawling area ("Ventura Flats") is located inshore of the proposed platform and can be seen in Figure 3.5-2. The area between the marine sanctuary limit 6 miles (9.6 km) and the 3-mile (4.8 km) limit adjacent to Anacapa Island is used extensively for shrimp and prawn trawling and sea urchin harvesting (refer to Figure 3.5-3).

The gill net fishery is limited in the project area, but some activity is found around and offshore (west) of the Channel Islands for shark and swordfish. This fishery is composed of both drift and anchored gill netting.

3.5.2 Shipping

3.5.2.1 Vessel Traffic

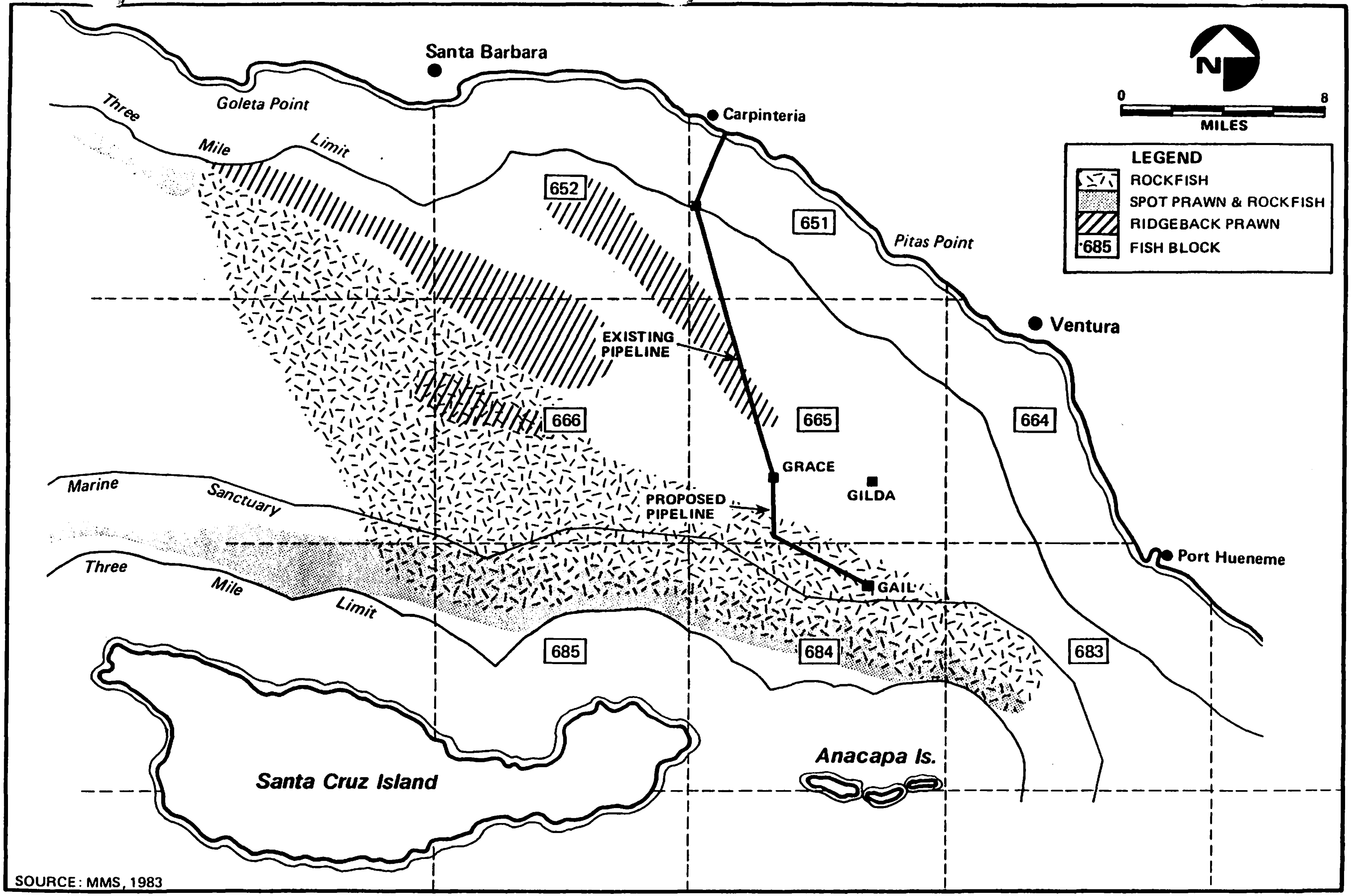
The primary marine traffic generators in the project area are the Ports of Los Angeles and Long Beach, Port Hueneme, and ship moorings along the coast. The U.S. Coast Guard Vessel Routing Survey reports that 65 percent of all ships calling at the Ports of Los Angeles and Long Beach pass through the Santa Barbara Channel.



SOURCE: MMS, 1983

Major Commercial Fishing Areas — Eastern Santa Barbara Channel

FIGURE 3.5-2



SOURCE: MMS, 1983

Major Commercial Fishing Areas — Eastern Santa Barbara Channel

FIGURE 3.5-3

WESTEC Services, Inc.

Table 3.5-2 presents vessel traffic data and projections in the project area for the years 1990 and 2000. The projections take into consideration growth of containerization, increase in ship size, OCS development, Alaskan oil development, demand for coal, deepening of the channels, and the Consolidated Marine Oil Terminal (CMOT) at Los Angeles. The vessel estimates for the project area assumed baseline estimates from the year 1976-1977 and 1977-1978. The projections have been estimated for each of the following types of ships:

- Tankers
- Container ships
- Dry bulk carriers
- General cargo carriers
- Other (auto and lumber carriers, passenger ships, etc.)

The data presents the average of nominal and maximum projections; the nominal case assumed no OCS shipment by tanker (all oil would be transported by pipeline).

Table 3.5-2

SHIP TRAFFIC PASSING THROUGH THE SANTA BARBARA CHANNEL BY THE PROJECT AREA IN EACH DIRECTION (PER DAY)

Ship Type/Year(s)	1990	2000
Tanker	7.02	7.96
Container	4.92	7.73
Dry Bulk	2.88	2.48
General Cargo	3.58	2.26
Other*	3.20	4.55
Total	21.60	24.98

*Passenger ships, etc.

Source: California Coastal Commission, 1981.

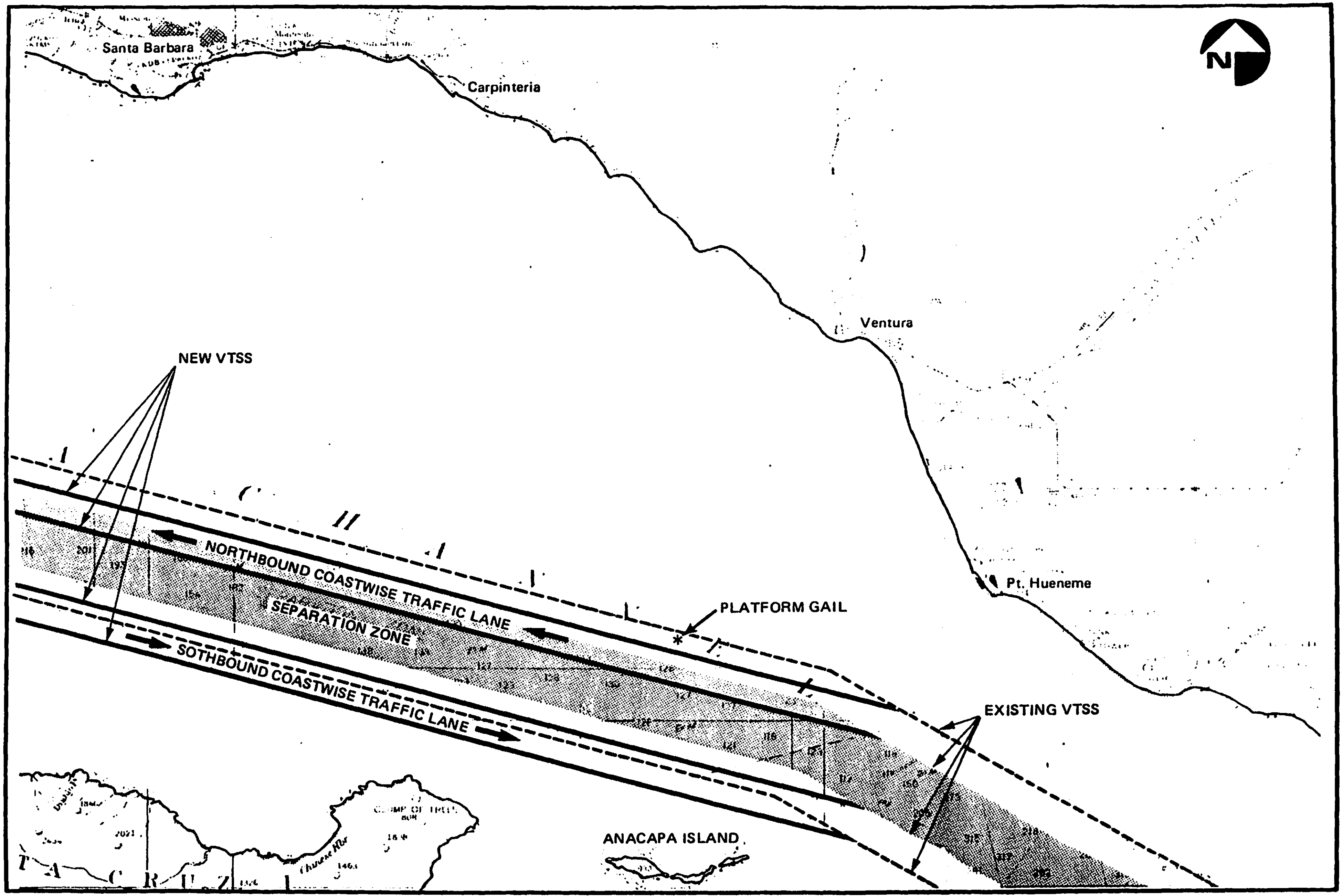
3.5.2.2 Shipping Lanes

Vessels transiting the Santa Barbara Channel utilize a low-level vessel traffic system which consists of a passive and voluntary Vessel Traffic Separation Scheme (VTSS) established in 1969 by the U.S. Coast Guard. The VTSS consists of a northbound and southbound lane running parallel to one another. The lanes are 1 mile

(1.6 km) wide and are separated by a 2-mile (3.2 km) wide separation zone. The southbound shipping lane is approximately 600 feet (183 m) and 9000 feet (2743 m) from the nearest points of Anacapa and Santa Cruz Islands, respectively. The northbound lane lies closer to the coast, approximately 8.9 nautical miles (14 km) from the mainland. The U.S. Coast Guard and the International Maritime Organization (IMO) recognize a 1640 foot (500 m) wide buffer zone on each side of each shipping lane. IMO is the only international body that can establish internationally recognized shipping lanes. No structure is permitted within the buffer zone or the shipping lanes.

In 1981 the U.S. Coast Guard conducted a vessel routing survey for commercial vessels calling at the ports of Los Angeles and Long Beach. The results of the survey indicated that 99 percent of the ships using the Channel used the Vessel Traffic Separation Scheme as opposed to alternate routes. Thus, it may be concluded that these vessels will also follow the pivoting of the VTSS north of Port Hueneme discussed in the following paragraph. While increased levels of transiting vessels are projected for the channel, the great majority of ships will travel within the designated traffic for the channel, the great majority of ships will travel within the designated traffic lanes, thus reducing the potential for marine traffic hazards. Between 1976 and 1980 the average number of daily ship movements through the Santa Barbara Channel Vessel Traffic Separation Scheme increased from 6.5 to 13 ship movements per day in each direction. This increase can be attributed to two primary factors: 1) the increase in number of vessel arrivals and departures at the ports of Los Angeles and Long Beach and 2) the percentage of total north-south ship movements in the area that use the VTSS has increased from 77 to 93 during that period (Texaco, 1983).

On June 15, 1981 the U.S. Coast Guard submitted the Port Access Route Study (PARS) to the U.S. Coast Guard Headquarters in Washington, DC. The study included a number of recommendations, one of which was to pivot the shipping lanes north of Port Hueneme approximately 1/4 to 1/2 mile (0.4 to 0.8 km) northwest, closer to the Channel Islands. This change will effectively shift the VTSS 1/2 mile (0.8 km) south closer to Anacapa Island and approximately 2/3 of a mile (1.1 km) from Platform Gail (Figure 3.5-4). This specific recommendation was made to eliminate oil and gas resource conflicts within the Santa Barbara Channel, and specifically in the Sockeye Field which includes Platform Gail. During the spring of 1982, notice of the proposed change was published in the Federal Register. A public hearing and comment period followed publication of the notice and continued through the end of June 1982. In late 1982 the Coast Guard submitted the recommendations to the International Maritime



Santa Barbara Vessel Traffic Separation Scheme

FIGURE 3.5-4

Organization (IMO), who reviewed the proposals. IMO approved the lane modification described above at the 28th session of IMO in London, England in October 1983. Also during 1983, all concerned regulatory agencies, including the U.S. Department of Transportation and the California Coastal Commission, were provided the opportunity to review and comment on the lane change recommendation.

The lane modification, published in the Local Notice to Mariners on July 11, 1984, will subsequently be published by related agencies, such as the National Oceanic and Atmospheric Administration (NOAA). As with all international agreements, the modification will not go into effect until February 1, 1985 due to the lead period required for the revision of navigational charts.

3.5.3 Military Uses

Essentially all of the Southern California OCS is used for various military operations. Operating military areas are shown in Visual No. 5 of the Environmental Impact Statement for the Southern California Lease Offering, February 1984 (MMS, 1984). The Santa Barbara Channel is the key exception to the extensive military operations being conducted offshore southern California. This is due to the fact that both oil and commercial fishing industries have historically been very active in the Channel (MMS, 1984). The Channel is, however, on the periphery of the Western Space and Missile Center at Vandenberg AFB, and the Pacific Missile Test Center at Point Mugu. Both of these facilities conduct missile testing and firing on a daily basis requiring large safety zones, bordering on both the western and eastern ends of the Channel. Current operations at these facilities include: all-weather flight training; air intercepts; air to air, air to surface, surface to air, and surface to surface missile launches, bomb drop exercises; dumping operations; and submarine activity. In addition, space-shuttle crafts will use Vandenberg AFB, their flight paths going directly over the Channel (MMS, 1984). The angle of inclination upon launching will determine the overpressures felt by individual islands. Spashdown areas planned for recovery of booster rockets lie west and southwest of San Miguel Island. Returning shuttles will approach reentry paths passing near and directly over San Miguel Island.

Platform Gail will be situated in an "inactive area" with respect to military operating areas (MMS, 1984). This "inactive area" encompasses the northern shorelines of Santa Cruz and Santa Rosa Islands and all of San Miguel Island to the coastline generally between Point Conception to Port Hueneme. However, the Pacific Missile Range essentially surrounds this inactive area. Platform Gail is situated approximately 4 miles north of the Pacific Missile Range boundary. The possibility does exist for military and other vessel traffic to stray onto the tract. However, the Department of Defense indicates that it anticipates no conflicts with the Santa Barbara Channel area with oil and gas interests (BLM, 1981). Since the Chevron Lease does not lie within any present areas of military use, the possibility of military conflicts occurring is unlikely.

3.5.4 Small Craft Pleasure Boating, Sportfishing and Recreation

Ventura and Santa Barbara counties are an important recreational asset to residents of the State and to tourists. In the project region, recreation is primarily water-oriented, both from an active participation and from an aesthetic and passive aspect. The major recreational activities of the project region are sightseeing, beachcombing, picnicking, boating, swimming, sunbathing, diving, surfing, and sportfishing. Sightseeing and beachcombing are enjoyed along the entire coastline and are mainly dependent on the aesthetic aspect of the area. Picniking is mainly family group oriented, and tends to be concentrated at easily accessible recreational facilities. Boating is not limited to any specific area along the coast, although concentrations can be found in areas with suitable harbors such as Ventura, Channel Islands, and Santa Barbara.

There are numerous state and county parks in the project region which offer a wide variety of recreation opportunities. These include the following:

- Ventura County
  State Beaches and Parks
    - Point Mugu State Park
    - McGrath State Beach
    - San Buenaventura State Beach
    - Emma Wood State Beach

  County Beaches and Parks
    - Hobson County Park
    - Faria County Park
    - Rincon Parkway
    - Mandalay Beach Park
    - Hollywood Beach Park
    - Silver Strand Beach
- Santa Barbara County
  State Beaches and Parks
    - Carpinteria State Beach
    - El Capitan State Beach

Refugio State Beach
Gaviota State Park

County Beaches and Parks

Rincon Beach County Park
Goleta Beach County Park
Isla Vista Beach

Base-line estimates of demand for State parks for the year 1982 through 2000 shows an annual growth rate of 1.5 percent.

Tourism is one of the major industries in Ventura and Santa Barbara counties. Both counties are heavily dependent economically on the tourist industry. The value of tourism for these counties is shown below:

	Total[1] Lodging Receipt	Vacation[2] Pleasure Lodging	Vacation/Pleasure[3] Total Expenditure
Ventura County	14,588,944	6,710,914	54,560,278
Ventura	5,301,329	2,438,611	19,826,107
Oxnard	4,742,383	2,181,496	17,735,743
Port Hueneme	1,072,288	493,252	4,010,181
Santa Barbara County	31,164,429	14,335,637	116,549,898
Santa Barbara	15,164,817	6,975,816	56,713,949
Carpinteria	556,988	256,214	2,083,043

Source: MMS. Draft EIS Proposed Southern California Lease Offering, 1984

[1] Based on Bed Tax Receipts

[2] 46 percent of Hotel/Motel Receipts are from Vacation/Pleasure use (California Office of Tourism, 1981a)

[3] 12.3 percent of Tourist expenditure is for lodging (The Grandville Corp. 1981)

Sportfishing is an important recreational activity in the project region, supporting an extensive infrastructure of marine related commercial and industrial activities. The primary methods used by recreational fishermen are commercial passenger fishing vessels (party boats) private boats, shoreline and open coastline fishing. Most sportfishing, boats utilizing the project area originate out of Santa Barbara Harbor, Ventura Harbor, Channel Islands Harbor and Port Hueneme Harbor. These facilities provide party boats, launching facilities, bait and tackle stores and boat repair facilities.

The major sportfishing activity in the project area is generated by party boats. The California Department of Fish and Game obtains catch data from party boat operators and can provide generic level statistics of species taken, number of fishermen and the number of boats operating.

Table 3.5-3 shows the species taken and landed by party boats in Santa Barbara and Port Hueneme in 1981. No specific fish block information is available, and is of minimal value considerably the normal movements of party boats during a trip may place the vessel in two different blocks. The most significant blocks in the project area are 665, 683 and 684. Blocks 665 and 683 are nearshore blocks, providing a variety of different fishing habitats, including kelp beds, reef areas and sandflats. Block 684 is in the area of Anacapa Island and provides excellent fishing for giant sea bass, barracuda, yellowtail, kelp bass and rockfish especially near the island.

As can be seen, rockfish, kelp bass and Pacific mackeral are the dominant species taken, making up 91 percent of the fish taken. All of these species are taken adjacent to reef areas or near kelp beds. Sportfishing in the area of the proposed platform is relatively limited. Figure 3.5-5 shows the significant recreational fishing areas and the primary species taken in those locations.

In 1981, a program of random field sampling of anglers and divers fishing from privately-owned boats was conducted by CDF&G at launch ramps, boat hoists, and boat rental facilities to determine catch composition. Results are as follows:

Santa Barbara County

- Gaviota - Pacific bonito, red abalone, Pacific mackeral, kelp bass and California halibut
- Santa Barbara - Pacific mackeral, kelp bass, Pacific bonito, rockfish and rock scallop

Ventura County

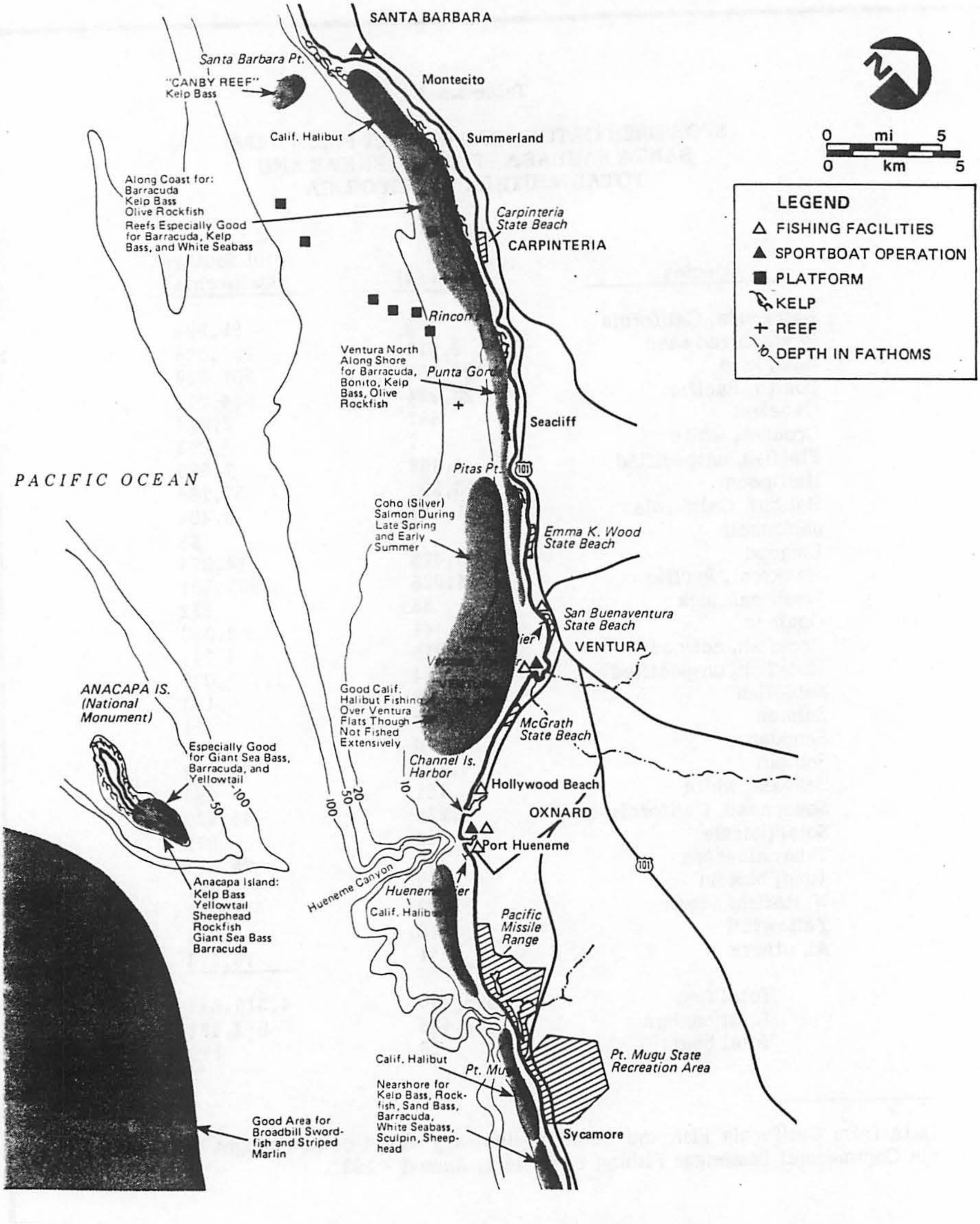
- Ventura - white croaker, Pacific mackeral, kelp bass and blue and copper rockfish
- Oxnard - blue rockfish, Pacific mackeral, white croaker, copper rockfish and kelp bass

Table 3.5-3

SPORTFISH CATCH - PARTY BOAT FLEET - 1981
SANTA BARBARA - PORT HUENEME AND TOTAL SOUTHERN CALIFORNIA

Species	Catch (#)	Total Southern California
Barracuda, California	498	69,924
Bass, barred sand	8,010	237,084
Bass, kelp	120,188	501,900
Bonito, Pacific	22,984	654,019
Cabezon	597	2,314
Croaker, white	7	8,693
Flatfish, unspecified	4,468	7,539
Halfmoon	13,292	57,768
Halibut, California	1,537	8,404
Jacksmelt	5	58
Lingcod	9,473	14,374
Mackeral, Pacific	53,025	957,581
Mackeral, jack	33	232
Opaleye	41	2,380
Rockfish, cowcod	3,010	4,741
Rockfish, unspecified	741,434	1,708,039
Sablefish	48	163
Salmon	0	11
Sanddab	6	615
Sculpin	4,102	73,362
Seabass, white	167	887
Sheephead, California	4,229	46,479
Sole, petrale	940	972
Tuna, albacore	46	25,974
Tuna, bluefin	3	497
Whitefish, ocean	7,583	24,352
Yellowtail	218	88,911
All others	351	18,373
Total fish	996,295	4,515,646
Total anglers	87,438	618,181
Total boats	26	179

Data from California Fish and Game, preliminary report of fish caught by the California Commercial Passenger Fishing Boat Fleet, Annual - 1981.



SOURCE: Gusey, 1982

Sportfishing and Marine Recreational Areas – Eastern Santa Barbara Channel

FIGURE 3.5-5

Red abalone, rock scallop, California spiny lobster, and California sheephead were the major species taken by sport divers in both counties.

In Santa Barbara County, Santa Barbara Harbor is the major launching facility for recreational crafts. The destination of the majority of recreational boaters is Santa Cruz Island. Small craft facilities in Ventura County include the Ventura Harbor, owned by Ventura Port District and Channel Islands Harbor, owned by Ventura County Department of Airports and Harbors. There is a small craft harbor within the commercial harbor at Port Hueneme. The destination of most boaters from this area is also the Channel Islands.

The Santa Barbara Harbor now has approximately 1160 boat slips that are normally 100 percent occupied. Approximately two-thirds of the vessels in this facility are sailboats. The Ventura Marina contains 1170 slips for recreational boats and 25 slips for government and commercial vessels. The Channel Islands Harbor provides 1800 recreational boat slips.

In the Channel Islands area, water-based recreational activities are pursued by three, often interrelated groups: pleasure boats (sail and power), scuba divers and spear fishermen, photographers and naturalists. There are many popular diving areas off the island coastlines in addition to mainland and kelp bed sites. Boat and charter aircraft overflights provide access to the islands.

The attractiveness of the islands as a destination for recreationists is generally on the upsurge, yet natural controls, i.e., public accessibility, favor rather sparse activity densities. According to the California Department of Parks and Recreation, regional water-oriented leisure demands on the mainland coast appear to be exceeding supplies on the mainland.

A potential stimulant to growth of recreation in the area is the Channel Islands National Park which includes San Miguel, Santa Rosa, Santa Barbara, and Anacapa Islands, as well as the eastern portion of Santa Cruz Island. The National Park Service's current policy encourages tightly monitored visitations and is cautious of public overuse. The two largest islands in the Channel Islands group, Santa Cruz and the eastern part of Santa Rosa Islands have been recently added to the management area, and a draft general management plan supplement has been prepared for addition to the NPS Sanctuary Management Plan (NPS, 1984).

Private recreational boaters cruise throughout the Channel Islands region, but the majority arrive on commercial charters. Recreational boating accounts for the greatest recreational use of the area and occurs mainly around Anacapa and Santa Cruz Islands. The majority of land visits occur on Anacapa Island.

Recreational fishing is a major use of the fish resources around the islands. Although some fishermen seek tuna, marlin, and swordfish in deeper waters, most recreational fishermen from party boats are attracted to nearshore island shelf waters, especially over kelp beds. While rockfish, kelp, and sand bass are species caught in the greatest abundance (Table 3.5-3) in the last several years, yellowtail and bonito catches have been increasing.

3.5.5 Kelp Harvesting

All significant kelp bed resources in California are under the jurisdiction of the California Department of Fish and Game. The proposed platform and pipeline alignment are in a water depth of approximately 739 feet (225 m) and no kelp resources are within the project footprint. The nearest designated beds are Bed 109 around Anacapa Island (not harvested) and Bed 17 which runs from Pt. Mugu to Pt. Dume. Bed 109 is approximately 6.6 miles (10.6 km) from the platform; while Bed 17 is approximately 27 miles (43 km) from the platform.

Bed 109 is currently under the protection of the Channel Islands Marine Sanctuary and no harvesting is permitted. Three sites (refer to Figure 3.5-6) are currently designated as sampling stations by the National Park Service and are evaluated on a routine basis. Bed 17 is a commercially harvested bed and at the present time is in excellent productive condition (D. Glantz, Kelco, personal communication, refer to Figure 3.5-7). Refer to Section 3.6.2 for additional information.

3.5.6 Existing Pipelines and Cables

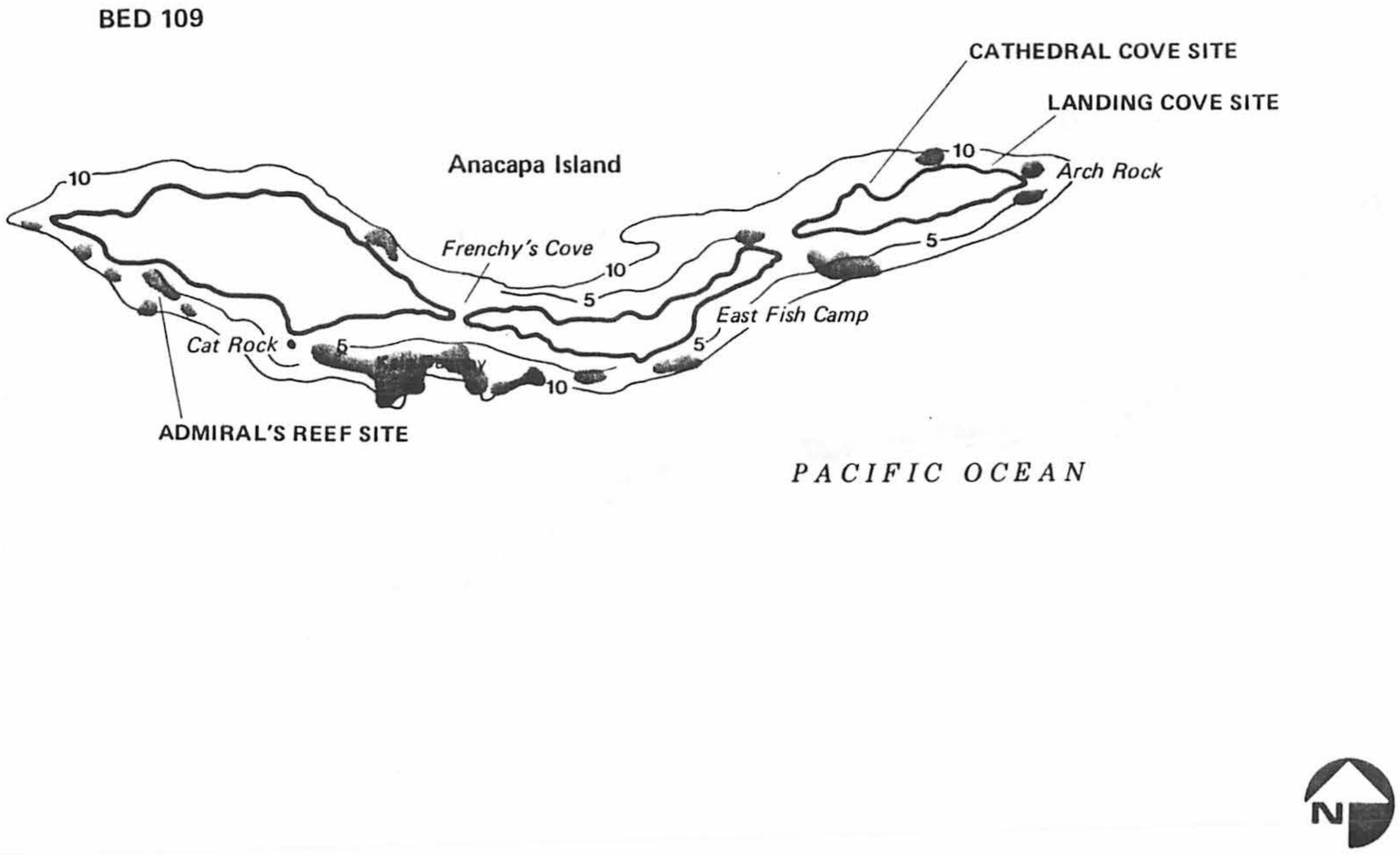
Submerged pipelines and cables intersect Lease P-0205 as discussed in Section 3.9. There are several platforms with producing wells in the project area including the Santa Clara Unit development.

3.5.7 Other Mineral Uses

There are no other mineral resources in the vicinity of Lease P-0205.

3.5.8 Ocean Dumping

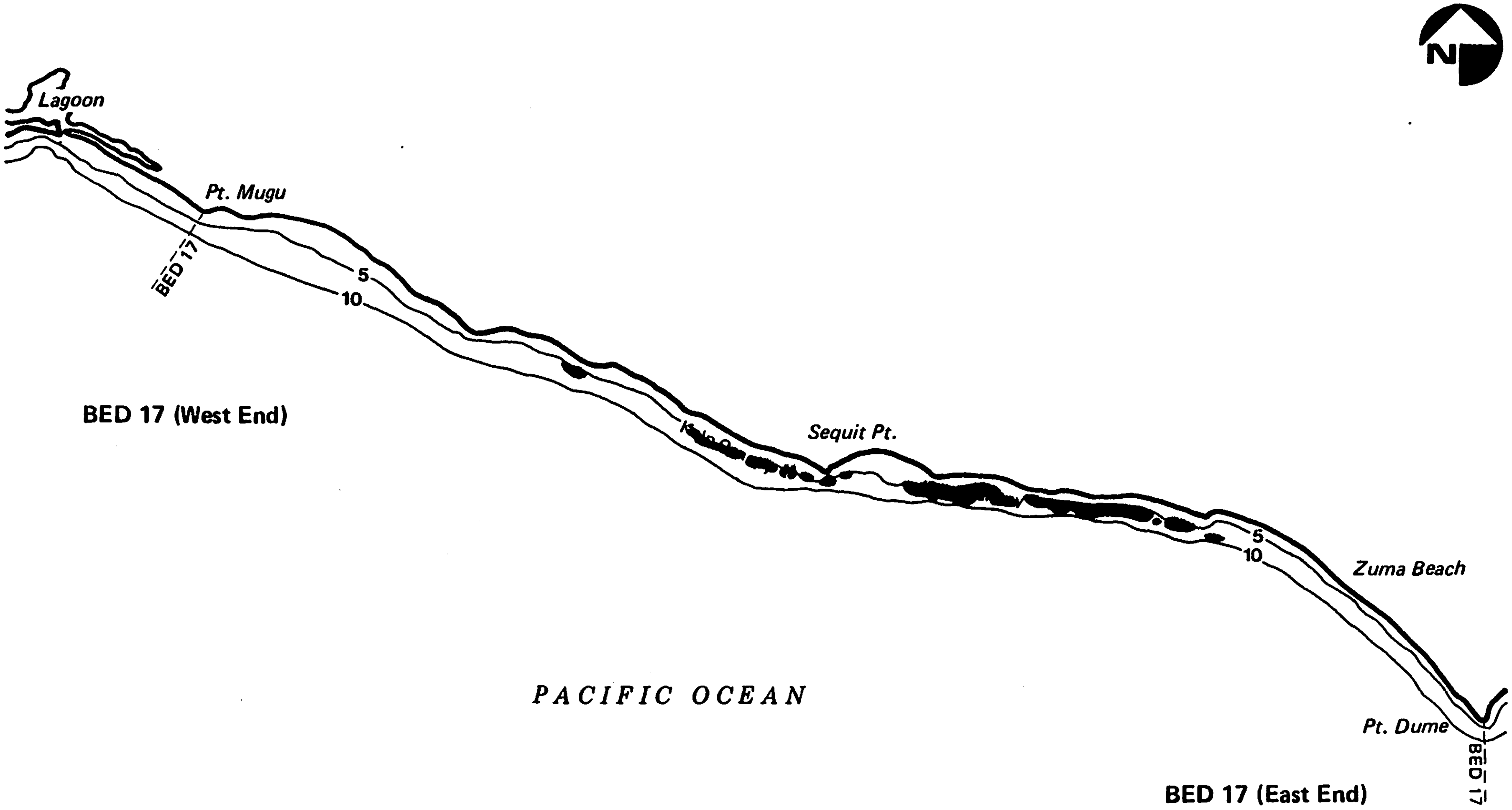
There are no active dumping sites, military or otherwise, on or in the vicinity of the project lease. Dumping in Santa Barbara Channel has consisted of two dredge spoil sites both located off Port Hueneme approximately 12 mile (19 km) east of the proposed platform. A large ocean dumping area is also situated approximately 28 miles (45 km) to the south between Anacapa and San Nicolas Islands. Waste consists of industrial and low level radioactive wastes.



SOURCE: Dale Glantz, Kelco

Kelp Bed 109 Anacapa Island Marine Sanctuary
(Sites are Monitoring Locations)

FIGURE 3.5-6



SOURCE: Dale Glantz, Kelco

Kelp Bed 17 Pt. Dume to Pt. Mugu — Commercial Kelp Bed

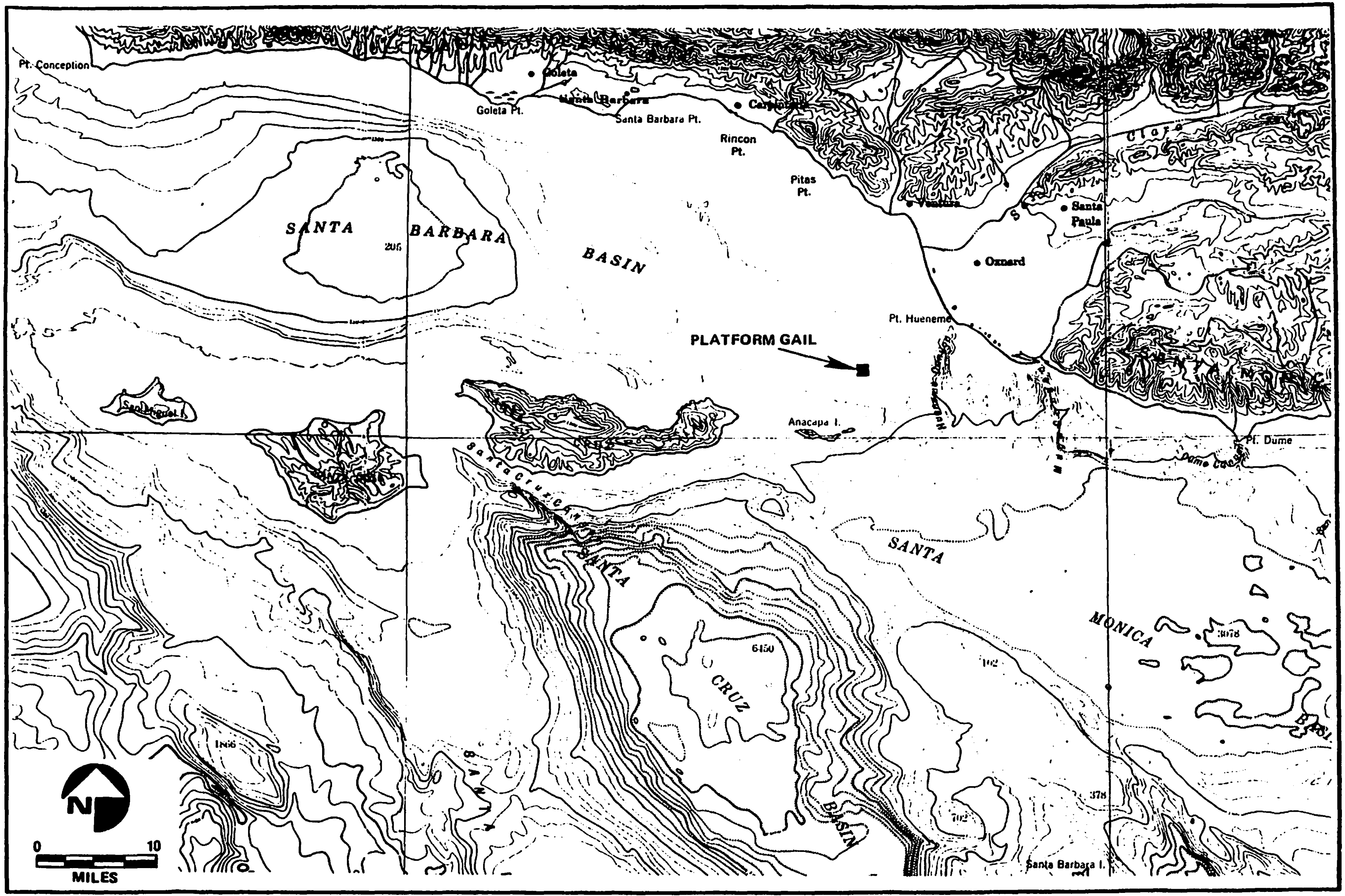
FIGURE 3.5-7

3.6 FLORA AND FAUNA

3.6.1 Regional Marine Environment

The Santa Barbara Channel and Point Conception have long been regarded as an important biogeographic boundary for eastern north Pacific biota (Figure 3.6-1). Commonly, Point Conception has been reported to separate a northern cold temperate province (e.g., the Oregonian) from a southern, warm temperate province (e.g., the Californian) based on analyses of marine benthic invertebrate distributions. A similar role for the Point Conception and Santa Barbara region has been established for marine fishes (Hubbs, 1960; Horn and Allen, 1978) and marine seaweeds (Setchell, 1915; Abbott and Hollenberg, 1976; Pielou, 1978; Murray, Littler, and Abbott, 1980). Most biogeographical studies reveal a general uniformity of the coastal marine biota from Point Conception north to Puget Sound, Washington, with the possible exception of Monterey Bay (Hall, 1964; Valentine, 1966; Hayden and Dolan, 1976; Horn and Allen, 1978). The Santa Barbara Channel and the Southern California Bight provides a transitional environment between the cold and warm temperature biotas resulting in a complex mixture of northern and southern species of marine fish and invertebrates. A true southern, warmwater biota is established at Cedros Island, Mexico and continues south to the equator along the Pacific Coast (Dawson, 1951). Recently, the Southern California islands, which lie just south of Point Conception, have been shown (Murray, Littler, and Abbott, 1980) to contain intertidal communities transitional in composition between cold temperate and warm temperate biotas.

Clearly, the biogeographical significance of the area is related to the prevailing patterns of oceanic circulation. The cold waters of the California Current off central California flow southeastwardly along the coast (Wyllie, 1966). Consequently, near-shore waters are generally cold north of Point Conception because of the influence of the California Current and the extended periods of spring and summer upwelling of deep water (Bolin and Abbott, 1963). At Point Conception, the California coastline swings abruptly eastward, away from the southerly flow of the California Current which continues south, west of the Santa Rosa-Cortez ridge (Reid, Roden, and Wyllie, 1958). As the California Current flow breaks off from the coast, a large gyre circulation system is produced in the Southern California Bight (Jones, 1971). The Southern California Countercurrent represents the easternmost component of this gyre, and flows in a northerly direction inside the offshore islands, bathing the mainland coastline with warm water. Consequently, coastal surface water temperature exhibit a relatively abrupt change near Point Conception; e.g., mean minimum and maximum surface



Regional Marine Environment

FIGURE 3.6-1

temperatures change 2°C between points just south and north of Point Conception (Horn and Allen, 1978).

Until lately, the eight Southern California islands, which range from (60 to 90 miles) 20 to 98 km in distance from the mainland, received little scientific attention despite their biogeographical importance and the fact that they contain most of the relatively pristine coastal habitats remaining in Southern California. Four of these islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) are located 12 to 27 miles (20 to 44 km) offshore of the Santa Barbara-Ventura County coastlines, and form the seaward boundary of the Santa Barbara Channel. The eight Southern California islands are in a region of mixing between the cold California Current waters which lie to the north and west and the warmer waters of the Southern California Countercurrent which flow from the south (Schwartzlose, 1963; Reid et al., 1958). Greater northern (San Miguel, Santa Rosa, and San Nicolas Islands) or southern (San Clemente and Santa Catalina Islands) biotic affinities have been described for sites on several of the islands, depending on their relationship to the complex surface circulation patterns; other island sites (Santa Barbara, Santa Cruz, and Anacapa Islands) exhibited more transitional biotas. Generally, the island biotic affinities appear to reflect prevailing patterns of oceanographic surface temperatures (Kanter, 1978) and to be similar to species groups on the mainland in similar habitats.

3.6.1.1 Intertidal Communities

The intertidal environment in the general project area must be separated into two components, the mainland, (primarily sand beaches) and the offshore islands (primarily rocky and cobble intertidal). The mainland shoreline from Santa Barbara to Point Mugu is mainly sand beaches, with an occasional rocky intertidal and subtidal area. Ricketts et al. (1968) define this coastline as a protected outer coast with a significant amount of protection provided by the offshore islands, reducing the normal wave action from the west. However, as observed in the winter of 1983, waves and swells from the south and southwest can be extensive and can cause substantial beach erosion and shoreline damage.

The most recent survey of the intertidal environment was conducted during the Southern California Baseline Study (SAI, 1978; 1979). Littler (1979) reported 539 species at 22 Southern California Bight locations during the 3-year (1975 to 1978) BLM study. All these species were macro-organisms and consisted of 224 macrophyte (plants) and 315 macroinvertebrate species. Most species appeared to be restricted to certain geographic portions of the Bight. Only 42 species (25 macrophyte, and 17 macroinvertebrate) were found at all locations (Table 3.6-1).

Table 3.6-1

TAXA COMMON TO ALL ROCKY INTERTIDAL STATIONS SAMPLED DURING THE BASELINE STUDY

Macrophytes

Blue-green algae
Bossiella orbigniana ssp. *dichotoma*
Ceramium eatonianum/sinicola (2)
Corallina officinalis var. *chilensis*
Corallina vancouveriensis
Crustose Corallinaceae (2)
Gelidium coulteri/pusillum (2)

Ulva californica/lobata (2)
Egregia menziesii
Cryptopleura spp. (4)
Gigartina canaliculata
Polysiphonia spp. (6)
Rhodoglossum affine

Macroinvertebrates

Phragmatopoma californica
Balanus glandula
Chthamalus fissus/dalli (2)
Pachygrapsus crassipes
Tetraclita squamosa rubescens
Anthopleura elegantissima
Acmaea (Collisella) limatula
Acmaea (Collisella) pelta
Acmaea (Collisella) scabra
Littorina planaxis
Littorina scutulata
Cyanoplax hartwegii
Nuttallina fluxa/californica (2)

Pagurus spp. (2)

Source: (Littler, 1979)

The rocky intertidal community in the Southern California Bight has been well described by Murray (1974), Ricketts, Calvin and Hedgpeth (1968), Carefoot (1979), Straughan and Kanter (1977, 1978, 1979), Littler (1977, 1978, 1979a, b), Littler and Littler (1980), Straughan (1977, 1978, 1979), and BLM (1975, 1978a, 1978b, 1979, 1980 and 1981).

Although rocky intertidal areas are very rich in plant and animal life, the inhabitants must withstand environmental pressures not endured by subtidal organisms. Because of tides, the intertidal community is exposed to air for varying amounts of time. This exposure causes organisms to dry out and eventually die, unless certain morphological, physiological or behavorial adaptations are made. Behavorial adaptations include hiding under rocks, or large algae, or becoming part of a subassemblage association such a mussel bed.

The rockweed Pelvetia sp. and Hesperophycus sp. are upper middle intertidal inhabitants which provide cover and protection for numerous snails, limpets, crabs, etc., during low tide. Another type of microhabitat, a mussel bed, has been described by Kanter (1979) as a three dimensional community, providing associated organisms with physical protection from predators and dissection as well as collecting sediments for use by microfaunal species. In his study (Kanter, 1979) 610 species of marine plants and invertebrates were found associated with mussel beds at 20 stations examined within the Southern California Bight.

Characteristic of the middle intertidal zone in Southern California are the closely compact algal turf communities which also show island-mainland differences. Extensive algal turf communities were prevalent in the middle-to-low intertidal zones at nearly all sites. The island turfs were larger and more robust with epiphytes consisting of medium-sized frondose algae. Mainland turf communities near populated areas were characterized by smaller and simpler forms with more compact structure, which were often heavily coated with a predominance of fine, filamentous epiphytes. Littler (1979) suggested that the highly epiphytized compact turf morphology, characterized by algal populations having relatively large surface-to-volume ratios, high reproductive capacities, high growth rates, simple thallus forms, and mechanisms for short and simple life histories, is characteristic of communities in stressed environments.

Because Littler considered space and light as the limiting resource in the rocky intertidal, biotic cover was the primary ecological concern of the baseline study. Major cover throughout the Bight at Littler's stations was contributed by plants, primarily by blue-green algae, coralline algae, the red algae Gigartina canaliculata and surf grass. Brown algae, particularly the feather boa kelp Egregia and southern kelp palm Eisenia, were also considered important because of the large size and high cover at their relatively restricted vertical location in the lower intertidal. In terms of overall cover, macroinvertebrates contributed less than the plants, although several animal species were important to the cover. Sandcastle worms, Phragmatopoma, barnacles and mussels Mytilus contributed cover equivalent to many of the more important macrophytes.

Seasonal variability at the stations was relatively small, especially when compared with many other areas of the United States. Kanter (1979) found seasonal variability so small, he discontinued seasonal sampling after the first year of the study. Littler found some decrease in most biological parameters following the winter months. This was primarily due to algae which tended to be reduced during low tides coinciding with warm Santa Ana winds.

The sandy beach intertidal environment is considerably less stable than the rocky intertidal. A great deal of sand is moved on the beach during each wave. Organisms on surf-swept sandy beaches generally protect themselves by burrowing into the sand. As a result of the dynamic nature of the beach system the number of individual and species per unit area will vary significantly from year to year.

Straughan (1977, 1978, 1979) reported that physical factors defining the energy regime of sandy beaches were probably directly responsible for the variation in biotic diversity observed. It is likely also that these factors play an important role in determining the actual species composition. The sand crab, Emerita dominated the fauna of the steepest, most unstable beaches. Worm associations are best developed on the flattest, most regular beaches such as Scripps, Point Loma, and Coal Oil Point.

The upper beach is normally dominated by the amphipod beach hoppers of the genus Orchestoidea and Orchestia. These animals remain in the moist sand above high tide during day and emerge to feed at night. Its habit of following the tides as it feeds on dinoflagellates, other minute organisms and small plant particles produces a broad tidal distribution for these species. The major inhabitants of the mid- and low-tide zones are polcheatous (segmented) and nemertean (round) worms, especially on beaches with a gently sloping foreshore. The polychaete Euzonus mucronata typically occupies a narrow zone in the vicinity of mid-tidal level. Another sand crab, Blepharipoda, is infrequently found at the lowest tides along with the bean clam, Donax gouldii.

The nearest island to the proposed platform is Anacapa, a small three-island group located 6.6 miles (10.6 km) south of the Platform Gail site. The intertidal environment along the shoreline of the island is a mixture of sandy beach and rocky intertidal habitat. Due to the protection given the islands as marine sanctuaries, the intertidal habitats represent some of the best undisturbed habitat left in Southern California. The baseline study prepared by Science Applications, Inc. (1978, 1979) conducted several site specific analyses on the intertidal environment on Anacapa and found them to be similar to species and zonation to coastal rocky intertidal environments, although in general the island intertidal had a greater diversity of both plants and animals when compared to the mainland.

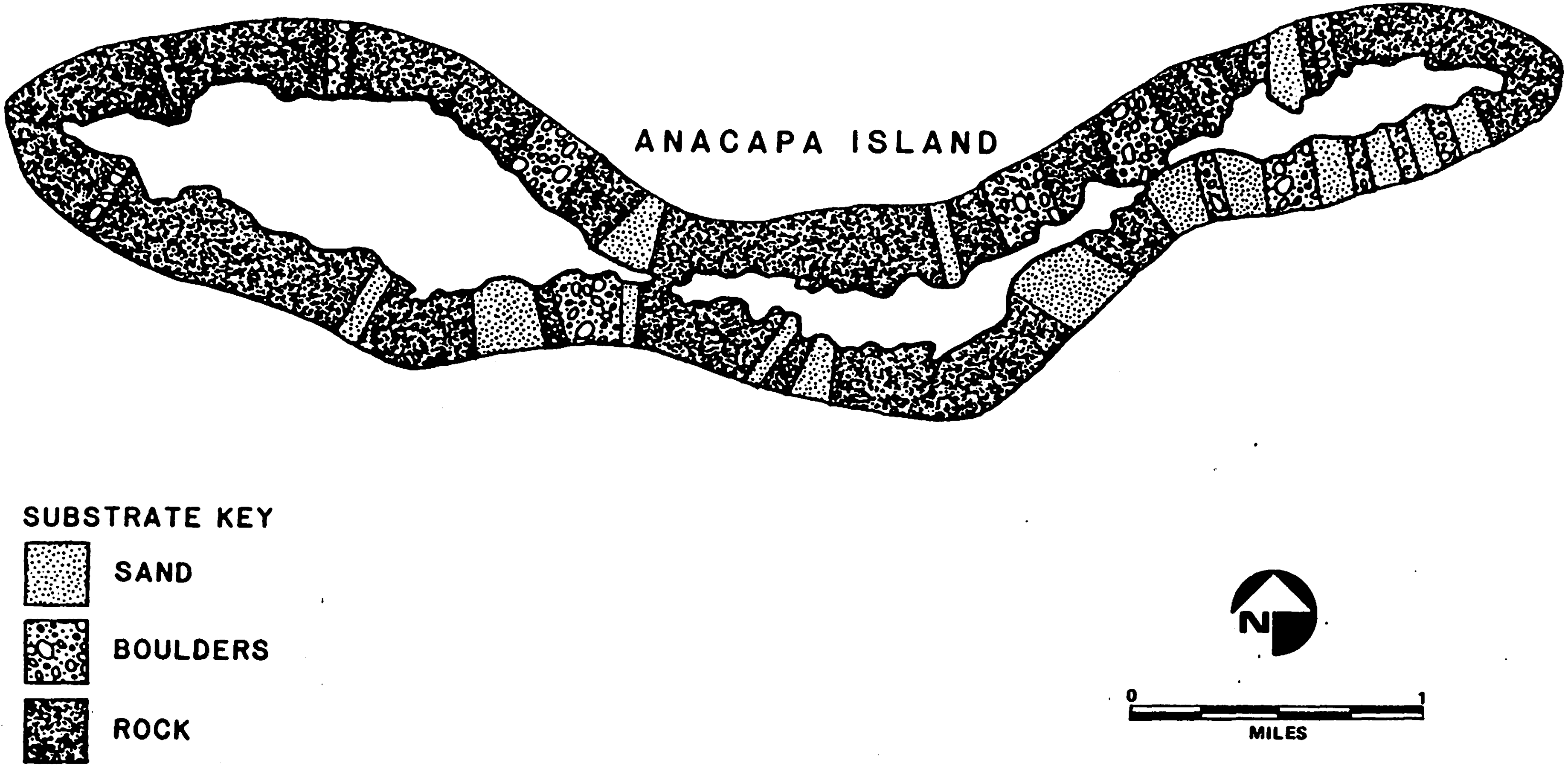
Anacapa Island appears to occupy a less transitional position than the more westerly islands. This is primarily due to the increased influence of the warm counter current. The intertidal species tend to be more representative of the southern warm water fauna. A description of habitat mapping of the Anacapa Island (Figure 3.6-2) intertidal environment is presented in the FEIS prepared for the Southern California Lease Offering of February, 1984 (MMS, 1983).

3.6.1.2 Benthic Communities

Most of the previous research on subtidal communities in the Southern California Bight has concentrated on soft-bottom habitats of the shelves and basins. Additionally, most work has been performed in the eastern Santa Barbara Channel and offshore areas to the south of the Point Conception shelf.

The first quantitative sampling of Southern California mainland shelf soft-bottom habitats began in 1952 (Jones, 1969), when Hartman (1955, 1966) recorded the benthic macrofaunal elements collected between San Pedro, California and Santa Catalina Island. Beginning in 1956, the Allan Hancock Foundation (1959, 1965) undertook a shelf sampling program extending from Point Conception to the United States-Mexico border as part of a California State Water Pollution Control Board study. Fauchald (1971) reported on the benthic fauna in the eastern Santa Barbara Channel following the 1969 Santa Barbara oil spills. Recently, the U.S. DOI, BLM has sponsored a series of studies of soft-bottom benthic habitats, including areas of the mainland shelf, island shelves, basins, and their respective slopes (SAI, 1978, 1979).

The best data for the near-shore soft-bottom subtidal benthic communities are those of Barnard, Hartman, and Jones (1959, 1965). In general, they found the shallow water 33 to 66 feet approximately (10 to 20 m) class of samples for the Santa Barbara shelf to contain low biomass averages which they attributed to the presence of



SOURCE: Littler, 1979

Intertidal Substrate Types of Anacapa Island

FIGURE 3.6-2

coarse sediments. However, they did not examine the shallow water less than 33 feet (10 m) or epilithic (rocky) communities, although they point out that these areas typically support much algal growth and many epifaunal associations containing high biomass. Greatest macrofaunal biomass for the soft-bottom benthic communities was determined for the 115 to 180 feet (35 to 55 m) region of the adjacent Santa Barbara Shelf, a zone where the echiuroid Listriolobus was by far the most abundant faunal constituent.

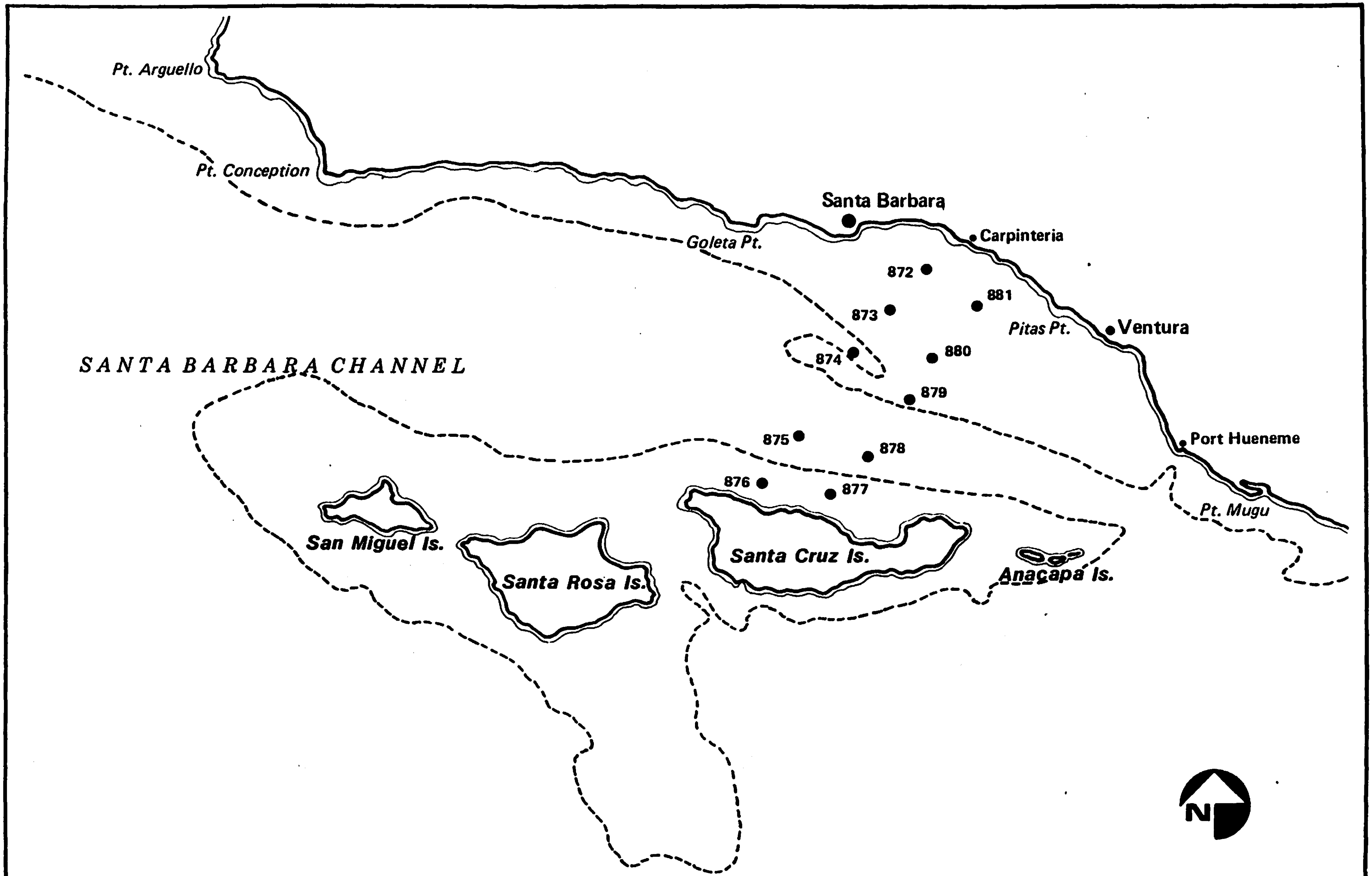
In the SAI study (1978) 10 sampling locations were located at two 5-station transects extending southwestward from the mainland shelf across the channel and up onto the shelf of Santa Cruz Island. These transects ranged in depth from 115-1075 feet (37 to 347 m) and are shown in Figure 3.6-3 (SAI, 1978).

In general, the sediments at all of the stations were fine, with silty-clays dominating. Oxygen content within 33 feet (10 m) of the bottom ranged from 5.73 ml/l at Station 881 148 feet (45 m) to 0.80 ml/l at Station 875 1138 feet (347 m). Temperatures at the deep stations are shown in Table 3.6-2.

Polychaetes formed the most important faunal component at all depths, with crustaceans and echinoderms being a relatively smaller species group although they provide the majority of the biomass. The density of organisms was high on the mainland and island shelf (2600-2920 organisms/m^2) and decreased in the deeper waters of the basin (683 organisms/m^2). The number of different species (species richness) followed a similar pattern with mainland shelf samples averaging 45 species per sample, deeper stations averaged 21 species per sample, and island shelf stations averaged 83 species per sample.

The standing crop (biomass per square meter) was shown to be inversely related to diversity. Both shelves averaged 95 g/m^2 with the deeper station averaging 799 g/m^2. It appeared that the chance collection of a few large echinoderms accounted for the high values at the deep stations.

An adequate description of the faunal composition of an area as large as the Santa Barbara Channel was not possible on the basis of the limited SAI sampling. Distinction could be made between the areas of high density and species richness (mainland and insular shelves) and areas of low density and richness (the basin stations). However, many species (primarily polychaetes and mollusks) were broadly distributed and overlapped stations at depth ranges. Table 3.6-3 shows the dominant organisms found at the basin stations.



SOURCE: SAI, 1978

Map of Santa Barbara Channel Showing Stations Studied in SAI Baseline (1975-1978)

FIGURE 3.6-3

Table 3.6-2

ENVIRONMENTAL DATA FOR THE SANTA BARBARA CHANNEL DESCRIPTIVE AREA

Station Number	Depth (feet/meters)	Bottom °F/°C	Bottom O_2 (ml/l)
872	121/37	57.7/14.3	5.21
873	259/79	54.5/12.6	4.82
874	623/190	48.9/9.4	2.34
875	1138/347	45.7/7.6	0.80
876	279/85	50.9/10.5	3.22
877	292/89	54.5/12.5	4.67
878	945/288	46.7/8.2	1.10
879	508/155	49.8/9.9	2.69
880	272/83	55.2/12.9	4.77
881	148/45	59.2/15.1	5.73

Source: SAI, 1978.

Table 3.6-3

BENTHIC FAUNA TAKEN AT BASIN STATIONS DURING THE SAI BENTHIC STUDY (1978)

	Station (SAI #)		
	874	878	875
	Depth feet (m)		
Species	623 (190)	890 (288)	1138 (347)
Polychaetes			
Paraprionospio pinnata	2	1	1
Tauberia gracilis		3	
Nephtys punctata	2	1	
Harmothe scriptora		2	
Nothria iridescens		1	1
Nephtys cornuta franciscana	1		1
Mollusks			
Parvilucina tenuisculpta	1		
Cyclocardia ventricosa		3	1
Crustaceans			
Euphilomedes producta	1		1
Ampelisca near macrocephala		6	
Eudorella pacifica	1	1	
Ericthonium, near hunteri		19	
Maera, near danae		13	
Janiridae, unid.		11	
Echiroderms			
Allocentrotus fragilis		2	
Brisaster latifrons	1	3	
Brissopsis pacifica			1

Data from SAI, 1978 (Figure II-18.0-9)

A site-specific, soft-bottomed marine biological survey was conducted for Chevron at the Platform Gail location by McClelland Engineers (1985). Eight benthic stations were grab sampled with three replicate samples being taken at an average depth of 730 feet (222 m). Samples were sieved through 1.0 and 0.5 mm screens, preserved, and the 1.0 mm samples were identified to species level. Sediment samples were taken to analyze grain size distributions, total organic carbon, and oil and grease. In addition, samples were taken by otter trawl of the benthic habitat in the area of the platform site.

A total of 151 taxa were identified, represented by a total of 2381 individuals. Polychaetes were the most diverse as well as the most abundant taxonomic groups of organisms sampled. Crustaceans were high in diversity but low in abundance; while echinoderms were low in diversity but high in abundance. *Amphiodia urtica*, a brittle star, was the single most abundant species collected representing over 19 percent of the total number of individuals. Table 3.6-4 shows the diversity and abundance percentages for the collected organisms.

The characteristic infauna in the vicinity of the platform Stations 1 through 4 includes the polychaetes, *Spiophanes berkeleyorum* and *Decamastus gracilis*, the echinoderm, *Amphiodia urtica*, the mollusk, *Huxleyia munita* and the amphipod, *Rhepoxynius dabious*. At 1000 m from the platform position (Stations 5 through 8), the fauna is similar but also includes *Prionspio streenstrupi* and the ostracod, *Euphilomedes producta*. The reason for these species increasing in abundance at Stations 5 through 8 is not clearly understood, although *E. producta* appears to favor the finer-grained sediments of Stations 7 and 8. All species collected are representative of soft bottom habitat.

In addition to these species, a potential new species was recorded at Station 8 (1000 m from the platform). This species (*Petalosarsai* sp. A) is a cumacean which has not been recorded from the eastern Pacific coast. The genus *Petalosarsai* is common to the western Pacific. This cumacean feeds on available forage such as detritus, phytoplankton or other algaes. Their importance ecologically is as a minor member of the food chain. The presence or absence of this cumacean is not expected to directly affect the benthic community.

At each station the dominant biomass was contributed by echinoderms, led by the brittle star *A. urtica*. Echinoderms contributed 89.9 percent of the total biomass. This is in sharp contrast to the polychaetes which were the most diverse and abundant major taxonomic group, but contributed only 3.4 percent of the total biomass.

Table 3.6-4

TOTAL NUMBER OF INFAUNA TAXA AND INDIVIDUALS FOR TWENTY-FOUR SMITH-MACINTYRE 0.1 m^2 GRAB SAMPLES USING A 1.0 mm SCREEN (by Major Taxonomic Group)

	Total Taxa/24 Grab Samples	%/Total	Total Abundance/24 Grab Samples	%/Total
Annelida	70	46.4	945	39.7
Arthropoda	45	29.8	400	16.8
Mollusca	20	13.2	169	7.1
Echinodermata	7	4.6	835	35.1
Other Taxa	9	6.0	32	1.3
Total	151	100.0	2,381	100.00

McClelland Engineers, Inc., 1985.

Mollusks contributed 4.2 percent while the Crustaceans only contributed 1.1 percent. The remaining percentage (1.4 percent) was contributed by other taxa (McClelland, 1985).

During the trawling conducted for the marine survey, numerous epibentic invertebrate species were collected. The complete list is presented in the Biological Survey Report, McClelland, 1985. The most commonly observed invertebrates were a brittle star, *Allocentrotus fragilis*, the heart urchin, *Brisaster latifrons*, and the prawn, *Pandalus jordani*. All of the species collected are characteristic of the soft bottom community.

In general, the benthic infauna at the site is representative of the Santa Barbara Channel Basin and is typically found in the dominant sediment sand substrate within a 3280 foot (1000 m) radius of the platform site. No high relief rocky outcrop areas are located in the vicinity of the platform site.

3.6.1.3 Planktonic Communities

Planktonic communities consist of suspended plants and animals that depend upon the ocean currents for their dispersal. Plankton range in size from large jellyfishes to microscopic single-celled plants, and because they are so readily transported by water currents, they are transient components of any specific area. Plant components of the plankton (phytoplankton) include the larger diatoms and dinoflagellates, forms readily obtained by sampling nets, as well as the smaller algal flagellates and blue-green algae, forms which pass through most net devices. Zooplankton include smaller forms such as protozoans, (e.g., ciliates, tintinnids, foraminifera), as well as the characteristic array of cocepods, cladocerans, pelagic tunicates, chaetognaths, medusae, fish larvae and eggs. The phytoplankton form the base of the pelagic food chain, being consumed along with detrital material (some of terrestrial origin, particularily for coastal systems) by the smaller zooplankton. Phytoplankton production is largely dependent upon the supply of light and nutrients, particularly nitrogenous compounds in Southern California waters. Consequently, to understand the nature and functional role of planktonic communities in the Santa Barbara Channel, complete data on nutrients and the dynamics of oceanic circulation are required along with determinations of plankton standing stocks, turnover rates and productivity.

As part of the State Water Pollution Control Board survey, Resig (1959, 1965) reported on foraminifera and microplankton collected from numerous stations (Allan Hancock Foundation, 1965) in the Santa Barbara Channel including several near the project site. Oguri and Kanter (1971) studied the productivity of phytoplankton populations in the Santa Barbara Channel in the aftermath of the 1969 Santa Barbara oil spills. Observations of zooplankton (McGinnis, 1971), however, were restricted to the eastern Santa Barbara Channel. Additionally, the California Cooperative Oceanic Fisheries Investigations (CalCOFI) program has extensively sampled plankton communities of the upper 459 feet (140 m) of California coastal waters, although, according to McGinnis (1971).CalCOFI surface data have largely been obtained by oblique tows that fail to discriminate planktonic components by depth within the upper ocean layers.

The waters in the project area are not generally considered to be an area of intense upwelling. Owen and Sanchez (1974) presented phytoplankton pigment and productivity measurements for the California current from 1969-1972. CalCOFI Station 83.043 is within a mile of the platform site. In general, chlorophyll levels and primary productivity were higher nearshore than offshore stations. Chlorophyll-a (Chl-a) levels at Station 83.043 were generally highest within 16 feet (5 m) of the surface and ranged from 0.22 to 1.38 mg/m^3 during the 1969-72 period. A typical offshore station, (83.060, west of San Miguel Island), had Chl-a maxima at 66-98 feet (20-30 m) and ranged from 0.15 to 0.82 mg/m^3. An upwelling area off Point Conception (CalCOFI 80.052) presented a relatively uniform distribution of Chl-a from the surface to 66-98 feet (20-30 m).

In summary, the results of the surveys taken since 1959 indicate that diatoms and dinoflagellates dominate the phytoplankton in the Santa Barbara Channel. Diatoms were found at highest densities during the summer, from the surface to 52 feet (16 m), with marked seasonal variations. Dinoflagellates were distributed from 0-26 feet (0-8 m) and did not exhibit a strong seasonality.

Zooplankton

Zooplankton are those animals who spend part or all of their life cycle in the plankton. Although some forms can perform relatively long vertical mitgrations, they still depend on the current for long-range movement. Zooplankton are typically divided into two groups based on their life cycle. Those forms that spend their entire life in the plankton are termed holoplankton, while those forms that spend only part of their life cycle in the plankton are termed meroplankton. Within the meroplankton are found the larvae of many commercial forms including fish, lobster, abalone, and crabs.

The seasonal and geographical pattern of zooplankton along the California coast appear to be related to the physical dynamics of the California Current (Loeb et al., 1983). The overall pattern of zooplankton abundance is related to the phytoplankton standing stock which is, in turn, related to nutrient levels. There is a general decrease in zooplankton biomass along the California coast from north to south and from inshore to offshore. Spring zooplankton increases are normally related to both holoplanktonic and meroplanktonic forms, while fall increases are normally related to increases in holoplanktonic forms. The spatial distribution of zooplankton, like phytoplankton, is extremely patchy in nature.

MBC (1976) conducted a study off Oxnard examining the nearshore plankton community during August and December 1975. They reported that copepods, especially Acartia tonsa and Paracalanus parvus, dominated the zooplankton community in their study area. They also indicated that the offshore waters (brought nearshore by the gyre-effect in the Santa Barbara Channel) had a noticeable effect on the zooplankton community they sampled. This conclusion was based on the common occurrence of several oceanic species within their study area. The species included the calanoid copepods Pleurommamma borealis, Metridia lucens, Lucicuta flavicornis, and Calanus tenuicornis.

Johnson (1960) reported that larval California spiny lobster are most abundant as zooplankton during late summer and fall with the peak months being August and September. She further indicated that the early larval stages occur near shore and nearer the Channel Islands, while the older stages occur offshore throughout the Bight.

The larval occurrence of the commercial Cancer spp. in the plankton was examined by MBC/Applied Environmental Sciences and California Department of Fish and Game (MBC/CDF&F) (1982) in the waters south of Point Conception. Results of their investigation indicated that Cancer ssp. larvae were collected throughout the channel during most of the year with peak occurrences during December-January and again from June-August. They reported that the larvae occurred throughout the water column with the highest concentrations normally occurring in the neuston samples. Larval densities in their study decreased with distance from shore.

Other commercially important zooplankton found in Santa Barbara Channel waters include the eggs and larval of abalone species (Haliotis sp.), and the red sea urchin, Stronglyocentrotus franciscanus. In general, zooplankton peaks during the early spring and early summer periods (Smith, 1971 ADL). The plankton of the Channel Islands is expected to be similar to that observed in studies of the Santa Barbara Basin (Smith, 1971).

Ichthyoplankton

The spatial and temporal distribution and composition of ichthyoplankton species within the Southern California Bight reflect the spawning habits and requirements of the various species of fish that inhabit the area. Seasonal patterns in the offshore waters reflect the spawning cycles of pelagic and migratory species as well as demersal species such as rockfish (Sebastes spp.). Seasonal patterns within the inshore waters are heavily influenced by the spawning cycles of demersal species together with the spawning cycle of the northern anchovy, the major pelagic migratory species. The spatial distribution of ichthyoplankton, like phytoplankton and zooplankton, is extremely patchy. The patchy nature of the ichthyoplankton is directly related to the spawning habits and requirements of the adult fish.

The temporal and spacial distribution of fish larvae in the Santa Barbara Channel is directly related to the distribution of the three dominant species (Engraulis mordax, northern anchovy; Genyonemus lineatus, white croaker; and Lepidogobius lepidus, bay goby). Gruber et al. (1982) reported on the ichthyoplankton community occurring in the California Bight (inshore of the California Current) from September 1974 to January 1977. Their results indicated that E. mordax comprised over 80 percent of the larvae collected. Other major species collected included Sebastes ssp., Leuroglossus stilbus, Stenobranchius leucopsarus and G. lineatus.

Loeb et al. (1983) examined ichthyoplankton data collected from the CalCOFI cruises conducted during 1975. Their results indicated that in the region of the Southern California Bight the dominant ichthyoplankton members included E. mordax, Merluccius productus, Sebastes ssp., L. stilbus and S. leucopsarus. They further reported that ichthyoplankton densities reached their maximum during the period from January through March. The late winter peak was reported to be reported to be related to the spawning of primarily E. mordax, together with M. productus, Trachurus symmetricus, Scomber japonicus and Sardinops sagax. During the January-March period, larvae of these species comprised up to 84 percent of the sample. They further indicated that within the California Current System (from San Francisco to Lower Baja California), ichthyoplankton densities decreased from north to south and from inshore to offshore.

3.6.1.4 Fishes

More than 500 species of marine fishes are known from California coastal waters (Miller and Lea, 1972). Horn and Allen (1978), in their biogeographical analysis of Californian fishes, studied a total of 504 coastal species, 224 of which were determined to occur in bays and estuaries and 280 whose distribution did not include bay and estuarine habitats.

During the marine biological survey conducted at the Platform Gail site, paired trawls (3 replicates) were taken at depths of 710-760 feet (229-245 m). The predominant fish taken in these trawls was the Pacific sanddab (Citharichthys sordidus) representing 38.4 percent of the total number of fish taken. The 5 most dominant species, representing more than 94 percent of the total number taken, were 4 flatfish species and 1 rockfish species. The list is shown in Table 3.6-5. All fish species taken during the sampling are shown in Table 3.6-6 and in general are considered deepwater, soft-bottom species (McClelland Engineers, Inc., 1985).

Ecomar (1984), during its biosurvey of the Texaco Cicero lease area of San Miguel Island, identified 30 species of fish representing 14 families at a depth of 600-1000 feet (183-304 m). The most common fish family was Scorpaenidae (rockfishes), represented by two genera (Sebastes and Sebastolobus). Thirteen species, or 43 percent of the total fish observed, were rockfishes. The majority of the juvenile fish observed by Ecomar were also rockfish species. However, many egg cases of the brown cat shark (Apristurus brunneus) were found attached to epilithic biota. The fish species identified by Ecomar represent both commercial and non-commercial species and are considered typical deeper water forms for the Santa Barbara Channel.

3.6.2 Refuges, Preserves and Marine Sanctuaries

There are a number of different types of protected areas occurring in the Santa Barbara Channel. In general, protection is given to a specific area in order to control or restrict specific types of development or activities in sensitive biological habitats or environments.

- **State Oil and Gas Sanctuary.** This buffer zone was originally designated to preclude offshore drilling within the 3 mile (4.8 km) limit of Santa Barbara and the offshore Islands. Platform Gail will be approximately 25 miles (40 km) south of the sanctuary off Santa Barbara.
- **Federal Ecological Preserve and Buffer Zone.** The area was created to prevent damage to the State Oil and Gas Sanctuary, and to extend that area further offshore an additional 3 miles (5 km) into OCS waters off Santa Barbara. It is located approximately 20 miles (32 km) from Lease P 0205.

Table 3.6-5

NUMBER AND PERCENTAGE OF FIVE DOMINANT FISH CAUGHT DURING TRAWLING PLATFORM GAIL SURVEY BY STATION

Taxa	Paired Trawl A	Paired Trawl B	Paired Trawl C	Total Abundance	Total Percentage
Citharichthys sordidus (Pacific sanddab)	186	167	111	464	38.4
Sebastes saxicola (Stripetail rockfish)	111	105	55	271	22.4
Microstomus pacificus (Dover sole)	38	30	121	189	15.6
Parophrys vetulus (English sole)	36	60	46	142	11.7
Lyopsetta exilis (Slender sole)	27	26	21	74	6.1
Total	413	405	391	1,209	94.3
Depth range (m)	240-245	230-240	240		

McClelland Engineers, Inc., 1985.

Table 3.6-6

LIST OF FISH SPECIES TAKEN DURING TRAWLING AT PLATFORM GAIL

Pacific argentine	*Argentina sialis*
Bigfin eelpout	*Aprodon cortezianus*
Spotted cusk-eel	*Chilara taylori*
Pacific sandab	*Citharichthys sordidus*
Rex sole	*Glyptocephalus zachirus*
Rat fish	*Hydrolagus colliei*
Slender sole	*Lyopsetta exilis*
Bearded eelpout	*Lyconema barbatum*
Pacific hake	*Merluccius productus*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Sandpaper skate	*Raja kincaidii*
Splitnose rockfish	*Sebastes diploproa*
Shortbelly rockfish	*S. jordani*
Stipetail rockfish	*S. saxicola*
Blackedge poacher	*Xeneretmus latifons*
Shortspine combfish	*Zaniolepis frenata*

Source: McClelland Engineers, Inc., 1985.

- **Areas of Special Biological Significance (ASBS).** Areas of Special Biological Significance have been designated by the State Water Resources Control Board to protect extraordinary or unique biological communities from sewage disposal outfall construction. ASBS areas in the vicinity of the project are the mainland coast from Mugu Lagoon to Latigo Point offshore 1 mile or to the 300 foot isobath, and a 1 mile or 300 foot isobath perimeter around the channel islands. The mainland ASBS is approximately 11 miles (17.7 km) east of Platform Gail and the Anacapa Island ASBS would be 5.6 miles (9 km) southwest.
- **Channel Island National Park.** The recently created park encompasses the previously designated Channel Islands National Monument and also includes San Miguel, Santa Rosa, Santa Cruz and Anacapa Islands. Lease P-0205 is located closest to Anacapa Island.
- **Channel Islands National Marine Sanctuary.** Created on March 5, 1980, this sanctuary includes the waters surrounding the northern Channel Islands and Santa Barbara Island, extending from the mean high tide line seaward 6 nautical (1.1 km) miles. Sanctuary regulations permit hydrocarbon exploration, development, and production on any lease executed prior to the effective date of regulations, but require that operations be conducted from locations outside the Sanctuary, if feasible. Pipeline laying within the Sanctuary is also permitted, but no future leases within the Sanctuary will be granted. Lease P-0205 is situated outside the Channel Islands Marine Sanctuary. However, the southern lease boundary abuts the Sanctuary boundary. The platform will be located approximately 0.6 nautical miles (1.1 km) from the Sanctuary boundary. Access and utilization of marine resources is jointly controlled by California Department of Fish and Game and the National Park Service. This was done to protect the brown pelican nesting areas, undisturbed tide pool areas, pinniped breeding grounds and archaeological resources. In April, 1984 a draft General Management Plan Supplement Environmental Assessment was prepared by the National Park Service to document the impacts associated with development of Anacapa for limited recreational use (NPS, 1984).

Environmentally sensitive areas and designated sanctuaries in the Santa Barbara Channel Region are listed in Table 3.6-6 and depicted in Figure 3.6-4. In addition to the five main types of areas listed above, biological sensitive areas (BSA) are included into Table 3.6-7. These areas have one or more of the following characteristics:

- high biological productivity
- high ecological significance
- unique features or areas
- vulnerability to oil pollution

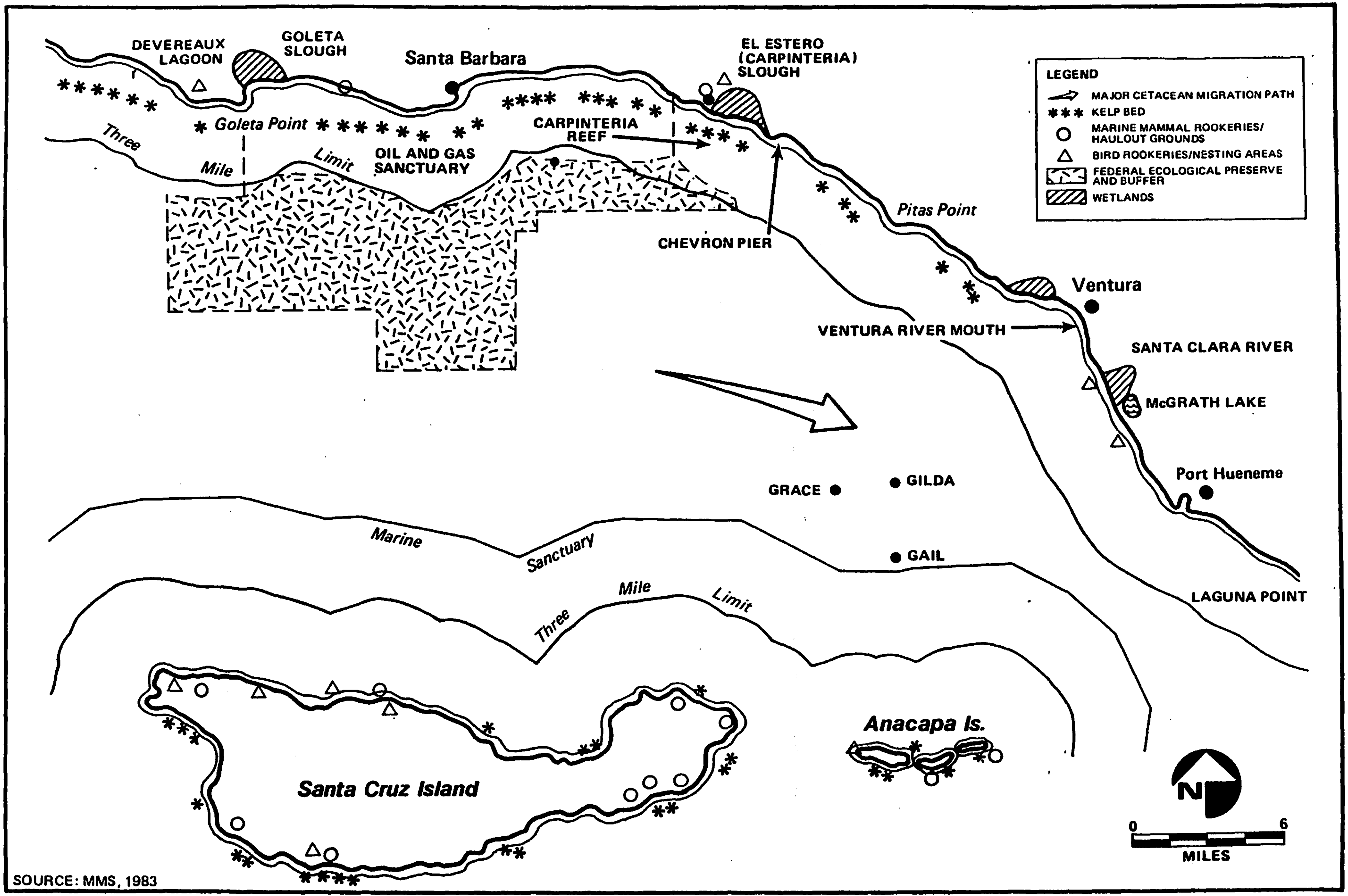
Between Point Conception and the Mexican Border are 11 Ecological Reserves and 9 Marine Life Refuges (these are legally defined and controlled by the State of California). The closest ecological reserve to the lease is the Channel Islands. San Miguel, Santa Barbara and Anacapa Islands, including all waters within 1 nautical mile of shore, have been designated Ecological Reserves by the State of California (C. Mehlert, California Department of Fish and Game, pers. comm.).

There are a number of habitat types considered to be highly sensitive in the general project area. These are the areas of kelp beds and subtidal reefs generally found south and east of the site at Anacapa Island, and the rocky intertidal zone found on the north side of Anacapa Island.

3.6.2.1 Kelp Beds and Subtidal Reefs

Kelp beds are major population complexes of large brown algae, generally Macrocystis. They occur throughout the Santa Barbara Channel area as well as north of Point Conception in shallow waters (less than 100 feet [31 m]) adjacent to the mainland and coastal islands. Kelp beds provide habitat for a wide variety of marine species by creating a multivel complex of physical environments. Generally, kelp beds are found over hard substrate areas (rocks) but can be found in areas of sedimentary bottoms. Depth ranges for kelp are 16 to 78 feet (5 to 30 m) and will be highly variable based upon local conditions. Turbidity is considered to be of major significance when determining onshore and offshore limits (BLM, 1974).

Kelp stands and adjacent rocky outcrops provide a heterogeneous environment which serve as a source of food, shelter and attraction for fishes (Quast, 1968a). A total of 57 species was listed by Quast (1968a) as being associated with kelp beds in southern California; kelp bass (Paralabrax clathratus), California sheephead; (Pimelometopon pulchrum), and blacksmith (Chromis punctipinnis) were the most frequently encountered species. Even larger numbers of species have been recorded in other



SOURCE: MMS, 1983

Environmentally Sensitive Areas in the Santa Barbara Channel Region

FIGURE 3.6-4

Table 3.6-7

ENVIRONMENTALLY SENSITIVE AREAS IN THE SANTA BARBARA CHANNEL REGION

Area	Designation [1]	Significant Characteristics
Santa Ynez River Mouth	None	Estuarine habitat.
Point Conception to Ellwood	BSA, ESH (SBC)	Area of concentration for migrating birds; staging area for migrating gray whales; relatively undisturbed rocky intertidal habitat; important biogeographic area; extensive kelp beds. Designated South Coast Intertidal Preserve by the California Coastal Commissions.
Naples Reef	BSA, ESH (SBC)	Diverse subtidal reef habitat, long-term research area and UCSB Marine Sciences Institute.
Burmah Beach	BSA	Harbor seal haulout area.
Coal Oil Point	ESH (SBC, UCSB)	Low-lying reef area; rich intertidal marine fauna; natural reserve in the University Natural Land and Water Reserves System.
Devereux Slough and Lagoon	ESH (SBC, UCSB), ASBS	Wetland habitat; heavily used by several species of birds; coastal dune habitat. Included in Coal Oil Point Natural Reserve.
University Lagoon	ESH (UCSB)	Wetland; important habitat for rare and endangered bird species including the Brown Pelican and California Least Tern.
State Oil and Gas Sanctuary	Sanctuary (State of California)	This buffer zone was designated to preclude offshore drilling within close proximity of Santa Barbara and the Channel Islands.
Federal Ecological Reserve and Buffer	Ecological Reserve (U.S. Government)	Designated to prevent drainage from the State Oil and Gas Sanctuary.
Goleta Rocks/Point	BSA	Harbor seal haulout area.
Goleta Slough	BSA, ESH (SBC)	Extensive marsh/estuarine habitat; heavily used by several species of birds including endangered Light-footed Clapper Rail and Belding's Savannah Sparrow.
Carpinteria or El Estero Slough	BSA, ESH (SBC, CC)	Extensive marsh/estuarine habitat; heavily used by several species of birds including endangered Light-footed Clapper Rail and Belding's Savannah Sparrow; 120 acres included in University of California Natural Land and Water Reserves System.
Carpinteria Reef	ESH (SBC, CC)	Important rocky marine habitat.
Chevron Pier	BSA, ESH (SBC, CC)	Harbor seal haulout area.
Ventura River Mouth	ESH (VC)	Estuarine habitat.
Santa Clara River Mouth	ESH (VC)	Estuarine/marsh habitat; heavily used by several species of birds, including endangered California Least Tern and Belding's Savannah Sparrow.
McGrath Lake	ESH (VC)	Fresh water marsh and coastal dune habitats.

Table 3.6-7

ENVIRONMENTALLY SENSITIVE AREAS IN THE SANTA BARBARA CHANNEL REGION (Continued)

Area	Designation[1]	Significant Characteristics
Mugu Lagoon	ESH (VC)	Extensive marsh/estuarine habitat, possibly the least disturbed such habitat along the California coast; heavily used by several species of birds including endangered California Least Tern; pinniped haulout area.
Laguna Point to Latigo Point	ASBS	Relatively undisturbed marine habitat.
Channel Islands	National Park, Marine Sanctuary (U.S. Government); ASBS, Oil and Gas Sanctuary (State of California), UBA	Islands and surrounding waters provide relatively undisturbed habitat for pinnipeds, cetaceans, seabirds and other marine organism; characteristic insular flora and fauna including commercial, recreational, or educational importance.
Anacapa Island		Second largest seabird colony in southern California, including endangered Brown Pelican; heavy use of surrounding waters by foraging birds, pinnipeds, and cetaceans; migratory path of the gray whale and waterfowl.
Santa Cruz and Santa Barbara Islands		Presence of major bird colonies including the Brown Pelican; pupping grounds for harbor seals; heavy use of nearshore waters by foraging birds and pinnipeds.
San Miguel Island		Largest bird and pinniped reproductive colonies in Southern California including 5 pinniped, 3 alcid, and 3 cormorant species; heavy use of nearshore waters for foraging; migratory path of gray whale; heavy seasonal foraging use by Pacific white-sided and common dolphins; seasonal concentrations of endangered humpback whale.

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* Data based on SAI, Inc. 1983.

[1] Designation Key

ASBS	Area of Special Biological Significance
BSA	Biological Sensitive Area
ESH	Environmentlaly Sensitive Habitat
UBA	Unique Biological Area
SBC	Santa Barbara County, Coastal Plan
VC	Ventura County, Land Use Plan
CC	City of Carpinteria, Local Coastal Plan
UCSB	University of California at Santa Barbara, Long Range Development Plan

studies. Miller and Geibel (1973) identified 67 species over a 5-year period in kelp beds from San Simeon to Monterey in central California, and Feder et al. (1974) listed 111 species that were observed by diving in kelp bed-rocky bottom habitats in southern California.

Quast (1968b) determined that the mean standing crop of resident kelp fed fishes was 313 pounds/acre (351 kg/ha), an estimate close to median values for lakes and coral reefs. Miller and Geibel (1973) obtained higher estimates (706-1120 kg/ha) for fishes of central California kelp beds using techniques difficult to compare with those of Quast (1968a). Increased standardization of sampling procedures is required to obtain comparable values.

In terms of habitat complexity and species richness, kelp beds and associated areas form the temperate counterpart of coral reefs in the tropics, although overall diversity is greater in the latter environment. The dual behavior of kelp bed fishes follows the same basic patterns as tropical reef species but the kelp bed community appears to be more loosely programmed in terms of specialized day-night activities (Ebeling and Bray, 1976). Less large-scale replacement of fishes between discrete areas or vertical zones occurs at dusk, even though Hobson and Chess (1976) have shown that there are generalized planktivores feeding at night in open shallow waters seaward of kelp beds off Santa Catalina Island.

At the present time many of the coastal kelp beds are recovering or have recovered after having been seriously depleted during the 1983 storms and the recent incursion of warm tropical waters. Commercial Bed 17 (from Point Mugu to Point Dume) is currently in excellent condition and has been recently harvested (R. McPeak, Kelco). Bed 109 around Anacapa Island is protected by the marine sanctuary. Refer to Section 3.5.5 for additional information.

3.6.2.2 Rocky Intertidal Habitat

An important landward extension of subtidal reefs is the rocky intertidal zone, a productive and heterogeneous habitat that is particularly well developed on the California coast and offshore islands. A wide variety of fishes and invertebrates occupies the intertidal environment either on a permanent or a periodic basis. Rocky shores with associated tide pools are generally considered to be important habitats for the juveniles of a number of commercial and noncommercial species. Reduced predation in these habitats, as compared to subtidal areas, is frequently cited as a major factor in the occupation of the intertidal zone by young fishes; however, solid support of this hypothesis is yet to be obtained.

Although the eastern North Pacific, including California, has one of the most highly diverse intertidal fish faunas in the world, relatively little research has been conducted on community structure and composition. It is possible, however, to identify the fish families contributing the greatest number of species to the zone. The results of a 2 year survey of intertidal fishes at Diablo Cove, 35.2°N (Burge and Schultz, 1973) is indicative of species composition for central California shores. In this study, 54 species were encountered in the intertidal zone, with Cottidae (10 species), Scorpaenidae (8 species), Embiotocidae (8 species), and Stichaeidae (6 species) being the principal families in terms of richness of species. Intertidal habitats are particularly important for the juveniles of scorpaenids and embiotocids, whereas many of the cottids and stichaeids occur as adults and spawn in the intertidal zone.

An extensive review of the intertidal invertebrates is presented in Section 3.6.1.1. The intertidal zone on the southern California mainland is generally dominated by the sandy beach type system, and the infrequency of the rocky intertidal zone creates a rather unique component subsystem in the intertidal environment. However, the Channel Islands represents the opposite situation, being dominated by rocky intertidal habitat. The Anacapa Island coastline is 70 percent rock, 14 percent boulder beach and 15 percent sandy beach, while the mainland from Pt. Arguello to the Mexican border is approximately 22.5 percent rock, 7.5 percent boulder beach and 70 percent sandy beach (MMS, 1983).

3.6.2.3 Offshore Islands

The eight southern California offshore islands have been considered as consisting of two groups: the northern islands which include San Miguel, Santa Rosa, Santa Cruz and Anacapa; and the southern islands including Santa Barbara, San Nicolas, Santa Catalina and San Clemente. These islands, primarily due to their inaccessibility, contain the only remaining "pristine" marine assemblages in southern California. The northern group has been considered to lie in the transitional area between the northern and southern faunal groups. Anacapa Island is the closest to the project area.

The intertidal marine environment of Anacapa Island is defined primarily by low rock platforms formed by the erosion of high vertical cliffs. These form a series of terrace steps off the island into deeper water (Emery, 1960). The shallowest terrace at a depth of approximately 20-40 feet (6-12 m) has been extensively colonized by kelp beds which nearly surround the island. The macroalgae, invertebrates and fish from these beds are typical of kelp bed species found on the mainland coast, described previously in this report. A list of wildlife and marine fish and mammals defined by the

USFWS for the islands is shown in Table 3.6-8. The Brown pelican is the only federally listed endangered species on the island.

The National Park Service has opened a number of islands for low intensity camping, hiking, and day use. This includes several locations on Anacapa Island particularly the East Island. The Middle and West Island are generally restricted to research or very limited day use (ranger guided tours) (NPS, 1984).

3.6.3 Avian Resources

A variety of terrestrial and marine birds utilize the coastal environment of the study area including coastal upland, sandy beach, rocky shore, cliff, wetland, and offshore rock habitat. Dames and Moore (1977) reported that more than 250 species of birds had been recorded in the Santa Barbara region, with 105 of these considered to inhabit coastal, beach or open ocean (pelagic) habitats. Shore birds utilizing the sandy beach habitat include the Long-billed Curlew, Semipalmated Plover, Lessor Golden Plover, Black-bellied Plover, Snowy Plover, Whimbrel, Marbled Godwit, Sanderling, Western Sandpiper, and the Least Sandpiper (BLM, 1979). Precipitous cliffs, such as those that occur on the offshore islands, are commonly used as nesting sites and feeding areas for southern California marine birds such as the American Black Oystercatcher, Black Turnstone, Ruddy Turnstone, Spotted Sandpiper, Surfbird, and Western Gull (BLM, 1979). Offshore rocks provide a multitude of nesting and roosting sites for shorebirds and are of particular importance near populated areas where they provide protection from human disturbance due to their isolation.

A map of bird colonies on the island and the mainland by the USFWS is shown in Figures 3.6-5 and 3.6-6. Colony composition and abundance levels are shown in Table 3.6-9. The data for the figures and table are summarized from Gusey (1982), and was originally derived from BLM (1979), NOAA (1979), and Varojean (undated). The major rookery of the Federally listed Brown Pelican is located on west Anacapa Island and on the nearby Scorpion Rock. As expected, considerable shorebird activity, including Brown Pelicans, Western Gulls, Brandt's Cormorants, Pigeon Guillemots, Pelagic Cormorants, Xantu's Murrelet, and Double-crested Cormorants occurs near Anacapa Island. Nearshore waters are used extensively for feeding, particularly by brown pelicans. A recent study (Anderson et al., 1980) established a relatively close relationship between pelican reproduction and fledgling success and anchovy production in Santa Barbara Channel waters. Pelicans feed almost completely on anchovies (90-95 percent of diet) and the availability of nearshore food resources has a significant influence on the numbers of birds fledged annually.

Table 3.6-8

WILDLIFE RESOURCES OF ANACAPA ISLAND
(USFWS, 1981)

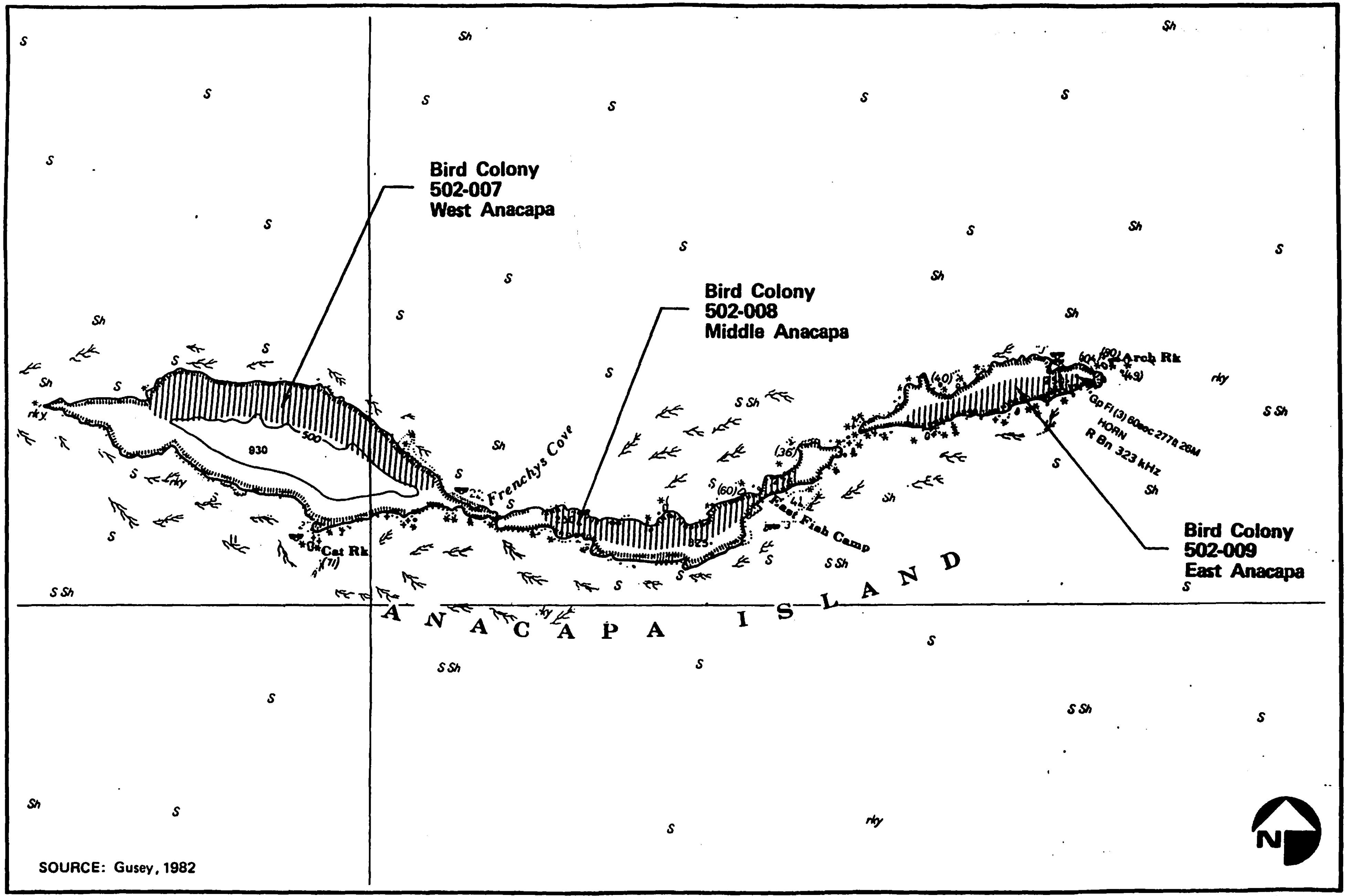
West Island Species		Notes
California Brown Pelican (F)	-	major nesting area in California
American Black Oystercatcher	-	nesting area
Shearwaters	-	observed, not nesting
Storm Petrels	-	observed, not nesting
Double-crested Cormorants	-	nesting area
Pigeon Guillemot	-	nesting area
Passerines	-	observed
Central Island **Species**		
Western Gull	-	nesting area
Sea Ducks	-	observed
Shearwaters	-	observed
Storm Petrels	-	observed
Brandt's Cormorant	-	nesting area
Pelagic Cormorants	-	nesting area
Passerines	-	observed
East Island **Species**		
American Black Oystercatcher	-	nesting area
Western Gull	-	nesting area
Sea ducks	-	observed
Shearwaters	-	observed
Storm Petrels	-	observed
Cormorants	-	observed
Xantu's Murrelet	-	nesting area
Passerines	-	observed

Table 3.6-8

WILDLIFE RESOURCES OF ANACAPA ISLAND (USFWS, 1981) (Continued)

Offshore		Notes
East Island		
Giant sea bass	-	sportfishing
Yellowtail	-	sportfishing
Pacific Barracuda	-	sportfishing
Frenchy's Cove (between West and Central Island)		
California Sea lions	-	adult concentration
Harbor seals	-	adult concentration

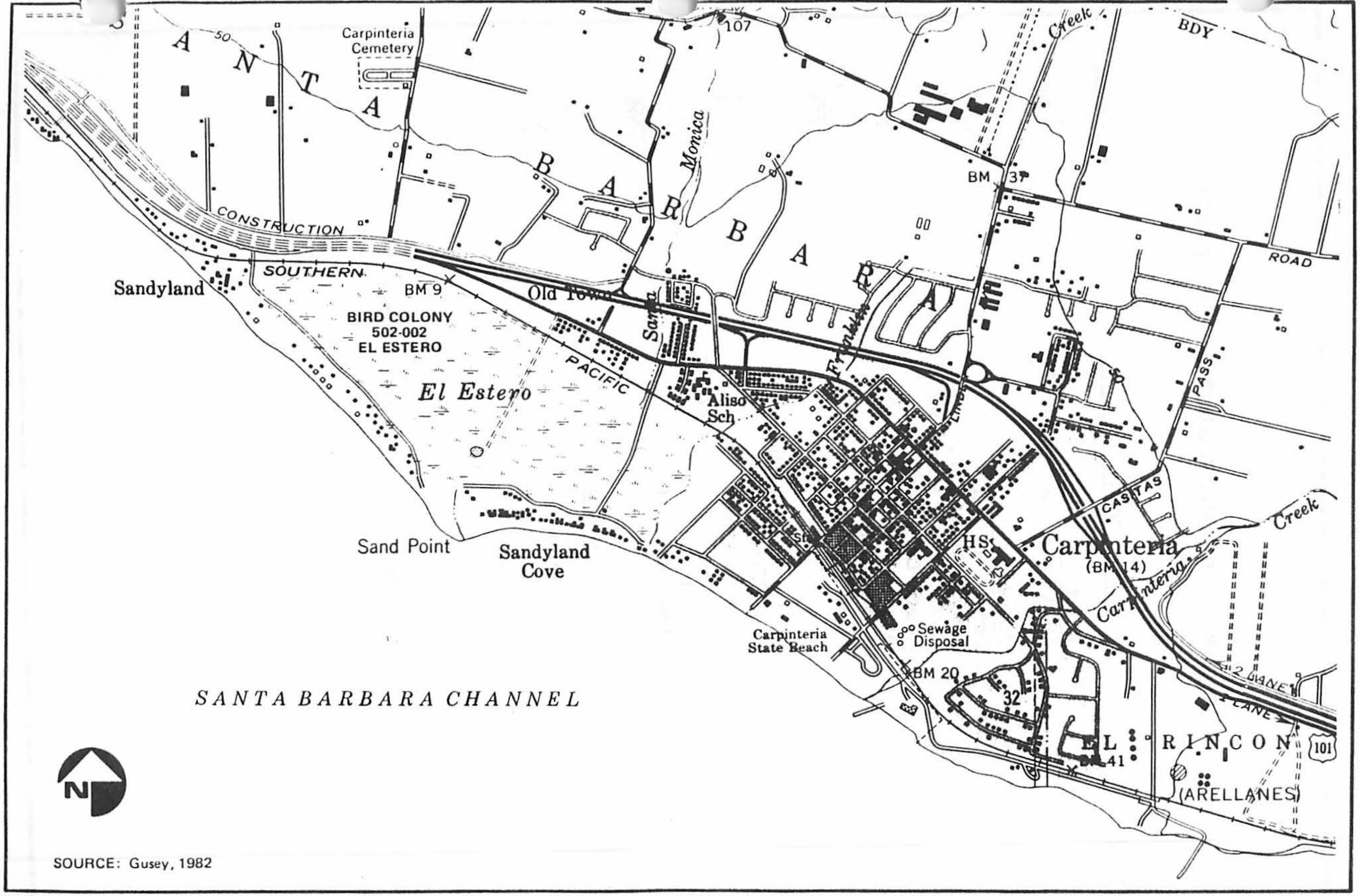
Data from USFWS (1981) Pacific Coast Ecological Inventory.



SOURCE: Gusey, 1982

Anacapa Island Bird Colonies

FIGURE 3.6-5



SOURCE: Gusey, 1982

Mainland Seabird Colony in Project Area

FIGURE 3.6-6

WESTEC Services, Inc.

Table 3.6-9

DESIGNATED MARINE BIRD COLONIES IN THE PROJECT AREA
(Gusey, 1982)

Colony Code	Location	Abundance
502 002	El Estero	
	Light-footed Clapper Rail (F)	36
502 007	Anacapa Island West	
	Brown Pelican (F)	2,516
	Brandt's Cormorant	0
	Double-crested Cormorant	132
	Pelagic Cormorant	0
	American Black Oystercatcher	X
	Western Gull	X
	Pigeon Guillemot	10*
		2,658
502 008	Anacapa Island Middle	
	Brandt's Cormorant	4
	Pelagic Cormorant	4
	American Black Oystercatcher	X
	Western Gull	5,000
	Pigeon Guillemot	P
		5,008
502 009	Anacapa Island East	
	Western Gull	200
	Xantu's Murrelet	X
	Pigeon Guillemot	P
		200

X - present

* - Estimate for entire Anacapa; birds probably are from West Anacapa.

F - Federally Listed Endangered Species.

P - Probably Present.

3.6.4 Marine Mammals

The largest and most diverse marine mammal populations in the world for temperate waters occur in the southern California region (Norris et al., 1975; CCMS, 1980). Within this area, approximately 32 of the over 100 species of known marine mammals have been recorded. The pinnipeds (seal and sea lions) are by far the most numerous forms, and several species, including Mirounga angustirostris (northern elephant seal), Zalophus californianus (California sea lion), and Phoca vitulina (harbor seal), breed and pup yearly in southern California waters. The southernmost extension of the breeding ranges for the northern fur seal (Callorhinus uirsinus) and the Stellar sea lion (Eumetopias jubata) is on San Miguel Island (Norris et al., 1975). The most important southern California habitats for pinnipeds are the offshore islands.

The greatest number of seals and sea lions breed and pup on the west end of San Miguel Island; San Nicolas Island ranks second among the islands in importance among pinniped rookeries, followed by San Clemente and Santa Barbara Islands. Phoca and Zalophus both breed and pup on Anacapa Island (MMS, 1983). Pinniped rookeries and haulout areas are shown in Table 3.6-10.

The southern sea otter (Enhydra lutris nereis) generally ranges from Pismo Beach in San Luis Obispo County north to Monterey (Miller, 1980; USFWS, 1982). The potential of finding this species in the study area is remote (refer to Section 3.6.5.1).

The cetaceans (whales, dolphins, and porpoises) are also common in southern California waters, although the majority of animals consist of smaller dolphins and porpoises (Norris et al., 1976). Several of the larger whale species migrate through the area, the most notable of which are the California gray whale (Eschrichtius gibbosus) and the humpbacked whale (Megaptera novaengliae). Inshore cetaceans include the common dolphin (Delphinus delphis), Pacific bottlenose dolphin (Tursiops gilli), white-sided dolphin (Lagenorhynchus obliquidens), Dall's porpoise (Phocoenoides dalli), Minke whale (Balaenoptera acutorostrata), gray whale, and Pacific pilot whale (Globicephala scammoni). Three of these forms (common and white-sided dolphins and the pilot whale) were the most commonly sighted cetaceans in southern California waters during 1975-76 (Norris et al., 1976). The major migratory routes of the larger cetaceans include the waters near Point Conception and through the Channel.

During the marine survey conducted by McClelland Engineers, Inc. (1985), few marine mammals were observed. A pod of three gray whales were sighted northeast of the platform location. A single sea lion was seen on each of the survey days and a group of four unidentified dolphins was seen on one day. A list of marine mammals of southern California is shown in Table 3.6-11.

Table 3.6-10

PINNIPED ROOKERY AND MAJOR HAUL OUT AREAS FOR THE POINT CONCEPTION REGION AND THE SANTA BARBARA CHANNEL

Nameplace	Species Present	Activity
Richardson Rock (San Miguel Is.)	*Zalophus* *Callorhinus*	Breeding-Pupping Breeding-Pupping
Castle Rock (San Miguel Is.)	*Zalophus* *Callorhinus* *Eumetopias*	Breeding-Pupping Breeding-Pupping Breeding-Pupping
Point Bennett Rock (San Miguel Is.)	*Arctocephalus*	Haul out only
Point Bennett Rock (San Miguel Is.)	*Callorhinus* *Zalophus* *Mirounga* *Eumetopias*	Breeding-Pupping Breeding-Pupping Breeding-Pupping Breeding-Pupping
Simonton Cove (San Miguel Is.)	*Phoca* *Mirounga*	Breeding-Pupping Breeding-Pupping
Cuyler Harbor Area (San Miguel Is.)	*Phoca*	Breeding-Pupping
Sandy Point Blockhouse Beach (Santa Rosa Is.)	*Phoca*	Breeding-Pupping
Beechers Bay (Santa Rosa Is.)	*Zalophus*	Breeding-Pupping
Fraser Point (Santa Cruz Is.)	*Zalophus*	Breeding-Pupping
Arch Rock East (Santa Cruz Is.)	*Phoca*	Breeding-Pupping
Scorpion Anchorage (Santa Cruz Is.)	*Phoca*	Breeding-Pupping
Kinton Point South/Morse Point (Santa Cruz Is.)	*Phoca*	Breeding-Pupping
Gull Island (Santa Cruz Is.)	*Zalophus* *Phoca*	Breeding-Pupping Breeding-Pupping
Anacapa Island	*Zalophus* *Phoca*	Breeding-Pupping Breeding-Pupping
Goleta Beach (Mainland)	*Phoca*	Haul out

Table 3.6-10

PINNIPED ROOKERY AND MAJOR HAUL OUT AREAS FOR THE POINT CONCEPTION REGION AND THE SANTA BARBARA CHANNEL (Continued)

Nameplace	Species Present	Activity
Chevron Pier (Mainland near Carpinteria)	*Phoca*	Haul out
Burmah Beach (Mainland)	*Phoca*	Haul out
Point Mugu (Mainland)	*Zalophus*	Haul out
	Phoca	Haul out

Source: Norris et al., 1976.
Lindstedt-Siva, 1976.

Table 3.6-11

MARINE MAMMALS OF THE SOUTHERN CALIFORNIA BIGHT (Point Conception-Mexican Border)

Common Name	Genus/Species	Estimated Population
Pinnipeds		
California sea lion	(Zalophus californianus)	40,000
Northern fur seal	(Callorninus ursinus)	1,200
Stellar sea lion	(Eumetopias jubatus)	5-20
Guadalupe fur seal	(Arctocephalus townsendi)	1-5
Northern elephant seal	(Mirounga angustirostris)	16,600
Harbor seal	(Phoca vitulina)	1,400
Fissipeds		
Sea otter	(Enhydra lutris)	1-5
Cetaceans		
Bryde's whale	(Balaenoptera endeni)	—
Minke whale	(Balaenoptera acutorostrata)	60
Blue whale	(Balaenontera musculus)	7
Sei whale	(Balaenoptera borealis)	—
Finback whale	(Balaenoptera physalus)	23
Humpback whale	(Megaptera novaengliae)	6
Gray whale	(Eschrichtius robustus)	336
Common dolphin	(Delphinus delphis)	33,564
Pacific pilot whale	(Globicephala macrorhynoa)	4,333
Risso's porpoise	(Grampus griseus)	556
White-sided dolphin	(Lagenorhynchus obliiquidens)	10,007
Northern right whale dolphin	(Lissodelphis borealis)	1,848
Killer whale	(Orcinus orca)	122
Harbor porpoise	(Phocena phocoena)	0
Dall porpoise	(Phocenoides dalli)	647
False killer whale	(Pseudorca crassidens)	0
Long-beaked dolphin	(Stenella coeruleoalba)	0
Pacific bottlenose dolphin	(Tursiops gilli)	557
Sperm whale	(Physeter catadon)	0
Pygmy sperm whale	(Kogia breviceps)	0
Baird's beaked whale	(Berardius bairdii)	—
Ginko-toothed whale	(Mesopolodon ginkgodens)	—
Cuvier's beaked whale	(Ziphius cavirostris)	—
Pacific right whale	(Balaena glacialis)	0
Pacific spotted dolphin	(Stenella graffmani)	0
Rough-toothed dolphin	(Steno bredanensis)	0
Hubb's beaked whale	(Mesoplodon carlhubbsi)	0
Total Sighted		52,066

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*Numbers for cetaceans indicate sightings from air and ship (Norris et al., 1975).

3.6.5 Threatened and Endangered Species

A total of 17 species listed as Endangered or Threatened under the Endangered Species Act of 1973 may be found in or near the project area, defined by MMS as shoreline and offshore waters from the Santa Maria River south to Oceanside. These species include four reptiles, five birds, seven mammals, and one plant. Additionally, one proposed species is found in the area. The following accounts of the biology of each species have been summarized from previous enviornmental documents, biological opinions, and other sources and are taken from the Endangered Species Analysis for Platform Gail prepared by L. Seeman Assocates for Chevron U.S.A. (1985).

3.6.5.1 Listed Species

Marine Turtles

Four species of marine turtles are found in the Southern California Bight. In 1978, USFWS listed the green sea turtle (Chelonia mydas) as Threatened wherever found except for breeding colony populations in Florida and the Pacific coast of Mexico, where it is endangered (USFWS, 1984c). The leatherback sea turtle (Dermochelys or coriacea) was listed as Endangered throughout its range in 1970 (USFWS, 1984c). Loggerhead sea turtles (Caretta caretta) were listed as Threatened throughout their range in 1978 (USFWS, 1984c). The olive, or Pacific, Ridley sea turtle (Lepidochelys olivacea) was listed as Threatened wherever found, except breeding colony populations on the Pacific coast of Mexico, where it is Endangered. This species was listed in 1978 (USFWS, 1984c). The National Marine Fisheries Service has recommended that the nesting population in the western North Atlantic Ocean be reclassified to Endangered status (Mager, 1984). Critical habitat has been designated for the leatherback sea turtle, but not for the other three species (USWS, 1984c).

Use of the Southern California Bight by marine turtles is by transient individuals near the northern edge of their ranges (NMFS, 1979, 1980). The leatherback sea turtle has been recorded as far north as Alaska (Mager, 1984), green sea turtles have been found as far north as British Columbia (Stebbins, 1966; Mager, 1984), and olive Ridleys have been recorded from Humboldt County, California (Stebbins, 1966). A few sightings of leatherback sea turtles have been recorded recently from the Southern California Bight (CCMS, 1981, 1982).

Marine turtles do not breed in the Southern California Bight. The nearest historical breeding beach was at Guerrero Negro, Baja California Sur, Mexico (NMFS, 1979), used by olive Ridleys (Mager, 1984). The nearest active breeding beaches for green, leatherback, and olive Ridley sea turtles are on the Pacific coast of mainland

Mexico. The nearest active breeding beach used by loggerhead sea turtles is on the Pacific coast of Panama (Mager, 1984).

Brown Pelican

All subspecies of the brown pelican (Pelicanus occidentalis) were listed as Endangered on June 2, 1970, and the California subspecies (P. o. occidentalis) was listed as Endangered on October 13, 1970 (USFWS, 1979b, 1984c). No critical habitat has been designated. The State of California has also listed the brown pelican as Endangered (Anonymous, 1984).

Brown pelicans are resident year-around in the Southern California Bight and the Channel Islands, concentrated between Point Dume, Anacapa Island, and Santa Cruz Island (MMS, 1982, 1984a) and along the mainland coast between Santa Barbara and Point Dumé (USFWS, 1983a). Large numbers of non-breeding resident birds roost between Ventura and Point Mugu in late spring (MMS, 1982). Other traditional roosts are located on Anacapa Island and outlying rocks, Santa Cruz Island and nearby Scorpion Rock and Gull Island, and on Santa Barbara and nearby Sutil Island (USFWS, 1983a). The resident population is augmented from late July to November year by migrants from Mexico (MMS, 1982, 1984a; USFWS, 1979b, 1981a). The number of migrants peak in September and October, and the migrants are generally gone by early December (USFWS, 1979b, 1981a).

Habitat occupied by brown pelicans is close to salt water and rarely more than 20 to 30 miles offshore (USFWS, 1979b, 1981a). Nesting habitat in California consists of islands with steep, rocky slopes, vegetative cover is variable (USFWS, 1983a). Brown pelicans only nest on islands free from mammalian predators (Gress, 1980; USFWS, 1983a). Roosting habitat, considered essential to the species, includes offshore rocks and islands, river mouths with sand bars, breakwaters, pilings, jetties, and estuaries (USFWS, 1983a). Waters within 30 to 50 km (18.6 to 31.1 miles) of shorelines are considered to be essential as feeding habitat (USFWS, 1983a).

Pelicans feed by plunge-diving to near surface, capturing small fishes (USFWS, 1979b, 1981a). Northern anchovies are the primary prey species (USFWS, 1979b, 1981a, 1983a). Estimtes of the portion of the pelican's diet consisting of anchovies range from 80 percent (WESTEC, 1984) to 90 to 95 percent (USFWS, 1981a); intermediate estimates are 92 percent (Anderson et al., 1980; Gress et al., 1980, cited in MMS, 1984b; USFWS, 1983a) and 93 percent (Gress, 1980; MMS, 1984a).

A relationship, characterized as a strong (USFWS, 1983a) and as highly significant (Southwest Fisheries Team, 1983), between anchovy availability and abundance and pelican reproductive success has been demonstrated recently. The relationship has been demonstrated between anchovy abundance/availability in the pre-breeding and breeding season and breeding status of pelicans, and between anchovy spawning biomass and the number of fledglings produced per pair of pelicans (Southwest Fisheries Team, 1983). Pelican reproductive and survival rates have been noted to vary with variations in anchovy availability (Anderson et al., 1980; USFWS, 1983a). Pelican mortality rates (MMS, 1983a), are noted to be closely correlated with anchovy abundance.

Low pelican reproduction between 1976 and 1978 has been attributed to a reduced supply of anchovies (Gress, 1980; USFWS, 1983a). During the 1980 season anchovy abundance was high early in the year, but declined greatly in May, and nest abandonment rates reached 50 percent in May and 72 percent in subsequent months (USFWS, 1983a). In 1981, anchovy abundance was high early in the season, and a record number of nest initiations occurred on Anacapa Island (Gress, 1980). A sharp reduction of anchovy abundance occurred in mid-April, resulting in an overall nest abundance rate of 53 percent (USFWS, 1983a), and nest abandonment rates up to 72 percent in some places (Gress, 1980). The mortality rate of prefledgling pelicans was particularly high in 1981 due to early nest abandonment (USFWS, 1983a). High nest abandonment and chick mortality rates in 1982 and 1983 are attributed to a low anchovy supply (MMS, 1982). The 1982 season was similar to 1981 with high abandonment rates possibly due to competition for food with pelicans from Los Coronados Islands (MMS, 1982). The 1983 season may have been influenced by the 1983 El Nino, which was one of the strongest in the past 100 years (MMS, 1984b). Anchovy spawning shifted to west of the Channel Islands and north of Point Conception, with little or none in the Santa Barbara Channel due to a cold water plume associated with El Nino (Fiedler, 1984).

The Brown Pelican Recovery Plan (USFWS, 1983a) addresses the need for anchovy management, however, anchovy populations vary unpredictably from year to year (USFWS, 1981a; MMS, 1984a). A management plan for northern anchovies (PFMC, 1978) has been prepared, which attempts to reserve 1 million tons of anchovies for fish and wildlife consumption (USFWS, 1981a). The plan is supported by a Department of Fish and Game computer model, but has weaknesses in biomass estimates and knowledge of the needs of fish and wildlife consumers (USFWS, 1981a). The Fish and Wildlife Service (1981a) has stated that the resource appears overfished, based on sex ratios, the increasing mackerel population, and the Mexican anchovy harvest. There is little data on the effects of oil spills on anchovies (USFWS, 1981a).

Adult anchovies are pelagic schooling fish, generally found offshore in fall and winter and moving inshore in spring, and generally found well below surface during the day and nearer the surface at night (Ganssle, 1973). The adults rarely live more than 4 years. The eggs are planktonic in the upper water layers, and hatch at 2 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 (Ganssle, 1973).

Feeding areas used by breeding brown pelicans are usually concentrated near Anacapa Island (CCMS, 1980), and just north of Anacapa Island in the Santa Barbara Channel (USFWS, 1981a). The feeding areas used by the breeding colony birds varies, and is correlated with anchovy movement (Gress, 1980). In 1978 and 1979, feeding occurred almost exclusively in the Santa Barbara Channel and in 1981 most feeding was in the channel (MMS, 1982). In 1980, most feeding occurred between Anacapa Island and Santa Barbara Island (Gress cited in MMS, 1981, 1982). In early 1982, feeding was split almost evenly north and south of Anacapa Island, but was expected to be mostly in the Santa Barbara Channel for the overall year (Gress cited in MMS, 1982).

Brown pelicans usually begin to nest at 3 to 5 years of age (USFWS, 1983a). Clutches are most commonly three eggs, which are incubated by both parents for about 30 days, beginning with the first egg layed (USFWS, 1983a). Renesting after an initial attempt is considered to be uncommon, and apparently has only occurred in significant numbers on Anacapa Island in 1969 (USFWS, 1983a).

Nest timing varies from year to year and from island to island. Between 1970 to 1980, egg laying on Anacapa Island began between January and May, mostly in March; and laying was completed between May and August, mostly in June and July (USFWS, 1983a). Peak nesting activity occurred from February through July, with most in April and May (USFWS 1983a). Nest timing was unseasonal in 1980 and 1981 (MMS, 1981, 1982), the 6.5-month 1980 season was the longest recorded (USFWS, 1981a, 1983a). In 1982, nesting began in the third week of January (Gress, 1980), and young were fledged in late September to early October (Gress, 1980). At Scorpion Rock peak nesting activity between 1980 and 1980 occurred between January and April (USFWS, 1983a). Egg laying began in January and February, and, with the exception of one nest completed in July of 1972, was finished between March and May (USFWS, 1983a). The nesting on Santa Barbara Island during the 1980 season began in December of 1979, peaked in January of 1980, and egg laying was complete by February (USFWS, 1983a).

When hatched, young pelicans are fed and cared for by both parents (USFWS, 1983a). Mortality rates are highest during the first 5 weeks after hatching, when the nestlings lack a fat reserve (MMS, 1981, 1982). From 5 weeks to fledging, nestling pelicans have a fat layer that allows fasting for several days (MMS, 1981, 1982). Fledging occurs at about 13 weeks of age, the fledged yound continue to be fed by the adults after fledging (USFWS, 1983a). Fledglings do not range far from the colony at first and often congregate in large numbers on rocks and on the water near the colony (USFWS, 1981a). Mortality rates remain high through the first year (MMS, 1981, 1982).

Food availability is currently the primary reproductive constraint (USFWS, 1983a; MMS, 1984a), which was discussed above. Other limiting factors include pesticide pollution and colony disturbance (USFWS, 1983a).

Chlorinated hydrocarbon pesticides (DDT and its metabolites) were the primary cause of the brown pelican's endangerment, and continue to operate at a chronic low level (USFWS, 1983a). The major reproductive failure between the mid to late 1960s and the early to mid 1970s is attributed to DDT-caused egg shell thinning (USFWS, 1981a, 1983a; MMS, 1984a). DDT entered the marine food webs through sewage effluent containing wastes from a DDT manufacturing plant (USFWS, 1981a), and the DDT levels in the southern California marine environment were among the highest recorded worldwide (USFWS, 1983a). This dumping was stopped in 1970, with the land disposal of manufacturing plant wastes in a sanitary landfill (USFWS, 1981a, 1983a). DDT levels in the ocean ecosystem have declined since about 1974 (USFWS, 1983a; MMS, 1984a), and are now near background levels (Gress, 1980). Brown pelicans began to recover about 1974 (USFWS, 1983a), with higher but still fluctuating reproductive success (USFWS, 1979b, 1981a) and decreased pesticide levels in the birds (USFWS, 1981a). Thin shelled eggs still occur, although at a greatly reduced degree (Gress, 1980; USFWS, 1983a).

Colony disturbance has not been a major problem at Anacapa Island, although it has resulted in abandonment of Mexican colonies (USFWS, 1983a). Vulnerability to disturbance is greatest early in the nesting season, when disturbed pelicans easily abandon nests (USFWS, 1983a). Hyperthermia and hypothermia can cause nestling mortality if the parents are away from the nest for an extended period, and young nestlings are subject to predation by western gulls and ravens if the parents are forced off the nest (USFWS, 1983a). Predation, which is not normally a problem, can also occur if food supplies are depleted near the colony (MMS, 1981, 1982). Colony disturbance can result from both direct human disturbance and from low-flying aircraft (USFWS, 1983a).

The non-breeding range of the Pacific coast brown pelican subspecies extends from Vancouver Island to Colima, Mexico (USFWS, 1983a, 1984b), and possibly as far south as El Salvador (USFWS, 1983a). The breeding range currently extends from the Channel Islands to islands off Nayarit, Mexico, and may extend to Isla Ixtapa off Acapulco, Mexico (USFWS, 1984b, 1983a).

Current Southern California Bight breeding colonies are found on several islands in U.S. and Mexican waters. West Anacapa Island is the only U.S. site used each year (USFWS, 1983a, 1984b). Between 1970 and 1981, pelicans generally nested on the north side of the island (with the exception of 1978), although the specific nesting area shifts from year to year (USFWS, 1983a). Scorpion Rock, located off Santa Cruz Island and about 10 km (6 miles) west of Anacapa, is the only other regularly used breeding location in U.S. waters. Los Coronados Islands are the only active breeding location in Mexican waters of the Southern California Bight (USFWS, 1983a). The USFWS (1984b) lists Isla Todos Santos and Isla San Martin as breeding colony locations, but the recovery plan (USFWS, 1983a) indicates that these two islands have been abandoned due to excessive disturbance. The Isla San Martin colony has been inactive since 1974 (USFWS, 1983a).

Santa Barbara Island, including the nearby Sutil Island, is characterized by the recovery plan as the second most important site in U.S. waters of the Southern California Bight (USFWS, 1983a). It was used for successful nesting in 1980, probably due to unusual anchovy distribution (Gress, 1980; USFWS, 1983a). There are some reports of nesting in 1967 and 1971 (USFWS 1981a; MMS 1984a), but these are probably erroneous (USFWS, 1983a). Santa Barbara Island was historically used in 1911, 1912, and possibly 1940, but nesting data has not been published (USFWS, 1983a).

Several other islands have historically support pelican nesting colonies. Prince Island, off San Miguel Island, was used in 1910 and 1939, and possibly sporadically between 1939 and the early 1960s (USFWS, 1983a). This island has not supported a nesting colony since at least the early 1960s (USFWS, 1983a). Santa Cruz Island may have been used for nesting in 1909, but the actual location used is uncertain, and could have been the main island, Gull Island, or Scorpion Rock (USFWS, 1983a). Bird Island, off Point Lobos in Monterey County, is the only other identified historical pelican nesting site (USFWS, 1983a). This island was used in the 1920s and sporadically to 1959, but has not been used since 1959 (USFWS, 1983a). There are no published reports of brown pelicans nesting on the California mainland (Sorenson, cited in MMS, 1984b).

The Pacific coast subspecies is thought to include a maximum of 55,000 to 60,000 breeding pairs (USFWS, 1983a, 1984b). The number of breeding pairs ranges from about 28,700 (poor years) to about 58,500 (good years), with 48,500 breeding pairs representing usual years (USFWS, 1983a). Total population data, including non-breeding adults and juveniles, is difficult to obtain and is subject to high variance (USFWS, 1983a). Overall population trends have not been determined, as no survey of all colonies has been completed in a single year and colony size can vary greatly from year to year (USFWS, 1984b).

The resident Channel Islands population consists of approximately 4000 to 5000 birds (MMS, 1984b). On Anacapa Island, the breeding population included roughly 1877 pairs in 1984, and 1856 pairs in 1983 (Gustafson cited in MMS, 1984b). Earlier, the breeding population on Anacapa Island has ranged from 2946 pairs in 1981 to 76 pairs in 1977 (USFWS, 1983a). The breeding population on Scorpion Rock produced 112 nests in 1972, 105 nests in 1974, and 97 nests in 1975 (USFWS, 1983a). On Santa Barbara Island, the 1980 breeding population produced 97 nests (Gress, 1980; USFWS, 1983a).

The pelicans migrating into the Southern California Bight from Mexico number 50,000 to 70,000 individuals (MMS, 1982, 1984a). At least some recruitment of Mexican migrants into the southern California population occurs, as 18 birds banded in Mexico have been found nesting on Anacapa Island (Gress, 1980). This recruitment may occur regularly (USFWS, 1981a).

The reproductive success of the Anacapa Island colony was 1149 fledged young, or 0.62 fledged young per pair in 1983 and chick mortality was high, at 39 percent (MMS, 1984b). Between 1981 and 1974, reproductive success on Anacapa Island ranged from 0.18 young per pair in 1978 to 0.88 young per pair in 1975; and from 37 fledged young in 1978 to 1805 fledged young in 1981, or 0.61 fledged young per pair (USFWS, 1983a). Between 1969 and 1973, reproductive success at Anacapa Island ranged from 0.002 fledged young per pair in 1970 to 0.22 fledged young per pair in 1972; and from 1 young bird fledged in 1970 to 57 young fledged in 1972 (USFWS, 1983a).

Reproductive success at Scorpion Rock was 0.28 fledged young per pair in 1972, 0.71 fledged young per pair in 1974, and 0.93 fledged young per pair in 1975 (USFWS, 1983a). Respectively, 31, 75, and 74 young were fledged in these years

(USFWS, 1983a). At Santa Barbara Island in 1980, 77 young were fledged, with a success rate of 0.79 fledged young per pair (USFWS, 1983a).

In contrast, the brown pelican colonies in the Gulf of California typically fledge 1.4 young per nest (MMS, 1981). Reproductive success rates of 1.0 fledged young per pair (USFWS, 1981a) or 1.0 to 1.5 fledged young per pair (MMS, 1981) are considered stable.

Recovery objectives are based in part on breeding populations and reproductive success rates. Estimates of the necessary population include 2000 breeding pairs on Anacapa Island (Gress, 1980), and 3000 to 4000 breeding pairs on Anacapa Island and Los Coronados (MMS, 1982). Estimates of the required reproductive success rates are rates greater than or equal to 1.0 fledged young per nesting attempt (Gress, 1980) and 1.0 ± 0.1 fledged young per pair as a 5-year average (MMS, 1982). Two levels of population and reproductive success objectives appear in the recovery plan. For listing as Threatened, the Southern California Bight population should include at least 3000 breeding pairs with a 5-year average reproductive success rate of at least 0.7 young fledged per nesting attempt (USFWS, 1983a). For delisting, the Southern California Bight population should include at least 3000 pairs, with a 5-year average productivity of at least 0.9 fledged young per nesting attempt (USFWS, 1983a).

Bald Eagle

Bald eagles, *Haliaeetus l. leucocephalus*, found in California are listed as Endangered by the Federal government (USFWS, 1984c). The species was first listed in 1967, and the listing was modified in 1978 (USFWS, 1984c). No critical habitat has been designated (USFWS, 1984c). Bald eagles are also listed as Endangered by the State of California (Anonymous, 1984).

Bald eagles last nested on the Channel Islands in the mid 1950s (USFWS, 1979b, 1981a). There is currently no nesting use of the Channel Islands, but reintroduced birds are present on Catalina Island (USFWS, 1981a). The species may forage occasionally in the Santa Barbara Channel during the winter (WESTEC, 1984), and success of the reintroduction efforts will result in increased bald eagle use of coastal areas (USFWS, 1979b).

Most of the bald eagles found in California are wintering individuals (CDFG, 1980). The birds winter nearly statewide (CDFG, 1980), and are usually associated with aquatic habitats such as lakes, reservoirs, large rivers, and estuaries (CDFG, 1980; USFWS, 1979b, 1981a). The diet consists mostly of dead or dying fish and waterfowl, and secondarily of upland carrion and small mammals (CDFG, 1980).

The breeding range of bald eagles in California has been restricted to Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity counties since 1977 (CDFG, 1980). Most of the wintering population is found in inland areas of California (USFWS, 1979b), more than half at the Klamath National Wildlife Refuge (CDFG, 1980).

Bald eagles formerly nested on the Channel Islands, and are being reintroduced to Catalina Island (CDFG, 1980; USFWS, 1981a). Five of these eagles were still present in 1981 (USFWS, 1981a). The reintroduced birds have been observed to feed mostly on feral goats and pigs, including carrion (USFWS, 1981a).

The Channel Islands have been identified as the highest priority site for further reintroductions by Ron Jurek, the Pacific Bald Eagle Recovery Team Leader (USFWS, 1981a). Release of six additional eagles per year on Catalina Island is planned (USFWS, 1980b), and reintroductions to the northern Channel Islands is also planned (USFWS, 1979b).

The Channel Islands historically supported a minimum of 24 nesting pairs (USFWS, 1981a). Extirpation of the population was caused by both direct mortality, as sheepherders and tourists killed eagles annually, and by indirect mortality, such as egg collecting, human disturbance, and sonic booms (USFWS, 1981a). The role of chlorinated hydrocarbon pesticides in the extirpation of bald eagles from the Channel Islands is unclear, as the population was already reduced and confined to the larger islands when DDT was introduced (USFWS, 1981a).

The species as a whole has declined primarily due to the effects of habitat loss and chlorinated pesticides (USFWS, 1979b).

Peregrine Falcon

In 1984, the federal government listed all wild peregrine falcons in the coterminous United States as Engangered due to similarity of appearance (USFWS, 1984c). The American peregrine falcon (Falco peregrinus anatum) was listed as Endangered by the federal government in 1970 (USFWS, 1984c), and is also listed as Endangered by the State of California (Anonymous, 1984). This subspecies is resident in the project area. The arctic peregrine falcon (F. p. tundrius) is a rare migrant in the project area (USFWS, 1981a). This subspecies was listed as Endangered in 1970, but was reclassified to Threatened in 1984 (USFWS, 1984c). It is not listed by the State of California. No critical habitat has been designated for the species.

Peregrine falcons are found in small numbers in the project area year-round (USFWS, 1984b), particularly near the coast (USFWS, 1980b). The birds are concentrated in the area during winter (USFWS, 1984b) and during migration (USFWS, 1980b), responding to an influx of wintering prey species to coastal wetlands (USFWS, 1980b, 1984b).

There have been one or two sightings of peregrine falcons per year along the coast of Santa Barbara County (Lehman, 1982). Sighting records include several recent records from the Santa Maria River Mouth (MMS, 1984b), one individual seen at Hollister Ranch on March 2, 1975 (WESTEC, 1983), at Refugio State Beach between January 1970 and December 1978 (Collins, 1983), and at the Gaviota Oil Facility in 1982 (Collins, 1983). The Santa Cruz Predatory Bird Group has released a number of young birds at Gaviota Pass, in the Santa Monica Mountains, and on Catalina Island.

Although no active eyries are known to exist south of Morro Bay (USFWS, 1981a; Collins, 1983), USFWS (1979b) indicated that there was one active eyrie west of Santa Barbara. Sightings of peregrines at Point Conception during the breeding season strongly suggest the presence of an active eyrie there, but no adequate survey of the area has been conducted to confirm the eyrie's activity.

Peregrine falcons exhibit varying degrees of migratory behavior. Individuals in the northern part of the range are highly migratory (USFWS, 1979b, 1981a). The species is less migratory in the southern part of its range (USFWS, 1979b, 1980b, 1981a; MMS 1984a), and southern California residents are probably non-migratory.

Peregrins are opportunistic feeders (USFWS, 1981a), preying almost exclusively on birds (USFWS, 1980b), and particularly on coastal birds (USFWS, 1979b, 1981a). Prey items include small mammals (including bats), fish, rock doves, mourning doves, band-tailed pigeons, and shorebirds (USFWS, 1982). Smaller prey, particularly doves and pigeons, are preferred when feeding nestlings (USFWS, 1982). Preferred foraging habitats are found in coastal areas, and include coastal ponds, sloughs, and estuaries (MMS 1984b). Nesting habitat is composed of cliffs and steep rocky slopes (USFWS, 1979b, 1981a).

The historical range of peregrine falcons included the Channel Islands (USFWS, 1979b, 1980b, 1980b, 1981a). There were a number of historic eyries along the coast from Point Conception to the Mexican border (USFWS, 1979b, 1984a). These eyries included Jalama Beach, Point Conception, Sacata (USFWS, 1984b), Gaviota Pass (Collins, 1983; HDR, 1983). Most currently active eyries in California are in the central and northern parts of the state (MMS, 1984a).

Reintroductions of peregrine falcons into the project area has occurred at a number of sites. A release program has been underway on the Los Padres National Forest for 2 years (Freel, 1984). Four or more individuals have been released from

Gaviota Pass to reestablish the historic eyries at Gaviota Pass and San Onofre Canyon (Collins, 1983). Birds have also been released on Catalina Island.

. Reintroduction plans for the area include several areas on the channel Islands (USFWS, 1981a; MMS, 1984a), and reintroduction at San Miguel Island is planned this year or next year (Walton, personal communication). The recovery plan calls for eventual establishment of 5 pairs on the Channel Islands (USFWS, 1981a, 1984b), 8 pairs between Point Arguello and San Francisco, and 15 pairs slightly inland between Point Arguello and San Diego (USFWS, 1984b). The recovery goal for reclassification of the American peregrine falcon is to have 120 nesting pairs in the state (USFWS, 1984b).

Estimates of the number of breeding pairs of peregrine falcons in California vary. The USFWS (1984b) indicates that 64 pairs are known, and Harlow (cited in MMS, 1984b) estimates the state breeding population at 50 to 60 pairs. Other recent estimates are about 50 pairs in 1983 (MMS, 1984a), 39 known pairs in 1980 (USFWS, 1981a), less than 50 pairs (USFWS, 1980b), and 31 known pairs in 1979 (USFWS, 1981a).

The primary cause of mortality and nest failure include shooting, predation, egg collecting, disease, illegal collection by falconers, nest disturbance, powerline collisions, and habitat loss (USFWS, 1981a; MMS, 1984a).

Light-Footed Clapper Rail

The light-footed clapper rail (Rallus longirostris levipes) was listed by USFWS as an Endangered species in 1970 (USFWS, 1984c). The State of California also lists this subspecies as Endangered (Anonymous, 1984). No critical habitat has been designated (USFWS, 1984c).

Light-footed clapper rails are present year-round in several marshes in the Santa Barbara Channel area, including Goleta Slough, Carpinteria Marsh (El Estero), and Mugu Lagoon (USFWS, 1979a; MMS, 1984a). Carpinteria Marsh is the northernmost recently occupied site, and is the only marsh north of Los Angeles to Support clapper rails consistently over the last several years (USFWS, 1984b; MMS, 1984b). In 1983, Carpinteria Marsh had the third highest (USFWS, 1984b) or fifth highest (MMS, 1984b) light-footed clapper rail population in the state, comprising 7 percent of the state's population and 95 percent of the population north of Los Angeles (MMS, 1984b).

The light-footed clapper rail is normally found in estuarine habitats, particularly salt marshes (USFWS, 1981; Lewis and Garrison, 1983; MMS, 1984a). Salt marshes with vegetation dominated by cordgrass and pickleweed are preferred, and areas with well-developed tidal channels are preferred (USFWS, 1981; Lewis and Garrison, 1983). Dense cover is preferred for nesting sites and nesting density is highest in cordgrass, suggesting preference for that species (USFWS, 1979a; Lewis and Garrison, 1983). Nesting early in the season is known to occur in gum plant, before cordgass growth has begun. Later renestings, after tidal nest flooding, often is in pickleweed. Although nests are usually built above the high tide mark (Lewis and Garrison, 1983), nest flooding by high tides is known to occur (USFWS, 1979a). Nest sites are normally near the water in tidal sloughs (Lewis and Garrison, 1983).

The rails feed almost entirely on invertebrates, primarily crustacean, mollusks, and annelids (USFWS, 1979b, 1981a) taken from tidal channels, mudflats, and the marshes (Lewis and Garrison, 1983). Staple foods are striped shore crabs, purple shore crabs, fiddler crabs, beach hopper, California hornshell, the gastropod *Melampus olivaceus* (USFWS, 1979a), and bivalves (USFWS, 1979a; Lewis and Garrison, 1983).

Light-footed clapper rails are most sensitive to disturbance during the breeding season (Zembal and Massey, 1981, 1983). Most nesting occurs between early April and early May, with extremes at mid March and July (USFWS, 1979a).

Individual rails are known to move between marshes. An individual banded at Newport Bay was later found 12 miles away an Anaheim Bay (USFWS file data cited in MMS, 1984a), and maximum recorded movement is 13.5 miles (Zembal and Massey, 1983). Telemetry and banding work studying this type of work is continuing (MMS, 1984b).

The historic range of light-footed clapper rails extended from Santa Barbara County south to Bahia de San Quintin, Baja California (USFWS, 1979a, 1979b, 1981a; MMS, 1984a), Mexico, and possibly the Mexican mainland (USFWS, 1981a, 1979b; MMS, 1984a). The taxonomy of rails south of Bahia de San Quintin is unclear (USFWS, 1979a). Sporadic historical records from as far north as Morro Bay appear in the literature, but the taxonomy of these sightings is also unclear (Zembal and Massey, 1981, 1983).

Historic light-footed clapper rail habitat in California was approximately 26,000 acres in area (Speth, 1971; MMS, 1984a). Between 8 and 16 marshes were suitable habitat and occupied by rails between 1976 and 1980 (USFWS, 1979a, 1979b, 1981a; MMS, 1984b).

At least two marshes in baja California are occupied by light-footed clapper rails (USFWS, 1979a). El Estero at Ensenada and Bahia de San Quintin are known sites, and two other Baja California sites may be occupied (USFWS, 1979a, 1979b, 1981a). The Mexican range and population appear to be at or near historic levels (MMS, 1984a).

Present California range extends along 200 miles of coastline (USFWS, 1979b), but distribution is markedly interrupted due to the discontiguous habitat (USFWS, 1981a). Current California habitat for light-footed clapper rails has been estimated at 8500 acres (Speth, 1971; MMS, 1984a), and at 45 percent of the original area (USFWS, 1979b, 1981a). Several areas supporting large rail populations have been particularly reduced (USFWS, 1979a; MMS, 1984a). Only portions of the existing coastal wetlands remain suitable, of 36 extant coastal wetlands (MMS, 1984a), 18 are suitable and currently occupied by light-footed clapper rails during the breeding season (MMS, 1984b; USFWS, 1984b). Five of these were publicly owned in 1979, and supported approximately 40 percent of the population (USFWS, 1979b). Ten of the occupied marshes have estimated populations of less than 10 pairs (MMS, 1984a), and 90 percent of the population is found in 5 marshes (Zembal and Massey, 1981). Repopulation of some areas where the rails have been previously extirpated is occurring naturally (USFWS file data cited in MMS, 1984a).

The population at Carpinteria Marsh was estimated at 18 pairs (MMS, 1984b), or 36 breeding individuals (USFWS, 1984b) in 1983. Estimates for previous years range from 10 individuals in 1977 (USFWS, 1979a) to 20 pairs in 1982 (MMS, 1984b). No light-footed clapper rails have been found at Goleta Slough in 1980, 1981, and 1983 (no survey was conducted in 1982) (MMS, 1984b). One pair of rails was detected at Mugu Lagoon in 1983, but none were found in 1981 (MMS, 1984b).

Light-footed clapper rail populations are subject to periodic population crashes. This phenomenon is known to affect individual marshes, and may affect the entire range (MMS, 1984a).

The primary factor responsible for the decline of the light-footed clapper rail is habitat loss (USFWS, 1979a, 1981a). Overharvesting may have contributed to the decline before 1939 (USFWS, 1979b), particularly in Santa Barbara County (USFWS, 1979a).

California Least Tern

The California least tern (Sterna antillarum (=albifrons) browni) was listed as Endangered by USFWS in 1970 (USFWS, 1984c) and as Endangered by the State of California (Anonymous, 1984). No critical habitat has been designated (USFWS, 1984c).

California least terns breed and forage along the California coast, and are normally present from April through August (USFWS, 1980a) or September (USFWS, 1979b, 1981a). Birds have been recorded in California as early as March and as late as

November (USFWS, 1980a). A number of breeding locations exist in the Southern California Bight, and several roosting, post-breeding concentration area, and feeding areas are also found in the bight.

California least terns are migratory, with the breeding season spent between Baja California, Mexico and San Francisco Bay (USFWS, 1979b, 1981a). Migration routes and winter range are poorly understood, some records of wintering birds exist from the Pacific coast of Central America (USFWS, 1980a), and Mexico may be part of the winter range (USFWS, 1979b, 1981a).

Nesting occurs between mid-May and early August, with most nests completed by mid-June (USFWS, 1980a). Not all nesting colonies are occupied each year, and the number of nests in each colony is highly variable from year to year (USFWS, 1980a; MMS, 1984b). The fledging rate also varies from year to year at each colony (MMS, 1984b). Nesting habitat is normally close to a lagoon or estuary, or where food is available. Bare sand, dried mud, or bare earth are preferred nesting substrates (USFWS, 1979b, 1981a; MMS, 1984b).

Least terns plunge-dive for food, which is entirely small fishes. Prey species include northern anchovy, deepbody anchovy, jacksmelt, topsmelt, California grunion, shiner surfperch, California killifish, and mosquitofish (USFWS, 1979b, 1980a, 1981a). Most food is obtained from lagoons and estuaries (USFWS, 1980a), but some feeding occurs offshore. Although least terns are seldom seen more than 2 or 3 miles offshore (USFWS, 1984b), individuals have been sighted up to 15 miles from shore (Sorenson cited in MMS, 1982). The significance of offshore feeding areas is not well documented (MMS, 1984b).

The California breeding range of the least tern extends from the Mexican border to San Francisco Bay. There were 31 to 48 nesting colonies in California in 1984 (USFWS, 1984b; Gustafson cited in MMS, 1984b). Most of these colonies were south of Los Angeles, with major colonies located at Venice Beach, Huntington Beach, and the Santa Margarita River (MMS, 1984b). In 1983, 11 nesting colonies were active from San Luis Obispo County south through Los Angeles County, two colonies were inactive, and two other key habitat areas were known. These sites are listed in Table 3.6-12 along with breeding population estimates.

Venice Beach supports the largest breeding population, over 300 individuals in 1983. Nesting has occurred here since 1977 (USFWS, 1980a). Terminal Island has supported up to 170 breeding individuals. Other breeding colonies in these four counties are small, ranging from a single pair to 50 individuals. The Santa Ynez River

Table 3.6-12

KEY AREAS CALIFORNIA LEAST TERN

Location	Type of Use	Breeding Population Size and Range*	Remarks
Oso Flaco Lake and Dune Lakes	Nesting**, Foraging, Roosting***	2 (?) (1983)** 2-4 (1982)** Large non-breeding flocks***	Observed since 1975**
Santa Maria River Mouth	Nesting	14 (1983)** 50 (1977)***	
San Antonio Creek	Nesting	8 (1978)*** 36 (1983)**	Includes both north and south areas.
Purisima Point	Nesting	10 (1978)*** ~50 (1979)***	Both north and south of the point.
Santa Ynez River Mouth	Nesting Post-breeding**	6 (1971)*** 16 (1983)**	Major post-breeding area.**
Santa Clara River Mouth	Nesting	34-40 (1982)** 6 (1983)**	Nesting suspected in 1970.
Ormond Beach	Nesting	12-60 (74-79)*** 8 (1983)**	
Mugu Lagoon (Point Mugu)	Nesting Post-breeding***	44 (1983)** 10 (1977)	Major post-breeding area.**
Venice Beach	Nesting	160-190 (1979)** 300-378 (1982)***	
Playa del Rey	Nesting	0 (76, 82-83)**,*** 50 (78, 79)***	Exact size has varied.
Terminal Island	Nesting	48 (73-79?)*** 170 (73-79)*** (1983)**	
Harbor Lake	Post-breeding foraging		Major post-breeding foraging.***
San Gabriel River	Nesting	120 (71-79?)*** 0 (82, 83)**	Includes Cerritos Lagoon**
Belmont Shores	Roosting		Major spring and summer night roost.***
Costa del Sol	Nesting	36-48 (1982)** 40-50 (1983)**	No data for 1969-1979.

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*Breeding population size (estimated pairs x 2) from MMS (1984) and USFWS (1980a). Years of high and low populations are given.

**MMS (1984).

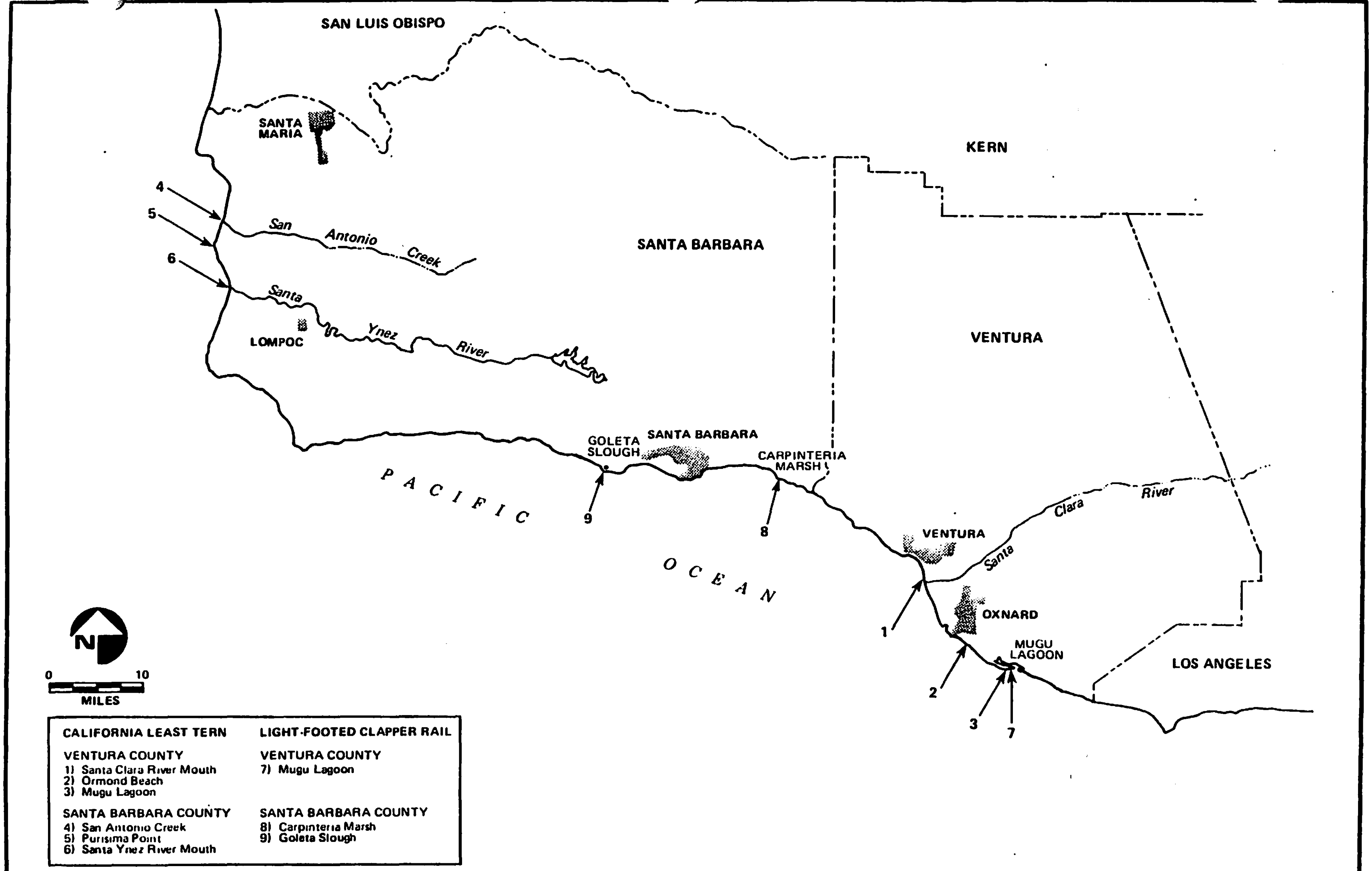
***USFWS (1980a).

mouth, which is more heavily used by non-breeding individuals, supported nesting birds in 1971 (USFWS, 1980a), 1977, and 1983 (MMS, 1984b). The 7 nests found in 1983 were the largest recorded for this site, and occurred one-half mile upstream from the river mouth (Gustafson cited in MMS, 1984b). The other breeding locations north of Point Conception supported about 44 pairs total in 1984 (USFWS, 1984b).

Foraging and non-breeding individuals range throughout the southern California coastal zone (WESTEC Services, 1984). Year-old birds are rarely in the breeding areas during the nesting season (USFWS, 1980a), and are presumably more widely distributed than the breeding adults. From 20 to 25 non-nesting birds were observed 1/2 mile downstream from the Santa Ynez River mouth nesting site during the 1983 breeding season (Gustafson cited in MMS, 1984b). Significant foraging areas are known to occur at Jalama Beach and Government Point/Cojo Bay (MMS, 1984b), 30 to 40 miles from the breeding site at the Santa Ynez River. Foraging habitat for the San Luis Obispo County and Santa Barbara County colonies is poorly understood, but preliminary studies indicate extensive offshore foraging at these areas (USFWS, 1984b).

Post breeding concentration areas are apparently used by birds from a number of surrounding breeding sites. One of the largest post-breeding concentration areas is at the Santa Ynez River mouth (Gustafson cited in MMS, 1984b). Birds from Venice Beach have been observed here, and the flocks observed to disappear from Purisima Point may have regrouped at the Santa Ynez River as well (Bevier, cited in MMS, 1984b). Mugu Lagoon is also a large post-breeding concentration area (Gustafson cited in MMS, 1984b), and Harbor Lake in Los Angeles County is also an important post-breeding foraging area (USFWS, 1980a). Figure 3.6-7 shows nesting areas in the project area.

Recovery goals for the least tern include a minimum of 20 viable colonies, with a minimum total breeding population of 1200 pairs, at 20 secure coastal wetland sites (USFWS, 1980a). Key habitats identified from San Luis Obispo County south through Los Angeles County include Osos Flaco Lake, the Santa Maria River mouth, San Antonio Creek, Purisima Point, the Santa Ynez River mouth, the Santa Clara River mouth, Ormond Beach, Mugu Lagoon, Venice Beach, Playa del Ray, Terminal Island, Harbor Lake, San Gabriel River/Alamitos Bay, and Belmont Shores. In addition, four key habitat areas are identified in Orange County, 15 key areas are identified in San Diego County, and two key areas are in Baja California, Mexico (USFWS, 1980a).



SOURCE: Chevron, 1985

Nesting Areas for the California Least Tern and the Light-Footed Clapper Rail

FIGURE 3.6-7

Current California breeding population estimates range from 1210 individuals (MMS, 1984b) to 940 breeding pairs, or 1880 individuals (USFWS, 1984b). Reproductive success varies widely from year to year and between colonies (USFWS, 1980a). In 1983, California least terns fledged 0.76 young per nest overall. The nesting colonies in San Luis Obispo through Los Angles counties produced about 0.62 fledged young per pair in 1983, ranging from zero (Oso Flaco Lake) to over 0.90 (Venice Beach and Terminal Island). In 1982, the same colonies produced an average of 0.33 fledged young per pair, ranging from zero (Oso Flaco Lake, Mugu Lagoon, and Ormond Beach) to 1.7 (Pismo Beach) (MMS, 1984b).

The primary factors responsible for the decline of the species are loss of feeding and nesting habitats and nest disturbance (USFWS, 1979b, 1980a 1981a). Sixty least tern nests were destroyed by human activity in San Diego County during the 1984 breeding season (USFWS, 1984b). Egg shell thinning has recently been detected in least terns (USFWS, 1984b).

Southern Sea Otter

The southern sea otter (Enhydra lutris nereis) was listed as a Threatened species by the U.S. Fish and Wildlife Service in 1978. No critical habitat has been designated (USFWS, 1984c). The species was listed due to concerns of oil spill impacts from tanker traffic (USFWS, 1977).

Sea otters are generally found north of Point Conception except for a few nomadic males. A few individuals inhabit the Point Conception/Point Arguello area (MMS, 1984a). These are apparently nomadic males (USFWS, 1984b), and are not considered an integral part of the population nor pioneering individuals (USFWS, 1984a). Recent sightings in this area include 11 otters between 1 mile north of Point Arguello and 2 miles south of Point Conception on May 27, 1984; 1 otter each in Cojo Bay and between Point Conception and Point Arguello on June 6, 1984; and averages of 2 to 3 otters between Point Conception and Point Arguello subsequent to June 6, 1984 (Hardy cited in MMS, 1984b). No sightings have been reported from the vicinity of Platform Gail.

The southern sea otter population is concentrated in two range "fronts" at the north and south ends of the overall range, with the largest concentrations of otters occurring in the fronts (USFWS, 1981a; MMS, 1984a). The number of otters in the fronts vary seasonally, the fronts contain the most otters in winter and early spring and the least otters in the summer and fall (USFWS, 1981b). The southern front currently extends from Shell Beach to the Santa Maria River (MMS, 1984a), or from Avila Beach to Arroyo Grande Creek (USFWS, 1983b). The otters occupying the fronts are males (USFWS, 1981a, 1981b) or males and non-breeding females (MMS, 1984a). The southernmost individuals are thought to be nomadic, subdominant males (USFWS, 1984b; MMS, 1984b). Although Southern sea otters appear to prefer rocky bottoms and kelp beds, the animals can make use of sandy bottomed areas (Woodhouse et al., 1977). They area known to raft offshore from kelp beds during storms (Woodhouse et al., 1977; USFWS, 1981a), but more commonly seek shelter from storms in coves (USFWS, 1981a; MMS, 1984a). During the winter, sea otters tend to concentrate in kelp beds that survive storms (USFWS, 1981a; MMS, 1984a).

The southern sea otter lacks an insulative blubber layer (USFWS, 1981a). Insulation is provided by air trapped in the pelage, which is groomed constantly to maintain its insulative qualities (USFWS, 1981a). The metabolic rate is high, and the animals consume food equal to 25 to 30 percent of body weight per day (Kenyon, 1969; USFWS, 1981a). Foraging occurs intermittently through the day (USFWS, 1981a).

Preferred foods of the southern sea otter include sea urchin, abalone, and rock crab (Woodhouse et al., 1977; USFWS, 1981a); Pismo clam has also been identified as a preferred food item (USFWS, 1981a). The diet shifts to smaller invertebrates after an area has been occupied for a prolonged period (USFWS, 1981a); these invertebrates include turban snail, kelp crab, mussel, and octopus (Woodhouse et al., 1977). Although these food items are most abundant in rocky bottoms (USFWS, 1981a), southern sea otters also forage in soft-bottom areas (USFWS, 1979b). Foraging is generally limited to water depths of 120 feet (USFWS, 1981a) or 120 to 180 feet (USFWS, 1979b).

The historical range of the southern sea otter extended from Morro Hermoso, Baja California, Mexico in the south, and was contiguous with the Alaskan subspecies to the north (USFWS, 1981a). Current range extends from Ano Nuevo to the Santa Maria River (USFWS, 1984a; cited in MMS, 1984b). A few individuals are found south of the range, with isolated observations as far south as Point Loma (Hardy cited in MMS, 1984b).

Information on range expansion conflicts. Recent information indicates that there is no evidence of continuing range expansion (MMS, 1984a). Other sources indicate that the rate of range expansion is declining (WESTEC Services, 1984). In 1981, continued range expansion at then current rates was expected to result in the range reaching Point Conception between 1993 and 1995 and the Channel Islands Marine Sanctuary by 1995 (USFWS, 1981a). Average range expansion rates have been estimated at 1.8 miles per year southward (USFWS, 1981a; MMS, 1984a) and 1.6 miles per year

(MMS, 1984a) or 1.06 miles per year (USFWS, 1981a) northward. The U.S. Fish and Wildlife Service (1981a) indicates that range expansion is faster over rocky bottoms and slower over sand, possibly due to food abundance, but Woodhouse et al. (1977) indicates faster range expansion (14 to 18 miles per year) occurs over sandy bottoms.

Estimates indicate that the historical southern sea otter population of the California Coast numbered about 16,000 animals (CDFG, 1976; USFWS, 1981a). Between 1940 and 1976, the population increased at an average rate of 5.4 percent per year, ranging from 4.1 percent per year to 7 percent per year (Woodhouse et al., 1977; USFWS, 1981a). The population peaked in 1976, when numbers were estimated at 1789 (MMS, 1984b) and 1856 (USFWS, 1979b) animals.

Estimates of the current population vary substantially, due primarily to differing methods of estimating the number of otters. Problems have been identified with the census method used by the California Department of Fish and Game (CDFG), which is a combination of aerial and ground censuses (USFWS, 1981b). Kenyon (1969) indicates that ground censuses underestimate by 50 percent, requiring use of correction factors. The correction factors applied to raw count data to respond to these inherent underestimates account for part of the variation in population numbers. Recent populaton estimates from USFWS are 1226 animals, including 164 pups (USFWS, 1984a; cited in MMS, 1984b) and 1304 animals in June 1984 (USFWS, 1984b). Recent estimates are 1521 animals, excluding pups (CDFG news release cited in MMS, 1984b), and 1535 animals (USFWS, 1984b).

The current dynamics of the southern sea otter population are unclear. The population no longer appears to be increasing (USFWS, 1983b). Some sources indicate that population numbers have been static since the mid 1970s (USFWS, 1981a, 1983b; USFWS, 1984a; MMS, 1984a, 1984b). Other indications are that population numbers have declined since the mid 1970s (USFWS, 1984a, cited in MMS, 1984b; MMS, 1984a; Estes and Jameson, 1983), but USFWS (1983b) indicates that evidence is inconclusive.

The southern front has been estimated to contain up to 150 to 200 animals (MMS, 1984a) or a maximum of 160 animals (USFWS, 1981b). Recent aerial counts indicate that about 60 individuals are present in the southern front (Jameson cited in MMS, 1984a). The nucleus of southern sea otters south of Morro Bay has grown from about 6 to 20 - 25 individuals in 6 years (USFWS, 1983b).

Reproduction can occur year-round (MMS, 1984a). Breeding peaks from October through December (Vandevere, 1970), and pupping peaks from December through February (Sandegren et al., 1973). Pups can be produced each year (Vandevere, 1970), but females of the northern subspecies average one pup every other year (Kenyon, 1969). The pups are dependent on the females for 6 to 8 months (Vandevere, 1979).

Several mortality factors have been identified. Shooting accounts for half of the human-caused deaths among carcasses that have been recovered and necropsied (USFWS, 1981b). Mortality due to entanglement in gill and trammel nets is estimated to have been 74 individuals in 1984 (USFWS, 1984b). Gill and trammel net mortality betwen 1973 and 1983 is estimated at 49 to 168 individuals (USFWS, 1984b). Efforts are underway to curb this mortality factor (USFWS, 1984b). The Interagency Scoping group has postulated gill and trammel net mortality as the cause of the recent population decline and cessation of range expansion. Although not identified as a direct cause of mortality, concern has been expressed over heavy metal buildup in shellfish (USFWS, 1984b), and over the elevated levels of chlorinated hydrocarbons, heavy metals, PCBs, and petroleum detected in some individuals (USFWS, 1981b).

Guadalupe Fur Seal

The National Marine Fisheries Service has recently listed the Guadalupe fur seal (Arctocephalus townsendi) as a threatened and endangered species (NMFS, 1985). No critical habitat is being proposed because areas that would qualify as critical habitat are located in Mexican territory (NMFS, 1985). The species was formerly listed as threatened under the Endangered Species Protection Act of 1966, but was apparently inadvertently deleted from the list in 1970 (Seagars, 1984; NMFS, 1985). This species is also listed as Rare by the State of California (Anonymous, 1984).

The Guadalupe fur seal is regularly found on San Miguel Island and occasionally found elsewhere in the Southern California Bight. Sightings have been made at Point Bennet on San Miguel island each year during the breeding season since 1969 (Seagars, 1984; NMFS, 1985). The number of seals seen in this area has ranged from one individual in 1970, 1979, and 1984 to a maximum of five individuals in 1978 (Seagars, 1984).

The species has been seen recently at San Nicholas, San Clemente, and Santa Barbara Islands (MMS, 1984a; Stewart et al., 1985). San Nicholas Island is apparently most frequently visited, there are nine records from this island (discounting five sightings of a juvenile in June and July 1982 which are presumed to be one individual) (Stewart et al., 1985). One individual was recorded from San Clemente Island in 1985 (MMS, 1984a; Stewart et al, 1985). Two sightings, probably of the same individual, were recorded from Santa Barbara Island in July 1982 (Stewart et al., 1985).

Like other fur seals, the Guadalupe fur seal relies on its thick fur for insulation (Seagars, 1984; NMFS, 1985; Stewart, 1985). Feeding habits and feeding range are virtually unknown (Seagars, 1984; NMFS, 1985), but this seal probably feeds on schooling fishes and deepwater cephalopods (Seagars, 1984). It appears to live pelagically at least part of the year, either in small groups or as solitary individuals (Seagars, 1984f).

The breeding season extends from May through July (Seagars, 1984). Subadult males and juveniles are apparently excluded from the rookery during this period (Seagars, 1984). Females begin to leave the rookery to forage for 2 to 6 days at a time following the birth of pups, which peaks in the third week of of June (Seagars, 1984). Adult males leave the rookery from late July to early August (Seagars, 1984).

The historical non-breeding range of the Guadalupe fur seal extended from 18°N (the Revillageigedo Islands off Mexico) to 37°N (Monterey Bay) (Seagars, 1984; NMFS, 1985). The northern limit of the species is uncertain, CCMS (1982; cited in MMS, 1984a) reports that the Farallon Islands may have been the northern limit, Stewart et al. (1985) indicates that individuals may have seasonally dispersed as far north as the Farallons, but Seagars (1984) and NMFS (1985) state that the evidence reviewed does not support his hypothesis.

The historical breeding range of the species is thought to have extended from the Channel Islands south to Guadalupe Island, the San Benitos Island, and the Cedros Islands off the coast of Baja California and may have extended as far south as Isla Soccoro in the Revillagiedos (Seagars, 1984; NMFS, 1985). San Miguel Island was probably a former breeding island (Seagars, 1984).

The current non-breeding range of the species is poorly known (Seagars, 1984; NMFS, 1985). The species has been observed with increasing frequency away from Guadalupe Island (Stewart et al., 1985). To the north, three males were seen at Point Piedras Blancas, San Luis Obispo County, in 1938; one juvenile was seen in Monterey Bay in 1977; and a female was stranded at Pillar Point, San Mateo County, in 1984 (Steward et al., 1985).

The Guadalupe fur seal has been presumed extinct twice since its original description (NMFS, 1985). The pre-exploitation population has been estimated at 20,000 to 200,000 individuals, 30,000 animals was probably the minimum number present at the time (Seagars, 1984; NMFS, 1985), although there is only one record from Santa Cruz Island dating from 1901 (Stewart, 1985). A herd of 35 to 60 seals were rediscovered in 1926, but this population was reported killed in 1928 (Seagars, 1984). The species was again presumed extinct until 1949, when one adult male was found on San Nicholas Island. A herd of 14 seals was discovered in 1954 on Guadalupe Island (Seagars, 1984; NMFS, 1985).

The current population is believed to be less than 2000 animals (Bonnell et al., 1982). A total of 1073 seals was counted on Guadalupe Island in 1977, and 1597 were counted on the island in 1984 (Seagars, 1984; NMFS, 1985). The latter count is considered the most reliable information currently available (Seagars, 1984; NMFS, 1985).

Overexploitation is the primary reason for the decline of the species and is the best supporting criterion listing of the species (Scammon, 1874; Hubbs, 1956; NMFS, 1985). Three delisting criteria are included with the listing proposal: 1) growth to a population size of 30,000 animals; 2) establishment of one or more additional rookeries within the historic range, and 3) growth to the level at which maximum net productivity of the population occurs (NMFS, 1985).

Gray Whale

The gray whale (Eschritius robustus) was listed as an Endangered species in 1970 (USFWS, 1984c). Recently, the National Marine Fisheries Service has recommended reclassification of the eastern North Pacific stock to Threatened status, and retention of the western, or Korean, stock as an Endangered species (MMFS, 1984a).

The Southern California Bight is used by both migratory and non-migratory individuals. The eastern North Pacific gray whale population migrates through or past the Southern California Bight twice each year. Some juveniles have spent extensive periods in kelp beds along the mainland coast and around the Channel Islands (NMFS, 1979), and are thought to winter in the bight (Wellington and Anderson 1978, cited in MMS, 1984a). These whales have been observed feeding on mysid shrimp in the kelp beds (MMS, 1984a). Some stragglers may remain between Point Conception and Oregon during the summer (NMFS, 1980).

One pod of three gray whales was observed northeast of the proposed platform location by McClelland Engineers (McClelland Engineers, 1984; cited in WESTEC Services, 1984). A total of 336 gray whales were sighted in the Southern California Bight between Point Conception and the Mexican border in a BLM-sponsored marine mammal survey (Norris et al., 1975).

Gray whales migrate between high-latitude summer ranges and low latitude winter ranges each year. Two routes are used through the Southern California Bight area, one inshore and one offshore (NMFS, 1984a). Most of the population uses the offshore route during the southbound migration (NMFS, 1984a), Rice and Wolman (1971) indicate that this route is used by 59 percent of the population. Migrating gray whales commonly cut across bights and other coastal identations (Rice and Wolman, 1971), but the proportion of the population using the offshore route has increased since the early 1960s (NMFS, 1979). The reasons for this behavioral shift are unclear. The inshore route was used by 90 to 95 percent of the southbound migrants before the mid 1960s (NMFS, 1979). The northbound migration is entirely coastal (NMFS, 1984a), with the possible exception of females with calves.

The southbound migration begins between October and November, and passes through Unimak Pass, Alaska from November through December (NMFS, 1984a). A number of dates are given for migration off California; late September through December with a peak in January (NMFS, 1980), and beginning in November with a peak in January (MMS, 1984a). The migration is segregated by sex and age class: pregnant females are first, followed by females that have recently ovulated, adult males, immature females (NMFS, 1984a) or adult males and immature females together, with immature males last (Rice and Wolman, 1971; NMFS 1984b).

Several dates have been given for northbound migration periods: February to June (NMFS, 1979), February to May (NMFDS, 1980; MMS, 1984a), and beginning in mid February with arrival in the Bering Sea beginning in April (NMFS, 1984a). The peak of the northbound migration is also segregated by sex and age classes: pregnant females are first, followed by anestrous females, adult males or adult males and anestrous females, immatures of both sexes, and females with calves last (NMFS, 1984a; Rice and Wolman, 1971). The routes taken by females with calves through the Southern California Bight is unknown, but is thought to be offshore (Rice and Wolman, 1971). In the early 1800s the route used by females with calves was inshore. However, Rice and Wolman (1971) made only one sighting of two females with two calves near San Clemente Island. North of the Southern California Bight at Point Piedras Blancas, NMFS (1984a) found that females with calves migrated very close inshore, in contrast to whales without young which migrated farther from shore.

The migration routes between summer and winter ranges are generally narrow (NMFS, 1979). The route passes within a few kilometers of shore at Yankee Point in Monterey County (Rice and Wolman, 1971), and at Point Pidras Blancas (Poole, 1984). In the Southern California Bight the route is much wider because of the inshore and offshore routes, Rice and Wolman (1971) indicate that it is at least 194.5 km wide off Point Loma in San Diego County. The offshore route, used only during southbound migration (NMFS, 1984a) and possibly by northbound females with calves, is seaward of the Channel Islands and as far as 200 km from the mainland (Rice and Wolman, 1971). The inshore route is relatively narrow, usually within a few kilometers of shore (NMFS, 1980), and passes through the Santa Barbara Channel.

The diet of gray whales consists primarily of benthic amphipods (Rice and Wolman, 1971; NMFS, 1984a). Other benthic species are taken incidentally (NMFS, 1984a). Feeding during migration is rare. In 180 stomach samples from southbound migrants, Rice and Wolman (1971), found no stomachs with food. Only minimal amounts of food were found in a few stomach samples from northbound gray whales (Rice and Wolman, 1971). Few observations of gray whales feeding in the Southern California Bight have been reported but include feeding on bait fish off Point Mugu and on *Acanthomysis* in kelp off Santa Barbara Island, and individuals have been seen mouthing kelp, possibly feeding, off San Miguel Island (Nerini, 1984).

The summer range of the eastern North Pacific gray whale stock is described by Rice and Wolman (1971) as the northern and western Bering Sea, the Chukchi Sea, and the western Beaufort Sea; and NMFS (1984a) describes it as the northern Bering Sea and the southern Chukchi Sea. There are also isolated summering locations ranging from Vancouver Island to Baja California (NMFS, 1984a), which may be associated with river mouths. Some individuals summer off the California coast.

The winter range of the eastern North Pacific stock ranges from Baja California and the southern Gulf of California south to Jalisco, Mexico (Rice and Wolman, 1970). Most of the wintering whales are in Bahia Sebastian Viscaino and Bahia de Ballenas off Baja California, and the calving whales are found in a number of coastal lagoons in Mexico (NMFS, 1984a). The western North Pacific stock summers in the Okhotsk Sea, and winters in coastal South Korea (Rice and Wolman, 1971; NMFS, 1984a).

The eastern North Pacific stock has been estimated to number 15,000 to 17,000 individuals (MMS, 1984a), and 15,000 individuals (NMFS, 1979, 1980). In the gray whale status report, NMFS (1984a) estimates the population at 15,647 with 95 percent confidence between 13,450 and 19,201.

The historical pre-whaling population of gray whales was probably about 12,000 individuals, reduced from an estimated carrying capacity of 24,000 by aboriginal whaling (NMFS, 1984a). The population was probably reduced to a low of a little more than 2000 individuals by whaling in the late 1800s (NMFS, 1984a).

The western North Pacific population has probably been reduced to below the minimum viable population, rendering it functionally extinct (NMFS, 1984a).

Right Whale

The right whale (Balaena (Eubalena) glacialis) is listed as Endangered by the U.S. Fish and Wildlife Service. This whale was listed in 1970, and no critical habitat has been designated (USFWS, 1984c).

Right whales are occasionally present in the Southern California Bight (NMFS, 1980). The bight may be on a migratory route, but migration routes of this species in the eastern North Pacific are poorly known (NMFS, 1980). There are only about 45 sightings of right wales recorded from the eastern North Pacific Ocean south of 50°N latitude (NMFS, 1984b). A right whale was observed in the Santa Barbara Channel in 1981 (Santa Barbara News Press May 5, 1981, cited in MMS, 1984a). Accounts differ regarding previous sightings: the source above indicates that this sighting was the first in the area since 1956, and NMFS (1979) states that no right whales had been seen for the previous 20 years, but Miller (1975) indicates that there have been occasional sightings in recent years near the Channel Islands. No sightings of right whales were recorded during the recent BLM marine mammal survey (MMS, 1984a).

Right whales are migratory, similar to most other large baleen whales (NMFS, 1979, 1980, 1984b). The species is seasonally coastal, particularly during the calving season. Right whales feed primarily on copepods, and to a lesser degree on Krill and "lobster-krill" (NMFS, 1984b).

The worldwide range of the right whale includes a minimum of three reproductively isolated populations. The North Pacific population may consist of only a single stock (NMFS, 1980), or may be two stocks. The International Whaling Commission has tentatively divided the North Pacific population into eastern and western stocks (NMFS, 1984b). The North Atlantic population consists of two stocks, and the southern hemisphere population includes at least five stocks (NMFS, 1984b).

The feeding, or summer range of the species, occupied from spring to autumn, is at higher latitudes, usually above 40° latitude. This range is normally well out to sea, particularly in the North Pacific and North Atlantic Oceans (NMFS, 1984b).

The breeding and calving, or winter, range of the right whale is occupied from late autumn to early spring. It is usually above 25° latitude, and the southernmost record of right whales in the eastern North Pacific is at 26°39'N latitude off Baja California, Mexico. Winter range for the eastern North Pacific population in unknown. Two situations are considered possible: the population may winter in pelagic waters of the eastern and central North Pacific, or these whales may be migrants from the western North Pacific. No evidence to date indicates that right whales calved or occupied coastal waters of the eastern North Pacific (NMFS, 1984b).

The right whale is the most depleted of the great whale species (NMFS, 1979, 1980, 1984b). The historical population is thought to have been between 100,000 and 300,000, two-thirds were in the southern hemisphere and one-third was in the North Atlantic and North Pacific Oceans. The current North Pacific population has been estimated at 100 to 200 individuals (NMFS, 1980, 1984b; MMS, 1984b) and 220 individuals (NMFS, 1979). A few hundred individuals are estimated to be in the North Atlantic, and 3000 to 4000 individuals are estimated to occur in the southern hemisphere (NMFS, 1984b).

The right whale has not recovered from exploitation in most areas, the only stocks showing evidence of recovery are in the southern hemisphere. Coastal and offshore development, particularly in the northwestern Atlantic Ocean, are the chief concerns regarding future recovery (NMFS, 1984b).

Other Cetaceans

Five additional endangered cetaceans are known from the Southern California Bight. The blue Whale (Balaenoptera musculus), finback (fin) whale (Balaenoptera physalis), sei shale (Balaenoptera borealis), humpback whale (Megaptera novaeangeliae), sperm whale (Physeter catadon (macrocephalis)) were all listed as Endangered by USFWS in 1970 (USFWS, 1984c). No critical habitat has been designated for these species.

These whales use the Southern California Bight primarily as a migration route (NMFS, 1979, 1980). The migratory paths and timing of migration vary by species (MMS, 1984a). Migration periods and corridors for these whales are shown in Table 3.6-13.

Several of the whales are found in the area beyond the migration period. The finback whale is present west of the Channel Islands all year (NMFS, 1979), and is the most abundant of the baleen whales off the California coast in spring and summer (NMFS, 1979, 1980). Summer range of the sei whale includes the central California coast (NMFS, 1980). This whale is present west of the Channel Islands in late summer and early fall, and may feed within the Southern California Bight during this period (NMFS, 1979). Part of the North Pacific humpback whale population migrates along the coast from alaska to Baja California, Mexico (NMFS, 1979), but humpback whales are found in all parts of their range during the summer (NMFS, 1979, 1980). The summer

Table 3.6-13

OTHER ENDANGERED CETACEANS

Species	Historical North Pacific Population	Current North Pacific Population	Season When Present In Southern California Bight	Primary Migration Areas
Blue Whale	4,900 individuals (NMFS, 1984c)	1,600 individuals (NMFS, 1984c) 1,700 individuals (NMFS, 1979, 1980)	Southward migration September to February (MMS, 1984a) Northward migration May to June/July (MMS, 1984a; NMFS, 1979)	>15 nautical miles from the mainland (MMS, 1984a), and generally north of Santa Rosa Island along Santa Rose - Cortez Ridge to Tanner and Cortez Banks (NMFS, 1979)
Finback Whale	42,000 to 45,000 individuals (NMFS, 1984d)	14,620 to 18,630 (NMFS, 1984d) 17,000 (NMFS, 1979, 1980)	Spring and summer, peaks May to June (NMFS, 1979, 1980), also August to November (MMS, 1984a)	Poorly defined (MMS, 1984a), but known to be offshore (NMFS, 1984d)
Sei Whale	45,000 individuals (NMFS, 1984e)	22,000 to 37,000 in 1967 (NMFS, 1984e) 9,000 individuals (NMFS, 1979, 1980)	Late summer, early fall (NMFS, 1979)	Little known (NMFS, 1979), but known to be offshore (NMFS, 1984e) over the continental slope (MMS, 1984a)
Humpback Whale	15,000 individuals (NMFS, 1984f)	1,200 individuals (NMFS, 1984f; Rice and Wolman, 1982, cited in MMS, 1984a) 850 individuals (NMFS, 1979, 1980)	All seasons, summer and winter ranges overlap in bight (NMFS, 1979, 1980), peaks in summer and fall (CCMS, 1981, 1982, cited in MMS, 1984a)	Has been observed over Santa Rosa ridge (NMFS, 1979)
Sperm Whale	No data	300,000 individuals (NMFS, 1979, 1980)	April to mid June and late August to mid November (NMFS, 1979)	Poorly known broad migration path (NMFS, 1979), normally pelagic and found in water >6,000 feet deep (MMS, 1984)

and winter range of this species overlaps in the Southern California Bight (NMFS, 1979, 1980), with peak numbers present in summer and fall (CCMS 1981, 1982; cited in MMS, 1984a).

Information on survey sightings of these species in the general project vicinity is summarized in Table 3.6-14, showing the numbers of these whales seen in the area. In addition to sightings from surveys, blue whales have been seen off San Clemente and San Nicholas islands (Miller, 1975). Humpback whales have been observed feeding on northern anchovies over the Santa Rosa Ridge (NMFS, 1979). Sperm whales are frequently seen offshore from the Channel Islands (NMFS, 1979), and have been observed every month of the year except July (CCMS, 1980, 1981, 1982; cited in MMS, 1984a).

All of these species are generally migratory (NMFS, 1979, 1980), moving from summer feeding grounds in higher latitudes to winter breeding and calving grounds in lower latitudes (MMS, 1984a). Migration in the finback and sei whales is segregated by age and sex class (NMFS, 1984d, 1984e).

Most of the rorquals fast during migration and during the winter (NMFS, 1984f). Diet consists of invertebrates and small fishes. Blue whales are nearly monophagous, feeding primarily on krill (NMFS, 1984e). Finback whales also feed on krill, but also feed on small fishes (NMFS, 1984d). Sei whales prefer copepods; krill and small fishes are secondary in their diet (NMFS, 1984e).

The blue whale is found in the North Atlantic Ocean, northern Indian Ocean, and in the southern hemisphere as well as the North Pacific Ocean (NMFS, 1984e). The number of stocks in the North Pacific is uncertain (NMFS, 1984c), but both eastern and western populations are known to occur (NMFS, 1980). Isolated stocks may occur in the Gulf of California, British Columbia, and the east China Sea (NMFS, 1984e). The individuals wintering off the southern California coast summer from central California to the Gulf of Alaska, but the summer range of the population as a whole is poorly known, individuals are seen across the North Pacific in summary (NMFS, 1984e). The winter range of the North Pacific population is unknown, although there have been numerous sightings off Baja California, Mexico recently (NMFS, 1984e).

The finback whale is found in the North Atlantic Ocean, southern hemisphere, and North Pacific Ocean (NMFS, 1984d). One North Pacific stock is recognized by the International Whaling Commission, although biologically there may be three or four (NMFS, 1984d). Both eastern and western North Pacific populations occur (NMFS,

Table 3.6-14

CETACEAN SIGHTINGS FROM SURVEYS

Species	Reported Sightings
Blue Whale	7 individuals seen in Southern California Bight (Norris et al., 1975, cited in WESTEC Services, 1984)
Finback Whale	23 individuals estimated in Southern California Bight (Norris et al., 1975 cited in WESTEC Services, in 1984) None seen in Santa Maria Basin survey, attributed to pelagic nature of species (CCMS, 1980, cited in MMS, 1984a)
Sei Whale	Two groups totalling 5 individuals seen west of Tanner-Cortez banks in September 1975 (CCMS, 1980, cited in MMS, 1984a) None seen in Southern California Bight (Norris et al, 1975, cited in WESTEC Services, 1984) Some in Santa Maria Basin in 1981 (CCMS, 1981, cited in MMS, 1984a)
Humpwhale Whale	6 individuals estimated in Southern California Bight (Norris et al., 1985, cited in WESTEC Services, 1984)
Sperm Whale	None seen in Southern California Bight (Norris et al, 1985, cited in WESTEC Services, 1984)

1980). In the eastern north Pacific, the summer range extends from off central California to the Gulf of Alaska (NMFS, 1984d). Winter range of all stocks in unknown (NMFS, 1984d).

The sei whale is found in most oceans (NMFS, 1984e). In the North Pacific Ocean there are biologically three or more stocks (NMFS, 1984e), both western and eastern (NMFS, 1980), although only one stock is recognized by the International Whaling Commission (NMFS, 1984d). The summer range of the North Pacific population extends from 35°N to 40°N, with a few individuals reaching 50°N (NMFS, 1984e). Winter range is unknwon (NMFS, 1984e).

Humpback whales are found in all oceans between the Arctic and Antarctic (NMFS, 1984f). The three stocks in the North Pacific are the Mexican, Hawaiian, and Asian groups (NMFS, 1984f), forming both eastern and western populations (NMFS, 1980. The whales range across much of the North Pacific in summer, in the eastern North Pacific summer range they extend south to about Point Conception (NMFS, 1984f). Winter range of the Mexican stock extends south of Isla Cedros off the Baja California coast, into the Gulf of California, and as far south as Jalisco and the Islas Revillagigedo (NMFS, 1984f). The Hawaiian stock winters near the main Hawaiian Islands (NMFS, 1984f).

Both eastern and western populations of sperm whales exist in the North Pacific Ocean (NMFS, 1980). Current and historical North Pacific populations of the baleen whales are shown in Table 3.6-13. Blue whales and humpback whales are the least numerous, and finback and sei whales are more numerous by an order of magnitude. Each of these species is most numerous in the southern hemisphere, and apparently least numerous in the North Atlantic Ocean (NMFS, 1984c, 1984d, 1984e). The humpback whale is considered to be among the most depleted of the whales (NMFS, 1979). In contrast, the sperm whale is the most abundant and widespread (NMFS, 1980). Overharvest is the primary cause of decline and reason for listing of the larger baleen whales (NMFS, 1984c, 1984d, 1984e).

Salt Marsh Bird's Beak

The salt marsh bird's beak (Cordylanthus maritimus spp. maritimus), an annual herb 15 to 30 cm tall with cream to purple flowers, was listed as Endangered by USFWS in 1978 (USFWS, 1984c). No critical habitat has been designated. The species is also listed as Endangered by the State of California.

The habitat of the salt marsh bird's beak has been described as high marsh (USFWS, 1979b, 1981a; MMS, 1984a). The Draft Recovery Plan (USFWS, 1984d) provides additional detail: the species is most commonly found in salt marsh above mean lower high water and below extreme high water. It is also known from low areas behind dunes, shell mounds, and depressions flooded by freshwater.

Other plants associated with salt marsh bird's beak are pickleweed, salt grass, fleshy jaumea, alkali heath, sea lavender, and alkali weed (USFWS, 1979b, 1981a, 1984d). Salt marsh bird's beak is hemi-parasitic, forming root connections with other species, including salt grass, beard grass, pickleweed, fleshy jaumea, common sunflower, alkali bulrush, and cattail (USFWS, 1984d).

The historical range of salt marsh bird's beak extended from Carpinteria Marsh in Santa Barbara County south into northern Baja California (USFWS, 1979b, 1981a, 1984d). Herbarium records indicate that it was found in at least 10 marshes in California (USFWS, 1984d; MMS, 1984b), and in as many as 5 marshes in Baja California (MMS, 1984b). Three of these historical sites were in Santa Barbara and Ventura counties (USFWS, 1984d; MMS, 1984b), with the largest and most vigorous historical population at Mugu Lagoon (MMS, 1984b).

The current distribution of salt marsh bird's beak includes six historical sites, one "new" location, and one reintroduction site (USFWS, 1984d; MMS, 1984b). These sites are Carpinteria Marsh, Ormond Beach, the Ventura County Game reserve (a "new" site, without previous herbarium records), Mugu Lagoon, Anaheim Bay (reintroduction), Upper Newport Bay, Sweetwater Marsh, and the Tijuana River estuary (USFWS, 1984d).

The Carpinteria Marsh is the most northerly known existing location of salt marsh bird's beak (USFWS, 1984d; MMS, 1984b) and 1983 (USFWS, 1984d). It was also observed at Ormond Beach in 1980, 1982 (USFWS, 1984d; MMS, 1984b) and 1983 (USFWS, 1984d). According to MMS (1984b), salt marsh bird's beak was first found at the Ventura County Game Preserve in 1981, but USFWS (1984d) indicates that it was found there in 1980. The Mugu Lagoon population is currently the largest and most vigorous in the general project area (MMS, 1984b). This population is experiencing wide variations in numbers, due primarily to changes in tidal inundations and freshwater availability (USFWS, 1984d; MMS, 1984b).

A number of tentative sites for this plant occur in Santa Barbara and Ventura counties. Most of these sites are not likely to support the species because the marshes are highly disturbed (MMS, 1984b), however, most of these sites have not been surveyed recently (USFWS, 1984d). Goleta Slough contains favorable habitat, and has been identified as a suitable reintroduction site (MMS, 1984b; USFWS, 1984d). There are no historical records of the species from Goleta Slough, and the slough has not been surveyed recently (USFWS, 1984d). The mouth of the Santa Clara River supported salt marsh bird's beak in 1960 (MMS, 1984b; USFWS, 1984d), but a survey conducted in either 1981 or 1982 produced negative results (USFWS, 1984d). Additional potential sites in Ventura county include McGrath State Beach and the Ventura River Mouth; however, there are no historical records from these sites and neither has been surveyed recently (USFWS, 1984d).

Population data are not available for most of the salt marsh bird's beak sites. The major factor responsible for the decline of the species is the destruction of coastal salt marshes (USFWS, 1979b, 1981a; MMS, 1984a).

3.7 SOCIOECONOMICS

The socioeconomic region of influence for the proposed project activities focuses on Ventura and Santa Barbara Counties, with emphasis placed on Ventura County where the direct effects of the project are likely to be more significant. The labor work force and majority of the transportation of supplies and workers will be from Ventura County using Port Hueneme and the Ventura County Airport at Oxnard.

The socioeconomic structure of both counties has been discussed in the Final EIS's for OCS Lease Sales Nos. 48 and 68, 73 and 80, the program for Leasing, Exploration and Development of Oil and Gas Resources on State Tide and Submerged Lands, Point Conception to Point Arguello, Santa Barbara County and recent Environmental Reports, for OCS development. Personnel requirements and onshore support facilities for the proposed project have been described in Section 2.6.2 of the report. The discussion below focuses on the existing and projected socioeconomic conditions for Ventura County followed by Santa Barbara County.

3.7.1 Related Employment and Area Unemployment

The following paragraphs present a description of the existing and projected employment and unemployment conditions for Ventura and Santa Barbara counties.

3.7.1.1 Ventura County

The total civilian labor force for Ventura County averaged 269,300 persons in 1983. Total employed population was approximately 244,900, resulting in an unemployment rate of about 10 percent in 1983 (24,400 persons). This represents an increase over the previous year's unemployment rate, which was 8.0 percent 19,600 persons) (CEDD, 1982). Ventura County unemployment rates from 1974-1983 indicate that the unemployed labor force has been increasing in size since 1980. Unemployment for 1983 (24,400, 10 percent) in the county is slightly lower than for the State (11.0 percent; 1,346,000 persons) and the nationwide unemployment rate of about 10.4 percent. The 1982 labor force breakdown for Ventura County appears in Table 3.7-1. The discrepancy between employed labor force (233,700) and employment (176,700) is at least partially explained by the large number of county residents commuting to Los Angeles and Santa Barbara Counties to work. An exact count of persons involved in intercounty commuting is not available.

Table 3.7-2 shows the employment history (by sector) of Ventura County from 1972 to 1982. During this period, employment in the county grew by 5.6 percent, while population rose about 30 percent. Employment categories which grew faster than the total county rate were: manufacturing (80.0 percent, from 14,400 to 25,900); trade (167.0 percent, from 23,900 to 39,900); finance, insurance, and real estate (142.0 percent, from 3500 to 8500); services 96.4 percent from 16,600 to 32,600); mining (76.4 percent, from 1700 to 3000); and transportation, communication and public utilities (61.4 percent, from 4400 to 7100) (CEDD, 1982).

Employment in the mining industry of Ventura County is associated almost exclusively with petroleum-related activities, which generated nearly 2 percent (3000 jobs) of the County's total employment in 1982. Employment in mining grew steadily from 1972 to 1981 and slightly in 1982.

Construction employment in the county reflects cyclical conditions prevalent in this industry. Table 3.7-2 shows the "dip" which occurred in the 1974-1976 period as a result of the recession. Construction employment recovered somewhat since that time but recently has significantly decreased. Construction employment is expected to increase in 1983 to equal the 1981 level of 7300 (CEDD, 1982b).

The economy of the Oxnard Plain area is based primarily on government, services, trade, diversified manufacturing, and agriculture. Although the economy is still oriented toward agribusiness, during the past decade this area has experienced significant growth of non-agricultural industries. This has created a trend toward a more diversified economy. Consequently, the labor force is changing rapidly in orientation from agricultural to commercial and industrial.

Retail Trade

The trade industry is the third largest source of employment in Ventura County, accounting for 18.6 percent of the total county employment in 1983. This sector has increased steadily from 1972 to 1983 with most of the recent increases

Table 3.7-1

SANTA BARBARA AND VENTURA COUNTY LABOR FORCE - 1982

Labor Force Characteristic	Santa Barbara County[a]	Ventura County[b]
Labor Force by County of Residence		
Employed	147,200	223,700
Unemployed	12,600	29,100
TOTAL	159,800	262,800
Labor Force by Employment Sector		
Mining (including petroleum production)	1,500	3,000
Construction	4,500	6,400
Manufacturing	18,300	25,900
Transportation, Communication and Public Works	5,400	7,100
Wholesale Trade	4,300	7,600
Retail Trade	25,200	32,200
Finance, Insurance and Real Estate	6,000	8,500
Services	34,800	32,600
Government	24,100	37,700
Federal	3,900	9,900
State and Local	20,200	27,800
Agriculture	8,100	15,600
TOTAL	132,200	176,700

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[a] Santa Barbara County figures are from CEDD (1982a).

[b] Ventura County Figures are from CEDD (1982b)

Table 3.7-2

VENTURA COUNTY EMPLOYMENT[a] BY EMPLOYMENT SECTOR

Employment	Employment in Thousands of Persons by Year											Percent Change
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1972-82
Mining	1.7	1.7	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.9	3.0	76.4
Construction	4.9	5.0	4.3	4.1	4.8	6.1	7.3	8.7	7.8	7.3	6.4	30.6
Manufacturing	14.4	16.2	17.2	17.0	18.0	19.6	21.4	23.3	24.2	25.4	25.9	80.0
Transportation, Communication & Public Utilities	4.4	4.5	4.4	4.3	4.6	5.2	5.8	6.2	6.6	6.9	7.1	61.4
Wholesale and Retail Trade	23.9	24.7	25.6	26.9	27.6	29.9	32.9	34.5	36.3	38.1	39.9	67.0
Finance, Insurance and Real Estate	3.5	3.7	4.0	4.0	4.5	5.4	6.1	7.0	7.5	8.3	8.5	142.0
Services	16.6	18.2	18.9	19.8	20.5	22.9	26.1	28.8	30.9	32.0	32.6	96.4
Government	31.0	31.9	26.4	35.9	35.7	37.2	36.7	36.2	37.5	37.9	37.7	22.0
Federal	10.5	10.4	2.9	10.6	10.0	10.1	9.9	9.9	10.0	9.9	9.9	-5.7
State and Local	20.5	21.5	23.5	25.3	25.7	27.1	26.8	26.3	27.5	28.0	27.8	35.6
Agriculture, Forestry and Fisheries	12.3	12.6	13.5	13.7	13.9	14.7	15.2	14.6	15.2	15.9	15.6	26.8
TOTAL	112.8	118.0	124.0	127.7	131.7	143.0	154.1	161.9	169.6	174.7	176.7	56.6

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[a] 1972-1982 data from CEDD (1982d); 1982 data from CEDD (1982b).

occurring in restaurants and food stores (CEDD, 1982d). Taxable retail sales have shown a consistent, steady increase in the county, although much of the increase from 1970 to 1980 can be attributed to inflation.

Government

The government sector is the largest source of employment in Ventura County, accounting for 20.7 percent of the total county employment in 1983. Employment in this sector fluctuated considerably between 1972 and 1982; overall employment grew by 22.0 percent (6700 persons) during this period. Between 1980 and 1982, state and local employment was responsible for growth in the government sector, increasing by 1.1 percent (300 persons). Most of this growth occurred in education, due to increasing enrollment in Ventura County schools. The federal government accounts for roughly one-quarter of total government employment (CEDD, 1981).

Much of the growth in Oxnard Plain area came after the outbreak of World War II with the establishment of military bases in the area. These include the Naval Construction Battalion Center ("Seabee" Base) in Port Hueneme, the Naval Air Station and Pacific Missile Test Center at Point Mugu, and Oxnard AFB. Although the latter is not active, the two Navy facilities remain important contributors to the economic base of the region.

Services

The services sector accounted for 18.9 percent of the county employment in 1983, to rank as the second largest source of employment in the county. Between 1972 and 1982, employment increased by 16,000 jobs (96.4 percent) over the 1972 level of 16,600. From 1980 to 1982, employment in the Services sector increased by 1700 jobs (5.5 percent). Of these 1700 new jobs, the largest increases were in business services (a diverse sector that includes such services as building maintenance, personnel, and research and development), health services, and motion picture theaters (CEDD, 1981).

Manufacturing

The manufacturing sector, as the fourth largest source of employment in the county, had 14.6 percent of the county employment (25,900 employees) in 1983. Over two-thirds of the county's factory workers are employed in the durable goods sector, and almost one-third in non-durable goods. Employment in the durable goods sector has been increasing at a much faster rate than non-durable goods, primarily due to the rapid growth in both electronic equipment and supplies and non-electrical machinery. Other leading classes of manufactured products in the county are aircraft and parts, plastics, chemicals, and paper products (CEDD, 1981).

Agriculture

Although employment in agriculture has declined slightly since 1981 (from 15,900 to 15,600), this sector still ranks fifth in terms of number of persons employed in the major industry groups in Ventura County. As is the case in Santa Barbara County, monthly employment fluctuates seasonally throughout the year and in 1982 changed by nearly 7000 from the low in January (12,000) to the peak in June (19,100).

In 1981, agriculture contributed approximately $500 million to the economy of Ventura County, an increase of almost $16.0 million (3.3 percent) over 1979. Agriculture is the county's leading source of income. Of the total increase of $16.6 million, $16.2 million was derived from increases in income from fruit and nut crops, primarily strawberries and Valencia oranges. Another $3.7 million increase was derived from ornamentals, where unit price increases of nearly 48 percent offset a production decrease of 2.8 percent.

3.7.1.2 Santa Barbara County

The Santa Barbara county civilian labor force averaged 167,625 persons in 1983, compared to 154,350 in 1981 (Economic Outlook, May 1984). The mining industry sector, under which oil and gas extraction is a subcategory, accounted for the employment of 1500-1600 workers. Although the oil and gas related employment is not broken down from the overall employment figures, available information indicates that 80 percent of the mining activity is associated with oil and gas extraction (Texaco, 1983). Workers in other trades, such as construction, manufacturing and services may also be providing a support function for oil and gas development in the channel.

The retail and services employment sectors in Santa Barbara County accounted for approximately 67,000 jobs or 44 percent of the total labor force in 1983 (California Employment Development Department, 1981). A substantial portion of the services category is associated with the tourism industry in the City of Santa Barbara and elsewhere along the South Coast area. In the North Coast area, agriculture dominates the local economy and employment structure.

Total unemployment for 1983 averaged 7.4 percent (12,500 persons) as compared to the statewide rate of 11.0 percent. This rate of unemployment represents an increase over the previous year's rate, which was 6.1 percent (9300 persons). The unemployment rates from 1972 to 1983 shows that the county's unemployment labor force has been increasing in size since 1980. The labor force breakdown for 1982 for the county is shown in Table 3.7-1. Again as with Ventura County, the wide variance between employed civilian labor force (147,200 persons) and employment (132,200 persons) within the county in 1982 can be partly explained by the larger number of county residents commuting to Los Angeles, Ventura, and San Luis Obispo counties to work.

Table 3.7-3 shows the employment history (by sector) of Santa Barbara County from 1972 through 1982. During this period, employment in the county grew by about 47 percent, while population increased by approximately 10 percent. Employment categories which grew faster than the county average during this period were: mining (87.5 percent, from 800 to 1500 persons); manufacturing (72.6 percent, from 10,600 to 18,300 persons); transportation, communication, and public utilities (58.8 percent, from 3600 to 5400 persons); trade (49.0 percent, from 19,800 to 29,500 persons); finance, insurance, and real estate (66.7 percent, from 3600 to 6000 persons); services (64.9 percent, from 21,100 to 24,100 persons).

The mining industry of Santa Barbara County is associated almost exclusively with the exploration and production of crude oil and natural gas. Employment remained virtually unchanged in the early 1970s, but increased an average of 13.8 percent annually from 1976 to 1980. Employment is projected (CEDD) to grow at an average annual growth rate of 1.8 percent from 1980 to 1985 (1982e).

Construction employment in the county reflects cyclical conditions prevalent in this industry. Table 3.7-3 shows the "dip" which occurred in the 1974-1976 period as a result of this the recession. Significant recovery has occurred since that time until very recently (1981) when construction again declined. Construction employment will recover to an average of 6500 in 1985 (CEDD, 1982).

The five sectors responsible for the greatest amount of employment and personal income in Santa Barbara County are services, retail trade, government, manufacturing, and agriculture. In 1982, four of these sectors held a greater share of total employment than they had in 1972. Government was the exception; employment in this sector declined from 24.4 percent (21,900) of total employment (89,700) in 1972 to 18.2 percent (24,100) of total employment (132,200) in 1982. Much of this decline occurred in state and local government employment, which peaked in 1976 at 22,000 employees, and declined to 20,000 in 1982 (refer to Table 3.7-3). A further decline to 17.5 percent of total employment occurred in 1983.

Retail Trade

The retail trade industry is the second largest source of employment in the county, with an average of about 25,200 employees in 1982. Employment in this sector has increased only slightly since 1979. Food stores were the only sector to show

Table 3.7-3

SANTA BARBARA COUNTY EMPLOYMENT[a] BY EMPLOYMENT SECTOR

Employment	Employment in Thousands of Persons by Year											Percent Change 1972-82
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	
Mining	0.8	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.5	1.6	1.5	87.5
Construction	3.9	4.0	3.6	3.2	3.5	4.0	4.3	4.4	4.2	4.9	4.5	36.4
Manufacturing	10.6	12.0	13.4	12.9	13.8	13.7	14.9	16.8	16.8	17.8	18.3	72.6
Transportation, Communication & Public Utilities	3.4	3.3	3.4	3.4	3.4	4.0	4.3	4.6	5.1	5.3	5.4	58.8
Wholesale and Retail Trade	19.8	21.1	21.6	22.5	24.4	26.4	28.3	29.1	29.1	29.3	29.5	49.0
Finance, Insurance and Real Estate	3.6	4.1	4.3	4.4	4.5	4.6	5.1	5.4	5.7	5.9	6.0	66.7
Services	21.1	22.6	23.5	23.4	24.2	26.5	29.6	31.8	32.9	33.9	34.8	64.9
Government	21.9	22.9	24.0	25.2	25.8	24.8	25.0	24.3	24.5	24.9	24.1	10.0
Federal	3.9	3.9	3.8	3.8	3.8	3.7	3.7	3.9	3.9	3.9	3.9	0.0
State and Local	18.0	19.0	20.2	21.4	22.0	21.1	21.3	20.4	20.6	21.0	20.2	12.2
Agriculture, Forestry and Fisheries	5.2	5.6	6.1	6.4	6.5	6.7	6.9	7.1	7.1	7.9	8.1	55.8
TOTAL	89.7	95.8	100.4	102.1	106.9	112.8	120.0	125.9	129.2	131.5	132.2	47.3

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[a] 1972-1981 data from CEDD (1982c); 1982 data from CEDD (1982a).

consistent growth over the past 3 years, while general merchandise stores and eating and drinking places showed little or no change during this period. Taxable retail sales have shown a consistent, steady increase in the county (Table 3.7-3), although much of the increase from 1970 to 1980 can be attributed to inflation.

Government

The government sector is the third largest source of employment in the county, with 25,100 jobs in 1982. This number of jobs represents a decrease from the level of employment in 1980 (24,500), and is about 5 percent less than the peak government employment of 25,800 in 1976. Much of the decline occurred in county and city government employment due to the passage of proposition 13. Many federal government employees work at Vandenberg AFB. Vandenberg AFB was established by the Department of Defense in 1958 as the first missile base in the county. The base currently employs an estimated 9600 persons, of which 5500 are permanent military and civilian workers, and 4100 are contract workers (Texaco, 1983).

Services

The services industry provided an average of 34,800 jobs or 26.3 percent of total county employment, accounting for the largest number of jobs for a single sector in Santa Barbara County in 1982. Services is one of the fastest growing industries in the local economy. Although the business services sector of the services industry accounts for over 30 percent of the service jobs, growth in the health and transient lodging services was primarily responsible for the employment increase experienced by the services industry in recent years. (CEDD, 1982c).

Manufacturing

Manufacturing is the fourth largest industry in Santa Barbara County. During the period from 1972 to 1982, employment in manufacturing rose from 10,600 jobs to 18,300 jobs, an increase of about 73 percent. However, in recent years, growth has slowed, with the number employed increasing by 1500 (19 percent) from 1979 to 1982. It is expected that the aerospace sector will continue to lead other industries in terms of the number of new jobs created due to the expansion of the Space Shuttle program at Vandenberg AFB, but growth is expected to occur at a slower pace than during the early to middle 1970s.

Agriculture

Agriculture ranks fifth in terms of employment among the major industry groups in the county with an average of 8100 jobs in 1982. This level of employment represents an increase of 1000 jobs (49.1 percent) from 7100 average in 1980 and an increase of 2900 jobs (55.7 percent) from 1972 (5200 jobs). Monthly employment, however, fluctuates seasonally throughout the year and may change by 3000 from the low in January to the peak in July or August (Texaco, 1983).

In 1983, agriculture contributed approximately $317 million to the economy of Santa Barbara County, an increase of $51.5 million (20.7 percent) over 1979. Of the total increase of $51.5 million, $30.8 million was derived from increase in income from fruit and nut crops (Santa Barbara County Agricultural Commissioner, 1981).

3.7.1.3 Tourism

Tourism is an important industry in the two-county region. It is particularly important in the coastal area of Santa Barbara County. Tourism as an industry is not easily defined. Tourism generally refers to visitors to an area, not local residents, participating in eating, drinking, shopping, sightseeing, beaching, or other recreational activities available in an area. Economic activity involves the services, trade, and transportation sectors, and to a certain degree, governmental sector through provisions of parks and other government-sponsored activities.

Table 3.7-4 presents selected economic characteristics of travel-related economic activity for the two-county region. Travel expenditures and travel-generated payroll, employment, and revenue effects in Santa Barbara County are all approximately twice the levels in Ventura County.

3.7.2 Location and Size of Related Population and Industry Centers

3.7.2.1 Ventura County

Ventura County will experience more rapid growth over the period of 1984 to 2000 than Santa Barbara County. As of July 1, 1982, Ventura County had an estimated total population of 544,200 (California Department of Finance, 1983), approximately 2.2 percent of the total State of California population. Growth has steadily increased in the county from 1950 (14,547 persons) to 544,200 persons in 1981. The compound annual growth rate of Ventura County during the period between 1950 and 1980 was 5.2 percent (about 415,000 persons), about double the compound annual growth rate of the state, which was 2.7 percent during the same period. This trend is expected to continue into the future. The State of California predicts that Ventura County's population will grow by a compound annual growth rate of 3.4 percent between 1980 and 1990, while the rate of the state is predicted to be 1.7 percent (Texaco, 1983).

Population centers in Ventura County include the cities of Oxnard, Ventura, and Port Hueneme. Of these, Ventura and Port Hueneme serve as major offshore

Table 3.7-4

SELECTED ECONOMIC CHARACTERISTICS OF THE TOURISM INDUSTRY FOR SANTA BARBARA AND VENTURA COUNTIES IN 1982

(From U.S. Travel Data Center, 1984)

	Santa Barbara	Ventura
Total Travel Expenditures (million $)	341.3	184.6
Travel Generated Payroll (million $)	77.1	40.5
Travel Generated Employment (thousand of jobs)	8.9	4.4
State Tax Receipts (million $)	15.7	7.9
Local Tax Receipts	8.3	4.0

Reference: Continental Shelf Associates, Inc., 1985. Draft Environmental Impact Report, Chevron Exploratory Drilling Operations, State Oil and Gas Lease PRCs 2199, 3150, and 3184.

and onshore petroleum industry centers. Port Hueneme functions as the principal supply port for Santa Barbara and Ventura County offshore areas. Petroleum-related services located in the City of Ventura include oil field maintenance, oil well completion and pumping equipment, and oil well servicing. The City of Ventura also is the site of exploration and production offices of sereral major oil companies (including Chevron, Texaco, Conoco, Shell, Getty and Union). The City of Oxnard, because of its substantial population base, provides a labor pool for petroleum-related industries in Ventura County. (In general, the population base of Ventura County serves as a labor pool from which the petroleum industry and support services draw their personnel.) The cities of Oxnard, Port Hueneme, and Ventura have experienced historical growth rates. The compound annual growth rates from 1950-1980 for Oxnard is 5.5 percent; for Port Hueneme, 6.0 percent and for Ventura 6.7 percent. Projections of future population growth have been made by the county in connection with the Areawide Waste Treatment Management Plan (208 Plan) for the county's designated growth areas. The growth areas include those outside the presently incorporated cities, but which are likely to be annexed as growth occurs. Projected compound annual growth rates (1985-2000) for the Oxnard, Port Hueneme, and Ventura Growth Areas are as follows:

Growth Area	Compound Annual Growth Rate (1985-2000) (%)
Oxnard	2.3
Port Hueneme	1.1
Ventura	1.4

As of January 1980, Ventura County reported the total housing inventory as 173,000 units of which 65 percent were owner-occupied and almost 80 percent were single unit structures. Vacancy rates for rental units was 5.4 percent and 3.1 percent for owner occupied units. The county-wide value for persons per housing unit was 2.79 in 1979, compared to 2.84 in 1978, 3.00 in 1975, and 3.36 in 1970. This reflects a significant change in occupancy characteristics (Texaco, 1983).

Future housing growth projections for the county indicate a persons-per-housing-unit value of 2.88 in 1990, with a slight decrease occurring after that date. By the year 2000 there will be an estimated 2.86 persons per housing unit (Texaco, 1983). Housing-unit growth is projected to increase from 213,912 units (1985) to 283,322 units in 2000.

Housing counts and occupancy characteristics for 1980 for the cities of Oxnard, Port Hueneme, and Ventura (Texaco, 1983) are as follows:

City	Population	Housing Units	Persons Per Housing Unit
Oxnard	108,195	35,087	3.08
Port Hueneme	17,803	6,788	2.62
Ventura	74,474	30,656	2.43

Housing vacancy rates in Oxnard and Port Hueneme for the years between 1975 and 1980 have shown a decrease.

3.7.2.2 Santa Barbara County

The general outlook is for slow but sustained growth for the economy of Santa Barbara between 1984 and 2000. As of July 1, 1982 Santa Barbara County had a total population of 309,200 approximately 1.3 percent of the total population for the State. Growth of the county's population from 1950 to 1981 is 98,220 and 304,100, respectively. Future county population projections by the State for 1985 and 1990 are 315,400 and 329,400, respectively. The compound annual growth rate of Santa Barbara County between 1950 and 1980 was 1.7 percent, less than the compound annual growth rate of the State (2.7 percent). The State of California predicts that the county's population will grow by a compound annual growth rate of 1.0 percent between 1980 and 1990 (nearly 31,000 persons). The urbanized South Coast area accommodates 64 percent of the County-wide population and includes the population centers of Isla Vista, Goleta, Santa Barbara, Montecito, Summerland, and Carpinteria. The coastal area extending from Point Conception to Ellwood is predominantly rural with a total population of 2530 (1980 Census data). There is no notable concentration of population or industry within this portion of the coast.

Within the southern portion of Santa Barbara County, several oil companies maintain exploration and production offices. Although support services are supplied via Carpinteria and Ellwood piers and the Santa Barbara Airport, southern Santa Barbara County is not considered a major oil and gas industry center. In the northern county, near the City of Santa Maria, there are numerous petroleum-related companies and maintenance services. All urban centers of Santa Barbara County have experienced growth from 1950-1980. Compound annual growth rates of the urban centers are as follows:

Area	Percent
City of Santa Maria	5.8
City of Santa Barbara	1.7
City of Carpinteria	4.5
Goleta Valley	7.6

Texaco, 1983

The total housing inventory for Santa Barbara County as of April 1980 was 114,933 units; primarily single family units. For the coastal area between Point Conception and Carpinteria, housing counts totalled 61,899 (Texaco, 1983). Between 1975 and 1980, housing units in the County increased by a compound annual growth rate of 2.0 percent. This trend is expected to continue with a projected 140,190 housing units by 1990.

The County-wide household size was 2.62 persons in 1980, as compared to 2.73 persons per household in 1975 and 2.99 in 1970. This reflects a growing change in the average family size and occupancy characteristics of the County.

Vacancy rates in the South Coast area of Santa Barbara County are currently low due to such factors as the desirability of the area, the decline of new construction caused by water permit moratoriums, and high property acquisition and rental costs. Vacancy rates are currently between 1.3 and 5 percent, depending upon the coastal area. Generally, the South Coast cities of Santa Barbara, Summerland and Montecito experience the highest vacancy rates.

Transient accommodations are prevelant in the tourist-oriented South Coast area with an estimated 3404 rooms located within the Santa Barbara-Goleta-Carpinteria-Montecito area (Texaco, 1983).

3.7.3 Existing Community Services

This section provides an overview of current service and utility conditions available. Descriptions of each infrastructure component are presented. The following discussion is concerned primarily with Ventura County as public services and utilities will be most affected. However, for completeness, Santa Barbara County is also included in the discussion.

3.7.3.1 Fire Protection

Ventura County

Fire protection in the Ventura area is furnished by three municipal agencies: the Ventura County Fire Department, the Ventura City Fire Department and the Oxnard Fire Department. The City of Port Hueneme is served by the county department under a contract agreement. In addition to these agencies, the U.S. Navy facility at Port Hueneme maintains its own firefighting services. Mutual aid agreements have been executed among all of these fire departments so that emergency aid can be called for from other firefighting agencies both inside and outside the county.

As a supplement to shore-based facilities, the U.S. Coast Guard at Channel Islands Harbor and the Harbor Patrol operate fireboats. In response to an emergency at the Port of Hueneme, engine companies would be dispatched from the closest fire stations, which include both City of Oxnard and County of Ventura stations.

The Ventura County Fire Department is responsible for protective services in unincorporated territory and the City of Port Hueneme. In 1984, the department was staffed with 363 persons, 328 of whom were uniformed personnel. The department maintains 28 stations throughout the county. The firefighting equipment of the department consists of 53 engines (including 25 reserves), 24 brush patrols, 5 heavy duty rescue trucks, 1 aerial ladder truck, 2 water tenders, 1 helitender, 1 airport crash truck, and numerous support vehicles (Texaco, 1983).

The City of Oxnard Fire Department in 1984 has 71 personnel located in 6 stations throughout the city. The normal crew size is 3 and the equipment housed at each station includes pumpers with capacities of at least 400 gallons and 1000 gpm. In addition to city equipment SCE possesses a foam truck which carries 2500 gallons (9500 l) of foam which can be mixed at a 600:1 ratio (water to foam) and pumped with its 1000 gpm pump (Texaco, 1983).

Santa Barbara County

Fire protection in southern Santa Barbara County is furnished by three municipal agencies: the Santa Barbara County Fire Department, the City of Santa Barbara Fire Department, and the Carpinteria-Summerland Fire Protection District. A fourth fire protection agency in the area is the Santa Maria City Fire Department. Mutual aid agreements have been executed among all of these and other fire departments so that emergency aid can be called for from other firefighting agencies, both inside and outside the county (Texaco, 1983).

The Santa Barbara County Fire Department is responsible for protective services in unincorporated territory in Santa Barbara County. Currently, the department is staffed with approximately 200 persons, 186 of whom are uniformed personnel. The department maintains 14 stations throughout the county. The firefighting equipment of the department includes 22 engines (including reserve engines), 2 heavy duty rescue trucks, 1 aerial ladder truck, 1 water tender, 2 airport crash trucks, and numerous brush trucks and support vehicles (Texaco, 1983).

The City of Santa Barbara Fire Department currently has 98 personnel located in 7 stations. The normal crew size is 3 people at 6 stations, and 7 people at headquarters. The city fire department houses 10 fire engines, 3 of which are reserve engines. All of these engines pump at a rate of 1000 gallons per minute (gpm). Four engines have 400-gallon tanks, 5 engines have 500-gallon tanks, and 1 has a 11,000-gallon tank. The engine with the 1000-gallon tank belongs to the State Office of Emergency Services, which allows the department to use the engine as a reserve unit (Texaco, 1983).

The average response time for an emergency call is 4 minutes or less within the city. The fire department has mutual aid agreements with Santa Barbara County, Ventura County, Montecito, and Carpinteria fire departments, as well as with the U.S. Forest Service.

The Carpinteria-Summerland Fire Protection District serves both the City of Carpinteria and the unincorporated area of Summerland. The total personnel complement of the district is presently 25 persons, 23 of whom are engine company personnel. Carpinteria is served by Station 1, which is the main station in the district. The Summerland area is served by Station 2. The location, equipment, and crew sizes for the two stations are as follows:

Station and Location	Normal Crew Size	Major Equipment
No. 1 911 Walnut Street (Vicinity of Walnut and Carpinteria Avenue)	3 persons	2-1500-gpm pumpers 1-1000-gpm pumper
No. 2 2375 Lily Avenue (Vicinity of Lily and Valencia Road)	2 persons	1-1500-pumper 1-1000-gpm pumper

The district's response time within the city averages about 1.5 minutes. This district will respond to emergencies at the Chevron Carpinteria Processing Plant.

3.7.3.2 Police Services

Ventura County

Police protection in the Ventura area is furnished by three different agencies: The Ventura County Sheriffs Department, the Oxnard Police Department, and The Port Hueneme Police Department.

The Ventura County Sheriff's Department is presently staffed with 708 persons, including 472 sworn officers and 236 civilian employees. Substations are located in the County Government Center, Ojai, Camarillo, and Fillmore. The west county patrol administration headquarters is located in the County Government Center. Emergency response times are normally 8 minutes or less, while routine non-emergency response times are 20 minutes or less (Texaco, 1983).

The City of Oxnard Police Department has 161 full-time employees, with 115 sworn officers and 46 civilian employees. The authorized level of sworn officers is 130. The department operates approximately 50 pieces of equipment including patrol vehicles, motorcycles, and vans. The city is divided into six beat areas for patrol purposes. Emergency response time is less than 5 minutes, except for the beach areas where the response time may reach 6 minutes. Response time for routine calls is normally 11 minutes or less. The department operates out of a headquarters facility at "C" and 3rd Streets, adjacent to the City Hall complex.

The City of Port Hueneme Police Department has 25 full-time employees, with 18 sworn officers and 7 civilian employees. The department possesses nine vehicles, including unmarked cars and one four-wheel-drive vehicle. Emergency response times average 4 minutes. The Police Department operates out of headquarters located in the City Hall building on Ventura Road in Port Hueneme (Texaco, 1983).

Santa Barbara County

Police protection in Southern Santa Barbara County is furnished by three different agencies: the Santa Barbara County Sheriff's Department, the City of Santa Barbara Police Department, and the Carpinteria Police Department. A fourth law enforcement agency in the local area is the Santa Maria City Police Department.

The Santa Barbara County Sheriff's Department covers all the unincorporated areas of the county, including the portion of the Santa Barbara Channel Islands belonging to the county. The department is presently staffed with 430 persons: 230 sworn officers and 200 civilians. The operations are headquartered in the Santa

Barbara office, located at 4436 Calle Real, between Goleta and the City of Santa Barbara. Substations are located in Santa Maria, Solvang (the Santa Ynez Valley station), and Lompoc (the Lompoc Valley station). In addition, there are two resident deputies in Cuyama. Emergency response times are normally 2 to 3 minutes or less, while routing non-emergency times are 11 minutes or less.

The City of Santa Barbara Police Department has 176 full-time employees, with 116 sworn officers and 60 civilian employees. The authorized level of sworn officers is 130. The department possesses approximately 57 pieces of equipment including patrol vehicles, motorcycles, Cushmans, vans and a tractor-trailer. The city is divided into six beat areas for patrol purposes. Emergency response times average 2 minutes, including the beach areas. Response time for routine calls is normally 5 minutes or less. The department operates out of a headquarters facility at 215 East Figueroa Street, one block away from the County Court House (Texaco 1983).

The City of Carpinteria Police Department has 21 full-time employees, with 16 sworn officers and 5 civilian employees. It operates out of headquarters located in City Hall on Carpinteria Avenue. At least two patrol cars are on the streets at any given time. Emergency response time is 2 minutes or less, while routine responses are achieved in 3 to 5 minutes.

3.7.3.3 Medical Services

Ventura County

St. John's Hospital in Oxnard furnishes basic emergency medical services as defined by the California Administrative Code (C.A.C. Title 22, Division 5, Section 3). The Port Hueneme Adventist Hospital provides emergency care defined as "standby" by the code. Acute care hospital facilities are also available in each community. A total of 359 acute care beds are currently available in the Port Hueneme-Oxnard area.

Paramedic services are not currently available in the Port Hueneme-Oxnard area. Emergency responses are furnished by private ambulance services, which provide basic life support capability using emergency medical technicians. The county is divided into service areas, and one ambulance company is licensed for each service area. In Oxnard and Port Hueneme, service is provided by Oxnard Ambulance Service.

Paramedic services are provided within Ventura County via the 911 emergency services phone number. The new wing at the Ventura County Medical Center is scheduled to operate as a paramedic base station by January 1985. The new emergency room is equipped to handle medical crises including oil rig accidents and will be able to communicate with ambulance and helicopter personnel as injured patients are enroute. The County has two helicopters owned jointly by the Ventura County Sheriff's office and County Fire Department, and four helicopters owned by the U.S. Forest Service. If requested, these helicopters can be equipped with a physician, and will transport patients directly to a helipad at St. Johns Hospital in Oxnard.

Santa Barbara County

Three hospitals in south-central Santa Barbara County furnish basic emergency medical services as defined by the Calfifornia Administrative Code (Title 22, Division 5, Section 3). These are Santa Barbara Cottage Hospital and St. Francis Hospital, both in Santa Barbara, and Goleta Valley Community Hospital in Goleta. No hospitals in the county provide emergency care defined as "standby" by the code. (Standby hospitals are those without a physician in attendance 24 hours per day; in some cases, a physician must be called in to attend to health care needs.)

Emergency responses are furnished by one private ambulance service called 911 Emergency Services. This company provides ambulance services for all of Santa Barbara County, except for the University of California at Santa Barbara, the City of Lompoc, and a small area adjacent to Lompoc (Burton Mesa). The County Sheriff's office does all the ambulance dispatching for the county.

There are 7 medic units stationed in the south-central county area: 1 in Carpinteria, 3 in the City of Santa Barbara, 2 in Goleta, and 1 at the University of California at Santa Barbara (UCSB). Five of these units are staffed with employees of 911 Emergency Services. The unit at UCSB is staffed with UCSB employees, and one Goleta unit is stationed at the county fire station on Storke Road and staffed with fire department employees. There are a total of 55 paramedics in the county (Texaco, 1983).

For emergencies occurring in a wilderness area, or if rough waters prevent a boat from reaching an emergency at offshore locations, helicopters are used to transport medical personnel to the scene and transport injured or ill persons to the hospital. The county owns no helicopters, but does have access to two helicopters owned jointly by the Ventura County Sheriff's office and County Fire Department, and four helicopters owned by the U.S. Forest Service. If requested, these helicopters can be equipped with a physician, and will transport patients directly to a helipad at Goleta Valley Community Hospital. Response time for the helicopters averages about 20 to 25 minutes from the time of the request to arrival time (Texaco, 1983).

3.7.3.4 Utilities

Ventura County

Southern California Edison (SCE) presently operates two major oil-and-gas-fueled generating stations in Ventura County; the Ormond Beach Generating Station and the Mandalay Generating Station. The total electrical generating capacity of the two sources is approximately 2,000,000 kW. The energy is transmitted to various points in the county, including Port Hueneme, and to other counties throughout SCE's service boundary.

Municipal water and sanitary sewer systems at Port Hueneme in Ventura County are provided by the City of Oxnard. Water is particularly critical resource in Ventura. In portions of the County current water usage exceeds the safe yield of present water supply in the developed underground water basins. The overdrafting of groundwater is causing an estimated 60,000 to 80,000 acre-feet per year deficit in Ventura County. Current population projections will continue to deplete available and projected water supplies unless alternative sources are developed. The water supply deficit is projected to increase to 73,000 to 93,000 acre-feet per year by the year 2000 (A.D. Little, 1984). The platform will use to the greatest degree possible, desalinized salt water. Some bottled water will be purchased from local distributors. The supply base at Port Hueneme relies on the municipal water supply. This is the source of water to be used for both crew and supply boats originating at Port Hueneme. Limited supplies of bottled drinking water will be purchased from local distributors for drinking purposes.

In Ventura County, sewer system capacities are severely limited in the populated areas along the coast (Ventura, Oxnard, and Port Hueneme). Additional population growth will cause additional stress (A.D. Little, 1984). Current offshore oil facilities use EPA approved methods of ocean disposal as a means of waste disposal.

Santa Barbara County

Electrical power and energy is provided to Southern Santa Barbara County by the Southern California Edison Company (SCE). SCE operates one gas-fueled generating station in Santa Barbara County, the Ellwood Energy Support Facility, located just west of Goleta. The Ellwood facility is a peaking station, and is not used on a routine basis. Because SCE operates on a grid system, all generating facilities are tied together, and power is supplied as needed throughout the service area.

In Santa Barbara County water supply is a critical factor in assessing any new growth or development. Current water usage exceeds the safe yield of present water supplies, a situation caused mainly by high demands for water for irrigated agriculture, which accounts for 70 percent of the total water demand (Texaco, 1983). Approximately 75 percent of the County's water supply is extracted from groundwater basins; the balance is stored in surface reservoirs located on the Santa Ynez River.

The County is currently experiencing a water supply deficit of 40,000 acre-feet per year. These deficits are supported by overdrafting the groundwater basins, i.e., extracting more water than is replenished by rainfall. Projecting water demands to the year 2000 (based on population projections), the Santa Barbara County Water Agency anticipates that this deficit will increase to 73,600 acre-feet per year unless water usage is reduced to eliminate overdrafts, new supplies are developed within the County, water is imported from outside the County, or some combination of these options is implemented (Texaco, 1983).

The City of Carpinteria and Chevron's Carpinteria processing facility is supplied by the Carpinteria County Water District. Sanitary sewer services are provided by the Carpinteria Sanitary District.

3.7.3.5 Waste Disposal

Ventura County

There are presently no sites in Ventura County that can accept oil wastes for disposal. Until recently, these wastes were disposed of at the Simi or J&J disposal facilities.

The Simi facility is a Class I disposal site located northwest of the City of Simi Valley (just north of State Highway 118, between Alamos and Brea canyons). Muds and some brines are still being accepted but hazardous muds, including muds with oil wastes, are no longer accepted at Simi. Although this site presently is being evaluated with regard to the types of waste that will be accepted in the future, there is no indication that future waste disposal will differ significantly from wastes presently disposed of at Simi (Texaco, 1983).

The J&J disposal site, located northeast of the intersection of Harbor Boulevard and Fifth Street in Oxnard, is no longer in operation. The amount of material disposed of at this site varied between 1.9 and 2.3 million gallons (9400 to 11,400 cubic yards) per month. Most of the materials previously disposed of at this site are now being disposed of at the Casmalia site in Santa Barbara County.

Two agencies are currently evaluating sites for the purpose of providing additional disposal sites. The Ventura Regional County Sanitation District will evaluate

6 to 8 sites for locating 1 or 2 Class II facilities in Ventura County. The Southern California Association of Governments is evaluating potential Class II sites in southern California, including Ventura County.

Santa Clara landfill on Ventura Road in Oxnard is a Class II disposal site near Port Hueneme Harbor. This landfill is owned by the City of Oxnard and operated by the Ventura Regional County Sanitation District. The estimated lifetime of the site is 4 years, after which plans are to open a new 160-acre site adjacent to the new 80-acre site.

Santa Barbara County

Two solid waste landfills are located in Santa Barbara County. Tajiguas landfill is approximately 3 miles (5 km) west of the Corral/Las Flores canyons area and is used for solid waste disposal only. This 412-acre landfill is owned and operated by the County of Santa Barbara Public Works Department; it is a Class II-2 site. Aproximately 650 tons of waste per day are disposed of at the site (Texaco, 1983). At present rates of disposal and anticipated future rates, this site will be in operation until approximately the year 2000. An alternative to the Tajiguas Landfill is Foxen Canyon Land fill, which is privately-owned but operated by the County of Santa Barbara. This facility is located on Foxen Canyon Road, north of the town of Los Olivos. Approximately 50 tons of solid waste are disposed of at this site per day (Texaco, 1983). Based on this disposal rate, the site is expected to be used until about 1995 to 1997.

The Casmalia Disposal site is a Class I disposal site located north of the town of Casmalia, which is on the northern border of Vandenberg Air Force Base (AFB); oily wastes can be disposed of at this privately owned and operated site. Oily waste disposal is accomplished by ponding and neutralizing the disposed materials followed by distribution of the land. In 1980, about 35 million gallons (12,000 cubic yards) of materials were disposed of at Casmalia. The owners initially estimated that this site could be used for about 80 years based on the 1980 disposal rate and the initial size of 179 acres. This life could be extended due to an additional 71 acres permitted for use; however, due to the recent closure of the J&J disposal site in Ventura County, the rate of disposal has increased, since much of the material disposed of at the J&J site is now being disposed of at the Casmalia site (Texaco, 1983)

There are no other Class I disposal sites in Santa Barbara County. The nearest alternatives outside Santa Barbara and Ventura counties are Kettleman Hills, located near the intersection of Interstate 5 and County Road 46, southeast of Coalinga, and BKK, near the City of West Covina.

3.7.4 Public Opinion

Unlike other large southern California cities, Santa Barbara and the surrounding area has traditionally been a recreational and cultural center, deriving most of its income from the tourist industry and commercial establishments. The County's scenic coastline is valued considerably by both residents and visitors. Because offshore oil and gas development is a coastal-dependent industry, it conflicts with the desire of some residents to retain unobstructed views of the shoreline and channel. There is a wide difference of opinion concerning offshore oil and gas development in Santa Barbara County. A vocal minority segment of the public opposes offshore oil and gas development beneficial to the local and national economies. Another minority supports offshore oil and gas development, whereas the majority are undecided or indifferent. Additionally, Santa Barbara residents perceive very few direct benefits from the development of offshore resources such as increased employment or local revenues from taxation of onshore facilities.

Several community activist groups have organized to publicly express their concerns over development in the channel, among these are Get Oil Out, Inc. (GOO), Scenic Shoreline Preservation, Inc., Carpinteria Valley Association, the Environmental Defense League, and various Native American groups. The most common issues expressed include visual concerns, the threat of a major oil spill, environmental consequences of drilling mud and cuttings disposal, interference with commercial fishing, recreational boating, air quality, areas of religious significance and cumulative impacts. All of these issues in relation to the proposed project are discussed in applicable sections within this report.

Public opposition to development appears to be greater for some areas of the channel region than for others. In the Ventura-Oxnard area the industry employs many of the local residents. These people are familiar with the nature and importance of offshore operations and support continued exploration and development of energy resources.

3.7.5 Existing Transportation Systems and Facilities

3.7.5.1 Onshore Transportation

The primary transportation arterials of Santa Barbara and Ventura Counties are served by U.S. Highway 101. Highway 101 is the most heavily traveled route in the coastal plain, following the shoreline from Santa Barbara and turning inland at Gaviota. The majority of the traffic on Highway 101 is considered to be through traffic rather than commuter and increases almost 50 percent on the weekend, suggesting that it is recreation-oriented. The average daily two-way traffic count at the junction of Highway 101 is 15,000 to 16,000 vehicles per day (Caltrans, 1980).

State Highway 1, is the primary coastal route between Oxnard and western Los Angeles County. The Santa Paula Freeway (State Highway 126) links the Oxnard-Ventura metropolitan area with Santa Paula and the northern portion of Los Angeles County through the Santa Clara Valley.

A Southern Pacific Railroad line runs roughly parallel to the coastline and connects the cities of Santa Barbara, Ventura and Oxnard with San Francisco and Los Angeles.

Ventura County

U.S. Highway 101, a divided multi-lane, limited access freeway, is the primary transportation corridor connecting the coastal areas of Ventura and Los Angeles counties. State Highway 1, partly a two-lane road, forms an additional link between Oxnard and points southward, including Point Mugu, Malibu, and Santa Monica. Sections of Highway 1 have restrictions on 4+ axle trucks.

Port Hueneme is accessible from four primary access routes and various combinations of city streets. The four main approaches are State Highway 1/Hueneme Road; Pleasant Valley Road/Saviers Road; Oxnard Boulevard/Saviers Road; and Ventura Road/Hueneme Road. Based on measured traffic volumes and design capacities, all of these roadways are currently operating at acceptable levels of service, except for congestion experienced on the roads during peak afternoon hours (Texaco, 1983).

Victoria Avenue, was recently constructed adjacent to Ventura Road in the City of Oxnard. Although Victoria Avenue does not provide direct access to Port Hueneme, it accommodates some traffic previously associated with other roads serving the port. As a result, Victoria Road alleviates traffic throughout the day on access routes to the Port of Hueneme.

At present, about three-fourths of an acre adjacent to the Port of Hueneme is made available for parking by users of the Oxnard Harbor District's commercial dock space, including petroleum industry-related operators. Only a limited amount of additional parking space is currently available for new users of the port facility. The Harbor District plans to expand its parking facilities in the near future (Texaco, 1983).

Santa Barbara County

The coastal area between Carpinteria and Santa Barbara is served by U.S. Highway 101 which has two lanes in each direction and a wide median. The access roads to Chevron's Carpinteria processsing facility are Carpinteria Avenue and Dump Road in the City of Carpinteria.

3.7.5.2 Ports and Shipping and Airport Facilities

Between 1976 and 1980 the average number of daily ship movements through the Santa Barbara Channel Vessel Traffic Separation Scheme (VTSS) increased from 6.5 to 13 ship movements per day in each direction. This increase can be attributed to two primary factors: 1) The increase in number of vessel arrivals and departures at the ports of Los Angeles and Long Beach and 2) the percentage of total north-south ship movements in the area that use the VTSS has increased from 77 to 93 during that period (Texaco, 1983).

Ventura County

Port Hueneme contains commercial port facilities operated by the Oxnard Harbor District. Use of the district's harbor facilities is shared with the U.S. Naval Construction Battalion Center. The Oxnard Harbor District presently owns and operates a total of 59 acres of waterfront and terminal facilities. In addition, commercial port users lease over 95 acres of land from the Navy. The harbor, with 9 acres of waterways, is manmade and connected to the open sea by a jetty-protected entrance channel. The harbor entrance channel is 300 feet wide at its narrowest point, with an interior turning basin 1200 by 1400 feet. Berthing facilities include a 1800-foot long commercial deep-water berth, as well as slips for smaller commercial and sportfishing craft. Annual tonnage shipped through the port has increased steadily from 1,154,517 tons in 1972-1973 to 1,586,058 tons in 1980-1981. Major commercial activities at the port include Southern California Edison oil importation, Mazda shipping and storage, Del Monte Banana Company shipping, and offshore oil industry storage and supply. Approximately 2000 persons are employed in businesses directly engaged in using the port facilities (Texaco, 1983).

Storage space for use by commercial operators at the port is located in three separate areas in the vicinity of the port: the Oxnard Harbor District's commercial waterfront area; the U.S. Naval Construction Battalion Center's commercially leased land; and, in the Ormond Beach area, approximately 1 to 2 miles (1.6-3.2 km) south of the port.

The approximate numbers of vessel movements (one way) associated with Port Hueneme Harbor are as follows: 30 deep draft vessel movements per month; 900 vessel movements per month for offshore oil-related purposes, including crew and supply boat movements; 450 sport/commercial fishing boat movements per month; and

16 naval ship movements per month. Total vessel activity, including smaller fishing craft and supply boats in and out of Port Hueneme Harbor, is approximately 2400 movements per month or 50 movements per day (Harmuth, 1982). By comparison, the Port of Los Angeles receives about 1200 deep draft vessels per month alone, in addition to a significant number of recreational and commercial fishing boat movements.

Future development plans for Port Hueneme include major expansion of staging and berthing facilities for offshore oil industry use as well as growth in the harvesting and processing of ocean products, lumber wholesaling and retailing, auto importation and processing, wood pulp importation, and citrus, grapes, and egg shipping (Texaco, 1983).

Helicopters serving the Platform will use the Ventura County Municipal Airport as a service base. Air traffic in the Ventura area is related primarily to operations from the Ventura County Municipal Airport at Oxnard. Commercial carriers serving the airport include Wings West with 10 flights per day and Evergreen Airspur with 8 flights per day. Helicopter operations include three commercial carriers located on the northside of the runway which serve primarily the oil industry. All commercial carriers maintain their own heliports and therefore do not impact the Ventura County commercial landing ramp or the fixed wing aircraft runways or flight patterns (Doc Harper, Airport Operations, personal communication). Current use of commercial helicopter carriers is low to moderate with ample room for growth (Kevin Obrien, Evergreen Roto Aids, personal communication).

Santa Barbara County

Transfer of personnel by crew boats will be accomplished at Chevron's Carpinteria Pier. Currently, the Carpinteria Pier is used by 9 vessels accommodating about 40 vessel movements per day.

3.7.6 Coastal Resources

Onshore support and marshalling facilities will be located at Port Hueneme. Port Hueneme is adjacent to the greater Oxnard community. Although industrial statistics are not readily available, empirical data shows Port Hueneme to be the industrial center of the Oxnard Plain. This is due to two significant factors: 1) it is the only deep water port in the Santa Barbara Channel, and 2) it is directly accessible to major rail and highway arteries. For these reasons the redistribution of overseas goods, local agricultural products, and offshore support and recreation service focus on the port area.

As it is the only deep water port in the Santa Barbara Channel, Port Hueneme is showing increasing evidence of congestion. There are currently 47 supply boats based at the Port. Consequently berthing space is becoming scarce (MMS, 1983). Currently, plans to acquire more berthing space from the U.S. Navy (which owns most of the harbor area) should result in an increase to the civilian port capacity of approximately 80 percent. In addition, a major supply and crew boat base is being considered by the Petroleum Transportation Committee at either Gaviota or Elwood (MMS, 1983).

The needs of the proposed project with respect to community services are the following: dock space, storage facilities, waste disposal, recreation, transportation, food supplies, bottled water and housing facilities. All of these services exist in the Oxnard/Ventura district and will be available for oil industry-related use.

Supply of personnel and materials to the staging area is readily accomplished via existing air, road, and rail facilities. Helicopter transport will emanate from nearby Ventura County Airport. Truck transport of supplies will use Pleasant Valley, Ventura, and Hueneme roads - designated for truck use - within the City of Port Hueneme. Each of these routes are accessible from Highway 101 via secondary roads. Although rail transport is available to the port, it is not likely direct access will be required. Some imported bulk goods which reach the area by rail during the normal course of supply, may be used during the course of the proposed project.

Adequate dock space, recreational facilities, and food and bottled water supplies currently exist within the Oxnard/Port Hueneme environs for the support of this project. Platform Gail is equipped with onboard desalinization plants capable of meeting all required drilling and onboard human needs for fresh and distilled water. However, limited supplies of bottled drinking water will be purchased from local suppliers for drinking purposes.

Available commercial dock space at Port Hueneme is, at this time, a relatively scarce resource. There is, however, sufficient dock space available for the loading and offloading needed for equipment and personnel associated with this project. Chevron will make use of existing dock space and existing support vessels. Support services for Platform Gail will be coordinated and little additional pressure will be exerted on any limited support commodities.

The short-term demand for goods and services currently available in the Coastal Zone is discussed in Section 4.7.4.

3.8 VISUAL RESOURCES

The Ventura County coastline is extremely diverse in its variety of landforms, ranging from rugged cliff areas to flat sandy beaches and pristine locations to overdeveloped areas.

From Rincon Point to the Ventura River, the Ventura County coastline is characterized by coastal cliffs, narrow sandy beaches and rocky tidepools. Land uses in this area include agriculture, open space, oil wells and related petroleum facilities, and residences. Recreational facilities include Hobson and Faria County parks, Emma Wood State Beach, and Rincon Point Surfing Access. The area from the Ventura River to south of Port Hueneme is the sandy edge of the Oxnard Plain and includes agriculture, sand dunes, and fresh and saltwater marshes. Some heavy industry (two power plants, waste water treatment plants), small harbors, petroleum-related operations, and residential communities are located in this central area. Several popular beaches also are located here; they include: McGrath State Beach Park and Mandalay, Hollywood, Silver Strand, and Ormond Beaches. Channel Islands Harbor and a small craft harbor within the commercial harbor of Port Hueneme provide major recreational boating facilities in this area. The portion of the coast from the City of Oxnard to the Los Angeles County line encompasses Mugu Lagoon, coastal marshes, and the Santa Monica Mountains. The U.S. Navy Pacific Missile Test Center includes Mugu Lagoon. This southern area is used primarily for recreation and activities associated with the Pacific Missile Test Center. Recreational facilities are located at Point Mugu State Park, Leo Carrillo State Beach, and the Santa Monica Mountains National Recreational Area. Public access to the shoreline is available along most of the Ventura County coast (Ventura County Local Coastal Plan, 1981).

Petroleum platforms located in the OCS offshore Ventura County include Platforms Habitat, Grace, Gilda, and Gina. ARCO's Rincon Island is located near the Santa Barbara County border. Marine vessels utilize the Port of Hueneme and other smaller harbors located in Ventura County and often can be seen transiting the Santa Barbara Channel.

Attitudes regarding the quality of scenic resources are divergent being that the concept of what is aesthetically pleasing varies according to individual creativity, philosophical standards and cultural background. Coastal residents and visitors place great value on the beauty of scenic resources and directly associate this with a general quality of life.

The coastal zone offers vistas which provide unobstructed views of offshore areas including the Channel Islands. The Southern Pacific Railroad line and Highway 101 provide intermittent views off the Santa Barbara Channel in addition to many beach areas and lookout points. Although Highway 101 is contained in the California Master Plan of State Highways Eligible for Official Scenic Highway Designation, it has not been officially designated as such. Across the channel waters, the Northern Channel Islands provide a scenic vista. In addition, existing oil platforms constitute unique forms within this visual setting. At night, platforms are required to display lights as navigational aids. Several operating offshore platforms are located in the vicinity of the project lease including Platforms Gilda, Gina and Grace. The closest platforms are Gilda, approximately 4.1 miles (6.6. km) to the north and Grace, approximately 5.4 miles (8.7 km) northwest of proposed Platform Gail. Platform Gina is also located easterly of the project site. Ships, small craft and marine mooring buoys are also prominent visible features in nearshore waters. Views of the project lease can be seen from the following recreational areas:

- Ventura Marina - 9.5 nm (15.2 km)
- Port Hueneme/Channel Islands Marina area - 9 nm (14.5 km)
- Ventura River area - 10.5 nm (16.9 km)
- Anacapa Island (east end) - 6.5 nm (10.5 km)
- Santa Cruz Island (east end) - 8 nm (12.8 km)

Views seaward from these area currently include the three platforms mentioned above, vessel traffic and the Channel Islands in the background.

A comprehensive discussion of the asesthetic quality and impacts associated with Pacific OCS development is included in BLM OCS Technical Paper No. 81-5 (May 1981).

3.9 CULTURAL RESOURCES

NTL 77-3, "Minimum Cultural Survey Requirements, OCS Exploratory Drilling," requires that a cultural resource survey be conducted prior to approval of OCS drilling operations in less than 394 feet (120 m) of water. Platform Gail will be located in approximately 740 feet (226 m) of water, and is therefore exempt from this requirement. However, the proposed pipeline from Platform Gail to Platform Grace will be placed in depths as little as 317 feet (97 m). In accordance with the requirement, Dr. E. Gary Stickel (1984 Appendix E to Woodward-Clyde Consultants, 1981) reviewed sidescan sonar and subbottom profile data recorded from two sources: Woodward Clyde Consultants, 1981 and Nekton, 1983). Certain sidescan sonar targets were identified:

linear features (cables or anchor drag marks), an existing pipeline, and scattered low relief targets (possible outcrops).

3.9.1 Nautical History and Marine Archaeology

The general project vicinity is regarded as having low to moderate sensitivity for shipwrecks of European and American vessels. A geotechnical survey of the Platform Gail site area has been recently conducted by Woodward-Clyde Consultants, 1981. Sidescan sonar data provided by the survey does not indicate the presence of sunken ships or other major targets in the project area.

3.9.2 Prehistoric Archaeology

The Santa Barbara Channel region represents a potentially sensitive archaeological area. Due to its mild climate and abundant marine resources, the area has supported one of the oldest and most densely populated Native American occupations in California. Many of the archaeological sites in the area may have been destroyed during the course of urbanization of the region. However, several significant sites are still located in the Channel area.

There are approximately 60 known and recorded marine prehistoric sites in the Santa Barbara Channel. All of these sites are in state waters less than 1.3 miles (2 km) from shore and in less than 50 feet (15 m) of water depth with most sites within 0.6 miles (1 km) of land and in less than 50 feet (15 m) of water (MMS, 1984).

Paleontological analyses of borings S-1 and S-4 from the Platform Gail area indicate deposition of sediment during the Pleistocene and Holocene (recent) under marine conditions (Woodward-Clyde, 1981). Depth of deposition ranged from continental shelf conditions (neritic) of less than 125 feet (200 m) in the somewhat deeper water of the shelf edge and slope environment (bathyal). Mixtures of shallow and deeper water fauna in some of the samples suggest some downslope movement by slumping. The conclusion to be drawn from this paleontological analysis is that over the period sampled, the site of Platform Gail formed part of the continental shelf or slope off the California coast and was apparently not emergent. This would argue against the presence of any archaeological site in the area.

Geophysical survey results also support this conclusion. The sea bottom sediments "consist of a series of horizontally bedded unconsolidated silty sands and clays of Holocene age," (Woodward-Clyde, 1981). This indicates active recent sedimentation in the area, being that sea level reached its approximate present stand several thousand years ago. Thus, even if the shelf had been emergent during lowered sea level in the Pleistocene, archaeological materials associated with possible habitation sites would probably be deeply buried. Such habitation sites seem unlikely, because the geophysical surveys provide no indication of terraces or other similar areas that may have formed preferred habitation sites. There is evidence of tectonic activity and possible submarine erosion during the Pleistocene, probably resulting from activity along the Oak Ridge, Pitas Point, and/or Red Mountain faults. Holocene sediments overly deformed older sediments in an angular unconformity.

3.9.3 Native American Cultural Values

In recent years, the Chumash Indians of Santa Barbara area have expressed a concern for the preservation of archaeological sites, burial grounds, and marine and terrestrial resources. A number of onshore geographic sites in the area are of cultural significance to the Chumash today, because they were traditionally used by their ancestors. Some of these sites are still being used in traditional ways by contemporary Chumash.

SECTION 4

ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND RECOMMENDED MITIGATION MEASURES

4.1 GEOLOGY, SOILS AND GEOLOGIC HAZARDS

The following analysis of potential environmental impacts related to geology, soils and geologic hazards has been divided into two categories. The first discusses impacts to the geologic or hydrologic environment that could potentially occur as a result of the proposed development and production operations. The second category includes potential impacts to the project from natural geologic hazards known to exist in the area. Measures proposed by Chevron to reduce or alleviate impacts identified in these two categories are described in Section 4.1.3.

4.1.1 Development and Production Operations

4.1.1.1 Bathymetry

The existing seafloor topography (bathymetry) in the proposed Platform Gail and subsea pipeline project area will be affected to a small degree by construction and installation activities. The placement of Platform Gail on the lower slope and the driving of main and skirt piles will result in only minor disturbances to the seafloor with no significant topographic impact. The subsea pipelines will be placed on the seafloor from Platform Gail to Platform Grace using conventional lay barge, reel barge or bottom tow techniques. This activity will result in very minor changes to the seafloor topography and constitute a negligible impact.

4.1.1.2 Induced Seismicity

Seismic events induced by oil and gas production operations have been reported in several locales. The high-pressure subsurface injection of fluids, which is believed to reduce frictional resistance along previously stressed fault planes, is one potential causative mechanism. A second potential cause is the creation of horizontal shear stresses due to land subsidence resulting from the withdrawal of large volumes of subsurface fluids.

The Development and Production Plan (DPP) for the Platform Gail project indicates that high-pressure injection of fluids into subsurface formations is not anticipated. In addition, as described below, significant subsidence of the ground surface due to large-scale oil and gas withdrawal is not expected to occur. Thus, the potential for the proposed operations to induce seismic events is low.

Should operating experience at Platform Gail dictate that reinjection is required to maintain reservoir pressure or for wastewater disposal, both injection and subsurface pressure will be monitored. Injection pressures will be kept near existing reservoir pressure to avoid triggering seismic activity.

4.1.1.3 Induced Subsidence

The proposed withdrawal of oil and gas will result in a partial transfer of overburden load from the pore fluids to the reservoir rock. In some reservoirs this can lead to compaction of the rock and subsidence of overlying strata and the ground surface. As described in Section 3.1.5.5, the structural and lithologic character of the reservoir rock and overlying materials is such that there is an inherent resistance to deformation. Areal subsidence of the ground surface is therefore considered to be unlikely.

4.1.1.4 Reservoir Pressure

Pressure gradients within a reservoir are generally considered normal when hydrostatic pressures are in the range of 0.43 to 0.50 psi per foot (0.09 to 0.11 atm/m) of depth. When hydrostatic pressures substantially exceed this gradient and preventative measures are not taken, there is a potential for well blowout with subsequent escape of hydrocarbons into the surrounding rock and, possibly, the ocean. Although abnormally pressured reservoirs require careful attention during drilling, they are drilled routinely and without incident in many areas of the world, most notably south Louisiana, coastal Texas and the Norwegian sector of the North Sea.

In general, reservoir pressure conditions in California and the Santa Barbara Channel region are normal (McColloh, 1969). Several wells have already been drilled in the Santa Clara Unit, and no significant pressure conditions have been noted (Chevron, 1984). On the basis of these data, there does not appear to be a major hazard of release of hydrocarbons from blowout or rupture of the capping rock.

The proposed Platform Gail well casing program employs multiple strings of casing with at least one string of casing the entire length of the borehole. This casing program, combined with reservoir properties which include relatively thick sections of competent siliceous capping rock, should provide adequate protection against release of hydrocarbons into the ocean by blowout or hydraulic fracturing.

4.1.2 Geologic Hazards

Natural geologic hazards considered potentially capable of adversely affecting the proposed Platform Gail development and production area are discussed in detail in Section 3.1.5, and include seismic groundshaking, slope stability, and shallow gas. It is important to note that the alleviation of environmental impacts relative to most geologic hazards can be achieved through either the siting of project facilities to avoid sensitive areas or proper geotechnical engineering design, as discussed below.

4.1.2.1 Seismic Groundshaking

The proposed Platform Gail project is located in a seismically active region. A seismic analysis prepared by Dames and Moore (1981) for use in the design of the proposed platform recommends a strength level design response spectrum that has a 0.22 g peak horizontal ground acceleration for a 270-year return period. Similarly, a response spectrum for ground motions from a "rare, intense or extreme" event in rock/stiff sand was developed. The Dames and Moore analysis concluded that potential accelerations from such an event would be 0.55 g for the rock spectrum and 0.35 g for the mudline spectrum.

4.1.2.2 Slope Stability

Geotechnical investigations in the proposed platform area and along the pipeline route indicate the area 3000 feet (1000 m) or more north of the proposed facilities has a potential for a small amount of downslope movement under dynamic (seismic) loading. These small deflections would not affect the platform, due to their distance from the site.

4.1.2.3 Shallow Gas

Shallow, dispersed gas horizons were found beneath the proposed pipeline route from an area west of the Platform Gail site to Platform Grace. Depth to the gassy sediments along the pipeline is quite variable and on the order of 10 to 60 feet (3 to 18 m). In the area of Platform Grace, somewhat higher concentrations of gas are found at depths of 170 to 250 feet (52 to 76 m).

4.1.3 Mitigation Measures

4.1.3.1 Development and Production Operations

Alteration of the existing seafloor to install Platform Gail and the proposed pipelines will constitute a minor bathymetry impact. Anchor scars can occur on the ocean floor as a result of anchoring, pipelaying barges, and platform construction support vessels. The extent of any anchor scarring or mounding may vary from area to area. Differences in the amount of disturbance generally result from variations in ocean floor sediments and weather conditions. It has been noted that the most severe scarring of the ocean floor has occurred where drilling vessels or pipelaying barges have been anchored in soft bottom sediments such as is found in the project area, and have been subjected to storm conditions. During normal offshore operations (anchor deployment and anchor retrieval by the lay barge) only minor disturbance of the ocean floor would be expected to occur. Chevron's contractors will be instructed to take all feasible steps to minimize anchor scarring.

If seabed scarring does occur, various alternatives to mitigate the situation will be explored. As a possible mitigating procedure, Chevron could use underwater video equipment and, in some cases, side-scan sonar to determine the extent of disturbance to the ocean floor after platform and pipeline installation. In the event that a disturbance of the ocean floor is indicated by the surveys, Chevron would undertake appropriate mitigation measures to minimize this disturbance, as it appears to impair the future use of the area by fishermen.

The potential for significant impacts resulting from induced seismicity or subsidence were found to be very low. Therefore, no specific mitgation measures are considered necessary. Hazards related to high reservoir pressure conditions are believed to be unlikely, and the proposed well casing program and installation of blowout prevention equipment should provide adequate protection if any problems do occur.

4.1.3.2 Geologic Hazards

The mitigation of potential impacts resulting from natural geologic hazards takes two forms: avoidance and proper engineering design. The proposed platform site and pipeline route were carefully selected to avoid the seafloor irregularities and problem areas identified during the geohazards investigation. Potential hazards that could not be entirely avoided through siting considerations principally include seismic groundshaking, adverse slope conditions and shallow gas. Mitigation of related impacts will be achieved through compliance with geotechnical and structural engineering design criteria that are dictated by good practice and/or required by federal regulatory agencies. In the case of seismic groundshaking, the intent of the Federal requirements is to insure that structures subjected to earthquake loading have adequate energy absorption capacity to prevent collapse under a rare, intense earthquake. This ductility check must demonstrate that the structure-foundation system is capable of absorbing at least four times the amount of energy associated with the level of structural response determined in the strength analysis with the structure remaining stable. A Certified Verification Agent (CVA) will also verify the earthquake design for Platform Gail.

4.1.4 Cumulative Impacts Related to Geology, Soils, and Geologic Hazards

The potential effects of offshore oil development projects that could act cumulatively to create impacts include induced subsidence, induced seismicity, and seafloor alteration. As was discussed previously in this report (Section 3.1.5, Geologic

Hazards), the current understanding of the geologic setting of the regional Santa Barbara Channel area indicates that subsidence or induced seismicity from hydrocarbon extraction is not expected. From a geologic standpoint, the minor seafloor alterations that occur from cumulative projects are isolated and localized, and do not have significance in a cumulative sense. Cumulative geology impacts are generally non-additive because of their localized nature and no mitigation measures in addition to those discussed in Section 4.1.3 are required.

4.2 METEOROLOGY

There are no environmental consequences of the proposed action on meteorology. The indirect effects of adverse meteorologic conditions, such as high waves, are discussed in Section 4.4. Meteorological conditions which effect air quality impacts are taken into account in Section 4.3. Potential planned and future hydrocarbon development projects will not have a significant cumulative impact on regional meteorology.

4.3 AIR QUALITY

4.3.1 Applicable Rules and Regulations

4.3.1.1 Department of Interior Regulations

The DOI regulations apply to any temporary or permanent OCS facility that emits air pollutants which significantly affect onshore air quality. A facility is assumed to not significantly affect onshore air quality if its emissions are below the following emission exemption levels.

Pollutant	Exemption Level (tons per year)
TSP	33.3 D
NO_x	33.3 D
VOC	33.3 D
SO_2	33.3 D
CO	$3400\ D^{2/3}$

Where D = The distance from the proposed facility to the closest onshore area (Anacapa Island - 7.6 statute miles).

The concentrations of pollutants that this exemption level corresponds is directly related to the significance level EPA applies to Class II areas under the Prevention of Significant Deterioration Regulations. These limitations are designed to prevent an area designated as attaining the primary pollutant standards from degrading to any significant degree.

A temporary or permanent facility is subject to these regulations if its emissions on a yearly basis are greater than the calculated exemption level for each pollutant. If less than the exemption level the facility will not adversely impact air quality and therefore is exempt from further air quality review. If a facility's SO_2 NO_x, TSP, and CO emissions exceed DOI exemption levels, further analysis is required. This further analysis involves calculating the onshore air quality concentrations resulting from the facility operations and comparing them to DOI air quality significance levels. This calculation must be completed using a DOI-approved air quality dispersion model.

VOC emissions are reviewed differently since DOI assumes that emitted VOC will react photochemically in the atmosphere and form ozone. Air quality modeling cannot be used to calculate VOC effects on ambient ozone levels because DOI has not approved any photochemical models. For this reason, VOC emission from a facility which is not exempt based on DOI exemption levels for VOC are automatically considered to significantly affect onshore air quality.

The proposed project has two components or activities which must be analyzed under the regulations per 30 CFR, Part 250.57. The first activity is considered temporary and encompasses the platform and subsea pipeline installation activities as described in Section 2. A "temporary facility" is defined by the DOI as "activities associated with the construction of platforms on the OCS or with facilities related to exploration for or development of OCS oil and gas resources which are conducted in one location for less than three years" (30 CFR. 250.2). Mobile source emissions related to the construction activities are not included as part of the temporary facility.

The second activity is the platform operation during its drilling and production phases. Platform Gail is scheduled to complete its primary drilling during the first 8 years followed by approximately 25 years of oil and gas production activities.

4.3.2 Federal Jurisdiction (DOI Regulations)

4.3.2.1 Installation/Construction Phase Emissions

The installation/construction phase under DOI air regulations encompasses two activities. These include installation of the platform and the subsea pipelines within federal waters to Platform Grace. The facility emissions account for all the gaseous discharges from installation equipment required during platform and subsea pipeline installation. The emission calculations were based on past platform installation scenarios. These sources include tugboats required for the derrick barge (platform installation hook-up and commissioning), and the lay barge and trenching barge for subsea pipeline installation. In addition to the derrick barge's electrical generators, a boiler will be operating during 40 days of the installation period. The boiler will provide steam required for pile driving and is diesel fired. The total emissions for the facility installation activities are shown in Table 4.3-1. Detailed calculations for all the emissions are provided in Appendix A-1. NO_x is the emission generated in the largest amount totaling 182.6 tons over the 4 to 6 month facility installation period. These emissions will occur at the platform site and along the 5.4 mile (8.7 km) pipeline corridor from Platform Gail to Grace.

These emissions occur beyond the 3-mile limit and therefore fall under DOI air regulations per 30 CFR, Part 250. The construction activities described conform to the definition of a temporary facility. An analysis of emissions from this temporary facility with respect to the air regulations promulgated by the DOI is as follows:

Installation Phase - Facility Emissions

Table 4.3-2 shows the relationship between the facility construction-related emissions (Table 4.3-1) and the exemption limit determined with respect to Anacapa Island south of the proposed platform. The nearest shoreline to the platform is 7.6 statute miles (12.2 km). The project construction emissions are less than the exemption limit for all contaminants. Thus, the facility construction emissions will not significantly impact onshore air quality and no further air quality review of this temporary facility is required.

Installation Phase - Mobile Emissions

The mobile source emissions for the offshore construction activities occurring within federal waters include crew boats, supply boats and helicopters. A crew boat and make two round trips per day from the Carpinteria Pier and a supply boat will make one round trip per day to the project area from Port Hueneme. Helicopter trips to the construction area will total two trips per day from the Ventura County Airport. It was assumed that more than 50 percent of the support vessels' cruising emissions will occur beyond the 3-mile limit. The detailed calculations of the emissions associated with these mobile sources are included in Appendix A.

The average daily offshore mobile source emissions occurring beyond the 3-mile limit for the duration of the platform construction are as follows: CO = 83.0 lb/day, VOC = 16.3 lb/day, NO_x = 219.9 lb/day, SO_2 = 43.6 lb/day, TSP = 28.1 lb/day (Appendix A).

Table 4.3-1

FACILITY CONSTRUCTION EMISSIONS SUMMARY

Activity	Activity Duration (days)	Emissions lbs/day (tons per project)				
		NO$_x$	VOC	CO	SO$_2$	TSP
Platform Construction						
Installation Phase						
Derrick barge tugboat	2	1314.0 (1.31)	29.8 (0.03)	197.5 (0.20)	65.2 (0.07)	57.4 (0.06)
Cargo barge tugboat	18	1314.0 (~~1.31~~) 11.83	29.8 (~~0.03~~) 0.27	197.5 (~~0.20~~) 1.78	65.2 ~~(0.07)~~ 0.59	57.4 (~~0.06~~) 0.52
Derrick barge	69	1343.3 (46.34)	37.9 (1.31)	354.1 (12.22)	114.8 (3.96)	114.8 (3.96)
Anchor winches	2	923.1 (0.92)	26.0 (0.03)	243.4 (0.24)	78.9 (0.08)	78.9 (0.08)
Main crane	18	157.2 (1.41)	4.4 (0.04)	41.4 (0.37)	13.4 (0.12)	13.4 (0.12)
Auxiliary crane	69	55.7 (1.92)	4.5 (0.16)	12.1 (0.42)	3.7 (0.12)	4.0 (0.14)
Derrick barge boiler	40	95.6 (1.91)	1.2 (0.02)	23.9 (0.48)	169.6 (33.92)	9.6 (0.19)
Derrick barge fugitives	69		1.0 (0.03)			
Hook-up and Commissioning Platform generators	96	621.7 (29.84)	49.7 (2.39)	134.5 (6.46)	41.3 (1.98)	44.4 (2.13)
Subtotals (tons):		84.96	4.04	20.59	40.32	6.74
[illegible] cranes	20					
Subsea Pipeline Installation						
Pipelaying (Tug, Barge and Crane)	30	5220.4 (78.31)	170.4 (2.56)	1441.3 (21.62)	434.5 (6.52)	478.0 (7.17)
Pipeline hook-up (Aux. Generator, Crane, Tug)	20	1237.6 (12.38)	62.4 (0.62)	402.0 (4.02)	97.6 (0.98)	141.1 (1.41)
Subtotals (tons):		90.69	3.18	25.64	7.50	8.58
TOTAL TONS:		175.65	7.22	46.23	47.82	15.32

Table 4.3-2

AIR QUALITY IMPACT PER 30 CFR 250 INSTALLATION ACTIVITIES

Distance From Shore (D) (Statute Miles)	Exemption Limit (E) for SO_2, TSP NO_x, VOC (tons/yr.)[1]	Installation Emissions (Tons/year)[2]				Exemption Limit (E) for CO (tons/year)[3]	Installation Emissions CO (tons/year)[2]
		SO_2	TSP	NO_x	VOC[d]		
7.6	253.08	47.82	15.32	175.65	7.22	13,152	46.23

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[1] E = 33.3 D as stipulated in 30 CFR 250.57-1(d).

[2] From Table 4.3-1, Section 4.3.2.1.

[3] E = 3400 D $^{2/3}$, as stipulated in 30 CFR 250.57.-1(d).

[4] VOC cannot be calculated from factors and/or test data now available. The quantities listed are total unburned hydrocarbons; in all instances, VOC is substantially less than this quantity.

Installation of the subsea pipeline is expected to require approximately 3 months and employ 100 workers. A supply boat will make one round trip and crew boats and helicopter will make two round trips to the project area per day for the duration of this activity. Therefore, the daily emission rate will be identical to the platform construction mobile sources listed previously.

Detailed calculations of these emissions are shown in Appendix A, Table 4.3-1. It was assumed the more than 50 percent of the support vessel cruising emissions and 50 percent of the helicopter emissions will occur beyond the 3-mile limit.

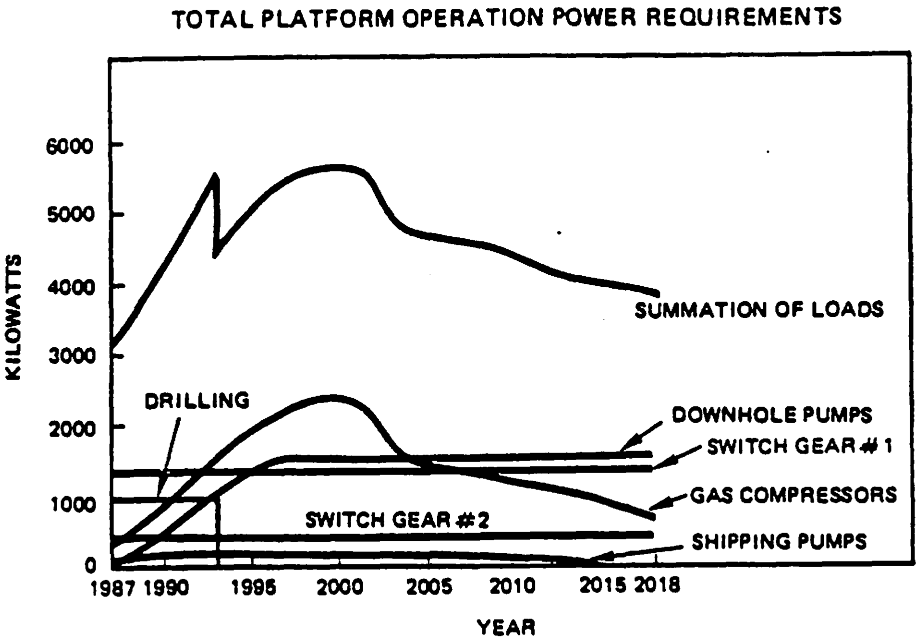
4.3.2.2 Operational Phase Emissions

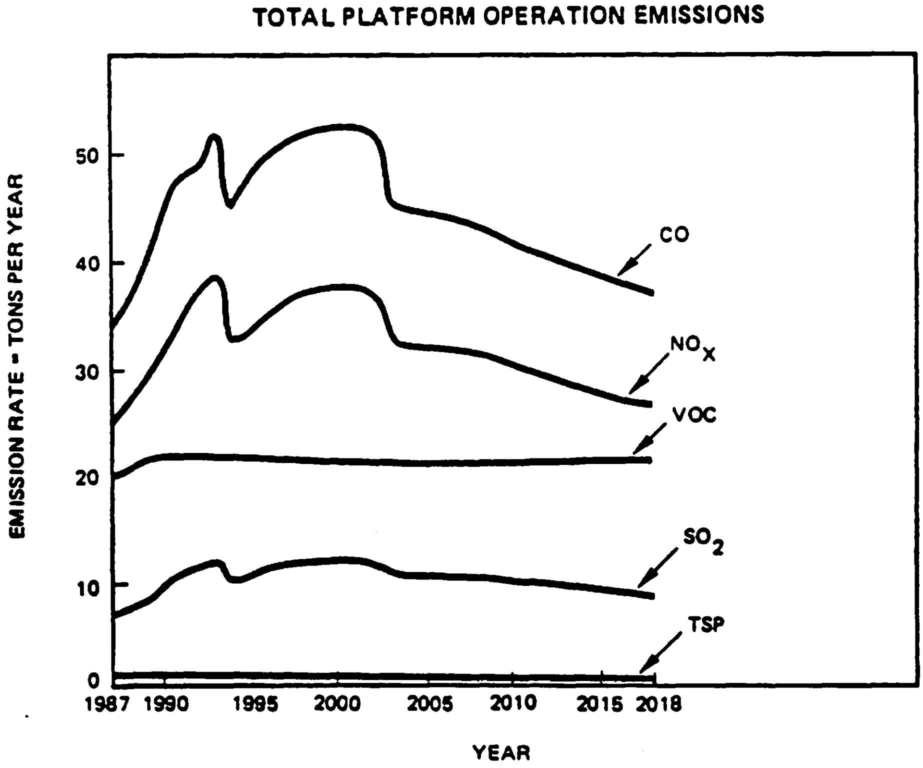
Facility Emissions

The second facility that falls under the DOI regulations is Platform Gail during its drilling and production years. Platform Gail operations include approximately 8 years of development drilling operations in conjunction with crude oil and gas production. Following the drilling phase there will be approximately 25 years of production operations with an electric workover drilling rig onboard. The gas fired turbine generators onboard the platform, in addition to the internal combustion equipment onboard the platform, will emit air pollutants. Because these activities vary with respect to drilling and production rates the emissions from the platform change considerably from year to year.

The primary sources of emissions are the gas turbines and fugitive hydrocarbon leaks. It is assumed that a maximum of two turbines would operate at any given time. The platform power utilization curve in Figure 4.3-1 demonstrates that the power requirements will be met by the use of two 3150 kilowatt (peak rating) gas fired turbine generators throughout most of the drilling and production phases. The emissions of nitrogen dioxide from these turbines were assumed to be reduced by 70 percent by use of water injection controls. In addition to these continuous emissions, the cranes, fire pumps, and emergency generator which are all diesel engine powered periodically operate on a less than continuous basis. The maximum annual platform facility emission rate is 37.3 tons of nitrogen oxides which is about one-sixth of the DOI exemption level (Table 4.3-3 and Figure 4.3-1).

There will be no increase in emissions from Platform Grace associated with gas from Platform Gail. The Stretford gas sweetening unit on Platform Grace has sufficient capacity to handle both platforms' peak gas production. (Note: Platform Gail's design only allows for the sweetening of fuel gas. The main sour gas production was designed to be, and still is, sent off the platform for treatment.)


TOTAL PLATFORM OPERATION POWER REQUIREMENTS


TOTAL PLATFORM OPERATION EMISSIONS

Total Platform Operation Emissions
(Drilling and Production)

FIGURE 4.3-1

Table 4.3-3

PLATFORM GAIL ANNUAL EMISSIONS(1)
(tons/yr)

Year	Power(2) Load (kilowatts)	NO_x	VOC	CO	SO_2	TSP
1987	3017	24.2	20.6	33.8	7.1	0.8
1988	3335	26.0	20.6	36.2	7.7	0.8
1989	3763	28.6	21.6	40.0	8.6	0.9
1990	4283	31.8	21.9	44.8	9.8	1.0
1991	4678	34.2	22.0	48.4	10.6	1.0
1992	5060	36.2	22.3	49.0	11.5	1.1
1993	5463	39.0	22.3	52.6	12.3	1.1
1994	4762	32.3	21.8	45.7	10.6	0.8
1995	5034	34.0	21.9	48.2	11.2	1.0
1996	5317	35.7	22.0	50.8	11.9	1.0
1997	5470	36.7	22.1	52.2	12.2	1.0
1998	5571	37.3	22.1	53.1	12.4	1.0
1999	5590	37.3	22.1	53.3	12.5	1.0
2000	5565	37.2	22.1	53.1	12.4	1.0
2001	5557	37.2	22.1	53.0	12.4	1.0
2002	5460	36.6	22.1	52.1	12.2	1.0
2003	4715	32.0	21.8	45.3	10.5	1.0
2004	4697	31.8	21.8	45.3	10.5	1.0
2005	4685	31.8	21.8	45.0	10.4	1.0
2010	4385	30.0	21.8	42.2	9.8	0.8
2014	4042	27.9	21.6	39.1	9.0	0.8
2018	3779	26.3	21.5	36.7	8.5	0.8

(1) Annual emissions are a summation of:

	NO_x	VOC	CO	SO_2	TSP
a) Flare	0.22	0.22	1.23	0.04	0.04
b) Fugitive hydrocarbons	—	20.0	—	—	—
c) Emergency generators	0.56	0.04	0.12	0.03	0.04
d) Cranes					
(1987-1993)	4.67	0.36	1.02	0.31	0.34
(1994-2018)	2.34	0.18	0.51	0.15	0.17

(2) The principal emission source is the power generating gas fired turbines. Emissions are calculated based on 1.4 lb. NO_x, 0.07 lb. VOC, 2.1 lb. CO, 0.5 lb. SO_2, and 0.03 lb. TSP per 1000 kilowatts output.

Mobile Source Emissions

The mobile source emissions beyond the state 3-mile limit associated with the drilling phase of Platform Gail operations result from supply boat, crew boats and helicopter activities. These sources are not continuous but will operate on a scheduled basis. It is expected that drilling activities will require one crew boat to make one round trip per day for crew transport. One helicopter would service the platform during drilling activities and make one round trip per day. Supply boat transportation during the 8 year drilling phase is expected to average one round trip per day. The boat and helicopter trips result in the following mobile source emissions beyond the 3-mile limit for the drilling phase: CO = 42.6 lb/day, VOC = 10.1 lb/day, NO_x = 118.4 lb/day, SO_2 = 21.7 lb/day, and TSP = 14.7 lb/day. Totals on a yearly basis are shown in Appendix A. It is assumed that the crew boat and supply boat, and helicopters will spend approximately more than 50 percent of the time cruising in federal waters.

The production phase, after development drilling is completed, requires approximately one helicopter trip per day for Chevron personnel. A crew boat will travel to the platform twice per day transporting both crew personnel and small supplies. The maximum daily mobile source emissions occurring beyond the state 3-mile limit for the production years (1994 to 2018) amount to: CO = 100.3 lb/day, VOC = 22.9 lb/day, NO_x = 297.2 lb/day, SO_2 = 34.3 lb/day, and TSP = 37.6 lb/day. This maximum daily emission rate would occur on the 1 day per month that the supply boat as well as the crewboats and helicopters travel to the platform. The average day without the supply boat trip will have the following mobile source emissions: CO = 52.3 lb/day, VOC = 8.5 lb/day, NO_x = 133.4 lb/day, SO_2 = 22.9 lb/day, and TSP = 17.2 lb/day. The percentage of time the crew boat and helicopter spend in federal waters is the same as in the drilling phase. Total emissions for the production phase are shown in Appendix A.

4.3.3 Mitigation Measures

1. An inspection and maintenance program on valve, pump, flange, and compressor seals in hydrocarbon service will minimize hydrocarbon emissions from these sources.
2. Low sulfur fuel will be burned where possible.
3. Water injection will be utilized for NO_x reduction on gas turbine engines.
4. Crane engines will be tuned for low NO_x emissions.
5. All diesel engines presently purchased for use on Gail have a vendor's guarantee to produce less than 8.0 grams NO_x per horsepower

hour in accordance with Chevron specifications. The following motors are being provided:

Service	Tag	Manufacturer	Model
Standby Generator	G-04	Detroit Diesel	16V-149T1
Deck Cranes	CR-01 CR-02	Caterpillar Catepillar	3306T 3412D1T
Starting Air Compressors	K-09	Hatz	Z790
Diesel Firewater Pump	P-18	Caterpillar	3408TA
Diesel Starting Engines for Gas Turbines	G-01 G-02 G-03	Detroit Diesel Detroit Diesel Detroit Diesel	5043-7001 5043-7001 5043-7001

4.3.4 Cumulative Air Quality Impacts

Cumulative air quality impacts resulting from hydrocarbon developments will be examined through the work of the Joint Interagency Study (JIMS). In this study, a grid model (PARIS) is being used to predict the change in ozone concentration from up to 15 planned platforms in the Santa Barbara Channel. It is anticipated that, upon completion of the JIMS project, cumulative impacts for the platforms around the proposed Platform Gail can be examined, provided sufficient meteorological data become available (probably through the SCCCAMP project). To date, it is believed that conservative use of the SAI RPM-II trajectory model would show higher impacts than the PARIS model because of the conservative inputs and assumptions agreed to under the protocol developed by Chevron and the ARB.

Measures to reduce cumulative air quality impacts are being taken by the applicant. Measures implemented to reduce individual and cumulative impacts of hydrocarbon development include: the use of water injection technology on turbine generators to reduce NO_x emissions by 70 percent or better; the use of gas blanketing and vapor recovery systems on all pressure vessels, surge tanks, and other process equipment; the use of a waste heat recovery system (from turbine exhaust); and the use of a fugitive emissions inspection program. These measures are specifically aimed at achieving the overall emissions reductions required to meet the federal ambient air quality standards.

4.4 PHYSICAL AND CHEMICAL OCEANOGRAPHY

4.4.1 Impacts of the Oceanography Environment on the Proposed Project Activities

Physical oceanographic parameters of the lease area (primarily high winds and seas) could temporarily impact the proposed construction of the platform and pipeline. Operations involving supply boats and barges may have limited access to the platform during adverse weather conditions. Normal currents and tide fluctuations should have no effect on drilling and production operations after the platform has been positioned. Pipelines will be designed to resist predicted reoccurring environmental loads resulting from steady-state and wave induced currents, seabed soil liquefaction, slumping and mud slides, and seismic activity. An analysis of the oceanographic data and hindcast models indicate that oceanographic conditions offer no problems for the safe design, installation and operation of the offshore structure. The Santa Barbara Channel presents relatively mild conditions when compared with other offshore petroleum regions (e.g., Beaufort Sea, Gulf of Mexico and North Sea).

In accordance with Chevron's Critical Operations and Curtailment Plan drilling activities will be restricted during severe weather and sea state conditions. Chevron has submitted to the MMS a Critical Operations and Curtailment Plan as a component of the Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace. Fog is most frequent during the summer and may restrict visibility (less than 5 percent of the time) preventing helicopter and boat operations as well as certain drilling operations. High winds (above 34 knots) occur at a maximum of 1.1 percent of the time and waves above six feet occur only 7 percent of the time off the southern California coast. These high winds occur most frequently in the spring when strong northwesterlies result from the strengthening of the Pacific High (Bureau of Land Management, 1979).

The waters off Anacapa Island do not experience high seas and hazardous wind conditions as are found in the western channel and around the western islands. During the McClelland Engineers' marine survey (1984), the research vessel encountered winds up to 35 knots and sea swells up to 7 feet (2 m) making sampling difficult. However, the platform itself should not be impacted by severe weather and sea states since it will be constructed to withstand conditions in excess of which it will be exposed. Refer to the Development and Production Plan for more information.

Adverse oceanographic conditions could hamper oil spill containment efforts in the unlikely event of an oil spill. Both the Mr. Clean I and Mr. Clean II have equipment capable of operating safely and effectively in moderate to heavy seas with response times to the lease area of approximately 3 and 12 hours, respectively. Oil spill containment efforts would be stopped in a severe storm with high seas if equipment deployment and containment efforts became ineffective and unsafe for the spill response teams. A severe storm with high winds and seas would act to disperse an oil slick, thus reducing the impact if the oil were to reach shore.

If sea states increase to a point which render mechanical cleanup methods unsafe or ineffective, Chevron may elect to initiate dispersant use request procedures. Chevron's Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace is designed to assist Chevron, Clean Seas, and contractors in responding quickly, safely, and effectively to an oil spill during normal and severe weather conditions. Implementation of the cleanup and control measures described in the plan will help reduce impacts on water quality should an accidental release occur.

4.4.2 Effects of Proposed Project Activities on the Ocean Environment

Operation of Platform Gail will have little or no impact on physical oceanographic conditions, such as sea state, currents, tides, waves, water depths, or longshore transport processes. The presence of this facility in the ocean environment causes minor turbulence in the immediate vicinity of the structure. This turbulence may contribute to the dispersion of materials discharged into the ocean and localized redistribution of sediments. Project-related impacts on the ocean environment will be associated with water quality effects. Specific water quality effects expected to occur as a result of the proposed project are discussed below.

4.4.3 Effects of the Proposed Project Activities on Water Quality

4.4.3.1 Introduction

All discharges associated with platform and pipeline construction and operations such as hydrostatic test water, sanitary and domestic waste, muds and cuttings, deck drainage, desalination brine, cement slurry, produced water, and completion fluid will result in intermittent, localized turbidity and water quality changes but are not expected to have adverse cumulative effects on the water quality in the vicinity of the proposed project.

All of the wastes discharged from the platform will be in accordance with the effluent limitations and monitoring requirements set forth in the General NPDES Permit for Oil and Gas Operations on the OCS Offshore Southern California (refer to Section 2.11 for status of the NPDES permit). The NPDES permit sets limits on the type and amounts of substances that may be discharged to receiving waters and require that the discharge comply with the monitoring and reporting program described in the permit. Oil contaminated substances will be containerized and transported to shore for disposal at an EPA approved disposal site.

All discharge points on the Outer Continental Shelf (OCS) are located farther than 3280 feet (1000 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 or the extended area of marine sanctuary surrounding Anacapa Island.

4.4.3.2 Platform and Pipeline Construction Impacts

Platform construction will create localized turbidity caused by suspended solids in the water column. This condition will not have an adverse cumulative effect upon flora and pelagic fauna. The water depth and currents in the project area ensure maximum dilution within a short distance and rapid settling of the suspended plume.

Sanitary sewage generated during platform and subsea pipeline installation would be processed by U.S. Coast Guard-approved treatment units located on the work vessels. Treated effluents would be intermittently discharged to the ocean in accordance with a NPDES permit. These sanitary waste discharges would be rapidly dispersed by surface currents and waves, resulting in no detectable degradation of water quality within 15 feet-30 feet (5-10 m) from the discharge point. Thus, ocean water quality would not be affected significantly.

Potable water requirements on the order of 1700 gallons (6426 l) per day during platform installation and approximately 1500 gallons (5677 l) per day during subsea pipeline installations will be met by desalinization units onboard the work vessel. The brine wastewater stream would be generated at a ratio of 6:1 (brine:potable water), with a discharge salinity of 40 parts per thousand. Upon discharge to the ocean, the brine would tend to sink because of its slightly higher density. Complete mixing and dispersion of the brine plumes is expected to occur within a distance of a few meters from each plume centerline. Thus, the effect of brine discharges at these levels on water quality during installation is expected to be of neglible significance.

In addition, the new platform would require approximately 200,000 to 250,000 gallons total (757,000 l to 946,000 l) of seawater for hydrostatic testing prior to the initiation of drilling. After use, hydrostatic test water would be discharged to the ocean in accordance with the NPDES permit.

Hydrostatic test water may include small quantities of oil and grease (used as a lubricant or coating) and trace metals. As a result, the concentrations of these materials in discharged test water may slightly exceed those normally found in seawater. However, test water concentrations of these materials are not expected to be significantly higher than concentrations in seawater, and the materials would be dispersed shortly after test water is discharged. Thus, within hours after release of test water, there would be no detectable increase in these materials in receiving waters and no significant impact on ocean water quality.

Any other liquid effluents will be collected in containers and shipped to shore. These effluents would be hauled by tank truck to an EPA approved disposal site.

4.4.3.3 Platform Operational Impacts

The primary impacts on water quality from the operation of the platform and pipeline will come from discharges of drilling muds and cuttings, produced water, minor platform discharges and from oil spills. Estimated quantity of various effluents from the platform are shown in the following table.

Effluent	Average Quantity
Drilling mud*	900 bbl/well
Cuttings	2,852 bbl/well
Completion fluid*	600 bbl/well
Sanitary effluent	2,000 gal/day
Domestic effluent	10,000 gal/day
Produced water	2,800 bbl/day
Seawater distillation brine	72,000 gal/day
Engine and pump room drainage** and washwater (deck drainage)	2,000-3,000 gal/day
Cement slurry	50 gal/day

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*Based on figures presented in the DPP

**The quantities are an estimated average discharge. Daily quantities will vary primarily due to rainfall.

Drilling Muds and Cuttings

Platform Gail is a 36 slot drilling and production platform. Each well drilled from Platform Gail is expected to produce approximately 2852 barrels of drill cuttings. These cuttings will be thoroughly washed to remove and recover fines, drilling mud and oil and grease, and then will be discharged to the ocean in accordance with a NPDES permit through a vertical pipe (disposal cassion) whose terminus will be at least 240 feet (73 m) below MLLW. A minor increase in local water column turbidity would occur during periods of cuttings disposal. Cuttings that cannot be washed clean of oil will be containerized, transported to shore and disposed at an approved disposal site.

Drilling (both phases) is expected to be carried out over a 6 year period, and it is estimated that a total of 102,672 bbl of cuttings, 30,600 bbl of clean drilling muds and 20,400 bbl of completion fluids will be discharged at the platform site over that time frame.

During drilling, muds will be recycled to the maximum extent practicable. When recycling is not possible, cleaned muds (approximately 900 bbls/well) will periodically be released to the ocean through the disposal caisson, as well as 600 bbls/well of completion fluids. These spent drilling muds will be discharged in accordance with a NPDES permit and in conformance with OCS Order No. 7, both of which limit allowable discharges. Refer to Section 4.6.4 for discussion of impacts to benthic organisms. No discharge of chrome lignosulfonate muds will occur as Chevron does not anticipate using this type of mud. Any oily or otherwise contaminated drilling mud will be collected and transported by supply vessel to Port Hueneme, then trucked to an approved disposal site. Drilling muds are also barged to shore if other "nonapproved" additives are used, or if approved additives are used in excess of concentrations specified in the NPDES permit.

Simulation of mud disposal was carried out by Chevron (1984) using a variety of oceanographic conditions including temperature/density, current speed and direction. The mud type was a lightly treated chrome-free lignosulfonate mud (Generic Mud Type 7). Mud density was 10.1 lbs per gallon with an initial solids concentration of 3.04×10^5 mg/l. Simulated discharge was 480 bbl (20,160 gallons) in 1 hour at a depth of 240 feet (73 m). The results of the simulation indicate that the soluble fraction of the mud is diluted to 1000:1 in 2.9-4.2 minutes at a distance of 82 to 91 feet (24.6-27.3 m) from the discharge point. The solid phase had slightly different dispersion characteristics than the soluble phase since it dispersed both horizontally via currents and vertically due the particulate weight. Under the six simulated conditions the solid phase component reached 1000:1 dilution in 3.6-13.4 minutes at a distance of 73-138 feet (22-42 m). Based upon these plume simulation results dispersion of the plume to 1000:1 is expected to occur within 150 feet (45 m) of the discharge point. Because the effects would be localized and intermittant no permanent changes to water column characteristics are expected and the overall impact on ocean water quality is expected to be of negligible significance.

Studies on the dispersion of discharged drilling muds have shown that dilution occurs rapidly and that background concentration levels of the mud components are reached within short distances of the discharge point; examples of these data are presented in Table 4.4-1. Results of several studies which were reported in the proceedings of the symposium "Research on the Environmental Fate and Effects of Drilling Fluids and Cuttings" (presented at Lake Buena Vista, Florida, in January 1980) suggest that because of their rapid dilution, discharged muds do not result in significant effects on water quality. In addition to these studies, a drilling mud dispersion field test was conducted by Ayers et al. (1980) to assess the effect of drilling fluids on water quality parameters during high-rate, high-volume discharges to the ocean. Their results showed that as a result of rapid settling and dilution, suspended solids and trace metal concentrations in the water column decrease rapidly with distance from the discharge source. They concluded that discharged drilling fluids have a negligible effect on open ocean water quality even during high-rate, high-volume discharges.

In a study by Trocine and Trefrey (1983) the idea of a "whole field" perturbation from drilling muds was discussed. Levels of particulate barium ranged from 100-400 ng/l in an area on the Texas OCS with many drilling platforms. This is high compared to the 10-20 ng/l found in open outer shelf waters but was less than the levels of dissolved barium in Gulf of Mexico waters (11,000 ng/l). This barium "haze" was attributed to the large percentage (18 percent) of small (F4 microns) barium particules in the barite. These small particles have an extremely low settling velocity (less than 3 m per day). The authors felt that the sporadic release of drilling muds during the drilling process would create and maintain this "haze," with its dimensions and persistence varying as a function of current velocities and direction and the amounts of drilling muds released. The "haze" should have no significant long-term effect on water quality.

Produced Water Discharges

As part of the drilling and production program, Chevron will separate formation water from oil at the platform prior to pumping ashore. The discharge of produced water is regulated by a NPDES permit from the EPA. Treatment on the platform includes the removal of residual oil (discharge F72 ppm). Produced water also includes some constituent heavy metals, high biochemical oxygen demand, and often, a high level of ammonia. It is also thermally enriched due to the heat required in the separation process. All of these factors will be considered in the application for an

Table 4.4-1

DILUTION OF DISCHARGED DRILLING MUDS

Investigator	Reported Dilution
Ecomar (1978)	100,000:1 within 100 m of discharge point; background levels reached within 200 m
Ray and Meek (1980)[1]	500-6000:1 within 3 m of discharge point; 50,000-600,000:1 within 100 m
Ayers et al. (1980a)[1]	1000:1 within 40 m of discharged point
Ayers et al. (1980b)[1]	100:1 in immediate vicinity of discharge point; 10,000:1 within 120 m; background levels reached within a few hundred meters
Brandsma et al. (1980)[1]	100:1 at 10 seconds after discharge; 1000:1 after 1 minute
Shinn et al. (1980)[1]	32:1 within 5 m of discharge point; 64:1 within 96 m
Zemel (1980)[1]	1000:1 within 10 m of discharge point

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[1] In Proceedings of the Symposium: Research on Environmental Fate and Effects of Drilling Fluids and Cuttings, Lake Buena Vista, Florida, January 1980.

NPDES permit and the subsequent monitoring requirements. References should be made to the DPP for treatment processes.

Other Discharges

Water quality is not expected to be impacted by the disposal of sanitary wastes into the ocean through the disposal caisson. The site area is typical of offshore water within the Southern California Bight, having naturally small or negligible coliform bacteria concentrations. No detrimental effects are anticipated because of the sewage processing technique adopted (aeration, chlorination) and the dilution factor. Anticipated discharge of sewage and domestic wastewaters is 7000 gpd.

Since all solid wastes will be transported onshore at Port Hueneme and then transferred via truck to an approved onshore disposal site, no offshore impacts are anticipated. No significant impact is expected to the onshore facilities from the small volumes of disposed materials.

Freshwater for the platform will be generated by desalinization of seawater. The distillation brine will be 15-20 percent higher in salinity than receiving waters and will be discharged at an estimated rate of 50 gpm (72,000 gpd). This will result in a slightly heavy plume which will be rapidly diluted. No impact on water quality is expected.

Clean engine, pump room and deck drain water will be collected by the platform drainage system and disposed through the disposal caisson. The quality of this effluent will meet the conditions set out in the NPDES Permit. No free oil will be discharged and therefore no impacts are anticipated.

Any cement slurry will be discharged to the ocean through the disposal caisson according to the conditions specified by the NPDES Permit. This will not be a continuous discharge. It should have an effect similar to the disposal of drilling muds and cuttings causing a temporary turbidity plume for a short period, but should not have a significant adverse impact.

Oil Spill Impacts

The discharge of crude oil from an accidental release, pipeline leak or rupture resulting in an oil spill of moderate to large ($\leq$240 barrels) magnitude should not significantly affect the quality of the surrounding waters based on observations of previous spills of comparable size (McAuliffe, 1973). If the water quality is affected, it would be generally of short duration. The presence of a floating oil slick would pose the most adverse impact. Water quality parameters which may potentially be altered by the presence of an oil slick include toxicity, biochemical oxygen demand, dissolved oxygen, nutrients, odor, and light transmittance.

Implementation of the cleanup and control measures described in Chevron's Oil Spill and Emergency Contingency Plan will assist in reducing impacts on water quality should an accidental release of oil occur.

Chevron will maintain oil spill control equipment on the platform at all times and will request assistance from Clean Seas and contractors when necessary.

- **Toxicity**

The most toxic period for crude oil spilled into the ocean is within the first few days after an oil spill occurs. It is within this time period that volatile low molecular weight hydrocarbons are still present (Bureau of Land Management, 1979). After and during initial evaporation the nonvolatile oil acts as a source of pollution, adsorbs onto small particles, settles to the bottom and remains as a source of pollution, and depletes dissolved oxygen by oxidation of chemical or biological products. Toxicity tests performed on oil by EPA show that aromatics are the most toxic, napthenes and olefines are intermediate in toxicity, and straight paraffins are the least toxic hydrocarbons present (State Lands Commission, 1980). Other reports (Blumer et al., 1971) suggest that oil can concentrate other fat-soluble substances such as pesticides.

- **Biochemical Oxygen Demand (BOD) and Dissolved Oxygen**

The film created on the water surface by an oil spill forms a barrier inhibiting gaseous exchange between the water and the atmosphere. As the petroleum concentration is increased, the dissolved oxygen content in sea water may be reduced through respiration of aquatic organisms and biochemical oxygen demand (BOD). In general, the BOD requirement of spilled oil would be spread over a relatively large area and concentrated in the upper layers of water (Alyakrinskaya, 1966). Since the near-surface waters are the most oxygen enriched, there should be sufficient capacity to satisfy the increased BOD (McAuliffe, 1973), except under conditions mentioned below. Oxygen levels would be replenished by reaeration, photosynthesis, and mixing by waves and currents.

Observations by the U.S. Fish and Wildlife Service (1969) during the Santa Barbara oil spill showed small dissolved oxygen reductions under thin slicks when compared with associated uncontaminated water. Kolpack et al. (1971) also detected decreased dissolved oxygen concentration in the upper 984 feet under an oil slick. These reductions, probably associated with increased biochemical oxygen demand, were insufficient to cause any biological damage, because resultant oxygen levels remained high.

In order to incur a significant reduction in dissolved oxygen at least one of several conditions would have to occur. These would include: (1) a continuous thick layer of oil in a broad layer (over hundreds of acres); (2) several days of calm surface conditions and minimal currents to retard mixing beneath the slick; (3) the presence of large populations of zooplanktonic and nektonic organisms (which use dissolved oxygen for metabolic processes and excrete wastes with relatively high BOD) and low populations of phytoplankton (which produce oxygen through photosynthesis); and (4) low activity levels of oleophilic (oil loving) bacteria.

- **Nutrients**

No significant variations during or after the 1969 oil spill were measured in near-surface nutrients (NO_2, NO_3, PO_3, SiO_2) in those areas contaminated by an oil slick (U.S. Fish and Wildlife, 1969). Kolpack et al. (1971) did not establish any significant variations in these same nutrients attributable to the Santa Barbara oil spill.

- **Odor**

At a petroleum concentration of 5 parts per thousand, polluted seawater covered by an oil film can retain the smell for 2 to 3 weeks. Under these conditions, petroleum may be taken to be a stable contaminant of the water (Alyakrinsekaya, 1966). The duration and extent of the slick, constituent hydrocarbons present in the petroleum, and temperature serve to determine the persistence of odor. As temperatures rise, the dissipation of odor will correspondingly increase. Odor can persist 1 to 3 days after dispersal of the slick and from 1 to 25 days when oil films are present.

- **Light Transmission**

The extent to which light transmission may be affected by oil slicks will depend on the nature of the oil and its thickness. Slicks of moderate thickness may be expected to reduce light penetration, but reduction of light transmission is, at most, a transient situation and should have minimal biological effect (McAuliffe, 1973). Only a small portion of a total spill area surface will be significantly affected under normal conditions, since oil remaining on the water surface tends to develop into a thick rope-like configuration surrounded by a thin sheen of surface oil. Only under extremely calm sea surface conditions, which occur rarely, does oil tend to form a continuous slick (McAuliffe, 1973). Measurements of photosynthetic activity (light required) measures under slicks at Santa Barbara showed no reduction in photosynethic activity (Oguri and Kanter, 1971).

4.4.4 Cumulative Impacts on Physical and Chemical Oceanography

This offshore hydrocarbon project should not contribute to any cumulative impacts on physical and chemical oceanography which may result from other cumulative projects in the greater Santa Barbara Channel area. This conclusion is based on the following considerations:

1) Minor increases in turbidity in the vicinity of the platform from the discharge of drilling fluids.

2) Minor increases in biochemical oxygen demand in the vicinity of the platform from the discharge of produced waters. The identified impacts will generally be limited to the area within 100 to 1000 meters of the point of discharge. These near-field impacts will be rapidly diluted in the water column. Thus, these impacts do not take on any added significance when the cumulative effect of cumulative projects are considered.

3) Minimal toxicity of drilling fluids which are discharged. This impact will generally be limited to the area within 100 to 1000 meters of the point of discharge (A.D. Little, 1984). Rapid dilution of the discharges to nontoxic levels occurs within this area. In addition, only EPA-approved generic muds will be discharged from the platform. All other muds will be barged to shore for onshore disposal when they do not meet EPA toxicity limits. Thus, these impacts do not take on any added significance when the cumulative effect of cumulative projects is considered.

4) Potential accumulation of drilling mud constituents in sediments. Computer simulations of the fate of a bulk drilling fluid discharge from the platform predict that measurable amounts of mud will be deposited on the bottom in localized areas, depending on currents and water depth. This localized impact will be temporary, diminishing as the sediment is reworked by benthos, bottom transport, or natural sedimentation of new materials. In addition, the National Research Council found that documented effects of long-term mud discharges on the benthos are transient and limited in area. Thus,

this impact will not take on any added significance when the cumulative effect of cumulative projects is considered.

5) Potential Oil Spills. The cumulative risk of platform oil spillage for the 10-year period from 1986 through 1995 has been calculated by Dames and Moore (Dames and Moore, 1985), using the Minerals Management Service production and spill rate exposure statistic (Minerals Management Service, 1983). This statistic has been applied to the total production estimated for the Santa Barbara Channel and Santa Maria Basin (A.D. Little, 1984). The results of the analysis are presented in Section 5. As shown, the overall probability of spill occurrence is affected to a very minor degree by the exclusion of Platform Gail's contribution to spill risk (Dames and Moore, 1985).

Mitigation measures relative to oil spill impacts are discussed in Section 4.6.11. In addition, Chevron participates in area-wide programs to improve oil spill response coordination and planning. Most recently, Chevron has worked with Clean Seas to gain approval for the acquisition of Mr. Clean III, which is the third and largest oil spill response ship in the Clean Seas fleet. This ship will be operational by late February 1986. Further, Chevron has improved its onsite immediate response capability as outlined in Section 600 of the MMS/USCG-approved Grace-Gail Oil Spill Contingency Plan. Chevron is committed to the improvement of oil spill response planning by continued participation in the Clean Seas Cooperative.

4.5 OTHER USES OF THE AREA

4.5.1 Commercial Fishing

Potential commercial fishing area will be lost at the project location for the life of the platform (30 years). Based upon the dominant species taken, based on Fish and Game records, the primary fishing gear used in the area are purse seines and trawls. Bottom trawling is used to take primarily spot prawn and ridgeback shrimp, rockfish and flatfish, while purse seines are used to take anchovies and mackeral.

The representative of the Fishermen's Co-op (Mr. Bozanich, personal communication, 1984) commented that purse seining activity in the general project area was significant and could be impacted. The majority of the purse seining activity is in the mid-channel area between Anacapa Island and the mainland, with Pacific mackeral, jack mackeral and northern anchovies being the major species. Mackeral are generally fished in waters shallower than 300 feet (91 m).

Trawling activity in the project area is considered to be moderate by California Fish and Game (Mr. J. Sunada, personal communication, 1984). At the present time there are restrictions on trawling within 3 miles (4.8 km) of the islands, although there are no restrictions on fishing in the surrounding marine sanctuary. The primary fishing is for rockfish, spot prawns and flatfish including near shore trawling for halibut. Figures 3.5-2 and 3.5-3 show the major trawling areas.

Local commercial fishermen have often voiced concern regarding potential damage to nets and trawls from unrecovered petroleum-related equipment left on the ocean bottom and substrate alteration from mud discharges and anchor scars. According to California Fish and Game, most of the trawling on shrimp is performed between 70 and 120 fathoms (420 to 720 feet), however, trawling equipment is capable of fishing at depths of 200 fathoms (1200 feet) and greater. Water depths at the platform ranges from 120-180 fathoms (720-1080 feet) and as such may be subject to trawling activity.

A study conducted by Centaur Associates, Inc. (1981) examined the vessel maneuverability of trawlers, among other fishing boats, in relationship to offshore oil and gas structures. The study indicated that typical California trawling vessels can retrieve their gear from 100 fathoms in 15 to 45 minutes while traveling at an average speed of 2 knots, resulting in a recovery distance of approximately 1.3 nautical miles (2.1 km). Trawling in shallower waters would require considerably shorter retrieval times and distances. The deployment of trawl gear is generally much faster than retrieving. The turning radius for the trawler and deployed trawl system were estimated as being between 650 and 1320 feet (198 and 402 m), depending upon the length of the trawler itself and the depth of the gear.

Based on the above parameters for operation of trawling vessels, the study concluded that oil structures would not prove to be a significant limitation to fishing activity or maneuverability because the trawler would be able to run off into a clear area. Observations and personal communications conducted by Centaur during the course of the study determined that trawlers can come within 100 to 200 feet (30 to 60 m) of an oil structure if 1) the position of the obstruction is known fairly precisely, 2) weather, sea state, and current conditions are not adverse, and 3) there is little concern for debris scattered around a structure (Centaur Associates, 1981).

Some concern was raised by Mr. John Tasso (Universal Packers, Ventura, personal communication) regarding the potential interference of the platform on purse seining. Once the purse seine is set, the fishing vessel is dead in the water while the net is retrieved. Both the net and vessel drift with the prevailing current (generally to the southeast in this area) and many drift from 2-4 miles (3.2-6.4 km) during the net hauling. Depending upon the current speed and direction this could create a de facto restricted zones, slightly ellipsoid in shape "upstream" from the platform, and could result in a fishing area restriction of 2-10 square miles. This area estimate is based upon the size of the nets (310-400 fathoms; 1860-2400 feet), and drift distances of 2-4 miles (3.2-6.4 km) and should be considered a relatively high estimate, since no data is readily available.

Based upon the projected installation schedule for the platform and pipeline, the platform will be launched and installed from August through mid-September and the pipeline from mid-September to December. During the placement of the platform, fishing will be restricted in the immediate area. This restricted area will be a circle with a 1 mile (1.6 km) radius originating from the platform. It is probable that fishing will be affected to the same magnitude as previously discussed for the fixed platform (2-10 square miles (3.2-16 square km) of area affected).

During pipeline installation the restricted area will be slightly higher due to lay barge anchoring and the linear routing. It is estimated that fishing will be restricted within 1 mile (1.6 km) of the pipeline and lay barge resulting in the total short-term loss of approximately 12 square miles (16 square km) of fishing area over a 1-1/2 to 2 month time frame. The affected area will be constantly changing during the pipeline construction period and the day-to-day affected area may be less than 2 to 4 square miles (3.2-6.4 square km). Since fishing for anchovies and mackeral is a year round activity, the restriction of this area will require some fishermen to move to other fishing areas for the construction period. Fishing in this area can vary from 1-2 days per week to nearly continuous fishing for weeks at a time (J. Tasso, Universal Packers).

The proposed offshore pipelines will be designed and constructed with either shrouding of pipeline connections or sandbagging to eliminate snagging or otherwise interfering with fishing gear. For large structures, slope sided enclosures may be required.

Anchor scars can occur on the ocean floor as a result of anchoring, pipelaying barges, and platform construction support vessels; creating problems for bottom trawlers. The extent of any disturbance may vary from area to area. Differences in the amount of disturbance generally result from variations in ocean floor sediments and weather conditions. It has been noted that the most severe scarring of the ocean floor has occurred where drilling vessels or pipelaying barges have been anchored in soft bottom sediments such as is found in the project area, and have been subjected to storm conditions. During normal offshore operations (anchor deployment and anchor retrieval by the lay barge) only minor disturbance of the ocean floor would be expected to occur.

If seabed scarring does occur, various alternatives to mitigate the situation will be explored. Chevron has committed to conducting a post-construction survey of the pipeline and platform project area. Retrievable debris will be removed.

Chevron will continue its efforts to inform local fishermen of the schedule, locations of construction activities, and potential hazards during the construction phases of the project via meetings with fishermen's groups, announcements of the project's activities in the Coast Guard's Notice to Mariners, and through announcements in the Santa Barbara Marine Advisory Newsletter. If the fishermen foresee a conflict with their operations, a Chevron Platform Gail contact person, and/or the Fisheries and Oil Industry Liaison Office are available for consultation.

If anchoring procedures or accidental equipment loses attributable to Chevron's activities leave seafloor obstructions which foul fishing nets, fishermen will be compensated for lost gear by Chevron. The Fishermen's Contingency Fund will continue to be available in those cases where clear responsibility cannot be established. Therefore, potential impacts of the proposed project on commercial fishing are expected to be minor, localized, and temporary.

Several studies (Allen and Moore, 1977; Wolfsen et al., 1979; Benech et al., 1980) have indicated that offshore oil structures serve as attractants to many types of fish and may actually benefit sport and commercial fishing stocks in the immediate area. Observations of high densities of commercially harvestable shrimps and crabs in the cuttings mound under similar channel platforms, such as Exxon's Hondo A, indicate that these species are not directly harmed by the mud discharges, although the long-term effects are still being studied.

Indirect effects of the project on commercial catches could also occur in the event of an oil spill. A major spill in the project area could limit commercial and sport fishing operations for anywhere from a few days to a couple of months, depending upon the extent of the spill. During the 1969 Santa Barbara spill, the reluctance of fishermen to foul boats and gear caused a measurable short-term reduction in sport and commercial fishing activity. However, because the project location is some distance from fishing harbors and ports, and containment equipment is readily available, the unlikely occurrence of a large spill at the project site would represent a short-term impact on the local fishing industry. Further, the possibility of a large spill is considered to be remote.

Following the Santa Barbara spill, fish trawl surveys were performed and compared with pre-spill studies to determine the extent of the impact on marine fishes. There appeared to be no significant reduction in the abundance and diversity of fishes following the spill, and the larvae of common fishes were found to be plentiful and uncontaminated (Ebeling et al., 1971). Thus, indirect impacts to the fishing industry as a result of possible oil spill contamination to commercial taxa are anticipated to be insignificant.

4.5.1.1 Cumulative Impact on Commercial Fishing

Cumulative developments offshore may increase the magnitude of impacts on commercial fishing identified for the proposed action. Such impacts could occur from loss of fishing areas due to the placement of platform structures, increased vessel traffic, and construction activities. Impact on purse seining and bottom trawling would be most significant during concurrent construction of several platforms due to the increased vessel activity required and the installation of support structures such as pipelines. The impact is short-term but could be regionally significant if several platforms are constructed in any one general area concurrently. Long-term impact on trawling is not significant since the actual area of exclusion is small.

Mitigation measures discussed for the proposed action are applicable to these cumulative impacts and are standard practice in the oil industry. Further, Chevron has committed to the use of crew and supply boat corridors set up by the Santa Barbara Channel Oil Service Vessel Traffic Corridor Program.

4.5.2 Shipping

The proposed project will result in increased small vessel activity in the Santa Barbara Channel. The maximum small vessel activity will occur during the construction phase, when three vessels will make one round trip to the platform site per day. If the subsea pipeline in constructed (concurrently), a maximum of five vessels will make one round trip per day. Chevron's current plans include the use of Port Hueneme as a supply vessel base and Carpinteria Pier and Ventura County Airport as a crew base. The level of vessel activity with Chevron's proposed project is minor in comparison to existing vessel activity at these locations.

The addition of an offshore structure in the Santa Barbara Channel may be considered a potential hazard to navigation, although it could also be considered as a navigation aid. Project-related support vessel movements during the construction through production phases would increase marine traffic in the project area, thereby increasing the possibility of ship-to-ship collisions.

Platform Gail will be erected approximately 0.6 nm (1.3 km) north of the northbound lane of the newly moved VTSS as shown in Figure 3.5-4. The VTSS will be pivoted slightly in a southerly direction, primarily as a result of inceased oil and gas development in the vicinity (Federal Register 47 [122], June 21, 1981). The VTSS modification was based on Chevron's development proposal for OCS P-0205 (which originally was situated in the northbound lane of the VTSS) and by Union Oil Company. A 500-meter buffer zone is also recognized for each transit lane. The proposed platform is outside of this buffer zone. The modification of lanes has received approval by the Coast Guard and IMO and went into effect on February 1, 1985 (considerably before Platform Gail construction is planned to occur).

Historically, vessels operating in the Channel have generally adhered to the traffic lanes. However, compliance with the VTSS is on a voluntary basis. Vessel traffic in the vicinity of the proposed project site is fairly heavy as shown in Table 3.5-2, Section 3.5.2.

Potential marine safety considerations associated with the erection of Platform Gail are ship-to-ship and ship-to-structure collisions. Although all major ships are equipped with radar, an accidental collision during periods of low visibility, such as at night or in fog, is a risk. Fog is the primary cause of low visibility in the Santa Barbara Channel area.

In addition to its location in an area subject to low visibility during portions of the year, Platform Gail is situated between Anacapa Island and Port Hueneme, north of the northbound VTSS shipping lane (approximately 4100 feet (1249 m)).

According to the 11th U.S. Coast Guard District, there have been no reported incidents involving the ramming of Santa Barbara Channel OCS platforms by ships. However, there have been a number of platform ramming incidents in the Gulf of Mexico. For the 15-year period beginning July 1, 1962 and ending June 30, 1977, the U.S. Coast Guard recorded 10 fixed-structure rammings by vessels greater than 500 gross tons while in the Gulf of Mexico outside Zone 1 (Texaco, 1983). As has been pointed out in several recent studies (e.g., Reese-Chambers Systems Consultants, 1981; National Maritime Research Center, 1981), Gulf of Mexico historical platform ramming rates are probably not applicable to the situation in the Santa Barbara Channel because of differences between the two regions concerning the variables listed above. For example, the possibility of a platform/vessel collision in the Gulf of Mexico would be expected to be greater than that for the Santa Barbara Channel because of the greater density of platforms in the Gulf. Thus, the Gulf of Mexico rate is, without question, conservative (i.e., too high) for the Santa Barbara Channel (Texaco, 1983).

The rate of platform ramming incidents in the Gulf of Mexico can be estimated by dividing the number of objects struck in **n** years by the cumulative number of fixed structures that could have been struck during that period. Based on data provided by the MMS (1981) plus earlier tabulations by Danenberger (1976) and Walker et al. (1975), it is estimated that for the period 1963 through 1977, the cumulative exposure of Gulf of Mexico deep water offshore platforms to potential collisions totaled approximately 28,000 structure-years. The rate of platform/vessel collisions inferred from these data is 3.6×10^{-4} ramming/structure-year by vessels larger than 500 gross tons (Texaco, 1983).

The frequency of platform ramming incidents can be expected to vary according to the density of platforms and the density of vessel traffic. Differences in traffic control procedures, meteorological and oceanographic conditions, and other factors are also likely to influence the rate.

Since the statistical data base for collisions/rammings in the channel region is minimal, probalistic methods are often used to assess shipping risks. A recent California State Lands Commission (SLC) leasing document (1982) analyzed the probability of a ramming based on historical data in the channel, that is, the number of safe platform passings and the length of time the platforms have been closer than 6 nautical miles to the vessel traffic lanes.

More distant platforms, mostly in State waters, were disregarded in the SLC study. The platforms considered and the number of safe passages by transiting vessels are as follows:

Santa Barbara Channel Platforms	Safe Platform Passages (1969-1981)
Platform Grace	24,000
Platform Hondo	29,000
Platform Harry	30,000
Platform Herman	68,000
Platform Gina	4,000
Platform Gilda	4,000
	159,000

The use of historical data permits calculation of an upper bound on the actual (but unknown) probability of a collision between a vessel and a permanent platform within 7.5 miles (12 km) of the VTSS, using standard probability theory based on the Poisson binomial distribution (Speigel, 1961). Such calculations indicate that based on historical experience one can be 95 percent confident that the probability of a platform ramming under current conditions is less than 1.9×10^{-5} per transit and 99 percent confident it is less than 2.9×10^{-5} (California State Lands Commission, 1982).

However, in 1980, in an effort to estimate future probabilities, WESTEC Services, Inc. performed a marine traffic hazard analysis for the Santa Barbara Channel. The probability of collision with a drillship or platform was considered to be the product of a causation probability and geometric probability. WESTEC estimated that the probability of a transiting vessel ramming a platform is 5×10^{-6} per transit of northbound ships. Therefore, using the traffic projections shown in Section 3.5.2, Table 3.5-1 as estimated by the California Costal Commission for the Santa Barbara Channel, for the years 1990 (21.6 passages/day) and the year 2000 (24.98 passages/day), the probability of an incident for these years under elevated, future traffic levels can be estimated, as shown below:

1990

21.6 northbound transits/day x 5×10^{-6} x 365 days/year = 3.9×10^{-2}

2000

24.98 northbound transits/day x 5×10^{-6} x 365 days/year = 4.5×10^{-2}

The calculations expressed above tend to indicate that as traffic levels increase in the channel during the life of the platform, the probability of a ramming incident also increases, although still remaining a relatively small value. In fact, due to the well-defined nature of the commercial vessel traffic through the Santa Barbara Channel the actual probability is likely to be much less than this upper limit.

The potential risk of accidents involving small boats could increase because of increased boat activity with Platform Gail construction and operation. Current activity in the project region includes commercial fishing and recreational boating. The increased risk of small vessel collisions due to Platform Gail crew and supply boat traffic cannot be precisely determined primarily because of an inadequate historical data base from which a probability of accident occurrence could be derived.

Potential small vessel accidents are expected to be primarily associated with vessel movements in and near harbors. Although vessel damage could potentially be severe, most small vessel accidents involve minor to moderate damage to one or both vessels involved. While the risk of a vessel accident probably is small, Chevron recognizes the importance of marine safety in keeping this risk low and will employ only licensed vessel captains. Chevron operators of contracted vessels will maintain liability insurance and will comply with any judged liability with respect to a vessel accident.

In view of the potential hazards to both marine traffic and the proposed platform, the U.S. Coast Guard will review the navigational safety of the proposed platform prior to issuance of a Navigation and National Security permit by the Army Corps of Engineers. The U.S. Coast Guard also establishes minimum requirements for aid for navigation on offshore structures (Chevron's DPP), and would ensure compliance by onsite inspection. Chevron will comply with the requirements of the Army Corps of Engineers and the U.S. Coast Guard to further reduce any potential hazard to navigation associated with the proposed project.

4.5.2.1 Mitigation Measures

The risk of a marine vessel accident associated with project-related vessel traffic or the addition of a new offshore structure is small. The U.S. Coast Guard does require Chevron to implement all practical mitigation measures. These include:

- Aids to Navigation: Additional lights/lighting should be provided on the platform to supplement the required Class A structure aids to navigation and enhance their visibility. If further measures to identify and discriminate between the offshore platforms in the project area are required, a radio navigation device called RACON (Radar Responder Beacon) could be used. RACON is a radio navigation system transmitting a response to a predetermined received radar signal. This response is a pulsed radar return signal with specific characteristics which provide bearing and distance data.
- Emergency Generator: An emergency electrical generating unit will be installed on the proposed platform. This system will be designed to ensure reliable automatic starting and transfer of aids to navigation electrical load (lights and fog signal) in the event of a power failure. The generators should have sufficient capacity to operate all such emergency equipment simultaneously.
- Visual Identification Measures: A conflict in objective exists in terms of the color scheme and visual characteristics of the platform. From the standpoint of onshore aesthetics, the platforms should be as unobtrusive as possible, blending with the marine environment. From the standpoint of marine traffic conflicts and collision avoidance, platforms should be highly visible and identifiable. Because of the proximity of the platform to the VTSS and Port Hueneme Fairway, identification for avoidance of collision purposes is considered the most important factor. To afford maximum visibility, white or yellow colors should be used. Procedures should be developed to ensure that the quality of the painted surfaces that afford this enhanced visual effect is maintained during the life of the structure.
- OCS Safety Zone: In accordance with International Maritime Organization (IMO) Resolution A.379 (X), the establishment of a permanent 500-meter safety zone around the platform should be required during construction, drilling, and production. This should provide reasonable separation between shipping activities and the platform. As presently situated and planned for installation, the

platform is farther than 500 meters from the Santa Barbara Channel and the Port Hueneme Fairway traffic lanes.

- Notification of Marine Interests: Prior to commencement of platform and pipeline installation, appropriate notification must be given to marine interests. Early notification of impending installation activities such as jacket installation and pipeline laying will be via Notices to Mariners by the Eleventh Coast Guard District and the Defense Mapping Agency Hydrographic Center. These notices will then be incorporated in the Pacific Coast edition of the U.S. Coast Pilot 7, published by the National Oceanic and Atmospheric Administration (NOAA). All permanent facilities would be identified in this publication, along with necessary safety precautions to avoid traffic conflicts. Mariners are expected to make chart corrections as a result of these notices and publications. Eventually, updated marine charts would be published which show the specific locations of the offshore project elements. These measures should ensure adequate notification to marine interests. Notices regarding anchoring restrictions would be particularly important to preclude pipeline damage.
- All support vessels will use a traffic lane set up by the Santa Barbara Channel Oil Service Vessel Traffic Corridor Program established between the petroleum and fisheries industries (Section 2.6).
- Automatic Radar Plotting Aid (ARPA): Chevron is committed to the use of a United States Coast Guard approved ARPA unit to be installed on a platform or a standby boat in the Santa Clara unit area. Platform Gail will be alerted of an approaching vessel's location by an ARPA unit. The northbound shipping lane will be monitored in the east to southwest direction. See the DPP, Section 4.7, for a more complete description.

4.5.2.2 Cumulative Impact on Shipping

Cumulative hydrocarbon developments may temporarily increase the level of tanker activity in the Channel as well as increase the number of platform structures. As a general relationship, the probability of a ramming incident will increase as structures are added offshore. It is possible that transportation of hydrocarbons by tankering will not occur at all in the Channel beyond the period that the Texaco Interim Terminal Facility at Gaviota is operational. With construction of an adequate onshore consolidated pipeline, the need for the Las Flores Marine Terminal and the Exxon OS&T is questionable. If these facilities are eliminated from consideration, the probability of a ramming incident would be reduced. If tankering does continue, however, the year 2000 ramming probability of 0.045 (as discussed in Section 4.5.2) is still considered insignificant.

4.5.3 Military Impacts

The impacts on military activities from oil and gas activities related to Platform Gail development and operation are not expected to be significant since military activities generally are coordinated with other uses in other areas. The project lease is clear of designated military operating areas. Military vessel traffic bound for, or emanating from, the Pacific Missile Range will use the Vessel Traffic Separation Scheme or their designated transit zones.

In the event of possible military operations which may affect the area occupants, the affected area will be notified well in advance by radio broadcasts, patrol crafts, and "Local Notices to Mariners" published weekly by the U.S. Coast Guard and available from the Commander of the Eleventh Coast Guard District located in Long Beach. The notification includes a projection of the weekly use of military operating areas. Military events are well planned such that advance notice of military activities are designed to prevent possible conflicts in use. If temporary suspension of operations due to national security requirements were to occur, it would come into effect upon the order of the Commander (SAMTEC) and (PMTC) or his authorized designee.

4.5.3.1 Cumulative Impact on Military Uses

The proposed action does not affect designated military use zones in the Santa Barbara Channel. From a cumulative standpoint, the project has no additive impact.

4.5.4 Small Craft Pleasure Boating, Sportfishing and Recreation

Construction of the platform and pipeline is expected to have no significant impact on the recreational or aesthetic enjoyment of fishing. Actual construction activities would take place offshore in areas that receive very little recreational fishing pressure from private boats or partyboats. Increased vessel traffic from Port Hueneme (supply boats) and crewboats during the construction phase from Carpinteria could cause some inconvenience to private boat fishermen. Shoreline fishing would not be affected.

Drilling activities should have no long-term direct significant impacts on recreational fishing. Indirect affects could result from discharged drill muds and cuttings, but are expected to be insignificant.

The effects of crew and supply boat traffic following completion of construction would continue, but at a reduced level as fewer trips will be necessary. Normal production from the offshore platform and subsea pipelines would have no significant adverse effects on recreational fishing.

A moderate oil spill (1000 barrels) could affect recreational fishing by port or harbor closure, by causing fishermen to avoid oil slick areas (i.e., loss of fishing area) and through toxic or sublethal effects on planktonic egg and larval stages or near-surface adults of recreational species or their food supply.

Port closure or persistence of oil slicks in areas heavily used by fishermen could have considerable economic impact on the partyboat industry as well as private boat fishing. Shoreline fishing would be affected where oil reached the shore and by the odor from offshore oil slicks. As such a moderate oil spill could have a significant impact on recreational fishing, but would only be temporary.

Operation of the proposed platform and subsea pipeline could also impact shoreline recreational facilities in the area in the event of an offshore oil spill. Based on the spill trajectory modeling for Platform Gail, there is the possibility of offshore oil spills impacting recreational beaches. However, not all of the coastal beaches will be impacted easily. The most significant area of impact (based on 75 hour spill trajectories) during July through November, is Port Hueneme and the northern Ventura County coastline. Oil spills offshore will contact the northwest corner of Santa Cruz Island based upon the modeled trajectories.

Many tourists to the Ventura County area would not be affected visually by the proposed project facilities, as the offshore area is currently the site of several existing platforms. However, local tourism could be impacted in the event of an oil spill reaching coastline beaches. However, presently there are no usable data, other than a study performed by Meade and Sorenson in 1970, to measure the impact on tourism resulting from a project such as that proposed herein (A.D. Little, 1984). Oil spills will be the main impacting agent on tourism as a spill could close sections of the coastline to recreational use and have a degrading affect on the visual quality wherever contact with the coastline occurs. In the event that a spill does occur, containment will be initiated as swiftly as possible, and when combined with the action of the local oil spill cooperative, the impact to the shoreline could be substantially lessened.

No significant impact to county parks or camping facilities is anticipated due to the provision of temporary housing accommodations offshore on work barges during construction and because construction work force requirements would be drawn from the Ventura-Santa Barbara County area.

4.5.4.1 Cumulative Impact on Small Craft Pleasure Boating, Sportfishing and Recreation

Activities associated with construction of cumulative projects would cause a short-term loss in the amount of area available for party boat and private recreational fishing. The impact is considered insignificant since the area affected is minor in relation to that available for sport fishing and recreation. Over the long-term, sport and recreational fishing may benefit from the offshore oil platforms since such structures act as artificial reefs and attract a variety of fish.

4.5.5 Kelp Harvesting and Mariculture

No mariculture activities are currently underway within or near Lease P 0205. No impacts are expected for these areas of concern from normal drilling and production operations. However in the unlikely event of a major oil spill, the harvesting of Kelp Bed #17 at a distance of 27 miles (43 km) (Figure 3.5-7) could potentially be affected by restricting the kelp harvesting vessel activities. No harvesting is permitted on Bed #109 at Anacapa Island, therefore no impacts on commercial activities are expected.

4.5.5.1 Cumulative Impact on Kelp Harvesting and Mariculture

The construction and operation of the platform will provide a new potential site for mariculture operations; however, none are currently anticipated. No cumulative effect for kelp beds or harvesting is expected.

4.5.6 Existing Pipelines and Cables

No existing pipelines or cables would be disturbed by the proposed Platform Gail and subsea pipelines as they will be avoided.

4.5.7 Other Mineral Uses

No activities associated with the extraction of minerals other than petroleum presently occur within the Santa Clara Unit development.

4.5.8 Ocean Dumping

No existing dumping sites are located on Lease P-0205 or in the vicinity of the Santa Clara Unit development.

4.6 MARINE BIOLOGY

4.6.1 General Analysis of the Biological Impacts

Potential impacts on the marine environment from implementation of the proposed project under normal operating conditions could result from the transportation of personnel and supplies to the platform site; installation of the platform and pipelines; drilling of wells and the deposition of drilling muds and cuttings during operations.

4.6.1.1 Construction

The installation of the oil and gas pipelines will result in the physical disturbance of benthic and epibenthic organisms along the proposed route. This disturbance will be greatest during the construction phase of the project. However, overlying material should be rapidly recolonized and the lines themselves will serve as attachment surfaces increasing epibiotic growth. The offshore pipeline will be installed within 100± feet (30 m) of the designated route. If anchors are needed, they will span an area approxiamtely 5000 feet (1515 m) on each side of the pipeline. These anchors can be placed within 100 feet (30 m) of sites that will be designated in the final pipeline design. Chevron has committed, however, to survey this area before installation of the pipelines. Rocky areas will be avoided when choosing the anchor sites. This will be possible by accurately plotting the hazards, possibly marking their location by buoys, and then selecting mooring patterns to avoid them. Recolonization of the disturbed area by species from nearby populations is expected to occur shortly after the anchoring systems are removed from the site. Thus, these impacts would be highly localized, short term and of minor significance.

4.6.1.2 Operations

There will be some impacts associated with the deposition of wastes generated by platform personnel including domestic sewage, produced water, desalinization brine, and potentially, water used in cleaning deck areas. Secondary treatment of sewage will occur aboard the platform prior to its discharge below the water surface. This disposal of treated sewage at sea will result in minor inputs of nutrients, but dilution should be rapidly accomplished by natural water movement.

Produced water will be treated by passing it through a corrugated plate interceptor followed by a flotation cell to remove suspended oil from the water. Then it will be discharged to the ocean through a disposal caisson approximately 240 feet (72 m) below the ocean surface. A detailed analysis of the produced water is not available. However, since all produced water discharged will be treated and monitored, it is not expected to significantly impact water quality.

The deposition of drill cuttings and drilling muds may represent a source of impact on the marine organisms inhabiting the direct vicinity of the platform within a maximum radius of 3048 feet (1000 m). The principal impacts of the deposition of drill cuttings and drilling muds are assumed to be physically similar to those of dredge spoils disposal including increased turbidity and the potential for burial of organisms. The presence of elements such as barium and chromium, if used, in drilling muds adds a potential for bioaccumulation (BLM, 1979). Chevron will not discharge chromium muds, and barium will be in the form of barite, which is relatively inert.

It is proposed that these waste muds and cuttings will be discharged from the platform at a depth of 240 feet (73 m) below the water surface, resulting in the deposition of approximately 900 barrels (37,800 gallons) of mud and 2852 barrels (119,784 gallons) of cuttings per well. Cuttings will be allowed to settle by gravity to the ocean bottom and will be distributed by subsurface current movements according to their settling rates which are dependent upon particle size and density. The complex and energetic currents in the project site will likely distribute the muds and cuttings in all directions, thereby reducing the potential buildup of material in one direction from the platform. Generally, organisms inhabiting the benthic environment near the project site would be subjected to the greatest impact due to discharge of drill muds and cuttings, as a portion of the ocean floor will be subject to increased sedimentation. However, Figure 3.4-10 shows that waters near the bottom (within 1 m) are high in suspended solids. Increased turbidity of the water will occur over a broader area due to the addition of fine particles of mud and cuttings to the seawater. In high concentrations, the particles causing this tubidity can clog the respiratory organs and feeding mechanisms of marine animals inhabiting the benthic environment although most infaunal species are capable of removing particulates from these organs. Concentrations of these particles are expected to be very low by the time they reach the ocean floor (Section 4.6.4).

4.6.1.3 Catastrophic Impacts

Clearly, the greatest potential impact from the proposed project would be expected to result from an episodic (catastrophic) event such as a well blowout resulting in an oil spill. The proximity of the platform to Anacapa Island makes the impact of an oil spill on the intertidal and shallow-water communities much more significant, even though trajectory modelling has not demonstrated that an oil spill will contact the island.

In the event of a small accidental hydrocarbon discharge during normal operations, existing containment and cleanup equipment, as outlined in the Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace, will be more than adequate to contain and remove the discharge. Such accidental discharges are not expected to occur during normal operations. Therefore, no adverse impacts are anticipated.

The Bureau of Land Management (1979), SLC (1978, 1982), and Woodward-Clyde (1982), have provided several reviews concerning the multitude of potential impacts resulting from an oil spill. The Bureau of Land Management (1979) discusses the fate of spilled oil in the ocean and oil spill variables, based on oil content and physical and chemical aspects of the envirionment in which the spill has occurred. State Lands Commission et al. (1978) provides a summary of the effects of spilled oil on marine biotic communities.

The type of oil and its concentration appear to be the most important factors in determining the biological impact of an oil spill. Generally, oil spilled into ocean waters will change in physical and chemical makeup as it floats on the ocean surface, with the rate of change being markedly influenced by prevailing environmental conditions. Lighter and aromatic fractions of oil, which are of greater toxicity to organisms, are more rapidly lost than other oil fractions during weathering. Consequently, the longer the crude oil is at sea and the greater the intensity of the environmental factors (i.e., winds, waves and temperature), the greater will be the changes in the makeup of the oil (weathering) and the higher will be the loss of the more toxic, lighter and aromatic components.

Oil spill impacts are divided into lethal effects, sublethal effects and habitat alteration. Lethal effects include chemical toxicity from water soluble aromatic hydrocarbons such as napthalenes, toluene, and various benzene ring compounds. These low to medium molecular weight compounds are potentially the most deleterious components of crude oil. Crude oil exposed to environmental weathering rapidly looses these compounds to evaporation and dissolution.

Sublethal effects are harder to define but can include physiological effects, mutagenic effects, carcinogenic effects, mechanical coating, and tainting. The impact of crude oil deposition on marine substrates can alter the habitat in such a way as to limit settling of marine invertebrate larvae or restrict feeding areas. Beach coverage can kill or cause the dislocation of infaunal organisms. The assimilative capacity of marine biotic communities has not been conclusively tested to determine the impacts of acute oil pollution events. Recent studies in Texas on the Ixtoc oil spill have shown a relatively rapid recolonization of beaches. The Bureau of Land Management (1979) states that there is a lack of knowledge as to the effects of long-term low level (chronic) oil pollution on marine organisms.

The magnitude of oil spills can vary greatly and certainly exerts considerable influence over the extent of the potential environmental impacts. During exploratory drilling, small-scale spills are most likely and the probability of a major spill much less. However, the SLC (1978) has suggested that with reference to impacts on the marine environment, small-scale or large-scale spills exert similar impacts on the environment, only with different magnitude.

The Bureau of Land Management (1979) has summarized the effects of several major oil spills on the marine environment. The results reveal that the biological effects of an oil spill vary based upon several factors. Nine factors proposed by Straughan (1972) bear consideration when interpreting the effects of spilled oil. These include: (1) type of oil; (2) concentration reaching the biota; (3) physiography of the spill area; (4) weather conditions at the time of the spill; (5) biota living in the impacted habitats; (6) season at the time of the spill; (7) prior exposure of the biota to oil or other pollutants; (8) co-contamination of the impacted biota by other pollutants; and (9) use of treatment agents to clean up the spilled oil.

Generally, the most direct measurable impacts of the majority of oil spills have been on populations of marine birds (particularly pelagic birds) and shallow-water benthic organisms. Intertidal communities have also been found to be vulnerable, particularly the highly adapted upper rocky shoreline forms such as barnacles, limpets and several species of algae.

With regard to the 1969 oil spill in the Santa Barbara Channel, Straughan (1972) indicated that several factors complicated the problem of determining the biological effects. These included: (1) the presence of natural oil seeps in the area and the influence of natural seepage on the ecology of the Santa Barbara Channel, and (2) the occurrence of unusually heavy rains during the spill period which lowered salinities, increased sedimentation, and possibly increased concentrations of pesticides in coastal waters. In light of these complications, Straughan (1972) summarized the results of the several investigations performed in the aftermath of the spill to indicate that damage to the biota was not widespread and that major effects included significant mortality in pelagic bird populations, populations of the intertidal barnacle Chthalmus fissus, the marine sea grass Phyllospadix torrey, and the marine alga Hesperophycus harveyanus. Sublethal effects included a reduction in breeding in Pollicipes polymerus in localized areas. A cautionary approach to these conclusions is advised however, as it has been strongly emphasized that because of the cumulative effects of environmental alteration in southern California and a general lack of the proper kind of baseline information, the full short- and long-term impacts of the 1969 oil spills were perhaps impossible to determine.

4.6.2 Intertidal Communities

The placement of the platform and the pipelines are not expected to significantly impact the intertidal and biofouling communities at Anacapa Island or along the mainland coast. The discharge of wastes resulting from normal drilling operations and transportation activities should be of limited volume and quickly diluted. The deposition of drill cuttings and drilling muds in the vicinity of the drilling site is not anticipated to impact the intertidal communities. The most significant impact to the intertidal communities would be from a large-scale oil spill. In the event of a major spill from the platform or pipeline the coastline north of Point Hueneme to Ventura could be damaged.

Generally, deposited crude oil may physically coat organisms or produce toxins causing mortality or physiological stress. As indicated by the Bureau of Land Management (1979), repopulation of the impacted habitats will commence once oil is cleared from the substrate and sexually reproducing populations are available to provide new colonizers. Most intertidal and subtidal invertebrates and plants at mainland sites had recovered and appeared viable in a 1972 survey by Strachan (1972) after the 1969 Santa Barbara Oil Spill.

A recent study by Woodward-Clyde Consultants for the County of Santa Barbara (County of Santa Barbara, 1984) evaluated the relative sensitivities of various coastline habitats to an oil spill. Important elements in evaluating oil spill impacts are the potential vulnerability and sensitivity of biological resources to oil and the ability of the resource to recover from the effects of the oil. This evaluation led to the establishment of three concern levels regarding biological resources.

- Primary Level of Concern
  - Major change expected in distribution, size, structure, and/or function of affected biotic resource (population, community, or habitat).
  - Recovery from these changes expected to require several years to decades.
- Secondary Level of Concern
  - Moderate change expected in distribution, size, structure and/or function of affected biotic resource (population, community, or habitat).
  - Recovery from these changes expected to require several years.
- Tertiary Level of Concern
  - None to minor change expected in distribution, size, structure, and/or function of affected biotic resources (population, community, or habitat).
  - Recovery from these changes expected to require several months to several years.

The levels of concern represent the potential effect to the impacted biotic resource if the resource contacts oil. It is possible (and even likely) that the anticipated magnitude and/or duration of impact which defines a level of concern will not materialize. Rocky intertidal areas are limited in the Santa Barbara Channel and offshore islands and these areas are generally considered to be of primary and secondary level of concern. Recovery can be rapid in the lower intertidal and quite slow in the high, splash zone.

In response to being oiled, the biota of the intertidal zone may suffer immediate large mortalities as measured by body counts of individuals and, in the longer term, the recolonization of individuals may be slower than expected in the affected area. The sensitivity of the macrobiota in the intertidal zone varies with species and may show temporal and spatial variability, depending upon a number of factors such as:

- Type of oil spilled
- Amount of oil reaching the intertidal zone
- Weathered state of oil

- Life history stage of the species
- "Health" of the species
- Season
- Record of prior exposure

The literature indicates that the capacity of the intertidal macrobiota to recover to pre-spill conditions, or to conditions prevailing on nearby nonoiled shorelines, will generally not be diminished following a single crude oil spill, even though there were substantial mortalities of some species. Areas affected by an oil spill are expected to exhibit recolonization and recovery not unlike that which occurs continuously under natural conditions in the rocky intertidal. The time required for recovery may depend upon the size and location of the area affected and season in which impact occurs but the process would begin immediately, often before the last traces of oil are removed (County of Santa Barbara, 1984).

The oil spill trajectories for Platform Gail are presented in Chevron's Oil Spill and Emergency Contingency Plan for Platform Grace-Platform Gail. Table 4.6-1 summarizes spill trajectory direction by month. The most significant area of impact during the majority of the year is Port Hueneme and the Ventura coastline.

Shaw et al. (1981), Maynard et al. (1978) and Chan (1978) all examined the impacts associated with acute and chronic depositions of oil in the rocky intertidal zone. In general, oil and "tar balls" were deposited in the high intertidal or splash zone. The majority of the rocky intertidal species and biomass are lower in the intertidal zone and did not appear to be significantly affected either by accumulation of petrogenic hydrocarbons or by habitat loss to oiling effects. Organisms in the splash zone were affected by bioaccumulation of hydrocarbons and loss of habitat. Chan (1978) observed extensive mortality of rocky shore crabs and echinoderms, seagrasses and some mangrove areas. Chan also observed that elevated temperatures on oil covered substrates exceeded upper lethal limits for many intertidal organisms.

These studies focus on rocky intertidal habitat with little data provided for beach habitat. In a recent study, Rabalais and Flint (1983) evaluated the impact of the Ixtoc-1 well blowout and subsequent oil spill (estimated at 140 x 10^6 bbl) on south Texas beaches. Approximately 3.3 x 10^6 bbls of oil were stranded on the coast. No attempt was made to remove the oil washing ashore. The Rabalais study dealt with the ecological effects of a tar reef created in the intertidal region on Padre Island. The reef was a combination of oil/water mousse, sand and shell fragments and formed an asphalt-like structure in the lower intertidal. The reef was at its maximum in March 1980, was

Table 4.6-1

OIL SPILL TRAJECTORY SUMMARY PLATFORM GAIL LOCATION

	Dispersed Spill Contact Point/Hours	Non-Dispersed Spill Contact Point/Hours
January	No land contact/70 hours	No land contact/75 hours
February	No land contact/70 hours	No land contact/75 hours
March	No land contact/70 hours	Carpenteria/60 hours
April	No land contact/70 hours	No land contact/70 hours
May	No land contact/70 hours	No land contact/70 hours
June	No land contact/70 hours	No land contact/70 hours
July	North of Ventura to Carpinteria/ 45-50 hours	Ventura-Point Hueneme/ 50 hours
August	North of Ventura/45 hours	Point Hueneme/50 hours
September	North of Ventura/45-50 hours	Point Hueneme/50 hours
October	North of Ventura/45-50 hours	Point Hueneme/50 hours
November	North of Ventura/45 hours	Point Hueneme/65 hours
December	No land contact/70 hours	No land contact/75 hours

The data presented is a summary of the oil spill trajectory modelling report prepared by Tetra Tech Inc. for Chevron (Appendix 2; Oil Spill and Emergency Contingency Plan, Platform Gail-Platform Grace, Santa Clara Unit, 1984). Modelled volume is for a blowout of 1000 bbl/day, sea states are based upon averaged wind and current data.

reduced significantly by May 1980 and was gone in October 1980. Normally tar reefs are relatively persistent (Kaiser et al., 1978; Gunldlach et al., 1981). The most significant impact was on infaunal densities, in the tar reef area with a 50 percent reduction of infaunal density.

Teal and Howarth (1984) summarized the results of a number of oil spill studies conducted since 1975. Littoral or intertidal effects ranged from a reduction in species diversity and biomass for marine invertebrates to total mortality of oiled marsh grass (Spartina alteriflora). Some marine macroalgae was depleted, while other species suffered no apparent loss. Marine amphipods appear to be highly susceptible to oil or some soluble fraction.

Recovery of oiled intertidal habitats began within 2 months in most location, but observable reduction in species diversity in oiled areas were found up to 6 years after the spill. Salt marshes are particularly intolerant of oil spills and oil is often a significant element of the muds for up to 12 years (Teal and Howarth, 1984).

The use of oil dispersants is severely restricted in California waters and can only be used under specific circumstances (Chevron's Oil Spill and Emergency Contingency Plan for Platform Gail-Grace, Santa Clara Unit). Various oil dispersants have been tested and found to elicit a variety of toxic responses in marine biota. Emulsification of the oil tends to decrease droplet size and increase the deposition area, as well as increase the toxic effects observed in marine invertebrates particularly on beaches (Battershill and Bergquist, 1982; Seigler and Leibovitz, 1982; Hartwilk et al., 1982; Greenwood, 1983).

A recent workshop was held to examine the role dispersants play in oil spill control (U.S. Coast Guard et al., 1984). Present dispersants are less toxic and more efficient than earlier dispersants (Lindstedt-Siva, 1984) and the toxicity of the dispersant is generally less than the toxicity of the oil. Observed toxicity is more likely to result from the emulsified oil in the water column then the dispersant. The concensus of the workshop was that dispersants could serve as alternative method in specific oil spill situations, however the dispersant to be effective would require early use on "fresh oil" and is much less effective on weathered oil.

The decision to use dispersants would rest with the rapid response team (RRT) for the Santa Barbara Area in consultation with the EPA. The RRT has established guidelines for approval or denial of dispersant use, including specific criteria such as affected resource ranking and probability assessment. Acting quickly in emergency situations, the RRT must evaluate risk and tradeoffs for dispersant use.

Dispersants and emulsified oils have been shown to be toxic in some marine organisms and the approval or disapproval for use by the RRT will often result in tradeoffs of one biotic group (plankton) being impacted while another, possibly more significant biotic groups (birds and marine mammals) is protected (U.S. Coast Guard, et al., 1984).

The.intertidal communities near the project area could be impacted from an oil spill due to the proposed project activities. The degree of this impact would vary with the magnitude of the spill and the ability to contain the oil. The impact on the intertidal habitat would be generally limited to the high splash zone and should pose no long-term degradation in the local populations.

4.6.3 Biofouling Communities

The effects of a crude oil spill on the littoral biofouling community could be fatal to all or part of this community depending on the dose and time of exposure. Nicholson and Cimberg (1971) reported extensive mortalities to the barnacles Chthamalus and Balanus, the limpet genus Collisellia, and the mussel Mytilus, as a result of the 1969 Santa Barbara oil spill. Mortality was due to suffocation and not to ingestion of toxins; recolonization was slow compared to control sites. It is expected that reestablishment of the littoral biofouling community following a small spill would be accelerated by weathering and dispersal of the crude oil by wave action at the platform site. The subtidal biofouling community is not expected to experience any adverse effects from a small spill of crude oil. This is predicted because any oil reaching this community will have gone through extensive weathering, dispersal, chemical, and microbial degradation prior to contact with the subtidal community. Nicholson and Cimberg (1971) report mortalities in intertidal species which are also common to fouling communities, when those species were exposed to heavy crude oil from the Santa Barbara oil spill. The biofouling community associated with the offshore platform would be impacted similarly by a spill; however, recruitment would begin as soon as water quality and substrate became suitable. Harbor and offshore biofouling communities are exposed to alternating periods of immersion and exposure, sudden infusions of freshwater, deviations in salinity, changes in temperature, and contaminants, including oil. Organisms accustomed to this type of habitat tend to be hardier and more resistent to sudden changes to their environment. After the Torrey Canyon spill, Crapp (1971) demonstrated that several species of Chthamalus and Balanus were unaffected after being subjected to long-term coating by weathered Kuwait crude.

Coating of a substrate (such as the surface of a newly installed offshore structure) with crude oil will affect settling and recruitment by fouling organisms. Other possible effects include mortalities of less-tolerant juvenile forms of these organisms, thus inhibiting recruitment. Depletion of food supply, especially marine algae, could affect distribution of limpets and other grazing populations associated with biofouling communities. Oil at sublethal concentrations may have adverse effects due to organisms having different tolerance levels with respect to recruitment. Hence, alteration in the relative species abundances in the population can occur. In addition, resistent species may flourish when populations of less-tolerant species decline and make available previously limited resources, e.g., primary substrate. Stainken (1975) and Neff (1975) demonstrated that several species of bivalves can magnify the concentration of petroleum hydrocarbons up to five times that of ambient concentrations, yet there seems to be no direct effect to the organisms. Latent effects nonetheless may occur and include mortalities and reduction of reproductive potentials of fish and other populations dependent upon the biofouling community as a food source.

4.6.4 Benthic Communities

Impacts associated with the proposed development on benthic communities include the effect of the platform placement and the laying of the pipeline. These actions will result in the disruption and/or destruction of limited areas of benthic habitat. Non-motile epifaunal and infaunal organisms at impact points will be lost. No hard-bottom habitats are located within 3280 feet (1000 m) of the platform site area and no impacts are expected to that particular type of benthic habitat. During the placement of pipelines and platform, temporary anchors will be placed by construction barges and vessels. These anchors will cause scarring on the bottom, eliminating the benthic infauna at the point of contact. The addition of the pipeline and platform will increase the availability of attachment surfaces and increase the local abundance of epibiota attachment organisms.

The primary impact on benthic organisms in the area around the platform (within 3280 feet [1000 m]) will be from the deposition of drilling muds and cuttings. Recent field studies have been conducted by Shell (in Southern California) and ARCO (in Alaska) to determine the fate and potential effect of mud and cuttings discharges. As cuttings are discharged, the material separates into two phases upon entering the water. First, the cuttings fall rapidly to the bottom due to their weight. Secondly, most of the mud that adheres to the cuttings (usually 1 to 5 percent by volume), is washed off and spreads horizontally to form the surface plume. Under conditions of moderate discharge expected for this project (480 bbl/hr, bulk discharge) the simulation of discharge dilution projected 1000:1 dilution within 150 feet (45 m) in less than 13 minutes. The particulates in the mud have extremely low settling velocities and will have reached background levels of suspended solids and heavy metals prior to reaching the bottom (Ray, 1978).

Cuttings particles generally range in size from 100 microns to 900 microns and are dominated by sharply angular, nonbiogenic particles. Deposition of this material onto a silty substrate will alter the average grain size at the sediment surface and, potentially, the distribution of infaunal organisms. The effect of changes in grain size distribution on infauna and epifaunal species was well demonstrated by Wolfson et al. (1979). He concluded that most benthic species were not affected by the addition of cuttings size particles, though several species in his study responded positively to the addition of cuttings.

The median grain size of benthic substrate taken during the marine survey (McClelland Engineers, 1985) was approximately 150 microns (2.62 Φ). The addition of sand size particles (cuttings) should have no significant affect on distribution of the benthic infauna at the platform site.

Biological effects from the deposition of drilling muds can be induced by chemical contamination of the water column and sediments, and by the physical act of burial of marine organisms by the deposited cuttings. The testing of chemical effects is conducted by use of bioassay; testing both acute as well as chronic effects. Table 4.6-2 presents representative bioassays on drilling fluid components.

Table 4.6-2

REPRESENTATIVE BIOASSAYS ON DRILLING FLUID COMPONENTS
(Results expressed as 96-HR TL_m unless otherwise indicated)
(concentrations in parts per million)

Component	Concentration	Organism
barium sulfate (barite)	100,000	white shrimp
bentonite	10,000	rainbow trout
formaldehyde	28	salmon
lignite	24,500	sailfin molly
lignosulfonate, chrome	1,925	white shrimp
lignosulfonate, iron	7,800	white shrimp
polyacrylate, low molecular weight	3,500	white shrimp
sodium acid pyrophosphate	1,200	sailfin molly

Source: Ray, 1978

In a recent study (Carls and Rice, 1984), the toxicity of drilling muds (supernatants and suspensions) and drilling mud components [(barite and bentonite (particulates) and ferrochrome lignosulfonate (soluble)] were tested on six species of shrimp and crab larvae. The results of that study indicate that whole mud toxicities vary significantly (0.58 to 82.4 percent for supernatants) with the variability attributed to differences in original components and their properties, age of the mud, history of use, depth of drilling and the formations penetrated. In general, the LC_{50}s and EC_{50}s determined in the Carls and Rice study were similar to other studies that tested the sensitivity of crustacean larvae to drilling muds.

Suspensions of muds were on the average over seven times more toxic than supernatants. This was attributed to adsorption of soluble compounds on the particulates as well as the physical effects of the particles on the fragile larvae (Carls and Rice, 1984).

Barite and bentonite had low toxicities, affecting survival only until they settle out of the water. Carls and Rice (1984) found that the larvae responded quite slowly to tested suspensions, indicating that the observed response was due to physical rather than chemical factors. When compared to the toxicity of the water soluble factors of crude oil, drilling mud supernatants were 1/1000 to 1/10,000 as toxic. Ferro chrome lignosulfonate was more toxic than the supernatant but was still 100 times less toxic than the water soluble oil fraction. Their conclusions were that under most conditions in the marine environment, drilling mud would probably not measurably affect planktonic crustaceans, due to rapid dilutions of low apparent toxicity.

Chronic effects of drilling mud components are much more difficult to determine. Marine invertebrates have been shown to bioaccumulate heavy metals in their tissues. It has also been demonstrated that bioaccumulation does not occur at the same rate for all species, in fact wide variability in uptake is found within the same species (Carls and Rice, 1984).

Major components of concern in the drilling muds are normally barium sulfate and chrome and ferrochrome lignosulfonate. These metals have been shown to accumulate in sediments, especially barium. Several studies cited by Ray (1978) have shown elevated barium levels in the sediments up to 1641 feet (500 m) from a platform. Barium does not have a significant toxic effect on aquatic vertebrates and invertebrates, and apparently passes through the digestive tract. In a recent study Neff et al. (1978) concluded that bioaccumulation of heavy metals was highly species-dependent, and was usually influenced by a variety of physical environmental parameters (temperature, salinity, etc.). A most significant element of his study was the data showing how control animals were just as likely to accumulate metals as those tested in contaminated sediments, often demonstrating an inverse relationship. Iron was the only metal showing a dominating bioaccumulation potential and iron is generally considered nontoxic even at highly elevated levels.

The National Academy of Science (NAS, 1983) recently reviewed the impacts of drilling discharges in the marine environment. This extensive review was derived from existing literature and discussions with academic, industry and regulatory personnel. In summary, the panels' review of existing information on the fate and effects of drilling fluids and cuttings on the OCS shows that the effects of individual discharges are quite limited in extent and are confined mainly to the benthic environment. These results suggest that the environmental risks of exploratory drilling discharges to most OCS communities are small. Production drilling, however, produced much larger quantities of material over longer periods of time. Results of field studies suggest that the accumulation of materials from these longer-term inputs is less than additive and therefore the effects of exploratory drilling provide a reasonable model for projecting the effects of development drilling. Uncertainties regarding effects still exist for low energy depositional environments, which experience large inputs of drilling discharges over long periods of time.

Platform Gail will discharge approximately 2852 barrels of rock cuttings and 900 barrels of drilling muds and completion fluids per well. Discharged drilling muds will not contain free oil, diesel fuel, or chrome or ferrochrome lignosulfonate. Under normal circumstances clean cuttings, containing small quantities of drilling muds, will be discharged continuously while drilling. Drilling muds generally are discharged sporadically in bulk, during the drilling operation, usually when a change in mud components is required and at the end of the drilling cycle.

Considering the physical oceanographic conditions present at the platform site, Chevron will discharge its mud and cuttings at 240 feet (73 m) below mean lower low water. Discharge at 240 feet (73 m) will allow maximum dispersion of muds and cuttings while minimizing visual/aesthetic impacts.

Due to their heavier weight, cuttings will settle to the bottom much more rapidly than the drilling mud. The vast majority of cuttings discharged into the water column settle near the discharge point (NAS, 1983). While cuttings will, by nature, settle near the platform, discharge at 240 feet (73 m) will increase the initial dispersion of the cuttings reducing significant accumulation in the sediments.

It is expected that limited physical burial by the cuttings of sessile animals may occur within 328-656 feet (100-200 m) of the well sites. Mobile epibenthos will avoid this burial impact and no sustained burial impacts are expected beyond this initial zone. Plume modeling was conducted to predict drilling mud dilution rates for discharges at the platform periods.

Based on these modeling results, and the energetic nature of physical oceanographic conditions on the Chevron lease, drilling mud dilution in the water column is expected to be high, and deposition on the bottom should be highly dispersed.

In summary, only biota in the immediate vicinity of the well site (100-200 meters radius) will be impacted through physical burial by cuttings. Due to the discharge of muds in 240 feet (73 m) of water (with the added water column volume available for dispersion plus high current speeds in surface waters) drilling muds should dilute rapidly to very low levels. Given the expected low deposition rates, plus the apparent ability of the soft bottom organisms to survive measurable sedimentation, little or no physical impact is expected from drilling mud discharge. Chevron's commitment to the discharge of only those EPA approved muds which do not contain free oil, diesel, and chrome lignosulfonate should minimize or eliminate toxic impacts.

Crude oil spilled from the platform would represent a potential hazard to subtidal benthic communities. Oil that reaches the shallow water epibenthic communities would result in damage to organisms. The extent of this impact would be difficult to predict, though Straughan (1972) found most subtidal populations had recovered and were viable 2 weeks after the Santa Barbara Oil Spill of 1969. The impacts of oil deposition on deep water environments is less well known (Karinen, 1980). The Bureau of Land Management (1979) suggests that complete destruction would not be anticipated, but that certain populations of various sensitive species, particularly microcrustaceans and shallow water endemics, may be eliminated or significantly reduced from the area impacted by oil. Regional populations should not be affected.

4.6.5 Planktonic Communities

Impacts to the planktonic communities due to the installation and operation of the platform and pipelines should be highly localized. Very small and probably insignificant increases in nutrient levels near the platform may occur due to the discharge of secondary treated sewage. This could elevate phytoplankton production slightly. Any increase in turbidity in the photic zone due to the deposition of drill cuttings and drilling muds would reduce phytoplankton production and may reduce zooplankton feeding and alter respiratory mechanisms.

Potential impacts on planktonic communities from an oil spill could range from lethal, for cases of high concentrations of spilled oil on surface waters, to various more subtle sublethal effects (SLC, 1974). The Bureau of Land Management (1979) suggests that for the phytoplankton, sublethal effects such as reduced photosynthetic and growth rate could result from exposure to low-level concentrations of oil, while for zooplankton, abnormal feeding and behavioral patterns from the uptake of hydrocarbons in food sources would be likely. However, Prouse et al. (1976) reported that at crude oil concentrations of less than 1 ppm, oceanic phytoplankton did not display growth characteristics significantly different from control species, and some phytoplankton was actually stimulated by small concentrations. Rice et al. (1981) documented 96-hour EC_{50}s for the water-soluble fraction of crude oil on larval crustaceans at 0.4-2.5 ppm.

4.6.6 Fishes

Limited disturbance of the fish populations near the project lease is expected. Impacts are anticipated to be largely from the deposition of drill cuttings and drilling muds and the resultant increase in turbidity and the alteration of benthic habitats. Demersal fishes are likely to be most affected, although fishes (particularly filter-feeding forms) that swim through the drilling area may be disturbed by the expected increase in suspended particles in the water.

The bioaccumulation potential of heavy metals in discharged drilling muds is not well known. However, the resuspension of deposited muds did not appear to be significant in a recent study (Trocine and Trefry, 1983) and it is possible that once material is deposited it remains relatively insoluble.

Fishes can be susceptible to spilled oil as adults, juveniles, larvae, or in the egg stage of the life history, however little information is available on the effects of spilled oil on animals of the nekton other than fish. The egg and larval stages are the most sensitive of all stages in the life histories of most species (Teal and Howarth, 1948). The State Lands Commission et al. (1978) has indicated that available studies on the effects of oil on fish eggs generally revealed reduced survival or resulted in an alteration of development patterns. The Bureau of Land Management (1979) has also indicated that perhaps the greatest impact on marine fishes would result from the use of chemical disbursing agents in treating the spill although the impact would be nearly impossible to quantify. The State Lands Commission et al. (1978) has summarized the potential effects of an oil spill on marine fishes as resulting in some direct mortalities but has also noted that fishes should be able to recover their populations fairly rapidly.

A more recent study (MBC/SAI, 1983) assumed the potential toxicity of oil on California commercial and sportfishes and on shellfish. Major findings included increased bioaccumulations of petroleum hydrocarbons and decreased survivability in fish embryos as concentrations increased. Growth rates were reduced in larval fishes and frequent abnormalities were observed. It was clearly demonstrated that early and adult life stages of fish and shellfish experienced both lethal and sublethal effects following exposure to parts per billion levels of petroleum hydrocarbons.

4.6.7 Refuges, Preserves and Marine Sanctuaries

The proposed lease borders the Channel Islands National Marine Sanctuary. Normal drilling and production activities should not directly impact the Sanctuary. The remote possibility of a major oil spill does pose potentially serious impacts. The major areas to be affected in the event of an uncontrolled spill could be along the northeast coast of Anacapa Island approximately 6.6 nautical miles (10.6 km) south. The areas of special biological significance are sandy beaches and rocky intertidal areas used by marine mammals and birds. Based upon the oil spill trajectory modeling provided by Chevron, no spill should contact Anacapa Island within 75 hours during any month of the year. Models are based upon average conditions and may not reflect all possible outcomes. Reference should be made to Appendix 2 of the Oil Spill Contingency Plan for Platform Gail-Platform Grace for detail on the oil spill trajectory modeling.

Environmentally sensitive areas, as listed in Table 3.6-7 in Section 3.6, have the potential of being impacted by any major oil spill. Habitats anywhere in the eastern Santa Barbara Channel may suffer an impact. These include marshes and wetlands, sand and rocky beaches and cliffs which serve as bird habitats and pinniped haulouts. Section 3.6 contains a detailed description of these habitats.

In the event of a significant oil spill from the platform, the major areas to be affected as interpreted from the trajectory analysis would be the intertidal areas along the mainland coast near Ventura and Port Hueneme. The areas of biological significance, are the sandy beaches and rocky intertidal areas used by marine mammals and birds and potentially El Estero Marsh. The time to landfall for an oil spill on the coastline is 50 hours. No contact is projected for any offshore island within the 75 hour trajectory modeling constraint.

The impact of a major oil spill on the Santa Barbara Channel area (including Anacapa Island and other critical habitats) has been the subject of extensive and detailed studies during the past two decades. The Final Environmental Impact Statement for OCS Lease Sale No 48 contains a thorough review of these impacts, as do scientific papers by Moore, S.F., et al., 1973; Evans, D.R., et al., 1974; and Lee, 1977.

The Santa Barbara Oil Spill of 1969 probably provides the most pertinent data for analyzing the possible impacts of a large spill in the area covered by this report. Marine bird populations were most severely impacted by this spill; the California Department of Fish and Game estimated that over 3600 individuals were killed (Department of Fish and Game, 1971). The impact on all other groups of animals was apparently short term and did not affect community relationships or population size. Straughan (1970) noted a lack of acute catastrophic effects on plankton, benthos, or marine mammals. No fish kills were observed (University of California, Santa Barbara, 1971).

While Nicholson (1972) observed the smothering of some sessile rocky intertidal organisms, Straughan (1973) detected no change in species distribution and abundance of sandy intertidal biota as a result of the Santa Barbara oil spill. Additionally, no long-term effects on commercial fisheries could be attributed to the spill, however, decreases in catches after the spill were probably caused by loss of fishing time and oil fouling of gear (BLM, 1979).

In general, the severity of the impacts of a major spill would depend upon temporal variations in the abundance of marine organisms; seasonal cycles of reproductive phases; the degree of oil weathering; type, rate, and volume of oil; and the weather and oceanographic conditions at the time of the spill. These parameters would determine how much oil is dispersed into the water column, the degree of weathering before impacting a shoreline, and the final amount, concentration, and composition of the hydrocarbons at the time of impact.

The effect of an oil spill of 1000 bbl on ocean water quality is generally short term and insignificant (BLM, 1981). However, a spill in or affecting wetlands or estuarine areas with decreases depths and limited dilution capacity would reduce the oxygen content of the water, cause a decrease in light transmittance and significantly elevate toxic compound levels in the water column. These effects could be long lasting if oil was trapped in the sediments and slowly released by weathering after the initial impact (BLM, 1981).

4.6.8 Avian Resources

The operation of the platform should have no significant impact on marine birds. Increased noise and boat traffic should not affect the normal activity patterns, including feeding behavior of marine bird species. Migratory patterns should not be affected by the platform.

The most significant impact on avian resources will be generated in the event of a catastrophic oil spill. The effects of spilled oil on birds remains poorly understood. The review by Clark (in press) lists the following caveats regarding current knowledge of the effects of oil on birds. Laboratory studies often cannot be extrapolated to wild birds due to differences in life history and environments. The effects of spilled oil on populations is poorly documented, and it is difficult to separate oil-caused mortality from natural and other causes. There is little relation between the size of the spill and resulting bird mortality.

Many factors influence the vulnerability of birds to an oil spill. The tendency to form large, dense flocks on the water increases vulnerability, as does the amount of time spent on the water surface (Connell and Miller, 1981; MMS, 1984a). Species that forage by diving are more vulnerable to spilled oil as well as species that are attracted to oil slicks (Connell and Miller, 1981). Cold weather or a cold climate increase vulnerability to oil by exacerbating thermoregulatory effects (Clark, in press).

Spilled oil is often ingested by birds, usually during preening (Nero and Associates, 1982). The short-term effects of ingestion can include acute toxicity.

Longer-term effects can be lethal or sublethal. Numerous histological effects have been noted, including: wasting of muscle and fat, liver abnormalities including fatty degeneration, kidney abnormalities including toxic nephrosis, adrenal disorders including adenocortical hyperplasia, pituitary inhibition, spleen enlargement, pancreatic atrophy, lipid pneumonia, abnormalities in the nasal salt gland, gastrointestinal tract abnormalities, and a reduction in the white blood cell count (Clark, in press; Holmes and Cronshaw, 1977; Connell and Miller, 1981).

The primary physiological effect associated with ingested oil is severe dehydration. Several mechanisms have been proposed for this effect: salt gland malfunction, impairment of intestinal ion absorption, and inhibition of intestinal ion absorption resulting in hypertrophy of the nasal salt gland (Clark, in press) (Connell and Miller, 1981). Crude oil is apparently the most toxic form of oil in this regard, and weathered crude oil is more toxic than fresh crude oil. This effect has been observed to result from a dose of 0.5 g in young mallards, herring gulls, black guillemots, and in adult Leach's storm-petrel, but was not observed in adult mallards (Clark, in press; Connell and Miller, 1981).

Ingested oil may have physiological effects on reproduction in adult birds, but evidence conficts on this effect. Egg laying may stop (Connell and Miller, 1981), or be depressed (MMS, 1984a), while Clark (in press) indicates that a temporary reduction in laying can be observed in some species following doses of up to 1 g of various types of oil. Reduced hatchability of eggs can also result from oil ingestion (MMS, 1984a; Clark, in press). This effect is due to abnormalities in the yolks, and is dependent on the rate and timing of yolk formation and laying (which varies widely between species), and the timing of the oil ingestion. The growth rate of offspring may be reduced by ingested oil (MMS, 1984a), but results from different researchers conflict.

Dispersants may be ingested if used to control a spill. No effects on weight gain, organ weights, corticosteriod levels, or plasma thyroxine levels were observed in wild herring gulls or Leach's strom-petrels dosed with dispersant (Butler et al. 1979; Miller et al. 1980; Peakall et al. 1981; Albers, 1984).

Contact with spilled oil has been shown to have a number of effects on birds. Increased feather wear, matting, and breakage resulting from oil contact has been documented (USFWS, 1981a). The insulative qualities of the plumage are impaired and buoyance is decreased (Connell and Miller, 1981; WESTEC Services, 1984; Clark, in press). Decreased insulation results in increased fat and muscle metabolism (Clark, in press). Clark indicates that the amount of oil contact necessary to produce lethal effects varies from species to species, and that drowning and hypothermia are the primary cause of death in the great majority of cases where birds are oiled. Surface active agents such as detergents can produce the same effect as oiling.

Eggs can be contaminated by oiled adults, resulting in well-documented toxicity (USFWS 1979, 1981; Albers, 1984; Clark, in press). Egg contamination causes increased egg mortality in mallards, Cassin's auklets, and gulls (Clark, in press). Eggs are most sensitive to oiling when the embryo is less than 10 days old (Szaro, 1977). Significant effects on mallard eggs were noted at doses as low as 1 microliter; Clark gives the 50 percent mortality external dose (LD_{50}) for mallard eggs as 5 microliters, and Connell and Miller (1981) report the external LD_{50} for mallard eggs as 20 microliters and significant egg mortality in common eiders resulting from external doses of 20 microliters.

If dispersants are used for spill control, birds can be affectd by contact with dispersant. Plumage contact with dispersants results in dispersal of the feather oils (MMS, 1984a), leading to wetting and feather matting (Albers, 1984). As of 1984, the effects of dispersants on eggs have only been examined for mallards, and microliter quantities of Corexit 9527 were found to delay embryonic development and reduce hatchability (Englehardt, 1984). Mixtures of dispersant and oil and dispersant alone were found to be as toxic to eggs as oil alone (Albers, 1979). In another experiment, Albers and Gay (1982) found that dispersant applied to water had no effect on mallard egg hatchability, and that dispersant and oil on water had the same effect on hatchability as undispersed oil.

The dispersal of the spill could also lead to the uptake and storage of petroleum hydrocarbons in planktonic invertebrates, fish and algae leading to the potential bioaccumulation of hydrocarbons in higher trophic level species including birds. (Teal and Howarth, 1984).

4.6.9 Marine Mammals

The operation of the platform should result in a limited impact on marine mammals. The increased level of boat traffic on marine mammals is not well documented, though it is speculated that the increased level of marine shipping traffic may have reduced the effective communication ranges for many whale species. Although no generally accepted conclusions on the effects of noise generated by offshore oil development have been reached (Gales, 1982), whale migration through the Southern California Bight does not appear to have decreased since oil development began.

The impacts of day-to-day (non-accident) activities on marine mammals in the project area will be minimal. The nearest pinniped breeding and pupping areas occur on Anacapa Island where harbor seals and California sea lions have been observed. This island is over 6.6 miles (10.6 km) from the proposed platform, and other rookery and hauling-out areas on the other islands are an even greater distance from the proposed site. Support vessels and helicopter will travel between the platform and Port Hueneme and Carpinteria; the routes to be followed will not bring these vehicles closer than 6.6 miles (10.6 km) to any island.

Because of fundamental differences in life history and morphology, the potential effects of contact with spilled oil differ between furred marine mammals (sea otters and fur seals) and those with minimal fur (cetaceans). These two groups are discussed separately below.

The effects of ingested oil on furred marine mammals are variable from species to species (Englehardt, 1983). Oil ingestion usually occurs while grooming the fur (Connell and Miller, 1981; MMS, 1984a). The ingested oil is potentially acutely toxic (Connell and Miller, 1981; USFWS, 1981), and is possibly carcinogenic (USFWS, 1981). Seals are known to have a high ability to metabolize ingested oil (Englehardt, 1983, 1984). Oil ingestion may also occur while juveniles nurse if the mother has been oiled (WESTEC Services, 1984). The effects of ingested oil on elephant seal and sea lion pups on San Miguel Island during the 1969 Santa Barbara Channel spill are uncertain (Connell and Miller, 1981). No difference was observed in mortality rates of oiled and unoiled gray seal pups in Wales (Connell and Miller, 1981).

Contacts with spilled oil can have a number of effects. The insulative qualities of fur are decreased (Connell and Miller, 1981; Englehardt, 1983, 1984; MMS, 1984a; WESTEC Services, 1984). The effects are greatest in species relying on air trapped in the pelage for insulation (Englehardt, 1983). Oiled fur results in an increased metabolic rate, and leads to increased grooming and consequent oil ingestion in some species (Englehardt, 1983). Buoyancy is decreased by oiled fur (WESTEC Services, 1984). Irritation of the eyes and exposed mucous membranes can occur (Connell and Miller, 1981; Englehardt, 1983), but this effect is temporary (Englehardt, 1983). Cutaneous absorption of oil has been demonstrated in seals (Englehardt, 1984). Long-term coating can result from contract with viscous oils (Englehardt, 1983, 1984), depending on the oil viscosity, temperature, pelage type, and the frequency and duration of exposure (Englehardt, 1983). Furred species are most susceptible to oil adherence (Englehardt, 1983). Adhered oil is known to affect the swimming ability of seals (Englehardt, 1983, 1984).

Spilled oil may be inhaled (WESTEC Services, 1984), but Englehardt (1983) indicates that only heavy oils cause this effect. Some deaths of heavily oiled harbor seals were attributed to suffocation by inhaled oil after the Arrow spill (Connell and Miller, 1981), and Englehardt (1983) indicates that inhaled oil has affected both seals and dolphins.

Oil ingestion has been identified as a potential effect on cetaceans (Geraci and St. Aubin, 1982), and has been documented in bottlenosed dolphins (Duguy, 1978). Ingested oil has variable effects from species to species (Englehardt, 1983). The baleen of baleen whales can be fouled by ingested oil (NMFS, 1979, 1980; Englehardt, 1983, 1984; MMS, 1984a), resulting in decreased filtering efficency and causing food to adhere to the oil if it is persistent (MMS, 1984a). This effect may occur in bowhead whales (Braithwaite, 1980), but has been conclusively shown to have only a temporary adverse effect on the filtering efficiency of gray and fin whales (Geraci and St. Aubin, 1982). Although cetaceans have a high potential to metabolize ingested oil, petroleum hydrocarbons have been detected in the blubber of stranded cetaceans and may accumulate in the blubber (Englehardt, 1983, 1984).

The effects of contact with spilled oil varies from species to species in cetaceans (Englehardt 1983), but no documented occurrences of wild cetaceans affected by contact with spilled oil exist (Geraci and St. Aubin, 1979; Englehardt, 1983). Eye damage has been identified as a possible effect of contact with spilled oil (NMFS, 1979, 1980), as has skin damage (NFMS, 1980). The skin of cetaceans is virtually unshielded from the environment (Geraci and St. Aubin, 1982), but no petroleum hydrocarbons were detected in the skin of whales passing through the 1969 Santa Barbara Channel oil spill (Brownell, 1971). The effects of experimental oiling on bottlenosed dolphin skin were temporary, with no gross effects noted (Geraci and St. Aubin, 1982), and Englehardt (1983, 1984) indicates that effects on skin contact were temporary for several cetacean species.

Inhalation of oil has been identified as a possible effect on cetaceans (NMFS, 1979; Geraci and St. Aubin, 1982), possibly disrupting respiration (NMFS, 1980). Volatile constituents of oil may be inhaled (NMFS, 1979; MMS, 1984a), but the effects of inhaled volatile hydrocarbons on whales is unknown (MMS, 1984a). Plugging of the blowhole is very unlikely due to the explosive nature of the blow, followed by rapid inhalation and closing of the blowhole (Geraci and St. Aubin, 1979).

Spilled oil may result in behavioral changes, particularly avoidance (Geraci and St. Aubin, 1982). Evidence regarding the responses of cetaceans to oil conflicts, although studies show that cetaceans should be able to detect and avoid oil, the animals often do not actively avoid oil (Englehardt, 1983). Whales and dolphins have been observed swimming and feeding in oil slicks (Goodale et al. 1981; Gruber, 1981). Experiments with bottlenosed dolphins show that this species can detect heavy oil by echolocation and avoid it, and that the species avoids oil when contact is made (Geraci and St. Aubin, 1982). A number of behavioral changes have been noted in gray whales swimming through natural seep areas: swimming speed changed, and individuals spent less time at the surface while blowing less frequently and faster (Geraci and St. Aubin, 1982). Some whales either could not detect the oil or were indifferent to it.

The potential effects of noise on whales can be divided into two classes, disturbance and displacement effects and physical effects. Disturbance and displacement effects include startle and flight, auditory discomfort (Gales, 1982), and communication masking (Turl, 1982). Physical effects may include hearing loss (Gales, 1982), which can occur if a short-term noise is loud enough (Turl, 1982; MMS, 1984a), or by prolonged exposure to moderate noise (Turl, 1982). Although audiograms indicate that cetaceans and pinnepeds are capable of hearing offshore drilling noises (Turl, 1982), there is no confirmed evidence that gray whales actively avoid platforms, helicopters, or seismic operations.

Pipelaying is a temporary noise source. Pipes will be laid by the conventional barge and stringer method over a period of 3 months (WESTEC Services 1984). This installation method produces little noise (MMS, 1984a).

Platform installation and abandonment are also temporary noise-producing activities (MMS, 1984a). The entire installation process typically requires 6 months, including initial jacket launching and upending, pile installation, and installation of the platform modules (MMS, 1984a). Abandonment is expected to occur in 25 to 35 years, with noise-producing activities including cementing, capping, and cutting wells; removal of the jacket and platform by crane and barge, and cutting of pilings (MMS, 1984a).

Drilling and production are more or less constant sources of noise. Drilling will require about 8 years (WESTEC Services, 1984). Production noise begins within a year after drilling begins, and continues through the life of the project. The major noise sources are compressors and diesel engines, which produce noise with loudness of about 90 dB(A) (MMS, 1984a). Total noise from a semi-submersible drill rig in the Atlantic Ocean was measured at 140 to 150 dB with a frequency range of 200 to

1100 Hz (Turl, 1982). The signal to noise ratio produced by drilling activities was as high as 80 to 100 dB above background noise (Turl, 1982). There is little difference between drilling and production noise (Gales, 1982).

Subsurface drilling and production noise, particularly low-frequency components, can be detected up to 100 miles from the source under ideal conditions (Gales, 1982). Low frequency (20 Hz) drilling and production noise can theoretically be detected by large whales up to 38 km from the source, large whales should be able to detect mid-frequency (100 Hz) noise as far as 17.4 km from the source, and higher frequencies (100 Hz) can be detected up to 174 km from the source (Turl, 1982).

Operational noise above the water surface can be heard up to 2 miles from the source under ideal conditions, but is inaudible beyond 1/8 mile under rough sea and weather conditions (MMS, 1984a).

Crew boats and helicopters are another source of noise. The primary source of noise from crew boats is propeller cavitation, which occurs during normal, high speed, and maneuvering operations (MMS, 1984a). Noise produced by boats ranges from about 140 to 150 dB relative to 1 micro Pascal at 1 m in loudness, with a frequency range of 300 to 1800 Hz (Turl, 1982). Measured noise from crew boats and supply boats in the Beaufort Sea was 20 to 40 dB above background levels (Fraker et al. 1981). Helicopters operate daily, but most of the noise produced is reflected from the water surface (MMS, 1984a).

No data on the responses of whales to boat noise are available. Gray whales showed no noticeable response to helicopters flying at an altitude greater than 1000 feet), but playback of helicopter noise at 250 m altitude, and producing an estimated 111 to 118 dB resulted in an annoyance and avoidance response (Malme et al. 1983).

4.6.10 Threatened and Endangered Species

The construction of the platform and pipelines should not significantly impact any State or Federally listed species. The bird colonies on Anacapa Island and at El Estero are at a sufficient distance from the platform to preclude impacts from activity, noise or the disposal of materials from the platform including drilling fluids and muds and cuttings.

The following synopsis of impacts on endangered species is from Seeman (1985). The greatest likelihood of impacts to threatened and endangered species from operating Platform Gail would result from potential oil spills. The probability of occurrence of a large spill (more than 1000 bbl) is quite low (0.07). In general, this low probability results in very low impact probabilities and expected impact levels for most species.

Reptiles

Four listed reptiles may be present in the project area: green sea turtle, leatherback sea turtle, loggerhead sea turtle, and olive (Pacific) Ridley's sea turtle. These species are potentially affected by an oil spill, platform discharges, noise, and increased vessel traffic (MMS, 1984a).

The probability of impacts on individuals of these species is very low, primarily because a very small number of turtles are scattered in the project area (MMS, 1984a). Vessel traffic has been identified as the agent most likely to cause impacts on marine turtles, but is likely to result in very low level impacts and no significant impacts (MMS, 1984a). Impacts on the populations of these turtles are also very unlikely due to the very small portion of the populations present in the project area.

In summary, no significant impacts on marine turtles are anticipated.

Birds

Five listed bird species may be present in the project area: brown pelican, bald eagle, peregrine falcon, light-footed clapper rail, and California least tern. An oil spill is the impact producing agent most likely to affect these species (USFWS, 1979, 1981, 1984; MMS, 1984a). Platform discharges are not likely to affect birds because of the distance between the platform and bird concentration areas and because of dilution of the discharges (MMS, 1984a). Noise is not an impact producing agent for birds because of the distance between birds and the noise source and because of rapid sound attenuation in air. Crew boats are also not expected to cause significant impacts. Three of the species in question, the bald eagle, peregrine falcon, and light-footed clapper rail are rarely offshore, and all birds are relatively capable of avoiding boats.

Brown Pelican. The estimated most likely impacts on brown pelicans can be summarized as follows. A spill could result in low to moderate level impacts at any location within the foraging range, which includes essentially the entire Santa Barbara Channel. The probability of low to moderate level impacts on the mainland concentration area is low/moderate, but very low at other concentration areas. Impacts on breeding or fledgling pelicans are unlikely, but there is a small probability of low to moderate level impact in feeding areas, and breeding locations.

Pelicans' use of the project area includes year-round feeding, concentration areas, and breeding locations. The following analysis considers each of these uses individually.

Because the foraging range of brown pelicans includes essentially the entire Santa Barbara Channel, any oil spill from Platform Gail would be within the pelicans' feeding range. Pelicans have several traits increasing their vulnerability to an oil spill: they forage by diving, they spend a significant amount of time on the water, and they tend to form flocks on the water. Pelicans do not dive when alarmed, so their vulnerability to oil spills is not increased this factor, and the attraction to oil slicks is unknown. Pelicans could be affected by spilled oil either by diving through it when feeding or by landing in a slick.

The more likely to occur small spills (less than 1000 bbl) are likely to contact pelicans, given the widespread nature of foraging pelicans. Although pelicans do concentrate in certain areas at various seasons, individuals can be found throughout the range at any time of the year. Considering the size of the spill, direct impacts would be at the very low to low level. To reach the moderate level of impact, mortality would have to exceed 40 to 50 individuals in winter and spring and exceed 550 to 750 individuals if the spill occurred in summer or fall. Past spills (e.g., Manatee) have resulted in mortality levels lower than this mortality threshold (the percent mortality lying between different impact levels defined by MMS). Indirect impacts from a small spill would probably be minor.

The large spills that are less likely to occur are also likely to contact pelicans. Direct impacts would probably be at the low to moderate level, with the same thresholds. The spill risk analysis indicates that the probability of two spills from Platform Gail larger than 1000 bbl is zero (Dames and Moore, 1985), discounting the probability of cumulative impacts resulting from multiple spills. Indirect impacts are more likely to occur, but are unlikely to be measurable considering the lack of definite knowledge on the subject.

Non-breeding concentration areas are located on the mainland coast between Ventura and Point Mugu, at Santa Cruz Island (including Gull Island and Scorpion Rock), on the Anacapa Islands, and at Sutil and Santa Barbara Islands. With the exception of the mainland between Ventura and Point Mugu, pelicans concentrate at these areas year-round. The factors influencing vulnerability and the modes of impact would be the same as described above. Table 4.6-3 illustrates the probability of contact at these locations.

Table 4.6-3

Contact Probability at Brown Pelican Concentration Areas

Location and Season	Conditional		10-day
	3-day[1]	10-day[2]	Total >1,000 bbl[3]
Ventura to Pt. Mugu			
Spring	76.23	87.88	6.15
Santa Cruz Is., Gull Is., and Scorpion Rock			
Winter	0.67	1.33	0.70
Spring	0.34	0.17	0.01
Summer	0	0	0
Fall	0.67	0.67	0.19
Anacapa Islands			
Winter	0.66	0.67	0.08
Spring	0.17	0	0
Summer	0	0	0
Fall	0	0.67	0.05
Santa Barbara and Sutil Islands			
all seasons	0	0	0

Source: Dames and Moore, 1985

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[1] Percent conditional probability for a spill of unspecified size.
[2] Percent conditional probability for a spill of unspecified size.
[3] Percent total probability for a spill >1,000 bbl.

An oil spill, if one were to occur, would be likely to contact the mainland concentration area between Ventura and Point Mugu. The relatively high probability of contact is due both to the expected trajectory of a spill and to the relatively large size of this target. The resulting level of impact is uncertain, as population data for this concentration area is unavailable. The impact level would probably be similar to those expected from a spill in the feeding range. The probability of contact at the Santa cruz Island complex is very low in winter and fall. Population data to evaluate the level of impact are unavailable, but would also be expected to be similar to a spill in the feeding range. The probability of contact at the other islands and at the Santa Cruz Island complex in spring and summer is very low to zero, making significant impacts very unlikely.

The main pelican breeding areas is located at West Anacapa Island, and less frequently used breeding sites are found at Scorpion Rock, Prince Island, and Sutil Island. The breeding season normally begins in early spring and extends through summer, with fledglings remaining in the area through the fall season. The adult birds would be vulnerable to spilled oil for the reasons discussed above, and fledglings would be vulnerable due to their tendency to land on the water near the breeding islands. The mode of impact for adults and fledglings would including landing in an oil slick, adults may be oiled while diving for food, and eggs or nestlings could be oiled by contaminated adults. Table 4.6-4 presents the probabilities of contact at pelican breeding sites.

The probability of contact at any of the pelican breeding locations during the nesting season is zero, so no effects would be expected. The probability of contact during the fledging season at Prince Island and Sutil Island is also zero, and the contact probability at Scorpion Rock and West Anacapa Island is very low during this season. The likelihood of impacts at Scorpion Rock is reduced by the irregular use of this site, no impact on fledglings could occur unless this site were in use when a spill occurred. Although contact with the Anacapa Island site is very unlikely, the mortality threshold between the low and moderate impact levels would be approximately 45 to 75 individuals (1 percent of pairs plus young).

Peregrine Falcon. Peregrine falcons may be present in the project area as migrants, released birds, and possibly as nesters.

The probability of a migrant peregrine contacting spilled oil is very low, due to the very small numbers of migrant peregrines present in the area. Their low abundance and the fact that the species does not form flocks, does not spend any appreciable time on the water, and does not dive when foraging or alarmed contributes

Table 4.6-4

Contact Probability at Brown Pelican Breeding Areas

Location and Season	Conditional 3-day[1]	Conditional 10-day[2]	10-day Total >1,000 bbl[3]
West Anacapa Is.			
Spring	0	0	0
Summer	0	0	0
Fall	0	0.67	0.05
Scorpion Rock			
Spring	0	0	0
Summer	0	0	0
Fall	0.17	0.67	0.05
Prince Island			
Spring	0	0	0
Summer	0	0	0
Fall	0	0	0
Sutil Island			
Spring	0	0	0
Summer	0	0	0
Fall	0	0	0

Source: Dames and Moore, 1985

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[1] Percent conditional probability for a spill of unspecified size.
[2] Percent conditional probability for a spill of unspecified size.
[3] Percent total probability for a spill >1,000 bbl.

to low vulnerability. Peregrines may be attracted to oil slicks by easily captured oiled prey. These birds would have to capture and consume oiled prey to be affected. The most likely impact level on migrant peregrines would be very low.

An active peregrine falcon eyrie may exist in the Point Conception area. The contact probability at Point Conception is zero at all seasons (Dames and Moore 1985), so no impacts are expected on possible nesters. The factors influencing vulnerability of nesters are the same as those described for migrants, however, nesting peregrines could be affected by oiling of eggs or young by adult birds in addition to capture and consumption of oiled prey.

In summary, no significant impacts on peregrine falcons are expected.

Bald Eagle. Bald eagles may be present in the project area as migrants and as released birds.

Migrant bald eagles are present in very small numbers, making the probability of contact very low. In addition to the low numbers present, the vulnerability of bald eagles to spilled oil is reduced by their non-flocking habitrs, negligible time spent on the water, most commonly a non-diving foraging method, and non tendency to dive when alarmed. Bald eagles may be attracted to oiled prey in or near oil slicks, making capture and consumption of oiled prey the most likely mode of impact. Due to the small probability of contact and relatively low level of vulnerability, no significant impacts on wintering bald eagles are expected.

Light-footed Clapper Rail. The estimated most likely impacts to light-footed clapper rails can be summarized as follows. Significant impacts at Goleta Slough are unlikely, and no impacts are expected at the locations south of Los Angeles. The probability of contact at Carpinteria Marsh is very low; and if contact were to occur, the most likely impacts on a U.S.-wide basis would probably be low, with moderate to high impact levels progressively less likely. Impacts at Carpinteria Marsh would be regionally significant if any mortality were to occur. The most likely impacts at Mugu Lagoon would be less than at Carpinteria Marsh.

Light-footed clapper rails may be year-round residents at Goleta Slough, Carpinteria Marsh, Mugu Lagoon, Anaheim Bay, and Upper Newport Bay. Table 4.6-5 shows the probability of contact at these sites for each season of the year.

Light-footed clapper rails could be affected by direct oiling if a spill entered an occupied marsh, by indirect oiling from contaminated vegetation or prey, and by subsequent oiling of eggs or young. The vulnerability of light-footed clapper rails is influenced both by the life history of the species and by related oil spill control

Table 4.6-5
Contact Probability at Light-footed Clapper Rail Breeding Areas

Location and Season	Conditional		10-day
	3-day[1]	10-day[2]	Total >1,000 bbl[3]
Goleta Slough			
Winter	0	0.33	0.02
Spring	0	0	0
Summer	0	0	0
Fall	0	0.67	0.05
Carpinteria Marsh			
Winter	0.17	0.83	0.06
Spring	0.33	1.17	0.08
Summer	0	0	0
Fall	0	10.67	0.75
Mugu Lagoon			
Winter	0.67	1.50	0.11
Spring	0	4.50	0.32
Summer	0.67	0.83	0.06
Fall	0.67	0.83	0.06
Anaheim Bay			
all seasons	0	0	0
Upper Newport Bay			
all seasons	0	0	0

Source: Dames and Moore, 1985

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[1] Percent conditional probability for a spill of unspecified size.
[2] Percent conditional probability for a spill of unspecified size.
[3] Percent total probability for a spill >1,000 bbl.

technology. The species does not form flocks, spends little time on the water, does not dive to forage, does not normally dive when alarmed, and probably has no attraction to oil or oiled prey, each of which reduces vulnerability to spilled oil. The rails inhabit tidal marshes with small openings to the ocean, which are relatively easily protected from spilled oil. The results of the spill trajectory analysis indicate that oil would be unlikely to reach light-footed clapper rail sites within 3 days, allowing time to transport and install oil protection devices and further reducing the vulnerability of light-footed clapper rails to spilled oil.

The probability of contact at Goleta Slough is very low to zero. Considering the relatively low vulnerability resulting from the species life history and spill control technology, significant impacts are unlikely at this site. The probability of impact is reduced further by the fact that this site may be unoccupied, no impacts to rails at this site could occur if none are present.

At Carpinteria Marsh, the contact probability ranges from zero to very low, depending on the season. The contact probability is very low in fall, spring, and winter; and zero in summer. Again, the life history of the rails and spill control technology reduce the vulnerability of rails at Carpinteria Marsh. If oil were to enter the marsh, the level of impact would depend on the degree of mortality and persistence of the effects. As 100 percent mortality rate is unlikely considering the vulnerability factors, however, 100 percent mortality at this site would reduce the U.S. population by 7 percent and the regional (north of Los Angeles) population by 97 percent. These effects are high levels of impact. Lesser mortality rates are more likely to occur: a mortality rate of 69 percent represents the threshold between moderate and high impact levels on a U.S.-wide level, and a 14 percent mortality rate is the threshold between moderate and low impact levels on the same basis. Because the population of rails north of Los Angeles is small, loss of one pair of rails in Carpinteria Marsh would be regionally significant.

The probability of contact at Mugu Lagoon is very low in all seasons. Potential mortality would be affected by the factors described above, and would probably be less than 100 percent. The rail population at Mugu Lagoon is very small, so 100 percent mortality would be at a very low impact level at both the U.S.-wide and a moderate level impact at the regional level.

<u>**California Least Tern.**</u> The estimated most likely impacts on non-breeding least terns would be low to very low, and the post-breeding concentration areas are unlikely to be affected. Three breeding locations have very low to low probabilities of

contact: the Santa Clara River mouth (low in spring and summer), Ormond Beach (low in spring and very low in summer) and Mugu Lagoon/Point Mugu (very low in spring and summer). The level of impacts would depend on the numbers of terns present, which varies from year to year. If spilled oil reached these sites, impact levels would range from very low to high, depending on the numbers of terns.

Least terns are present in the project area as non-breeding birds, breeding birds, and as post-breeding birds.

Non-breeding birds are widespread along the coast, and are present during the spring and summer. The 3-day trajectory simulation indicates that 79.7 percent of spring trajectories and 65.7 percent of the summer trajectories reach shore (Dames and Moore, 1985). The vulnerability of least terns to oil is increased by their diving foraging method, but the birds do not form large flocks, spend little time on the water, and do not dive when alarmed. Their attraction to oil slicks is unknown. The most likely mode of impact would be oiling while diving for food.

Population data are not available to evaluate the significance of potential impacts. Because of the widespread nature of these birds, a small spill would be unlikely to result in mortality exceeding the low impact level threshold and would probably be at the very low level. Larger spills, which are less likely to occur, could result in mortality exceeding the low impact level on a regional basis.

Post-breeding concentration areas are located at Oso Flaco and Dune Lakes, the Santa Ynez River mouth, Point Mugu and Mugu Lagoon, Harbor Lake, and at Belmont Shores. Terns are present in these areas during the summer. Factors influencing the vulnerability of these birds are the same as described above, and the mode of impact would be the same. Table 4.6-6 presents the probability of contact at the post-breeding concentration areas.

The contact probabilities for all post-breeding concentration areas except Mugu Lagoon and Point Mugu are zero, so no impacts are expected at these sites. At Mugu Lagoon and Point Mugu, the contact probability is very low, indicating that significant impacts are unlikely.

Least tern nesting locations are found north of Point Conception (Santa Ynez, Purisima Point, San Antonio Creek, Santa Maria River, and Oso Flaco and Dune Lakes), at the Santa Clara River, Ormond Beach, Mugu Lagoon, and in Los Angeles County (Venice Beach, Playa del Rey, Terminal Island, San Gabriel River, and Costa del Sol). The nesting season begins in spring and is completed by summer. Breeding birds could be oiled while diving for food and eggs or young could be oiled by adults, factors

Table 4.6-6

Contact Probability at California Least Tern Post-breeding Areas

Location and Season	Conditional 3-day[1]	Conditional 10-day[2]	10-day Total >1,000 bbl[3]
Oso Flaco Lakes and Dune Lake	0	0	0
Santa Ynez River	0	0	0
Mugu Lagoon/Point Mugu 0.67 0.83	0.06	0.83	0.06
Harbor Lake	0	0	0
Belmont Shores	0	0	0

Source: Dames and Moore, 1985

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[1] Percent conditional probability for a spill of unspecified size.
[2] Percent conditional probability for a spill of unspecified size.
[3] Percent total probability for a spill >1,000 bbl.

influencing vulnerability are the same as described above. Contact probabilities for the breeding locations are shown in Table 4.6-7.

Contact probabilities for the Santa Clara River, Ormond Beach, and Point Mugu and Mugu Lagoon range from very low to low. The Santa Clara River site contact probability is low in both summer and spring. At Ormond Beach, contact probabilities are low in spring and very low in summer. The contact probabilities at Mugu Lagoon/Point Mugu are very low in spring and summer. Because least terns forage offshore in addition to protected estuaries, oiling and mortality are relatively likely to occur if a spill reaches these areas. Although mortality rates would probably be lower, a 100 percent rate was used in the following analysis. The significance of these effects would be highly variable from year to year due to the high variability in the population size at breeding sites.

On a regional basis (San Luis Obispo to Los Angeles Counties), a 100 percent mortality rate at the different sites would have the following significance. The Santa Clara River location had much less than 1 percent of the regional population in 1983, which is the lowest recorded, but the highest recorded population would have been 12 percent of the 1983 regional population. Impact levels would range from very low to high at this site, depending on the actual population if a spill contacted the area. Ormond Beach is also at the lowest populationrecorded, 1 percent of the regional population, and the highest recorded population would have accounted for 18 percent of the 1983 regional population. Impact levels would be low to high at this site. Mugu Lagoon/Point Mugu is at the highest recorded level, representing 7 percent of the 1983 regional population, and would have contained 3 percent of the 1983 regional population at its lowest level. Impact levels here would range from high to moderate.

On a species-wide basis, 100 percent mortality at the breeding locations would have these effects: the Santa Clara River had much less than 1 percent of the 1983 population, and would have 3 percent of the population if it were at the highest recorded population. Impact levels would be very low to moderate. Ormond Beach supported less than 1 percent of the population in 1983, and would account for 5 percet of the population if at the highest recorded levels. Impact levels here would be very low to moderate. The 1983 population at Mugu Lagoon/Point Mugu was 2 percent of the total, and would be much less than 1 percent if at the lowest recorded levels, representing moderate and very low impact levels.

Table 4.6-7
Contact Probability at California Least Tern Breeding Areas

Location and Season	Conditional 3-day[1]	Conditional 10-day[2]	10-day Total >1,000 bbl[3]
North of Point Conception[4]			
all seasons	0	0	0
Santa Clara River			
Spring	20.83	33.67	2.36
Summer	25.20	51.17	3.58
Ormond Beach			
Spring	17.50	17.67	1.24
Summer	10.80	9.67	0.68
Mugu Lagoon/ Point Mugu			
Spring	5.83	4.50	0.32
Summer	0.67	0.83	0.06
LA County and south[5] all seasons	0	0	0

Source: Dames and Moore, 1985

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[1] Percent conditional probability for a spill of unspecified size.
[2] Percent conditional probability for a spill of unspecified size.
[3] Percent total probability for a spill >1,000 bbl.
[4] Includes Santa Ynez River, Purisima Point, San Antonio Creek, Santa Maria River, and Oso Flaco Lakes and Dune Lake.
[5] Includes Venice Beach, Playa del Rey, Terminal Island, San Gabriel River, and Costa del Sol.

Mammals

Four listed mammal species or species groups may be present in the vicinity of Platform Gail: southern sea otter, gray whale, right whale, and other endangered whales. An oil spill could potentially affect any of these speices, and noise and crew boats could potentially affect the cetaceans. Noise and crew boats are unlikely to affect southern sea otters due to the distance between the otter range and the project site. Platform discharges are unlikely to affect listed mammals due to rapid dilution and the low probability of prolonged contact (MMS, 1984a).

Southern Sea Otter. The main range of the sea otter is north of the Santa Maria River, and the range of the nomadic males extends south to Point Conception. The probability of an oil spill contacting either of these areas is zero (Dames and Moore, 1985). No impacts on southern sea otters is expected for this reason.

Gray Whale. Gray whales migrate past the project area twice each year, on both southbound and northbound migrations. A few individuals winter in the project area, particulary around the islands.

The offshore migration route is used by most of the gray whale population during the southbound migration. The probability of spilled oil reaching the offshore migration route is zero (Dames and Moore, 1985), so no impacts from spilled oil would affect whales using this route. Noise generated by project activities would probably be detectable at parts of the offshore route, but the route is much farther from the platform than the distance at which behavioral changes result from much louder seismic operation noise, so no behavioral or physical impacts would be expected. This migration route is well offshore from project vessel routes, so no impacts would result from vessel traffic.

The inshore migration route is used by less than half of the southbound gray whales. The 3-day trajectory simulation indicates that 80.7 percent of fall trajectories and 76.5 percent of winter trajectories remain at sea, and the 10-day simulation indicates that 9.8 percent of fall trajectories remain at sea and 20.7 percent of winter trajectories remain at sea (Dames and Moore, 1985). Spills remaining at sea would probably not cross the migration route, which closely follows the coastline. The total shoreline contact probability for the 10-day simulation the total probability of shoreline contact by spills larger than 1000 bbl is 6.37 percent in fall and 5.63 percent in winter. Based on these figures, the probability of contact is low/moderate, but relatively few individuals would be affected due to the small numbers of whales that might cross a slick during the time the slick would be temporary, and may include temporary physical and behavioral impacts. Mortality and lasting ecological effects are unlikely, so impacts would be at the very low level.

The entire population, with the possible exception of cows with calves, uses the inshore route on the northbound migration. The contact probability during the winter would be the same as noted above, and both the 3-day and 10-day trajectory simulation showed that 20.7 percent of the trajectories remain at sea during the spring (Dames and Moore, 1985). The total shoreline contact probability for spills larger than 1000 bbl in spring is 5.59 percent. The contact probability would be low/moderate, but again would be likely to affect a limited number of individuals, with temporary effects at the very low impact level.

Project generated noise would be within detectable range of the inshore migration route. Again, the route is much farther from the platform than the range at which behavioral effects result from louder seismic operation noise, so no mortality or short-term behavioral effects are expected. The impact level for noise on the inshore migration route would be very low.

Vessel traffic from Platform Gail will cross the inshore migration route. The probability of a collision between a whale and boat is very low, and is not expected to result in significant mortality.

Individual gray whales have been observed wintering near San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Catalina Islands. The wintering season includes the latter part of fall, winter, and early spring. Table 4.6-8 presents the contact probability at these locations. Contact probability ranges from very low at Santa Cruz Island, San Miguel Island, and the Anacapa Islands to zero at other islands. Only a few whales would be present, and the effects of contact would probably be temporary. Impact levels would be very low.

The effects of noise on gray whales wintering near the islands would be similar to those described above for the migration routes. Project crew boats would not operate near the islands, and would have no effects.

Right Whale. Right whales are present in the project area on a sporadic basis in very small numbers. Impacts from any of the potential agents are unlikely to affect the population as a whole for this reason. Impacts on individuals, which are unlikely to occur, would probably be similar to those discussed above for gray whales, and would be at a very low level.

Table 4.6-8

Contact Probability at Gray Whale Offshore Island Wintering Areas

Location and Season	Conditional 3-day[1]	Conditional 10-day[2]	10-day Total >1,000 bbl[3]
San Miguel Island			
Fall	0	0	0
Winter	0	0.17	0.02
Spring	0	0	0
Santa Rosa Island			
Fall	0	0	0
Winter	0	0.34	0
Spring	0	0	0
Santa Cruz Island			
Fall	0.67	2.67	0.19
Winter	0.67	1.33	0.70
Spring	0.34	0.17	0.01
Anacapa Islands			
Fall	0	0.67	0.05
Winter	0.66	0.67	0.08
Spring	0.17	0	0
Catalina Island			
all seasons	0	0	0

Source: Dames and Moore, 1985

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[1] Percent conditional probability for a spill of unspecified size.
[2] Percent conditional probability for a spill of unspecified size.
[3] Percent total probability for a spill >1,000 bbl.

Other Cetaceans. The other listed cetaceans potentially present in the project area include blue whale, fin whale, sea whale, humpback whale, and sperm whale.

Most of these species are very unlikely to be effected by an oil spill because they inhabit offshore areas that spills would not reach. The only exception is teh blue whale, which migrates north of Santa Rosa Island to the Santa Rosa-Cortez Ridge. The probability of contact at Santa Rosa Island is very low to zero (Dames and Moore, 1985), and contact would probably result in temporary impacts. Overall, impact levels would be very low.

Project-generated noise may be detectable within the range of these whales, but is not expected to result in noticeable behavioral or physical changes. Impact levels would be very low. Crew boats from the project would be present in the ranges of these whales.

Plants

Salt marsh bird's beak is the only listed plant present within the area that could be affected by the project. Oil spills are the only impact agent that could potentially affect this species. Noise has no effect on plants, platform discharges would not reach the plant's habitat, and crew boats would not operate in the habitat.

In summary, there is a small probability of locally significant impacts on known populations of salt marsh bird's beak, and a somewhat higher probability of locally significant impacts at possible sites. The probabilities of low to moderate level impacts on a regional and species-wide basis are similar.

Salt marsh bird's beak is known to occur at Carpinteria Marsh, Ormond Beach, the Ventura County Game Preserve, Mugu Lagoon, Anaheim Bay, and Upper Newport Bay. It may also occur at Goleta Slough, the Ventura River, and McGrath State Beach. The plant is most vulnerable to oiling during a high tide, particularly in winter when tides are highest. Salt marsh bird's beak grows in estuaries and marshes with small openings to the ocean, reducing vulnerability by being well-suited to spill-control technology. Some populations may not be vulnerable if they are located behind sand dunes or in similar location where there is no tidal influence. The vulnerability of the plant at other seasons is minimal. The probability of contact at known sites is shown on Table 4.6-9.

Population data are unavailable to evaluate the levels of impacts on salt marsh bird's beak. At the known sites, winter contact probabilities range from zero at Anaheim Bay and Upper Newport Bay to very low at Ormond Beach, the Ventura County

Table 4.6-9
Contact Probability at Salt Marsh Bird's Beak Known Population Areas

Location and Season	Conditional 3-day[1]	Conditional 10-day[2]	10-day Total >1,000 bbl[3]
Carpinteria Marsh			
Winter	0.17	0.83	0.06
Spring	0.33	1.17	0.08
Summer	0	0	0
Fall	0	10.67	0.75
Ormond Beach			
Winter	7.00	7.00	0.49
Spring	17.50	17.67	1.24
Summer	10.80	9.67	0.68
Fall	4.20	3.33	0.23
Ventura County Game Preserve			
Winter	0.67	1.50	0.11
Spring	5.83	4.50	0.32
Summer	0.67	0.83	0.06
Fall	0.67	0.83	0.06
Mugu Lagoon			
Winter	0.67	1.50	0.11
Spring	5.83	4.50	0.32
Summer	0.67	0.83	0.06
Fall	0.67	0.83	0.06
Anaheim Bay			
all seasons	0	0	0
Upper Newport Bay			
all seasons	0	0	0

Source: Dames and Moore, 1985

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[1] Percent conditional probability for a spill of unspecified size.
[2] Percent conditional probability for a spill of unspecified size.
[3] Percent total probability for a spill >1,000 bbl.

Game Preserve, and Mugu Lagoon. To reach a population, spilled oil would have to enter the marsh or estuary past oil control devices and would have to coincide with a seasonally high tide, an unlikely combination of events. If oil were to reach one of these sites, the effects would probably be locally significant. High mortality rates at a vigorous population site could result in regional or species-wide impacts at low to moderate levels.

Impact levels at the possible sites would be dependent on the presence of the species, no impact could occur if the species were not present. Winter contact probabilities are very low at Goleta Slough, the Ventura River, and McGrath State Beach. If the plant is present at these sites, the likely impacts would be similar to those described above.

Proposed Mammals

One species currently proposed for listing, the Guadalupe fur seal, is present in the project area. This species could potentially be affected by an oil spill, noise, or vessel traffic. Platform discharges are not likely to affect this species due to dilution and the low probability of prolonged contact (MMS, 1984a).

Guadalupe Fur Seal. Guadalupe fur seals are regularly present in small numbers at San Miguel Island, and individuals are occasionally present on San Nicholas, San Clemente, and Santa Barbara Islands. The seals are present in spring and summer.

Guadalupe fur seals could be affected by spilled oil if they were to swim through or feed in a slick. The contact probability at each of the Guadalupe fur seal sites is zero, so no impacts from oil spills are expected.

Noise from project operations may be audible to Guadalupe fur seals, but would be at low levels due to the seals' distance from the source, and impact levels would be very low. Crew boats would not operate in the vicinity of the seals, so no impacts would be expected.

The major cumulative impact related to endangered species is the increased potential for oil spills in the channel. Existing oil and gas operations located in the Santa Barbara Channel and the Santa Maria Basin yield a probability of an oil spill from platforms and pipelines larger than 1000 bbl of 97.7 percent and the probability of a spill larger than 10,00 bbl is 80.2 percent (Dames and Moore, 1985). The probability of a spill larger than 1000 bbl from a pipeline or platform is currently 90.3 percent and 76.8 percent, respectively, and the probability of a pipeline or platform spill larger than 10,000 bbl is 62.4 percent and 47.4 percent, respectively (Dames and Moore, 1985, cited in Seeman Assoc., 1985).

Construction and operation of Platform Gail would result in an incremental increase in the probability of an oil spill in the Santa Barbara Channel and Santa Maria Basin. With Platform Gail, the probability of a spill from platforms or pipelines greater than 1000 bbl increases 0.3 percent to 98.0 percent and the probability of spills greater than 10,000 bbl increases 1.0 percent to 81.0 percent (Dames and Moore, 1985). For pipeline spills greater than 1000 bbl, the spill probability increases 0.7 percent to 90.9 percent and the probability of a spill over 10,000 bbl increases 1.4 percent to 63.3 percent (Dames and Moore, 1985). The probability of platform spills over 1000 increases 1.9 percent to 48.3 percent (Dames and Moore, 1985).

Platform Gail would result in an incremental increase in subsea noise in the Santa Barbara Channel. Project-generated noise would add to noise from other oil and gas operations in the area and to noise from other activities in the channel. No data are available to compare existing and projected noise.

Platform discharges would also increase incrementally, but data are not available to compare existing and projected discharge volumes. Some types of discharges, particularly thermal discharges, desalinization brine, and sanitary effluent, dissipate completely and are not cumulative. Other discharges, such as drilling muds and cuttings, which are diluted or settle to the bottom are not expected to cumulatively effect listed species. In the Gulf of Mexico, very fine barite particles have been found to form a "haze" of very slow settling particles in areas with many drilling platforms (Trocine and Trefry, 1983), but this effect is not expected to occur in the Santa Barbara Channel dur to the much lower density of platforms.

Platform Gail would result in a small incremental increase in vessel traffic. This increase would not be significant relative to exiting vessel traffic in the Santa Barbara Channel.

As discussed previously in Section 3.6.8, the Southern Sea Otter (Enhydra lutris nereis) is not expected to be found in the project area therefore no impact on this species is expected. Current range of the population is from Pismo Beach to Monterey. Sea lions are often observed under and around existing platforms during drilling and discharge operations. Impacts on these marine mammals from the drilling operation is not expected to be significant.

4.6.11 Mitigation Measures

The operation of the platform will have some impact on the marine ecosystem as previously described. The losses associated with the placement of the platform and pipeline, anchors and anchor chains will reduce the benthic fauna at any contact locations. Any loss should not be considered highly significant due to the relatively uniform infauna at the project location and the type of habitat affected. The most significant negative impacts would be generated from catastrophic oil spills.

The physical impacts of cutting deposition may result in the loss of some existing infauna near the platform. To reduce the extent of this burial and grain size alteration, the discharge pipe on the platform will be placed at a depth of 240 feet (73 m) below the surface water. Placement of the pipe at a depth of 240 feet (73 m) will increase dilution of muds and cuttings in the water column primarily due to the ocean depth (which provides a large water column for dispersion to occur in) and the generally higher current speeds in surface waters. Refer to Section 4.6.4 for a discussion of the discharge plume modelling results. Additionally, discharge at 240 feet (73 m) will avoid the visual impact of the plume at the water surface.

Long-term effects of drilling muds on the bioaccumulation of metals by marine fauna are not well known, but is not expected to be significant as Chevron will not discharge chrome or ferrochrome lignosulfonate.

Chevron has developed an Oil Spill and Emergency Contingency Plan for Platform Gail-Platform Grace, Santa Clara Unit for dealing with potential catastrophic events, including cleanup operations and reducing the level of operations during hazardous conditions. These measures are designed to reduce the probability of an oil spill and to provide high level cleanup operations if they are needed. The plan is specifically oriented towards protection of sensitive resources. Protection and cleanup techniques specific to the varied habitats and environs are clearly delineated in the plan.

4.6.12 Cumulative Impacts on Marine Biology

4.6.12.1 Cumulative Impact on Intertidal Habitat

The cumulative effect of the installation of Platform Gail would be the relatively small increase in the probability of an oil spill in the Channel. The distribution of oil spill trajectories shows a relatively low probability of land contact, particularly on the sensitive Channel Islands. The slight increase (0.55 percent) in probability does not significantly add to the cumulative probability of an oil spill from all sources including existing platforms, pipelines, and tanker traffic. While the probability of a spill is low, the impact of a spill on the intertidal habitat can range from moderate to very high.

4.6.12.2 Cumulative Impact on Biofouling Communities

No significant cumulative impacts are expected.

4.6.12.3 Cumulative Impacts on Benthic Communities

The construction and operation of Platform Gail will have an incremental but insignificant cumulative impact on benthic communities in the Channel. It is highly likely that some impacts in the vicinity of the platform may be observed. However, this impact would be limited to within a few hundred meters of the platform. No significant hard-bottom habitat would be impacted and no effect should be observed on soft-bottom communities.

4.6.12.4 Cumulative Impacts on Plankton Communities

No significant cumulative impacts are expected on planktonic communities in the Santa Barbara Channel from the installation of this platform.

4.6.12.5 Cumulative Impact on Fishes

The cumulative impacts to fishes from the placement of Platform Gail in the Channel should not be significant. It is expected that some fish populations will decrease due to increased fishing pressure as the demand for fish and fish products increases in southern California (MMS, 1984).

The slight increase in oil spill probability should not significantly affect fish populations, although local populations may be affected particularly during sensitive life stages. Squid and northern anchovy could be affected during larval life stages, resulting in localized population reductions for 1-2 years. These are both rapidly reproducing populations and the localized losses should not be significant.

4.6.12.6 Cumulative Impact on Refuges, Preserves, and Marine Sanctuaries

The installation of the platform will incrementally increase the potential risks to refuges, pressures and sanctuaries on the mainland from oil spills. The trajectory analysis does not show a spill contacting the Channel Islands, therefore the cumulative risk of impact to these sensitive resource areas does not increase above existing levels.

4.6.12.7 Cumulative Impact on Avian Resources

The cumulative impacts from the installation and operation of Platform Gail will be an increased potential for oil spills, increased platform discharges, and increased levels of noise and disturbance. The impact of an oil spill on birds has been shown to be highly variable and dependent upon a wide variety of factors. Data from Dames and Moore (1985) show probability of one spill to range from 3 percent for a spill in excess of 10,000 bbl to 69 percent for a spill of 10 bbl. While the probability of a major spill is low, impacts from a major spill can be significant. Cumulative impacts are therefore a matter of increased probability rather than actual impacts.

Platform discharges have been shown to be rapidly diluted to background levels within several hundred meters from the platform and pose no significant cumulative effect.

Noise from construction, operation, or crewboat activity is not expected to affect birds due to sounds rapid attenuation in air.

4.6.12.8 Cumulative Impact on Marine Mammals

Cumulative impacts on marine mammals are the result of increased oil spill probability, increased platform discharges and increased levels of noise in the underwater environment. The impacts of oil on cetaceans and pinnipeds has been shown to be highly variable and conflicting (L. Seeman Assoc., 1985). The cumulative effect of the proposed development is in reality a matter of increased probability of occurrence. In the event of an oil spill, pinnipeds could be affected in a variety of ways (Seeman Assoc., 1985) while cetaceans are expected to be less affected.

Platform discharges have been shown to have no significant cumulative effect due to rapid dilution.

Increased levels of noise in the aquatic environment appears to have some effect on marine mammals. Seismic operations tend to produce some avoidance behavior in grey whales, particularly in the range of less than 5 km (3 miles). The critical distance from air gun to whale was 2 km, with marked behavioral changes and some confused swimming (MMS, 1984).

Other sources of noise includes pipeline construction, installation and operation of the platform drilling, and crewboat activity. Medium (less than 100 Hz) and high frequency (more than 100 Hz) sound can be theoretically detected by large whales at distances from 17 to 170 km (Turl, 1982). No significant alteration in migration pattern have been observed in grey whales since oil development began in the channel; therefore, it is assumed that the ambient sound levels in the aquatic environment have not significantly affected the marine mammals of the channel.

4.6.12.9 Threatened and Endangered Species

Impacts to threatened and endangered species would occur as a result of an oil spill. Cumulatively, the project would result in a very small increase in probability of an oil spill. Oil spill effects on endangered and threatened species are discussed in Section 4.6.10.

4.7 SOCIOECONOMIC IMPACTS

4.7.1 Effect on Local Employment, Population and Housing

4.7.1.1 Construction

The construction phase for the installation of Platform Gail and associated facilities would encompass a 6 month period commencing in August 1986 and continuing until February 1987. Project components to be constructed at various points during this time period include the installation of the platform and offshore pipeline from Platform Gail to Platform Grace. Table 4.7-1 shows the anticipated work-force requirements and schedule for specific project elements during 1986 and 1987, respectively.

The following is a brief description of the construction work-force characteristics and any probable impacts upon local employment, population and housing. Construction-related effects on community services and local transportation systems, both as a function of project development and project-induced employment, are discussed in Sections 4.7.2 and 4.7.4, respectively.

Platform Gail

The principal components of Platform Gail, the platform jacket and modules, will be fabricated in a shipyard outside of Santa Barbara County and transported to the site by barge. No local labor would be involved in the fabrication process, therefore, no impact on Ventura or Santa Barbara County's population or housing would occur as a result of this activity.

Installation and commissioning operations at the site will require 6 months with a maximum employment of 240 workers. Approximately 140 persons will be employed during installation and 90 during hook-up and commissioning. It is anticipated that 80 percent of the personnel (192 employees) will be contract labor, 10 percent (24) will be Chevron supervisory personnel and 10 percent (24) specialized service workers. The contract personnel will work two 12-hour shifts and generally be scheduled for 14 consecutive workdays followed by 7 days off. Because the installation phase is composed of various specialized tasks, not all 240 workers will be onsite at the same time.

The majority of the construction workers would be drawn from the Ventura-Santa Barbara county area, where an ample work force currently exists. However, the actual source of labor will depend on competing requirements of other potential projects underway at that time, such as the Point Arguello Field and the Santa Ynez Unit developments.

Table 4.7-1

ESTIMATED MONTHLY CONSTRUCTION LABOR REQUIREMENTS
PLATFORM GAIL AND PIPELINES
(1986-1987)

Facility	1986			1987	
	Oct	Nov	Dec	Jan	Feb
Platform Gail					
Installation	140	140	140		
Hookup and Commissioning			90	90	90
Pipelines					
Installation	100	100	—	—	—
	240	240	230	90	90

Because construction work force requirements would be met by existing labor, the impact on local employment conditions would be beneficial, but insignificant. Local secondary income and employment impacts generated by equipment purchasing and employee spending would be minor in magnitude and widely distributed. Since project employment for the construction phase would be temporary in nature, it is doubtful that any new employees or their families would relocate permanently in Santa Barbara County, resulting in negligible impacts on permanent population patterns.

Living quarters for the majority of platform construction personnel would be provided on work barges stationed at the site. Personnel would likely return to their permanent residences for their off days. Platform installation activities are not expected to create new demands on transient or permanent accommodations in Santa Barbara or Ventura Counties.

Offshore Pipelines

Construction and installation of the subsea pipelines from Platform Gail to Platform Grace would require approximately 100 employees for an estimated 2-month period. The crews will work in two 12-hour shifts and be quartered on the work barge. The estimated breakdown of local versus nonlocal employees is similar to that for platform construction, with 80 percent of the workers hired locally and 20 percent from out of the immediate area. Total project personnel offshore could reach a maximum of 240 persons if all offshore components are constructed concurrently.

Due to the temporary nature of the project activity (typical for activities of this type) and the provision of housing accommodations at the site, no substantial impacts upon employment, population or housing are anticipated as a result of offshore pipeline constuction and installation.

Permanent relocation of nonlocal personnel to Santa Barbara or Ventura Counties is not anticipated because of the short-term duration of construction activities. Thus, no long-term impacts to population or housing is evident as a result of project construction activities.

4.7.1.2 Development Drilling

Employment levels during the 8-year development drilling phase would average 80 persons, divided into approximately 50 contract drilling personnel, 15 company production personnel and 15 service persons and visitors. Drilling crews would comprise 35 persons for both the day shifts (18) and night shifts (17) and work a 7 days-on, 7 days-off schedule. Contract drilling crews would likely consist of personnel already engaged in offshore drilling activities in the Santa Barbara Channel. Drilling crews are accustomed to being moved about as drilling assignments change and normally return to their permanent residences during their 7 off-days.

No significant impacts on area population levels and housing market conditions are expected due to a number of factors. The majority, if not all, drilling phase employment would not represent new employment but be filled by persons in similar jobs. Although this may lead to employment opportunities at other programs, project support workers (e.g., helicopter operators, crewboat operators) would already be employed by Chevron or project subcontractors. Service workers would be involved only intermittently for short-term assignments during the development drilling and production phases. Consequently, direct project-related impacts on population and employment within Ventura and Santa Barbara County's would be insignificant.

There may be a slight increase in the demand for transient housing in the counties, however most project-related personnel would be staged from the local area and/or are expected to return home on their off days. Therefore, increased demands on housing should be insignificant.

4.7.1.3 Production

The ongoing operation of the platform will require an estimated 32 workers, consisting of 20 company personnel in charge of production operations, 12 contract drilling personnel employed for scheduled well workover activities over the life of the project. The work schedule will be 7 days on, 7 days off.

Approximately 75 percent (24) of the employees would be residents of Santa Barbara and Ventura counties. The 25 percent (8) nonlocal workers would probably relocate to the Santa Barbara/Ventura area. Additional persons from local service companies will be required during scheduled maintenance and periodic repairs.

4.7.1.4 Employment Summary

Average monthly project construction employment levels would peak in the winter of 1986 when the platform and pipeline installation phases overlap, as shown in Table 4.7-1. Maximum employment during this period is estimated to be 240 workers. Following platform and pipeline installation, employment levels would decrease significantly during 1987 (as shown in Table 4.7-1). During the development drilling years 1987 to 1994, a maximum of 80 persons will be offshore on Platform Gail consisting of drilling, production and services personnel, and thereafter maintaining 32 production-phase employees. Although the majority of the work force will be comprised of persons already engaged in similar activities, there is the potential for new employment opportunities to result from the proposed project, either through direct project employment or induced employment in the support and service sectors. Overall, project employment opportunities will represent a moderately beneficial impact to the Santa Barbara-Ventura County mining and construction industries.

As discussed in the preceding sections, no significant impacts to local population or housing conditions are anticipated due to the predominantly short-term duration of the various project phases and the use of construction forces already established locally.

4.7.1.5 Cumulative Impact on Employment, Population, and Housing

Employment impacts from cumulative hydrocarbon development (peaking in 1988) are expected to be significant and beneficial to the economics of Santa Barbara and Ventura Counties. A lowering of the unemployment rate by up to 0.5 is forecast (A.D. Little, 1984). Though some categories of workers would be in high demand during the peak period, Platform Gail construction would occur largely in 1986-87 and would not be affected by peak period demand. Population levels from cumulative development are essentially within planned levels and are considered negligible. Demand for housing due to this growth; however, is a significant and unavoidable long-term impact. It is expected that the demand for housing will exceed the available supply in Santa Barbara and Ventura Counties from a short-term and long-term perspective. Short-term housing needs relate to the temporary requirement for housing of construction personnel. Long-term housing needs are demanded by permanent industry worker in-migration due to induced population and employment. The greatest housing demand will be for low and moderate income "affordable" units (A.D. Little, 1984). Because of the limited nature of the Platform Gail project and the specialized nature of platform construction, the project is expected to have negligible impact on permanent housing. The project's impact in this case is not proportional from a cumulative standpoint and no mitigation is proposed.

It should be pointed out that Chevron participates in the Tri-County Socioeconomic Monitoring Program which is aimed at monitoring housing, service, and transportation needs in the three county area (includes San Luis Obispo County). Chevron is also participating in a reassessment of the projected impacts of the Point Arguello Project on Ventura County. The purpose of these programs is to more accurately assess the socioeconomic impacts of an applicant's project and to establish appropriate mitigation. Chevron is presently participating in several other socioeconomic mitigation programs in conjunction with its Point Arguello project. These programs include identification of temporary housing for construction workers and assistance in development of low and moderate income units. As a result of this participation, Chevron is, or will be, presently mitigating a substantial amount of the cumulative socioeconomic impact from offshore oil developments.

4.7.2 Effects on Community Services

4.7.2.1 Police Protection

Construction and operation of the proposed platform and offshore pipeline will not result in any direct impacts to local police services onshore. The crew base and supply staging areas will receive normal patrol service although prevention against vandalism and theft will rely on such areas being properly secured.

Transient construction workers and the minor increase in permanent population as a result of project development should not warrant a greater level of police protection than currently exists. The potential increase in permanent population will not place any additional demands on police services.

4.7.2.2 Fire Protection

While there is a potential for fire hazards at the platform, prevention, detection and suppression of fires would be the responsibility of Chevron, and therefore not create increased demands on local fire-fighting entities. For detailed information about the type of fire suppression equipment available on the platform, see Sections 5.3.7 and 6.4.3 of the DPP.

4.7.2.3 Medical Care

Emergency medical care may be required during the construction of any or all project elements. In the event of an injury or illness at the offshore site requiring immediate treatment, helicopter service could be provided to St. John's Hospital in Oxnard or the Ventura County Medical Center Hospital. These hospitals, among others in the project area, provide 24-hour emergency aid.

Emergency medical response to onshore facility locations could be provided by ambulance or helicopter. Potential impacts on emergency care services are expected to be negligible due to the infrequent demand for such services.

The minor potential increase in permanent population is not expected to affect the provision of routine or emergency medical personnel and facilities.

4.7.2.4 Cumulative Impact on Community Services

Cumulative demands made on police, fire, and medical services in the region will require expansion of these services by approximately a factor of 10 (A.D. Little, 1984). Note that the A.D. Little data is old and conservatively high. The reassessment for Ventura County will be available in a month and the new data is expected to show lower impact than the 1984 Little analysis. Though substantial, the impact is mitigatible through allocation of funds by local agencies as a function of the budgetary approval process and through direct funding during the development plan approval process. Chevron's contribution to the impact from Platform Gail is disproportionate (much less in magnitude) since no onshore facilities are part of the action. No mitigation measures are proposed.

An additional task of the Socioeconomic Monitoring Program is to monitor whether project related revenues (fees) will compensate for needed capital and operating expenses necessary to provide utilities or services. Through participation in this program, Chevron will contribute a pro-rata share of the required costs of filling any service related deficiencies.

4.7.3 Effects Upon Existing Transportation Systems

Project-generated traffic impacts upon local roadway systems, railroad and air transportation patterns are discussed below. Offshore vessel traffic associated with the proposed project is discussed in Sections 4.5.2, Shipping and 4.5.4, Pleasure Boating. Estimates of the increased traffic associated with the various project components were based on the operational schedules outlined in the Project Description and Section 4.7.1, Effects on Local Employment, Population and Housing. All worker vehicle trips are expressed in roundtrips per day and assume that 10 percent of the workers carpool with 2 persons per car.

The proposed activities will have a minor and relatively short-term impact on transportation systems and facilities. Slight increases in traffic would be experienced from supply trucks, helicopters and employee transportation.

Maximum traffic volumes generated by offshore support personnel and onshore construction workers would occur during late-1986 when platform installation and offshore pipeline construction phases overlap. Peak daily traffic volumes during this period could reach 220 vehicles on a peak day. Daily traffic volumes would decline during the first quarter of 1987, with further decreases during the production phases. Daily traffic volumes assume a normal work schedule of 7 days on and 7 days off for the drilling and production phases, with crew changes interpersed throughout the week. Vehicle destinations include the Carpinteria Pier, Ventura County Airport and Port Hueneme, in association with the offshore operations.

An estimated 80 percent of all personnel vehicle trips are expected to travel to or from the southeast via U.S. Highway 101. The remaining 20 percent of vehicle trips would be to or from the northeast via U.S. Highway 101. Traffic impacts on the regional highway system in Ventura and Santa Barbara Counties is considered to be insignificant because maximum traffic volumes would represent only a 1.3 percent increase over current traffic volumes of 16,000 vpd on U.S. Highway 101, and will be of limited duration. It should also be noted that a substantial percentage of personnel-related traffic is generated by persons already living in the area, and therefore does not represent the actual influx of new traffic to the area.

The proposed project will also create an incremental increase in truck traffic associated with the delivery of equipment and materials to support offshore construction, drilling and operational phases. The maximum projected increase would be 8 to 10 truck trips per day during overlapping phases. Since this activity occurs throughout the day and is not concentrated at any one time, a negligible traffic impact will result.

Helicopter trips during the platform installation will occur approximately twice per day and twice per day during subsea pipline installation. Helicopter trips will decrease to one trip per day during drilling operations primarily for Chevron personnel. No impact upon normal airport operations at the Ventura County Airport is expected as a result of this minimal increase in air traffic.

Commercial helicopter charter service is located on the northside of the runway and each use their own heliports and, therefore, do not impact the Ventura County commercial landing ramp. Current helicopter operations at the airport do not currently interfere with fixed-wing aircraft runways or flight patterns (Dock Harper, Airport Operations, personal communication).

It is anticipated that project-related personnel demands open public transportation systems and railways will be negligible.

4.7.3.1 Mitigation Measures

All equipment transport convoys or oversize truck traffic will be accompanied by a lead vehicle equipped with warning devices. Project-generated traffic should avoid peak travel times and car pooling of personnel will be promoted during this period.

4.7.3.2 Cumulative Impacts on Transportation

Onshore traffic levels generated by the implementation of cumulative projects will have adverse impacts on roadway level of service (LOS) at several specific onshore locations. None of the specific locations that would be affected by Platform Gail related traffic, including Highway 101 in the South Coast area, Carpenteria streets and intersections in the vicinity of Chevron pier, and streets and intersections near Port Hueneme, were determined to have significanct adverse cumulative impacts. Therefore, the mitigation measures discussed for the proposed project are appropriate and no additional measures are proposed.

4.7.4 Demand for Goods and Services

4.7.4.1 Supplies and Equipment

The following is a list of supplies and equipment that will be required during the platform drilling phase. The average per well is estimated to be:

- 150 to 250 tons oilfield casing.
- 3500 to 5000 cubic feet cement.
- 25,000 cubic feet mud (barite, bentonite, and miscellaneous mud additives).
- 33 oil well rock bits.
- Food to prepare 3 meals per day for 80 persons.
- Soap and laundry detergent (130 pounds detergent, 30 to 40 gallons bleach).
- Linen supplies for 80 persons.
- Miscellaneous items to maintain the platform.

It is anticipated that the majority of these supplies will be purchased locally (Santa Barbara, Ventura, Los Angeles counties), thus adding increased income to area businesses and benefiting the economy. None of these supplies or equipment are in short supply and project demand for these goods will not strain the existing distribution capacity in the area. Supplies required during the construction phases will also be purchased locally, whereas major facility components may be imported from other areas within the western United States.

4.7.4.2 Water

Potable water needs during the platform and offshore pipeline construction phases will be provided primarily by desalinization units onboard the work barges. Bottled water for drinking purposes may also be purchased from a local distributor. Pipelines will by hydrostatically tested with seawater. Potable water requirements for construction of the onshore facilities will be supplied in bottles by a local vendor. Therefore, no demands on municipal water systems will occur during the construction phase.

Approximately 7000 gallons per day of fresh water will be utilized at the platform during the drilling phase. This requirement will be provided by two vapor compression desalinization units on the platform. Fresh water produced from the desalinator unit will continually resupply the 300 bbl potable storage tank. Fresh drill water storage capacity will be provided in the platform jacket legs. The water will be removed from the legs by means of compressed utility air. This water will be used primarily for preparation of the drilling muds and cement. Makeup water for drilling purposes will be derived from the desalinator or purchased from local vendors as needed and transported to the platform by supply boat. Salt water will be utilized in fire suppression systems and for washdown, process cooling and drill cuttings wash water.

It is anticipated that adequate water supplies will be available for all platform drilling and production requirements. During the production phase project facilities will be essentially self sufficient in regard to water supplies due to the use of seawater desalinization units. Thus, no service demands would be placed on municipal water supply.

4.7.4.3 Cumulative Demand for Goods and Services

The demand for water from cumulative development, including the increase in water demand attributable to induced growth, would be substantial particularly in Santa Barbara County. Accommodation of growth from cumulative projects would require the development of alternative water supplies (A.D. Little, 1984). The proposed action, however, does not have a direct demand for water resources from any municipality or agency since it incorporates desalinization to meet plant and platform processing and domestic needs.

4.7.5 Effects On Tourism: Oil Spills

The effect of an oil spill upon tourism levels in the potentially affected communities depends upon the severity of the spill and whether the spill occurs during peak tourism months (typically summer months) or during the off-season. (Continental Shelf Associates, 1985)

Much of what can be understood, or inferred, concerning effects oil spills have upon tourism levels are case studies performed for spills which have occurred in the past and have affected tourism-dependent coastal communities; the effects of the 1969 Santa Barbara oil spill are of most interest. Other spills which have been the subject of similar case studies are the AMOCO CADIZ oil spill along the coast of Brittany, France in 1978, and the IXTOC I spill in the Gulf of Mexico in 1979.

In the Santa Barbara case study, Mead and Sorenson (1970) examined bed tax receipts of potentially affected jurisdictions along the south coast and monthly attendance records at local beaches immediately before and after the spill. The results were inconclusive because the changes in visitor levels and beach attendance were attributable to other changes such as entrance fees and quality of facilities. Survey data were analyzed which indicated that the mean number of visits to the beach per Santa Barbara area resident in the previous 12-months before the spill declined approximately 25 percent in the 12-month period immediately following the spill. Again, these results are inconclusive as to the effect the spill had upon the economy in that the decline in local residents' visits to beach areas, in terms of dollars spent in the local economy, is not as significant as dollars spent by visitors to the area.

In the case of the IXTOC I oil spill (reported by Restrepo and Associates, 1982), depressed recreational and tourism levels resulted in direct economic losses in tourism-related expenditures of $3,979,000 to $4,440,000. Most of the affected businesses, however, were the businesses directly on the water's edge and the report was unable to identify any substitution effects among specific sites in the study area which may have occurred. Indirect effects for any one major visitor-serving sector suggested that no significant indirect economic impact in the study region could be attributed to the oil spill.

With respect to the AMOCO CADIZ oil spill, estimated losses to the tourism industry ranged from $13 to $82 million (Bonnieux and Rainelli, 1982). Declines in employment and earnings in the visitor-survey sectors in both the polluted and unpolluted portions of the Cores-du-Nord area were reported: 29.2 percent in the polluted portion and 10 percent in the unpolluted portion over the 1977-1978 period.

4.8 VISUAL RESOURCES

Potential impacts of the proposed project on visual resources will occur from additional structures placed offshore the Santa Barbara/Ventura mainland. Additional visual impacts may occur in the unlikely event of an oil spill.

4.8.1 Scenic Resources

Assessment of potential visual impacts involves evaluating the intrusive effect of various project elements from public access points. Important determinants in this scenic effects evaluation include distance from viewing points to the project elements or activities, ambient climatic limitations (e.g., fog and/or haze), and potential for visual change in the existing landscape. The degree of visual intrusion is influenced by the duration of the project element or activity, quality of the affected visual field, contrast with the existing landscape, and by individual perceptions and attitudes. Because perception of the visual environment varies individually and therefore is highly subjective, the following analysis focuses on objective factors influencing visibility.

4.8.2 Construction

Offshore construction activities potentially visible from coastal areas shown on Figure 2.5-2 include installation of the platform and offshore pipelines. Visible elements associated with these activities will be: crew and supply boats delivering materials and personnel to the platform sites, a lay barge and tugboat involved in pipeline installation, work barges at the platform site, and the platform jacket being towed to the installation site.

Small boats transiting the Santa Barbara Channel are a normal component of the visual character of the Channel and are not generally viewed as displeasing. In 1981, vessel movements in the Channel averaged about 358 on a monthly basis (Texaco, 1983). An additional 90-150 monthly movements from the Platform Gail project during construction will not result in a measurable change in the visual character of the Santa Barbara Channel. Barges anchored at the platform site will not be visible from most onshore locations due to distance and fog. In addition, the construction period will be relatively short (4-6 months). Therefore, aesthetic impacts resulting from Platform Gail construction activities will be negligible.

Potential aesthetic impacts from onshore activities will be limited to the Carpinteria Pier and Port Hueneme areas and will be associated with crew and supply boat loading and unloading. These activities will not represent a change in the existing visual environment because of the existing industrial nature of these areas.

4.8.3 Drilling

Potentially visible elements associated with drilling activities primarily will be crew and supply boasts traversing the Santa Barbara Channel between Port Hueneme, Carpinteria Pier and the platform location. About 60 monthly vessel movements will occur during drilling, considerably less per month than during construction. Therefore, aesthetic impacts during the drilling phase will be slightly less than those described above for the construction phase (negligible). The platform will also become a major visual element (Section 4.8.3).

4.8.4 Production

The major visible element during the production phase will be the platform. The physical appearance of Platform Gail will be similar to that of existing platforms in the Santa Barbara Channel. The addition of an industrial structure (the platform) will not significantly alter the visual character of the seascape, because Platform Gail will be located further offshore from three existing platforms in the project area (i.e., Gilda, Gina and Grace). Distances to the proposed platform from various points along the south-coast are also shown in Section 3.8. Proposed Platform Gail and project-related activity should not be visible from north Ventura coast locations as distances exceed 16 nautical miles (26 km). The only coastal areas from which Platform Gail may be visible are from the Ventura River south to Port Hueneme. Distances range from 10.5 nm (17 km) to 9 nm (14 km), respectively. At these distances, coupled with the presence of the existing platform in the project area, Platform Gail will produce a minor additional incremental visual impact to coastal areas. The platform will be obscured from the shore by haze and fog 40-60 percent of the time (BLM, 1981).

The proposed platform could result in potentially more significant visual impacts from Anacapa Island at a distance of approximately 6.5 nm (10.4 km) and Santa Cruz Island, approximately 8 nm (12.8 km). The platform will be visible more often than from mainland coastal viewpoints due to the decrease in distance. Potential visual intrusion would be moderate to adverse depending on visibility and time of year. One of the major destinations for divers and boaters are the Channel Islands. The National Park Service estimates that there were approximately 2288 boat days for Anacapa Island in 1983 (WESTEC Services, 1984). This figure is based on actual counts taken for boat visitors to Anacapa and Santa Barbara Islands. Visitors to Anacapa and Santa Cruz Island will be exposed to the platform structure which would be the closest offshore platform to the Islands thus far.

4.8.5 Mitigation Measures

No mitigation measures are available to reduce the visual presence of an offshore platform. The distance from sensitive receptor areas coupled with reduced visibility in the project area will aid in reducing the dominant presence of the structure throughout the years.

4.8.6 Cumulative Impact on Visual Resources

Cumulatively, oil-related projects proposed for the OCS and state waters will significantly impact the aesthetic attributes of the coastal area of Ventura and Santa Barbara Counties (A.D. Little, 1984). Increased intensity of use of coastal areas from both oil and non-oil related population increases will futher degrade the existing visual amenities. The visual impact due to offshore construction activities is considered short-term. The visual impact of platform operations, though long-term, is minor for Platform Gail (it can be seen from southern Ventura County only). Thus, its contribution to cumulative visual impact is minor as well.

4.9 CULTURAL RESOURCES

As the platform will be installed in water depths greater than 394 feet (120 m), no site-specific cultural resource survey is required for the platform site. According to current regulations (NTL 77-3, 1979), areas of probability for the occurrence of potentially significant cultural remains are limited to water depths of 394 feet (120 m) or less.

Portions of the proposed pipeline from Platform Gail to Platform Grace located in water depths less than 394 feet (120 m) were reviewed for cultural resources (Section 3.9). Review of existing and recently acquired sidescan sonar and subbottom profile data by Stickel (1984) did not identify any potentially significant cultural resources. The proposed project is not expected to disturb cultural deposits.

4.9.1 Cumulative Impact on Cultural Resources

Cumulative development will not have a significant impact on offshore cultural resources since occurrences of such resources are rare and are avoidable. Procedures employed to comply with offshore lease development plan regulations protect resources so that no significant impact will occur.

4.10 ACCIDENTS

Potential impacts related to oil and gas development involve the possibility of accidents. Potential accidents associated with the Platform Gail project (including platform operations, the pipelines from Gail to Platform Grace, and Platform Gail support vessel activities) could potentially result in an oil spill, fire or explosion and platform marine vessel collision.

4.10.1 Oil Spills

Section 5 of the ER includes an oil spill risk and impact assessment for the Platform Gail project. Section 4.6 (Marine Biology) discusses the impact of an accidental oil spill on marine organisms. Chevron's oil spill prevention and contingency planning is an integral element of the proposed project development. This is partly a result of the legal requirements of the MMS and other agencies and partly a reflection of Chevron's business practices. Chevron's Oil Spill and Emergency Contingency Plan for Platform Gail - Platform Grace has been submitted to the MMS for approval. This plan describes in detail, procedures that would be implemented in the event of a spill, including:

a. reporting and notification procedures;
b. response decision guidelines and checklists;

c. organization and responsibilities of Chevron's onsite and corporate response teams;

d. containment equipment and procedures appropriate to the volume and location of the spill and the nature of the resources potentially affected;

e. inventories of equipment and personnel available through industry oil spill cooperatives and government agencies; and

f. oil spill trajectories for all months of the year for both contained and uncontained spills from the platform and pipeline.

4.10.2 Platform/Marine Vessel Collisions

Marine vessel/platform collisions are discussed in Section 4.5.2 (Shipping).

4.10.3 Fire/Explosion

The results of a fire or explosion on an offshore platform can range from minor to extreme. It is estimated (Blake, 1978) that unprotected steel columns and beams loaded to normal design limits, such as are used in the construction of offshore platforms, can collapse after 10 to 15 minutes of exposure to fire.

No historical data is available on fire or explosions in the Santa Barbara Channel. Historical data involving platforms on the Gulf of Mexico OCS were analyzed to estimate an historical occurrence rate of fire and explosions for offshore platforms. For the 18-year period from 1964 through 1981, 416 fires/explosions were recorded for platforms on the Gulf of Mexico OCS (Texaco, 1983).

The rate of occurrence for fires/explosions is estimated by dividing the number of fires/explosion incidents occurrence rate of: 416 incidents/34,474 structures-years = 0.0121 fire/explosions per structure-year (Texaco, 1983).

This rate applies to any fire/explosion incident regardless of severity. Based on the historical data, incidents were classified as "minor" if no injury, pollution, or damage was reported to have resulted from the fire/explosion. "Not minor" thus refers to any fire/explosion involving any injury, any platform/equipment damage, or any oil spill greater than 1 bbl as reported to the MMS. Applying these definitions, 44 percent (183 incidents) of all fire/explosions occurring on Gulf of Mexico OCS platform from 1964 through 1981 would be categorized as minor (Texas, 1983).

For Platform Gail, the total exposure to potential fire/explosion incidents is estimated to be 30 platform-years. Assuming that they occur as a Poisson process, the Poisson equation can be used to obtain an estimate of the risk of a fire/explosion for

Platform Gail. The probability of occurrence of one or more "not minor" fire/explosions occurring on a platform over the life of the structure (30 years) is estimated to be about 12 percent (Texaco, 1983).

While modern platforms employ basic design features and multiple safety systems to prevent and extinguish fires and explosions (Refer to Section 6 of the DPP), the presence of large amounts of hydrocarbons makes accidents possible. In extreme cases, consequences could include the failure of a platform and the loss of human life, however, the likelihood of a severe accident is considered low.

4.10.4 Minor Accidents in Normal Operations

Minor accidents associated with normal platform operations may occur during the Platform Gail lifetime and include the types of accidents previously discussed. The consequences of these minor accidents are discussed below.

4.10.4.1 Small Spills

Small spills of fuels, lubricants, solvents, oil and other materials can occur during normal operations. As described in Section 6 of the DPP and Section 2.11.2 of this report, Platform Gail will be designed with a system of deck drains and gutters to funnel any crude oil into wash tanks for proper disposal. Small spills that could affect ocean waters generally are rapidly containable with on-site equipment and pose no substantial threat to the marine environment.

4.10.4.2 Equipment Losses

Construction and operational equipment, such as tools, drilling equipment and construction materials, may be accidentally dropped into the ocean. These losses would have no significant effect on the environment or on other uses of the project area unless large pieces of equipment were lost over trawling grounds en route to the platform site. Chevron and its contractors will comply with OCS Order No. 1 requirements regarding the marking of such equipment.

4.10.4.3 Personal Injuries

The risk of personal injuries exist in all petroleum development operations. The risk is higher in offshore operations, where boats and platform equipment may have to be operated under hostile conditions. It is Chevron's policy to minimize hazards to offshore personnel on Chevron-supervised projects. All offshore operations will be conducted in accordance with Chevron's Critical Operations and Curtailment Plan and OSHA regulations.

4.10.5 Cumulative Impact of Accidents

The risk of a major oil spill or other accident involving a platform or subsea pipeline increases as the level of activity increases. For cumulative developments, about 3.9 spills of 1000 barrels or more of oil and 1.7 spills of 10,000 barrels of oil are expected between 1986 and 1995 (Dames and Moore, 1985). One way to reduce oil spill risk is through consolidation of processing and transportation facilities. Chevron will consolidate its Platform Gail operations through utilization of existing oil and gas subsea pipelines between Platform Grace and shore, and will use an existing onshore pipeline transportation system to transport products to the LA basin. Chevron will also operate its Gaviota oil and gas processing plant as a consolidated facility for western Channel developments. The aforementioned oil spill emergency response and contingency planning mitigation measures (Section 4.4.4) are applicable to this impact as well.

SECTION 5

OIL SPILL RISK AND IMPACT ASSESSMENT

5.1 SPILL OCCURRENCE RATES

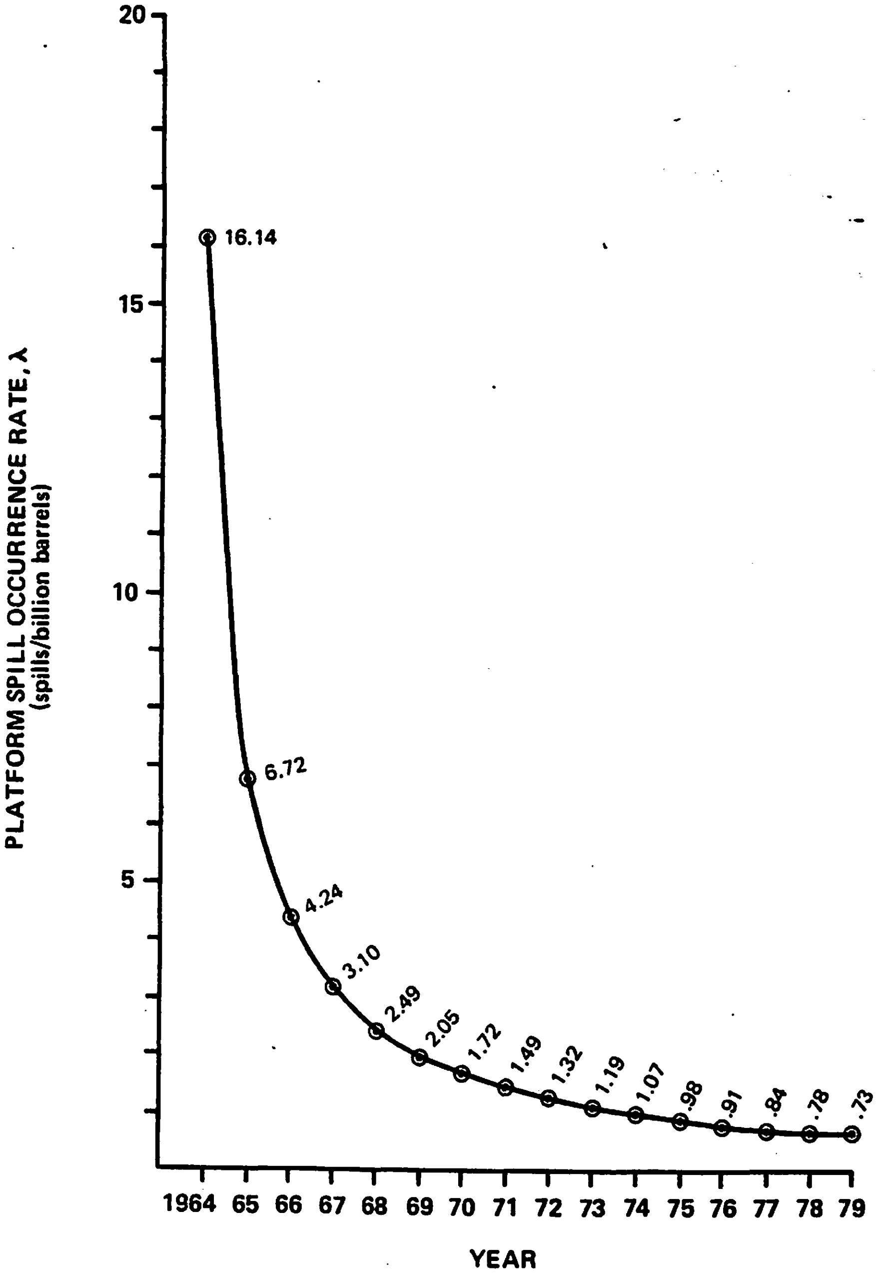
The oil spill occurrence probabilities for Platform Gail have been calculated using the Dames and Moore Oil Spill Trajectory Model for 3- and 10-day trajectories, and the Minerals Management Service (MMS) lease sale 80 results for 30-day trajectories (Dames and Moore, 1985). Detailed results have been published and submitted to MMS under separate cover.

Determination of the risk of oil spill occurrence is based on the following assumptions:

1. Past spill experience is a reliable indication of future spill experience (based on work done by Nakassis in 1982 and illustrated on Figure 5-1).
2. The underlying causes of oil spills will be the same in the future as they have been in the past.
3. True (intrinsic) oil spill occurrence rates will not be affected by improvements in spill prevention technology or more stringent regulatory requirements imposed on OCS operators.
4. Causes of oil spills in the Santa Barbara Channel OCS would be the same as for other U.S. offshore areas and regions of the world where historical oil spill occurrence rates have been determined (e.g., the Gulf of Mexico OCS).

The basic calculations for spill occurrence consist of two parts: determination of the historical spill frequency and the probability of oil spill occurrence. Historical spill rates are used to calculate future spill frequencies. The spill occurrence rate, or frequency, is generally calculated by dividing the number of spills greater than a given magnitude by the total number of barrels produced or transported for the designated time period.

Oil spill occurrence rates have been derived from historical data contained in a study by Stewart and Kennedy (1978). Also necessary for the assessment of oil spill risk is the frequency distribution of spill sizes. For the Platform Gail project, volume distribution functions have been used to estimate the statistically expected number of spills exceeding 1000 and 10,000 barrels. The resulting spill occurrence rate and frequency distributions for well blowouts, non-blowout platform spills and offshore pipeline spills are shown in Table 5-1.



DATA FROM NAKASSIS, 1982.

Platform Spill Occurrence Rate (λ) Versus Year

FIGURE 5-1

Table 5-1

PROBABILITY OF SPILL OCCURRENCE BY TYPE AND SIZE

Mode	1,000-10,000	≥10,000
Platform (Blowout)	0.577	0.302
Platform (Operational)	<0.001	< 0.001
Pipelines	0.002	< 0.001

Source: Dames and Moore (1985)

5.2 COMPUTED RISK OF OIL SPILL OCCURRENCE

The estimated oil spill risk exposure associated with Platform Gail and the subsea pipeline connecting it to the Platform Grace is detailed in Table 5-2. These estimates were combined with historical spill rates using the computational procedure described in Dames and Moore (1985) to determine the estimated number of oil spills associated with the Platform Gail project and the probability of oil spills of various sizes over the entire project lifetime. As shown in Table 5-3, the statistically expected number of spills over 1000 barrels is 0.074, or essentially zero since a fraction of a spill cannot occur. Table 5-4 presents the probability of spill occurrence for different spill-size categories, and indicates a 6 percent chance of one or more spills greater than 1000 barrels and a 3 percent chance of one or more spills greater than 10,000 barrels originating from Platform Gail. As indicated on Table 5-4, the subsea pipeline is more likely to result in small spills, and the probability of one or more large spills (greater than 1000 barrels) is approximately 1 percent.

5.3 OIL SPILL TRAJECTORY SIMULATIONS

The movement of an oil spill originating from Platform Gail was simulated over an area extending from Oceanside and San Clemente Island on the south to the Santa Maria River at the north. Due to the size of the study area, two modeling grids were employed in this analysis. To facilitate the usefulness of this study to interpret impacts on resources of special interest, "target" locations were also identified within the area of study. These locations are described and illustrated in Dames and Moore

Table 5-2

OIL SPILL RISK EXPOSURE PARAMETERS PLATFORM GAIL AND PROPOSED SUBSEA PIPELINES

Project Element	Spill Type or Cause	Estimated Oil Spill Risk Exposure
Platform Gail	Blowouts	800 well-years
	Operational/Break-in period	10 platform-years
	Operational/Post Break-in	22 platform-years
Offshore Pipeline	Leak or rupture	192 mile-years

Source: Dames and Moore, 1985.

Table 5-3

STATISTICALLY EXPECTED NUMBERS OF SPILLS (λ) PLATFORM GAIL AND ASSOCATED PIPELINE

	Volume (barrels)	
	>1000	>10,000
Platform Gail	0.066	0.035
Pipeline	0.008	0.000
TOTAL	0.074	0.035

Source: Dames and Moore, 1985.

Table 5-4

PROBABILITY OF SPILL OCCURRENCE* PLATFORM GAIL AND ASSOCIATED PIPELINE

	Platform Gail	Pipeline	Total
>1000 BBL			
P_0	0.94	0.99	0.93
P_1	0.06	0.01	0.07
P_{2+}	0.00	0.00	0.00
>10,000 BBL			
P_0	0.97	1.00	0.97
P_1	0.03	0.00	0.03
P_{2+}	0.00	0.00	0.00

---

*P_0 = Probability of zero spills.

P_1 = Probability of exactly one spill.

P_{2+} = Probability of two or more spills.

All values are rounded to the nearest hundreth.

Source: Dames and Moore, 1985.

(1985). Oil spill "hits" on target resources were interpreted as occurring if any of the grid cells occupied by a target were contacted during the simulation period. Because most of the shoreline and target contacts occurred close to the Platform Gail location within 10 days, graphic illustrations of spill impacts in the eastern Santa Barbara Channel area were prepared to facilitate the review of 3-day and 10-day modeling results (see Dames and Moore, 1985, for simulation illustration).

5.3.1 3-Day Trajectory Results

The results of the 3-day oil spill trajectory simulations include consideration of the following:

1. The conditional probabilities of spill contact (the probability of contact assuming that a spill will occur) at specific shoreline segments;
2. Total probability that an oil spill greater than 1000 barrels will occur and will contact specific shoreline segments;
3. Total probability that an oil spill between 1000 and 10,000 barrels will occur and will contact specific shoreline segments;
4. Total probability that an oil spill greater than 10,000 barrels will occur and will contact specific shoreline segments;
5. Conditional probabilities of spill contact at specific sensitive resource targets; and
6. Total probabilities that an oil spill greater than 1000 barrels will occur and will contact specific sensitive resource targets.

As indicated by the results presented by Dames and Moore (1985), the locations most likely to be affected within 3 days by a spill originating from Platform Gail are relatively close to the platform site. The mainland coast from Ventura to Ormond Beach is the most commonly contacted shoreline segment in the 3-day analysis during all seasons of the year. The minimum time to impact in this area was calculated as low as 15 hours in some cases. Most of the spill trajectories reach shore within 3 days during the spring and summer months, but over 75 percent do not make a shoreline contact within 3 days during the fall and winter.

5.3.2 10-Day Trajectory Results

The results of the 10-day oil spill trajectories are analogous to those presented for the 3-day trajectory simulations. Although some trajectories are transported much farther from the platform location over the 10-day simulation period, the most common area of contact is still the area from Ventura to Ormond Beach. Shoreline contacts from Ventura to Santa Barbara increase during all seasons, but are particularly pronounced during the fall season. Very few spill simulations did not contact land within the 10-day simulation period. The number of trajectories which did not make contact with 10 days ranged from zero percent (summer) to 20.7 percent (winter and spring).

5.3.3 30-Day Spill Trajectory Estimates

Oil spill trajectories and resulting shoreline and sensitive resource target contacts were estimated using the conditional probability results for launch site E-24 in the Pacific OCS Technical Paper 83-9 (Minerals Management Service, 1983). Because the MMS analysis uses a courser modeling grid, these results cannot be transformed into probabilities addressing the same shoreline segments and sensitive resource "targets" as presented for the 3-day and 10-day trajectories. The shoreline segments and sensitive resource locations referred to in Tables 3-53 and 3-54 of Dames and Moore (1985) correspond to those locations referenced in the MMS study. The results presented address probabilities over an entire year-long period because no seasonal results were reported by the MMS for launch site E-24 in the technical paper.

5.4 CUMULATIVE OIL SPILL RISK

Oil production rate estimates for all southern California offshore development over the expected production life of Platform Gail are not readily available. Arthur D. Little (1984) presents a projection of crude oil production over the period 1986 through 1995, however. This period encompasses the period of maximum production associated with Platform Gail, and the Arthur D. Little data may be used to evaluate Platform Gail's contribution to cumulative oil spill risk. Spill rate estimates presented by Minerals Management Service (1983) were used in this analysis, and the computation of pipeline spills assumes that all oil produced between 1986 and 1995 will be transported to shore by pipeline. As the results in Tables 5-5 and 5-6 indicate, the cumulative probability of spill occurrence between 1986 and 1995 is quite large and the overall probability of spill occurrence is effected to a very minor degree by the exclusion of Platform Gail contribution to spill risk (Dames and Moore, 1985).

5.5 OIL SPILL CONTINGENCY PLANNING

The Chevron Oil Spill and Emergency Contingency Plan for Platform Gail - Platform Grace, Santa Clara Unit accompanies this Environmental Report. The Contingency Plan details the procedures for containment and cleanup of oil spills. The

Table 5-5

CUMULATIVE PROBABILITY OF OIL SPILL OCCURRENCE
1986 THROUGH 1995
SANTA BARBARA CHANNEL AND SANTA MARIA BASIN
WITH AND WITHOUT PLATFORM GAIL
SPILLS >1000 BARRELS

Scenario	Total Production (Billion BBL)	Platform Spills		Pipeline Spills		Total Spills	
		Probability (%)	Expected Value ( )	Probability (%)	Expected Value ( )	Probability (%)	Expected Value ( )
Platform Gail Included	1.497	77.6	1.497	90.9	2.395	98.0	3.892
Without Platform Gail	1.459	76.8	1.459	90.3	2.334	97.7	3.793

Source: Dames and Moore, 1985.

Table 5-6

CUMULATIVE PROBABILITY OF OIL SPILL OCCURRENCE
1986 THROUGH 1995
SANTA BARBARA CHANNEL AND SANTA MARIA BASIN
WITH AND WITHOUT PLATFORM GAIL
SPILLS >10,000 BARRELS

		Platform Spills		Pipeline Spills		Total Spills	
Scenario	Total Production (Billion BBL)	Probability (%)	Expected Value ( )	Probability (%)	Expected Value ( )	Probability (%)	Expected Value ( )
Platform Gail Included	1.497	48.3	0.659	63.3	1.003	81.0	1.662
Without Platform Gail	1.459	47.4	0.642	62.4	0.978	80.2	1.6200

Source: Dames and Moore, 1985.

Chevron Contingency Plan is supported by the Clean Seas Contingency Plan which specifies protection and cleanup procedures to the degree of discussing individual sensitive habitats and their unique requirements for protection or cleanup. Further, the document details contingency plans for protection of the Channel Islands.

The key to any plan is, of course, implementation. The Chevron Contingency Plan clearly delineates areas of responsibility and provides for periodic training of its personnel. Chevron's Contingency Plan along with the operation and equipment of Clean Seas will provide sufficient protection to the project area. Please refer to this report for information regarding oil spill clean-up equipment, onsite response and area response spills.

SECTION 6
ALTERNATIVES TO THE PROPOSED ACTION

6.1 NO PROJECT

Should the project be denied, existing environmental conditions within the Lease P-0205 area would be maintained. Minor adverse effects on the physical, biological, and social environments and beneficial economic and domestic energy supply impacts would not occur. Selection of this alternative may not completely eliminate environmental impacts to the Santa Clara Unit area as there are currently two operating platforms in the unit. Since the Platform Gail project already includes the use of consolidated pipelines and onshore processing, the only impacts avoided by the no project alternative will be minor incremental effects of one additional platform, subsea connecting pipelines to Platform Grace and increased oil and gas production. Although the selection of the no project alternative would preserve a nonrenewable natural resource, selection of this alternative would not be consistent with United States national energy policies which encourage increased development of domestic oil and gas reserves to reduce U.S. dependence on foreign nations.

6.2 DELAY THE PROJECT

Delaying the proposed project would delay additional production of domestic oil and gas. It would also delay the environmental impacts of the proposed project. Although this would preserve a nonrenewable resource for use at a later date, it is not consistent with current national energy policies which encourage increased domestic oil and gas production. If the delay were to occur past the operating life of the existing facilities (i.e., platforms Grace, Hope and the Carpinteria gas plant) the economic incentive for Chevron to implement the project would be eliminated. This would also occur if the MMS terminates the lease due to non-development.

6.3 IMPLEMENTATION OF PARTIAL ACTION

The Platform Gail project involves a single offshore platform and maximizes the use of consolidated facilities for the transport of production to shore, onshore processing, and transport to the Los Angeles area. As such, few options associated with partial action are available. The proposed project has been developed based on environmental, operational and economic concerns. As proposed, it represents the most environmentally sound economically feasible option for Chevron's production of oil and gas reserves from Lease P-0205. Partial implementation such as constructing a smaller platform and drilling fewer wells would adversely affect project economics, and could

Some of #s come from CARB relative & credit for Cogeneration Air Basins

Power Plants are peaking at maximum during worst smog conditions – ie worst case

result in greater overall environmental impact if another offshore structure was required at a later date to produce reserves that are proposed to be produced by Platform Gail. Based on these considerations, the partial action alternative is not considered feasible by Chevron.

6.4 USE OF ELECTRIC SUBSEA CABLE, VERSUS OFFSHORE GAS TURBINES

#s Consistency hearing from Hermosa

two - three years

An alternative that was evaluated for a possible platform power source was the use of an electric subsea cable. A cost and air impacts comparison was made between the use of an electric subsea cable and proposed three gas turbine generators. A comparison was made of Platform Gail's turbines (2 operating, 1 standby) NO_x emissions versus emissions resulting from the use of the electric cable (Southern California Edison (SCE) power plant and platform heater treaters). This comparison demonstrated that the NO_x emissions from an onshore power plant plus platform heaters would be approximately 14.7 lb/hr which is 53 percent higher than the emissions from the platform turbines. The NO_x emissions for the platform turbines would be approximately 7.8 lb/hr. In addition to the increase of emissions, the air emissions impacts from the platform would be relocated from the OCS to the power plant location onshore if the electric cable was installed. The cost analysis showed that the total costs would be 55 percent greater if the electric subsea cable was installed as compared to the cost of the three turbines.

As a result of the above evaluations, it was determined that the use of the electric subsea cable was not feasible.

6.5 OFFSHORE GAS PROCESSING, TREATMENT AND TRANSPORTATION

Platform Gail, as proposed, will contain complete production facilities for the treatment of produced crude oil and wastewater. However, the gas (that which is not used for fuel, lift and blanket gas on the platform) must undergo additional processing (sweetening) onshore at the Carpinteria gas plant prior to distribution.

The alternative of generating power for complete processing of gas onboard the platform would necessitate the installation of additional energy sources. This would be due to the insufficient amount of process heat provided by recovering waste heat from the turbine generators' exhausts. Presently, all waste heat is used for the oil treatment processes aboard the platform. The installation of additional energy sources on the platform would also increase potential air pollution emissions.

6.5.1 Crude Transport

An alternative that can be evaluated in terms of crude transport is transporting to shore by lightering to barge. An alternative to the connection from Platform

Gail to the existing pipeline on Chevron's Platform Grace is to barge the crude to shore after treatment on the platform. This would require offshore loading facilities and significantly greater crude storage facilities on the platform. While barging the crude is economically unattractive to Chevron, it is a possible alternative.

The primary environmental consequences of such a system would be:

- Marine traffic - greater risks of collision due to creation of lightering operations in VTSS.
- Oil spills - greater potential for spills due to increased platform storage facilities and offshore loading operations. These would outweigh any benefit of reducing the risk of pipeline failure.
- Air quality - implementation of this alternative would result in significant air pollution emissions from the tankers. Specifically, significant amounts of ozone-producing hydrocarbons would be emitted during unloading.

SECTION 7

UNAVOIDABLE ADVERSE IMPACTS

As currently proposed, the Platform Gail project incorporates several design features intended to eliminate or mitigate potential adverse environmental impacts. As with any proposed project, some degree of adverse impact is unavoidable. Chevron's incorporation of mitigation measures identified in the course of these environmental investigations has minimized potential impacts to the maximum extent considered feasible. Unavoidable impacts and qualitative findings of significance are summarized in the discussion below.

7.1 GEOLOGICAL CONSIDERATIONS

Unavoidable impacts on the geologic environment include: short-term alterations of bottom topography associated with construction vessel anchoring and cuttings discharges, localized re-distribution of surface sediments, and removal of non-renewable hydrocarbon resources. Although unavoidable, these impacts are expected to be of minor significance.

7.2 AIR QUALITY

Although Chevron has incorporated several air pollution control measures into the design of Platform Gail, some incremental increase in ambient air pollutant concentrations will occur in the vicinity of the platform. Peak annual facility emissions of NO_x, SO_2, particulate matter, CO, and volatile organic carbons are estimated to be lower than the emissions exemption limits specified by the Department of the Interior air quality regulations. Because the proposed facility emissions are well below the exemption limits, no significant onshore air quality impacts are expected to occur.

7.3 OCEANOGRAPHIC CONSIDERATIONS

Unavoidable localized adverse impacts on ocean water quality will occur. Redistribution of bottom sediments associated with construction activities (setting the platform jacket, driving piles, pipeline installation, and work vessel anchoring) will result in temporary, localized increases in ocean water turbidity. Discharges of treated sewage, graywater, galley water, deck runoff and wash water, desalination unit brine, seawater used for hydrostatic testing, and produced water will result in a localized decrease in ocean water quality, primarily associated with slightly increased salinity and minor amounts of chlorine, heavy metals, and nutrients. All liquid wastes will be discharged in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements. Additionally, since these discharges are expected to disperse rapidly in the receiving waters, this impact is expected to be negligible. Trace amounts of metallic ions will leach from sacrificial anodes for corrosion control. Although the exact amounts of metals released is unknown, mussel tissue metals content analysis conducted at Texaco's Platform Habitat suggest that this will have an undetectable impact.

Drilling muds and cuttings discharges will affect ocean water quality and seafloor sediments. Chevron will not discharge muds containing free oil. Drilling mud studies have indicated rapid dispersion of discharge plumes and generally minor, localized effects. Impacts associated with drilling muds and cuttings discharges are expected to be localized and of minor significance.

The Platform Gail project will also result in an incremental increase in the overall probability that an oil spill will occur offshore Ventura County. Although Chevron has incorporated a detailed site-specific oil spill response plan into their Platform Gail operating procedures and will maintain response equipment on the platform, adverse effects associated with a large spill (greater than 1000 barrels) would have an ocean water quality impact of moderate significance. Depending on the degree of direct bottom impact (caused by oil sinking or spill origin at the seafloor) adverse impacts on seafloor sediments could be of moderate to major significance in the vicinity of the spill site. The area affected and severity of impacts associated with both water quality and sediment chemistry impacts would be dependent on the size of the spill, the spill origin, effectiveness of containment and cleanup operations, and physical factors affecting spill behavior. Because the probability of a large spill is small, the potential for significant impacts to actually occur is considered low.

7.4 COMMERCIAL FISHING

The Platform Gail project should not adversely affect overall commercial fishing activities is the three fishblocks identified in 3.5.4. However, the presence of the platform will create a de facto restricted area for purse seine fishermen. The loss of fishing area could range from 2-10 square miles (3.2-16 square km) and would be highly dependent upon physical conditions including wind direction, wind speed, and current direction and speed. During pipeline installation the restricted area will be slightly higher due to lay barge anchoring and the linear routing. It is estimated that fishing will be restricted within 1 mile (1.6 km) of the pipeline and lay barge resulting in the total short-term loss of approximately 12 square miles (16 square km) of fishing over a 1.5 to 2 month time frame. The affected area will be constantly changing during the pipeline construction period. (Refer to Section 4.5.1 for discussion of restricted area estimation.)

No significant impacts are expected on the trawl fishery or the mackeral purse seine fishing activity. Nearshore fisheries such as abalone, sea urchin, crab and halibut should not be affected by the proposed development. It is not known at the present time if the drift or set gill net fishing will be affected due to the low level of activity in the project area.

7.5 SHIPPING ACTIVITIES

Increased large vessel traffic in the Santa Barbara Channel and small vessel activity between Port Hueneme, Carpinteria Pier, and the Platform Gail site will be associated with the proposed project. Adverse impacts associated with these increases include possible traffic congestion (especially near ports), and an increased risk of vessel collisions due to the proximity of the platform to the northbound shipping lane. Because of the number of vessel trips associated with the proposed project will be small in comparison to existing vessel traffic, impacts are expected to be of low significance.

The addition of a structure offshore Ventura County will incrementally increase the probability of a vessel/platform collison. The risk analysis conducted for Platform Gail (Section 4.5.2) indicates that this probability is small. For this reason, increased potential for vessel/platform collisions is considered an impact of low significance with respect to the Platform Gail project.

7.6 MILITARY USES

The proposed project will not interfere with existing military activities in the vicinity of Lease 0205. The Platform Gail site is not located in any military precautionary areas. It is located in an "inactive area" and will not pose any potential adverse impacts to military uses.

7.7 PLEASURE BOATING, SPORTFISHING AND RECREATION

Construction and operation of the proposed Platform Gail project will not alter recreational opportunities in the eastern Santa Barbara Channel. The installation of the platform and pipelines would preclude the use of a small ocean area for recreational boating or sportfishing. This effect is considered insignificant because little recreational boating and no reported sportfishing activity currently occurs near the Platform Gail site due to its proximity to the shipping lanes.

The proposed project will result in increased oil spill risks. A major oil spill could temporarily disrupt recreational activities by the oiling and closure of beaches, harbors and the Channel Islands. Although this would have a short-term impact of major significance, the likelihood of a major spill is small and natural processes would restore beaches over time. The overall potential for significant adverse effects is considered low.

7.8 KELP HARVESTING AND OTHER COMMERCIAL USES

No adverse effects on kelp harvesting or other mariculture operations are anticipated as a result of the proposed project.

7.9 CULTURAL RESOURCES

As proposed, the Platform Gail project is not expected to disturb any potential cultural resources.

7.10 MARINE BIOLOGY

Potential marine biological impacts associated with the Platform Gail project include: (1) seafloor disturbance and elimination of soft-bottom habitat and associated organisms at the platform site and along the pipeline route, (2) localized adverse impacts on filter feeding benthic organisms associated with increased turbidity caused by seafloor disturbances and drilling muds discharges, (3) entrainment of organisms in desalination unit seawater intakes, (4) minor, localized effects of discharges, including possible brief osmotic stress associated with desalination unit brines and produced water discharges, (5) localized impact on benthic organisms associated with drilling muds and cuttings discharges, (6) potential (though considered unlikely) disturbance of marine mammals associated with increased noise and activity, and (7) the introduction of a new hard-bottom, high-relief habitats at a location currently characterized by unconsolidated sediments. All but the last of these potential impacts would be temporary or highly localized and are expected to have negligible effects overall. The last, an introduction of a new hard-bottom, high-relief habitat, would result in a change in the characteristic fauna at the Platform Gail location and is sometimes considered a beneficial impact.

No adverse impacts are expected on marine refuges, preserves or marine sanctuaries. The proximity of the platform to the Channel Island marine sanctuary may be of concern. However, anticipated impacts from drilling muds and cuttings would be minimal within the sanctuary based upon dispersal modelling data discussed in Sections 4.4 and 4.6. The potential for oil spills affecting the islands also appears to be low, based upon trajectories detailed in Chevron's Oil Spill and Emergency Contingency Plan for Platform Grace-Platform Gail, Santa Clara Unit.

7.11 ONSHORE IMPACTS/SOCIOECONOMICS

The Platform Gail project will result in minor impacts onshore. Minor increases in local employment and local expenditures for goods and services will occur, and are expected to have a beneficial effect of low significance. Increased vehicle traffic in the vicinity of Port Hueneme and the Carpinteria Pier will have an adverse impact of low significance on local onshore transportation. The relatively low level of increased vessel activity at Port Hueneme will have a negligible effect on port operations. The presence of a new offshore structure will not have a significant adverse visual effect from coastal beaches. Because Platform Gail is located over 9 miles (14 km) away, this impact is considered to have only low significance. However, the platform can be seen from the Channel Islands (Anacapa Island) at a distance of approximately 6.6 nautical miles (10.4 km). The Platform Gail project will also contribute to the need for increased onshore treatment facilities.

Platform Gail derived oil and gas production will not have any incremental effects at the Carpinteria processing facility. The existing Carpinteria facility has sufficient capacity to handle the additional production from Platform Gail.

7.12 ACCIDENTS

The proposed Platform Gail project will result in increased accident risk, including: (1) risks of an oil spill, (2) risk of platform fires, (3) risk of a marine vessel/platform collision, (4) risk of crew or supply boat accidents, (5) and risk of minor accidents such as equipment losses and worker injuries. As discussed in Section 4.10, the probabilities of occurrence of each of these accident groups are small, and so the potential for significant adverse environmental impacts is considered low.

SECTION 8
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SECTION 9

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This Environmental Report (Production) was prepared by WESTEC Services, Inc., under contract to Chevron U.S.A. Inquires concerning report contents should be addressed directly to the Chevron information contacts listed on the Title Page.

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MODELING OF THE FATE OF DRILLING FLUID DISCHARGES FROM PLATFORM GAIL

March 19, 1985

SUMMARY

The Offshore Operators Mud Discharge model was used to simulate the fate of a bulk drilling fluid discharge from the proposed Platform Gail in the eastern Santa Barbara Channel. The model determines the distribution in time and space of both soluble and solid mud components in the water column and on the bottom for specific oceanographic conditions. Muds in the water column were generally transported toward Santa Barbara or Santa Monica Basins. The simulations indicated rapid dilution to nontoxic levels in the water column within a few hundred feet of the platform. The predicted distribution of mud solids on the bottom occurred in deep water toward the basins. Simulated onshore transport did not impact State lands and the 1000 m buffer zone seaward of State lands or Anacapa Island.

ENVIRONMENTAL CONDITIONS AT THE PROPOSED SITE

Platform Gail will be located in the eastern Santa Barbara Channel at latitude 34°07'30" N., longitude 119°24'01" W. The site is approximately 8.7 nmi (16.2 km) from the nearest landfall on the mainland between Pt. Hueneme and Ventura and about 6.6 nmi (12.3 km) from the closest landfall on Anacapa Island to the south. Platform Gail will be located 4.7 nmi (8.7 km) southeast of Platform Grace. The water depth at the site is 739 ft.

Oceanographic conditions in this vicinity vary seasonally and are characterized generally by three different periods. Current patterns and profiles for these periods were derived from numerous sources from the literature[1-6] as well as various current measurement programs.[7-10]

During the Oceanic period (from around July to November), the California Current dominates coastal current patterns. This current is a southeastward flow of subarctic water which follows the coastline past Point Conception and may enter the Santa Barbara Channel through the western channel or the San Miguel and Santa Cruz passages to drive circulation in the western channel. In addition, a portion of the California Current diverges from the main offshore flow to form a large, persistent counterclockwise gyre in the Southern California Bight. This results in a northwestward flow of warmer water, the Southern California Countercurrent, which enters the Santa Barbara channel from the southeast. ESE or NW flow may occur through the eastern entrance during the Oceanic and other periods.[2,3] In addition, a gyre may develop in the eastern channel due to this intrusion.[5]

The Davidson Current, a surface manifestation of the existing northward countercurrent, is dominant from approximately mid-November to mid-February. Surface flow may be westward,[2] or a clockwise eddy may result in southward flow at the proposed site.[4,5,6]

Upwelling is prevalent along the California coast during the period from about mid-February to mid- or end of July. The water mass associated with this upwelling current is cold and saline. Currents are most variable during this period. Surface flow can be NW[8] but may be ESE,[2,5] and NE flow toward the mainland occurs a smaller percentage of the time.[8]

Subsurface flow in the eastern Santa Barbara Channel is influenced by tides and bathymetry, which tends WNW-ESE in the vicinity of the platform site. Subsurface flow often parallels surface flow[8] but may vary in speed and direction.[1,4] Bottom flow is also influenced by tides and bathymetry and may follow currents in upper layers, although flow in other directions may occur.

Current speed for the three periods in the eastern Santa Barbara Channel is influenced by season, tides and bathymetry and occurs in several configurations. Surface velocities of 0.67-0.84 ft/sec in summer and 0.84-1.18 ft/sec in winter have been reported.[2] Middepth velocity may exceed surface velocity in some cases, while the pattern of velocities decreasing with depth also occurs.[1] Bottom currents have been measured at 0.84 ft/s, exceeding middepth speeds.[4]

MODEL SIMULATION CONDITIONS

Six simulations of mud discharge from Platform Gail were constructed based on the oceanographic conditions shown in Table 1. Density structures for the three periods were derived from temperature and salinity profiles measured in the Santa Barbara Channel[3] and density tables from Riley and Chester.[11] Wave heights and periods were estimated from Chevron Oil Field Research Company data collected at Platform Grace.[12]

Simulations Nos. 1 and 2 reflect conditions existing at times in both the Upwelling and Oceanic periods with surface currents running northwest through the channel at 0.75-0.84 ft/sec. In No. 1, the middepth (around 300 ft) and bottom currents also run northwest, with the middepth current having the highest velocity (0.80 ft/sec). In No. 2, velocities decrease with depth from 0.84-0.30 ft/sec except for a fast bottom current (0.84 ft/sec). Simulation No. 3 depicts a decreasing velocity profile with all currents running southeast, such as might occur during the Oceanic period. The fourth simulation models a westward current in the Davidson period at low velocities (0.25-0.10 ft/sec). Simulation No. 5 illustrates an onshore current at moderate velocities toward the mainland during the Upwelling period. The southerly and subsequent westerly current condition in No. 6 models a clockwise gyre, which may be present in the Davidson period.

A typical mud to be discharged from Platform Gail was used in these simulations, a lightly-treated chrome-free lignosulfonate mud (Generic Mud Type 7) with a density of 10.1 pounds per gallon and an initial solids concentration of 3.04×10^5 mg/l. A bulk discharge of 480 bbl discharged over a period of one hour at a depth of 240 ft (73.2 m) from a 54-in diameter pipe was simulated. Since discharges of this magnitude will occur only a few times during the drilling of a well, these simulations represent maximum, worst-case discharge conditions.

Simulations 1-4 and 6 of mud distribution were run over a period of 60,000 sec (16.7 hr). Since onshore transport (No. 5) generally occurs for only a few hours this simulation was run for 40,000 sec (11.1 hr).

The model calculates maximum concentrations of mud solids and fluid components and their location around the discharge point at several time steps. The maximum concentrations of the components were used to compute dilution ratios presented in Tables 2 and 3.

SIMULATION RESULTS

Fluid (Soluble) Component

Soluble component dilution ratios for the six simulations are shown in Table 2. In simulations No. 1-3 where velocities up to 0.84 ft/sec were specified, a dilution of 300:1 was reached in 1.5 min or less. Dilutions around 1000:1 were reached in 2.9 to 4.2 min, resulting in a concentration of 0.1 mg/l (100 μg/l or ppb) 82-91 ft from the discharge pipe. This concentration is orders of magnitude below toxic levels (see discussion).[13] Dilutions of 17,800:1 to 71,400:1 (concentrations of 1.4 - 5.6 μg/l) were achieved in 10,000 sec (2.8 hr) within 4380-7300 ft from the discharge pipe. At the end of the simulation (16.6 hr), dilutions at the points of highest concentration were at least 323,000:1.

Fluids in lower velocity simulations (Nos. 4 and 5) diluted somewhat less rapidly, where dilutions of 300:1 resulted within 2.2 min but at a shorter distance from the discharge (22 ft or less). At 20,000 sec dilutions of 30,100:1 to 40,200:1 (about 3 μg/l) were achieved at distances of 4000-4450 ft.

Fluids transported south in simulation No. 6 traveled 22,300 ft in 50,000 sec (13.9 hr), where the maximum concentration was 0.2 μg/l. At this point, about 3.0 nmi from Anacapa, the circulation of the gyre would direct the mud components in a westerly direction, resulting in a dilution of 415,000:1 after 16.6 hr.

Mud Solid Component

Mud solids have different dispersion characteristics from the soluble components. After discharge, solids are dispersed by currents and also disperse while descending through the water column, resulting in greater dispersion than soluble components. Consequently, dilution ratios are greater for mud solids than for fluids.

The direction of the solids distribution was determined primarily by the current direction at the depth of discharge. Surface currents had no effect on transport, since the discharge pipe was located at 240 ft. Consequently, simulations with current direction reversals in surface layers are not shown. During the Upwelling period, a northwesterly flow predominates, and fluids and solids were distributed accordingly, carrying mud solids toward the deeper area of the Santa Barbara Basin. Westward flow (Davidson period) would have the same effect. Southeast flow directed muds along the isobaths toward the Santa Monica Basin.

Initial dilution of muds was rapid in simulations No. 1-3 (300:1 in 1.4 min; Table 3). Dilutions of 1000:1 (304 mg/l) were reached in 3.6 min within 73-83 ft of the discharge. This concentration is less than the lowest (most toxic) 96-hr LC_{50} reported by Neff for acute bioassays of drilling muds.[13] At 20,000 sec (5.6 hr) dilutions of 85,600:1 to 271,400:1 (less than 3.55 mg/l) occurred at distances of 8910-13,000 ft from the discharge. At the end of the simulations, dilutions ranged from 1.7×10^6 to 2.4×10^6:1 at 26,000 - 42,500 ft from the discharge.

Muds in the lowest velocity simulation (No. 4) traveled more slowly. 1000:1 dilution (304 mg/l) occurred within 13.4 min at 138 ft from the discharge. At 10,000 sec (2.8 hr) dilution was 23,900:1 (12.7 mg/l) at 2000 ft. At the end of the simulation (16.7 hr) a dilution of 1.6×10^6:1 was reached at 11,000 ft.

Transport onshore toward the nearest point on the mainland (simulation 5) represented worst-case conditions of unidirectional currents (resulting in the least dispersion in the water column) at velocities measured for onshore transport.[10] Although onshore transport usually occurs for only a few hours before a change in direction occurs, a very conservative 11.1 hour duration was modeled. Under these worst-case conditions, particulate material was transported 9450 ft toward shore, to a point about 22,150 ft (3.6 nmi) seaward of the 1000 m buffer zone. The material remaining in the water column (maximum concentration 0.65 mg/l; 468,000:1 dilution) would most likely be transported WNW or ESE as currents paralleling bathymetric contours are resumed. Thus no impact to the 1000 m buffer zone or adjacent State lands will occur.

Transport in a clockwise gyre (No. 6) could carry particulates SSW toward Anacapa. However, the circular pattern of the gyre would result in transport toward the west and away from the island after a period. Material was allowed to move at 195° for 13.9 hr, resulting in a concentration of 0.29 mg/l 20,470 ft from the discharge or 3.3 nmi from the nearest landfall on Anacapa. Shoaling bathymetric contours at this point or earlier directed the material in the gyre westward from this point, resulting in a dilution of 1.8×10^6:1 after 16.6 hr.

Current velocity at middepth was a major determinant in dispersion of the solids. A high middepth current (No. 1) transported material farther than a velocity profile decreasing over depth (No. 3). A high bottom current (modeled here in the opposite direction to the middepth current, No. 2) decreased dispersion somewhat during the duration of the simulation.

Bottom Deposition

Major factors affecting mud distribution on the bottom include water depth and middepth current speed and direction. In simulations No. 1-3 (Table 4 and Figs. 1-3), where relatively high velocities were modeled, most of the mud (i.e., deposition greater than 0.1 g/m^2,* or the two darkest areas in the figures) was deposited according to the primary middepth current direction to the northwest or southeast of the platform site within 15,050 ft (4.6 km*) to 21,570 ft (6.6 km) for No. 2 and No. 3 and 37,620 ft (11.5 km) where the middepth current was fastest (No. 1). Average deposition for these simulations was 0.69-0.88 g/m^2 (1 gm/m^2 is about one sugar cube distributed over one square meter).

Maximum deposition values for the three simulations were 1.46-4.30 g/m^2. In simulation No. 2 where the bottom current was fast and directed opposite to the middepth current (SE), the heaviest deposition occurred closer to the platform (1.4 km), and small amounts of material were deposited ESE of the platform site.

In the low velocity simulation (No. 4), a larger percentage of discharged mud settled to the bottom during the 16.7 hr duration and was concentrated in a smaller area (Table 4 and Fig. 4). Average deposition was 1.41 g/m and maximum deposition was somewhat greater (7.13 g/m^2).

The onshore simulation (No. 5; Table 4 and Fig. 5) was run for 11.1 hr with currents at all depths directed toward the coast (60°). At 5.6 hr a small portion of the muds reached bottom

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*Metric units are used in this section since sediment transport is conventionally measured in this system; 1 nmi = 6080 ft = 1853 m.

within 5520 ft (1.7 km) of the platform, with an average deposition of 0.97 g/m^2 and a maximum deposition of 3.87 g/m^2. The deposition at this point was 8.0 km (4.3 nmi) from the 1000 m State lands buffer zone. At this point, remaining solids would most likely be dispersed in a different direction, probably paralleling the isobaths.

Although it is unlikely that a shoreward current would persist for more than a few hours, the simulation was allowed to run for 11.1 hr. Due to the shoaling bathymetry a larger amount (39%) of the mud settled to the bottom within 11,040 ft (3.4 km) of the platform, or 6.3 km (3.4 nmi) from the 1000 m State lands buffer zone. Average deposition was 3.62 g/m^2, and maximum deposition of 21.3 g/m^2. This simulation, even using worst-case conditions, predicts no impact to the buffer zone or adjacent State lands.

Similarly, where a clockwise gyre might carry particulates south toward Anacapa Island (No. 6; Table 4 and Figure 6), transport in that direction would occur until the shoaling bathymetry directed the discharge to the west, away from Anacapa and into Santa Barbara Basin. After 13.9 hr of transport the muds reached an area where the water depth decreased, and current direction was altered to 270°. At the end of the simulation (16.6 hr) deposition occurred within 22,320 ft (6.8 km) southwest of the platform, or about 6.1 km (3.3 nmi) north of the nearest landfall on Anacapa. Average deposition was 0.73 g/m^2, and maximum deposition was 1.53 g/m^2.

DISCUSSION

The eastern Santa Barbara Channel is a complex area due to interactions of currents, tidal forces and bathymetry. Consequently, currents may travel at relatively high velocities to the northwest or to the southeast, resulting in transport of material to deeper water of the Santa Barbara or Santa Monica Basins. Transport in a gyre directs sediment transport into Santa Barbara Basin.[7] The model assumes persistence of current direction over the duration of the simulation (16.6 hr), but it may actually be less; onshore transport occurs infrequently and for short durations.[10] In addition, clockwise or counterclockwise eddies which may shift in location can form in this area, directed by bathymetry of the mainland and island slopes and prevailing conditions. As a result, a number of circulation patterns may occur, several of which have been modeled in the computer simulations.

Input for the drilling mud discharge model included a number of different parameters; however, it is apparent from Tables 2 and 3 that current speed and direction are major determinants of the dilution and distribution of drilling fluid discharges. The discharge from Platform Gail will occur 240 ft below the surface, and therefore currents at this depth or lower will most affect dispersion. Material was transported the farthest and was diluted fastest where the velocity of the middepth current was high (No. 1). Lower current velocities (Nos. 4,5) resulted in slower dispersion and higher concentrations in the water column nearer the platform.

Water depth also affects the fate of discharged material. The deeper the depth, the longer the material remains in the water column and the more dispersed it will be when it encounters the bottom. These simulations indicate transport of muds to basins, in agreement with Kolpack[3,17] and Drake et al.[7]

The rate and amount of drilling fluid discharge also influence distribution. The 480 bbl bulk discharge assumed here occurs only a few times in the life of a well and thus represents a worst-case situation. Smaller discharges would result in much lower concentrations in the water column and less deposition on the bottom.

The biological impact of discharged fluids in the water must be considered in interpreting these simulation results. It is unlikely that any organisms in the vicinity of a discharge will be exposed continuously to concentrations of mud for 96 hr, the duration of most acute bioassays. Dispersion is very rapid, reaching a dilution of 1000:1 (304 mg/l) in a few minutes. In the worst case of a used mud with a 96-hr LC_{50} of 400 mg/l, measured for a larval stage of a sensitive species,[13] the duration of this level of exposure is about 30 min. This level of exposure will occur within a few hundred feet (within the mixing zone) of the discharge pipe for all current velocities. Thus the areal exposure and volume of water in which this toxic concentration occurs will be small, and the actual time of such exposure short. Chronic and sublethal effects have been reported at concentrations as low as 50 ppm.[13] The duration of such exposure predicted by the simulations (less than 3 hr) is much less than the duration of exposure required to result in chronic effects. Since planktonic organisms move along with the water, subsequent discharges will not increase exposure of a population.

The acute toxicity of any of the muds to be discharged in California will not exceed a 96-hr LC_{50} of 10,000 mg/l for either the aqueous or the suspended particulate phase.[14] The mud proposed to be discharged from Platform Gail is generic mud No. 7. On previous bioassay this mud had a 96-hr LC_{50} greater than 200,000 mg/l.

The isopleth distribution of mud solids on the bottom was plotted using a Uniras Geopak program, which interpolates between data points using a bicubic polynomial function to determine lines of equal concentration. Disjunct deposition, e.g., in Fig. 1, is probably an artifact resulting from the low number of size classes determined for the solids; the distribution of mud is likely to be more continuous. Nevertheless, the figures illustrate the behavior of muds deposited on the bottom under a series of conditions.

The distribution of mud solids on the bottom is affected by water depth as well as current speed and direction. Where the depths were roughly constant, much of the mud remained in the water column at the end of the 16.7 hr simulations, resulting in proportionately low accumulations of mud on the bottom, both in terms of area affected and concentration. A larger proportion was deposited where the depth decreased (No. 5). As discussed previously, the material remaining in the water column after 16.7 hr is very dispersed, i.e., concentrations are orders of magnitude below toxic levels, resulting in less deposition. Deposition generally coincided with the primary current patterns. Simulation No. 1 showed the impact of a high velocity middepth current, where the material was deposited within 11.5 km, compared to 4.6 and 6.6 km for Nos. 2 and 3. A high velocity bottom current in the opposite direction (No. 3) resulted in a more even distribution of muds closer to the platform.

Predicting the effect of mud deposition on the benthos is difficult. Acute toxicity of the mud to be used is very low, and for the most part the amount of mud deposited over a unit area is low. The 0.1 g/m^2 isopleth has been used to account for the bulk of deposited mud, although this concentration may not in fact result in adverse impacts. In areas of maximum deposition, a thin layer of mud (less than a few millimeters[17]) may result which could possibly affect larval recruitment by altering sediment texture (grain size), which has been suggested as a cause of altered abundance and/or species composition observed in some field and microcosm studies.[13]

This localized impact would be temporary, diminishing as the sediments are reworked by benthic organisms and bottom transport or natural sedimentation of new materials occurs.

Cumulative impacts of mud deposition are not addressed by these simulations of a single bulk discharge. However, the National Research Council found that documented effects of long-term discharges on the benthos were transient and limited in area.[15] In addition, contamination of bottom sediment from multiple wells appears to be less than simply additive.[16] Bottom transport, bioturbation and deposition of new, natural material affect the accumulation of mud. The latter factor may be particularly relevant at this site due to the proximity of the Santa Clara River, which discharges 12.5 million metric tons of sediment in a dry year and 50 million metric tons in a wet year, vastly greater than discharge from one or several platforms.[17]

In summary, these computer simulations indicated rapid dilution of a bulk discharge of drilling fluids to nontoxic levels. Any adverse effects in the water column of ocean discharge of drilling fluids from Platform Gail will be intermittent and localized at the site and will be minimal outside this vicinity. No cumulative impacts will occur in the water column. Measurable amounts of mud were predicted to be deposited on the bottom in localized areas, depending on currents and water depth. Where maximum deposition occurs, temporary localized impacts to the benthos are possible and might include alterations in species abundance or composition. Although cumulative impacts to the benthos are not addressed by this model, accumulation of drilling fluids from multiple wells is less than simply additive. In addition, field studies have indicated limited areal effects of mud deposition. The worst case simulations indicate no impacts to State lands or the 1000 m buffer zone along the mainland coast or Anacapa Island.

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ALH:be/na

References
Tables 1-4
Figures 1-6

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Table 1: SIMULATION CONDITIONS

Current Conditions

	No. 1-Upwelling Period	No. 2-Upwelling Period
Surface	300°, 0.75 ft/sec.	300°, 0.84 ft/sec.
Mid-depth	300°, 0.80	300°, 0.51
Bottom	330°, 0.47	115°, 0.84

	No. 3-Oceanic Period	No. 4-Davidson Period
Surface	115°, 0.84 ft/sec.	270°, 0.25 ft/sec.
Mid-depth	115°, 0.51	270°, 0.20
Bottom	115°, 0.25	270°, 0.10

	No. 5-Upwelling Period	No. 6-Davidson Period
Surface	60°, 0.42 ft/sec.	195°, 270°, 0.84 ft/sec
Mid-depth	60°, 0.25	195°, 270°, 0.51
Bottom	60°, 0.25	195°, 270°, 0.25

Density Gradient (g/ml)

Depth (ft)	Upwelling No. 1,2,5	Davidson No. 4,6	Oceanic No. 3
0	1.02569	1.02482	1.02463
100	1.02608	1.02515	1.02492
200	1.02635	1.02566	1.02569
300	1.02665	1.02630	1.02630
400	1.02692	1.02667	1.02665
500	1.02715	1.02693	1.02693
630	1.02736	1.02719	1.02722
730	1.02770	1.02755	1.02765

Wave Height and Period

	Upwelling No. 1, 4	Davidson No. 2	Oceanic No. 3, 5
Height (ft)	3.7	4.3	3.2
Period (sec)	7.6	11.5	8.5

Discharge Conditions

Discharge: 480 bbl at 480 bbl/hr

Discharge pipe:	Depth	240 ft
	Diameter	54 in.

Table 1: SIMULATION CONDITIONS (continued)

Mud Characteristics

Mud Density: 10.1 ppg
Initial Solids Concentration: 3.04×10^5 mg/l

Mud Solids

Category	Solid Density (g/cm³)	Volume Fraction in Mud	Fall Velocity (ft/sec)
1	3.053	.00796	1.68×10^{-2}
2	3.053	.01194	7.22×10^{-3}
3	3.053	.01592	3.68×10^{-3}
4	3.053	.03582	2.16×10^{-3}
5	3.053	.01592	1.25×10^{-3}
6	3.053	.01194	2.62×10^{-4}

Mud Fluid

Volume fraction	0.9005
Soluble component concentration	100 mg/l

(ambient background - 1 μg/l)

∿10% of the fine solids were uniformly forced from the plume during the plume's descent to form the upper plume observed in mud discharges.

Table 2: DILUTION RATIOS FOR THE FLUID (SOLUBLE) COMPONENT

DILUTION RATIOS FOR THE FLUID SOLUBLE COMPONENT

No.	Period	Time (sec)	Distance (ft)	Maximum Concentration (mg/l)	Maximum Concentration Dilution Ratio[1]
1	Upwelling	74.4	38.5	0.333	300:1
	(high middepth velocity)	172	91.2	0.100	1,000:1
		10,000	7,300	0.00140	71,400:1
		20,000	14,500	0.000716	140,000:1
		40,000	28,700	0.000205	488,000:1
2	Upwelling	90.5	32.9	0.333	300:1
	(high bottom velocity)	229.0	81.8	0.100	1,000:1
		10,000	4,530	0.00167	59,900:1
		20,000	8,600	0.000910	110,000:1
		40,000	19,000	0.000614	163,000:1
3	Oceanic	90.6	33.1	0.333	300:1
	(decreasing velocity)	253.7	90.6	0.100	1,000:1
		10,000	4,380	0.00561	17,800:1
		20,000	8,910	0.00273	36,600:1
		40,000	19,700	0.000652	153,000:1
4	Davidson	132.5	20.9	0.333	300:1
	(low velocity)	970.1	175	0.128	781:1
		10,000	2,000	0.00690	14,500:1
		20,000	4,000	0.00332	30,100:1
		40,000	8,000	0.000716	140,000:1
5	Upwelling	124.2	22.0	0.333	300:1
	(onshore)	459.4	81.1	0.100	1,000:1
		10,000	2,100	0.00572	17,500:1
		20,000	4,450	0.00249	40,200:1
		40,000	9,450	0.000661	151,000:1
6	Davidson	90.3	33.0	0.333	300:1
	(gyre)	260.9	93.1	0.100	1,000:1
		10,000	4,250	0.00458	21,800:1
		20,000	8,280	0.00195	51,300:1
		40,000	18,400	0.000543	184,200:1
		50,000	22,300	0.000244	410,300:1

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[1] Initial concentration of soluble component in mud fluid = 100 mg/l (ppm)

Table 3: DILUTION RATIOS FOR MUD SOLIDS

No.	Period	Time (sec)	Distance (ft)	Maximum Concentration (mg/l)	Maximum Concentration Dilution Ratio[1]
1	Upwelling (high middepth velocity)	70.8	36.5	1013	300:1
		155.4	82.5	304	1,000:1
		10,000	7,300	4.08	74,500:1
		20,000	13,000	1.12	271,400:1
		40,000	28,700	0.38	800,000:1
2	Upwelling (high bottom velocity)	85.1	31.0	1013	300:1
		202.5	72.7	304	1,000:1
		10,000	4,530	3.09	98,400:1
		20,000	11,600	0.95	320,000:1
		40,000	19,000	0.36	844,000:1
3	Oceanic (decreasing velocity)	85.8	31.3	1013	300:1
		218.6	78.4	304	1,000:1
		10,000	4,380	9.74	31,200:1
		20,000	8,910	3.55	85,600:1
		40,000	17,810	0.64	475,000:1
4	Davidson (low velocity)	122.8	19.4	1013	300:1
		803.8	138	304	1,000:1
		10,000	2,000	12.7	23,900:1
		20,000	4,000	4.77	63,700:1
		40,000	8,000	0.71	428,000:1
5	Upwelling (onshore)	116.5	20.6	1013	300:1
		339.5	60.1	304	1,000:1
		10,000	2,100	11.42	26,600:1
		20,000	4,450	3.64	83,500:1
		40,000	9.450	0.65	468,000:1
6	Davidson (gyre)	85.5	31.2	1013	300:1
		219.2	78.7	304	1,000:1
		10,000	4,250	8.80	34,500:1
		20,000	8,280	3.36	90,500:1
		40,000	18,400	0.55	553,000:1
		50,000	20,469	0.29	1,048,000:1

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[1] Initial concentration of solids in mud = 3.04 x 10^5 mg/l

TABLE 4: DEPOSITION OF DRILLING FLUIDS ON THE SEAFLOOR

No.	Period	Time (sec)	Average Concentration[1] (g/m²)	Distance[2] (ft)	Maximum Concentration[3] (g/m²)	Distance[4] (ft)	% on bottom
1	Upwelling (high middepth velocity)	60,000	0.70	37,620	3.19	17,120	12.2
2	Upwelling (high bottom velocity)	60,000	0.88	15,050	1.46	4,500	14.7
3	Oceanic (decreasing velocity)	60,000	0.69	21,570	4.30	8,750	13.5
4	Davidson (low velocity)	60,000	1.41	10,530	7.13	4,010	17.1
5	Upwelling (onshore)	20,000 40,000	0.97 3.62	5,520 11,040	3.87 21.29	3,760 9,530	3.1 39.2
6	Davidson (gyre)	60,000	0.73	22,320	1.53	10,160	14.4

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[1] Calculated from grid squares with deposition equal to or greater than 0.1 g/m²

[2] Measured as farthest extent of 0.1-1.0 g/m² isopleth

[3] Calculated from single grid square with highest deposition

[4] Measured to grid point of highest concentration

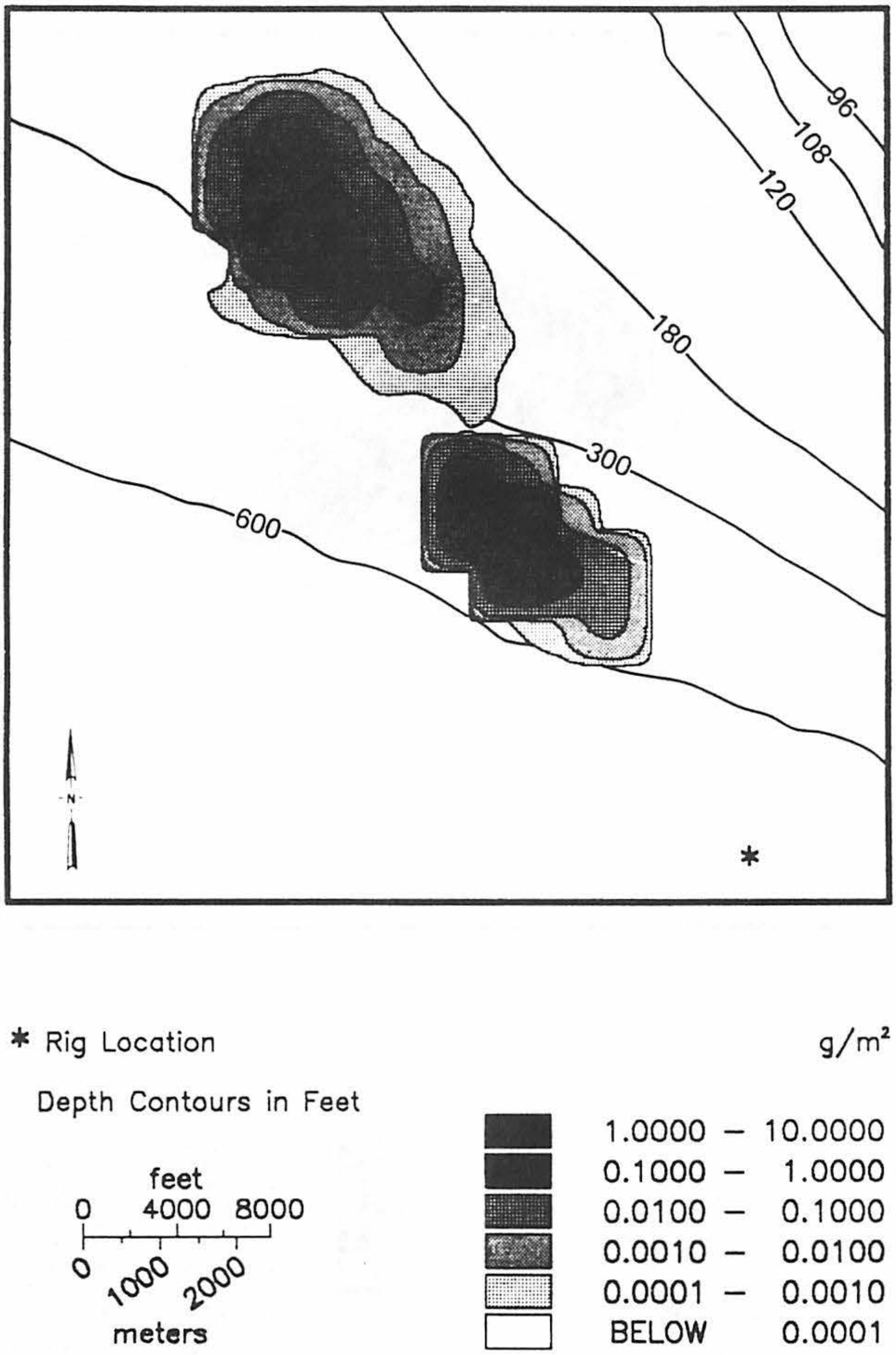

Figure 1
Total Accumulated Solids on Bottom, Simulation No. 1

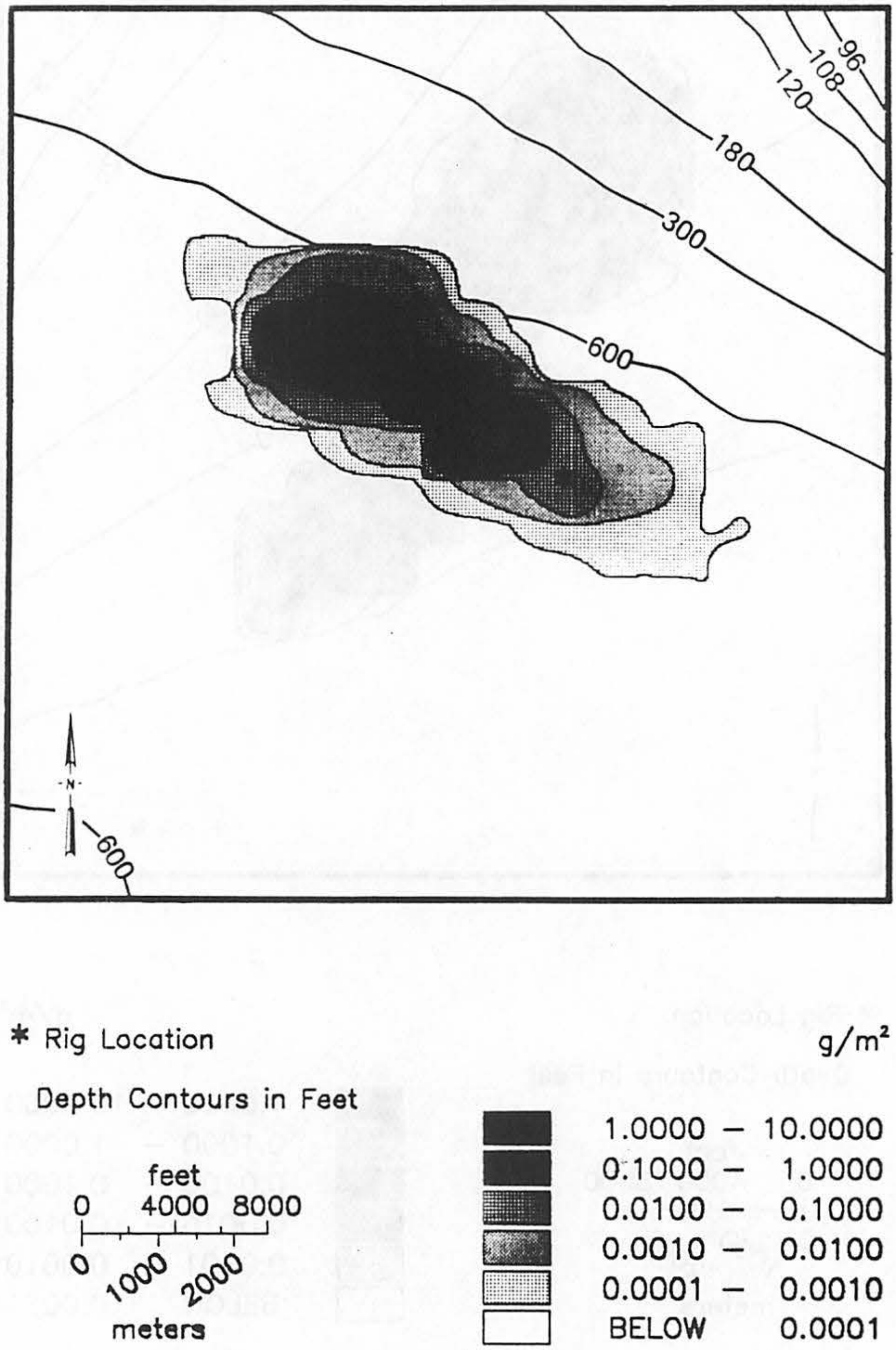

Figure 2
Total Accumulated Solids on Bottom, Simulation No. 2

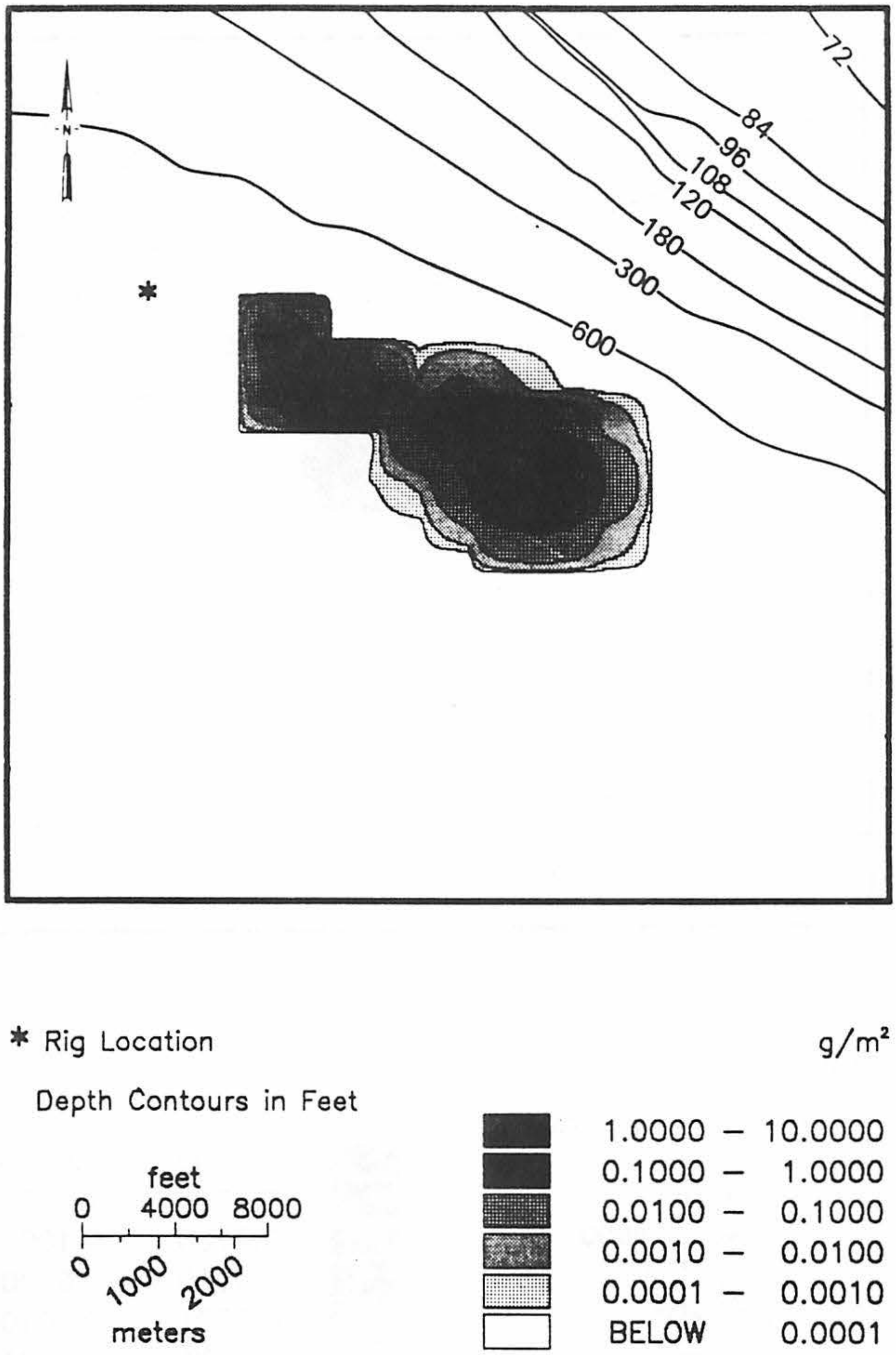

Figure 3
Total Accumulated Solids on Bottom, Simulation No. 3

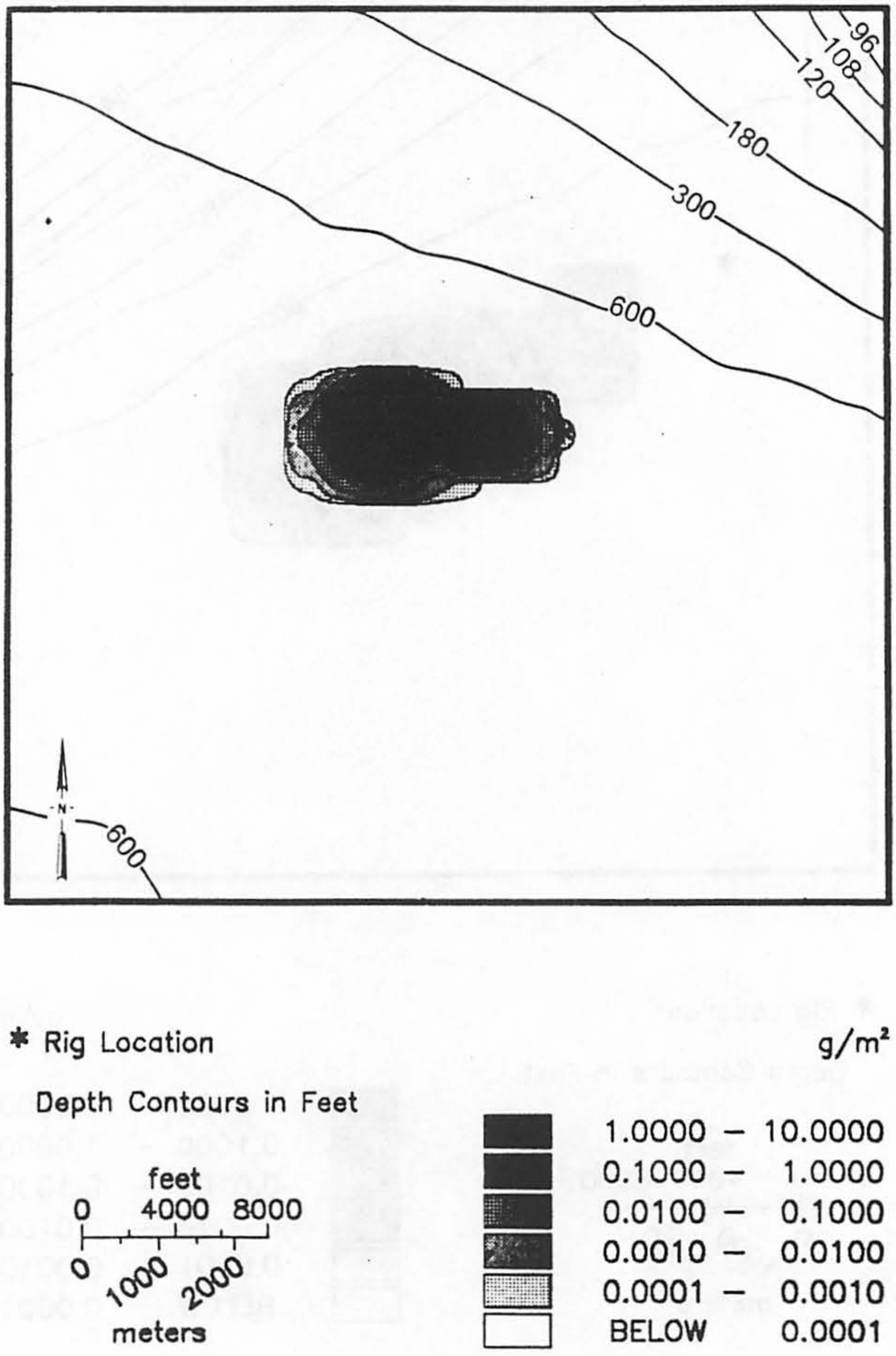

Figure 4
Total Accumulated Solids on Bottom, Simulation No. 4

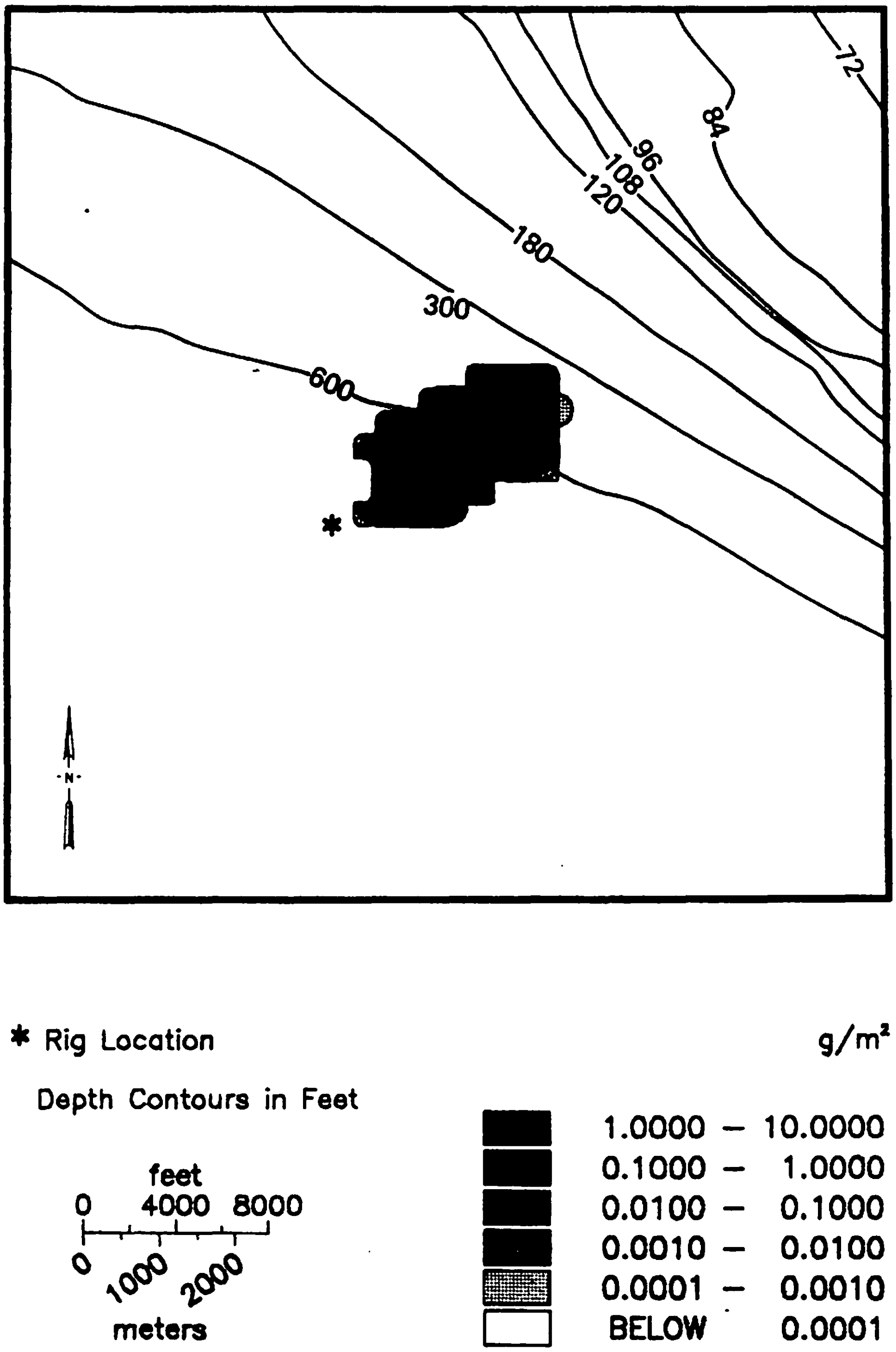

Figure 5
Total Accumulated Solids on Bottom, Simulation No. 5

LE 85–3177

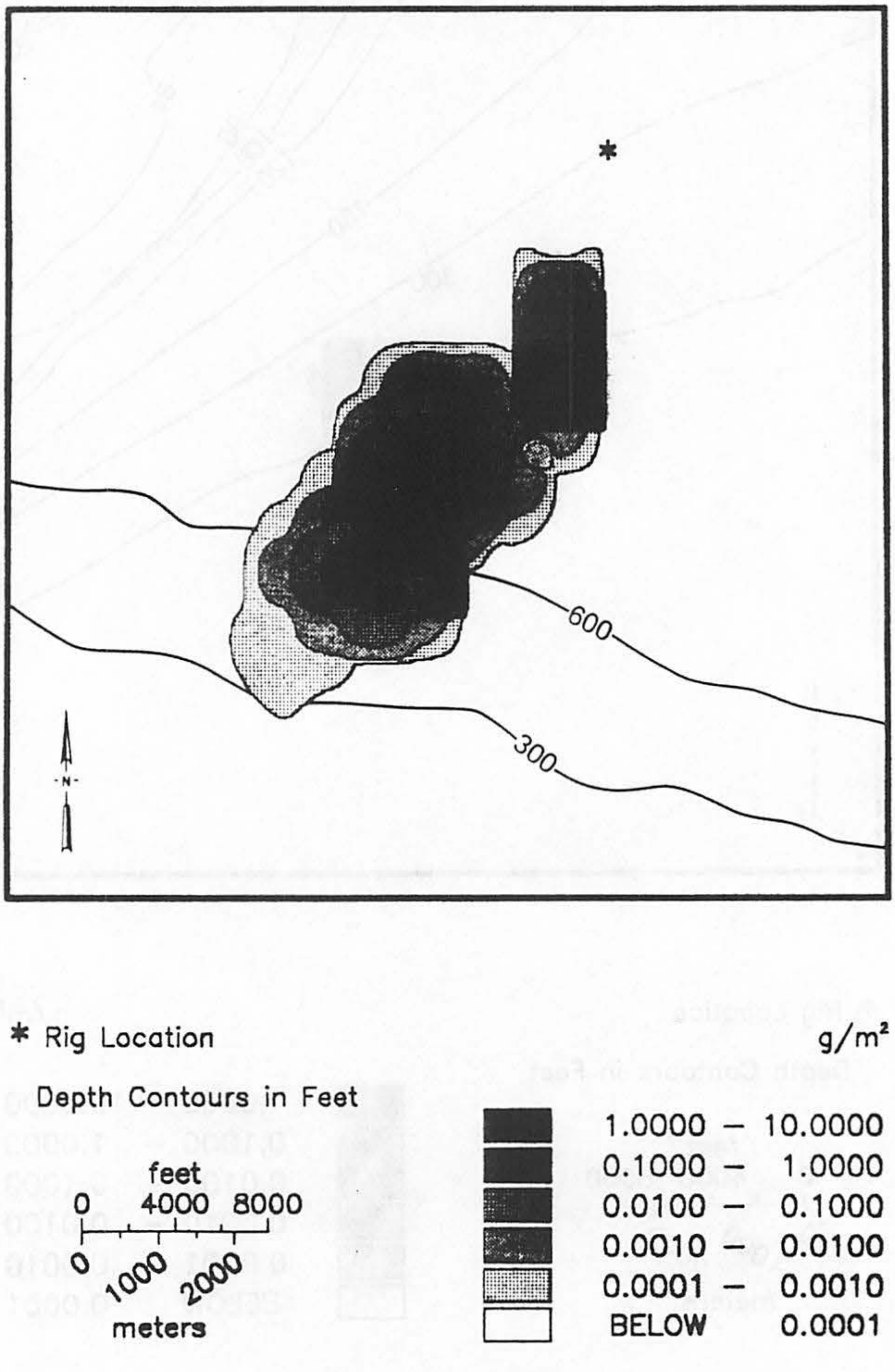

Figure 6
Total Accumulated Solids on Bottom, Simulation No. 6

APPENDIX A

MOBILE SOURCE AND OFFSHORE EMISSION CALCULATIONS RELATED TO CONSTRUCTION AND OPERATION OF PLATFORM

APPENDIX A
EMISSION FACTORS

1. Crew and Supply Boats - AP42, Table 3.2.3-4
   Units - lbs of pollutant per 1000 gal. fuel.
   Cruise mode: NO_x - 394, CO - 140, SO_2 - 28.5, VOC - 21.6, TSP - 51.
   Idle mode: NO_x - 438, CO - 83, SO_2 - 28.5, VOC - 63.3, TSP - 51.

2. Helicopter - Platform Hildago Environmental Report, Chevron
   Units - Landing and Take-off (LTO) lbs per LTO cycle.
   \- Cruise lbs per hour.
   LTO: NO_x - 3.02, VOC - 6.78, CO - 13.54, SO_2 - 0.44, TSP - 0.40.
   Cruise: NO_x - 4.8, VOC - 1.2, CO - 5.8, SO_2 - 0.8, TSP - 0.6.

3. Tugboat - Goodley et al., CARB memo, 1976.
   Units - lbs of pollutant per 1000 gal. fuel.
   Full operating mode: SO_2 - 28.4, NO_x - 572, TSP - 25, CO - 86, VOC - 13.

4. Diesel engines greater than 600 hp - AP42, Table 3.3.4-1.
   Units - grams pollutants per horsepower hour.
   Normal operation: NO_x - 11.0, CO - 2.9, VOC - 0.31, $SO*_2$ - 0.8, TSP* - 0.86.

5. Diesel engine less than 600 hp - AP42, Table 3.3.3-1.
   Units - grams of pollutant per horsepower hour.
   Normal operation: NO_x - 14.0, CO - 3.03, VOC - 1.12, SO_2 - 0.931, TSP - 1.0.

6. Boiler for pile driver - AP42, Table 1.3-1.
   Units - lbs of pollutant per 1000 gal. fuel.
   Normal operation: $SO*_2$-35.5, NO_x-20, TSP - 2, CO - 5, VOC - 0.25.

7. Derrick Barge Fugitive Hydrocarbons - Platform Hildago Environmental Report, Chevron.
   Units - 0.3 lbs total hydrocarbon per 1000 gal. throughput.

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*0.25 percent sulfur in fuel, particulate factored from sulfur level and AP-42 Table 3.3.3-1 values.

8. Platform Gail's estimated fugitive emissions were calculated using the API generalized prediction method for offshore producing facilities, publication 4322, March 1980.

9. Diesel engines (platform cranes, emergency generators, and fire pumps) - AP42, Table 3.3.3-1.
Units - lbs of pollutant per 1000 gal. fuel.
Normal operation: NO_x - 469, VOC - 37.5, CO - 102, SO_2 - 31.2, TSP - 33.5.

MOBILE SOURCE AND ONSHORE EMISSION CALCULATIONS RELATED TO CONSTRUCTION PHASE

The following shows the emission calculations for mobile sources used for employee and material transportation. These sources are not considered part of the regulated construction facility emissions per 30 CFR 250.2.

PLATFORM CONSTRUCTION (mobile sources)

Supply boat transportation

Supply boat origination point - Port Hueneme to Platform Gail = 9.7 nm.

Assumes: 1 round trip per day. 0.75 hour to platform, 2 hours idle at platform, 0.75 hour return to Port Hueneme. Boat in State waters 3.1 nm.

Assumes: 68 percent of cruising time spent in Federal waters per trip or a total of 1 hour.

Cruise speed: 13 nautical miles per hour (nm/hr)

Cruise fuel consumption: 130 gal/hr

1 trip/day x 1.5 hr/trip in Federal waters x 0.68 x 130 gal/hr = 132.6 gal/day

132.6 gal/day x 394 lb $NO_x/10^3$ gal = 52.2 lb NO_x/day

132.6 gal/day x 140 lb $CO/10^3$ gal = 18.6 lb CO/day

132.6 gal/day x 28.5 lb $SO_2/10^3$ gal = 3.8 lb SO_2/day

132.6 gal/day x 21.6 lb $VOC/10^3$ gal = 2.9 lb VOC/day

132.6 gal/day x 51 lb $TSP/10^3$ gal = 6.8 lb TSP/day

Supply boat transportation

Assumes: 2 hours idle at platform in Federal waters.

Idle Mode

Fuel consumption = 35 gal/hr

2 hours/trip x 1 trip/day x 35 gal/hr = 70 gal/day

70 gal/day x 438 lb $NO_x/10^3$ gal = 30.7 lb NO_x/day

70 gal/day x 83 lb CO/10^3 gal = 5.8 lb CO/day

70 gal/day x 28.5 lb $SO_2/10^3$ gal = 2.0 lb SO_2/day

70 gal/day x 63.3 lb VOC/10^3 gal = 4.4 lb VOC/day

70 gal/day x 51 lb TSP/10^3 gal = 3.6 lb TSP/day

Crewboat transportation

Crewboat origination point - Carpinteria Pier to Platform Gail = 17.7 nm

Assumes: 2 round trips per day. 1.1 hour to platform at 16 nm/hr, 0.5 hour idle at platform site, 1.1 hour return to Carpinteria Pier. Crewboat in State waters 3.0 nm.

Assumes: 83.1 percent of cruising time spent in Federal waters/trip

Cruise Mode

Fuel consumption = 84 gal/hr

2.2 hr/trip x 2 trips/day x 0.831 x 84 gal/hr = 307 gal/day

307 gal/day x 394 lb $NO_x/10^3$ gal = 121.0 lb NO_x/day

307 gal/day x 140 lb CO/10^3 gal = 43.0 lb CO/day

307 gal/day x 28.5 lb $SO_2/10^3$ gal = 8.7 lb SO_2/day

307 gal/day x 21.6 lb VOC/10^3 gal = 6.6 lb VOC/day

307 gal/day x 51 lb TSP/10^3 gal = 15.7 lb TSP/day

Idle Mode

Assumes: 0.5 hrs idle at the platform in Federal waters per trip

Fuel Consumption = 20 gal/hr

0.5 hr idle/trip at platform site x 20 gal/hr x 2 trips/day = 20 gal/day

20 gal/day x 438 lb $NO_x/10^3$ gal = 8.8 lb NO_x/day

20 gal/day x 83 lb CO/10^3 gal = 1.7 lb CO/day

20 gal/day x 28.5 lb $SO_2/10^3$ gal = 0.6 lb SO_2/day

20 gal/day x 63.3 lb VOC/10^3 gal = 1.3 lb VOC/day

20 gal/day x 51 lb TSP/10^3 gal = 1.0 lb TSP/day

Helicopter transportation (landing take-off [LTO] cycle)

Assumes: 2 helicopter trips per day

Assumes: 1 landing and takeoff occurs in Federal waters per trip

Helicopter origination point - Ventura County Airport to Platform Gail = 10.7 nm

1 LTO cycles/trip x 2 trips/day = 2 LTO cycle/day

2 LTO cycles/day x 3.02 lb NO_x/LTO cycle = 6.0 lb NO_x/day

2 LTO cycles/day x 6.78 lb VOC/LTO cycle = 13.6 lb VOC/day

2 LTO cycles/day x 13.54 lb CO/LTO cycle = 27.1 lb CO/day

2 LTO cycles/day x 0.44 lb SO_2/LTO cycle = 0.9 lb SO_2/day

2 LTO cycles/day x 0.40 lb TSP/LTO cycle = 0.8 lb TSP/day

Helicopter transportation (cruise mode)

Assumes: 90 nm/hr cruise speed, 21.4 nm round trip (RT)

Assumes: 52.3 percent of emissions occur in Federal waters

0.24 hr/RT x 2 RT/day x 0.523 = 0.25 hr/day

0.25 hr/day x 4.8 lb NO_x/hr = 1.2 lb NO_x/day

0.25 hr/day x 1.2 lb VOC/hr = 0.3 lb VOC/day

0.25 hr/day x 5.8 lb CO/hr = 1.4 lb CO/day

0.25 hr/day x 0.8 lb SO_2/hr = 0.2 lb SO_2/day

0.25 hr/day x 0.6 lb TSP/hr = 0.2 lb TSP/day

SUBSEA PIPELINE INSTALLATION (mobile sources)

Supply boat transportation (origination point - Port Hueneme)

Round trip distance, daily trips and emissions are identical to the platform installation phase (mobile sources) on a per day basis.

Crewboat transportation (origination point - Carpinteria Pier)

Round trip distance, daily trips and emissions are identical to the platform installation phase (mobile sources) on a per day basis.

Helicopter transportation (origination point - Ventura County Airport)

Round trip distance, daily trips and emissions are identical to the platform installation phase (mobile sources) on a per day basis.

FACILITY CONSTRUCTION EMISSIONS

Derrick Barge Tugboat Emissions (5,750 hp, Full Mode)

Assumes: 33 percent daily use factor, full mode

290 gallons per hour fuel rate

24 hr/day x 0.33 x 290 gal/hr = 2,297 gal/day

(Goodley, et al. emission factors)

2,297 gal/day x 28.4 lb $SO_2/10^3$ gal = 65.2 lb SO_2/day

2,297 gal/day x 572 lb $NO_x/10^3$ gal = 1,314 lb NO_x/day

2,297 gal/day x 25 lb TSP/10^3 gal = 57.4 lb TSP/day

2,297 gal/day x 86 lb CO/10^3 gal = 197.5 lb CO/day

2,297 gal/day x 13 lb VOC/10^3 gal = 29.8 lb VOC/day

Cargo Barge Tugboat Emissions (5,750 hp, Full Mode)

Assumes: 33 percent daily use factor, full mode

290 gallons per hour fuel rate

24 hr/day x 0.33 x 290 gal/hr = 2,297 gal/day

(Goodley, et al. emission factors)

2,297 gal/day x 28.4 lb $SO_2/10^3$ gal = 65.2 lb SO_2/day

2,297 gal/day x 572 lb $NO_x/10^3$ gal = 1,314 lb NO_x/day

2,297 gal/day x 25 lb TSP/10^3 gal = 57.4 lb TSP/day

2,297 gal/day x 86 lb CO/10^3 gal = 197.5 lb CO/day

2,297 gal/day x 13 lb VOC/10^3 gal = 29.8 lb VOC/day

Assume: Tugboat will be used for approximately 18 days for delivering platform modules via cargo barge.

Derrick Barge (3,300 hp)

Assumes use of three 1100-hp diesel engine powered generators or a total of 3300 hp to provide all electrical power needs. Assumes barge operates 24 hours/day at 70 percent of full mode. AP-42 Table 3.3.4-1 for emission factors.

24 hours/day x 0.70 x 3300 hp = 55,440 hp-hr/day

55,440 hp-hr/day x 11.0 g NO_x/hp-hr x 1 lb/454 g = 1343.3 lb NO_x/day

55,440 hp-hr/day x 2.9 g CO/hp-hr x 1 lb/454 g = 354.1 lb CO/day

55,440 hp-hr/day x 0.31 g VOC/hp-hr x 1 lb/454 g = 37.9 lb VOC/day

55,440 hp-hr/day x 0.94 g SO_2/hp-hr x 1 lb/454 g = 114.8 lb SO_2/day*

55,440 hp-hr/day x 0.94 g TSP/hp-hr x 1 lb/454 g = 114.8 lb TSP/day

Anchor Winch Emissions

Assumes five winches operating a total of 48 hours at a 50 percent load factor with power provided by five 635-hp diesel engines or a total of 3175 hp.

Anchor Deployment (24 hours)

24 hours/day x 0.50 x 3175 hp = 38,100 hp-hr/day

38,100 hp-hr/day x 11.0 g NO_x/hp-hr x 1 lb/454 g = 923.1 lb NO_x/day

38,100 hp-hr/day x 2.9 g CO/hp-hr x 1 lb/454 g = 243.4 lb CO/day

38,100 hp-hr/day x 0.31 g VOC/hp-hr x 1 lb/454 g = 26.0 lb VOC/day

38,100 hp-hr/day x 0.94 g SO_2/hp-hr x 1 lb/454 g = 78.9 lb SO_2/day*

38,100 hp-hr/day x 0.94 g TSP/hp-hr x 1 lb/454 g = 78.9 lb TSP/day

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*Assumes a 0.25 percent sulfur content and TSP is equivalent to SO_2.

Anchor Retrieval (24 hours)

24 hours/day x 0.50 x 3175 hp = 38,100 hp-hr/day

38,100 hp-hr/day x 11.0 g NO_x/hp-hr x 1 lb/454 g = 923.1 lb NO_x/day

38,100 hp-hr/day x 2.9 g CO/hp-hr x 1 lb/454 g = 243.4 lb CO/day

38,100 hp-hr/day x 0.31 g VOC/hp-hr x 1 lb/454 g = 26.0 lb VOC/day

38,100 hp-hr/day x 0.94 g SO_2/hp-hr x 1 lb/454 g = 78.9 lb SO_2/day*

38,100 hp-hr/day x 0.94 g TSP/hp-hr x 1 lb/454 g = 78.9 lb TSP/day

Main Crane (4,325 hp - 50 percent full mode)

Assumes nine lifts with crane will be required over 18 days, or one lift every 2 days. Each lift requires 6 hours of crane operation at full load or a total of 54 hours of operation over 18 days. Power provided by one 1325 hp diesel engine and three 1000 hp diesel engines or a total of 4325 hp at an average load factor of 50 percent.

1 lift/2 days x 6 hours/lift x 0.50 x 4,325 hp = 6,487.5 hp-hr/day

6,487.5 hp-hr/day x 11.0 g NO_x/hp-hr x 1 lb/454 g = 157.2 lb NO_x/day

6,487.5 hp-hr/day x 2.9 g CO/hp-hr x 1 lb/454 g = 41.4 lb CO/day

6,487.5 hp-hr/day x 0.31 g VOC/hp-hr x 1 lb/454 g = 4.4 lb VOC/day

6,487.5 hp-hr/day x 0.94 g SO_2/hp-hr x 1 lb/454 g = 13.4 lb SO_2/day*

6,487.5 hp-hr/day x 0.94 g TSP/hp-hr x 1 lb/454 g = 13.4 lb TSP/day

Auxiliary Crane (753 hp)

Assumes an average daily use factor of 20 percent operating a 50 percent of full mode. Power provided by one 386 hp diesel engine and one 367 hp diesel engine.

24 hours/day x 0.20 x 0.50 x 753 hp = 1,807 hp-hr/day

1,807 hp-hr/day x 14.0 g NO_x/hp-hr x 1 lb/454 g = 55.7 lb NO_x/day

1,807 hp-hr/day x 3.03 g CO/hp-hr x 1 lb/454 g = 12.1 lb CO/day

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*Assumes 0.25 percent sulfur content and TSP is equivalent to SO_2.

1,807 hp-hr/day x 1.12 g VOC/hp-hr x 1 lb/454 g = 4.5 lb VOC/day

1,807 hp-hr/day x 0.931 g SO_2/hp-hr x 1 lb/454 g = 3.7 lb SO_2/day*

1,807 hp-hr/day x 1.0 g TSP/hp-hr x 1 lb/454 g = 4.0 lb TSP/day

Boiler for Pile Driving (800 hp, full mode)

Assumes: 83.3 percent daily use factor

239 gallons per hour fuel rate x 24 hrs/day x 0.833 = 4,778 gal/day

4,778 gal/day x 35.5 lb $SO_2/10^3$ gal = 169.6 lb SO_2/day

4,778 gal/day x 20 lb $NO_x/10^3$ gal = 95.6 lb NO_x/day

4,778 gal/day x 2 lb TSP/10^3 gal = 9.6 lb TSP/day

4,778 gal/day x 5 lb CO/10^3 gal = 23.9 lb CO/day

4,778 gal/day x 0.25 lb VOC/10^3 gal = 1.2 lb VOC/day

Derrick Barge Fugitive Emissions

10.7 lb THC (gas)/1000 gal throughput x 0.3 psia (diesel)/10.0 psia (gas) - 0.3 lb THC/1000 gal throughput.

Daily throughput:

Piling boiler: 4,778 gal/day

Derrick barge: 55,440 hp-hr/day x 8000 Btu/hp-hr x 1 gal/137,000 Btu = 2,327 gal/day

3,237 gal/day x 0.3 lb THC/1000 gal = -.97 lb THC/day = 0.97 lb VOC/day

NOTE: For fuel consumption, see Exxon, Santa Ynez Unit, Volume III, 1982.

SUBSEA PIPELINE INSTALLATION

Pipelaying and Hook-up (50 days total)

Barge Tug (3,600 hp, Full Mode)

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*Assumes 0.25 percent sulfur content and TSP is equivalent to SO_2.

Assumes: 40 percent daily use factor, full mode

200 gallons per hour fuel rate

24 hr/day x 0.40 x 200 gal/hr = 1,920 gal/day

1,920 gal/day x 140 lb CO/10^3 gal = 268.8 lb CO/day

1,920 gal/day x 394 lb NO_x/10^3 gal = 756.5 lb NO_x/day

1,920 gal/day x 28.5 lb SO_2/10^3 gal = 54.7 lb SO_2/day

1,920 gal/day x 21.6 lb VOC/10^3 gal = 41.5 lb VOC/day

1,920 gal/day x 51 lb TSP/10^3 gal = 97.9 lb TSP/day

Lay Barge Emissions

Pipelaying Emissions (30 days)

Main diesel generators (10,800 hp at 70 percent load): Main generator set is powered by three diesel engines at 3600 hp each, or a total of 10,800 hp operating at 70 percent of full mode.

24 hr/day x 0.70 x 10,800 hp = 181,440 hp-hr/day

181,440 hp-hr/day x 11.0 g NO_x/hp-hr x 1 lb/454 g = 4,396 lb NO_x/day

181,440 hp-hr/day x 2.9 g CO/hp-hr x 1 lb/454 g = 1,159 lb CO/day

181,440 hp-hr/day x 0.31 g VOC/hp-hr x 1 lb/454 g = 123.9 lb VOC/day

181,440 hp-hr/day x 0.94 g SO_2/hp-hr x 1 lb/454 g = 375.7 lb SO_2/day*

181,440 hp-hr/day x 0.94 g TSP/hp-hr x 1 lb/454 g = 375.7 lb TSP/day

Utility Crane Emissions (367 hp)

Assumes use of one crane at 367 hp operating 12 hours/day at 50 percent of full mode.

24 hr/day x 0.50 x 0.50 x 367 hp = 2,020 hp-hr/day

2,020 hp-hr/day x 14.0 g NO_x/hp-hr x 1 lb/454 g = 67.9 lb NO_x/day

2,020 hp-hr/day x 3.03 g CO/hp-hr x 1 lb/454 g = 13.5 lb CO/day

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*Assumes 0.25 percent sulfur content and TSP is equivalent to SO_2.

2,020 hp-hr/day x 1.12 g VOC/hp-hr x 1 lb/454 g = 5.0 lb VOC/day

2,020 hp-hr/day x 0.931 g SO_2/hp-hr x 1 lb/454 g = 4.1 lb SO_2/day*

2,020 hp-hr/day x 1.0 g TSP/hp-hr x 1 lb/454 g = 4.4 lb TSP/day

Hook-up Emissions (20 days)

Auxiliary standby generator (1,115 hp at 70 percent of full mode)

24 hr/day x 0.70 x 1,115 hp = 18,732 hp-hr/day

18,732 hp-hr/day x 11.0 g NO_x/hp-hr x 1 lb/454 g = 453.9 lb NO_x/day

18,732 hp-hr/day x 2.9 g CO/hp-hr x 1 lb/454 g = 119.7 lb CO/day

18,732 hp-hr/day x 0.31 g VOC/hp-hr x 1 lb/454 g = 12.8 lb VOC/day

18,732 hp-hr/day x 0.94 g SO_2/hp-hr x 1 lb/454 g = 38.8 lb SO_2/day*

18,732 hp-hr/day x 0.94 g TSP/hp-hr x 1 lb/454 g = 38.8 lb TSP/day

Utility Crane Emissions (367 hp)

Assumes use of one crane at 367 hp operating at a daily use factor of 20 percent at 50 percent of full mode.

24 hr/day x 0.20 x 0.50 x 367 hp = 880.8 hp-hr/day

880.8 hp-hr/day x 14.0 g NO_x/hp-hr x 1 lb/454 g = 27.2 lb NO_x/day

880.8 hp-hr/day x 3.03 g CO/hp-hr x 1 lb/454 g = 5.9 lb CO/day

880.8 hp-hr/day x 1.12 g VOC/hp-hr x 1 lb/454 g = 2.2 lb VOC/day

880.8 hp-hr/day x 0.931 g SO_2/hp-hr x 1 lb/454 g = 1.8 lb SO_2/day*

880.8 hp-hr/day x 1.0 g TSP/hp-hr x 1 lb/454 g = 1.9 lb TSP/day

Lay Barge Fugitive Hydrocarbon Emissions

10.7 lb THC (gas)/1000 gal throughput x 0.3 psia RVP (diesel)/10.0 psia RVP (gas) = 0.3 THC/1000 gal.

Fuel usage:

181,440 hp-hr/day x 8,000 Btu/hp-hr x 1 gal/137,000 Btu = 10,595 gal/day

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*Assumes 0.25 percent sulfur content and TSP is equivalent to SO_2.

10,595 gal/day x 0.3 lb THC/1,000 gal + 3.1 lb THC/day = 3.1 lb VOC/day

NOTE: For fuel usage, see Exxon, Santa Ynez Unit, Volume III, 1982.

DRILLING PHASE (mobile sources)

Crewboat transportation

Crewboat origination point - Port Hueneme to Platform Gail = 9.7 nm

Assumes: 1 round trip per day. Cruise speed = 16 nm/hr. 0.61 hour travel to platform, 0.5 hour idle at platform, 0.61 hour return to Port Hueneme. Boat in State waters 3.1 nm.

Assumes: 68 percent cruising time spent in Federal waters per trip.

Cruise Mode

Fuel consumption = 84 gal/hr

1.22 hr/trip x 84 gal/hr x 1 trip day x 0.68 = 69.7 gal/day

69.7 gal/day x 394 lb $NO_x/10^3$ gal = 27.5 lb NO_x/day

69.7 gal/day x 140 lb $CO/10^3$ gal = 9.8 lb CO/day

69.7 gal/day x 28.5 lb $SO_2/10^3$ gal = 2.0 lb SO_2/day

69.7 gal/day x 21.6 lb $VOC/10^3$ gal = 1.5 lb VOC/day

69.7 gal/day x 51 lb $TSP/10^3$ gal = 3.6 lb TSP/day

Idle Mode

Assumes: 0.5 hrs idle at platform in Federal waters per trip

Fuel consumption = 20 gal/hr

0.5 hr idle/trip x 20 gal/hr x 1 trip day = 10 gal/day

10 gal/day x 438 lb $NO_x/10^3$ gal = 4.4 lb NO_x/day

10 gal/day x 83 lb $CO/10^3$ gal = 0.8 lb CO/day

10 gal day x 28.5 lb $SO_2/10^3$ gal = 0.3 lb SO_2/day

10 gal/day x 63.3 lb VOC/10^3 gal = 0.6 lb VOC/day

10 gal/day x 51 lb TSP/10^3 gal = 0.5 lb TSP/day

Supply boat transportation

Supply boat origination point - Port Hueneme to Platform Gail = 9.7 nm

Assumes: 1 round trip per day. Cruise speed = 13 nm/hr. 1 hour travel to platform, 2 hours idle at platform, 0.75 hour return to Port Hueneme. Boat in State waters 3.1 nm.

Assumes: 68 percent of cruising time spent in Federal waters per trip.

Cruise Mode

Fuel consumption = 130 gal/hr

1 trip/day x 1.5 hr/trip x 130 gal/hr x 0.68 = 132.6 gal/day

132.6 gal/day x 394 lb NO_x/10^3 gal = 52.2 lb NO_x/day

132.6 gal/day x 140 lb CO/10^3 gal = 18.6 lb CO/day

132.6 gal/day x 28.5 lb SO_2/10^3 gal = 3.8 lb SO_2/day

132.6 gal/day x 21.6 lb VOC/10^3 gal = 2.9 lb VOC/day

132.6 gal/day x 51 lb TSP/10^3 gal = 6.8 lb TSP/day

Idle Mode

Assumes: 2 hours idle at platform in Federal waters per trip.

Fuel consumption = 35 gal/hr

2 hours idle/trip x 1 trip/day x 35 gal/hr = 70 gal/day

70 gal/day x 438 lb CO/10^3 gal = 30.7 lb CO/day

70 gal/day x 83 lb NO_x/10^3 gal = 5.8 lb NO_x/day

70 gal/day x 28.5 lb SO_2/10^3 gal = 2.0 lb SO_2/day

70 gal/day x 63.3 lb VOC/10^3 gal = 4.4 lb VOC/day

70 gal/day x 51 lb TSP/10^3 gal = 3.6 lb TSP/day

Helicopter transportation (landing take-off [LTO] cycle)

Assumes: 1 round trip per day for Chevron personnel, service personnel

Assumes: 1 landing and takeoff occurs within Federal waters per trip

Helicopter origination point - Ventura County Airport to Platform Gail = 10.7 nm

1 LTO cycle/trip x 1 trip/day = 1 LTO cycles/day

1 LTO cycle/day x 3.02 lb NO_x/LTO cycle = 3.0 lb NO_x/day

1 LTO cycle/day x 6.78 lb VOC/LTO cycle = 6.8 lb VOC/day

1 LTO cycle/day x 13.54 lb CO/LTO cycle = 13.5 lb CO/day

1 LTO cycle/day x 0.44 lb SO_2/LTO cycle = 0.4 lb SO_2/day

1 LTO cycle/day x 0.40 lb TSP/LTO cycle = 0.4 lb TSP/day

Helicopter transportation (Chevron personnel, service personnel)

Assumes: 90 nm/hr cruise speed, 21.4 nm round trip (RT)

Assumes: 52.3 percent of emissions occur in Federal waters.

0.24 hrs/RT x 1 round trip/day x 0.523 = 0.13 hr/day

Cruise mode

0.13 hr/day x 4.8 lb NO_x/hr = 0.6 lb NO_x/day

0.13 hr/day x 1.2 lb VOC/hr = 0.2 lb VOC/day

0.13 hr/day x 5.8 lb CO/hr = 0.8 lb CO/day

0.13 hr/day x 0.8 lb SO_2/hr = 0.1 lb SO_2/day

0.13 hr/day x 0.6 lb TSP/hr = 0.1 lb TSP/day

PRODUCTION PHASE (mobile sources)

Crewboat transportation

Crewboat origination point: Carpinteria Pier to Gail via Platform Grace = 17.7 nm.

Assumes: 2 round trips per day. Cruise speed = 16 nm/hr. 1.1 hour travel to platform, 0.5 hour idle at platform, 1.1 hour return to Carpinteria Pier.

Assumes: 83.1 percent cruising time spent in Federal waters per trip.

NOTE: Crewboat will transport both crew personnel and small supplies.

Cruise Mode

Fuel consumption = 84 gal/hr

2.2 hr/trip x 84 gal/hr x 2 trips/day x 0.831 = 307 gal/day

307 gal/day x 394 lb $NO_x/10^3$ gal = 121.0 lb NO_x/day

307 gal/day x 140 lb $CO/10^3$ gal = 43.0 lb CO/day

307 gal/day x 28.5 lb $SO_2/10^3$ gal = 8.7 lb SO_2/day

307 gal/day x 21.6 lb $VOC/10^3$ gal = 6.6 lb VOC/day

307 gal/day x 51 lb $TSP/10^3$ gal = 15.7 lb TSP/day

Idle Mode

Assumes: 0.5 hrs idle at platform in Federal waters per trip.

Fuel consumption = 20 gal/hr

0.5 hr idle/trip x 20 gal/hr x 2 trip/day = 20 gal/hr

20 gal/day x 438 lb $NO_x/10^3$ gal = 8.8 lb NO_x/day

20 gal/day x 83 lb $CO/10^3$ gal = 1.7 lb CO/day

20 gal/day x 28.5 lb $SO_2/10^3$ gal = 0.6 lb SO_2/day

20 gal/day x 63.3 lb $VOC/10^3$ gal = 1.3 lb VOC/day

20 gal/day x 51 lb $TSP/10^3$ gal = 1.0 lb TSP/day

Helicopter transportation (landing take-off [LTO] Cycle)

Assumes: 1 round trip per day for Chevron personnel, service personnel

Assumes: 50 percent of emissions occur in Federal waters.

Helicopter origination point - Ventura County Airport to Platform Gail = 10.7 nm

1 LTO cycle/trip x 1 trip/day = 1 LTO cycles/day

1 LTO cycle/day x 3.02 lb NO_x/LTO cycle = 3.0 lb NO_x/day

1 LTO cycle/day x 6.78 lb VOC/LTO cycle = 6.8 lb VOC/day

1 LTO cycle/day x 13.54 lb CO/LTO cycle = 13.5 lb CO/day

1 LTO cycle/day x 0.44 lb SO_2/LTO cycle = 0.4 lb SO_2/day

1 LTO cycle/day x 0.40 lb TSP/LTO cycle = 0.4 lb TSP/day

Helicopter transportation (Chevron personnel, service personnel)

Cruise Mode (origination point - Ventura County Airport)

Assumes: 90 nm/hr cruise speed, round trip = 21.4 nm

Assumes: 52.3 percent of emissions occur in Federal waters.

0.24 hrs/RT x 1 round trip/day x 0.523 = 0.13 hr/day

0.13 hr/day x 4.8 lb NO_x/hr = 0.6 lb NO_x/day

0.13 hr/day x 1.2 lb VOC/hr = 0.2 lb VOC/day

0.13 hr/day x 5.8 lb CO/hr = 0.8 lb CO/day

0.13 hr/day x 0.8 lb SO_2/hr = 0.1 lb SO_2/day

0.13 hr/day x 0.6 lb TSP/hr = 0.1 lb TSP/day

PLATFORM OPERATION

Turbine Generators

Assumes: Allison 501 KB, natural gas fired turbines (2800 kW each).

Fuel consumption 32,500 standard cubic feet per hour at 1190 BTU per cubic foot.

Water injection to achieve 70 percent NO_x reduction over non-injected engine. For documentation of this reduction, please see the DPP, pages VI-19, 20.

Fuel gas with H_2S content no greater than 15 grains/100 cubic feet

Three turbines on platform with one designated as standby.

Emission Rates (Manufactured supplied data)

NO_x - ~~1.4~~ 1.51 lb/1000 kWh (output)

VOC - 0.07 lb/1000 kWh (output)

CO - 2.1 lb/1000 kWh (output)

SO_2 - 0.50 lb/1000 kWh (output)

TSP - 0.03 lb/1000 kWh (output)

Peak year power requirements 1999 at 5590 kilowatts per hour.

5590 kW/hr x ~~1.4~~ 1.51 lb NO_x/1000 kWh x 8760 hr/yr x 1 ton/2000 lbs =
~~34.3~~ 37.0 tons NO_x/yr

5590 kW/hr x 0.07 lb VOC/1000 kWh x 8760 hr/yr x 1 ton/2000 lbs =
1.7 tons VOC/yr

5590 kW/hr x 2.1 lb CO/1000 kWh x 8760 hr/yr x 1 ton/2000 lbs =
51.4 tons CO/yr

5590 kW/hr x 0.5 lb SO_2/1000 kWh x 8760 hr/yr x 1 ton/2000 lbs =
12.2 tons SO_2/yr

5590 kW/hr x 0.03 lb TSP/1000 kWh x 8760 hr/yr x 1 ton/2000 lbs =
0.7 tons TSP/yr

Flare

Assumes: Emission factors from South Coast AQMD

High and low pressure system use 600 cubic feet per hour of natural gas for purge and pilot maintenance.

Gas has 1190 BTUs/cubic foot

600 cu. ft/hr x 1190 BTU/cu. ft x 0.072 lb $NO_x/1 \times 10^6$ BTU
x 8760 hr/yr x 1 ton/2000 lbs = 0.23 tons NO_x/yr

600 cu. ft/hr x 1190 BTU/cu. ft x 0.074 lb VOC/1 x 10^6 BTU

x 8760 hr/yr x 1 ton/2000 lbs = 0.23 tons VOC/yr

600 cu. ft/hr x 1190 BTU/cu. ft x 0.396 lb CO/1 x 10^6 BTU

x 8760 hr/yr x 1 ton/2000 lbs = 1.24 tons CO/yr

600 cu. ft/hr x 1190 BTU/cu. ft x 0.013 lb SO_2/1 x 10^6 BTU

x 8760 hr/yr x 1 ton/2000 lbs = 0.04 tons SO_2/yr

600 cu. ft/hr x 1190 BTU/cu. ft x 0.02 lb TSP/1 x 10^6 BTU

x 8760 hr/yr x 1 ton/2000 lbs = 0.06 tons TSP/yr

Fugitive Emissions

Emissions prediction based on American Petroleum Institute study (API, 1980) and Minerals Management Service Study (MMS, 1983).

Number of components per well, y = 1/2.69 x 10EE-4 + 8.61 x 10EE-5(x)

where x = number of wells on platform.

For Platform Gail with 36 well slots use x = 36, even though the present drilling plan is to completed only 34 wells.

y = 1/2.69 x 10EE-4 + 8.61 x 10EE-5 (36) = 297 components/well

The total number of components = 297 components/well x 36 wells = 10,692 components. Refer to Table A-1, Predicted Fugitive Emissions from Process Equipment.

The average proportion of the THC emissions from offshore platforms for each species category are shown below (API, 1980).

AVERAGE PROPORTION BY WEIGHT (Carbon) OF SPECIES

	C1	C2	C3	C4	C5	C6+
Gas	0.767	0.033	0.025	0.024	0.016	0.135
Other	0.588	0.039	0.031	0.042	0.055	0.245

Since the C1 and C2 (methane, ethane) fractions are considered nonreactive, the VOC fraction would be the sume of the C3 through C6+ fractions.

	VOC Fraction
Gas	0.20
Other	0.37

The VOC emissions are then calculated by multiplying the estimated THC emissions by the VOC fractions. The resulting VOC emissions are shown below:

	VOC Emissions (tons/year)	THC Emissions (tons/year)
Gas	9.3	46.4
Other	0.2	0.6
Total	9.5	47.0

*Note: This factor (0.007 lb/day/device) was confirmed with the API library in Washington, DC. If there are further questions contact Mr. Ed Crockett (202) 682-8000 ext. 8318.

Emergency Generators and Fire Pump Engines

Assumes: AP-42 Table 3.3.3-1 Diesel Industrial Engines Emergency generators consist of 2-850 kW units using 66 gal/hr (total) at peak load.

Fire pump engines consist of 2-250 hp units using 26 gal/hr at peak load.

Both emergency generators and fire pumps are tested 30 minutes per week at peak load..

[66 gal/hr (generated) + 26 gal/hr (fire pump)] x 0.5 hr/wk = 46 gal/wk

46 gals/wk x 469 lb NO_x/1000 gals x 52 wk/yr x 1 ton/2000 lbs = 0.56 tons NO_x/yr

46 gals/wk x 37.5 lb VOC/1000 gals x 52 wk/yr x 1 ton/2000 lbs = 0.04 tons VOC/yr

46 gals/wk x 102 lb CO/1000 gals x 52 wk/yr x 1 ton/2000 lbs = 0.12 tons CO/yr

46 gals/wk x 31.2 lb SO_2/1000 gals x 52 wk/yr x 1 ton/2000 lbs = 0.03 tons SO_2/yr

46 gals/wk x 33.5 lb TSP/1000 gals x 52 wk/yr x 1 ton/2000 lbs = 0.04 tons TSP/yr

Cranes

Assumes: AP-42 Table 3.3.3-1 Diesel Industrial Engines

Primary crane (260 hp diesel engine) is 60 ton capacity with fuel usage of 14.25 gal/hr (max.), average load factor is of 50%.

Secondary crane (240 hp diesel engine) is 25 ton capacity with fuel usage of 13.0 gal/hr (max.), average load factor is of 50%.

Average fuel consumption - 14.25 gal/hr + 13 gal/hr ÷ 2 = 13.6 gal/hr.

Operation of each crane 4 hours per day, from 1987 thru 1993, and 2 hours per day after drilling operations are completed (1994 thru 2018).

2 cranes x 13.6 gal/hr x 469 lb NO_x/1000 gal x 4 hr/day x 365 day/yr

x 1 ton/2000 lbs = 9.31 tons NO_x/yr

2 cranes x 13.6 gal/hr x 37.5 lb VOC/1000 gal x 4 hr/day x 365 day/yr

x 1 ton/2000 lbs = 0.74 tons VOC/yr

2 cranes x 13.6 gal/hr x 102 lb CO/1000 gal x 4 hr/day x 365 day/yr

x 1 ton/2000 lbs = 2.03 tons CO/yr

2 cranes x 13.6 gal/hr x 31.2 lb SO_2/1000 gal x 4 hr/day x 365 day/yr

x 1 ton/2000 lbs = 0.62 tons SO_2/yr

2 cranes x 13.6 gal/hr x 33.5 lb TSP/1000 gal x 4 hr/day x 365 day/yr

x 1 ton/2000 lbs = 0.67 tons TSP/yr

Table A-1

PREDICTED FUGITIVE EMISSIONS FROM PROCESS EQUIPMENT

Component Type	Percentage in Service		In Service		THC Emission Factor lb/day/device		THC Emissions lb/day (tons/year)			
	Gas	Other	Gas	Other	Gas	Other	Gas		Other	
Valve	6.1	7.9	652	845	0.0581	0.0007*	37.9	(6.9)	0.6	(0.1)
Connection	52.0	29.1	5,560	3,111	0.0294	0.0007	165.0	(29.8)	2.2	(0.4)
Hatch	0.1	0.1	11	11	0.0516	0.0147	0.6	(0.1)	0.2	(0.0)
Seal Packing	0.5	0.2	53	21	0.4985	0.0013	26.4	(4.8)	0.0	(0.0)
Diaphragm	1.0	0.0	107	0	0.1495	0.744	16.0	(2.9)	0.0	(0.0)
Seal Mechanism	1.3	1.7	139	182	0.0738	0.0031	10.3	(1.9)	0.6	(0.1)
Total	61.0	39.0	6,522	4,170			254.7	(46.4)	3.6	(0.6)