Final Program Environmental Impact Report
for the
Construction and Management of an Artificial Reef in the Pacific Ocean Near San Clemente, California

Prepared for:
California State Lands Commission
Sacramento

Prepared by:
Resource Insights
Sacramento

May 1999

Volume I – Final PEIR

State Clearing House Number 9803127

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1.0 Introduction

1.0 Introduction

This document is the Final Program Environmental Impact Report (PEIR) for the Construction and Management of an Artificial Reef in the Pacific Ocean Near San Clemente, California, May 1999 (State Clearing House Number 9803127). The Draft PEIR of the same name was issued for public comment on November 9, 1998, and the comment period ended on December 28, 1998.

A PEIR has been prepared because the proposed project involves the development of an artificial reef in two separate phases that would be constructed several years apart. The first phase would be a 22.4-acre experimental reef constructed of quarry rock and recycled concrete that tests different materials, different levels of coverage on the ocean bottom, the influence of location within the site, and kelp planting treatments. The experimental reef would be monitored for five years. Once the results of the experimental reef are evaluated, a second phase of development would commence. This would involve the design and construction of a low-relief artificial reef, yielding a minimum of 150 acres of sustainable, medium-to-high density kelp beds (defined as having a minimum of 4 plants per $100m^2$) and associated kelp bed biota. The project would be located 0.6 mile offshore from the City of San Clemente within 356 acres of suitable sand substrate for artificial reef construction (defined as the project site). The project site is surrounded by an additional buffer zone, bringing the total lease area to 862 acres. Only the 22.4-acre experimental reef project is being permitted at this time. Once the results of five-years of experimental reef monitoring are evaluated and the final mitigation reef build out design is completed, the project proponent would apply for permits for construction of the second phase. It may be determined at that time that additional environmental documentation is needed.

The artificial reef is intended to establish a persistent, natural, healthy, giant kelp forest and associated biota (i.e. algae, invertebrates and fish) at a site near San Clemente, California. The California Coastal Commission (CCC) has required the owners of the San Onofre Nuclear Generating Station (SONGS) to carry out this project to mitigate for resource losses associated with operation of SONGS Units 2 and 3 at the nearby San Onofre Kelp bed (SOK). The requirements for mitigation are outlined in the SONGS Coastal Development Permit No. 6-81-330-A, as amended by the CCC. SONGS is owned by Southern California Edison Company, San Diego Gas and Electric Company, City of Anaheim and City of Riverside (hereafter referred to collectively as the project proponent). The project proponent initially filed an application (February 1998) with the California State Lands Commission (CSLC), for a 355-acre lease of State lands off the coast of San Clemente to construct a 150-acre artificial reef in two phases. The lease application was subsequently amended (March 1999) to encompass a total of 862 acres to include a buffer zone around the 356 acres identified as suitable sand substrate for artificial reef construction (defined as the project site). CSLC is serving as the Lead Agency pursuant to the California Environmental Quality Act (CEQA).

The Final PEIR presents a revised Draft PEIR with changes that include: 1) corrections and changes in response to public comments; 2) changes in the analysis due to new information; and 3) editing errors and omissions. The major differences between the Draft and Final PEIR are outlined below. However, none of the changes to the PEIR analysis have changed any conclusions regarding significant impacts or required mitigation measures.

Chapter 9 has been added to the Final PEIR, which contains responses to written comments received from the public on the Draft PEIR by December 28, 1998. These are followed by responses to oral comments given at the Public Comment Meeting held on the Draft PEIR on Thursday, December 10, 1998, in the afternoon and evening. This meeting was held in the San Clemente Community Center in San Clemente, California.

1.1 Changes in the Final PEIR

There are a number of important revisions in the Final PEIR analyses that are explained further below.

1.1.1 Changes to the Experimental Reef Project at San Clemente

- Comments were received regarding the reliance of the experimental reef project on natural recruitment of kelp given the short five-year time frame of the experimental reef monitoring. It was suggested that kelp transplantation could significantly enhance the success of the artificial reef and supplement natural recruitment, which has been low in recent years.

In response to this concern, two treatments of kelp planting were added to the design of the experimental reef project at San Clemente. The new experimental design would add two modules with kelp planting (one of recycled concrete and one of quarry rock at 34 percent coverage) in each of the seven replicate blocks. The addition of the kelp planting modules brings the total number of experimental modules to 56 (previously 42) and the overall size of the experiment to 22.4 acres (previously 16.8 acres).

- Comments were received regarding the placement of experimental reef modules primarily in the southern portion of the 356-acre project site. It was suggested that the blocks should be more evenly distributed throughout the project site. Also related to this, was a comment requesting that one block of modules be located in an area north of the present lease site.

In response to these comments, the experimental reef design has been slightly modified to space the blocks of modules fairly evenly throughout the 356-acre project site. The last of the seven blocks would be located in the far northern end of the lease area, near the San Clement Pier. This spacing would provide greater information about location effects within the San Clemente site.

1.1.2 New Information on Alternative Sites

- Several comments on the Draft PEIR were received stating the experimental reef should be expanded to include one or more of the alternative locations evaluated in the Draft PEIR. These comments indicated alternative sites would help provide additional information regarding the suitability of various locations and provide a back up if the San Clemente site did not succeed in growing kelp as expected. In addition, sites closer to the Port of San Diego would help reduce the significant air quality impacts of construction.

In response to these comments, consideration was given to adding an experimental reef at another site as part of the preferred project. The project proponent, the CCC staff and CSLC staff studied the possible sites and different design options. The first choice for another experimental reef location was the South Carlsbad site, and after that the North Carlsbad site, due to the proximity of these locations to the San Onofre Kelp bed and their expected site characteristics. The North and South Carlsbad sites were identified as suitable sites in the Draft PEIR based on earlier surveys, which had identified areas of sandy bottom interspersed within existing kelp beds. These earlier studies were also the basis for identifying the two smaller 25-acre sites at Leucadia and Encinitas. However, the designation of acres with suitable sand substrate for reef construction were only estimates, as the sites were not part of the sonar surveys done in recent years for the artificial reef siting studies.

Additional work was done to verify the present conditions in the Carlsbad area and the actual acreage of suitable sand substrate available. Consultants to the project proponent conducted sonar surveys in early March 1999 along three miles offshore from the City of Carlsbad. These sonar surveys found small areas of sandy bottom interspersed with patches of hard substrate all along the coast. The surveys found only a very small, narrow band of ocean bottom with the appropriate veneer of sand (0 to 0.5 meters) for artificial reef construction. The larger sandy bottom areas were found to have depths of 0.5 to 1 meter, which includes approximately 60 to 100 acres near South Carlsbad and about 20 acres near the Encina Treatment Plant discharge pipe. With a sand veneer of 0.5 to 1 m, artificial reef material would be at high risk of subsidence and burial.

Given the results of the March 1999 sonar surveys, adding experimental reef modules offshore from Carlsbad was abandoned. It is felt that the Leucadia and Encinitas sites would have similar characteristics to Carlsbad. Also, given the small size of these sites, they do not provide a real alternative for the mitigation reef and have likewise been abandoned.

Consideration was also given to adding an experimental reef at the Mission Beach site. However, after further discussions with CCC staff scientists and the California Department of Fish and Game (CDFG) Coordinator for the Artificial Reef Program (see letter from Dennis Bedford in Appendix I), Mission Beach was rejected. The agencies concluded that the Mission Beach site is too far from San Onofre Kelp bed to provide replacement for lost resources at San Onofre. As stated in the SONGS Permit, the mitigation should be "in kind" and "as close as practical to the impact site."

As a result of the new information, all of the alternative sites evaluated in the Draft PEIR are no longer considered viable, given the differences in site characteristics from the San Clemente site and/or the distance from the San Onofre Kelp bed. However, for the sake of consistency all of the alternative discussions and comparative analyses have been maintained in the Final PEIR as they were presented in the Draft PEIR. The alternatives have been revised to reflect the revisions in concrete and quarry rock weight estimates (see below) and the new, slightly larger acreage of the proposed project experimental reef at San Clemente. It is too speculative at this time to say whether these alternative sites might be reconsidered for the mitigation reef depending on the results of the experiment at San Clemente.

1.1.3 Changes to Construction Assumptions

The Draft PEIR contained assumptions regarding the weight of recycled concrete and quarry rock materials that would be needed to construct an experimental and mitigation artificial reef at different levels of coverage on the ocean bottom. The original estimates used in the Draft PEIR were based on preliminary assumptions regarding the size, shape and density of materials observed at one rock quarry and based on information about materials currently in place at a number of CDFG artificial reefs.

Since these original estimates were developed, consultants to the project proponents visited a number of different potential concrete and rock suppliers and evaluated the materials available. Based on new information regarding the shapes and availability of materials, the weight estimates for recycled concrete and quarry rock have been revised.

The reasons for the corrections to estimated weights are as follows:

<u>Recycled Concrete</u>: The Draft PEIR assumed that recycled concrete used for artificial reef construction would be primarily thin slabs of concrete approximately two feet by three feet by six inches. This shape would allow greater coverage of the ocean bottom with less overall weight because of the low height of the slabs in comparison to rounder quarry rock boulders. However, concerns were raised by CCC staff scientists that using only thin slabs of concrete would not provide the necessary habitat for benthic organisms that is provided by rocky reefs. Rocks normally are found in a variety of shapes and have irregular edges with more nooks and crannies that attract organisms. In addition, when recycled concrete brokers were contacted they expressed concern that it would be difficult to sort recycled concrete material to meet the specifications for thin slabs, particularly if large quantities of material were needed. While it probably would be possible to meet these specifications for the experimental reef, it would be more difficult to find enough material for the mitigation reef. A valid experiment must use the same types of materials that would be used for the full mitigation reef.

As a result, it is now assumed that the recycled concrete proposed for use in the experimental reef project would include a mixture of shapes, including some thin slabs and some larger chunks of rubble concrete. Samples of this mix of material were measured at several brokers' yards and weights were calculated on this basis. The specifications for the mix of concrete material are as follows: 1) slabs would average 3-6 ft by 2 ft by 8 inches; and 2) chunks of rubble would average 2.5 ft by 1.5 ft by 1 ft. Corrections to the estimates of concrete material needed to construct the experimental and mitigation reefs are contained in Chapter 3.0 Project Description and in the Chapter 6.0 Alternatives to the Proposed Project. As shown in the revised Tables 3-1. 3-2 and 3-4, the weight of recycled concrete material needed for the proposed project experimental and mitigation reefs would be approximately 2.3 times greater than previously estimated.

Quarry Rock: The Draft PEIR assumed that the quarry rocks used for the experimental and mitigation artificial reefs would be rounded boulders in a range of sizes from one to three feet in diameter. Recent discussions with quarry rock operators and visits to the quarries have changed these assumptions. It was found that many quarries blast rock from mountainsides in huge slabs, which results in chunks of rock in a wide variety of shapes. This makes the shapes of rocks closer to the chunks of recycled concrete rubble. Some of the rocks would be more slab-like in shape, while other shapes would be square or rounded. On average the size of the quarry rock would be 2 ft by 1.5 ft by 15 inches. As shown in the revised Tables 3-1. 3-2 and 3-4, the weight of quarry rock material needed for the proposed project experimental and mitigation reefs would be approximately 0.6 times that previously estimated.

These revised estimates for the weight of recycled concrete and quarry rock are different from those used in the Draft PEIR. The weight of concrete is now greater than originally estimated and the weight of quarry rock is less than previously estimated. The Draft PEIR indicated that 4.5 times as much quarry rock material would be needed as recycled concrete material to achieve the same level of coverage for artificial reef construction. The corrected weights show that 1.3 times as much quarry rock would be needed as recycled concrete to achieve the same level of coverage.

The change in the estimated weights of the two materials has the effect of reducing the differences in environmental impacts of recycled concrete and quarry rock. The environmental impacts associated with the worst-case scenario for constructing the mitigation reef with quarry rock at 67 percent coverage, as outlined in the Draft PEIR, are now less than previously estimated. At the same time, the impacts of the mitigation reef build out using only 67 percent coverage recycled concrete are greater. However, these changes have not changed any conclusions regarding significant impacts or the required mitigation measures.

1.2 Project Background

The CCC issued a permit for the construction and operation of SONGS Units 2 and 3 in 1974. This permit provided for a Marine Review Committee (MRC) to monitor the impact of the operations of SONGS on the marine environment. After 15 years of study, the MRC reported that the operation of SONGS had resulted in significant impacts to fish populations in the Southern California Bight and to the SOK community. The CCC adopted permit conditions in 1991 that required a package of mitigation to compensate for these losses, which included the construction of a 300-acre artificial reef for kelp. Subsequent studies determined that resource losses at SOK were less than originally estimated and the CCC amended the permit conditions in May 1997, to require an artificial reef that will sustain 150 acres of medium-to-high density kelp bed and associated biota, along with a mariculture/fish hatchery program. The amended permit called for a first phase 16.8-acre experimental reef project with five years of monitoring and a minimum 133.2-acre second phase to complete the full mitigation reef.

Following CCC approval of the SONGS Permit amendments in May 1997, the project proponent filed a lease application with the CSLC on June 26, 1997, for a 200-acre lease to construct a 16.8-acre experimental reef. After reviewing the application and the SONGS Permit, it was determined that under the requirements of CEQA (CEQA Guidelines, Section 15168) a PEIR should be prepared to evaluate both the experimental reef and the subsequent full mitigation reef. The project proponent then filed an amended application with CSLC on February 27, 1998, for a 355-acre lease to accommodate both phases of the project.

The CSLC filed a Notice of Preparation (NOP) with the State Clearinghouse (SCH #98031027) on March 6, 1998, and sent the NOP to State and local agencies. It described the proposed project and provided additional information, including the time, day, and place of a public meeting, along with the closing date for comments on the scope of the PEIR. The public meeting was also noticed in local newspapers. Verbal comments on the content of the PEIR were provided by members of the public and agency representatives during two public meetings, one in the afternoon and one in the evening, held in San Clemente on March 30, 1998. Several written comments were received prior to the closing date for comments, and several were received after the formal closing date. All of the verbal and written comments were considered in preparing the PEIR. In addition, informal discussions were held with the known interested parties, including local commercial fishing groups, the Surfrider Foundation, the Marine Forests Society and the United Anglers. Agencies that have jurisdictional responsibilities over the resources potentially affected by the proposed project were also consulted, including the Department of Fish and Game (CDFG), the California Department of Parks and Recreation (CDPR), the South Coast Air Quality Management District, the San Diego Air Quality District, and the City of San Clemente. These discussions were also considered in developing the scope of the PEIR.

The Draft PEIR was issued in November 1998 and formal public comments, both oral and written, were received by December 28, 1998. The Draft PEIR evaluated the 16.8-acre experimental reef and a range of build out mitigation reefs from 133.2 acres to 283.2 acres.

As discussed above, the project proponent filed another amendment to their application on March 22,1999, based on public comments on the Draft PEIR. The proposed project would now include a 22.4-acre experimental reef project and the build out of a low-relief, artificial reef yielding a minimum of 150 acres of sustainable, medium-to-high density kelp beds (defined as having a minimum of 4 plants per $100m^2$) and associated kelp bed biota. It is possible that a greater amount of reef construction would be required. Based on observations of the existing San Mateo kelp bed, CCC scientists feel there is a potential that up to 300 acres of artificial reef construction might be needed to achieve the required 150 acres of medium-to-high density giant kelp. However, one of the primary reasons for adding kelp planting treatments to the experimental reef project is to enhance kelp recruitment and the success of growing kelp on artificial reef. The full mitigation reef would be managed and monitored for a period equivalent to the operating life of SONGS. Depending on the success of the artificial reef in meeting CCC performance standards, other remediation could be required, including enhancements to the mitigation reef (e.g. additional materials being placed).

The proposed project lease area encompasses 862 acres and is located off the coast of San Clemente, in southern Orange County, California (see Figures 3-1 and 3-2 in Chapter 3). The lease area is approximately 0.6 miles offshore and extends 2.5 miles from San Mateo Point to just north of the San Clemente Pier (Figure 3-3). Within the lease area, the proposed experimental reef would occupy a total of 22.4 acres scattered fairly evenly throughout the 356 acres of suitable sand substrate (or project site). The full mitigation artificial reef would require as a minimum an additional 127.6 acres of construction and up to 277.6 acres of additional artificial reef. The San Clemente site was chosen after several years of study, because it provides physical conditions thought to be suitable for an artificial kelp reef, it is in relatively close proximity to the SOK, and there are no potentially incompatible uses.

This PEIR contains the following additional chapters:

- ***Chapter 2.0 Executive Summary.*** This chapter provides an executive summary of the document that briefly describes the project, the project alternatives, the document's findings on significant impacts, recommended mitigation measures and project costs estimates.

- ***Chapter 3.0 Project Description.*** This chapter outlines the project history and the proposed project objectives. It also describes the project location, the components of the proposed project and the assumptions used for evaluating a probable worst-case construction scenario and estimated project costs.

- ***Chapter 4.0 Evaluation of the Proposed Project.*** This chapter evaluates the proposed project for each of the 14 resource areas of concern identified in CEQA. Each resource area discusses the environmental setting, the methodology and significance criteria used in evaluating impacts and recommended mitigation measures.

- ***Chapter 5.0 CEQA Considerations.*** This chapter includes discussions on cumulative impacts, growth-inducing impacts, and significant unavoidable impacts.

- ***Chapter 6.0 Alternatives Analysis.*** This chapter provides a comparative analysis of a reasonable range of alternatives to the proposed projects. The evaluation considers the ability of each alternative to achieve the project purpose and reduce significant impacts associated with the proposed project. The chapter also identifies the environmentally superior project.

- ***Chapter 7.0 PEIR Authors and Persons and Agencies Consulted.***

- ***Chapter 8.0 References.***

- ***Chapter 9.0 Responses to Public Comments on the Draft PEIR.***

2.0 Executive Summary

2.0 Executive Summary

This chapter of the Final Program Environmental Impact Report (PEIR) provides a summary of the document as revised from the Draft PEIR, including the proposed project evaluation, the analysis of alternatives to the proposed project, and the major findings of the document. The discussion includes the effects found not to be significant, and the effects found to be significant, and the recommended mitigation measures. This summary also includes brief descriptions of the project alternatives, areas of controversy, and issues to be resolved.

2.1 Project Under Review

This PEIR evaluates the environmental effects of the construction and management of an artificial reef developed in two phases. The reef is intended to establish a minimum of a 150 acres of medium-to-high density, giant kelp forest (defined as 4 plants per 100m^2) and associated biota (i.e. algae, invertebrates and fish). The California Coastal Commission (CCC) has required the owners of the San Onofre Nuclear Generating Station (SONGS) to carry out this project to mitigate for resource losses associated with operation of SONGS Units 2 and 3 at the nearby San Onofre Kelp bed (SOK). The requirements for mitigation and the project objectives are outlined in the SONGS Coastal Development Permit No. 6-81-330-A, Condition C, as amended by the. SONGS is owned by Southern California Edison Company, San Diego Gas and Electric Company, City of Anaheim and City of Riverside (hereafter referred to collectively as the project proponent). The project proponent filed an amended application with the California State Lands Commission (CSLC) on February 28, 1998, for a 355-acre lease of State lands off the coast of San Clemente to construct a 150-acre artificial reef in two phases. On March 22, 1999, the project proponent filed another amendment to their application to modify the lease area to include 862 acres, providing a buffer zone around 356 acres of suitable sand substrate that have now been identified for artificial reef construction (defined as the project site). In response to public comments, this amendment also changes the size of the experimental reef project to include kelp planting treatments. CSLC is serving as the Lead Agency pursuant to the California Environmental Quality Act (CEQA).

A PEIR has been prepared because the proposed project involves the development of two separate phases that will be constructed several years apart. The first phase of the project would involve the construction of a 22.4-acre (previously 16.8-acre) experimental artificial reef consisting of 56 (previously 42) low-relief modules (0.4-acre each) grouped in seven blocks and scattered fairly evenly throughout the 356-acre lease site. Construction of the experimental reef would require 17,640 tons of quarry rock and 13,860 tons of recycled concrete. The experimental reef would test: 1) the use of different materials (quarry rock and recycled concrete); 2) different levels of material coverage of the ocean bottom (17, 34, and 67 percent); 3) the influence of location within the site and in relation to the proximity of the San Mateo kelp bed for natural recruitment; and 4) the effects of kelp planting treatments on enhancing kelp growth. The experimental reef would be monitored for five years.

Once the results of the experimental reef monitoring program are evaluated, a second phase of development would commence. This would involve the design and construction of a minimum of 127.6 (previously 133.2) additional acres of low-relief, artificial reef, supporting a total of 150 acres of sustainable, medium-to-high density kelp beds (defined as having a minimum of 4 plants per $100m^2$) and associated kelp bed biota. It is possible that a greater amount of reef construction could be required either initially or at a later time. Based on observations of the existing San Mateo kelp bed, CCC scientists feel there is a potential that up to 300 acres (an additional 277.6 acres construction) of artificial reef construction might be needed to achieve the required 150 acres of medium-to-high density giant kelp. However, one of the primary reasons for adding kelp planting treatments to the experimental reef project is to enhance kelp recruitment and the success of growing kelp on artificial reef. The full mitigation reef would be managed and monitored for a period equivalent to the operating life of SONGS. Depending on the success of the artificial reef in meeting CCC performance standards, other remediation could be required, including enhancements to the mitigation reef (e.g. additional materials being placed).

The proposed project lease area encompasses 862 acres and is located off the coast of the City of San Clemente, in southern Orange County, California (Figures 2-1 and 2-2). The lease area is approximately 0.6 mile offshore and extends 2.5 miles along the coast from San Mateo Point to just north of the San Clemente Pier (Figure 2-3). Withing this area, 356 acres have been identified as having suitable sand substrate for artificial reef construction (the project site). The San Clemente site was chosen after several years of study, because it provides physical conditions thought to be suitable for an artificial kelp reef, it is in close proximity to the San Onofre Kelp Bed, and there are no potentially incompatible uses.

A number of changes have been made to the Final PEIR that reflect: 1) responses to written comments on the Draft PEIR; 2) changes in the analysis due to new information; and 3) editing errors and omissions. However, none of the changes to the project or analysis have changed the conclusions regarding significant impacts or required mitigation measures from the Draft PEIR. The major changes are summarized below.

- **Changes to the Experimental Project at San Clemente** – In response to public comments, the project proponent, CCC staff and CSLC Staff agreed to amend the proposed project to include kelp planting treatments as part of the experimental reef. This would add 14 modules to the experiment, increasing the total from 42 to 56 modules and the acreage from 16.8 to 22.4 acres. In addition, the experimental reef modules would now be placed fairly evenly throughout the 356-acre project site, where previously they were located more towards the southern end of the area.

- **New Information on Alternative Sites** – In response to public comments, the project proponent considered adding a second experimental reef site. The first choice was South Carlsbad given information from previous surveys of the area. New sonar surveys were conducted in March 1999 along three miles of coast to verify current conditions. The results of the survey showed that the Carlsbad area has only a very

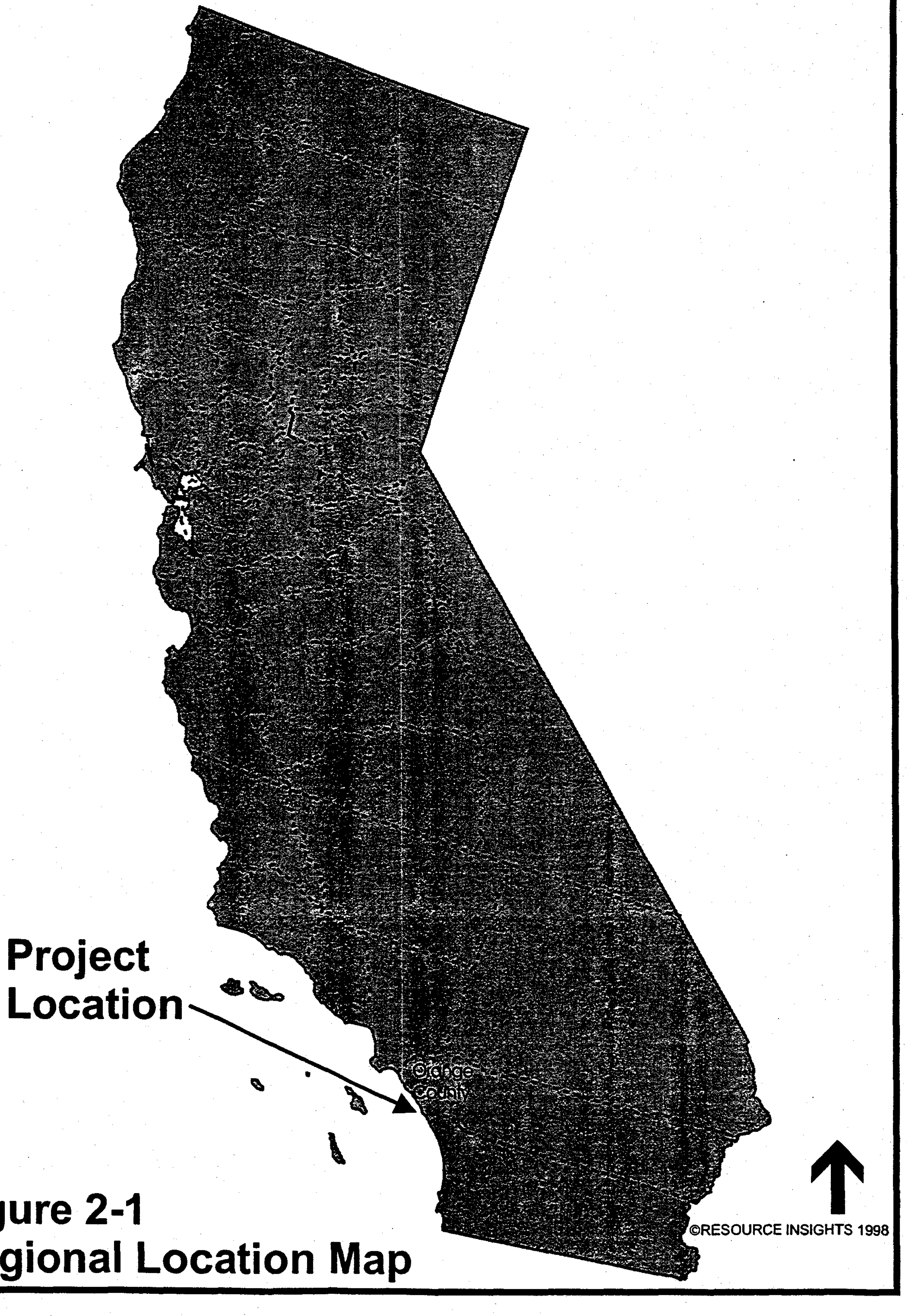

Figure 2-1
Regional Location Map

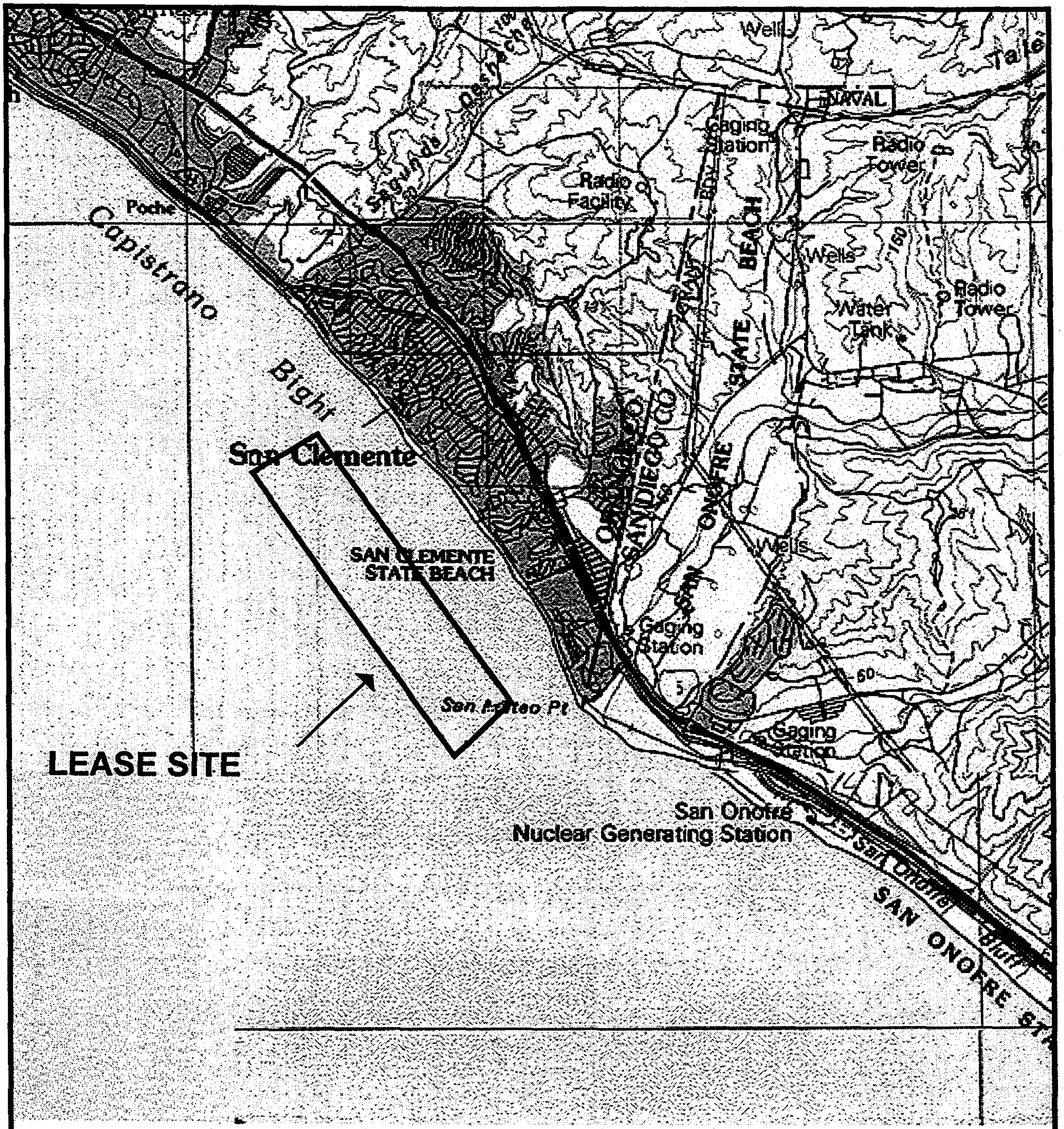

Figure 2-2
Local Area Map

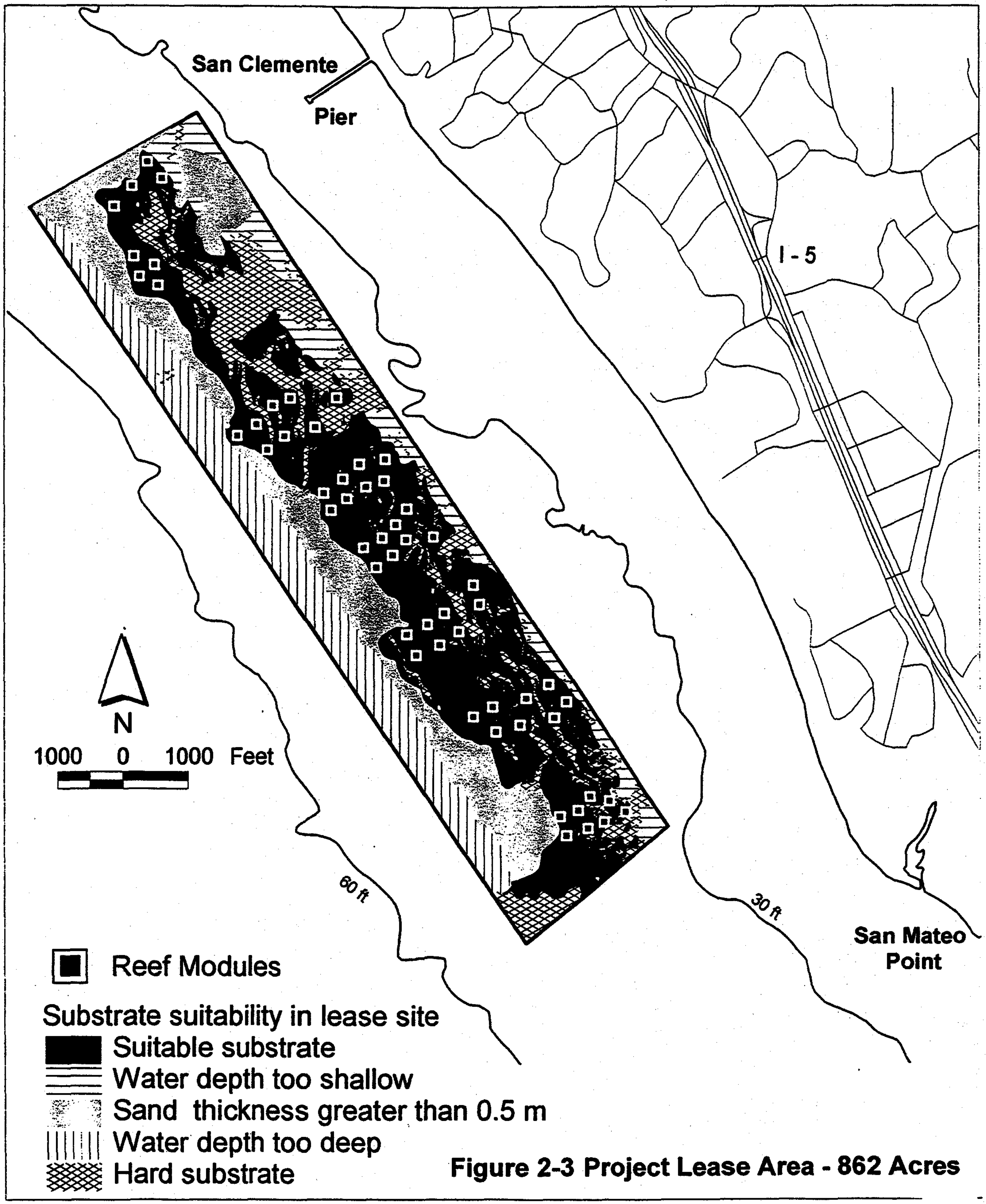

Figure 2-3 Project Lease Area - 862 Acres

Proposed positions of experimental reef modules and substrate suitability within the SCE lease site offshore of San Clemente CA.

small amount of suitable sand substrate for artificial reef construction. As a result, the sites near Carlsbad are no longer considered viable alternative locations for the experimental and mitigation artificial reefs.

Consideration was also given to adding an experimental reef at the Mission Beach site. However, after further discussions with CCC staff scientists and the California Department of Fish and Game (CDFG) Coordinator for the Artificial Reef Program (see letter from Dennis Bedford in Appendix I), Mission Beach was rejected. The agencies concluded that the Mission Beach site is too far from the San Onofre Kelp bed to provide replacement for lost resources at San Onofre. As stated in the SONGS Permit, the mitigation should be "in kind" and "as close as practical to the impact site."

- **Changes to Construction Assumptions** – Based on new information regarding the shapes and availability of quarry rock and recycled concrete materials, the weight estimates for the amount of material needed to construct artificial reef have been revised. The amount of concrete material needed would be more and the amount of quarry rock would be less than previously estimated. The Draft PEIR indicated that 4.5 times as much quarry rock would be needed as recycled concrete. The corrected weight estimates in the Final PEIR show that 1.3 times as much rock would be needed as concrete.

2.2 Scoping and Public Review of the Draft PEIR

The CSLC is serving as the Lead Agency responsible for preparing the CEQA document in consultation with other agencies and the public. As such, the CSLC filed a Notice of Preparation (NOP) with the State Clearinghouse (SCH #98031027) on March 6, 1998, and sent the NOP to State and local agencies. It described the proposed project, provided information on the time, day, and place of a public scoping meeting, and gave the closing date for comments on the scope of the PEIR. The public scoping meeting was also noticed in local newspapers. Verbal comments on the scope of the PEIR were provided by members of the public and agency representatives during two public meetings, one in the afternoon and one in the evening, held in San Clemente on March 30, 1998. Several written comments were received prior to the closing date for comments, and several were received after the formal closing date. All of the verbal and written comments were considered in preparing the PEIR.

In addition, informal discussions were held with the known interested parties, including local commercial fishing groups, the Surfrider Foundation, the Marine Forests Society and the United Anglers. Agencies that have jurisdictional responsibilities over the resources potentially affected by the project were also consulted. These included the CCC, theCDFG, the California Department of Parks and Recreation (CDPR), the South Coast Air Quality Management District (SCAQMD), the San Diego Air Pollution Control District (SDAPCD) and the City of San Clemente. These discussions were also considered in developing the scope of the PEIR.

The Draft PEIR was circulated for agency and public review on November 9, 1998, and the formal comment period ended on December 28, 1999. Chapter 9 has been added to the Final PEIR, which contains responses to written comments received from the public on the Draft PEIR. These are followed by responses to oral comments given at the Public Comment Meeting held on the Draft PEIR on Thursday, December 10, 1998, in the afternoon and evening. This meeting was held in the San Clemente Community Center in San Clemente, California.

The Final PEIR has been completed in response to public and agency comments. The Draft and Final PEIR will be used by the CSLC in determining whether to grant the project proponent's 862-acre lease and approve the first phase construction of a 22.4-acre experimental artificial reef. Because this is a PEIR, the project proponent would be required to come back to the CSLC for review and approval of the second phase of the project at a future date, when the design and construction of the full mitigation reef have been decided upon. It may be determined at that time that additional environmental review is necessary if the final mitigation reef design is substantially different from what has been evaluated in this PEIR, or there is new information that changes the conclusions of this PEIR. For example, if there were new technologies for mitigating air quality impacts. If a supplemental document were required at that time, it would go through public review and comment as required by CEQA.

Responsible agencies under CEQA include other State or local agencies with discretionary approval over the proposed project. The PEIR will be used by these agencies in determining whether to issue permits or other approvals. Responsible agencies include the CCC and the Regional Water Quality Control Board, San Diego Region. Trustee agencies are other State or local agencies with resources affected by the project that will review the PEIR and comment on the findings. Trustee agencies include the CDFG, the CDPR; the California Public Utilities Commission, the SCAQMD, the SDAPCD; Orange County; the City of San Clemente; the City of Long Beach; and the City of San Diego.

The project will also be approved or reviewed by a number of federal agencies including, the U.S. Army Corps of Engineers, San Diego Regulatory Branch; the U.S. Fish and Wildlife Service, Marine Resources Division; the National Marine Fisheries Service; and the U.S. Coast Guard. The U.S. Army Corps will be the Lead Agency for the purposes of the National Environmental Policy Act (NEPA) review, which is being conducted independent of the CEQA review.

2.3 Mitigation Measures Incorporated into the Project Description

A number of mitigation measures were incorporated as construction assumptions for the experimental and mitigation artificial reefs into the project description and resource sections. These measures were incorporated to either avoid or reduce significant impacts created by the proposed project. These include:

1. Construction of the experimental and mitigation reefs will be limited to the period May 1 to September 30 to avoid conflict with the lobster fishing season.

2. To help reduce significant PM_{10} impacts associated with truck loading and hauling, the following assumptions were made: 1) inland sources of quarry rock and recycled concrete will be purchased from locations within 20 miles of the port where material will be shipped; 2) quality gravel will be applied to unpaved areas between paved roads and recycled concrete piles, so that vehicles and mobile equipment will never maneuver on dirt; and 3) traffic speeds on unpaved roads and access ways will be kept to 15 mph or slower.

3. All materials used for construction of the experimental and artificial reef will meet the CDFG's Material Specifications Guidelines.

2.4 *Significant Effects and Recommended Mitigation Measures*

A number of project effects were considered in detail in the PEIR and found to be significant or potentially significant, including effects to the following:

Socioeconomics

- *Recreational Fishing Businesses:* by restricting the use of the project site during construction for the experimental and mitigation reefs.
- *Commercial Fishing Activities:* by restricting access to fishing area for species fished year-round during the construction of the experimental and mitigation reefs.
- *Commercial Fishing Sites:* by reef material being placed on existing hard substrate and proven fishing grounds (mitigation reef only).

Air Quality

- *Experimental Reef*: construction related daily emissions for NOx and PM_{10} and quarterly emissions for NOx.
- *Mitigation Reef*: construction related daily and quarterly emissions for NOx and PM_{10}.

Transportation and Noise: Due to Truck Traffic

- *Level of Service:* at intersections in San Diego and Los Angeles Counties near the Ports during peak hours
- *Noise Levels:* for residences within 50 feet of truck routes along truck routes within 20 miles of the Port of San Diego.

***Geology, Hazards, Public Services, and Recreation*: Rocks/Concrete Washing Onshore**

- *Hazard to Human Health:* rocks/concrete from the experimental and mitigation reefs washing onto beaches or into the shallow surf would create a hazard for people
- *Need for Beach Maintenance Services:* the need to remove rocks/concrete from the artificial reefs could increase the level of service and costs required for beach maintenance

***Public Services and Recreation*: Kelp Wrack Washing Onshore**

- *Need for Beach Maintenance Services:* the need to remove kelp wrack resulting from the mitigation reef could increase the level of service and costs required for beach maintenance
- *Deterrent to Recreation Users:* kelp on the beaches from the mitigation reef could cause recreation users to go to other areas

Mitigation measures were recommended that would bring these effects to a less-than-significant level for all impacts with the possible exception of significant air emissions for the mitigation reef. Table 2-1, found at the end of this chapter, summarizes all of the findings for effects on resources from the proposed project. The significant effects and recommended mitigation measures to reduce the effects to a less-than-significant level are highlighted in bold print. A draft Mitigation Monitoring Plan outlining how the mitigation measures would be implemented has been included as Appendix H.

2.5 Effects Found Not To Be Significant

The PEIR found there would not be any effects on several resource areas and these were then eliminated from further discussion. The PEIR also found the effects in a number of resource areas would be less-than-significant. These findings do not require mitigation. However, there were several areas where effects were found to be less-than-significant, but mitigation measures were recommended as a precaution to protect the resources. Table 2-1, found at the end of this chapter, also summarizes the less-than-significant effects and the recommended mitigation for some of these effects.

2.6 Unavoidable Significant Adverse Impacts

2.6.1 Experimental Reef

All project-related significant impacts for the experimental reef project can be mitigated to a less-than-significant level, with the exception of cumulative air quality impacts. The significant daily NOx and PM_{10} emissions and significant quarterly NOx project emissions from the experimental reef construction activities can be mitigated below the thresholds for significance. However, the remaining less-than-significant emissions contribute to cumulative air quality impacts in the South Coast Air Basin (SCAB) and the

San Diego Air Basin (SDAB). Both of these air basins exceed federal and State air quality standards for one or more air pollutants, which is referred to as being in "nonattainment". The air basins are in nonattainment for State and federal ozone standards and State PM_{10} standards. The SCAB is also in nonattainment for federal PM_{10} standards, and is described as in extreme nonattainment for federal ozone standards. As there is no way to mitigate the emissions from this project to zero, any additional air emissions in these districts can be considered unavoidable significant adverse effects on a cumulative basis. It should be noted that the construction of the experimental reef involves only 32 days.

2.6.2 Mitigation Reef

All project-related significant impacts for the mitigation reef project can be mitigated to a less-than-significant level, with the possible exception of air quality impacts. The estimated air emissions for the full mitigation reef would exceed daily and quarterly NOx and PM_{10} thresholds of significance, based on the probable worst-case scenario of the air quality analysis. Reducing the emissions to less-than-significant levels would require substantial changes in the construction assumptions in addition to standard mitigation measures. The possible changes include: 1) using thin slabs of concrete instead of rock to construct the reef if it meets the SONGS Permit performance standards; 2) constructing the reef with lowest possible level of coverage; 3) extending the time for construction activities; and 4) potentially placing the reef at several locations closer to the sources of materials. It is not clear at this time that a reef constructed with these restrictions would also meet the project objectives and performance standards outlined in the SONGS Permit. However, without such basic changes, the proposed project is expected to have unavoidable significant adverse impacts for NOx and PM_{10} emissions.

The final design and location of the mitigation reef will not be determined until after the experimental reef has been constructed and monitored for five years. Additional means of mitigating air emissions may be available (e.g. cleaner burning engines, etc.). It may be possible at that time to create a final design and incorporate mitigation measures that reduce project emissions to a less-than-significant level and still meets the project objectives outlined in the SONGS Permit.

As discussed for the experimental reef, even if project emissions were below the daily and quarterly thresholds for significance, the mitigation reef air emissions would still create unavoidable significant adverse effects on a cumulative basis.

2.7 Alternatives That Avoid Or Lessen Impacts

Section 15126(d) of the CEQA Guidelines, states an EIR must, "*Describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project, but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives.*" The CEQA Guidelines also require that a No Project Alternative be evaluated and that an environmentally superior alternative be designated, other than the No Project Alternative.

The Draft PEIR considered eight alternative experimental and mitigation reef proposals, which were suggested through the PEIR scoping process. These included alternative locations for the artificial reef, alternative designs, and decommissioning of SONGS. Five of these alternatives were not included for evaluation because they did not meet the SONGS Permit project objectives. These included: 1) an alternative reef site north of San Clemente Pier; 2) an alternative reef site farther offshore from the proposed project site at San Clemente; 3) compound reefs at Big Sycamore Canyon; 4) a kelp planting alternative; and 5) decommissioning SONGS.

Three alternatives were evaluated in the Draft PEIR in addition to No Project. The alternatives evaluated all have two phases of artificial reef development: 1) an experimental phase that tests recycled concrete and quarry rock at various levels of coverage of reef material; and 2) a full mitigation reef build out phase that looks at several scenarios with a range of reef size and construction materials. The comparative evaluations of alternatives in Chapter 6 focused on: 1) how well the alternatives meet the project objectives, as outlined in the SONGS Permit; and 2) how well the significant impacts identified for the proposed project might be reduced or eliminated. Generally, all of the alternatives were thought to have the potential to meet the project objectives and performance standards for creating a kelp bed and associated biota to replace resource losses at SOK. With a few exceptions, all of the alternatives have the same significant impacts as the proposed project, which can be mitigated to a less-than-significant level. The resource area where the proposed project and alternatives differ most relates to air quality impacts. The mitigation reef build out could have significant unavoidable air quality impacts for the proposed project and all of the alternatives.

In response to public comments on the Draft PEIR, consideration was given to adding a second experimental reef site to the first phase of the proposed project at one of the alternative sites identified in the Draft PEIR. South Carlsbad was the first choice for a second site followed by North Carlsbad. Additional work was done to verify the present conditions in the Carlsbad area and the actual suitable acreage for reef development. Consultants to the project proponent conducted sonar surveys in early March 1999 along three miles offshore from the City of Carlsbad. These sonar surveys found small areas of sandy bottom interspersed with patches of hard substrate all along the coast. The surveys found only a very small, narrow band of ocean bottom with the appropriate veneer of sand (0 to 0.5 meters) for artificial reef construction. The larger sandy bottom areas were found to have depths of 0.5 to 1 meter, which includes approximately 60 to 100 acres near South Carlsbad and about 20 acres near the Encina Treatment Plant discharge pipe. With a sand veneer of 0.5 to 1 m, artificial reef material would be at high risk of subsidence and burial. In addition, it appears that the 1998 El Nino has badly damaged existing kelp beds in the area and only a few juvenile plants were seen (similar to recent observations at the San Mateo Kelp bed).

Given the results of the March 1999 sonar surveys, adding experimental reef modules offshore from Carlsbad was abandoned. It is felt that the Leucadia and Encinitas sites would have similar characteristics to Carlsbad. Also, given the small size of these sites, they do not provide a real alternative for the mitigation reef and have likewise been abandoned.

Consideration was also given to adding an experimental reef at the Mission Beach site. However, after further discussions with CCC staff scientists and the California Department of Fish and Game (CDFG) Coordinator for the Artificial Reef Program (see letter from Dennis Bedford in Appendix I), Mission Beach was rejected. The agencies concluded that the Mission Beach site is too far from the San Onofre Kelp bed to provide replacement for lost resources at San Onofre. As stated in the SONGS Permit, the mitigation should be "in kind" and "as close as practical to the impact site."

As a result of the new information, all of the alternative sites evaluated in the Draft PEIR are no longer considered viable, given the differences in site characteristics from the San Clemente site and/or the distance from the San Onofre Kelp bed. However, for the sake of consistency all of the alternative discussions and comparative analyses have been maintained in the Final PEIR as proposed in the Draft PEIR. The alternatives have been revised to reflect the revisions in concrete and quarry rock weight estimates and reflect the new, slightly larger acreage of the proposed project experimental reef at San Clemente. It is too speculative at this time to say whether these alternative sites might be reconsidered for the mitigation reef depending on the results of the experiment at San Clemente.

The following is a brief description of the alternative projects followed by a discussion of how each alternative compares to the proposed project for air quality impacts.

2.7.1 No Project Alternative

The No Project Alternative assumes that the CSLC lease would not be issued and that the proposed lease area would remain in its present condition into the foreseeable future. No experimental or build-out reef would be constructed. Existing Coastal Plans do not include any policies or plans for development offshore and no other development projects are proposed at this time.

> ***Comparison to Proposed Project.*** If the experimental reef and mitigation reef were not built, there would not be any project impacts, but the SONGS Permit conditions would not be met. The CCC would most likely reconsider other types of out-of-kind mitigation to compensate for lost kelp and associated biota at the SOK, such as wetlands restoration or fish hatchery projects. Changing the mitigation requirements would require amending the SONGS Permit and would be part of CCC proceedings with public notice and review. Once new mitigation requirements were defined, the project proponent's would apply for the appropriate permits and a new environmental evaluation would be prepared at that time.

2.7.2 *Alternative 2. Experimental and Mitigation Reefs at Multiple Locations*

This alternative includes an experimental reef phase implemented at three test sites, including San Clemente, South Carlsbad and Mission Beach. Each site would have 16 test modules of one acre each, resulting in a total surface area for the experimental reef at the three sites of 48 acres. Each site would test both quarry rock and recycled concrete modules at 34 percent and 67 percent coverage. The experimental modules would be grouped together to provide large areas of reef for kelp forest development. Based on the outcome of the experimental phase, a 150-acre to 300-acre full build-out reef would be constructed by adding 102 to 252 acres of reef material. This could be constructed at San Clemente an/or five alternative sites, including North Carlsbad, South Carlsbad, Leucadia, Encinitas and Mission Beach.

> ***Comparison to Proposed Project.*** Differences in environmental impacts between this alternative and the proposed project result from: 1) size of the experimental reef versus the mitigation reef; 2) testing only 34 and 67 percent coverage of reef materials; 3) the use of three sites versus only one site; and 4) the location of the alternative sites closer to the Port of San Diego. This alternative experimental reef would require three to eight times the amount of material for reef construction as the proposed project. This is due to both the larger size (48 acres) and the levels of coverage being tested (only 34 and 67 percent, rather than 17, 34 and 67 percent). However, assuming successful performance of the experimental reef the mitigation reef build out would require less construction if the experimental reefs are successful at each of the sites. Overall the two phases of artificial reef would be fairly comparable to the proposed project.
>
> The larger experimental reef results in additional air quality and transportation impacts due to construction activities than with the proposed project, but potentially less air emissions for the mitigation reef. The South Carlsbad, Mission Beach and other alternative sites are located closer to the Port of San Diego, which reduces the travel time for tugboats and barges, and lowers air emissions. However, the mitigation reef could still have significant unavoidable air quality impacts for the proposed project and all of the alternatives as well.

2.7.3 *Alternative 3. 150-Acre Reef Built Now with Experiment*

This alternative involves building a 150-acre artificial reef constructed right away at the San Clemente site using only concrete at 17 percent coverage. In addition, an experimental project would be embedded into the overall project site, which tests differences in coverage of both concrete and quarry rock at 17, 34 and 67 percent. Depending on the success of the various levels of coverage, additional material could be placed and additional construction (up to an addition 150 acres) could be required to meet the SONGS Permit performance criteria for a 150 acres of high-to-medium density kelp bed.

Comparison to Proposed Project. Because this project includes both an experimental reef and larger trial mitigation reef right away, it varies considerably from the proposed project. There are really three comparisons to the proposed project:

- Compared to just the proposed project experimental reef this alternative (with 135.6 acres of concrete at 17 percent cover and a 14.4-acre experimental reef project) would have considerably more impacts in the near term, particularly for air quality and transportation.

- Compared with the proposed project mitigation reef build out this alternative would have substantially fewer impacts, if the 17 percent cover of concrete were successful in meeting the project objectives and performance standards.

- However, if the 17 percent cover of concrete did not meet the performance standards, the maximum build out scenario for this alternative would actually result in greater air quality and transportation impacts than the proposed project.

2.7.4 Alternative 4. Compound Reefs (High and Low Relief) at Multiple Locations

This alternative would involve building an experimental reef project at the South Carlsbad and Mission Beach sites. The experiment would test eight reef designs using quarry rock and recycled concrete material replicated six times, for a total of 48 modules at each site. Each module would be 0.4 acre bringing the size of the experimental reef phase to 38.4 acres. The designs include two low-relief modules of concrete and two of rock at 34 and 67 percent coverage, and two compound reef modules of concrete and two of rock having high-relief centers (12 feet) and low-relief perimeters with 34 and 67 percent coverage.

Comparison to Proposed Project. Differences in environmental impacts between this alternative and the proposed project result from: 1) the size of the experimental reef (38.4 acres); 2) the use of two sites versus only one site; 3) the location of the alternative sites closer to the Port of San Diego; 4) testing only 34 and 67 per coverage of reef material; and 5) the inclusion of high relief mounds within the low relief reef. Because of these differences, this alternative experimental reef would require 4.4 times the amount of material for reef construction as the proposed project. The mitigation reef build out may also require more construction materials if the final design includes high relief mounds.

As a result, both the experimental reef and mitigation reef could result in greater air quality and transportation impacts than with the proposed project. The South Carlsbad and Mission Beach sites are located closer to the Port of San Diego, which reduces the travel time for tugboats and barges, and lowers air emissions somewhat. However, the mitigation reef would have significant unavoidable air quality impacts for the proposed project.

2.8 Areas Of Controversy

The CEQA Guidelines require a lead agency to identify known areas of controversy, including issues raised by agencies and the public, in the EIR summary.

The known areas of controversy center upon the selection of an appropriate artificial reef design that meets the project objectives with the least significant adverse effects on the environment. In general, the key trade-off considerations involve: 1) assuring that the biological resource objectives of the project are achieved; 2) keeping construction-related emissions of NOx and PM_{10} under the daily and quarterly thresholds of significance; and 3) assuring a timely construction period.

The air quality impact evaluation, in Section 4.4 Air Quality, discusses the difficulty of achieving emission reductions sufficient to avoid significant impacts for NOx and PM_{10} emissions for the full mitigation reef build out. A low emission construction scenario is described in the evaluation that has the potential to avoid most or all of these impacts. However, the duration of the construction would be substantially increased. This could increase the overall costs of the artificial reef project.

2.9 Issues To Be Resolved

The CEQA Guidelines require an EIR summary to identify issues to be resolved, including the choice among alternatives and whether or how to mitigate significant effects.

The issues to be resolved involve the trade-offs described above: 1) assuring that the biological resource objectives of the project are achieved; 2) keeping construction-related emissions of NOx and PM_{10} under the daily and quarterly thresholds of significance; and 3) assuring a timely construction period.

2.10 Environmentally Superior Alternative

CEQA Guidelines Section 15126(d)(2) requires that an EIR identify an environmentally superior alternative other than the No Project Alternative. The proposed project evaluated in this PEIR has two phases of development, an experimental reef phase and a mitigation reef build out phase. Only the experimental reef will be considered for approval at this time.

The major differences among the project alternatives are in the phasing of the experimental and mitigation reefs and the overall total construction necessary for the two phases. This in turn affects air quality impacts for each alternative in the first and second phases. Because the alternatives involve more construction in the first phase they all have greater air quality impacts initially. However, the second phases of these alternatives involve somewhat less construction and less air emissions under most scenarios. There are certain scenarios for Alternative 3 and 4 that would result in more impacts from the second phase. The air quality impacts for the mitigation reef/build out of the proposed project and the alternatives could be difficult to mitigate to a less-than-significant level. This will depend on the final size of the reef, the level of coverage required and the choice of materials used.

Based on the experimental reef phase only, the environmentally preferred project would be the proposed project because it involves less construction and less impacts initially.

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Unavoidable Significant Impacts			
Section 4. Air Quality			
Mitigation Reef Emissions The combined construction activities for either of the mitigation reef build out scenarios (127.6-acre or 277.6-with all concrete or all rock at 67%) would produce daily emissions of NOx and PM_{10} that exceed the thresholds of significance. In addition, the quarterly emissions for NOx and PM_{10} would also exceed the thresholds of significance. Looking at the breakdown of emissions by the type of construction activity helps identify mitigation opportunities: • PM_{10} emissions for the truck loading, hauling, and barge loading activities would be the same on a daily basis as for the experimental reef and would substantially exceed the daily threshold of significance. In addition, the mitigation reef emissions for these activities would also exceed the PM_{10} quarterly threshold for significance due to the longer periods of construction with the different scenarios. • Daily NOx emissions for tugboat shipping would substantially exceed the daily threshold of significance. In addition, the mitigation reef emissions would also exceed the NOx quarterly threshold for significance due to the longer periods of construction. • The barge off-loading element of the mitigation reef would produce daily emissions that are the same as for the experimental reef on a daily basis with significant NOx emissions. In addition, the mitigation reef construction would result in quarterly NOx emissions that exceed the threshold of significance.	S	*Changes in Construction:* • Shipping concrete from the Ports of Los Angeles and Long Beach • Purchasing reef materials closer than 20 miles to the ports • Using concrete instead of quarry rock • Using the lowest possible coverage of material • Taking longer to load barges • Taking more time to construct the project • Finding sources of material closer to the project site • Using the live-boat method to off-load *Standard Mitigation Measures* : *1. Reducing PM_{10} Emissions.* • Apply water sprays to the concrete piles and graveled areas at least twice daily. Water down quarry rock and conveyer belts if soil is visible. Increase the frequency of watering when wind speeds exceed 15 miles per hour.	S

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Unavoidable Significant Impacts			
Mitigation Reef Emissions (continued)		• Extend pavement from roads or access ways to concrete piles to remove at least three-quarters of the gap. Apply quality gravel to the remaining unpaved area so that vehicles and mobile equipment never maneuver on dirt. • Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving the site each trip. • Plan routes and schedules for truck trips that reduce trip times and slowdowns. • Sweep streets manually or with water sweepers at the end of the workday if visible soil material is carried onto private or public paved roads. Reclaimed water shall be used, if available with the water sweepers (35 percent reduction of PM_{10} from paved roads). • Apply quality gravel to unpaved areas between paved roads and recycled concrete piles, so that vehicles and mobile equipment shall never maneuver on dirt; and • Keep traffic speeds on unpaved roads and access ways to 15 mph or slower. Pave a dirt road or lot that is currently generating PM_{10} emissions, which is unrelated to the proposed project but in the vicinity of the truck hauling operations.	

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Unavoidable Significant Impacts			
Mitigation Reef Emissions (continued)		*3. Purchase Emission Offsets* • Purchase or lease NOx emission offset credits for project related emissions for the length of the construction period. *Potential Changes in Construction:* • Finding reef material sources closer to the ports • Obtaining quarry rock from Catalina Island where minimal trucking is required • Taking more time to load barges • Obtaining recycled concrete closer to the project site • Obtaining quarry rock closer to the project site • Using less building material to construct the reef • Using concrete instead of quarry rock to construct the mitigation reef • Taking more time to construct the project • Using less building material to construct the reef • Using concrete instead of quarry rock to construct the mitigation reef • Using the live boating method of off-loading	

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Section 3. Geology			
Movement of Reef Building Materials onto Beaches - Experimental and Mitigation Reefs There is a potential for the reef building materials to be moved during extreme storm events, particularly if attached kelp plants create a degree of buoyancy. The smaller rocks and pieces of concrete associated with the experimental and mitigation reefs could be washed up on the beach adjacent to the lease area during typical storm events. No conclusive evidence precludes the possibility that substantial rock or concrete might be moved ashore during an extreme storm event.	S	• Both the experimental and mitigation reef will be monitored for movement of construction material during storm events. Annual monitoring will be on a biweekly basis from November through March and monthly during the rest of the year, consistent with the program outlined under the public services section. Any recycled concrete or quarry rock from the reefs, which is found on the beaches or in the shallow surf zone will be removed by the project proponent.	LTS
Section 4. Air Quality			
Experimental Reef Construction Emissions The combined construction activities for the 22.4-acre experimental reef would produce daily emissions of NOx and PM_{10} that exceed the thresholds of significance. Quarterly NOx emissions would also exceed the threshold of significance. Looking at the breakdown of emissions by the type of construction activity helps identify mitigation opportunities: • Truck loading, truck hauling and barge loading activities produce daily PM_{10} emissions that exceed the threshold of significance. • Tugboat shipping would produce daily NOx emissions in excess of the threshold.	S	*All of the measures listed above for the mitigation reef, including Standard Mitigation Measures and Purchase of Emission Offsets.*	LTS

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Experimental Reef Construction Emissions • Barge offloading to place materials at the project sites would result in daily NOx emissions in excess of the threshold.		*Potential Changes to Construction Assumptions* • Finding reef material sources closer to the ports • Obtaining quarry rock from Catalina Island where minimal trucking is required • Taking more time to load barges • Obtaining recycled concrete closer to the project site • Obtaining quarry rock closer to the project site	
Section 5. Transportation			
Experimental Reef and Mitigation Reef Construction *Intersection Levels of Service –Los Angeles/Long Beach Area.* Project construction traffic during the 4:00 to 6:00 p.m. peak hour would reduce the LOS at two intersections, Ocean Boulevard and Atlantic Avenue, and Ocean Boulevard and Cherry Avenue, to unacceptable levels. *Freeway Operations Los Angeles/Long Beach Area.* The addition of experimental and mitigation reef construction traffic would alter the level of service during the 7:00 to 9:00 a.m. peak hour on southbound I-710 between Pacific Coast Highway and Willow Street from LOS D to LOS E. *Freeway Operations - San Diego Area.* The addition of experimental and mitigation reef construction traffic would alter the level of service during the a.m. peak hour on northbound I-5 between L and J Streets from LOS E to LOS F.	S	• The project proponent and all project contractors shall restrict truck trips to off-peak travel hours (9:00 a.m. to 4:00 p.m.).	LTS

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Section 8. Hazards			
Health Hazards – Experimental and Mitigation Reefs The experimental and mitigation reefs have the potential to introduce quarry rock and concrete onto the beaches and into the shallow surf nearest the lease site. In concept, large wave events could result in the transport of some kelp and reef material onshore. Concrete and quarry rocks are not natural components of the beach environment, and the presence of concrete pieces on the shoreline would potentially affect the safety of the beach environment. People walking on the beach could be injured by an unexpected block of concrete or rock. People wading, swimming, or surfing could be injured and become incapacitated in the water, leading to drowning.	S	• Both the experimental and mitigation reef will be monitored for movement of construction material during storm events. The monitoring will be on a biweekly basis from November through March and monthly during the rest of the year, consistent with the program outlined under the public services section. Any recycled concrete or quarry rock from the reefs, which is found on the beaches or in the shallow surf zone will be removed by the project proponent.	LTS
Section 9. Noise			
Construction Noise – Experimental and Mitigation Reefs *Truck Routes.* The use of project trucks in residential areas during the nigh time hours has the potential to violate County of Los Angeles and County of San Diego Noise Ordinances. As noted, the project trucks will produce substantial short duration increases in noise as they pass fixed points along the routes. While allowable during the day, substantial short duration noise increases during the night time are considered potentially significant impacts upon residential uses.	S	• The contractors will be directed to avoid the use of routes having residential uses during the weekday hours of 7 p.m. to 7 a.m., and all day on Sunday.	LTS

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Section 10. Public Services and Utilities			
Beach Maintenance – Experimental Reef There is a very small chance some small rocks or pieces of concrete used to construct the experimental reef could wash onshore or into the shallow surf because of the added buoyancy from attached kelp plants.	S	• A monitoring program will be initiated upon the construction of the experimental reef and continued for the next five years to determine the amount of kelp wrack washing onto the beaches. Because the City of San Clemente and CDPR do not collect data on the amount of kelp washing onto beaches currently, monitoring would establish a baseline. The monitoring of the experimental reef should observe whether the concrete and quarry rocks were moved toward the beach during strong wave events. This monitoring would make it easier to compare any changes due to the experimental reef or to the subsequent build out of the mitigation reef, as outlined below. • The beach monitoring would be done on a bi-weekly basis throughout the months of November through March and on a monthly basis during the other months. The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day). The beach monitoring would include: (1) observations of the amount of kelp wrack on the beach (cubic yards and/or percentage coverage); (2) tracking beach clean up schedules and costs (including disposal); and (3) tracking the number of	LTS

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Kelp and Beach Maintenance (continued) *Experimental Reef*		complaints from beach users or nearby residents and businesses due to kelp or rocks/concrete on the beaches or in the shallow surf zone. The movement of the concrete and quarry rock would be monitored as a component of the larger performance monitoring effort. • The project proponent will remove any rocks or concrete from the reef that wash onshore or into the shallow surf.	
Kelp and Beach Maintenance - Mitigation Reef. If a significant increase in the amount of kelp wrack reaching the beaches occurs, there could be a need for additional public services to clean up the kelp. The full mitigation reef with 150 acres of medium-to-high density kelp bed could increase the amount of kelp washing onshore annually by up to 3,000 yd^3, primarily between the months of November through February. There is a small chance some small rocks or pieces of concrete used to construct the experimental reef could wash onshore or into the shallow surf because of the added buoyancy from attached kelp plants.	S	• Due to uncertainty regarding the amount, frequency and location of increased kelp washing onshore, kelp on the beaches shall be monitored as part of the experimental reef (as discussed above) and the larger mitigation reef. Although rocks and concrete used in constructing the reef are not likely to wash onshore, the monitoring program shall also observe this possibility. Monitoring shall be conducted for five years or as long as needed after construction of the mitigation reef is completed or until a conclusion can be reached regarding the impacts of kelp and other materials washing onto the beaches. • The monitoring would be done on a bi-weekly basis throughout the months of November through March and on a monthly basis during the other months. The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day).	LTS

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Kelp and Beach Maintenance (continued)			
Mitigation Reef		The monitoring would include: (1) observations of the amount of kelp wrack on the beach (cubic yards and/or percentage coverage) and of potential rocks/concrete; (2) tracking beach clean up schedules and costs (including disposal); and (3) tracking the number of complaints from beach users or nearby residents and businesses due to kelp and rocks/concrete on the beaches. • Based on the results of the monitoring, it would be determined if additional clean up services are needed as a result of the artificial reef. Mitigation would include the project proponents establishing a trust fund to pay for: (1) leasing or purchasing special equipment for clean up, or possibly to bury kelp in the sand; (2) additional personnel for beach clean up; and/or (3) land fill or other disposal costs for kelp and rocks/concrete removed.	
Section 13. Recreation			
Effects of a Kelp Forest – Mitigation Reef The development of an additional 150 acres of medium-to-high density kelp forest within the lease area has the potential to substantially increase kelp wrack on the adjacent beaches by as much as 3,000 yd^3 per year. The additional kelp wrack on area beaches would adversely affect recreation if it discouraged use by the public.	S	• Due to uncertainty regarding the amount, frequency and location of increased kelp washing onshore, kelp on the beaches shall be monitored as part of the experimental reef and the mitigation reef. Monitoring shall be conducted for five years after construction of the mitigation reef is completed. This would be done on a bi-weekly basis throughout the months of November through March and on a monthly basis during the other months.	LTS

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Effects of a Kelp Forest (continued)		The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day). The monitoring would include: (1) observations of the amount of kelp wrack on the beach (cubic yards and/or percentage coverage); (2) tracking beach clean up schedules and costs (including disposal); and (3) tracking the number of complaints from beach users or nearby residents and businesses due to kelp on the beaches. • Based on the results of the monitoring, it would be determined whether additional clean up services are needed as a result of the experimental reef and mitigation reef. Mitigation would include the project proponents establishing a trust fund to pay for: (1) leasing or purchasing special equipment for clean up, or possibly to bury kelp in the sand; (2) additional personnel for beach clean up; and/or (3) land fill or other disposal costs for kelp removed.	

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Significant Impacts			
Potential for Concrete and Quarry Rock to Wash Ashore – Experimental and Mitigation Reefs The experimental mitigation reefs have the potential to introduce quarry rock and concrete onto the beaches and into the shallow surf nearest the lease site, which could present a hazard to beach users.	S	• Both the experimental and mitigation reef will be monitored for movement of construction material during storm events. The monitoring will be on a biweekly basis from November through March and monthly during the rest of the year, consistent with the program outlined under the public services section. The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day). Any recycled concrete or quarry rock from the reefs, which is found on the beaches or in the shallow surf will be removed by the project proponent.	LTS
Conflicts with Plans and Policies The creation of kelp wrack and the potential for concrete and quarry rock to be washed up on shore or into the shallow surf are two project effects that could conflict with the general goals and objectives of applicable plans and policies. Both excessive kelp wrack and the presence of concrete and rock could discourage the use of the local beaches for recreation.	S	• The mitigation measures described above for kelp wrack and concrete and quarry rock washing ashore or into the shallow surf are also required to assure consistency with the existing applicable plans and policies. The implementation of the recommended mitigation would reduce the effects to less-than-significant levels.	LTS

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Potentially Significant			
Section 2. Socioeconomics			
Recreational Fishing Businesses - Experimental and Mitigation Reefs The construction phases for both the experimental reef and the mitigation reef could potentially impact recreational sportfishing operators by restricting use within the project area during construction.	PS	• Recreational fishing businesses that conduct operations in the project area shall be notified of project-related activities two weeks prior to the onset of construction. Notification shall include a map of the project site, hours and duration of operation, and the predicted path of barge travel into and out of the construction site.	LTS
Commercial Fishing Activities - Experimental and Mitigation Reefs The construction of both the experimental reef and mitigation reef in the project lease area is planned to occur between May 1 and September 30, which is outside of the commercial lobster fishing season. However, there could be disruptions to commercial fishing activities for sea urchins and crabs during the construction, as these species are fished year-round.	PS	• Commercial fishermen that conduct operations in the project area shall be notified of project-related activities two weeks prior to the onset of construction. Notification shall include a map of the project site, hours and duration of operation, and the predicted path of barge travel into and out of the construction site.	LTS
Commercial Fishing Sites – Mitigation Reef The SONGS Permit conditions for the mitigation reef state that reef material will be placed to avoid existing hard substrate and kelp beds to the greatest extent possible. However, the placement of material over 127.6 to 277.6 acres increases the possibility of some of these resources being accidentally covered by reef material. Accidental coverage of hard substrate or kelp forest could reduce suitable habitat for target species.	PS	• Commercial fishermen that utilize the project area shall be consulted prior to finalization of the location for the mitigation reef. During consultations, proven fishing grounds shall be identified so that they can be avoided, if possible, during the construction of the mitigation reef.	LTS

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Section 1. Land Use and Planning			
Compatibility with Existing Uses - Experimental and Mitigation Reefs			
Although the presence of construction-related vessels 0.6 mile offshore at the project site would be evident, the associated construction activities would not affect the existing onshore land uses or commercial fishing uses of the project area.	LTS	• None required.	N/A
The monitoring activities associated with the experimental reef and mitigation reef would not affect the continued viability of adjacent or nearby land uses.	LTS	• None required.	N/A
Section 2. Socioeconomics			
Construction Employment – Experimental and Mitigation Reefs Given the small number of employees involved in the construction of the experimental and mitigation reefs (maximum of 40 workers), the project would have a minor positive effect on employment, income and economic activity in the study area. It is very unlikely that any new growth would be generated by this project. If there was any related growth, it would be well below the threshold of significance.	LTS	• None required.	N/A
Commercial Fishing Sites – Experimental Reef There is concern that proposed project activities would place rock or concrete material on existing hard substrate and kelp bed resources, which could impact known fishing sites. However, the experimental reef would cover only 22.4 acres of the 356-acre project site, allowing flexibility in the choice of module locations, and the use of a crane would allow a fairly high level of precision in placing the material. The SONGS Permit conditions require that placing rock and concrete on existing hard substrate be avoided to the greatest extent possible.	LTS	• None Required. Recommended Mitigation: Commercial fishermen that utilize the project area shall be consulted prior to the location of the 22.4-acre mitigation reef. During consultations, proven fishing grounds shall be identified so that they can be avoided, if possible, during the construction of the mitigation reef.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Monitoring - Experimental Reef There is a slight chance that transect lines could be disturbed by fish traps and lines, but it is unlikely as they would only be present during sampling events.	LTS	• None required.	N/A
Section 3. Geology			
Waves - Experimental and Mitigation Reefs The attenuation of short-period waves by the experimental and mitigation reefs would not result in conflict with an existing standard, nor would it have an indirect effect on beach development and coastal landforms. This would not conflict with the general plan policies.	LTS	• None required.	N/A
Coastal Currents - Experimental and Mitigation Reefs The presence of a kelp forest exerts a measurable attenuation effect on current speed. The reduced current speeds within the interior of kelp forests could result in at least temporary accumulations of fine sediments typical of existing kelp forests in the project vicinity. However, while the mitigation reef could affect coastal currents in the immediate vicinity of the kelp beds, the potential changes in currents would not cause an increase in nearshore sedimentation. Larger waves are expected to keep the kelp beds from silting up, and waves, rather than currents, dominate the suspension of sand.	LTS	• None required.	N/A
Beaches and Beach Width - Experimental and Mitigation Reefs Based on both process-oriented evaluations and statistical evaluations, the proposed experimental and mitigation reefs are not expected to substantially affect either beaches or coastal landforms.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Section 5. Transportation			
Intersection Levels of Service - San Diego Area - Experimental and Mitigation Reef Construction Project construction traffic during the p.m. peak hour would not reduce the LOS at any intersections below an acceptable level.	LTS	• None required.	N/A
Traffic Hazards – Experimental and Mitigation Reef Construction Construction of the experimental and mitigation reefs would place numerous slow-moving trucks, typically considered a safety hazard, on project area roadways. However, this hazard would only be apparent in areas presently characterized by ongoing traffic hazards of this sort, such as the driveway of the materials broker's yard and the turns into and within the Ports of Los Angeles, Long Beach and San Diego.	LTS	• None required.	N/A
Impacts to Waterborne Transportation– Experimental and Mitigation Reef Construction Construction of the experimental and mitigation reefs would involve the presence of barges and tugboats both within the project site and traveling primarily within established shipping lanes between the source of the materials source and the project site. Small watercraft would also likely transport workers between Dana Point Harbor and the project site. In addition, the vessels, along with marker buoys, would be temporarily present within the lease area site during materials placement activities. The presence of these vessels is not expected to interfere with existing waterborne traffic in the project study area. Furthermore, construction activities would occur during summer months, to avoid conflicting with commercial fishing uses of the project area.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Nutrients and Plankton Supply (cont.)		density to the proposed mitigation kelp reef and during periods when nutrient stress of kelp plants would be likely. If the research suggests that the mitigation reef, as currently planned, would adversely affect the San Mateo kelp forest, then the location of the mitigation reef would be shifted north to avoid these effects. If the scientific research results indicate that the mitigation reef would have no adverse effect on the San Mateo kelp forest, no further mitigation would be required.	
Reef Monitoring. The five-year monitoring program for the experimental reef and the longer-term monitoring program for the mitigation reef would be expected to include the monitoring of reference sites in the existing San Mateo and San Onofre kelp forests as well as other possible kelp beds in the region. Drilling into these reefs would be required to set eyebolts for the permanent transects and quadrants, but the drilling would affect little reef area.	LTS	• None required.	N/A
Marine Mammals and Birds *Marine Mammals – Experimental and Mitigation Reef Construction:* The seasonal construction period, May 1 to September 30, is outside of the migratory period for gray whale. The marine mammals that would most likely occur in the area during the construction period are California sea lion, Pacific harbor seal and bottlenose dolphin. The proposed construction actions could affect marine mammals through: collision with water craft, direct injury from falling concrete or quarry rock, injury related to turbidity, and interference with foraging.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Marine Birds - Mammals – Experimental and Mitigation Reef Construction: The construction activities associated with the experimental reef and the mitigation reef may prevent several of the avian species from foraging in the lease area for the duration of construction..	LTS	• None required.	N/A
Marine Mammals - Experimental and Mitigation Reef Monitoring: Monitoring activities associated with the experimental reef and mitigation reef have the potential to disturb marine mammals present in the lease area.	LTS	• None required.	N/A
Marine Birds - Experimental and Mitigation Reef Monitoring: Monitoring activities may disturb prey species for marine birds but that disturbance would be localized to lease site and avian species could utilize other areas for foraging.	LTS	• None required.	N/A
The Beach Community *Sedimentation Processes -- Experimental and Mitigation Reef:* The experimental and mitigation reefs have the potential to affect waves and currents and thereby affect littoral zone sedimentation processes and beach habitat.	LTS	• None required.	N/A
Section 7. Energy and Mineral Resources			
Energy Use – Experimental Reef Fuel use associated with both the construction and monitoring of the experimental reef is very small relative to fuel use in the region and California.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Energy Use - Mitigation Reef Fuel use related to the construction of the full mitigation reef is small relative to diesel fuel use within the region and California and as such is not a significant impact. The use rock for the full mitigation reef build out increases fuel consumption by about 1.3 times over what would be used for a concrete reef. Obtaining rock from Catalina Island and minimizing the amount of rock hauling would help by reducing fuel use about 30 percent.	LTS	• None required.	N/A
Mitigation Reef Monitoring. The use of fuel for mitigation reef monitoring would be minimal.	LTS	• None required.	N/A
Availability of Quarry Rock in the San Diego and Los Angeles County Regions			
Experimental Reef Construction. The amount of quarry rock required to construct the experimental reef represents about .005 percent of San Diego County's available aggregate reserves and about .002 percent of Los Angeles County's reserves. The 17,640 tons of material that would be utilized for the experimental reef represents about 0.13 percent of the annual consumption in San Diego County and about 0.08 percent of the annual estimated consumption in Los Angeles county.	LTS	• None required.	N/A
Mitigation Reef Construction. The amount of quarry rock required to construct the largest build out scenario for the mitigation reef (277.6 acres at 67 percent coverage = 777,280 tons) represents about 0.2 percent of San Diego County's available aggregate reserves and about 0.1 percent of Los Angeles County's reserves. Construction of the reef would require about 194,320 tons of aggregate a year, or about 1.4 percent of the total demand in the San Diego region and 0.9 percent of the total annual demand in the Los Angeles region.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Availability of Recycled Concrete in the San Diego and Los Angeles Regions			
Experimental Reef Construction. The relatively small amount of recycled concrete needed to construct the experimental reef is not expected to substantially effect the availability of recycled concrete in the region. The use of recycled concrete for the experimental reef would not exceed five percent of the total annual consumption of aggregate in either San Diego or Los Angeles Counties.	LTS	• None required.	N/A
Mitigation Reef Construction. The relatively small amount of recycled concrete needed to construct the mitigation reef is not expected to substantially affect the availability of recycled concrete in the region. The 277.6-acre build out would require 610,720 tons of concrete over a three year period. This would be about .2 and .08 percent of the PCC-grade aggregate available in the San Diego and Los Angeles regions respectively.	LTS	• None required.	N/A
Section 8. Hazards			
Release of Hazardous Materials – Experimental and Mitigation Reef Construction.			
The construction of the experimental and mitigation reefs requires the use of watercraft, vehicles, and equipment powered by fuel and lubricated by oil, and other mechnical fluids, which are considered hazardous substances. Accidents involving these craft, vehicles, and equipment would have the potential to adversely affect the environment through the release of these hazardous substances.	LTS	• None required.	N/A
Release of Hazardous Materials – Experimental and Mitigation Reefs. Recycled concrete used for the experimental reef and mitigation reef would be obtained from sources that meet cleanliness requirements set by the CDFG. No hazardous substances would be expected to be released during the construction of the reefs, nor released from the concrete as it decomposes after placement.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Release of Hazardous Materials – Experimental and Mitigation Reef Monitoring Small amounts of fuel would be on board the vessels used in monitoring. If fuel leaked into water, it would be in minimal amounts and would disperse quickly and therefore, present no risk of exposure to the public.	LTS	• None required.	N/A
Section 9. Noise			
Construction Noise - Experimental and Mitigation Reef Construction *Lease Area.* The concern for noise in the lease area is the effect on City of San Clemente residents and sensitive land uses, approximately 0.6 miles from the proposed construction activities. After traveling 0.6 mile, this construction noise would decrease at the shoreline to approximately 49 dBA. Project noise would be completely masked out by ambient noise during the day and at night.	LTS	• None required.	N/A
Rock Quarries. The rock quarries on Catalina Island and in San Diego County are existing industrial facilities. Quarrying, rock loading, and shipping or trucking are routine operations there and the related equipment noise is part of the existing environment.	LTS	• None required.	N/A
Concrete Brokers/Port Facilities. The concrete staging areas will be subject to the existing County and City noise control ordinances, which limit noise consistent with industrial zoning. The continued compliance with the applicable noise control ordinances would adequately control noise.	LTS	• None required.	N/A
Truck Routes. The use of project trucks within manufacturing, industrial, and agricultural zones would be consistent with the applicable noise control ordinances for these zones, which allow short duration (less than two minutes) increases in noise up to 90 dBA, depending upon the location. The daytime and nighttime thresholds are the same in these zones. The use of project trucks within these zones would create less-than-significant impacts regardless of the time-of-day of use.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Section 11. Public Services			
Offshore Emergency Response – Experimental and Mitigation Reef Construction The need for offshore emergency response services could occur during the construction of the experimental reef and mitigation reef. Available Orange County Harbor Patrol emergency response services would be adequate to handle any problems during the construction phase, and the construction would not create any problems for the Harbor Patrol in carrying out their duties. In addition, it is expected that current Coast Guard emergency services would be adequate for any problems that might occur.	LTS	• None required. Recommended Mitigation: The Harbor Patrol requested that they be notified when the construction plans and schedule for the experimental reef are finalized. The Harbor Patrol will be given notification two weeks prior to when construction activities are beginning for both the experimental and mitigation reefs.	N/A
Offshore Emergency Response – Experimental and Mitigation Reef Monitoring The existing available services would be adequate for the reef monitoring activities.	LTS	• None required.	N/A
Kelp and Beach Maintenance - Experimental Reef The 22.4-acre experimental artificial reef could potentially add twice the current amount of persistent kelp bed to the project area. The additional kelp wrack washing on shore from the experimental reef represents a relatively small increase in kelp wrack and is not likely to increase the need for clean up services.	LTS	• None required.	N/A
Section 11. Aesthetics			
Effects on Scenic Vistas or Scenic Highways – Experimental and Mitigation Reef Construction The presence of several barges 0.6 mile and farther offshore at the project site would not substantially alter the area's visual integrity as seen from any designated scenic routes or view corridors.	LTS	• None required. Recommended Mitigation: It is recommended that the project proponent conduct an educational outreach program to inform the public about the project and the construction activities. This would include notifying the media and residents about the type	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Effects on Scenic Vistas or Scenic Highways (continued)		and duration of construction activities a month prior to beginning construction. Temporary notices would also be posted along the shore at the San Clemente Pier and near the mouth of San Mateo Creek.	
Effects on Scenic Vistas or Scenic Highways – Experimental and Mitigation Reef. Upon successful colonization of the reef by a giant kelp community, the only project feature that might be visible offshore to sensitive receptors would be darker-looking areas in which the kelp might reach just below the ocean surface. The presence of additional kelp on area beaches during the winter months is not expected to greatly alter the beaches' visual character. Therefore, the presence of the mitigation reef would not substantially degrade views from any designated scenic routes or view corridors.	LTS	• None required.	N/A
Effects on Scenic Vistas or Scenic Highways – Experimental and Mitigation Reef Monitoring.. The presence of one to two small watercraft and several divers within the project site at various times during the year would not affect the area's visual integrity as seen from any designated scenic routes or view corridors.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Demonstrable Negative Aesthetic Effects – Experimental and Mitigation Reef Construction The appearance of project-related barges operating approximately 0.6 mile offshore would resemble existing offshore vessel activities, which include commercial fishing and shipping, and U.S. military exercises. Consequently, project construction activities are not expected to diminish the project area's visual quality.	LTS	• None required. Recommended Mitigation: It is recommended that the project proponent conduct an educational outreach program to inform the public about the project and the construction activities. This would include notifying the media and residents about the type and duration of construction activities a month prior to beginning construction. Temporary notices would also be posted along the shore at the San Clemente Pier and near the mouth of San Mateo Creek.	N/A
Demonstrable Negative Aesthetic Effects – Experimental and Mitigation Reefs Dark patches 0.6 mile offshore beneath the ocean surface could be visible to some sensitive receptors upon successful kelp colonization; however, the presence of these areas is not expected to negatively alter the appearance of the project area. In addition, the wintertime presence of kelp wrack on area beaches is not expected to negatively affect the beaches' existing visual character.	LTS	• None required.	N/A
Demonstrable Negative Aesthetic Effects – Experimental and Mitigation Reef Monitoring. The presence of one to two small watercraft and several divers within the project site at various times during the year would not lessen the project area's visual quality.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Creation of Light or Glare – Experimental and Mitigation Reef Construction Little additional light or glare is likely to accompany the placement of reef materials within the project site. Although barge travel could take place at all hours, material placement activities would occur during daylight hours, introducing no additional illumination into the project area. The barges would tend to appear darker than the surrounding reflective water, and would be unlikely to bring any new glare into the area.	LTS	• None required.	N/A
Creation of Light or Glare –Experimental and Mitigation Reefs. The experimental reef modules and the mitigation reef would be submerged and would contain no sources of light or glare.	LTS	• None required.	N/A
Creation of Light or Glare – Experimental and Mitigation Reef Monitoring. The monitoring activities associated with the experimental and mitigation reefs are not expected to introduce any new light or glare into the project area.	LTS	• None required.	N/A
Section 12. Cultural Resources - Experimental and Mitigation Reefs			
Paleontological Resources Reef construction would involve the placement of concrete and rock upon unconsolidated Quaternary sediments and/or Upper Miocene - Lower Pliocene age sedimentary bedrock, neither of which is expected to contain important or significant micro- or megafossils. If fossils do exist in sediments and bedrock beneath the site they would not be destroyed or removed, but would be buried. Following construction, neither the presence of the reefs nor the monitoring would disturb sediments or bedrock.	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Archaeological, Historic, and Ethnographic Resources Although there are no known archaeological resources in the APE, two types of prehistoric remains may occur within the water depths associated with the proposed project lease site. These are: (1) *in situ* prehistoric remains that pre-date the Holocene Transgression and that are situated on relict, submerged landforms, either mantled with unconsolidated marine sediments or exposed on bedrock outcrops; and (2) remains deposited subsequent to the Holocene Transgression and situated on the seafloor or within unconsolidated recent sediments. These remains would consist primarily of isolated prehistoric and historic artifacts (SLC 1986). Although three historic shipwrecks are recorded within the project vicinity, none has been physically located. Potential NRHP eligibility of the wrecks of the Agram, the Stranger, and the Kitty A. has not been determined and cannot be determined on the basis of available data. All three are more than 50 years old, but neither the precise location nor the condition of the wrecks is known, nor is the extent of possible salvage known. Because none of the wrecks has been physically located, and	LTS	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Archaeological, Historic, and Ethnographic Resources (continued) because the project site has been examined by side-scan sonar, and by divers without the identification of potential submerged resource locations, it is likely that remains of the wrecks lie outside of the project site. The likelihood of unrecorded wrecks within the project site is relatively low. The project site is not located on an approach to a major shipping or fishing port, which diminishes the probability of ship or fishing boat wrecks. There is, however, a small boat harbor at Dana Point. Thus, aside from the larger vessels for which records are likely to have been kept, numerous small recreational boats (e.g., sailboats, motorboats) have frequented this stretch of the coast and continue to do so. Sinkings may have occurred but it is likely that most would be less than 50 years old. Underwater surveys conducted by Coastal Resources Associates, which included side-scan sonar, did not identify historic resources in the lease area (Dean 1997). No magnetometer survey has been conducted in the area, and with strong sea surges such as characterize the southern California coast, it is possible that wreck remains could be obscured by sand. This is unlikely due to the shallow sand in the project area, and obvious wreck remains are not present within the project site. The only possible ethnographic resources are archeaological resources deposited subsequent to the Holocene Transgression. As previously noted, these are unlikely to occur *in situ* in the project environment. The proposed experimental reef and mitigation reef would be constructed in areas that are underlain by bedrock and thinly covered by sand. The lease area is a high energy dynamic environment in which the thin cover of sand is readily moved by waves and currents. These physical conditions essentially preclude the presence of *in situ* cultural remains from the Holocene. Furthermore, due to the high energy environment of the project area, isolated prehistoric and historic artifacts potentially found in the			

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Archaeological, Historic, and Ethnographic Resources (continued) project area would not be *in situ*. Restricting the proposed project actions to areas that have these physical conditions is an important element in meeting the biological goals and objectives of the project, and also is important to assuring that archaeological resources are not affected. This key element applies to all phases of the project, including construction, the presence of the reefs, and the monitoring of the reefs. Construction of the proposed reefs would not involve excavation. Thus the subsurface and any isolated artifactual remains, fragmentary shipwreck remains, and archaeological remains of ethnographic significance that might be buried in the shallow sands would not be destroyed or removed.			
Section 13. Recreation			
Proximity of Reef Construction to the Beaches – Experimental and Mitigation Reef The construction of the experimental reef and the mitigation reef would be visible to people using the adjacent beaches, at distances of 0.6 mile or greater. Neither the appearance of construction equipment, nor the noise associated with the construction activities, is expected to discourage recreational use of the project area beaches.	LTS	• None required.	N/A
Effects of Reef Construction on Boaters – Experimental and Mitigation Reef People in boats could view and hear the experimental reef and mitigation reef construction activities at closer distances than 0.6 mile, and the tugboats and barges could be more noticeable than they are from the shore.	LTS	• None required.	N/A

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Less-Than-Significant			
Effects of Excluding Other Uses During Reef Construction – Experimental and Mitigation Reef The use of portions of the lease area will not be available for recreation during the construction of the experimental reef and mitigation reef.	LTS	• None required.	N/A
Potential Effects on Waves and Surfing – Experimental and Mitigation Reef The experimental and mitigation reefs, and the resulting kelp forests, would create no measurable attenuation of height or energy of long-period swell waves, and would not affect the propagation or direction of swell waves. Furthermore, the experimental and mitigation reefs would not substantially affect the distribution and transport of sediment in the littoral zone, nor the width of the beach. However, the presence of a kelp forest would have a damping effect on high frequency sea waves. Any reduction in high frequency sea waves would likely have a beneficial effect on surfing conditions.	LTS	• None required.	N/A
Section 14. Water Quality			
Turbidity - Experimental and Mitigation Reefs During construction, the placement of recycled concrete pieces and quarry rock would momentarily disturb the fine sands and silts of the ocean floor, and would resuspend these particles, causing a local increase in turbidity. In addition, some sediment may be introduced into the water from material on the recycled concrete or quarry rock.	LTS	• None required.	N/A

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
No Effect			
Section 1. Land Use and Planning			
Compliance with General Plan and Zoning Designation - Experimental and Mitigation Reefs The presence of a total of 150 to 300 acres of artificial reef sustaining a giant kelp community within the 356-acre project site would be generally compatible with both the existing offshore uses and the adjacent onshore designations.	No effect.	• None required.	N/A
Compliance with Applicable Environmental Plans and Policies - Experimental and Mitigation Reefs The construction, implementation, and monitoring activities for the proposed 22.4-acre experimental reef and the 127.6-acre to 277.6-acre mitigation reef would support the policy direction of the applicable environmental plans and policies.	No effect.	• None required.	N/A
Compatibility with Existing Uses – Experimental and Mitigation Reefs The apparent use of the site with either the 22.4-acre experimental reef or the full mitigation reef would differ little from present site conditions, and is not expected to influence the continued viability of adjacent land uses in either the city of San Clemente or San Diego County.	No effect.	• None required.	N/A
Section 2. Socioeconomics			
Presence of the Experimental and Mitigation Reefs The presence of the experimental reef and mitigation reef would have no negative socioeconomic impacts. The creation of additional reef and kelp habitat should enhance fishing and create economic benefits over the long term.	No effect.	• None required.	N/A

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
No Effect			
Monitoring – Mitigation Reef The 150-acre to 300-acre reef would be monitored at some level over the equivalent of the life of SONGS; this monitoring is yet to be defined by the CCC. It would most likely involve post-construction side-scan sonar and diver surveys, followed by annual diver surveys.	No effect.	• None required.	N/A
Section 6: Biology			
Marine Mammals and Birds *Experimental and Mitigation Reefs – Marine Mammals.* The kelp forest development may increase habitat for some of the prey that dolphins and sea lions would take. Furthermore, grey whales generally do not forage during their migration, but they have been observed skimming kelp beds for food and utilizing kelp forests for escape cover.	No effect.	• None required.	N/A
Experimental and Mitigation Reefs – Marine Birds. The kelp forest would increase foraging and resting habitat for brown pelican, double-crested cormorant, common loon, California least tern and elegant tern. The kelp wrack that washes up on the beaches near kelp forests provides habitat for many of the prey species preferred by western snowy plover.	No effect.	• None required.	N/A
Section 7. Energy and Mineral Resources			
Oil, Gas, and Geothermal Resources – Experimental and Mitigation Reefs There are no active or abandoned oil, gas, or geothermal wells or fields underlying the proposed reef site or in the immediate area. Furthermore, there are no active or pending State leases. Upon issuing a permit to construct the reef, the State Lands Commission would retain their rights to all oil, gas, and geothermal resources beneath the site. In the event oil, gas or geothermal resources are discovered beneath the site in the future, the site is small enough that any potential reserves underlying the site could be accessed by nearby wells or using directional drilling techniques.	No effect.	• None required.	N/A

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Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
No Effect			
Section 8. Hazards			
Interference with Emergency Response/Evacuation Plans - Experimental and Mitigation Reef Construction, Presence and Monitoring. The proposed project would not interfere with implementation of emergency response plans or emergency evacuation plans in the project area.	No effect.	• None required.	N/A
Section 14. Water Quality			
Contaminants - Experimental and Mitigation Reefs The construction of the experimental reef and mitigation reef would use recycled concrete material or quarry rock that comply with the CDFG's "Material Specification Guidelines and Notification Procedure for Augmentation of Artificial Reefs with Surplus Materials."	No effect.	• None required.	N/A
Beneficial Effects			
Section 2. Socioeconomics			
Presence of the Experimental and Mitigation Reefs The creation of additional reef and kelp habitat would enhance local recreational and commercial fishing, which would in turn strengthen the area's tourist and recreational economic base, creating long-term economic benefits.	Beneficial	• None required.	

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

Table 2-1 Summary of Environmental Impacts and Mitigation Measures for the Proposed Project (continued)

Environmental Impacts	Level of Significance Without Mitigation	Recommended Mitigation Measures	Level of Significance With Mitigation
Beneficial Effects			
Section 13. Recreation			
Potential Effects on Waves and Surfing The presence of a kelp forest would have a damping effect on high frequency sea waves. Any reduction in high frequency sea waves would likely have a beneficial effect on surfing conditions.	Beneficial	• None required.	N/A

Key: S = Significant; PS = Potentially Significant; LTS = Less than Significant; N/A = Not Applicable

3.0 Project Description

3.0 *Project Description*

3.1 *Introduction*

This Final Program Environmental Impact Report (PEIR) evaluates the environmental effects of the construction and management of an artificial reef developed in two phases. The artificial reef is intended to establish a persistent, natural, healthy, giant kelp forest and associated biota (i.e. algae, invertebrates and fish) at a site near San Clemente, California. The California Coastal Commission (CCC) has required the owners of the San Onofre Nuclear Generating Station (SONGS) to carry out this project to mitigate for resource losses associated with operation of SONGS Units 2 and 3 at the nearby San Onofre Kelp bed (SOK). The requirements for mitigation are outlined in the SONGS Coastal Development Permit No. 6-81-330-A, as amended by the CCC in May 1997. Relevant portions of the permit related to the artificial mitigation reef are included in this chapter.[1] SONGS is owned by Southern California Edison Company, San Diego Gas and Electric Company, City of Anaheim and City of Riverside (hereafter referred to collectively as the project proponent). The project proponent filed an amended application with the California State Lands Commission (CSLC) on February 27, 1998, for a 355-acre lease of State lands off the coast of San Clemente to construct a 150-acre artificial reef in two phases. On March 22, 1999, the project proponent filed another amendment to their application to modify the lease area to include 862 acres, providing a buffer zone around 356 acres of suitable sand substrate that have been identified for artificial reef construction (defined as the project site). CSLC is serving as the Lead Agency pursuant to the California Environmental Quality Act (CEQA).

A PEIR has been prepared because the proposed project would be developed in two separate phases (CEQA Guidelines, Section 15168). The first phase would be a 22.4-acre experimental reef constructed of 56 quarry rock and recycled concrete modules (each 0.4-acre in size) that tests different materials, different levels of coverage of the ocean bottom, treatments of kelp planting and the influence of location within the site. The initial design for the experimental reef was outlined in the project proponent's *San Onofre Marine Mitigation Program: Experimental Reef for Kelp, Preliminary Plan* (see Appendix C), which was approved by the CCC in June 1997. The original plan called for a 16.8-acre experiment with 42 modules, which was evaluated in the Draft PEIR. In response to public comments, this plan has been amended as described in the Final PEIR. The new experimental reef plan adds 14 additional modules with kelp planting treatments.

The experimental reef would be monitored for five years. Once the results of the experimental reef are evaluated, a second phase of development would commence. This would involve the design and construction of at least 127.6 additional acres of low-relief,

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[1] Complete copies of Permit No. 6-81-330-A are available from: Energy Division, California Coastal Commission, 45 Fremont Street, Suite 2000, San Francisco, CA 94105.

artificial reef, supporting a total of 150 acres of sustainable, medium-to-high density kelp beds (defined as having a minimum of four plants per $100m^2$) and associated kelp bed biota. It is possible that a greater amount of reef construction could be required at a later time as remediation to the mitigation reef. Based on observations of the existing San Mateo kelp bed, CCC scientists feel there is a potential that up to 300 acres (an additional 277.6 acres) of artificial reef construction might be needed eventually to achieve the required 150 acres of medium-to-high density giant kelp. However, one of the primary reasons for adding the kelp planting treatments to the experimental reef project is to enhance kelp recruitment and the success of growing kelp on artificial reef. Kelp planting could help minimize the need for artificial reef construction beyond the 150-acre minimum required by the SONGS Permit. The mitigation reef would be managed and monitored for a period equivalent to the operating life of SONGS. Depending on the success of the artificial reef in meeting the SONGS Permit performance standards, other remediation could be required, including enhancements to the existing reef (e.g. placing additional reef material, or using additional kelp planting).

The Final PEIR evaluates the 22.4-acre experimental reef in detail based on the project proponent's design plan with the addition of kelp planting treatments and a redistribution of the experimental modules throughout the 356-acre project site (within the 862-acre lease area). The PEIR will be used by the CSLC in determining whether to grant the project proponent the 862-acre lease and approval of the first phase construction of the 22.4-acre experimental artificial reef. The PEIR evaluates the second phase of development based on a series of assumptions about the full mitigation reef design, which are described further in Section 3.4.2 of this chapter. There are many variables (e.g. size and type of material used, configuration, and location) that will go into the final design of the mitigation reef and that cannot be defined until the results of the experimental reef are analyzed. The Final PEIR evaluation of the mitigation reef looks at a range of artificial reef construction from a minimum of 127.6 acres and up to 277.6 acres as a probable worst-case analysis.

Because the CSLC would permit only the 22.4-acre experimental project at this time, the project proponent would be required to come back to the CSLC and other agencies for review and approval of the second phase of the project at a future date. This would occur once the final design for the full mitigation reef has been completed. At that time, it may be determined that additional environmental review is necessary. This would occur if the final mitigation reef design is substantially different from what has been evaluated in this PEIR, or if there is substantial new information that changes the conclusions of this PEIR (such as the development of new technologies for reducing air emissions related to the project). If a supplemental environmental document were required, it would go through public review and comment as required by CEQA.

This chapter provides background on the project purpose, need, and objectives. This is followed by a detailed description of the project location and activities. Finally this chapter discusses other regulatory reviews of the project, the project schedule and estimated project costs.

To assist the reader, the following describes commonly used project terms found throughout the document:

Project Lease Area – This includes 862 acres approximately 0.6-mile offshore of the City of San Clemente as described in the project proponent's amended lease application to CSLC (March 1999). The lease area includes 356 acres that have been identified as suitable sand substrate for artificial reef construction (defined as the project site) and a buffer zone surrounding this area.

Project Site – This term refers to the 356 acres that have been identified as suitable sand substrate for artificial reef construction contained within the 862-acre lease area.

Project Vicinity and Project Area – These terms are used in different resource sections to describe the nearby areas onshore and offshore from the project lease area and site. The definition varies slightly in different resource sections, but generally refers to the area offshore between San Onofre and Dana Point Harbor, and the communities and facilities onshore from San Onofre Nuclear Station to City of Dana Point.

Study Area – This term varies for the different resource sections and is defined in each section. In some cases it may include only areas near to San Clemente, and in other resource sections it may include all areas where project activities may occur, including Los Angeles and San Diego Counties.

3.2 Project Purpose, Need and Objectives

3.2.1 Project Purpose and Need

The CCC issued a permit for the construction and operation of SONGS Units 2 and 3 in 1974. This permit provided for a Marine Review Committee (MRC) to monitor the impact of the operations of SONGS on the marine environment. After 15 years of study, the MRC reported that the operation of SONGS had resulted in significant impacts to fish populations in the Southern California Bight and to the SOK community. The CCC adopted permit conditions in 1991 that required a package of mitigation to compensate for these losses, which included the construction of a 300-acre artificial reef for kelp. Subsequent studies determined that resource losses at SOK were less than originally estimated and the CCC amended the permit conditions in 1997 to require an artificial reef that will sustain 150 acres of medium-to-high density kelp bed and associated biota, along with a mariculture/fish hatchery program. The amended SONGS Permit calls for a first phase experimental reef project of a minimum of 16.8 acres, a five year monitoring program for the experimental reef, and a second phase of construction with a minimum of 133.2 acres to complete the mitigation reef.

In response to public comments on the Draft PEIR, the project proponent filed an amended application with CSLC on March 22, 1999, revising the experimental reef project to include additional modules with kelp planting treatments. The Final PEIR evaluates this revised plan for a 22.4-acre experimental reef project and a minimum 127.6-acre mitigation reef build-out.

The CCC and the project proponent, along with independent experts in the field, have concluded many years of debate, study, and public hearings in reaching a settlement on the mitigation that is required for damage at SOK and on the proposed design, location and phasing of the artificial reef project. (A copy of the Executive Summary of the SONGS Permit, as amended, is included in Appendix D, which details the project history). Condition C of the SONGS Permit sets out the requirements for an artificial reef project to mitigate for kelp bed losses at SOK and details the project objectives. A copy of Condition C is included in the following pages.

3.2.2 Project Objectives

The primary objective of the artificial reef project as stated in the SONGS Permit is, *"to provide adequate conditions for a community of reef associated biota similar in composition, diversity and abundance to the San Onofre kelp bed that compensates for the losses incurred by SONGS operations."* The CCC has determined that losses incurred at SOK due to the operation of SONGS include 179 acres of rocky reef kelp forest and associated biota of reef dwelling algae, invertebrates and fish. The proposed project is intended to serve as partial mitigation for these losses. To achieve this objective the CCC requires that the proposed project meet certain performance standards, which include the amount and type of hard substrate, the acreage of medium-to-high density giant kelp, and the abundance and diversity of understory algae, invertebrates and fish (Condition C, Section 2.4). The performance standards are specific project objectives.

- ***Experimental Reef Phase:***

- *"The primary goal of the experimental reef shall be to test several different substrate types and configurations to determine which of these can best provide: 1) adequate conditions for giant kelp recruitment, growth, and reproduction; and 2) adequate conditions to establish a community of reef-associated biota. Information gained from the experimental reef will be used in designing the mitigation phase of Condition C. This will help to ensure full compensation for kelp bed losses in a cost-effective manner..."*

The CCC approved the project proponent's *San Onofre Marine Mitigation Program: Experimental Reef for Kelp, Preliminary Plan*, pending environmental review by appropriate agencies (Appendix C). The plan outlines a 16.8-acre experimental reef project that would test: 1) the use of quarry rock versus recycled concrete material; 2) the level of coverage of material on the ocean bottom of low-relief configurations (at 17, 34and 67 percent coverage); and 3) how the location of reef construction in relation to existing kelp beds affects natural recruitment. This plan has been amended to include kelp planting treatments (with concrete and quarry rock at 34 percent coverage) and increase the size of the experimental reef to 22.4 acres.

B. CONDITION C: KELP REEF MITIGATION

NOTE: The following text of revised Condition C includes key elements of the Commission's 1991 permit condition. Site assessment, site selection, and performance standards and monitoring are substantially the same as the 1991 condition. The changes that the Commission approved on April 9, 1997 are:

1. Clarification and modification of the condition as it relates to the two phases of the reef (experimental and mitigation reef). These changes include more specifics about the goals of the experimental reef.
2. Reduction of the size of the reef required in the 1991 permit condition from 300 acres of medium-to high-density kelp to 150 acres of medium-to high-density kelp and the addition of $3.6 million to OREHP to fund a mariculture/fish hatchery program.

Mitigation for losses to kelp bed resources through the construction of an artificial reef will occur in two phases, an initial experimental phase followed by a mitigation phase.

1.0 EXPERIMENTAL REEF

The permittee shall, using qualified professionals and in consultation with the Executive Director, select a site and construct an experimental artificial reef for kelp to determine the optimal reef design for mitigating resource losses at the San Onofre Kelp bed (SOK) caused by SONGS' operation. The experimental reef shall test the design parameters necessary to provide a persistent giant kelp forest and associated ecosystem.

1.1 Site Assessment

The permittee shall select at least three potential sites and conduct pre-construction site assessments at these potential sites.

The permittee shall obtain sufficient information about each potential experimental reef site to allow the permittee to determine which site best meets the final site selection criteria described below. This information shall be used in both the site selection and design of the experimental reef. Necessary information shall include: (1) a description of existing biota at the site, (2) a reasonable prediction of the likelihood that a healthy kelp bed will be established and persist at the site, (3) a reasonable prediction of the extent of rock burial due to sediment deposition and/or sinking into soft sediment that could be expected at the site, and (4) a prediction of the effect of the proposed reef on local sand transport and local beach profiles.

1.2 Final Site Selection

Selection of the actual experimental reef site from among the potential sites shall be based on, but not limited to, the following criteria:

1. Location as close as possible to the SOK, and preferably between Dana Point (Orange Co.) and Carlsbad (San Diego Co.), but outside the influence of the SONGS discharge plume and water intake, and away from Camp Pendleton.
2. Minimal disruption of natural reef or cobble habitats and sensitive or rare biotic communities.
3. Suitable substrate with low mud and/or silt content (e.g., hard-packed fine to coarse grain sand, exposed cobble or bedrock without a persistent kelp biological community, or cobble or bedrock covered with a thin layer of sand).
4. Location at a depth locally suitable for kelp growth and recruitment.
5. Location near a persistent natural kelp bed.
6. Location away from sites of major sediment deposition.
7. Minimal interference with uses such as vessel traffic, vessel anchorages, commercial fishing, mariculture, mineral resource extraction, cable or pipeline corridors.
8. Location away from power plant discharges, waste discharges, dredge spoil deposition sites, and activities of the U. S. Marine Corps.
9. Location that will not interfere with or adversely affect resources of historical or cultural significance such as shipwrecks and archeological sites.

1.3 Experimental Reef Design and Final Plan

The permittee shall submit a preliminary plan describing the location and design of the experimental reef to the Executive Director for review and approval. Following the Executive Director's approval of the preliminary plan, but no later than June 30, 1997, the permittee shall apply for a coastal development permit for construction of an experimental reef for kelp. The coastal development permit application shall include an experimental reef plan that specifies the design and construction methods of the experimental reef. The design of the reef shall allow for identification of those parameters important to the establishment of a persistent, healthy giant kelp forest and associated ecosystem.

The primary goal of the experimental reef shall be to test several different substrate types and configurations to determine which of these can best provide: (1) adequate conditions for giant kelp recruitment, growth, and reproduction and (2) adequate conditions to establish a community of reef-associated biota. Information gained from the experimental reef will be used in designing the mitigation phase of Condition C. This will help to ensure full compensation for kelp bed losses in a cost-effective manner.

The total areal extent (as measured at the ocean bottom and equal to the surface area within the perimeter of the reef's outermost hard substrate/sand interface area, as installed by the permittee) of the experimental reef shall be a minimum of 16.8 acres.

1.4 Experimental Reef Construction

The experimental reef shall be constructed within 12 months of approval of the coastal development permit for the experimental reef. A post-construction survey shall be carried out by the permittee to demonstrate that the experimental reef was built to approved specifications. If the Executive Director determines that the reef was not built to specifications, the permittee shall modify the reef to meet the approved specifications within 90 days of the post-construction survey. Extension of this time limit may be granted by the Executive Director for good cause.

1.5 Experimental Reef Monitoring

The experimental reef shall be monitored independent of the permittee (as per Condition D) for 5 years. A monitoring plan will be developed by Commission scientists pursuant to Condition D. The independent monitoring program for the experimental reef shall be designed to assess the effectiveness of alternative reef designs, materials and management techniques. Monitoring shall be conducted with funds provided by the permittee through Condition D and shall include the monitoring and management of any additional experiments deemed necessary by the Executive Director. Successful completion of the experimental reef does not depend on the achievement of performance standards. However, information on the performance of different module designs will be used to identify those designs that would be likely to meet the performance standards for the mitigation reef. This information will be used to design the most cost-effective mitigation reef that is likely to meet the performance standards listed in Section 2 below.

2.0 MITIGATION REEF

In addition to construction of the 16.8-acre experimental reef, the permittee shall be responsible for the construction of at least 133.2 acres of artificial reef (yielding a minimum of 150 acres of artificial reef hereafter referred to as the "mitigation reef") that meets the performance standards listed below as mitigation for the resource losses at the San Onofre Kelp bed (SOK) caused by operation of the SONGS. The larger artificial reef may be an expansion of the experimental reef or may be established in a different .ocation, provided that the larger reef shall be located in the vicinity of SONGS, but outside the influence of SONGS discharge plume and water intake. The selection of a site for the larger artificial reef shall be based on the final site selection criteria stated in Section 1.2 above.

The purpose of the mitigation reef is to provide kelp bed community resources to replace the resources lost due to the operation of SONGS Units 2 and 3. Thus, the mitigation reef shall be designed to replace the lost and damaged resources at the San Onofre kelp bed and result in production of a persistent giant kelp forest and associated ecosystem.

2.1 Mitigation Reef Design and Planning

Within six months after completion of independent monitoring of the experimental reef, the permittee shall submit a preliminary plan describing the location and design of the mitigation reef to the Executive Director for review and approval. The type of hard substrate and the percent cover of hard substrate proposed in the preliminary plan for the mitigation reef shall be determined by the Executive Director.

The Executive Director will consult with the Coastal Commission scientists, scientific advisors, resource agencies, and others as appropriate to evaluate whether the preliminary plan meets the goals set forth in Section 2.2 below. Within one month following the Executive Director's determination that the preliminary plan meets the specified criteria, the permittee shall initiate development of a final mitigation plan along with appropriate CEQA and/or NEPA environmental impact analyses necessary in connection with local, State or other agency approvals.

Within twelve months of the Executive Director's approval of a preliminary plan for the mitigation reef, the permittee shall submit a final mitigation plan to the Coastal Commission in the form of a coastal development permit application. The final plan shall specify location, depth, overall hard substrate coverage, size and dispersion of reef materials, and reef relief and shall substantially conform to the preliminary plan approved by the Executive Director.

2.2 Mitigation Reef Goals

The primary goals of the mitigation reef shall be to provide adequate conditions for a community of reef-associated biota similar in composition, diversity and abundance to the San Onofre kelp bed that compensate for the losses incurred by SONGS operations.

2.3 Mitigation Reef Construction

The permittee shall construct the reef in accordance with the final plan in the approved coastal development permit. The permittee shall begin construction of the reef no later than 6 months after Commission approval of a coastal development permit for the reef. The permittee shall complete a post-construction survey to demonstrate that the reef was built to approved specifications. If the Executive Director determines that the reef was not built to specifications, the permittee shall modify the reef to meet the approved specifications within 90 days of the post-construction survey. Extension of this time limit may be granted by the Executive Director for good cause.

2.4 Monitoring

After construction of the mitigation reef is completed, the reef will be monitored, managed, and, if necessary, remediated. The following sections describe the basic tasks required for monitoring the mitigation reef pursuant to this Condition. Condition D specifies that the permittee shall provide funds to the Commission or an independent entity designated by the Executive Director for the purpose of completing the monitoring, as specified below.

A monitoring plan for the mitigation reef shall be developed by the Commission staff scientists pursuant to Condition D. The monitoring plan shall be completed within six months of approval of a coastal development permit for the mitigation reef proposed in a final plan developed pursuant to this condition. The monitoring plan shall provide an overall framework to guide the monitoring work. The monitoring plan shall describe the sampling methodology, analytical techniques, and methods for measuring performance of the mitigation reef relative to the performance standards identified below.

Monitoring independent of the permittee shall be implemented in accordance with Condition D to: (1) determine whether the performance standards of this condition are met (i.e., whether the mitigation reef successfully replaces the lost and damaged resources in the San Onofre Kelp bed), (2) if necessary, determine the reasons why any performance standard has not been met, and (3) develop recommendations for appropriate remedial measures. The permittee shall be responsible for fully implementing any remedial measures deemed necessary by the Executive Director.

Following completion of construction the mitigation reef shall be monitored for a period equivalent to the operating life of SONGS. The independent monitoring program for the mitigation reef shall be designed to assess whether the performance standards have been met. If these standards are met after ten years following the completion of construction, then monitoring can be reduced to annual site inspections. The permittee shall undertake necessary remedial actions based on the monitoring results and annual site inspections for the full operating life of the SONGS Units 2 and 3.

The following performance standards shall be used in measuring the success of the mitigation reef to determine whether remediation is necessary:

a. Substrate

1. The reefs shall be constructed of rock, concrete, or a combination of these materials, as determined from results of the experimental reef to be suitable for sustaining a kelp forest and a community of reef-associated biota similar in composition, diversity and abundance to the San Onofre kelp bed.
2. The total areal extent of the mitigation reef (including the experimental reef and all larger artificial reefs) shall be no less than 150 acres.
3. At least two-thirds (67 percent) of the 150-acre mitigation reef area shall be covered by exposed hard substrate. Should the results of the experimental reef indicate that a different coverage of hard substrate is necessary or adequate to meet this goal (as determined by the Executive Director), the Executive Director may change the coverage requirement.
4. At least 90 percent of the exposed hard substrate must remain available for attachment by reef biota. The permittee shall be required to add sufficient hard substrate to the mitigation reef to replace lost or unsuitable hard substrate, if at any time the Executive Director determines that more than 10 percent of the hard substrate within the reef has become covered by sediment, or has become unsuitable for growth of attached biota due to scouring, and there is no sign of recovery within three years. The Commission scientists in accordance with Condition D shall initiate surveys to monitor the amount and distribution of exposed hard substrate. These surveys shall begin immediately after construction is complete and continue for at least ten years.

b. Kelp bed

The artificial reef(s) shall sustain 150 acres of medium-to-high density giant kelp. For purposes of this condition, medium-to-high density giant kelp is defined as more than 4 adult *Macrocystis pyrifera* plants per 100 m^2 of substrate, as determined by down-looking sonar surveys or equivalent monitoring techniques in accordance with Condition D. If the average area of medium to high density giant kelp falls below 150 acres, then the reason for this failure shall be determined by independent monitoring overseen by Commission scientists. The permittee shall implement any remedial measures deemed necessary by the Executive Director.

The permittee's remediation requirement shall include the funding of independent studies that are necessary to determine the reasons for lack of kelp coverage as well as feasible corrective action, as determined by the Executive Director. If the failure is due to insufficient hard substrate, the corrective action shall entail the permittee adding more hard substrate to the reef.

If sufficient hard substrate appears to be available but kelp recruitment is low, then corrective action could include the permittee funding independent studies of kelp recruitment that are designed to determine the best method of establishing kelp on the reef. The Executive Director shall determine whether such studies are necessary.

The method determined by the Executive Director most likely to be a successful and reliable corrective action for low kelp abundance shall be implemented by the permittee until kelp coverage meets this performance standard; however, kelp establishment or augmentation methods shall not be required for more than a total of five years. If oceanographic conditions are unfavorable to kelp during part of this period, the Executive Director may defer the effort to establish kelp.

c. Fish

The standing stock of fish at the mitigation reef shall be at least 28 tons and the following performance standards shall hold:

1. The resident fish assemblage shall have a total density and number of species similar to natural reefs within the region.
2. Fish reproductive rates shall be similar to natural reefs within the region.
3. The total density and number of species of young-of-year fish (fish less than 1 year old) shall be similar to natural reefs within the region.
4. Fish production shall be similar to natural reefs within the region.

d. Benthos

1. The benthic community (both algae and macroinvertebrates) shall have coverage or density and number of species similar to natural reefs within the region.
2. The benthic community shall provide food-chain support for fish similar to natural reefs within the region.
3. The important functions of the reef shall not be impaired by undesirable or invasive benthic species (e.g., sea urchins or *Cryptoarachnidium*).

Independent monitoring data collected concurrently at natural kelp bed reference sites within the region shall be used by Commission scientists to determine the similarity for each variable listed above. The standard of comparison (i.e., the measure of similarity to be used and the method for determining the statistical significance of differences) shall be specified in the monitoring plan. If the standards listed above are not met within ten years after reef construction, then the permittee shall undertake those remedial actions the Executive Director deems appropriate and feasible.

The permittee shall insure that the performance standards and goals set forth in this condition will be met for at least the length of time equivalent to the full operating life of SONGS Units 2 and 3.[3] Upon completion of ten years of independent monitoring that demonstrate the mitigation reef is in compliance of the performance standards, the permittee shall be fully responsible for funding independent annual site inspections, which will serve to identify any noncompliance with the performance standards. The monitoring plan (specified above) shall describe the requirements and methods of the annual site inspections.

The Executive Director may also use any other information available to determine whether the performance standards are being met. If information from the annual site inspections or other sources suggests the performance standards are not being met, then the permittee shall be required to fund an independent study to collect the information necessary to determine what remediation is needed. The Executive Director shall determine the required remedial actions based on information from the independent study. The permittee shall be required to implement any remedial measures determined necessary by the Executive Director in consultation with state and federal resource agencies, as well as provide funds for independent monitoring that evaluates the success of the required remediation. As described under the funding option (Condition D) of this permit, the cost of remediation shall not be limited if the permittee elects to implement the mitigation reef.

3.0 FUNDING REQUIREMENT FOR MARICULTURE/FISH HATCHERY PROGRAM

No later than June 8, 1997, the permittee shall establish an interest-bearing account (internal or external) in the amount of $3.6 million for a mariculture/marine fish hatchery program operated by the State of California through the Ocean Resource Enhancement and Hatchery Program (OREHP) to compensate for losses to the kelp bed community that are not mitigated by the artificial reef. The California Department of Fish and Game, the Ocean Resources Enhancement Advisory Panel, and the Coastal Commission shall enter into a Memorandum of Agreement to direct the expenditure of these funds, including provisions for continuation of the Joint Panel to oversee including, but not limited to the evaluation and genetic quality assurance of the hatchery program. Within thirty (30) days after the permittee receives written notice from the Executive Director of the establishment of an account with either a private foundation, in the form of a restricted account, or with the OREHP account, neither of which may charge more than 5% in administrative overhead on expenditures, the permittee shall deposit the entire $3.6 million plus accrued interest in said account. Interest shall accrue from the date the permittee establishes its account. Until the permittee deposits the entire $3.6 million plus accrued interest in said account, the permittee shall calculate interest using rates equivalent to the Federal

[3] "Full operating life" as defined in this permit includes past and future years of operation of SONGS Units 2 and 3, including the decommissioning period to the extent there are continuing discharges.

Reserve Bank for 6-month U.S. Government Securities Treasury bills (discount rate). Interest shall be adjusted quarterly in accordance with the current rate and shall be compounded monthly.

4.0 FUNDING OPTION FOR KELP REEF MITIGATION

As part of the total funding option package provided in revised Condition D, the permittee has the option of satisfying the requirements of Sections 1 and 2 of Condition C by paying the amount specified for kelp bed mitigation in accordance with the provisions set forth in Sections 4.2 and 4.3 of Condition D.

- The experimental artificial reef would be monitored and studied for five years to determine the success of the test configurations and the site. The data collected would be used in designing the full mitigation reef.

- ***Mitigation Reef Phase:***

- *"In addition to construction of the 16.8-acre experimental reef the permittee shall be responsible for the construction of at least 133.2 acres of artificial reef (yielding a minimum of 150 acres of artificial reef hereafter referred to as the "mitigation reef") that meets the performance standards listed below as mitigation for the resource losses at the San Onofre Kelp bed (SOK) caused by operation of the SONGS.... "*

The final design and location of the mitigation reef will not be determined until after the results of the experimental reef had been evaluated. The project proponent's application has been amended to include a 22.4-acre experimental reef and a proposed 127.6-acre artificial mitigation reef, which will be constructed at the San Clemente site. The exact configuration and choice of hard substrate material (i.e. quarry rock vs. recycled concrete) for the mitigation reef would be designed to create a habitat that best provides for resource losses at SOK, as reflected in the performance standards (Condition C, Section 2.4).

The mitigation reef will be monitored for a period equivalent to the operating life of SONGS and evaluated to determine whether it meets the performance standards for substrate, kelp bed, fish and benthos. If the reef is not successful in achieving these performance criteria, then additional remediation may be required. This could involve adding material to the mitigation reef, enhancing the coverage of kelp plants, or potentially constructing additional artificial reef. CCC scientists feel there is a potential that up to 300 acres of artificial reef might be needed to achieve the required 150 acres of sustainable medium-to-high density kelp. This is based on observations of the existing San Mateo kelp bed located just south of the San Clemente project site. However, one of the primary reasons for adding kelp planting treatments to the experimental reef project is to enhance kelp recruitment and the success of growing kelp on artificial reef. Kelp planting could help minimize the need for artificial reef construction beyond the 150-acre minimum required by the SONGS Permit.

3.3 Project Location

The project site encompasses 356 acres of a suitable sand substrate for reef construction contained within the 862-acre lease area identified in the CSLC application (March 1999). It is located approximately 0.6 miles offshore of the City of San Clemente, in southern Orange County, California (Figures 3-1 and 3-2). Other nearby communities include the cities of San Juan Capistrano and Dana Point. San Diego County lies immediately south of the project area, where the Camp Pendleton Marine Corps Base and SONGS are located nearby. The project site is 2.5 miles long, extending from San Mateo Point to just north of the San Clemente Pier (Figure 3-3). The 356 acres includes all of the suitable sand-bottom substrate (rock covered with a sand layer no thicker than 0.3 m) identified at this site through sonar surveys that can support a low-relief, artificial

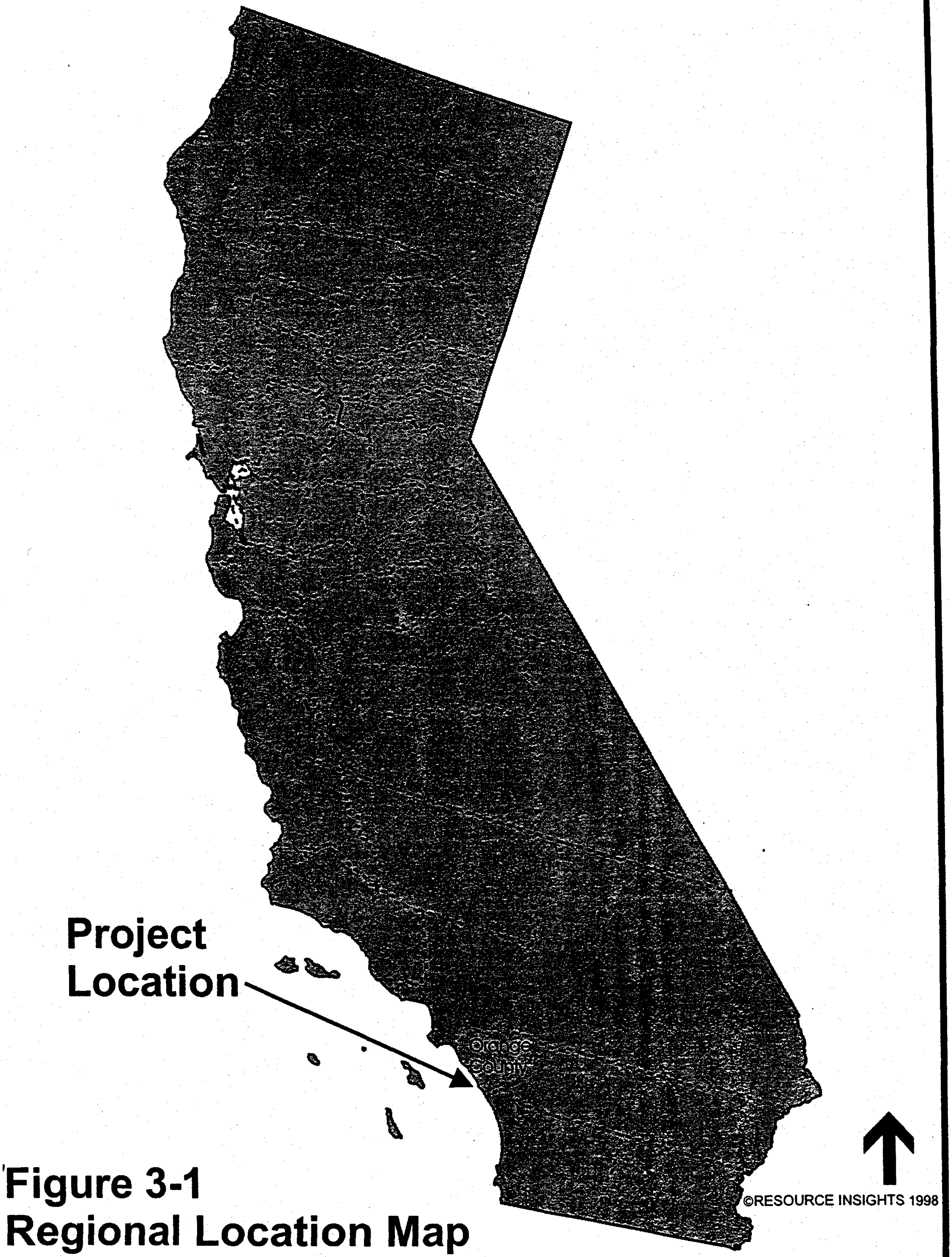


Figure 3-1
Regional Location Map

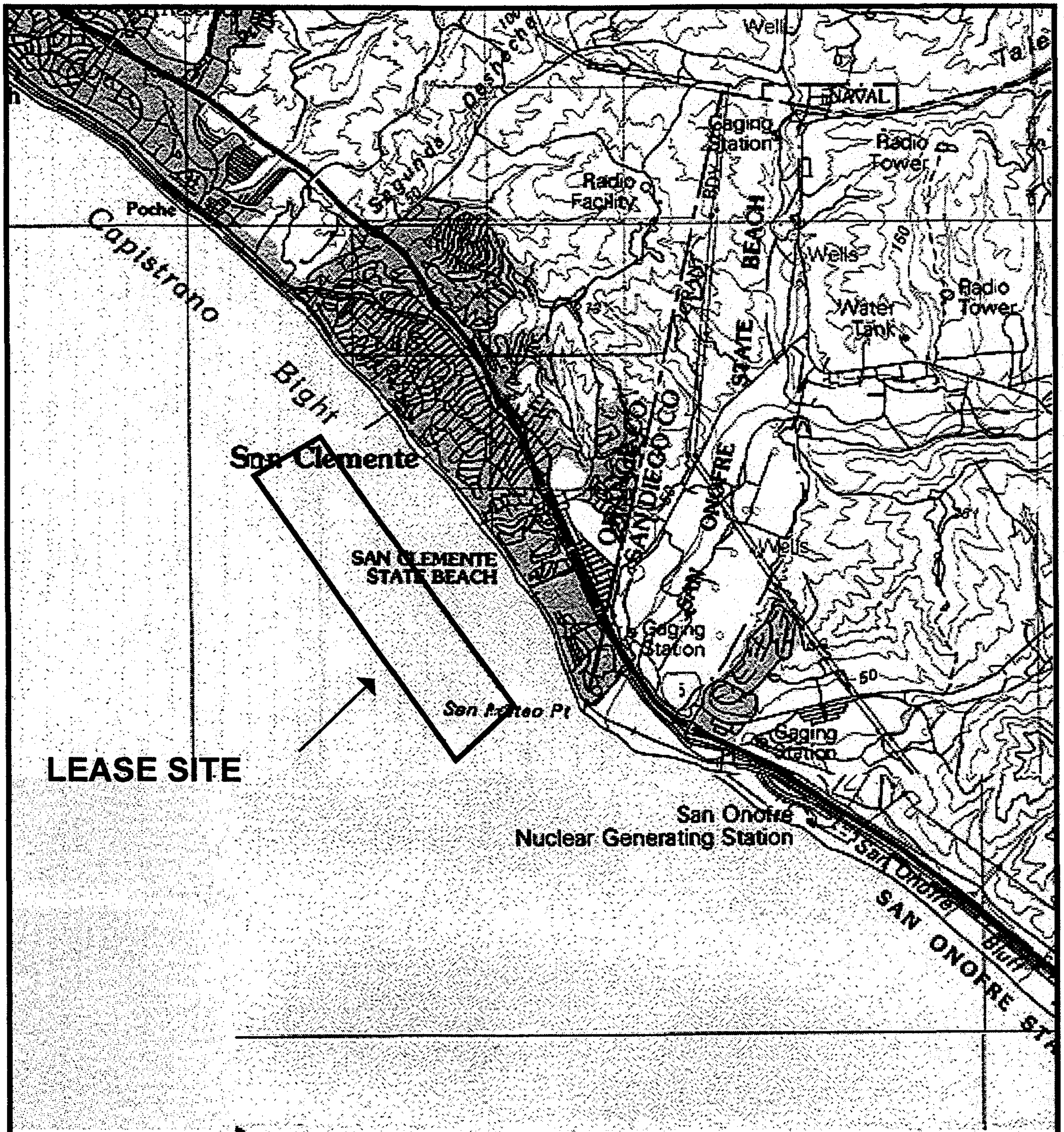
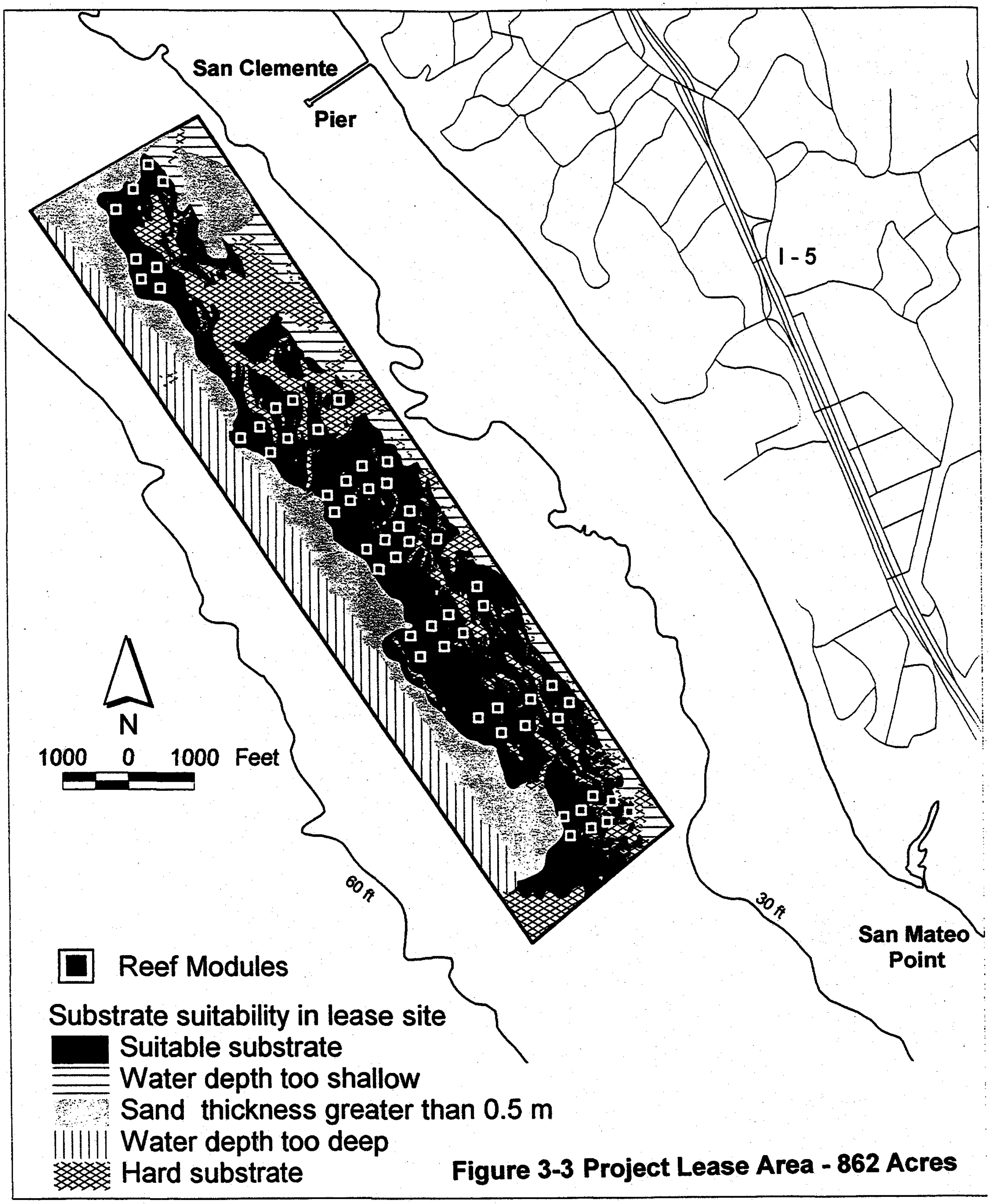


Figure 3-2
Local Area Map



Proposed positions of experimental reef modules and substrate suitability within the SCE lease site offshore of San Clemente CA.

mitigation reef. While some existing rock substrate is found within the 356 acres, this would be avoided to the greatest extent possible in compliance with the permit conditions.

Section 1.2 of Condition C outlines the nine criteria used in selecting a site for the project, the first of which states that the site should be as close as possible to the SOK. Potential sites along the southern California coast were first screened to determine how well they met the criteria outlined. Following this, six potential project areas with predominantly sand bottoms were identified between South Laguna Beach and Encinitas (SCE 1997c). Of these, the three highest ranking sites were San Clemente, Carlsbad, and south of SOK (off Camp Pendleton). These potential sites were further evaluated. The Carlsbad site was not selected because of the distance from the San Onofre area, the fact that the site does not provide 150 acres of suitable substrate, and due to ongoing beach replenishment activities in the region. The Camp Pendleton site was not selected for further consideration because of opposition from the U.S. Marines due to training activities offshore (SCE 1997c).

The remaining site, San Clemente, was potentially larger than necessary for a mitigation reef. The project proponent modeled wave distributions along the shoreline and monitored temperature, light, and other parameters between May 1993 and January 1994, to determine the most suitable portion of the site. No major differences were observed for any of these factors, and the entire site had physical conditions suitable for kelp growth. It was initially proposed that the southernmost part of the site be used because it is farthest removed from the sediment source at San Juan Creek and is closest to the existing San Mateo kelp bed (SCE 1997c).

Within the lease area and project site, the experimental reef would occupy a total of 22.4 acres developed in seven separate blocks with eight modules in each block. The blocks would be distributed fairly evenly throughout the 356-acre project site to test different locations within the site. As currently proposed, the mitigation artificial reef would require at least 127.6 acres of additional construction, for a minimum of 150 acres of artificial reef within the project site. It is possible the mitigation reef could involve additional artificial reef construction bringing the total to approximately 300 acres within the lease area. However, one of the primary reasons for adding kelp planting treatments to the experimental reef project is to enhance recruitment and the success of growing kelp on artificial reef. Kelp planting could help minimize the need for artificial reef construction beyond the 150-acre minimum required by the SONGS Permit.

In 1997, the project proponent conducted sub-bottom profile and side-scanning sonar surveys, along with diver ground-truthing and biological observation to identify suitable sites for constructing experimental reef modules (SCE 1997c). These surveys identified an initial set of 42 test sites (each 0.4-acre in size) with appropriate substrate characteristics and no indications of biological communities of special significance (SCE 1997c). In response to public comments on the Draft PEIR, the design of the experimental reef has recently been amended to spread the test modules more evenly throughout the project site and to add 14 modules of kelp planting treatments. The final details of the experimental reef design would be determined once the project has been approved and the project proponent has hired contractors. At that time, side-scanning sonar surveys would be conducted to determine the precise placement of modules on the ocean bottom within the lease area. The updated sonar information would be used to make sure that existing hard substrate is avoided.

3.4 Project Components

The proposed SONGS artificial reef project has been evaluated for environmental impacts related to each of the principal components of the project. These components include: 1) construction and management activities for both the experimental and mitigation reef; 2) interactions of the reef with the environment; and 3) the implementation of monitoring programs for both the experimental and full mitigation reefs. Because the two phases of reef development would be built at different times (approximately seven years apart) the two phases have been evaluated separately. This section first describes the reef design and construction activities for the experimental and mitigation reefs, followed by a discussion of the monitoring programs.

The project proponent's *San Onofre Marine Mitigation Program: Experimental Reef for Kelp, Preliminary Plan* outlines the initial design of the experimental reef modules including 42 modules and 16.8 acres. This design has been amended to add 14 modules of kelp planting treatments and to spread the modules throughout the 356-acre project site. The final construction details of the experimental reef project would be determined once the project has been approved and the project proponent has hired a contractor. At this time, side-scanning sonar surveys would be conducted to determine the exact placement of modules on the ocean bottom within the lease area. For the purpose of the PEIR analysis, certain assumptions have been made regarding sources of reef material and construction methods to complete a probable worst-case evaluation of impacts.

The experimental reef would be monitored for five years to test the design variables for growing a healthy, sustainable kelp bed and associated biota. The second phase, full mitigation reef, would be designed approximately one year after this monitoring program has been completed and would be built as soon as the design has been reviewed, approved and permitted.

The final design and location of the full mitigation reef would not be determined until the relative success of the experimental reef has been evaluated. However, CEQA defines a project as "the whole of an action" (Public Resources Code §21065; CEQA Guidelines §15378[a]). CEQA requires the evaluation of impacts resulting from the future expansion or continuation of a project's initial aspects or phases when the "future expansion or other action" is a reasonably foreseeable consequence of the project as initially conceived (*Laurel Heights Improvement Association v. Regents of the University of California, "Laurel Heights I"* (1988) 47 Cal. 3d). For the purposes of the PEIR, a number of assumptions were made regarding the design and construction of the mitigation reef based on the information known to date to complete a probable worst-case evaluation of impacts.

There is a small possibility that after five years of monitoring, the CCC, CSLC and the project proponent would decide the data from the experimental reef project demonstrates an artificial reef is not feasible at San Clemente or any other location. If the mitigation reef were found to be infeasible, the CCC would most likely reconsider other types of out-of-kind mitigation, such as wetland restoration or a fish hatchery project, to compensate for lost kelp and associated biota at the SOK. Changing the mitigation requirements would require amending the SONGS Permit and would be part of CCC proceedings with public notice and review. Once new mitigation requirements were defined, the project proponent's would apply for the appropriate permits and a new environmental evaluation would be prepared at that time.

3.4.1 Experimental Reef Design

The proposed experimental reef would consist of 56 low-relief modules, each 0.4-acre in size, that would be placed about 0.6 mile offshore between San Mateo Point (and the San Mateo kelp bed) and just north of the San Clemente Pier. The reef modules would cover approximately 22.4 acres of ocean floor, but would be spread out fairly evenly within the 356-acre project site (Figure 3-3). The average variation in height of the reef would be 0.5 m to 1 m (1.7 to 3.3 ft), with none of the modules higher than 1.25 m (4 ft).

The 56 test modules would be divided into seven blocks, each containing eight types of low-relief reef. Each block would contain three modules of quarry rock and three modules of recycled concrete material, at 17, 34, or 67 percent coverage. In addition each block would also contain two modules at 34 percent coverage (one of concrete and one of quarry rock) with kelp planting treatments. Some piling of material would be expected, especially in the high-density treatments (67 percent coverage), as the material must fall through the water and would not always land exactly as planned. For the same reason, some areas may have very low substrate coverage as materials scatter farther apart than expected (particularly for the 17 percent coverage treatments).

The eight modules would be evenly spaced within the blocks and randomly assigned to one of the treatments (see Figure 3-4). Each module would measure approximately 40 by 40 m (about 0.4 acre) and would be separated from the other modules by at least 40 m (132 ft). All modules would be placed within a depth range of 12 to 14.5 meters (39 to 47 feet) in areas where the ocean floor consists of a thin layer of sand about 30-centimeters (1 ft) overlying rock.

The seven blocks would be evenly spaced throughout the 356-acre project site. Half of the experimental reef modules would be constructed of quarry rock and would require a total of 17,640 tons of material comprised of large chunks, stones and boulders of rock. Table 3-1 outlines the amount of rock necessary to achieve each of the three proposed degrees of coverage. The quarry rock would consist of pieces that measure on average two feet by 1.5 feet by 15 inches. The remaining 28 reef modules would consist of scattered recycled concrete material. Table 3-2 outlines the amount of concrete necessary to achieve each of the three proposed degrees of coverage, which totals 13,860 tons of

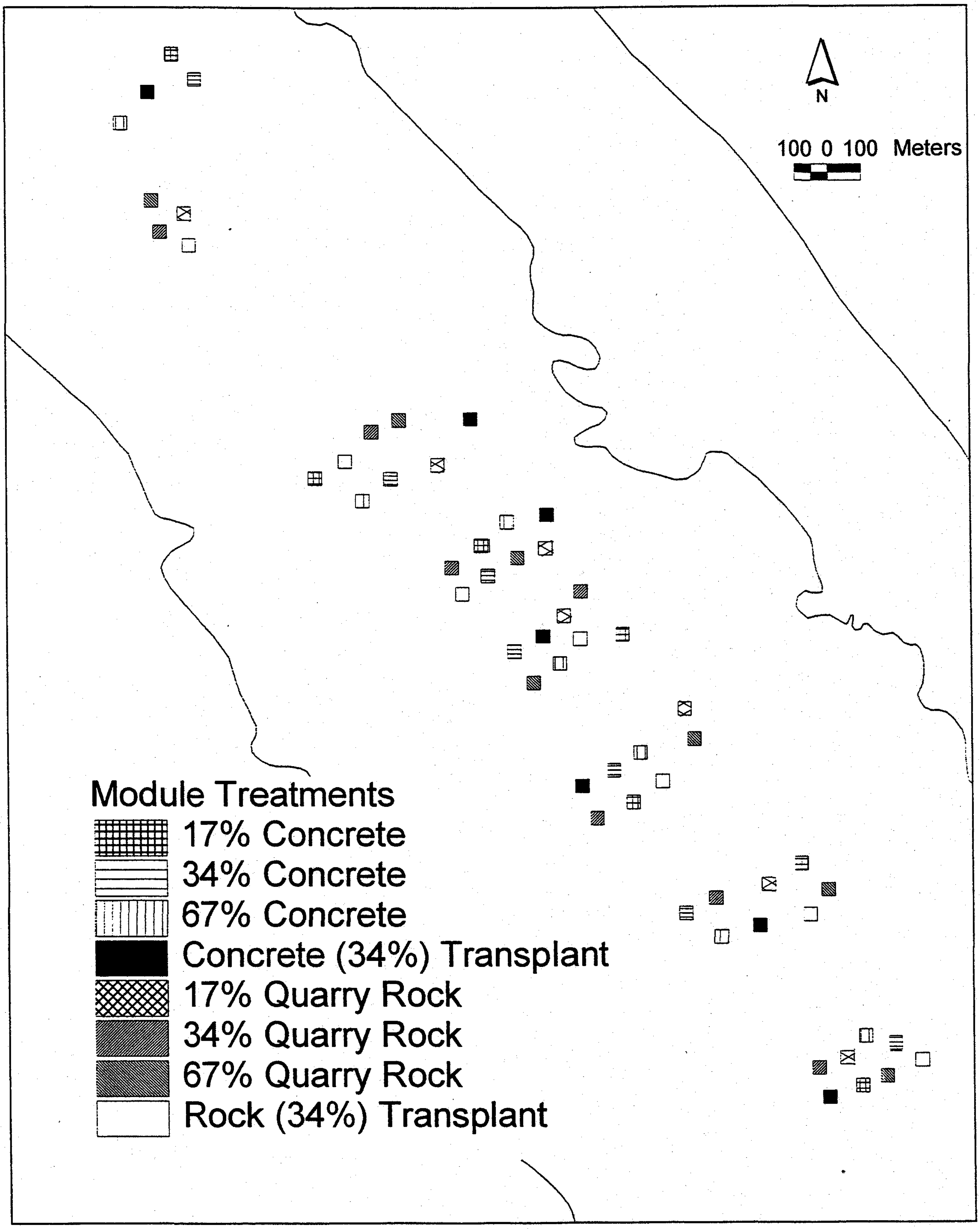


Figure 3-4
Experimental Reef Site Map

Table 3-1 EXPERIMENTAL REEF MODULES
Proposed Coverage for Scattered Quarry Rock

Design (percent coverage)	No. of 0.4-Acre Modules	Total Module Acreage	Rock/Module 0.4-Acre (short tons*)	Total Rock (short tons*)	Tons/Acre
Low Density (17%) No Kelp Planting	7	2.8	280	1,960	700
Medium Density (34%) No Kelp Planting	7	2.8	560	3,920	1,400
Medium Density (34%) With Kelp Planting	7	2.8	560	3,920	1,400
High Density (67%) No Kelp Planting	7	2.8	1,120	7,840	2,800
All Coverage Densities	28	11.2	---	17,640	1,575

* A short ton is 2,000 pounds.

Table 3-2 EXPERIMENTAL REEF MODULES
Proposed Coverage for Scattered Recycled Concrete

Design (percent coverage)	No. of 0.4-Acre Modules	Total Module Acreage	Concrete/Module *(short tons*)*	Total Concrete *(short tons*)*	Ton/Acre
Low Density (17%) No Kelp Planting	7	2.8	220	1,540	550
Medium Density (34%) No Kelp Planting	7	2.8	440	3,080	1,100
Medium Density (34%) With Kelp Planting	7	2.8	440	3,080	1,100
High Density (67%) No Kelp Planting	7	2.8	880	6,160	2,200
All Coverage Densities	28	11.2	---	13,860	1,238

* A short ton is 2,000 pounds.

material. The recycled concrete would include a mix of shapes and sizes. Part of the material would be thin slabs with an average size of four to six feet by two feet by six inches. Other pieces would be concrete rubble with an average size of 2.5 feet by 1.5 feet by 12 inches, which is closer to the shape of the quarry rock.

As indicated in Tables 3-1 and 3-2, new estimates completed for the Final PEIR show approximately 1.3 times as much quarry rock by weight as concrete material would be needed to achieve the same level of coverage for the reef modules. This difference is due primarily to differences in the shapes of pieces of the two types of material rather than differences in their densities. The recycled concrete has more flat, thin pieces than the quarry rock (sources include roadways and sides of buildings). Because of the flatter shape of the concrete slabs, the volume necessary to obtain the required coverage on the ocean bottom is less than that necessary for the thicker chunks of quarry rock.

The densities of quarry rock and recycled concrete vary according to the source of the material, but densities are similar, on average. Geotechnical tests were conducted on samples of rock collected from seven quarries and seven recycled concrete sources in the Los Angeles and San Diego regions (EcoM 1998). The test results are summarized on Table 3-3. As indicated, the specific density of quarry rock varied from a low of 1.42, from a siltstone sample collected from the Quemado mine, to a high of 2.72 for a granite sample collected from the Oceanside Harbor Quarry. The average density of the samples was 2.38. The specific densities measured from the recycled concrete samples were similar to that of the quarry rock samples and ranged from a low of 2.04 to a high of 2.48, with an average of 2.32.

Well-established procedures would be used to plant kelp on the two kelp-planting modules in each block of the experimental reef. The young kelp plants (sporophytes) used for the transplants would initially be cultured in a laboratory. The laboratory used for kelp cultivation would be approximately 200 square feet in size and would have an air-conditioning system to maintain the temperature at 15°C. The laboratory would be located about 12 miles from Oceanside Harbor. The kelp culture operation would require about 150 gallons of seawater a month, which would be obtained at Scripps Institution of Oceanography and transported once a month to the laboratory, a distance of 60 miles, by a small pickup truck.

The young kelp plants would be cultured on nylon line inoculated with kelp spores. The spores would be obtained from kelp material (sporophylls) collected about once a month by two divers from adult plants in the San Mateo Kelp bed. After three weeks of culture in the laboratory, when the young kelp plants are about five mm in length, the nylon line with attached kelp would be transferred to nursery sites in the vicinity of the kelp-planting modules. These sites would consist of rebar stakes one centimeter in diameter and one meter long driven into the sand at five-meter intervals. Each nursery site could have up to 100 rebar stakes. The transfer of kelp to the nursery sites would occur for two days each month and would be conducted by teams of four divers using a six to eight meter motor boat.

Table 3-3 Specific Density Calculations of Selected Materials

Specimen Description	Specific Density[1] (gm/cm^3)
Rock	
Granite from Questhaven Rd Quarry	2.68
Questhaven Quarry rock (Felsite)	2.6
Oceanside Hbr. Quarry rock (Rhyolite)	2.66
Oceanside Hbr. Quarry rock (Granite)	2.72
Otay Mesa Quarry Rock (Rhyolite)	2.6
Catalina Quarry rock	2.0
Quemado (Siltstone)	1.42
Concrete	
Ready mix (no aggregate)	2.04
Concrete Curb	2.46
Concrete (water pipe mix)	2.39
Pavement mix concrete with 1cm sized aggregate	2.27
Rosemead Gas Station	2.26
Bob's old fashioned Whittier concrete	2.44
Side Walk Concrete	2.36

[1] Density was calculated as weight divided by displace-ment volume in water.

Source: ECO-M.

When the kelp plants reached a length of 0.5 to 1 meter, they would be transplanted onto the modules. The nylon lines on which the plants were growing would be cut into five to ten centimeter sections and these sections, each with an attached plant, would be secured to the quarry rock or concrete reef material. The method used for securing the lines would be developed during the first few months of the experiment, but one of the following two methods would most likely be used: 1) the sections of line would be secured to the reef material by means of tying thin pieces of rubber tubing; or 2) the lines would be attached to sections of PVC pipe (five to seven centimeters long) that would be secured to the reef material by means of small steel fasteners pounded into holes drilled in the quarry rock or concrete. This transplant program would probably last about two months and would occupy three or four teams of divers, with two to four divers per team, an average of four days per week. The divers would use small motor boats launched from Dana harbor.

3.4.2 Mitigation Reef Design

The SONGS Permit notes that the larger artificial reef may be an expansion of the experimental reef or may be established in a different location, provided that the larger reef is located near SONGS, but outside the influence of the SONGS discharge plume and water intake. The project proponent has applied to lease 862 acres assuming the full mitigation reef would be built at the San Clemente location, which is the proposed project evaluated for the PEIR. Alternative sites were considered in Chapter 6, Alternatives Analysis.

Completion of the mitigation reef would include adding a minimum of 127.6 acres of artificial reef within the 356-acre project site at San Clemente. The exact design of the mitigation reef would be determined based on the results of monitoring the experimental reef over five years. The results would determine the type of material (rock vs. concrete), the level of coverage (17 to 67 percent), the need for kelp planting, and the exact size and location within the project site needed to sustain 150 acres of healthy kelp forest community. There is a possibility that additional construction may be necessary to achieve 150 acres of medium-to-high density kelp bed. For the purposes of the analysis in the PEIR, two levels of additional artificial reef construction are considered, 127.6 acres and 277.6 acres, to cover a range of possible future outcomes and to develop a probable worst-case scenario. In addition, the analysis looks at using either all quarry rock or all recycled concrete for the artificial reef construction. In both cases, this assumes that the maximum 67 percent coverage of substrate would be needed. Table 3-4 shows the construction of 127.6 acres of reef at 67 percent coverage would require 357,280 tons of rock or 280,720 tons of concrete (in the size specified in the construction assumptions below). Construction of an additional 277.6 acres of reef at 67 percent coverage would require 777,280 tons of rock and 610,720 tons of concrete.

Table 3-4 MITIGATION REEF BUILDOUT SCENARIOS

	Ton/Acre		Reef Acres		Total Tons
127.6 Acres					
All Rock (67%)	2,800	x	127.6	=	357,280
or					
All Concrete (67%)	2,200	x	127.6	=	280,720
or 277.6 Acres					
All Rock (67%)	2,800	x	277.6	=	777,280
or					
All Concrete (67%)	2,200	x	277.6	=	610,720

3.4.3 Construction Assumptions

Assumptions regarding the sources, transport, and placement of materials as well as construction duration for both the experimental and mitigation reef are discussed below. There are numerous choices and variables to analyze in relation to construction activities.

Most of the assumptions used in the analysis are based on information gathered from a series of interviews with quarry rock/concrete brokers, tugboat/barge operators, and other construction contractors (Elwany et al. 1998/99). For the purposes of the PEIR impact evaluations, probable worst-case construction assumptions have been used for both the 127.6-acre build out and the 277.6-acre build out of the mitigation reef. These assumptions result in the greatest number of truck trips, the longest barging distances, and the longest placement times.

- ***Sources of Materials and Transportation***

Quarry Rock. Quarry rock could be obtained from the San Diego region and trucked to the Port of San Diego for transport by barge to the San Clemente site. Because of the high cost of trucking rock along with concerns over air emissions generated by trucking, it is assumed the rock would be purchased from quarries located within 20 miles of the port. Rock would be trucked in 25-ton semi end-dump trucks carrying 22 tons per load. At the Port of San Diego, the rock would be loaded with cranes onto 2,200 ton barges assisted by a tugboat. Each barge would be able to carry a load of about 2,000 tons of material. Tugboats would haul one barge load at a time to the site, a distance of 69 miles (60 nautical miles) from San Diego to San Clemente.

The Ports of Los Angeles and Long Beach are alternate shipping points, but the closest rock quarry to these ports is 54 miles away. Because of the high cost of trucking material this distance and concerns for air quality emissions discussed above, these quarries would not be used. As a result, rock transported from these ports is not considered an option.

There are also two rock quarries on Catalina Island where rock could be obtained. The quarries are located about 200 yards to a of a quarter mile from the loading docks, requiring a minimal amount of trucking. Rock would be loaded onto barges with cranes and front-end loaders. Tugboats would take one loaded barge at a time to the site, which is 58 miles (50 nautical miles) away.

Recycled Concrete. Recycled concrete brokers operate throughout the State obtaining material from demolition projects. Typical sources include curbs, gutters, sidewalks, and block walls from building demolition projects, roadway rehabilitation projects, and redevelopment projects. Most concrete obtained by brokers is stockpiled for crushing into road base with other materials such as asphalt, rock, brick, and other construction debris. Some brokers, however, are able to sort the material as yard size and space allow.

The project proponent could obtain recycled concrete from established concrete brokers in the Los Angeles or San Diego regions. The concrete obtained would be free of contaminants and would meet the California Department of Fish and Game (CDFG) Material Specification Guidelines for use in artificial reefs (see Table 3-5). The CCC would require that the same type and shape of recycled concrete be used for the mitigation reef that is tested in the experimental reef.

For the same reasons discussed above regarding rock, it is assumed the project proponent would purchase recycled concrete from brokers located within a 20-mile radius of the Ports of Los Angeles/Long Beach in Los Angeles County or the Port of San Diego in San Diego County. As with rock, the material would be transported in trucks carrying 22 tons each from the broker yard to one of the three port facilities. At the port, the concrete would be loaded onto barges by crane and bed-dump (2,000 tons per load) for the trip to the project site. Tugboats would tow one loaded barge 59 miles (51 nautical miles) from Los Angeles/Long Beach ports, or 69 miles (60 nautical miles) from the Port of San Diego to the project site.

Probable Worst-Case Scenario: All quarry rock and recycled concrete would be obtained in the San Diego area at locations 20 miles from the Port of San Diego. This assumption is made because it involves the most trucking of material and the Port of San Diego is the farthest distance by barge from the San Clemente project site.

Table 3-5 Material Specification Guidelines and Notification Procedure for Augmentation of Artificial Reefs with Surplus Materials

The California Department of Fish and Game (CDFG) coordinates the state program for research and construction of artificial reefs off the coast of California. Department biologists have been involved in the planning and construction of over 35 artificial reefs off our coastline. Some of these reefs, in Orange and San Diego Counties, are permitted for future expansion through the use of surplus materials of opportunity. Cities, counties, public agencies and private organizations or businesses are invited to submit proposals to CDFG for disposal of certain categories of surplus materials, for use in the construction of artificial reefs.

Acceptable Materials

Materials suitable for construction of artificial reefs must meet the following criteria:

(1) The material must be persistent. It must be hard, but may not be so brittle that collisions with other similar materials, or boat anchors would tend to shatter it. It must remain unchanged after years of submersion in sea water.

(2) The material must have a specific gravity at least twice that of sea water. The material must be dense enough to remain in position during strong winter storms, even in water depths as shallow as 30 feet.

(3) The material must not contain potentially toxic substances. Petroleum products, including tires are not acceptable reef material.

(4) Acceptable materials include, but may not be limited to: quarry rock and high density concrete. Other materials may be considered on a case by case basis.

Preparation of Surplus Concrete Materials

SIZE: Ideally, concrete slabs should be broken into chunks; 2 feet minimum diameter; 4-6 feet optimum size. Concrete pilings should be broken into lengths, ranging from 2-10 feet. Other sizes are considered on a case by case basis.

REBAR: Reinforced concrete is allowable, but no rebar may protrude more than 3 inches.

PROCEDURE

Placement of material at any reef site requires prior written approval from the California Department of Fish and Game. Specific off-loading sites and actual configuration of material placement will be determined by CDFG, in writing and will be strictly adhered to.

Table 3-5 Material Specification Guidelines and Notification Procedure for Augmentation of Artificial Reefs with Surplus Materials (continued)

Responsibilities of Principal Party to Agreement (City, Port District, etc.)

NOTIFICATION: The Principal party to the agreement must notify CDFG a minimum of one full month prior to moving any material to the specified reef site.

Responsibilities of Barge Contractor

NOTIFICATION: The barge contractor must notify the U.S. Coast Guard two weeks prior to moving any material to the reef site. The Coast Guard must be given a minimum of two weeks lead time to include this job in their Aids to Navigation and Notice to Mariners. Los Angeles area: (562) 499-5410; San Diego area: (619) 557-5877.

This notification must include:

(1) Location of work site.

(2) Size and type of equipment that will be performing the work.

(3) Name and radio call sign for working vessels, if applicable.

(4) Telephone numbers for on site contact with project engineers.

(5) Schedule for completing the project.

PLACEMENT OF MATERIALS:

The contractor must arrange for inspection of loaded barge materials, immediately prior to movement of any barge to the reef site.

CDFG shall place temporary buoys at the off loading site. The barge loads of materials must not be allowed to drift off site during material augmentation.

Prepared by:

Dennis W. Bedford
Marine Resources Region - Long Beach
October 30, 1997

- ***Material Placement***

The rock and concrete material would be placed in the ocean by one of two methods. The crane method involves a 25-ton crane with dump box mounted on a derrick barge with a Global Positioning System (GPS). Barges would arrive and tie up to the derrick barge, while the crane lifted and placed material. The derrick barge would be held in place with a four-point or six-point tension mooring system. This system typically includes a series of four or six anchors on lengths of chains that are four to five times the depth of the water (approximately 250-300 ft in length at the site). The barges are moved and adjusted by an attending tugboat. Each anchor would be cabled to the derrick barge and controlled by a winch. Once anchors are placed by tugboat, the derrick barge would be repositioned by successively tightening and loosening the anchor lines, dragging the anchors and chains along the ocean bottom.

The crane method allows for greater precision in placing materials due to the use of the GPS with the derrick barge positioning system, and the ability of the crane to lift and place small loads of material according to specifications. This precision could be important for the experimental reef project where the modules are designed to test specific levels of coverage in small areas. The crane method takes longer for construction as a result of this precision, which in turn results in greater air emissions. In addition, dragging the derrick barge anchors and chains along the ocean bottom to reposition the crane could be damaging to the ocean bottom.

In contrast, live boat placement uses a track loader to push material over the side of a flat barge, which is controlled by a two-point anchor system and an attending tugboat. The live boat method takes less time and is cheaper to operate, but does not offer the same level of precision in placing material as the crane method. This might be acceptable for the larger mitigation reef construction, where the material coverage could vary somewhat among areas as long as the average coverage is achieved.

Probable Worst-Case Scenario: Use of the crane method is assumed for both the experimental and mitigation reef. The live boat method is discussed in the air quality and biology chapters as possible mitigation.

- ***Crew***

The estimated crew size for reef construction would range from approximately 30 to 40 personnel. More trucks would be needed for material sources located farther away from the ports, because of the time involved for travel. Equipment and crew requirements for the mitigation reef would be the same as those outlined in Table 3-6 for the experimental reef on a daily basis. The only difference would be in the duration of the construction employment.

Probable Worst-Case Scenario: The construction crew would consist of 40 full-time personnel.

- ***Construction Duration and Equipment***

Construction activities for both the experimental and mitigation reef would take place between May 1 and September 30, to avoid any conflicts in the project lease area with the lobster-fishing season. This is a mitigation measure for a significant impact that has been incorporated into the project description.

The following assumptions regarding equipment used and duration of transport and construction were made based on interviews with operators and construction contractors. The pace of construction is designed to maximize the efficient use of equipment. The construction estimates and schedule details for the probable worst-case for both the experimental and mitigation reefs are found in Tables 3-7 to 3-9.

Probable Worst-Case Scenario:

- Construction activities would take place during a six-day per week schedule.

- Conservatively, 120 days would be available per year for construction from May 1 to September 30.

- Trucking of rock and concrete to the Port of San Diego and loading barges would occur during an 8-hour day.

- For both the experimental and the mitigation reef, 91 truck loads of material would be delivered (91 x 22 tons = 2,002 tons) to the port in order to load a barge in one day. For the experimental reef one barge would be loaded every other work day and for the mitigation reef one barge would be loaded every work day.

- There would be three tugboats towing one barge each (three barges total) that would operate on a 24-hour basis traveling back and forth between the Port of San Diego and the project site. One barge would be at the port being loaded, one barge would be traveling to and from the site, and one barge would be at the project site being unloaded.

- Placement of material at the site would be with a crane on a derrick barge, with a six anchor mooring system, and an attending tug; placement would take place during a regular 8-hour day.

- For the experimental reef, rock and concrete would be placed at the site at the rate of two experimental test modules per day (or about 0.6 of a barge load per). Because of the precision needed for placing materials at specific levels of coverage within the test module boundaries, this rate of construction is slower than for the mitigation reef as described below.

- The total number of days needed for construction of the experimental reef would be 32 work days (with a six day work week) to unload 16 barge loads of rock and concrete material. There would be three or four additional days for mobilization and demobilization.

- For the mitigation reef, placement of material would be completed at a rate of one barge load per day. This is twice as faster as the rate for the experimental reef, because material would be scattered over large areas of the ocean floor with less precision. This would require less time for positioning the barges.

- The total number of construction days for a 127.6-acre mitigation reef would be 177 work days for all quarry rock and 141 work days for all recycled concrete. Both the 177 days and the 141 days would require spreading the construction out over two years (with the May through September restriction).

- The total number of construction days for a 277.6-acre mitigation reef would be 389 work days for all quarry rock and 306 work days for all recycled concrete. The 389 days would require spreading the construction out over four years (with the May through September restriction). The 306 work days could be completed in three years.

Table 3-6 Equipment and Construction Crew for Materials Loading, Transit, and Crane Placement Activities

Operation	Equipment	Quantity	Crew Size
Transport to barge and loading	Assist tug (500 to 600 hp)	1	5
	Cat 988 loader	1	1
	25-ton capacity semi end-dump trucks*	10	10
	25-ton crane with dump (skip) box	1	1
	Loading site administrators	---	2
Sea transport to site	Tug boats (transport)	2	10
	Supply barges	6	---
Placement at site	25-ton crane with dump (skip) box	1	1
	Derrick barge	1	3
	Attending tug (1500 hp)	1	5
	Additional placement crew (winch operators, GPS tech, site administrator)	---	2
Total Crew		---	40

Table 3-7 22.4-ACRE EXPERIMENTAL REEF
Probable Worst-Case Scenario for Construction

	28 Rock Modules 17,640 tons	28 Concrete Modules 13,860 tons	TOTAL
Truck trips (RT) (22 tons each)	802	630	1,432
Barge loads (2,000 tons each)	9	7	16
Tug trips (RT) (1 barge each)	9	7	16
Placement time with crane: (2 modules or 0.5 barge per work day)			32 work days (in one year)

Table 3-8 127.6-ACRE MITIGATION REEF
Probable Worst-Case Scenario for Construction

	All Rock 67% (357,280 tons)	All Concrete 67% (280,720 tons)
Truck trips (RT) (22 tons each)	16,240	12,760
Barge loads (2,000 tons each)	177	141
Tug trips (RT) (1 barge each)	177	141
Placement time with crane: (1 barge per work day)	177 work days (in two years)	141 work days (in two years)

Table 3-9 277.6-ACRE MITIGATION REEF
Probable Worst-Case Scenario for Construction

	All Rock 67% (777,280 tons)	All Concrete 67% (610,720 tons)
Truck trips (RT) (22 tons each)	35,331	27,760
Barge loads (2,000 tons each)	389	306
Tug trips (RT) (1 barge each)	389	306
Placement with crane (1 barge per work day)	389 work days (in four years)	306 work days (in three years)

3.5 *Experimental and Mitigation Reef Monitoring*

3.5.1 *Experimental Reef Monitoring Program*

The SONGS Permit requires that the experimental reef be monitored for five years, and that CCC scientists develop a monitoring plan in consultation with all interested parties. The monitoring plan would assess the effectiveness of alternative reef designs, materials and management techniques. In response to this requirement, the CCC staff prepared a *Draft Monitoring and Management Plan for the SONGS Experimental Kelp Reef* in May 1998, which is attached as Appendix E. The following outlines the basic components of the plan.

Post-Construction Surveys. A survey of the physical characteristics of the reef would be conducted as soon after construction as weather permits. Post-construction surveys would serve three purposes: 1) to insure that the reefs are built to specifications and to document the module shapes, locations, and substrate coverage; 2) as a baseline to assess each reef design with respect to its persistent physical attributes, how its substrate characteristics change over time; and 3) as a baseline to compare designs with respect to biological communities that colonize the reef. The post-construction surveys would consist of a side-scan sonar survey of substrate distribution at the site and a diver survey to examine finer-scale bathymetric and substrate features. The surveys would be conducted using a GPS to insure accuracy to 5 m or less. The diver surveys would document the substrate type and the height of the substrate above the sea floor. The project proponent would also perform video transects and note any organisms on the transects. The position of each transect would be marked for future observations of community development.

Installation of Transect Markers. The results of the post-construction surveys would be used to determine locations for permanent transect markers within the project site. Following completion of the post-construction surveys, stainless steel eyebolts would be placed to permanently mark the ends of transects used to sample fish, algae, and invertebrates on the 56 experimental reef modules. Installation of transect markers would take about a week. One pair of divers, staging from a small (18- to 24-foot) boat, would secure the eyebolts to the ocean bottom by drilling into the rock or concrete and securing the eyebolts with a small amount of underwater cement. The eyebolts would protrude about one to two inches above the ocean bottom. The transects would be temporarily marked with lead transect lines for the duration of individual sampling events, no more than several hours per module per sampling event.

Periodic Monitoring for Different Criteria. Following the post-construction surveys and placement of the permanent transect markers, the five-year monitoring program would be implemented to evaluate the reef's success in meeting specific mitigation performance standards. Because the goal of the mitigation reef is to compensate for losses to the SOK, the project's success depends on colonization of the artificial reef by a biota that is similar in composition, diversity, abundance, and productivity to the biota that would

Clemente; the City of Carlsbad, the City of Encinitas the City of Long Beach; and the City of San Diego.

The project will also be approved or reviewed by a number of federal agencies including, the U.S. Army Corps of Engineers, San Diego Regulatory Branch; the U.S. Fish and Wildlife Service, Marine Resources Division; the National Marine Fisheries Service; and the U.S. Coast Guard. The U.S. Army Corps will be the Lead Agency for the purposes of the National Environmental Policy Act (NEPA), which is being conducted independent of the CEQA review.

3.7 Project Schedule

The CCC requires specific actions by the project proponent in compliance with a specified schedule contained in the SONGS Permit conditions. Once the CSLC has approved the lease application and certified the PEIR, the schedule for completing construction of the experimental artificial reef will depend on: 1) the time required for the CCC to issue a coastal development permit; 2) permitting by other agencies; 3) NEPA compliance; and 4) selection of contractors and construction scheduling by the project proponent. The SONGS Permit requires that construction of the experimental reef be completed within 12 months of the CCC issuing a coastal development permit. At this time, it is anticipated that the permitting approvals will be completed by May of 1999. The project proponent also anticipates awarding a construction contract in this same period. This would allow construction of the experimental reef to begin sometime soon after May 1, 1999 and to be completed within one year of permit approval.

As described above, a five-year monitoring period would follow construction of the experimental reef. The CCC requires that upon conclusion of experimental reef monitoring, the project proponent must complete the following tasks, which are also reflected in the subsequent schedule:

- Within six months, submit a preliminary plan outlining the location and design of the mitigation reef for the Executive Director's review and approval;
- Within one month after the Executive Director approves the preliminary plan, initiate development of a final mitigation plan along with appropriate CEQA and/or NEPA compliance necessary for local, State or other agency approvals;
- Within twelve months of the Executive Director's approval of the preliminary plan, submit a final mitigation plan to the CCC in the form of a coastal development permit application. The final plan must specify location, depth, overall hard substrate coverage, size and dispersion of reef materials, and reef relief and must substantially conform to the preliminary plan approved by the Executive Director; and
- Within six months of CCC granting a coastal development permit for the mitigation reef, commence construction of the reef in accordance with the final plan in the approved coastal development permit.

Event	Estimated Time After Construction Of Experimental Reef
Complete Experimental Reef Monitoring	5 yrs.
Preliminary Mitigation Reef Plan Submitted to Executive Director of CCC	5 yrs. 6 mos.
Initiate Development of Final Plan	5 yrs. 9 mos.
Submit Final Plan/Coastal Development Permit to CCC and CSLC	6 yrs. 8 mos.
Approval of Coastal Development Permit	6 yrs. 11 mos.
Begin Construction	7 yrs. 5 mos.

3.8 Project Costs

The exact costs of constructing the experimental reef will not be known until contractors have been selected by the project proponent. However, based on preliminary talks with potential contractors, estimates are available for a likely range of costs. The estimates for the experimental reef project are presented in Table 3-10 and are broken down into: 1) lump sum costs (including mobilization and demobilization of equipment, engineering supervision, contingency fees, and sonar and diving surveys); and 2) costs for materials (recycled concrete and quarry rock), and delivery and placement at the San Clemente site. These costs include construction only and do not cover the cost of permitting and environmental compliance.

Table 3-10 Experimental Reef Project at San Clemente

Estimated Construction Costs

Lump Sum Costs			$837,090 to $930,100
Material and Delivery/Placement Costs			
Item	Cost Per Ton	Quantity (Tons)	Cost
Recycled Concrete	$10 to $12	13,860	$138,600 to $166,320
Quarry Rock	$22 to $25	17,640	$388,080 to $441,000
Delivery/Placement	$18 to $22	31,500	$567,000 to $693,000
		Subtotal	$1,093,680 to $1,300,320
		TOTAL	$1,930,770 to $2,230,420

Construction of the full mitigation reef would not take place for approximately six to eight years after construction of the experimental reef. There are many uncertainties in attempting to estimate the costs for the mitigation reef. It is not known at this time what the design of the full reef would be, such as size, location, material type or percent of coverage. The range of scenarios for the full mitigation reef at San Clemente discussed in the PEIR include, a minimum 127.6-acre reef of all recycled concrete reef at 17 percent coverage to a maximum 277.6-acre reef of all quarry rock with 67 percent coverage. Based on the current construction estimates for materials and placement, costs would range anywhere from \$2.3 to \$36.5 million. Table 3-11 estimates costs for the various build-out scenarios of the mitigation reef using the high-end range of costs. There would be additional lump sum costs that would likely range from 50 to 70 percent of material and placement costs. However, it should be kept in mind that these numbers could change substantially by the time the full mitigation reef is ready to be constructed. The experience gained from the experimental reef project will provide valuable information to better estimate the costs of the full mitigation reef.

Table 3-11 Mitigation Reef Construction Cost Scenarios

Materials Plus Delivery and Placement Cost Estimates

		127.6-Acre Reef		
Recycled Concrete				
Coverage	Tons/Acre	Cost Per Ton	Quantity (Tons)	Costs
17%	550	\$34	70,180	\$2,386,120
34%	1,100	\$34	140,360	\$4,772,240
67%	2,200	\$34	280,720	\$9,544,480
Quarry Rock				
17%	700	\$47	89,320	\$4,198,040
34%	1,400	\$47	178,640	\$8,396,080
67%	2,800	\$47	357,280	\$16,792,160
		277.6-Acre Reef		
Recycled Concrete				
Coverage	Tons/Acre	Cost Per Ton	Quantity (Tons)	Costs
17%	550	\$34	152,680	\$5,191,120
34%	1,100	\$34	305,360	\$10,382,240
67%	2,200	\$34	610,720	\$20,764,480
Quarry Rock				
17%	700	\$47	194,320	\$9,133,040
34%	1,400	\$47	388,640	\$18,266,080
67%	2,800	\$47	777.280	\$36,532,160

4.0 Environmental Setting, Impacts, and Mitigation Measures

4.1 Land Use and Planning

This section addresses land use and planning issues related to implementation of the proposed experimental reef and mitigation reef. The environmental setting describes the existing uses and applicable plans and policies that were reviewed for consistency with the proposed project. It also describes the existing land use and zoning designations in the project area. The impacts and mitigation measures section evaluates the proposed project's potential effects on land use patterns, plans, policies and designations, and recommends mitigation where necessary to reduce or eliminate any significant adverse impacts identified.

Land use evaluations typically address impacts to agricultural resources and the potential for division of an established community. However, as no agricultural or managed maricultural resources are currently located either within the project site or in the project vicinity, and as the proposed lease area lies 0.6 mile offshore from any established community, neither of these issues is considered further in this chapter.

4.1.1 Environmental Setting

4.1.1.1 Regional Land Use Patterns

The lease area and project site is located approximately 0.6 mile off the coast of the City of San Clemente, about halfway between the cities of Los Angeles and San Diego at the southern edge of highly urbanized Orange County. The cities of Dana Point and San Juan Capistrano border San Clemente on the north and northeast, and unincorporated rural areas of San Diego County, including the Camp Pendleton Marine Corps Base and the San Onofre State Beach, border the City on the south and southeast.

The proposed lease area parallels about 2.5 miles of the San Clemente coastline northward from the southern city limit. For purposes of this land use analysis the project study area includes: 1) the 862-acre lease area; 2) the area to the north encompassing the City's Pier Bowl area; 3) areas to the south and west of the site, which include nearby ocean resources and uses; and 4) areas to the east of the site which incorporate nearby areas of San Clemente's coastal zone. The following paragraphs summarize the existing uses of the project area, including the project site.

4.1.1.2 Project Area Land and Water Use Patterns

The project area is predominantly urban, with the exception of several public and private open space areas scattered along the San Clemente coastline and comprising much of the San Diego County coastline to the southeast. Within the project area there are an assortment of onshore developed and undeveloped uses, onshore and offshore recreational uses, and offshore commercial and military uses.

The project study area sustains residential, recreational, and commercial uses. Single-family residential uses and recreational areas occupy most of the project area coastline, special residential zones vary from the RL standards in characteristics such as lot size and setback requirements. The RM (Residential, Medium Density) designation allows multifamily housing to a maximum density of 24 units per net acre. The A (Architectural) overlay district applied to this RM zone denotes a visually distinct area, characterized by pedestrian oriented-development in San Clemente's traditional Spanish Colonial Revival architectural style.

4.1.2 Impacts and Mitigation Measures

4.1.2.1 Methodology

This land use evaluation is based on qualitative and quantitative comparisons of the existing and proposed uses in the project study area. Changes in the type, intensity, or pattern of land uses due to project implementation were evaluated for the immediate project vicinity. The project is compared to the applicable goals and policies found in relevant State and local planning documents. The evaluation does not attempt to provide a detailed explanation of the project's consistency with individual goals and policies; rather, it examines the project's support of the general intent of the planning documents and determines if any action would prevent a goal or policy from being met. In addition, the project is evaluated for its consistency with the permitted uses, and other provisions of the existing zoning designations for the project area.

4.1.2.2 Significance Criteria

Land use changes, in and of themselves, do not constitute environmental impacts. However, the effects of such an alteration could create environmental impacts. A significant land use impact occurs where a project substantially and adversely limits the ability to use affected property in accordance with existing or designated land uses. The review and evaluation of potential land use impacts is therefore based on direct physical conflicts between uses.

Many of the plans and policies guiding land use decisions are based on qualitative, rather than quantitative, information. Consequently, this evaluation determines the significance of land use and planning impacts on both qualitative and quantitative levels, as appropriate.

In accordance with the CEQA Guidelines and for the purposes of this analysis, impacts are considered significant if implementation of the proposed project would: 1) conflict with general plan designation and zoning; 2) conflict with applicable environmental plans or policies adopted by agencies with jurisdiction over the project; or 3) be incompatible with existing land use in the vicinity.

As previously indicated, land use evaluations typically address impacts to agricultural resources or operations (e.g., impacts to soils or farmlands, or impacts from incompatible land uses) and the disruption or division of the physical arrangement of an established community (including a low-income or minority community). However, since no agricultural or managed maricultural resources are currently located either at the project site or in the project vicinity, and the proposed project site lies 0.6 mile offshore from any established community, neither of these issues is considered further in the following analysis.

4.1.2.3 Compliance with General Plan and Zoning Designations

The 22.4-acre experimental reef and the full mitigation reef would be constructed 0.6 mile off the coast of San Clemente, on Submerged Lands of the State of California. These lands carry no designations under any local general plan or zoning ordinances. The construction, development, and monitoring activities associated with both the experimental reef and the mitigation reef would not interfere with onshore open space and residential designations or with the existing offshore recreational, commercial or military uses in the project study area. The presence of a 150 acres and up to 300 acres of artificial reef sustaining a giant kelp community within the 356-acre project site would be generally compatible with both the existing offshore uses and the adjacent onshore designations. The project-related changes would have no effect.

Mitigation Measures

- None required.

4.1.2.4 Compliance with Applicable Environmental Plans and Policies

Relevant policy guidance from the California Ocean Resources Management Program, the Coastal Act, the *City of San Clemente General Plan*, and the *San Clemente Coastal Element* emphasizes the conservation and enhancement of California's ocean and coastal zone resources.

The construction, implementation, and monitoring activities for the proposed 22.4-acre experimental reef and the 127.6-acre to 277.6-acre mitigation reef involve the restoration of kelp bed resources and associated biota to mitigate for losses at SOK. The activities associated with the experimental reef and the mitigation reef would support the policy direction of the applicable environmental plans and policies. The changes related to these activities would have no effect.

Mitigation Measures

- None required.

4.1.2.5 Compatibility with Existing Uses

The construction of the experimental reef and mitigation reef would each involve the presence of barges and tugboats both within the project site and traveling primarily within established shipping lanes between the port where material were obtained and the project site. Although the presence of construction-related vessels 0.6 mile offshore at the project site would be evident, the associated construction activities would not affect the existing onshore land uses. This is considered a less-than-significant impact.

The proposed experimental reef and mitigation reef would be located 0.6 mile offshore of San Clemente, approximately 12 to 15 meters (39 to 49 feet) below the ocean surface. The apparent use of the site with the artificial reefs in place would differ little from the present site conditions. The reefs would not influence the continued viability of adjacent land uses, such as existing open space, recreational, or residential areas in the City of San Clemente or open space and military uses in nearby San Diego County. The experimental and mitigation reefs would have no effect on existing land uses.

The monitoring activities associated with the experimental reef and mitigation reef would entail the presence of one to two small watercraft and several divers within the project site at various times during the year. These activities would not affect the continued viability of adjacent land uses in either the City of San Clemente or in nearby San Diego County. Therefore, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.2 Socioeconomics

4.2 Socioeconomics

This section gives a brief summary of the existing socioeconomic setting for local communities surrounding the proposed artificial reef site, and then briefly discusses a larger study area, including locations that would be affected during the construction phase of the artificial reef. The section then considers whether the socioeconomic impacts are related to any significant impacts on the environment. Socioeconomic impacts are typically related to changes in population, housing, employment or income that may be created by the proposed actions, which in turn may have impacts to the physical environment. In addition, the proposed actions may have impacts on the social well being of residents and the nature of the communities involved.

4.2.1 Environmental Setting

4.2.1.1 Project Area

The project area for the socioeconomics chapter includes the communities in the immediate vicinity of the proposed artificial reef site. The reef site is located offshore of the City of San Clemente, just north of the Orange County/San Diego County line. Along the coast to the north of San Clemente are portions of unincorporated Orange County, Doheny Beach State Park, and the City of Dana Point. The Camp Pendleton Marine Corps Base and the San Onofre Nuclear Generating Station (SONGS) are located south of San Clemente.

- ***City of San Clemente***

The City of San Clemente is a small, coastal community in southern Orange County. A large percentage of the City's development is residential, with a majority of the employment supporting commercial and retail businesses. The estimated population in January 1997 was 47,300 (DOF 1997), compared to a population of 40,777 in April 1990 (US Census 1990). This represents an average annual growth rate of 2.3 percent during the seven-year period. However, San Clemente experienced greater population growth during the 1980 to 1990 period, with an annual average growth rate of 4.9 percent (US Census 1990). In comparison, Orange County grew at an average annual rate of about 2.5 percent from 1980 to 1990, with the population increasing from 1,932,709 to 2,410,556 (US Census 1997). The county growth rate slowed to 1.4 percent per year between 1990 and 1997, when the population was estimated at 2,659,300 (DOF 1997). Moderate growth is expected in San Clemente over the next seven years, with a projected population of 49,219 by the year 2000 and 52,195 in 2005 (City of San Clemente 1997).

San Clemente businesses provide an estimated 9,800 jobs, with approximately 40 percent the jobs concentrated in service and retail sectors (City of San Clemente 1997). However, few of these jobs are held by local residents. The 1990 Census found that of the 22,121 employed residents, only 996 worked in San Clemente, while the rest commuted to jobs in other locations.

A majority of San Clemente residents hold professional positions or work in the finance, insurance or real estate industries. This is reflected in the 1989 median household income of $46,374 (US Census 1990), as compared to the statewide figure of $35,798. A 1997 estimate places median income for the City's residents at $63,200 (City of San Clemente 1997). The median home value for San Clemente in 1990 was $308,500 (US Census 1990).

Development along the shore of San Clemente includes several beaches and a fishing pier managed by the City. The San Clemente State Beach is also within the City boundaries, but is managed by the California Department of Parks and Recreation (CDPR). This is a popular recreation area that supports related retail businesses in the community. In addition, there are a number of exclusive, gated housing developments along the coastal bluffs adjacent to the proposed project lease area.

- ***City of Dana Point***

The City of Dana Point is another coastal community that is largely residential. The City was incorporated in January 1989, when the population was estimated to be 29,972 (DOF 1990). By January 1997, the estimated population was 36,200, representing an average annual growth rate of 2.6 percent (DOF 1997).

The City of Dana Point contains approximately 1,400 businesses supporting about 9,000 employees (City of Dana Point 1997). The service sector makes up approximately 45 percent of total employment, with another 23 percent in the retail trade sector. Hotels, restaurants, grocery stores, and finance and real estate offices are the largest sources of employment. As in San Clemente, the majority of Dana Point residents are employed outside the City in professional and managerial trades. Based on 1990 Census data, the labor force living in Dana Point was 17,925, with only 1,305 people working within the City of Dana Point. The median household income in 1989 was $54,516 (US Census 1990), but the City now estimates it is close to $60,000 (City of Dana Point 1997). The median home value in 1990 was $336,600 (US Census 1990).

Dana Point Harbor is a commercial focal point for the City of Dana Point. The harbor provides slips and moorings for over 2,500 boats along with 50 retail establishments (Dana Point Harbor Association 1997). The harbor is also home to the Orange County Marine Institute, a research and teaching facility dedicated to the protection of the marine environment. Dana Point Cove and the Doheny Beach State Park are adjacent to the harbor to the south, while Salt Creek Beach is just north. In addition, there are three major resort hotels and a bed and breakfast nearby, making the area a popular tourist and recreation destination.

- ***Camp Pendleton***

Camp Pendleton Marine Corps Base is located in northern San Diego County adjacent to San Clemente. The base encompasses 125,000 acres and includes 17 miles of coastline. It is the largest amphibious assault training facility in the country and provides training for marine, army and navy personnel as well as national, state and local agencies. The base has a population of more than 37,000 marines and sailors, with 14,000 family members living in base housing and another 14,000 active duty personnel living in barracks (US Marine Corps 1997).

- ***Recreational Activities***

Recreational activities and fishing, particularly hook and line fishing, are popular in the vicinity of the proposed artificial reef site. The area is not popular with divers, but Dana Wharf Sportfishing runs daily boats, for half-day fishing tours in the area of the proposed artificial reef site. Weekends are busiest for private boating and fishing activities. Barred sand bass and calico bass are the most popular sport fish, particularly during the fall and winter (Hansen 1997).

- ***Commercial Fishing***

In addition to recreational fishing, there are commercial fishing activities in and around the proposed artificial reef site. The major species caught within the project site include lobster, crabs, sea urchins and some halibut. Lobster traps are set during a limited season that runs from the first Wednesday in October through the first Wednesday after March 15 each year. Spider crabs and sea urchins may be fished all year, however, there is a size limit on what may be taken. - The California Department of Fish and Game (CDFG) keeps data on the quantity and value of various species caught by commercial fishermen. The data are collected by designated blocks along the coast. The blocks adjacent to and encompassing the project site include Block Nos. 756 and 757. The lease area is entirely within Block No. 756, however Block No.757 extends to Dana Point harbor and could be affected to a lesser degree by construction activities. Figure 4.2-1 shows the location of the data blocks in relation to the project lease area. Table 4.2-1 shows the annual catch from 1992 to 1996 for the major species fished in these two blocks. These totals somewhat overestimate the catch at the project site because the area encompassed by Block Nos. 756 and 757 ranges from north of Dana Point to south of San Onofre and extends farther offshore than the project lease area. Halibut has declined dramatically as a species harvested in this area, while the lobster catch has generally increased. A comparison of the 1996 commercial fish catch and value in the project vicinity (Block Nos. 756 and 757) with California totals for these same fish is presented in Table 4.2-2.

The lobster catch in the project vicinity represents 5 percent of the statewide total with a 1996 value of $289,786. This is an important economic resource in the project area.

Other commercial activities in the vicinity of the proposed reef site involve occasional kelp harvesting from the existing kelp beds around San Mateo Point and San Onofre. However, this is not a major harvesting center and there are currently no permits with the CDFG for harvesting in the area. The CDFG data on kelp harvesting activities for Kelp Bed Nos. 7 and 8 (offshore from the middle of Loma Alta Lagoon to the middle of San Juan Creek) show that over the past ten years 5,418 tons of kelp were harvested (Table 4.2-3). Most of this was cut in 1989, with smaller amounts harvested in 1996.

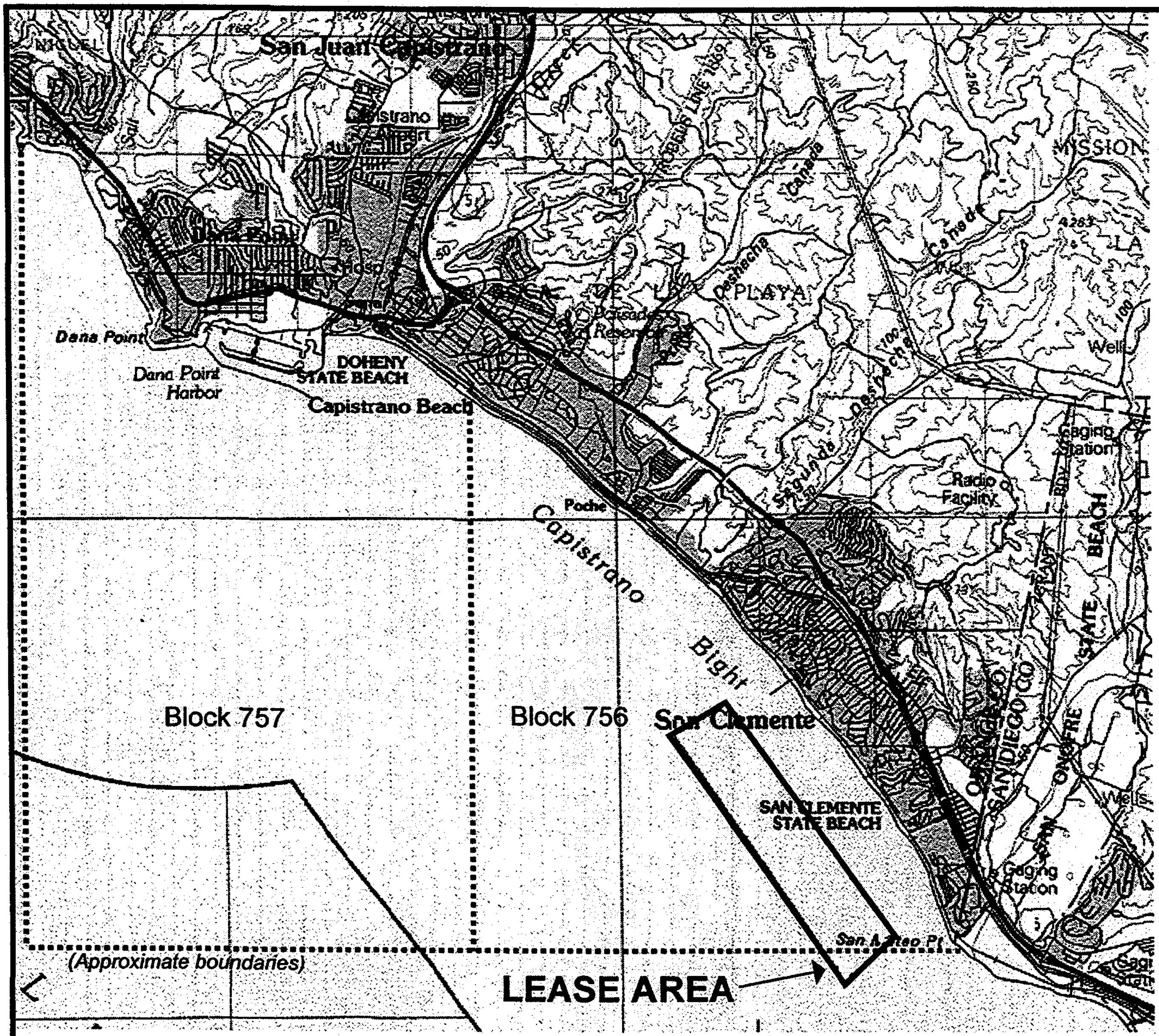


Figure 4.2-1
DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHING DATA

Table 4.2-1 Commercial Fishing Catch
Total Pounds Caught for Block Nos. 756 and 757

Species	Blocks	1992	1993	1994	1995	1996
	756	*10,662*	*12,376*	*3,207*	*4,474*	*23,615*
Lobster	*757*	*9,949*	*6,495*	*40,530*	*48,508*	*13,537*
	Total	**20,611**	**18,871**	**43,737**	**52,982**	**37,152**
	756	*6,273*	*11,368*	*4,949*	*3,949*	*55,615*
Crab	*757*	*4,891*	*56*	*1,565*	*2,008*	*7,070*
	Total	**11,164**	**11,424**	**6,514**	**5,957**	**62,685**
	756	*36,923*	*39,385*	*26,990*	*41,471*	*0*
Red Urchin	*757*	*213,399*	*143,766*	*75,432*	*69,092*	*48,823*
	Total	**250,322**	**183,151**	**102,422**	**110,563**	**48,823**
	756	*1,203*	*1,040*	*0*	*35*	*326*
CA Halibut	*757*	*3,849*	*1,734*	*0*	*0*	*75*
	Total	**5,052**	**2,774**	**0**	**35**	**401**

Source: CDFG, *Annual 1AA Report (Catch by Origin, Species, and Month)*, 1986-1997.

Table 4.2-2 Comparison of 1996 Commercial Fishing Catch
in Block Nos. 756 and 757 to California Totals

	Pounds		% of Total	Value	
	Project	California		Project	California
Lobster	37,152	715,590	5.0%	$289,786	$ 5,583,130
Crab	62,685	13,493,955	0.5%	$ 85,878	$18,529,517
Sea Urchins	48,823	20,120,418	0.2%	$ 45,405	$18,814,981

Source: CDFG 1997.

Table 4.2-3 Kelp Harvest by Bed Number, 1988-1997 in Tons

Bed	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	TOTAL Tons
# 7	128	1,428	1	N/D	1	0	0	0	648	0	2,206
#8	0	2,676	2	N/D	1	340	0	0	193	0	3,212

Source: CDFG 1998.

4.2.1.2 Study Area

For the purpose of the socioeconomic analysis, a larger study area is discussed that includes facilities and businesses in the Los Angeles/Long Beach and San Diego regions related to the proposed project construction activities. The rock and concrete used for artificial reef material would be transported to the project site by barge from one or more of the three major ports in Los Angeles, Long Beach or San Diego, or from Catalina Island.

Recycled concrete material is available throughout the State from commercial recycling operations. Because of the high costs of trucking material, used concrete is normally delivered to recycling yards within a 25- to 30-mile radius of demolition projects (Resource Insights telephone survey of 15 recycled concrete brokers in the Los Angeles and San Diego regions1998). A tipping fee is paid for disposal at the yards and the concrete operators then sell the concrete for reuse. Most recycled concrete material is crushed and sold for use as road base.

The inland Los Angeles region has two major ports where recycled concrete material could be shipped. The Ports of Los Angeles and Long Beach are approximately 59 miles from the San Clemente project site. Because of the high costs of trucking materials, only suppliers located within a 20-mile radius of the Ports of Los Angeles and Long Beach are considered viable. There are currently 21 concrete recycling companies in the Los Angeles area operating at 42 storage locations spread throughout the region (Integrated Waste Management Board 1998). While the majority of these locations are a greater distance from the port, a number are within the 20-mile radius.

The closest inland rock quarry is located approximately 54 miles from the Los Angeles area ports. Because of the expense of trucking rock this distance and the additional air emissions this would create, inland rock would not be shipped from Los Angeles or Long Beach ports.. However, Catalina Island is located offshore in Los Angeles County about 58 miles from the project site. Catalina Island is the closest quarry rock source to the project lease area. The Connolly Pacific Company operates two rock quarries on the island and provides barge delivery services. The quarries are located within a quarter mile of the loading dock and require a minimal amount of trucking for loading.

The Port of San Diego is approximately 69 miles from the proposed lease area. Because of the high cost of trucking quarry rock and recycled concrete materials, only suppliers located within a 20-mile radius of the Port of San Diego are considered viable. There are currently 16 quarry operators mining rock at 24 locations in the San Diego area, while there are 19 recycled concrete brokers operating at 21 locations. Only a few of the rock and concrete sources are located within 20 miles of the Port of San Diego.

4.2.1.3 Applicable Plans and Policies

While the Orange County and City of San Clemente general plans provide basic policy direction for development activities in the project area, no existing plans or policies specific to the socioeconomic impacts of the proposed project were identified

4.2.2 Impacts and Mitigation Measures

Socioeconomic impacts are primarily related to changes in population, housing, employment or income that may result from a proposed project, which in turn create changes in the physical environment In addition, the project may have impacts on the social well being of residents and the nature of communities. This section evaluates both the short-term construction impacts and long-term project implementation impacts. These impacts are considered for both the experimental reef and the full mitigation reef.

4.2.2.1 Methodology

This chapter evaluates the proposed project to determine if the construction, existence, and monitoring of the artificial reef would create economic impacts that may in turn lead to physical changes. This includes impacts to employment and commercial activities in the project and study areas. The evaluation is largely qualitative.

Because the final details for constructing the experimental and mitigation reefs are not known, the proposed project has been evaluated using assumptions for materials, equipment and design that result in a probable worst-case scenario, as outlined in Chapter 3.0, Project Description.

4.2.2.2 Significance Criteria

The CEQA Guidelines, Section 15131, provide the following guidance on determining the significance of socioeconomic impacts:

> "(a) Economic or social effects of a project shall not be treated as significant effects on the environment. An EIR may trace a chain of cause and effect from a proposed decision on a project through anticipated economic or social changes resulting from the project to physical changes caused in turn by the economic or social changes. The intermediate economic or social changes need not be analyzed in any detail greater than necessary to trace the chain of cause and effect. The focus of the analysis shall be on the physical changes.
>
> (b) Economic or social effects of a project may be used to determine the significance of physical changes caused by the project. ... Where an EIR uses economic or social effects to determine that physical change is significant, the EIR shall explain the reason for determining that the effect is significant."

For the purposes of evaluating this project, significance criteria are further defined as:

- A change in employment or income in the study area, which would result in additional population, housing or other growth of more than ten percent.
- A negative change of more than ten percent in the economic viability of commercial activities in the project area.

4.2.2.3 Construction Employment

- ***Experimental Reef***

The construction phase of the experimental reef would take approximately six weeks total with 32 work days for placing material at the sites. This would involve the delivery of quarry rock and recycled concrete by truck, tugboat and barge. As indicated in the project description, the number of crew involved in the construction phase would range from 30 to 40 people.

Given the small number of employees involved and the short construction timeframe for building the 22.4-acre experimental reef, the project would have a minor positive effect on employment, income and economic activity in the study area. A number of existing rock, recycled concrete and barge towing companies in southern California are capable of meeting the requirements of this project. Los Angeles and San Diego Counties are major economic regions with large labor forces providing adequate labor pools to meet the project employment without the need to recruit new employees to the region. It is very unlikely that any new growth would be generated by this project, but if any growth did occur it would be well below the ten percent significance threshold. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Mitigation Reef***

Construction of 127.6 acres to 277.6 acres of additional artificial reef, for a mitigation reef that sustains 150 acres of medium-to-high density kelp beds, would take place after the results of the experimental reef are studied. At that time, it would be determined if the larger reef should be built using quarry rock or recycled concrete, or possibly with some combination of the two. The level of coverage needed to successfully grow kelp would also be determined. For the purposes of analysis, this section examines the potential impacts under two scenarios: all rock or all recycled concrete at 67 percent coverage.

Construction of a 127.6 acres of artificial reef using only quarry rock would require 357,280 tons of rock for a total of 16,240 truck loads/177 barge loads. Given the large number of loads and the May to September construction period, the reef would be built over two years. Construction of the reef with recycled concrete would require 280,720 tons of material and 141 barge loads, which would be built in two years.

A 277.6-acre mitigation reef would require 777,280 tons of quarry rock or 610,720 tons of recycled concrete to complete the artificial reef. This would require 35,331 truck loads/389 barge loads or 27,760 truck loads/306 barge loads respectively. These scenarios would take four years and three years to construct.

The crew size for the construction activities would be 30 to 40 people hired from May to September over two years or up to four years. Given the small number of employees involved in the construction, this would have a minor positive effect on the employment, income and economic activity in the study area. A number of existing rock quarries, recycled concrete brokers and tugboat/barge construction companies in southern California are capable of meeting the project's requirements. Los Angeles and San Diego Counties are major economic regions with large labor forces providing adequate labor pools to meet the project employment without the need to recruit new employees to the regions. It is unlikely this project would result in any additional growth in the region, but if any growth did occur it would be well below the ten percent significance threshold. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.2.2.4 Recreational Fishing Businesses

The construction phases for both the experimental reef and the mitigation reef (between May 1 and September 30) could potentially impact recreational sportfishing operators by restricting use within the project area during construction. In accordance with Coast Guard safety regulations, the construction site would be marked with buoys to limit access. However, there are numerous alternative fishing sites that could be utilized during the construction period. A local sportfishing excursion boat operator indicated that notification of construction activities, including barge traffic, would assist in planning daily excursions to avoid conflicts (Hansen 1997). The interference of construction with recreational fishing businesses is considered a potentially significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- Recreational fishing businesses that conduct operations in the project area shall be notified of project-related activities two weeks prior to the onset of construction. Notification shall include a map of the project site, hours and duration of operation, and the predicted path of barge travel into and out of the construction site.

The notification of recreational fishing operators detailed above will allow operators to adequately plan for alternative fishing sites in advance of arrival at the construction site. This would limit any economic losses related to time lost by searching for alternative sites while conducting sportfishing operations. The implementation of this mitigation measure will reduce the impacts associated with both the experimental reef and the mitigation reef to less-than-significant levels.

4.2.2.5 Commercial Fishing Activities

The construction of both the experimental reef and mitigation reef is planned to occur between May 1 and September 30, which is outside of the season for commercial lobster fishing in the project lease area. This represents mitigation that has been incorporated into the project description. There could be disruptions to commercial fishing activities for sea urchins and crabs during the construction of the reefs, as these species are fished year-round. The experimental reef would only take 32 days to construct, but the mitigation reef could take anywhere from two to four construction seasons to complete. The exclusion of commercial fishermen from a proven fishing ground during construction could impact their livelihood if they did not have an alternate site to fish during that period. In addition, if fishing equipment was on the ocean floor during construction, it could be destroyed by the placement of reef materials. This is a potentially significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

The following mitigation measure would reduce this impact to a less-than-significant level.

- As stated in the project description, construction activities will be limited to the period between May 1 and September 30.

- Commercial fishermen that conduct operations in the project area shall be notified of project-related activities two weeks prior to the onset of construction. Notification shall include a map of the project site, hours and duration of operation, and the predicted path of barge travel into and out of the construction site.

The notification of commercial fishermen would allow for them to select alternative urchin and crab fishing sites and to collect any fishing equipment, such as crab pots, from the project area prior to the onset of construction. This would lessen any economic losses associated with both the experimental reef and the mitigation reef to a less-than-significant level.

4.2.2.6 Commercial Fishing Sites

- ***Experimental Reef***

Local fishermen in the project area expressed concern that the proposed project site has considerable existing hard substrate and kelp bed resources. They did not feel that surveys of the area completed for siting studies adequately detected all the existing resources. There is concern that proposed project activities would place rock or concrete material on the existing resources, which could impact known fishing sites.

The experimental reef would cover only 22.4 acres of the 356-acre project site, allowing flexibility in the choice of test locations. The SONGS permit conditions state that rock or concrete material is to be placed to avoid existing hard substrate and kelp bed resources.

Additional sonar and diver surveys would be conducted prior to construction of the experimental reef to ensure that existing resources are avoided. In addition, the use of a crane with a Global Positioning System would allow a higher level of precision in placing the material. This is considered a less-than-significant impact.

Mitigation Measures

- None required. Mitigation Recommended.

  Commercial fishermen that utilize the project area shall be consulted prior to finalization of the location for the 22.4-acre experimental reef. During consultations, proven fishing grounds shall be identified so that they can be avoided during the construction of the test reef modules.

- ***Mitigation Reef***

The same concerns discussed above for the experimental reef apply to the mitigation reef regarding commercial fishing sites. Permit conditions for the mitigation reef state that placing reef material on existing hard substrate or kelp beds should be avoided to the greatest extent possible. However, the placement of material over a minimum of 127.6 acres and up to 277.6 acres of ocean bottom increases the possibility that some existing resources could accidentally be covered by reef material. Accidental coverage of hard substrate or kelp forest could reduce suitable habitat for target commercial species. The five-year monitoring program of the experimental reef would help alleviate this risk by providing up-to-date information on ocean bottom conditions through the bi-annual side-scan sonar surveys. However, this is a potentially significant impact.

Mitigation Measures

Implementation of the following mitigation measures would reduce this impact to a less-than-significant level.

- Commercial fishermen that utilize the project area shall be consulted prior to finalization of the location for the 127.6-acre (and up to 277.6-acre) mitigation reef. During consultations, proven fishing grounds shall be identified so that they can be avoided during the construction of the mitigation reef.

The consultation between the project proponent and the commercial fishermen would identify economically important areas so that they can be avoided during construction of the mitigation reef. By identifying and then avoiding these areas, adverse impacts to commercial fishing sites would be a less-than-significant level.

4.2.2.7 Presence of the Experimental Reef and Mitigation Reef

The presence of the experimental reef and full mitigation reef would have no negative socioeconomic impacts. The creation of additional reef and kelp habitat should enhance fishing in the area and create economic benefits over the long term.

The proposed experimental and mitigation reef would be designed to create a healthy, sustainable kelp bed that would provide habitat for many species of fish and invertebrates. Over the long term this would enhance local recreational and commercial fishing. In addition, the reef could support the Orange County Marine Institute's research and education role, such as enhancing excursion boat trips to observe sea life. The benefits to local activities would in turn strengthen the area's tourist and recreational economic base. There are positive, beneficial socioeconomic impacts associated with the existence of the mitigation reef.

Mitigation Measures

- None required.

4.2.2.8 Impacts of Monitoring Program

- ***Experimental Reef***

Once the experimental reef is constructed, a five-year monitoring program would be implemented by the California Coastal Commission (CCC) to measure the success of the artificial reef modules in producing kelp. The basic components of this monitoring plan are summarized in the Project Description and the draft plan is included in Appendix E. The initial monitoring steps include post-construction side-scan sonar and diver surveys as well as installing permanent markers with temporary transect lines that would be attached during surveys. There is a slight chance the transect lines could be disturbed by fish traps and lines, but it is unlikely as they would only be present during sampling events (see Chapter 3.0, Project Description). This is considered a less-than-significant impact.

- ***Mitigation Reef***

The mitigation reef would be monitored at some level for a period equivalent to the operating life of SONGS; this monitoring is yet to be defined by the CCC. It would most likely involve post-construction side-scan sonar and diver surveys, followed by annual diver surveys. These activities would have no socioeconomic impacts.

Mitigation Measures

- None required.

4.3 Geology

4.3 Geology

This section addresses several issues involving waves, currents and sedimentation. This information is important in assessing the impacts of the experimental reef and mitigation reef in connection with several other resource areas: recreation; hazards; aesthetics; biology; and public services. A number of issues typically associated with new projects are not of concern because of the kind of project being proposed, and its location 0.6 mile offshore. These issues include: seismic shaking; exposure of people to seiche, tsunami or volcanic hazard; subsidence of the land; expansive soils; unstable soil conditions from grading, excavation, or fill; effects on groundwater movement and quantity; and exposure of people to floods. The description of the environmental setting includes information on the existing geological and sedimentological conditions of the lease area. The impacts evaluation focuses upon three areas of potential effect: 1) waves; 2) coastal currents; and 3) beaches. The environmental setting is briefly described first, as follows.

4.3.1 Environmental Setting

4.3.1.1 Geology

The proposed 862-acre lease area is situated on the San Onofre Shelf portion of the California Continental Borderland. The San Onofre Shelf between Dana Point and Oceanside, California, is about three to five miles (5 to 8 km) wide and extends seaward to about 295 feet (90 meters) in depth. Most of the bedrock underlying the lease area and exposed along the sea floor in the vicinity of the lease area is thought to be Capistrano Formation (Eco-M 1997). The Capistrano Formation is Late Miocene and Early Pliocene in age (McNey 1979) and consists of dark gray and light gray siltstone and clayey siltstone with scattered and interbedded layers of sandstone tuff, and diatomite. Concretions can be found within the clayey siltstone. Stratigraphic deformation of the Capistrano beds vary from tightly folded and sheared in the San Onofre bluff area to gently undulating with a westerly dip near San Mateo Point (Eco-M 1997).

Approximately 25 percent of the bottom in an area offshore of San Clemente that encompasses the lease site consists of exposed bedrock. About five percent of this area is exposed cobble and the remaining 70 percent is covered with a thin veneer of fine sand and silt (Anderson et al. 1995). An unconsolidated hard cobble surface underlies the sand veneer (Eco-M 1997). The patches of fine sand are generally less than two feet thick. The sand is most extensive at a depth of about 50 feet. The proposed lease site is situated at water depths ranging from 39 to 47 feet and consists of about 96 percent sand cover, generally less than one foot in thickness (SCE 1997a).

Within and adjacent to several kelp forests that lie between Dana Point and Oceanside, dune-like, elongated shore-parallel deposits of fine sands occur. These deposits average 65 ft. wide, 200 ft. long, up to two feet in thickness and about 400-525 cu. yds. in volume (SCE 1990). The elongated sand dunes tend to be stable in volume and coverage, but their position and configuration change over time.

4.3.1.2 Currents and Sediment Movement

The longshore currents within the proposed lease area tend to be consistent with the prevailing wind direction. The result is a southward flowing current along the shoreline that predominates in every season, with the strongest southerly flow occurring in the summer months (Daly et al. 1993). These currents, along with large storm waves are the primary forces that suspend and transport sediments (Cacchione et al. 1987; Wiberg and Smith 1983; Cacchione and Drake 1982).

The character of the ocean bottom in the project vicinity is the result of both natural processes and man-induced changes. The major natural sources of sediment to this system include San Juan Creek, San Mateo Creek, Santa Margarita River, San Luis Rey River and San Dieguito River, as well as material eroded from coastal bluffs. A limited amount of fine sediment in the littoral cell is transported shoreward from deep ocean sources. Historic human impacts to the littoral cell sediment budget in the project vicinity include the construction of Dana Point Harbor, the placement of railroad tracks at the base of the coastal bluff in San Clemente, the addition of artificial beach fill to the beach and littoral system and the construction of the seawalls and fortifications at SONGS, along the railroad tracks, and at the base of coastal bluffs (ACOE 1987).

4.3.1.3 Earthquake Faults

Several active and recently active faults are located in the project vicinity. The nearest segment of the Christianitos Fault Zone occurs about three miles east of the proposed site, and the Newport-Inglewood-Rose Canyon Fault Zone is located about three to five miles west of the lease site. While the various segments of the Cristianitos Fault exhibit no evidence of movement during the past 1.6 million years and are not considered to be highly active, the Newport-Inglewood-Rose Canyon Fault Zone contains numerous recently active segments (Jennings 1994). The most recent earthquakes on that fault zone occurred in 1933 near Newport Beach, about 25 miles northwest of the lease site, and measured up to 7.8 on the Richter Scale (Real et al. 1978).

4.3.1.4 Beaches

The adjacent onshore areas of the proposed project site stretche from San Mateo Point in the south to the City of San Clemente Beaches in the north. The beach berms in this area are typically 9.5 feet to 13 feet above mean sea level (Moffatt and Nichol 1990). The beaches at San Clemente State Beach, Califia County Beach Park and along the City of San Clemente are relatively narrow sandy beaches backed by railroad tracks protected with riprap boulders and a seawall. Behind the railroad tracks are highly erodible coastal bluffs that average about 100 feet in height (Moffatt and Nichol 1990). Severe storms have been known to overwash the tracks. Along San Mateo Point, the beachface is steep and the beach is comparatively wide and backed by a floodplain, marsh and low, active sand dunes (Griggs and Savoy 1985).

4.3.1.5 Applicable Plans, Policies and Regulations

The proposed actions were reviewed for consistency with the *Orange County General Plan* (1984) and the *City of San Clemente General Plan* (1993), which include a number of applicable goals, objectives, and policies, as follows:

Orange County General Plan:

Goal: Manage and utilize wisely the County's landform resources.
Objective: Minimize to the extent feasible the disruption of significant natural landforms in Orange County.
Policy: Protect the unique variety of significant landforms in Orange County through environmental review procedures and community and corridor planning activities.

City of San Clemente General Plan:

Goal: Maintain the visual character of the City.
Objective: Preserve the aesthetic resources of the City, including coastal bluffs, visually significant ridgelines and coastal canyons, and significant public views.
Policy: Work in conjunction with the California Coastal Commission with the expressed intent to develop implementation programs that will preserve and maintain the physical features of the coastal zone including bluffs, canyons, and beaches.

4.3.2 Impacts and Mitigation Measures

4.3.2.1 Methodology

Several studies were conducted to address the potential for the experimental reef and mitigation reef to affect waves, coastal currents, nearshore sediment deposition and erosion and beaches. These studies included field experiments and measurements of waves and currents in the vicinity of a kelp reef referred to as the North Carlsbad Kelp Forest, which is located approximately 23 miles to the south of the proposed lease area. The studies also included measurements and statistical evaluations to address: 1) the potential for concrete and quarry rock to be washed up on the beach; and 2) the effects of the experimental reef and mitigation reef on beach width. A report on these studies is contained in Appendix F of the PEIR. Brief descriptions are provided in the following.

The North Carlsbad Kelp Forest was selected for study because the size and density of the existing kelp forest are similar to those expected following the implementation of the proposed mitigation reef. The North Carlsbad Kelp Forest supports an average of 10 to 25 plants per $100m^2$ in water depths between 8 and 13m. The kelp bed is about 700m long and 350m wide (Elwany et al. 1998).

Wave gauges and current meters were placed inshore and offshore of the kelp forest and at an adjacent control site with no kelp (Elwany et al. 1993a, 1993b, 1995). Wave height and direction were compared over 67 days between sites inside and outside the kelp, and between the sites at the kelp forest and the control site outside of the effects of the kelp forest 750m to the north. Similarly, current speeds and direction were compared between locations in the interior of the kelp forest and outside of the influence of the kelp.

The wave heights and direction, and the current speeds and direction that were sampled during the field study are considered representative of the wave and current regime expected at the proposed project site in San Clemente (Elwany et al. 1998). Likewise, the North Carlsbad Kelp Forest is considered to be of sufficient density and size to accurately model the potential effects of the proposed artificial kelp reef on waves and currents (Elwany et al. 1998).

A regression analysis was carried out to evaluate the relationship between kelp beds and beach width in southern California. Beach widths and kelp bed widths were measured between Dana Point and the Mexican Border, and a correlation analysis was performed between beach width and the width of the kelp beds.

The potential for the concrete and quarry rock from the reef to be washed ashore was addressed through a review of existing information (Elwany et al. 1998).

4.3.2.2 Significance Criteria

The proposed experimental reef and mitigation reef would be considered to have a significant impact on waves, coastal currents, nearshore sediment deposition and erosion, and beaches if there was substantial conflict with adopted plans and policies. The information provided in this section on geology was also used elsewhere in this PEIR to assess the potential direct and indirect effects upon other resources, including: recreation; hazards; aesthetics; biology; and public services.

4.3.2.3 Waves

According to Elwany et al. (1998), if wave energy is not significantly reduced or the direction of wave propagation is not altered by kelp beds, then the experimental reef and mitigation reef are unlikely to cause either erosion or deposition on the adjacent beaches. The study carried out by Elwany et al. (1998) at the North Carlsbad Kelp Forest to address this question involved field measurement and quantitative analysis in the vicinity of an existing kelp reef similar in size to the proposed mitigation reef.

The study concluded that the presence of a kelp forest would likely result in the attenuation of short-period (<0.1Hz), local wind-driven waves such as surface chop, but would not have a substantial effect upon large-period (3 to 20 seconds), low frequency (>0.3Hz) swell waves. The attenuation of the short-period waves would result in a smoother water surface as compared to the site without the kelp beds (Elwany et al.

1993a, 1993b, 1998). The large-period waves, which are the principal cause of sediment transport, would not be substantially attenuated by the kelp reef.

The relationship between the wavelength of the incident wave and the typical frond length of the kelp canopy is important to explaining the potential influence of the kelp forest on wave energy. Large-period (3-20 seconds), low-frequency (>0.3Hz) swell waves with wavelengths as long or longer than frond length primarily move harmonically with the kelp plants. The kelp moves simultaneously with the wave-driven water motions, so the relative velocity between the kelp and the water is small, and the loss of wave energy is negligible (Elwany et al. 1993a, 1993b, 1998).

By contrast, short-period (<3 seconds), high-frequency (<0.1Hz) sea waves where the wavelength is shorter than the frond length results in a high relative velocity between the kelp and the wave-driven water motions. Statistically significant damping of high-frequency wave energy occurs. This creates the appearance of a smoother water surface, but does not substantially affect adjacent sediment movement. Short-period waves contain little energy relative to swell waves, and are a negligible component of littoral zone sedimentation processes. These are not important for recreational activities such as surfing.

The attenuation of short-period waves by the experimental reef and mitigation reef would not result in a conflict with an existing standard, nor would it have an indirect effect on beach development and coastal landforms. Therefore, the attenuation of the short-period waves would not conflict with the goals, objectives, and policies of the *Orange County General Plan* (1984) and the *City of San Clemente General Plan* (1993). This is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.3.2.4 Coastal Currents

According to Elwany et al. (1998), the presence of the 150 acre mitigation reef has the potential to affect coastal currents in the vicinity of the lease area, as follows. The presence of a kelp forest exerts a measurable attenuation effect on current speed. Kelp forest exerts considerable frictional drag on currents, so current speed within the forest can be reduced over 50 percent (Jackson and Winant 1983, Jackson 1984, Elwany et al. 1993a, 1998). Outside of the kelp forest, however, the opposite occurs: the kelp forest bifurcates the current stream and current speed increases as flow travels around the kelp. Longshore speeds reach a maximum as the current travels around the middle of a kelp forest (Elwany et al. 1998).

The reduced current speeds within the interior of kelp forests could result in at least temporary accumulations of fine sediments typical of the existing kelp forests that lie between Dana Point and Oceanside (SCE 1990). Linear, dune-like deposits of fine-grained sands are found in most of the natural, persistent kelp forests in the project vicinity. This material originates from the littoral zone where wave action retains sand-sized particles, but winnows out finer-grained sediments and transports them seaward. Reduced current speeds in the interior of kelp forests create depositional environments for fine sands and silts. Large storm wave events appear to periodically resuspend and transport this accumulated sediment (Elwany et al. 1993a).

While the mitigation reef could affect coastal currents in its immediate vicinity, Elwany et al. (1998) also provide information showing that the potential changes in currents would not cause an increase in nearshore sedimentation. Larger waves are expected to keep the kelp beds from silting up, and waves, rather than currents, dominate the suspension of sand. Since the changes in currents would not cause a standard to be exceeded, and the changes would not have direct or indirect effects on beaches or coastal landforms, the proposed actions would not conflict with the goals, objectives and policies of the *Orange County General Plan* (1984) and the *City of San Clemente General Plan* (1993). This is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.3.2.5 Beaches

• *Beach Width*

The work of Elwany et al. (1998) on the potential effects of the proposed kelp beds on waves and coastal current suggested that the processes that affect beach width would not be substantially changed as a result of the experimental and mitigation reefs. An additional evaluation of the potential for the kelp beds to affect beach width was carried out as a part of this PEIR, involving a regression analysis to evaluate the relationship between kelp beds and beach width in southern California. In this effort, beach widths and kelp bed widths were measured between Dana Point and the Mexican Border, and a correlation analysis was performed between beach width and the width of the kelp beds (Elwany et al. 1998).

This study determined that the variability of beach widths between Dana Point and the Mexican Border could not be explained by the presence, absence or width of kelp beds. No consistent, nor statistically significant pattern was found that beaches directly inshore of kelp beds are either wider or narrower than beaches not fronted by kelp beds.

Based on both process-oriented evaluations and statistical evaluations, the proposed experimental and mitigation reefs are not expected to substantially affect either beach development processes or widths. Since standards would not be exceeded, and since there would be no substantial direct or indirect effects on beaches or coastal landforms, the proposed actions would not conflict with the goals, objectives, and policies of the *Orange*

County General Plan (1984) and the *City of San Clemente General Plan* (1993). This would be a less-than-significant impact.

Mitigation Measures

- None required.

- ***Movement of Reef Building Materials onto Beaches***

The potential for the concrete and quarry rock from the reef to be washed ashore was addressed through a review of existing information (Elwany et al. 1998). There is a potential for the reef building materials to be moved during extreme storm events, particularly if attached kelp creates a degree of buoyancy.

Emery and Tschudy (1941, cited in Elwany et al. 1998) surveyed an area about 0.8 mile in length, north and south of La Jolla, inspecting the beaches for the presence of rocks, washed up on the beach, with kelp attached. They found a total of 93 kelp "holdfasts," of which 17 had pebbles attached, and seven had rocks attached. The largest rock found was 15 inches long and weighed 13 pounds.

It should be noted that the materials to be used in building the reef, both concrete and quarry rock will be substantially larger than 15 inches long and 13 pounds in weight, although some smaller rock will likely be mixed in with the preferred larger sizes. It is also possible that smaller pieces of material could break off as it is placed in the ocean.

This information suggests that the smaller rocks and pieces of concrete associated with the experimental and mitigation reefs could be washed up on the beaches adjacent to the lease area and into the surf zone during typical storm events. Although the information appears to alleviate an immediate concern that the materials used in the artificial reefs might readily move onto the beach, no conclusive evidence precludes the possibility that substantial rock or concrete might be moved onshore during an extreme storm event. There are no standards that apply to this potential effect of the proposed project. However, rock or concrete washing up on area beaches and the shallow surf would conflict with several beach protection goals, objectives, and policies contained in the *Orange County General Plan* and the *City of San Clemente General Plan*. These include the goal of maintaining the visual character of the beach area, the objectives of minimizing the disruption of natural landforms and preserving aesthetic resources; and the policy to protect the unique variety of scenic landforms. Therefore, this would be considered a significant impact.

Mitigation Measures

- Both the experimental reef and the mitigation reef will be monitored for the movement of construction material during storm events. The monitoring will be on a biweekly basis from the months of November through March and monthly during the rest of the year, consistent with the program outlined in the mitigation measures found in Section 4.10.2.4 of this chapter. Any recycled concrete or quarry rock from the experimental or mitigation reefs, which is found on the beaches or shallow surf, would be removed by the project proponent.

4.4 Air Quality

4.4 Air Quality

This section discusses the environmental setting for air quality in the vicinity of all potential project-related activities, and analyzes the impacts of air emissions generated by project actions. This analysis addresses the potential issues of concern identified in the CEQA Guidelines, Environmental Checklist Form, and the applicable rules and regulations of the affected air basins and air districts. The proposed actions could take place in two air basins and air districts in Southern California.

4.4.1 Regional Setting

This section describes the existing environment for air quality in the vicinity of all project related activities, including the jurisdictional boundaries for air quality management, physical geography, climatology, meteorology, and air pollutants of concern.

4.4.1.1 Air Basins

Project-related activities could occur in two air basins: the South Coast Air Basin (SCAB) and the San Diego Air Basin (SDAB). The proposed artificial reef and potential sources for recycled concrete and quarry rock are located within the SCAB in Los Angeles and Orange Counties. Other potential sources for recycled concrete and quarry rock are located in the SDAB in San Diego County (Figure 4.4-1).

These air basins are two of the 15 basins into which the California Environmental Protection Agency Air Resources Board (CalEPA-ARB) has divided the State for the purpose of managing air quality on a State and regional basis. Each air basin is characterized as having relatively uniform internal air quality and meteorological conditions. Some air basin, however, follow political rather than geophysical boundaries, and interbasin transfers of pollutants occurs.

4.4.1.2 Air Districts

The State is also divided into air pollution control districts (APCDs) and air quality management districts (AQMDs). These are county or regional governing bodies that regulate local sources of air pollution and are responsible for bringing local air quality into compliance with State and federal ambient air quality standards. While the CalEPA-ARB regulates emissions from mobile sources, including motor vehicles and marine vessels, the local air districts have primary responsibility for controlling air pollution from stationary sources, such as construction sites. Figure 4.4-1 shows the two air basins of interest, the corresponding air districts, and the locations of potential project-related activities. These air basins and air districts also apply to project alternatives.

- ***South Coast Air Quality Management District***

The South Coast Air Quality Management District (SCAQMD) has jurisdiction over the SCAB, which includes all of Orange County, and portions of Los Angeles, San Bernardino, and Riverside Counties located south and west of the Transverse and Peninsular Ranges. The

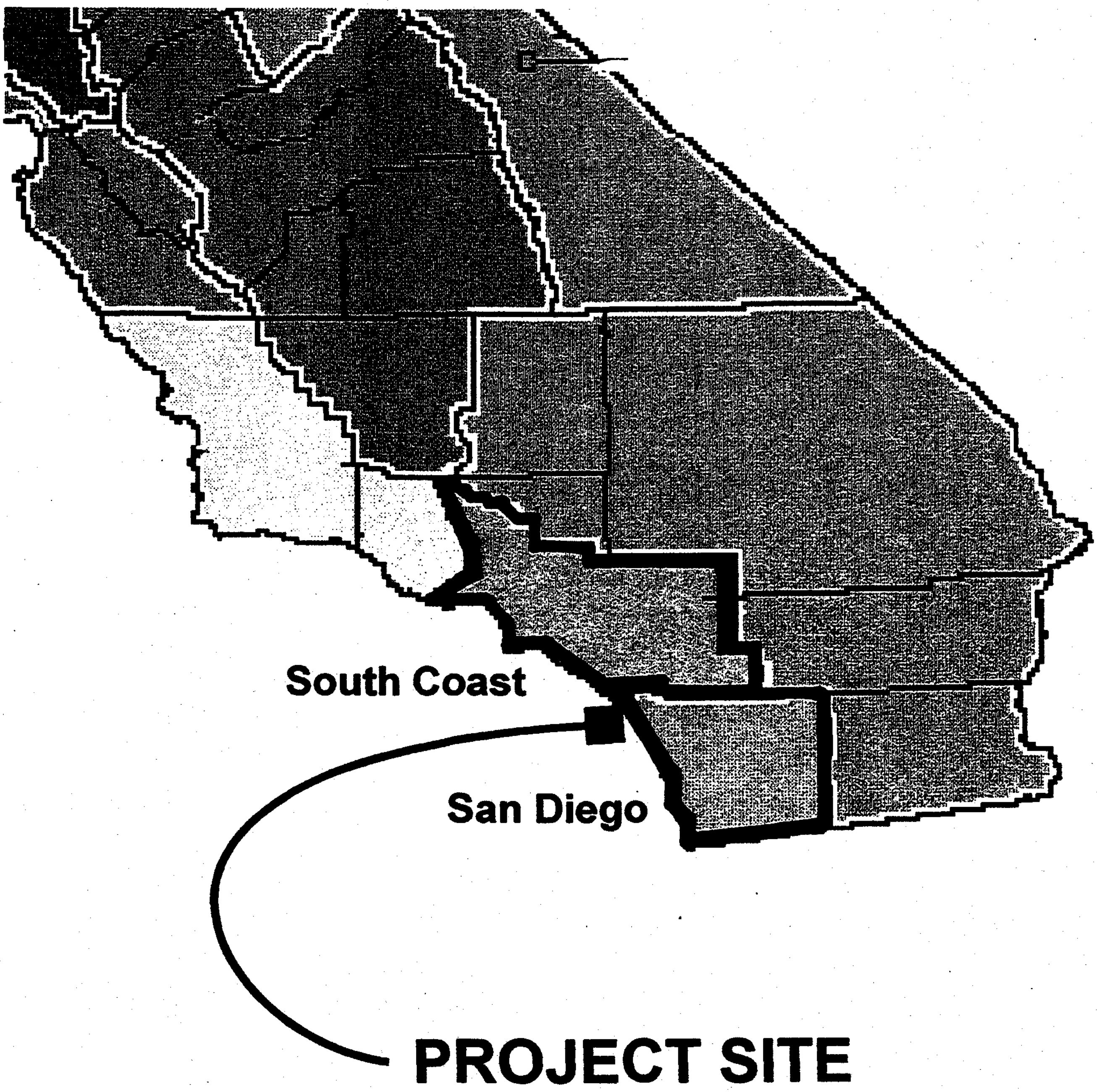


Figure 4.4-1
Project Air Basins
SOURCE:California Air Resources Board

proposed artificial reef would be located within the SCAB and all emissions from construction of the reef related to off-loading and placement of reef materials, and monitoring would occur within the SCAB.

If recycled concrete is obtained from suppliers in Los Angeles and shipped from the Ports of Los Angeles/Long Beach, and quarry rock is obtained from Catalina Island, then all hauling, storing, and loading activities would also take place within the SCAB as well. These activities include: 1) use of front end loaders to load the concrete and quarry rock onto semi-end dump trucks; 2) hauling concrete and rock in the trucks to the dock; 3) use of a crane to place materials on barges; and 4) tugboats towing the barges to the reef site near San Clemente.

- ***San Diego Air Pollution Control District***

The San Diego Air Pollution Control District (SDAPCD) has jurisdiction over the SDAB, and the jurisdictional boundaries of both are coincident with San Diego County. The greater San Diego area is a potential source of both recycled concrete and quarry rock, where materials would be shipped from the Port of San Diego. The emissions from loading, transporting, and shipping of quarry rock and recycled concrete would occur primarily in the SDAB, with the exception of some tugboat emissions that would also occur in the SCAB as tugs traveled into Orange County to reach the project site.

4.4.1.3 Physical Environment

All project-related activities would take place in the offshore or coastal portions of the air basins and air districts, as shown in Figure 4.4-1. Therefore, the discussion of topographic and meteorological settings emphasizes the coastal environment within the study region.

- ***Topographic Setting***

The project is situated within and adjacent to the Southern California Bight, a northwest-southeast trending shoreline along the West Coast of North America. The study area extends from the Los Angeles Basin in the north to San Diego Bay near the Mexican border in the south.

A series of mountain ranges and coastal plains are present along the Southern California Bight. The Transverse Ranges are a series of east-west trending ranges across the northern portion of Southern California, and include from west to east, the Santa Monica, San Gabriel, and San Bernardino Mountain Ranges. These ranges form the northern boundary of the SCAB. Much of the southern portion of the SCAB is bordered on the east by the Peninsular Ranges, a series of north-northwest trending ranges that include the Santa Ana Mountains in Orange County and the Cuyamaca Mountains in San Diego County. The latter range also follows the eastern border of the SDAB.

The mountain ranges trap air pollutants transported by prevailing onshore winds, exacerbating air quality on the coastal side of the ranges. All project-related activities would take place in the offshore or coastal areas of the region. Therefore, project-related air emissions generated near the coast would affect air quality within the affected air basins.

- ***Climate and Air Pollution Meteorology***

Climate. The project area has a mild, coastal Mediterranean-type climate characterized by warm, dry summers and cool, moist winters, and a lack of seasonal temperature extremes. The daily temperature range of roughly 20°F is typically greater than the seasonal range of 10° to 15°F. The most important climatic and meteorological factors that influence air quality are the persistent temperature inversions, predominance of onshore winds, and prevalent sunlight. Precipitation in the study area generally decreases from north to south, and falls primarily between November and April. Wind speeds are moderate, generally 6-7 mph, and originate out of the west-northwest (WNW) (see Table 4.4-1). Prevailing winds transport air pollutants eastward towards the Peninsular and Transverse mountain ranges (SCAQMD 1993).

Wind Speeds and Directions. Winds are capable of dispersing and transporting air pollutants long distances. Wind disperses air pollutants by mixing and diluting them with relatively unpolluted air, and transports the mixture to other locations downwind of the source. Windy conditions can also produce concentrations of particulates, especially wind-blown fugitive dust. In contrast, under stagnant conditions, relatively little mixing and dispersing of pollutants occurs; and the highest concentration of emissions are found near the source.

An onshore flow is common in the study area. A contrary wind condition is known as the Santa Ana Winds. The Santa Ana's occur when a high pressure cell over the Great Basin results in a reversal of the prevailing onshore winds, and transports air pollutants offshore. There the pollutants are entrained by offshore winds and carried further south and onshore within the Southern California Bight. A paradox of the Santa Ana is that the worst air quality in San Diego County commonly occurs during good air quality in Los Angeles County.

Inversion Layers. An inversion layer occurs when warmer air is present above cooler air in the atmosphere, contrary to the normal condition where temperatures decrease with altitude. Inversion layers are stable and persist until ground heating of surface air produces sufficient mixing to break up the condition. A temperature inversion inhibits mixing. Vertical escape of air pollutants is reduced by the inversion, which acts as a lid or trap. The inversion base is the altitude at which the inversion layer occurs, and it is an important factor in determining air quality. A low inversion base of 100 feet or less can lead to very high concentrations of pollutants near the ground surface, whereas an inversion base above a 1,000 feet may not result in unhealthy air quality.

Inversion layers are common year-round in the coastal air basins of Southern California. Subsidence inversions occur most frequently during the spring and summer when the land surface heats more quickly during the day than the adjacent ocean surface. This differential heating causes the land air to rise, producing a low pressure over the land surface that draws in the cooler, denser ocean air. The result is stable, cool air near the ground surface, warm air aloft and a persistent temperature inversion (SCAQMD 1993).

Surface inversions occur most frequently during the fall and winter when the surface cools on cloudless nights. The cool surface then chills the adjacent air by advection. Surface inversions typically break up in the late morning when the sun heats the ground surface sufficiently.

Table 4.4-1 Average Climatic Conditions in the Project Area

Location	Average daily maximum and minimum temperatures (°F)		Annual rainfall (in.)	Average wind speed (mph)		Wind direction	
	July	January		Summer	Winter	Summer	Winter
Long Beach WSCMO	82.7-63.5	66.8-45.3	12.08	6.8	5.6	WNW	WNW
Avalon Pleasure Pier	72.1-60.3	62.0-46.7	12.00	-	-	-	-
Oceanside Marina	72.9-62.0	63.9-44.5	10.34	-	-	-	-
San Diego WSO Airport	75.5-64.4	65.1-48.0	10.30	7.5	6.0	WNW	NE

Source: Western Regional Climate Center (1997a, b).

Temperatures. Air temperature has an important influence on air quality. Solar radiation and higher temperatures stimulate chemical reactions in the atmosphere that lead to the production of ozone and other photochemical air pollutants. On the other hand, very hot temperatures can result in lifting the subsidence inversion layer and decreasing concentrations of air pollutants in the late afternoon.

4.4.2 Air Pollutants

The quality of surface air (air quality) is evaluated by measuring ambient concentrations of pollutants that are known to have negative effects. The degree of air quality degradation is then compared to ambient air quality standards (AAQS) that are set by federal and State agencies. Air pollutants are classified as primary and secondary. Primary air pollutants are emitted by sources directly into the atmosphere. Secondary pollutants are derived from primary pollutants and are produced through transformations and chemical reactions in the atmosphere. The AAQS are listed in Table 4.4-2. Most are expressed in concentrations, either parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$), that are averaged over a specified sampling period.

In most cases, California ambient air quality standards (CAAQS) are stricter, i.e., more protective of human and environmental health, than the federal, or "national," standards (NAAQS). State and federal standards have been established for carbon monoxide (CO), lead, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), and fine particulate matter less than or equal to ten microns in diameter (PM_{10}). California has also established standards for sulfates (compounds containing SO_4), hydrogen sulfide (H_2S), vinyl chloride, and visibility-reducing particles. There are many other recognized air pollutants for which there are no established standards.

4.4.2.1 Primary Air Pollutants

Primary air pollutants are emitted directly from sources. The ones pertinent to the proposed project are summarized from CARB 1997b and SCAQMD 1993.

Sulfur dioxide. Sulfur dioxide (SO_2) is derived from the burning of fossil fuels that contain sulfur compounds, and during oil and gas production and processing. It is a colorless and odorless gas at low concentrations, but very pungent at high concentrations. Sulfur dioxide forms secondary acidic aerosols which damage lung tissue and corrode building materials and finishes (see sulfates [SO_4] below).

Fine particulate matter. Fine particulate matter (PM) is composed of several natural and artificial substances and is present in the atmosphere as both solid particles and aerosols (liquid droplets). PM includes aerosols, mists, fine minerals, smoke, and dust. Primary sources of PM in the region are fossil fuel combustion, dust from paved and unpaved roads, wood burning stoves and fireplaces, wildfires, and such ground disturbing activities as construction and earth moving that expose soils and other fine material to the wind. A secondary source of PM is the chemical conversion of gases, such as NO_2, SO_2 and ammonia, into nitrates, sulfates and organic aerosols.

PM_{10} consists of particulates that are less than ten microns in diameter, about 1/7 the thickness of human hair. Particulates of this size are an important health concern because they can be inhaled deeply into the lungs and impair lung function. Primary PM_{10} can include smoke, soot, dust, acids, and metals. In addition to health problems, particulates are responsible for much of the haze characteristic of smog that reduces visibility. Air quality standards were converted from PM to PM_{10} in recent years. The focus of concern is shifting further toward finer particulates that penetrate deeper into the lungs. A new $PM_{2.5}$ standard (particles 2.5 microns or smaller) was adopted by the Environmental Protection Agency (USEPA) in 1997 (see Table 4.4-2).

Toxic air contaminants (TACs) are air-suspended chemicals known or suspected to cause cancer and other serious illnesses in people. Some TACs are present in the diesel fuels that would be used during construction of the reef. AAQS have not been developed for TACs. However, Title III of the Clean Air Act Amendments (CAAA) of 1990 addresses risk-based regulation of TACs. Establishment of a level of risk in the study area is not presently possible.

4.4.2.2 Secondary Air Pollutants

Secondary air pollutants are produced during pollutant transport in the atmosphere, and include nitrogen dioxides (NO_2), sulfates (SO_4), and ozone (O_3). These secondary pollutants are described below.

Nitrogen dioxide. Nitrogen dioxide (NO_2) is derived from nitrogen oxide (NO) produced during combustion of fossil fuels in motor vehicles and industrial equipment. The NO reacts quickly in the atmosphere to form NO_2. The mixture of NO and NO_2 is commonly referred to as nitrogen oxides (NOx). Nitrogen dioxide produces the distinctive brownish color of smog haze and can cause eye, nose and throat irritation, as well as reduce plant growth. NO_2 is one of the main precursors to ozone, and can be a source of PM_{10} (see above).

Table 4.4-2 State and Federal Ambient Air Quality Standards and Averaging Times

Air Pollutant	California Standards	Federal Standards[1] Primary	Secondary
Ozone (O_3)	>0.09 ppm, 1-hr. avg.	>0.08 ppm, 1-hr. avg.	same as primary
Carbon monoxide (CO)	>9.0 ppm, 8-hr. avg. >20 ppm, 1-hr. avg.	≥9.0 ppm, 8-hr. avg. >35 ppm, 1-hr. avg.	
Nitrogen dioxide (NO_2)	>0.25 ppm, 1-hr. avg.	>0.053 ppm, annual avg.	same as primary
Sulfur dioxide (SO_2)	>0.25 ppm, 1-hr. avg. >0.04 ppm, 24-hr. avg. where a Calif. Ozone or PM standard is violated	>80 $\mu g/m^3$, annual avg. >365 $\mu g/m^3$, 24-hr. avg.	>1300 $\mu g/m^3$, 3-hr. avg.
Particulate matter	>50 $\mu g/m^3$, 24-hr. avg. >30 $\mu g/m^3$ annual geometric mean	>150 $\mu g/m^3$, 24-hr. avg. >50 $\mu g/m^3$, annual arithmetic mean	same as primary
$PM_{2.5}$[2]	---	>65 $\mu g/m^3$, 24-hr. avg. >15 $\mu g/m^3$, annual avg.	same as primary
Sulfates (SO_4)	≥25 $\mu g/m^3$, 24-hr. avg.		
Lead	≥1.5 $\mu g/m^3$, 30-day avg.	>1.5 $\mu g/m^3$, calendar quarter	same as primary
Hydrogen sulfide (H_2S)	≥42 $\mu g/m^3$, 1-hr. avg.		
Vinyl chloride	$\geq 0.0_{10}$ ppm, 24-hr. avg.		
Visibility-reducing particles	In sufficient amount to produce an extinction coefficient of 0.23/km due to particles when relative humidity <70%		

[1] Other than ozone, federal standards are not to be exceeded more than once a year. The ozone standard is attained when the number of days per calendar year with maximum hourly average concentrations above the standard is one or less.

[2] The $PM_{2.5}$ standard was adopted in 1997. There is no California 2.5-mieron particulate standard yet.

Sources: CalEPA-ARB 1997a., Scientific American, 1998

Sulfates. Sulfates (SO_4) are compounds in particulate aerosol derived from SO_2. They can aggravate respiratory and pulmonary diseases, reduce visibility, and cause damage to vegetation. Sulfates are related to nitrates (NO_4) which have similar deleterious effects. Nitrates derive from NO_2 and are as ubiquitous as sulfates in southern California. While nitrate concentrations are measured in the most aggrieved air basins, nitrate air quality standards have yet to be determined. Peculiar to the study area is acid fog, a mixture of nitrate and sulfate aerosols produced in the presence of fog. It is similar to acid rain, common in the middle and eastern United States.

Ozone. Ozone (O_3) is derived from two main precursors, NOx and reactive organic compounds (ROC), reacting over several hours in the presence of sunlight. Ozone is one of many oxidizing photochemical compounds and gets its notoriety from being the one used to define the oxidant air quality standards. ROC escape into the atmosphere from motor vehicles, oil and gas production and processing, solvents, and many consumer products. Ozone is colorless and odorless. The oxidants in smog cause breathing difficulties, eye irritation, and other adverse health effects. Ozone also damages vegetation, rubber, and other materials.

4.4.3 Local Air Quality

While air quality has improved in recent years in the SCAB and SDAB, both basins exceed standards for one or more air pollutants. A summary of the air quality status of these air basins, relative to the AAQS is provided in Table 4.4-3. (Additional information is located in Table 4.4-4, as well as at the CalEPA-ARB website, at URL: http://www.arb.ca.gov/aqd/aqd.htm.) Nonattainment is the term air quality regulatory agencies use to indicate violation of standards under their jurisdiction.

Table 4.4-3 Attainment Status of State and Federal AAQS for Each Air Basin for Ozone and Fine Particulate Matter, Averaged for the Years 1991-1995

Pollutant	Air Basin	Status
Ozone	SCAB	Extreme nonattainment. Exceeds State 1-hr. standard 175 days/yr, and federal 1-hr. standard 122 days/year.
	SDAB	Nonattainment. Exceeds State 1-hour standard 93 days/year, and federal 1-hour standard 16 days/year.
Fine particulate matter (PM_{10})	SCAB	Nonattainment. Exceeds State 24-hr. standard 68% of the time and exceeds State annual geometric mean standard. Exceeds federal 24-hr. standard 4% of the time and exceeds the federal annual arithmetic mean standard.
	SDAB	Nonattainment. Exceeds State 24-hr. standard 28% of the time and exceeds State annual geometric mean standard. All but one year, 1993, was in compliance with federal standards.

Source: CalEPA-ARB 1997b.

Table 4.4-4 Ambient Air Quality Summary (Highest Concentrations and Number of Days Exceeding AAQS During 1996)

Pollutant	SCAB		SDAB	
	North Long Beach	El Toro	Oceanside	San Diego (Overland)
Ozone (1-hr.)				
Highest concentration (ppm)	0.11	0.14	0.11	0.12
No. of days > CAAQS (0.09)	5	20	4	7
No. of days > NAAQS (0.12)	0	2	0	0
NO_2 (1-hr.)				
Highest concentration (ppm)	0.17	N/A	0.11	0.11
No. of days > CAAQS (0.25)	0		0	0
PM_{10} (24-hr.)				
Highest concentration ($\mu g/m^3$)	113	79	63	50
No. of days > CAAQS (50) [1]	7/48	4/61	1/60	0/55
CO (8-hr.)				
Highest concentration (ppm)	6.9*	4.0	2.8	3.3*
No. of days > CAAQS (9)	0	0	0	0

[1] "Days" are given as exceedances/number of annual measurements.

* Less than one year of data.

Source: CalEPA-ARB 1997a.

These air basins are in nonattainment for State and federal ozone standards, and State PM_{10} standards. The SCAB is also in non-attainment for federal PM_{10} standards, and is described as in extreme non-attainment for federal ozone standards.

Monitoring data for 1996 are the most recent to be published (CARB 1997a). The CAAQS were exceeded at several locations near proposed project activities. The NAAQS for ozone were exceeded near the proposed reef site at El Toro Marine Base.

An air quality monitoring site located in north Long Beach, provides air quality data pertinent to Long Beach and Los Angeles Harbors. The ozone CAAQS was exceeded on five days during 1996. The PM_{10} CAAQS was exceeded 7 times out of 48 measurements.

Data closest to the site of the proposed reef are recorded at El Toro in the SCAB and further south at Oceanside in the SDAB. The ocean-side site is the closer of the two, and because it is coastal rather than inland, more closely approximates the air quality of the proposed reef site. The ozone CAAQS was exceeded on 20 days at El Toro and four days at Oceanside. The NAAQS were exceeded twice at El Toro. The PM_{10} CAAQS was exceeded four times in 61 measurements at El Toro and once in 60 measurements at Oceanside during 1996.

Data recorded in the City of San Diego are representative of conditions for recycled concrete and quarry rock loading, hauling, and shipping out of San Diego Bay. The ozone CAAQS was exceeded seven days during 1996. The PM_{10} CAAQS was not exceeded at Overland Avenue, but once at another monitoring site in San Diego.

A comparison of these numbers with those in Table 4.4-3 show that the proposed reef site and locations of potential rock and concrete sources have better air quality compared to other parts of the air basins. Ozone generated regionally within the SCAB is a significant problem at the proposed project site. Sulfur dioxide was essentially immeasurable at these sites.

4.4.4 Applicable Regulations

USEPA implements the NAAQS, New Source Review, and Prevention of Significant Deterioration in accordance with the federal Clean Air Act of 1970. CalEPA-ARB implements the CAAQS in accordance with the California Clean Air Act. There are other agency and air district regulations that are not applicable to the proposed project.

The SCAQMD and SDAPCD have regulatory/permitting jurisdiction over stationary sources of air emissions in their respective air basins and each district has adopted air quality regulations that apply to various types of stationary sources. The air districts do not regulate mobile sources (transportation vehicles and mobile construction equipment), except where these sources are operated as a stationary source. This includes situations where vehicles are operated on site as part of a stationary source's operations for loading and hauling on the premises of the commercial operation. These vehicles would be included in the stationary source's air district permit. The air districts would also regulate cranes and idling tugboats used during loading and unloading of materials onto barges while they are stationary. However, the districts do not regulate trucks used in commercial hauling operations or tugboats under way when they are considered mobile sources. The air districts would issue permits for stationary activities involved in the proposed project only if contractors did not have an active permit in place for the equipment (these permits are normally issued for a year at a time). If permits were needed, the air districts would become responsible agencies for the CEQA review. However, the contractors have not been identified at this time and it is not known if any permits would be needed from the air districts.

Where the SDAPCD does not have permitting authority over project activities, the agency does not provide thresholds of significance to use in evaluating projects under CEQA. SCAQMD, on the other hand, does publish the CEQA Air Quality Handbook that provides guidelines to other lead agencies on how to evaluate air quality impacts. When consulted, the SDAPCD staff recommended using the SCAQMD CEQA guidelines for evaluating the project related activities in the San Diego Air Basin (Arthur Carbanero, SDAPCD, June 19, 1998).

The SQAQMD and SDAPCD regulate air quality in the first three miles seaward of the coastline. In addition, both districts have been designated as the corresponding onshore areas under 40 CFR Part 55, so they also regulate the next 25 seaward miles from the three-mile county boundaries. However, local air districts only regulate stationary sources of air emissions. Tugboat and barges are considered a stationary emission source when engines are operating, but not under way, such as during loading in port or unloading reef material at the project site.

Consequently, emissions from idling engines, working cranes, and other equipment on the tugboats and barges used to load and unload reef material are regulated under the visible emissions, nuisance, PM_{10} and fugitive dust rules of each air district, while the vessels are stationary in ports or at the project site. Table 4.4-5 summarizes the applicable rules.

The districts do not regulate emissions from marine vessels under way. Nonetheless, in compliance with CEQA, the potential emissions from the tugboat/barge shipping are included in the estimation of total project-related emissions.

4.4.5 Impacts and Mitigation Measures

This section analyzes air emissions that would be generated by the construction and monitoring of the proposed artificial experimental and mitigation reefs.

4.4.5.1 Methodology

The SCAQMD publishes the *CEQA Air Quality Handbook* (1993 and 1998) that provides guidelines to other lead agencies on evaluating project air emissions from both stationary and mobile sources. The SCAQMD provides calculation methods, reasonable assumptions, and emission factors to estimate emissions generated by vehicles and equipment during construction of the experimental and mitigation reefs. The emission factors for individual pollutants are multiplied by either the estimated hours of equipment operation, fuel consumed, or the distance traveled by vehicles at each site. SCAQMD emission factors for fugitive dust were used to estimate PM_{10} emissions generated from vehicle traffic associated with hauling recycled concrete and mainland sources of quarry rock.

Table 4.4-5 Summary of Air District Rules Affecting Construction Emissions

Category	SCAQMD	SDAPCD
Visible emissions	Rule 401. Limits visible emissions to shades less dark than No. 1 on the Ringelmann Chart in any 3 minutes per hour, and limits opacity to a similar level.	Rule 50. Similar to SCAQMD Rule 401.
Nuisance	Rule 402. Prohibits any emissions that cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or which have a natural tendency to cause injury or damage to business or property.	Rule 51. Similar to SCAQMD Rule 402.
PM_{10} and fugitive dust	Rule 403. Visible fugitive dust not allowed beyond property lines, PM_{10} concentration must be less than 50 mg/m^3, and best available control measures shall be used.	Rule 52. Limits PM_{10} emissions to less than 0.10 grain per dry standard cubic foot of gas at standard conditions.
Dust and fumes	Rule 405. Limits PM_{10} emissions to less than 24.9 lbs/hr. for handling 30 tons/hr, and 26.6 lbs/hr. for handling 312.5 tons/hr.	Rule 54. Limits total dust and fumes to less than 40 lbs/hr. for handling 30 tons/hr. or more.

Note: 1 gram = 15.43 grains; 2.2046 lbs = 1,000 grams; 1 mg = 1/1000 gram.

Air emissions for construction of the proposed project experimental reef and mitigation reef were calculated based on the assumptions outlined in Chapter 3, Project Description, which represents a probable worst-case scenario. The assumptions include the construction equipment/vehicles used, sources and quantities of reef material, hauling distances, and the rate of construction and are discussed further below in Section 4.4.5.3.

This analysis looks at one probable worst-case scenario for the construction recognizing there are numerous variables and options for the final construction plans. These other options for construction and the estimates of how they would reduce the emissions are also outlined in the mitigation discussion. In addition, an evaluation of the maximum construction activities (e.g. number of truck trips) that can take place before air emission thresholds are reached, is presented as a comparison to the proposed project assumptions.

4.4.5.2 Significance Criteria

The following is a description of various criteria that would be used in order to determine the significance of project-related emissions on the existing air quality.

- ***Clean Air Act***

The SCAB is the only extreme non-attainment area for ozone in the United States. Section 182(e) of the federal Clean Air Act identifies the significance level for any proposed project in an area of extreme non-attainment as 10 tons/year (20,000 lbs.) of volatile organic gas emissions or 10 tons/year of nitrogen dioxide emissions.

- ***State CEQA Guidelines***

The CEQA Guidelines, Appendix G (x), states that a project would be considered to have a significant effect on the environment if it will, "*violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations*".

- ***SCAQMD Significance Criteria***

The SCAQMD has established emission significance thresholds (primary effects of a project) and additional indicators (indirect effects of a project) to aid in determining whether a proposed project would have a significant impact on existing air quality (SCAQMD 1993). The proposed project is expected to have primary effects on air quality during construction, and is not expected to result in indirect (e.g., trip-inducing) impacts.

The SCAQMD has published emission thresholds as a guideline for determining whether a project would have a significant impact on air quality under CEQA. The thresholds are expressed in terms of daily and quarterly levels of emissions, and are provided for the construction and operations phases of the project. The period for estimating quarterly emissions is 78 days long, assuming a six-day work week for the construction of the reefs.

The proposed experimental and mitigation reefs would only generate potentially significant emissions during reef construction. As a result, only the construction related emissions and significance thresholds are considered for this analysis. The daily and quarterly significance thresholds for construction-related emissions adopted by the SCAQMD are listed below in Table 4.4-6.

- ***SDAPCD Emission Thresholds***

The SDAPCD does not have any established thresholds of significance for consideration under CEQA. However, the district recommended using the SCAQMD thresholds for this analysis of this project (SDAPCD 1998). The following impact evaluation adopts the SCAQMD thresholds in determining whether the potential project-related emissions in the SDAB are significant.

- ***Air Emissions Among Basins***

Depending on where materials are purchased, the tugboats and barges would travel from the Ports of Los Angeles, Long Beach or San Diego or from Catalina Island. Under some construction scenarios, all of the construction activities would be carried out within the South Coast Air Basin (SCAB). Other scenarios shift the on-land concrete or rock loading and hauling activities, and the majority of marine shipping activities into the San Diego Air Basin (SDAB).

The analysis presented in this chapter takes a conservative approach by evaluating air quality impacts for the southern California region as a whole. The approach is based on the premise that it is not appropriate to create a preference for polluting in either basin; i.e. shifting pollution to the SDAB because the air quality there is somewhat better than in the SCAB is not an appropriate way to mitigate for air emission impacts. Both air basins are in non-attainment for State and federal ozone standards (NOx is a precursor to ozone), and the SCAB is also in extreme non-attainment for federal ozone standards. Given the nature of the construction activities and the fact that much of the activity occurs offshore, most of the NOx air emissions are regional in nature. This makes it difficult to easily divide emissions between air basins. Emissions do not stop traveling at the county borders when tugboats are traveling offshore and across county lines. Because the San Clemente site is located on the border of San Diego County line, emissions generated in Los Angeles and Orange counties from tugboats traveling to the site and at the site during unloading activities may also travel into San Diego County. Depending on the prevailing winds it is also possible that emissions from San Diego County could travel into Orange County. Accordingly, the impact evaluation considers the SCAB and the SDAB as a single, combined planning area and uses the SCAQMD thresholds for significance for all project emissions.

The impact evaluation considers both daily and quarterly emissions; and it applies thresholds of significance to the experimental reef and the mitigation reef separately. This is done for review purposes, but also because the reefs would be constructed several years apart.

Table 4.4-6 SCAQMD Construction-Related Emission Thresholds for CEQA Analysis

Pollutant	Threshold of Significance	
	Maximum daily emissions (lbs./day)	Maximum quarterly emissions (lbs./qtr.*)
Carbon monoxide (CO)	550	49,500
Reactive (volatile) organic compounds (ROC)	75	5,000
Nitrogen oxides (NOx)	100	5,000
Sulfur oxides (SOx)	150	13,500
Fine particulates (PM_{10})	150	13,500

4.4.5.3 Reef Construction Assumptions

Air emissions resulting from the construction of the experimental and mitigation reefs are related to the type of construction activities. The project proponent would purchase either quarry rock or recycled concrete from current quarry operations and recycled concrete brokers. The businesses would be ongoing, permitted operations and as a result are not part of the PEIR evaluation. The project related impacts begin with the loading of material into trucks for delivery to the project site.

The following assumptions were made about the construction activities that were used in the air quality evaluation to estimate daily and quarterly emissions for a probable worst-case scenario. There are other construction scenarios that could reduce emissions and these will be discussed in the mitigation section. The assumptions used below are based on discussions with contractors and operators that would potentially provide these services. The assumptions for both the experimental and mitigation reef construction are the same except for a few components as noted below.

- ***General Assumptions***

1. All quarry rock and recycled concrete materials are obtained from the San Diego area within 20 miles of the Port of San Diego and are shipped from this port to the project site in San Clemente. Port of San Diego is 10 miles farther from the lease area than the Ports of Los Angeles/Long Beach and 11 miles farther than Catalina Island. 2. All construction equipment and vehicle engines would use diesel No. 2 fuel.

2. Vehicles and construction equipment would be derived from the existing, average population of vehicles (i.e, the exclusive use of newer, low emission vehicles is not assumed).

3. Construction would take place over a six-day work week, which results in 78 working days in a quarter year.

- ***Assumptions of Construction Components***

1. Truck Loading, Truck Hauling, and Barge Loading - The estimated daily and quarterly air emissions are calculated based on the following:

    - trucks are assumed to be heavy-duty diesel semi-end dump trucks weighing at least 25 tons, with 18 wheels;

    - each truck would carry approximately 22 tons of either concrete or rock;

    - a total of 91 truck loads per day would occur to fill one barge per day;

    - a maximum forty miles round trip is assumed for each of 91 truck loads, which is within range of several concrete brokers and rock quarries in the San Diego area; and,

    - 1 barge holds a maximum of about 2,000 tons of concrete or rock (91 x 22 = 2002 tons).

2. Worker Commuting - This includes consideration of daily and quarterly emissions produced by vehicles used by workers to commute to the project job sites in the San Diego area and San Clemente.

    - 40 workers would travel 25 miles per day, on average, to commute to and from work for the experimental and mitigation reef.

3. Tugboat and Barge Trips - The tugboat and barge shipping element of reef construction assumes:

    - for the experimental reef, one tugboat would make one roundtrip per every other day from the Port of San Diego to the Lease area, towing 1-2,000 ton-capacity barge;

    - for the mitigation reef, one tugboat would make one roundtrip per day from Port of San Diego to the lease area, towing 1-2,000 ton-capacity barge (only one contractor has suggested two barges could be towed by one tugboat, while the others consulted have said that one barge is the standard for marine shipping);

    - tugboats would be 1,500 horsepower with fuel consumption at an average of 38.2 gallons/hours (SCAQMD 1998); and,

    - tugboats would average 8.1 knots (9.3 miles per hour), completing a roundtrip between the Port of San Diego and the lease area in 17 hours.

4. Barge Off-Loading – This includes the off-loading and placement of rock and concrete at the San Clemente project site:

    - the method used would involve a 25-ton crane with a dump box mounted on a derrick barge with a Global Positioning System (GPS) and an attending tugboat;

- the barges would arrive and tie up to the derrick barge, while the crane would remove and place material;

- the derrick barge would be held in place with a six-point tension mooring system, which includes a series of six anchors that are moved and adjusted by an attending tugboat;

- for the experimental reef material placement would take place at a rate of two modules per day, which means approximately 0.5 of a barge a day during an 8 hour work day; and

- the mitigation reef material placement would occur at a rate of one full barge a day during an 8 hour work day.

4.4.5.4 Daily and Quarterly Air Emissions

The following sections present the total project daily and quarterly air emissions for both the experimental reef and mitigation reef under a probable worst-case scenario. The SCAQMD thresholds of significance must be applied to the project as a whole, however, it is important to break down the elements to understand the sources of air emissions and the impacts resulting from different choices about constructing the reefs. These choices include: 1) what materials are used; 2) where the materials are obtained; and 3) what construction methods/equipment are used. This in turn helps point towards choices for mitigating significant air quality impacts.

- ***Experimental Reef Emissions***

The experimental reef involves the construction of 56 modules (0.4 acre each), which requires the placement of 17,640 tons of quarry rock and 13,860 tons of recycled concrete. The construction would be completed over 32 days, with two modules placed each day. It would take 16 barge loads to transport the rock and concrete to the project site.

The experimental reef construction would produce daily and quarterly emissions of CO, ROC, NOx, SOx, and PM_{10} as seen in Table 4.4-7. The total estimated daily emissions for both PM_{10} and NOx exceed the thresholds of significance. The PM_{10} emissions are almost 4 times more than the threshold and NOx emissions are almost 5 times more than the threshold. The PM_{10} and NOx daily emissions for the experimental project are considered a significant impact and mitigation is required (see Section 4.4.5.6).

Quarterly emissions were estimated for total construction emissions over 32 days (although some construction activities occur over only 16 days), which would occur within one quarter (a quarter is 78 working days). As a result, the quarterly emissions are also the total project emissions for the experimental reef. Quarterly emissions are estimated by multiplying daily emissions by either 16 days or 32 days for different components of the construction activities and then taking the sum. Estimated quarterly NOx emissions exceed the threshold of significance by 1.9 times, while PM_{10} quarterly emissions are not exceeded. None of the other daily or quarterly emission thresholds for CO, ROC, or SOx are exceeded. The quarterly NOx emission are considered a significant impact and mitigation is required (see Section 4.4.5.6).

1. The break down of emissions by construction elements shows that the PM_{10} emissions are related primarily to truck hauling on paved roads, which produces fugitive dust. NOx emissions are primarily related to tugboat towing and off-loading activities. The use of a crane and derrick barge to off-load material exacerbates the NOx emission problem. The daily and quarterly emissions for the individual construction elements are as follows:

   The truck loading, hauling, and barge loading element of the proposed experimental reef project would occur over 16 days in the loading of 16 barges. These activities produce daily and quarterly emissions of CO, ROC, NOx, SOx, and PM_{10} (Tables 4.4-8, 4.4-9 and 4.4-10). The emission figures assume that one full barge would be loaded every other day for a total of 16 barges. Of these estimated emissions, PM_{10} emissions would substantially exceed the daily threshold of significance, however, the quarterly threshold is not exceeded. None of the other emissions exceed daily or quarterly thresholds of significance due to loading and hauling activities.

2. The estimated emissions for worker commuting are well within the daily and quarterly significance thresholds for all emission parameters (Table 4.4-11). These emissions are less-than-significant, and individually would not require mitigation. Nevertheless, these emissions would occur concurrently with those from other project elements. Any reduction in commuting emissions would reduce total project impacts.

3. The tugboat shipping element of the proposed project would produce daily and quarterly emissions of CO, ROC, NOx, SOx, and PM_{10} (Table 4.4-12 and 4.4-13). The daily NOx emissions would exceed the daily threshold of significance by 172 percent, which results in quarterly emissions that are just under the threshold for significance. The other daily and quarterly thresholds for CO, ROC, SOx, and PM_{10} would not be exceeded due to the tugboat shipping activities.

4. The barge off-loading element of the proposed project would produce daily and quarterly emissions of CO, ROC, NOx, SOx, and PM_{10}. The emission figures for the experimental reef assume that one half barge per day would be placed in the lease area during an 8-hour work day. This results in 32 days total of off-loading activities. The crane method of off-loading produces NOx emissions that are 18 percent above the daily threshold of significance, although they do not exceed the quarterly threshold (Tables 4.4-14 and 4.4-15). The combination of the daily NOx emissions from tugboat shipping and offloading, push the project NOx emissions over the quarterly threshold for significance. The other daily and quarterly thresholds, for CO, ROC, SOx, and PM_{10} would not be exceeded by the barge off-loading activities.

Table 4.4-7 EXPERIMENTAL REEF PROJECT
Total Daily and Quarterly Emission

Pollutant	Daily Emissions[1] (lbs/day)	Quarterly Emissions[2,3] (lbs/qtr)
CO	203.03	4,475.20
ROC	42.89	920.32
NOx	**480.37**	**9,603.20**
SOx	66.20	1,263.20
PM_{10}	**588.79**	9,612.48

[1] Daily emissions include all truck loading, truck hauling, barge loading, worker commuting, tugboat/barge shipping and material off-loading at project site during one day.

[2] Total of 32 days construction for experimental reef, all in one quarter, with some components of construction occurring over 16 days (loading, truck hauling and tugboat shipping). Quarterly numbers are computed by adding quarterly estimates for individual components.

[3] Emissions exceeding the threshold are bolded.

Table 4.4-8 EXPERIMENTAL AND MITIGATION REEFS
Daily Truck and Barge Loading Emissions

	Truck Loading		Barge Loading		Total
Pollutant	Emission factor[1] (lbs/hr)	Emissions (lbs/day)	Emission factor[2] (lbs/hr)	Emissions (lbs/day)	One barge (lbs/day)
CO	0.572	4.09	4.5	15.48	19.57
ROC	0.230	1.65	1.5	5.16	6.81
NOx	1.900	13.60	11.5	39.56	53.16
SOx	0.182	1.30	1.0	3.44	4.74
Exhaust PM_{10}	0.170	1.22	0.75	2.58	3.80

[1] Diesel 300-hp wheeled loader. Emission factors from (SCAQMD, 1993) Table A9-8-A; 46.5% of working capacity (Table A9-8-D). Ten minutes loading time per truck load for (277/3) loads daily, i.e. over 15.34 hr. while servicing 5 trucks in loading one barge/day.

[2] Diesel 500-hp crane. Emission factor from (SCAQMD, 1993) Table A9-8-B; 43% of working capacity (Table A9-8-D), operating over 8 hr. day to load one barge at 250 tons/hr.

Table 4.4-9 EXPERIMENTAL AND MITIGATION REEFS
Daily Truck Hauling Emissions

Pollutant	Emission Factors[1] (lbs/mi)	Daily Emissions[2,3] (lbs/day)	
CO	0.0178	64.61	79.09
	0.0866	13.15	
		1.33	
ROC	0.00218	7.93	9.85
	0.01116	1.70	
		0.22	
NOx	0.00933	33.97	36.14
	0.01382	2.10	
		0.07	
SOx[4]	-		-
PM_{10}			**577.34**
Exhaust PM_{10}	0.001025	3.74	3.90
	0.001025	0.16	
Paved PM_{10}[5]	0.149		542.36
Unpaved PM_{10}[6]	2.22		31.08

1 Emission factors from (SCAQMD, 1993) Table A9-5-K-5 for vehicles over 6,000 lbs in year 1999, Area 2 (L.A. County).

2 Emissions for concrete or rock loading. Those exceeding the threshold in bold.

3 First line of emissions is for 3640 VMT/day (vehicle miles traveled) at 35 mph, computed as 91 trips at 40 mi round-trip each; second is for 152 VMT/day at 5 mph to represent 20 min/trip idling to load and unload 18 trucks. Third line for emissions from cold starts, hot soaks and diurnal effects for 18 trucks (not in units of lbs/mi).

4 No emission factor; insignificant emissions of sulfur oxides.

5 Emission factor from (SCAQMD, 1993) Table A9-9-C for major streets & highways (for 3640 VMT/day).

6 Emission factor from Table A9-9-D; assumes 400 ft. of gravel road at loading point, trucks traveling at 15 mph max., rain on 34 days/year; 14 VMT on gravel from 91 trips/day.

Table 4.4-10 EXPERIMENTAL REEF
Quarterly Emissions for the Loading and Hauling Elements

Pollutant	One Barge[1] (lbs/day)	Quarterly[2,3] (lbs)
CO	98.66	1,578.56
ROC	16.62	265.92
NOx	89.30	1,428.80
SOx	4.74	75.84
PM_{10}	**581.14**	9,298.24

1 Sum of loading and hauling emissions for one barge in Tables 4.4-8 and 4.4-9.

2 16 barges loaded with materials from sources inland 20 miles.

3 Emissions exceeding the threshold are bolded.

construction with the different scenarios (Table 4.4-17). NOx emissions do not exceed the daily threshold, but the quarterly NOx emissions do exceed the threshold for this element. The other emissions, CO, ROC and SOx do not exceed daily or quarterly thresholds of significance due to loading and hauling activities.

2. The estimated daily emissions for worker commuting are the same as those for the experimental reef project. The emissions are well within the daily and quarterly significance thresholds for all emission parameters (Table 4.4-11). These emissions are less-than-significant, and individually would not require mitigation. Nevertheless, these emissions would occur concurrently with those from other project elements. Any reduction in commuting emissions would reduce total project impacts.

3. The tugboat shipping element of the proposed project would produce daily emissions of CO, ROC, NOx, SOx, and PM_{10} the same as the experimental project (Table 4.4-14). Both the daily and quarterly NOx emissions would substantially exceed the thresholds of significance (Table 4.4-18). The other daily and quarterly thresholds for CO, ROC, SOx, and PM_{10} would not be exceeded due to the tugboat shipping activities.

4. The barge off-loading element of the mitigation reef would produce daily emissions that are the same as for the experimental reef (Table 4.4-14). While the rate of off-loading the barges is half as fast for the experimental reef (0.5 barge/day) as for the mitigation reef (1 barge/day), the daily number of hours of equipment operation and related emissions would be the same. This results in daily NOx emissions that exceed the threshold of significance. In addition, the mitigation reef construction would result in quarterly NOx emissions that exceed the threshold of significance (Table 4.4-19). None of the other daily or quarterly emissions thresholds for CO, ROC, SOx or PM_{10} would be exceeded.

Total Mitigation Reef Emissions. The mitigation reef scenarios all involve large quantities of material being transported and placed over extended periods of time. Table 4.4-20 gives the total emissions for each build out scenario. It should be kept in mind that for most of the build outs these emissions would occur over a number of years as discussed above.

4.4.5.5 Recommended Mitigation Measures

Construction of the experimental and mitigation reefs includes several project actions that substantially exceed the daily and quarterly significance thresholds for PM_{10} and NOx.

There are three different mitigation strategies for reducing these emissions to less-than-significant levels: 1) standard mitigation measures for construction related emissions recommended by the air districts, and which apply to localized emissions; 2) purchasing or leasing emission offsets; and 3) changes in construction activities that reduce emissions. Table 4.4-21 contains a list of standard mitigation measures and emission offset measures, while Table 4.4-22 outlines changes to the construction activities that could be implemented as mitigation measures. These tables provide a brief summary of how much each measure would reduce PM_{10} and/or NOx emissions.

Table 4.4-17 MITIGATION REEF

Quarterly Emissions for Loading and Hauling Elements

Pollutant	Daily Emissions[1] (lbs/day)	Quarterly Emissions[2,3] (lbs/qtr)
CO	98.66	7,695.48
ROC	16.62	1,296.36
NOx	89.30	**6,965.40**
SOx	4.74	369.72
PM_{10}	**581.14**	**45,328.92**

[1] Daily emission factors from Table 4.4-10 for one barge.

[2] Quarter includes 78 working day.

[3] Emissions exceeding the threshold are bolded.

Table 4.4-18 MITIGATION REEF

Quarterly Tugboat Roundtrip Emissions

Pollutant	One Trip[1] (lbs/trip)	Quarterly[2,3] (lbs/qtr)
CO	37.02	2,887.56
ROC	12.34	962.52
NOx	**272.10**	**21,223.80**
SOx	48.71	3,799.38
PM_{10}	5.84	455.52

[1] Daily emissions for one roundtrip from Table 4.4-12.

[2] 78 working day per quarter with one barge trip per day.

[3] Emissions exceeding the threshold are bolded.

Table 4.4-19 MITIGATION REEF

Quarterly Emissions for Off-Loading Elements

Pollutant	Daily Factor[1] (lbs/day)	Quarterly[2,3] (lbs/qtr)
CO	59.60	4,648.80
ROC	13.35	1,041.30
NOx	**118.27**	**9,225.06**
SOx	12.75	994.50
PM_{10}	6.67	520.26

[1] Daily emissions factor from Table 4.4-15.

[2] Quarter is 78 working days.

[3] Emissions exceeding the threshold are bolded.

Table 4.4-20 MITIGATION REEF

Total Emissions for Build Out Scenarios

		127.6 Acres		277.6 Acres	
Pollutant	Daily Emissions (lbs/day)	Rock[1] (177 days)	Concrete[2] (141 days)	Rock[3] (389 days)	Concrete[4] (306 days)
CO	203.03	35,936	28,627	78,979	62,127
ROC	42.89	7,592	6047	16,684	13,124
NOx	480.37	85,025	67,732	186,864	146,993
SOx	66.20	11,717	9,334	25,752	20,257
PM_{10}	588.79	104,216	83,019	229,039	180,170

[1] Built over 2 years.

[2] Built in 2 years.

[3] Built over 4 years.

[4] Built over 3 years

Table 4.4-21 Standard Mitigation Measures and Emission Offsets Reducing NOx and PM_{10} Emissions for the Experimental and Mitigation Reefs

1. Apply water sprays to the concrete piles and graveled areas at least twice daily. Water down quarry rock and conveyer belts if soil is visible. Increase the frequency of watering when wind speeds exceed 15 miles per hour (30 percent reduction of PM_{10} from unpaved areas).	8. Instruct truck drivers to not idle their engines for more than two minutes (except when caught in traffic). Spot checks shall be periodically performed as part of the Mitigation Monitoring Program to verify success (after adding one or two hot starts per truck round trip; 90 percent reduction in idling emissions).
2. Extend pavement from roads or access ways to concrete piles to remove at least three-quarters of the gap. Apply quality gravel to the remaining unpaved area so that vehicles and mobile equipment never maneuver on dirt (vehicle miles traveled on unpaved roads reduced by 75 percent).	9. Implement a trip reduction strategy to achieve a 1.5 AVR (average vehicle ridership) for construction employees (one third reduction of commuting emissions).
3. Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving the site each trip (40-70 percent reduction).	10. Retard injection timing on diesel engines to two degrees Before Top Center (estimated ten percent reduction in NOx emissions).
4. Plan routes and schedules for truck trips that reduce trip times and slowdowns.	11. Use high pressure injectors on diesel engines to reduce NOx emissions by approximately 40 percent (not applicable to tugboats).
5. Sweep streets manually or with water sweepers at the end of the workday if visible soil material is carried onto private or public paved roads. Reclaimed water shall be used, if available with the water sweepers (35 percent reduction of PM_{10} from paved roads).	12. Retrofit tugboats used on the project with CAT 3606 series high efficiency diesel engines (48 percent reduction in fuel use and emissions) or other engine retrofit technologies currently being tested.
6. Keep traffic speeds on unpaved roads and access ways to 15 mph or slower.	
7. Pave a dirt road or lot that is currently generating PM_{10} emissions, which is unrelated to the proposed project but in the vicinity of the truck hauling operations as an offset for emissions (reductions would vary with situation).	

Table 4.4-22 Mitigation Through Changes in Construction Activities

Measures Applicable to Experimental and Mitigation Reefs	
• ***Finding reef material sources closer to the ports.*** Using suppliers of rock and concrete closer to the Ports of San Diego, Los Angeles or Long Beach would reduce both daily and quarterly estimated PM_{10} emissions while also reducing other emissions.	• ***Obtaining recycled concrete closer to the project site.*** Recycled concrete could be purchased in the Los Angeles area and shipped from either the Port of Long Beach or the Port of Los Angeles. This would reduce the roundtrip shipping time to the lease area by approximately 2.1 hours. This would reduce daily and quarterly NOx emissions for both the experimental reef and mitigation reef, but not below the significance threshold levels.
• ***Obtaining quarry rock from Catalina Island where minimal trucking is required.*** Obtaining rock from Catalina Island would substantially reduce the PM_{10} emissions from loading trucks and hauling rock to the Port of San Diego. The experimental reef requires 17,640 tons of quarry rock. If the rock was obtained at Catalina Island, it would reduce truck hauling to a minimal amount (0.25 of a mile) The related significant daily PM_{10} emissions would be reduced to below the threshold for significance. This would leave 13,860 tons of concrete to ship from inland sources, which requires seven days of truck loading and hauling. If the mitigation reef were built of all rock, obtaining materials on Catalina Island would eliminate the significant daily and quarterly PM_{10} emissions.	• ***Obtaining quarry rock. closer to the project site.*** The rock quarry at Catalina Island is located closer to the lease site, than the Port of San Diego. This would reduce the roundtrip shipping time to the lease area by about 2.5 hours. This would reduce daily and quarterly NOx emissions when compared with the trip from San Diego, but not below the significance threshold levels.
• ***Taking more time to load barges.*** The loading of one barge per day within the Ports of Los Angeles, Long Beach, or San Diego is estimated to generate PM_{10} emissions that exceed the daily significance threshold of 150 pounds per day. Taking two or three days to load one barge - the number depending upon the truck roundtrip distances - would be necessary to reduce the estimated PM_{10} emissions below the daily threshold. The loading of one barge every two or three days would have an effect on the overall construction period, particularly for the mitigation reef. The experimental reef might take up to 48 days to construct instead of 32 days, but it could be accomplished within one year. However, slowing the barge-loading schedule down would greatly increase costs because the equipment would need to be available, while under-utilized.	

Table 4.4-22 Mitigation Through Changes in Construction Activities (continued)

Measures Applicable to Mitigation Reef Only	
• ***Using less building material to construct the reef.*** Constructing the mitigation reef at the lowest practical density of quarry rock or concrete would reduce project-related PM_{10} emissions. For quarry rock, a reduction in the target coverage from 67 percent to 34 percent would reduce the necessary barge loads and days of construction from 387 to 191. Furthermore, a reduction in the target coverage from 67 percent to 17 percent would reduce the necessary barge loads of quarry rock and construction days from 387 to 95.	• ***Using less building material to construct the reef.*** Constructing the mitigation reef at the lowest practical density of quarry rock or concrete would reduce the project-related NOx emissions. A reduction in the target coverage from 67 percent to 34 percent would reduce the necessary barge loads and days of construction by half. Furthermore, a reduction in the target coverage from 67 percent to 17 percent would reduce the necessary barge loads and days of construction by 75 percent.
• ***Using concrete instead of quarry rock to construct the mitigation reef.*** This applies to materials shipped from the Port of San Diego. For the mitigation reef, about 1.3 times the number of truck trips are required to bring quarry rock to the port as compared to concrete. From an air quality standpoint, the Port of San Diego should be considered as a source for concrete but not for quarry rock. If quarry rock is the selected construction material, using the quarry at Catalina Island would dramatically reduce PM_{10} emissions.	• ***Using concrete instead of quarry rock to construct the mitigation reef.*** It takes 1.3 times as many tugboat roundtrips to bring quarry rock to the lease site as compared to concrete. From the standpoint of quarterly NOx emissions, concrete should be the preferred building material if it meets the SONGS performance standards.
• ***Taking more time to construct the project.*** Exceeding the estimated quarterly PM_{10} emissions thresholds could be avoided through further limits on the amount of construction carried out during each quarter.	• ***Using the live boating method of off-loading.*** Using the live boating method for placing material at the reef site would eliminate the use of the crane and derrick barge. Instead, material would be pushed off the towing barges with a track loader. This would reduce daily and quarterly NOx emissions. By itself it would not offset the very substantial NOx emissions from tugboat towing, but it would assist any construction scenario in avoiding exceeding the daily and quarterly NOx thresholds.

In the probable worst-case scenario that was used for the evaluation of impacts, virtually all PM_{10} emissions would be generated as fugitive road dust from trucks hauling reef materials from inland quarry rock and recycled concrete suppliers to the port. The problem of exceeding daily thresholds of significance is largely a function of transport distance and the number of truck trips per day. As a result the mitigation measures focus on adjusting these factors.

The largest contributors of NOx emissions are tugboats used for towing barges to the reef site. Significant NOx emissions also result from the use of a crane on a derrick barge with an assisting tugboat. Mitigation measures are also focused on options for reducing these emissions.

- ***Experimental Reef***

The significant daily NOx and PM_{10} emissions and quarterly NOx emissions resulting from construction of the experimental reef will be mitigated to a less-than-significant level by implementing a combination of standard mitigation measures, emissions offsets and/or changes in construction activities as outlined in Tables 4.4-21 and 4.4-22. Once the project proponent has awarded a construction contract for the experimental reef, the final mitigation plan will be negotiated with the project proponent, the CSLC and the appropriate air districts.

As an example of how these significant impacts could be mitigated, Table 4.4-23 calculates the daily truck hauling emissions for the experimental reef after implementing the following measures:

- *Standard Measures from Table 4.4-21:*

1. Apply water sprays to the concrete piles and graveled areas at least twice daily. Water down quarry rock and conveyer belts if soil is visible. Increase the frequency of watering when wind speeds exceed 15 miles per hour (30 percent reduction of PM_{10} from unpaved areas).
2. Extend pavement from roads or access ways to concrete piles to remove at least three-quarters of the gap. Apply quality gravel to the remaining unpaved area so that vehicles and mobile equipment never maneuver on dirt (vehicle miles traveled on unpaved roads reduced by 75 percent).
5. Sweep streets manually or with water sweepers at the end of the workday if visible soil material is carried onto private or public paved roads. Reclaimed water shall be used, if available with the water sweepers (35 percent reduction of PM_{10} from paved roads).
11. Retard injection timing on diesel engines to two degrees Before Top Center (estimated ten percent reduction in NOx emissions).
12. Use high pressure injectors on diesel engines to reduce NOx emissions by approximately 40 percent (not applicable to tugboats).

Table 4.4-23 Mitigated Daily Truck Hauling Emissions
Best Case - Loading One Barge Every Three Days
in Los Angeles and Long Beach at 16m RT

		One-Third Barge[2]		Plus Mitigation[2]	
Pollutant	**Emission Factors[1] (lbs/mi)**	**Daily Emissions[3] (lbs/day)**		**Daily Emissions[4] (lbs/day)**	
CO	0.0178	8.74	13.34	8.74	9.36
	0.0866	4.45		0.45	
		0.15		0.17	
ROC	0.00218	1.07	1.66	1.07	1.16
	0.01116	0.57		0.06	
		0.02		0.03	
NOx	0.00933	4.59	5.31	2.48	2.56
	0.01382	0.71		0.07	
		0.01		0.01	
SOx[5]	-		-		-
PM_{10}			84.27		50.00
Exhaust PM_{10}	0.001025	0.50	0.55	0.50	0.51
	0.001025	0.05		0.01	
Paved PM_{10}[6]	0.149		73.36		47.68
Unpaved PM_{10}[7]	2.22		10.36		1.81

1 Emission factors from (SCAQMD, 1993) Table A9-5-K-5 for vehicles over 6,000 lbs in year 1999, Area 2 (L.A. County).

2 Emissions for close-in concrete loading - eight miles from port (16 miles RT).

3 First line of emissions is 492 VMT/day (vehicle miles traveled) at 35 mph, computed as 13,860/22 = 630 trips over 21 days at 16 mi round-trip each; second is for 51 VMT/day at 5 mph to represent 20 min/trip idling to load and unload 2 trucks. Third line for emissions from cold starts, hot soaks and diurnal effects for 2 trucks (not in units of lbs/mi).

4 First line of emissions for NOx reduced by 46 percent through standard Measure 11 (10 percent reduction) and standard Measure 2 (40 percent); second is for 5 VMT/day at 5 mph to represent 2 min/trip idling to load and unload 2 trucks.

5 No emission factor; insignificant emissions of sulfur oxides.

6 Emission factor from (SCAQMD, 1993) Table A9-9-C for major streets & highways (for 492 VMT/day) with 35 percent reduction through Measure 5.

7 Emission factor from Table A9-9-D with 30 percent reduction through standard Measure 1; assumes 400 ft of gravel and 100 ft. of gravel road at loading point (on right after Measure 2), trucks traveling at 15 mph max., rain on 34 days/year; 9 VMT and 1.2 VMT on gravel from 30 trips/day.

- *Changes in Construction Activities from Table 4.4-22:*

  1. Ship concrete from the Port of Los Angeles or Long Beach.
  2. Use concrete brokers located as close as possible to the port.
  3. Load each concrete barge over a three-day period.
  4. Use quarry rock from Catalina Island.

In this example, significant impacts from PM_{10} emissions are reduced to a less-than-significant level on a daily basis. In addition, the NOx emissions are reduced by over 50 percent for this component of construction. Because the quarry rock would come from Catalina Island, the truck hauling emissions would be reduced to loading three barge loads of concrete over nine days.

Under this scenario, shorter shipping distances from Catalina Island (2.5 hours less) and Ports of Los Angeles/Long Beach (2.1 hours less) would reduce the NOx emissions. The emissions for one barge from Catalina Island would be 232.08 lbs/day and for one barge from Ports of Los Angeles/Long Beach emissions would be 238.49 lbs/day (versus the 272.10 lbs/day from Port of San Diego). While this represents approximately a 15 percent reduction in NOx emissions, these would still exceed the threshold of significance. A final mitigation measure could be implemented involving:

- *Purchase or lease of NOx emission offset credits.*

- ***Mitigation Reef***

The final design features of the mitigation reef are not known at this time, including the size of the reef, the location, the type of reef materials that will be used or the level of coverage that will be needed to meet the project objectives. Based on the analysis completed for a probable worst-case scenario, it will take major changes in the design and construction of the reef to reduce the significant daily and quarterly NOx and PM_{10} emissions to a level below the thresholds for significance.

As previously noted, once the final design of the mitigation reef has been determined, additional environmental review may be necessary if the plan is substantially different from what has been evaluated in the PEIR. In addition, there may be other technologies available at that time to reduce air emissions further. Also, during the next five to ten years, engines on construction equipment will be replaced with cleaner, more efficient engines. All of the mitigation measures available will be considered and a mitigation plan to reduce emissions to the greatest extent possible will be developed at that time. However, the air emissions for the mitigation reef could result in unavoidable significant impacts.

4.5 Transportation

4.5 Transportation

This section describes the existing ground and waterborne transportation environment of the project study area. The standards used to judge transportation impacts are presented, and relevant policy guidance is reviewed. The section then evaluates the potential effects of the project actions on these conditions, and identifies mitigation measures to alleviate significant impacts. The nature of the project eliminates some typical transportation issues from further consideration, including parking, public transit and rail and air traffic. Accordingly, the focus of the transportation analysis is upon the construction-related effects of both the experimental reef and the mitigation reef.

4.5.1 Regional Transportation Network

The project-related transportation network includes facilities that connect the sources of reef material sources and construction workers with the proposed lease area. As the lease site is 0.6 mile offshore, access to the lease area itself is restricted to waterborne craft. Reef materials would be loaded onto barges at one of following locations: the Port of Los Angeles, the Port of Long Beach, the Port of San Diego or from the dock at the Catalina Island quarries. Materials delivered to any of the three ports would require hauling in semi end-dump trucks. Trucks are also used at the Catalina quarries to transport rock up to a quarter mile to the dock for loading. However, these trucks operate on property and roads owned by the quarry and are part of the existing permitted operations. Tugboats would then take the materials by barge to the lease site. Workers would reach the lease area either by one of the construction-related transport vessels originating at one of the Ports or Catalina Island, or by smaller craft from nearby Dana Point Harbor. Therefore, the study area evaluated in this transportation analysis consists of the project-related roadway networks in relevant portions of: 1) the Los Angeles/Long Beach, San Diego, and southern Orange County regions; 2) the coastal waters between the ports and the lease area; and 3) the coastal waters between Catalina Island and the lease area.

4.5.1.1 Ground Transportation

The relevant portions of the existing ground transportation systems within the study area are shown on Figures 4.5-1 and 4.5-2. The following paragraphs describe these transportation systems for the Los Angeles/Long Beach area and the San Diego area.

Los Angeles/Long Beach Area. Interstate-710 (I-710, the Long Beach Freeway) is primary regional transportation route likely to be used for project-related travel in the Los Angeles/Long Beach area. In the project study area, I-710 runs north-south along the Los Angeles River through Long Beach, terminating near the Port of Long Beach. This freeway and a variety of local roads would facilitate the ground transport of materials from a concrete broker's yard to the ports and barges. Los Angeles/Long Beach area streets likely to be used for project materials hauling include South Alameda Street, Sepulveda Boulevard, Willow Street, Pico Avenue, Ocean Boulevard, and Cherry Avenue.

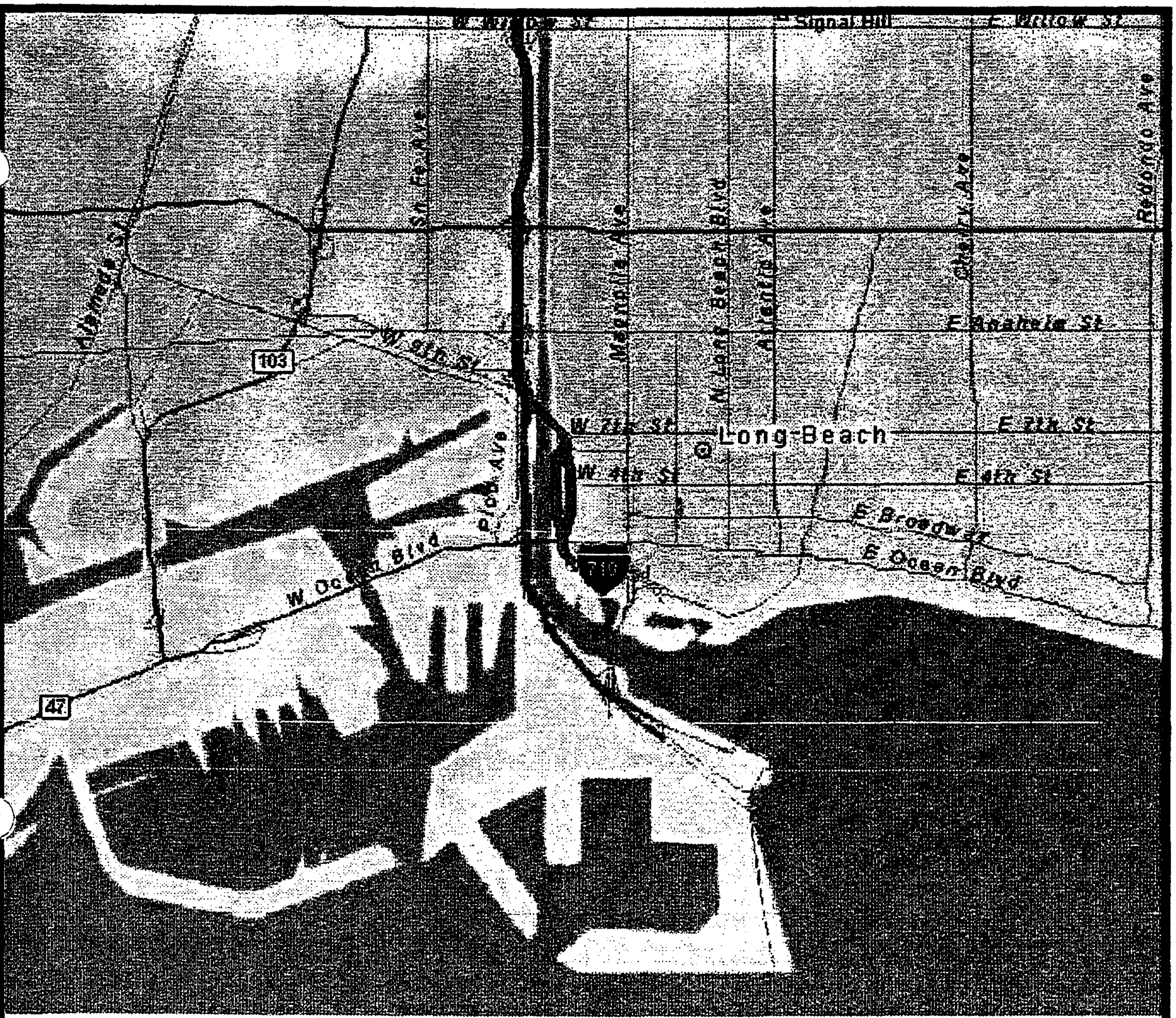


Figure 4.5- 2
Study Area Roadways-
Los Angeles/Long Beach Area

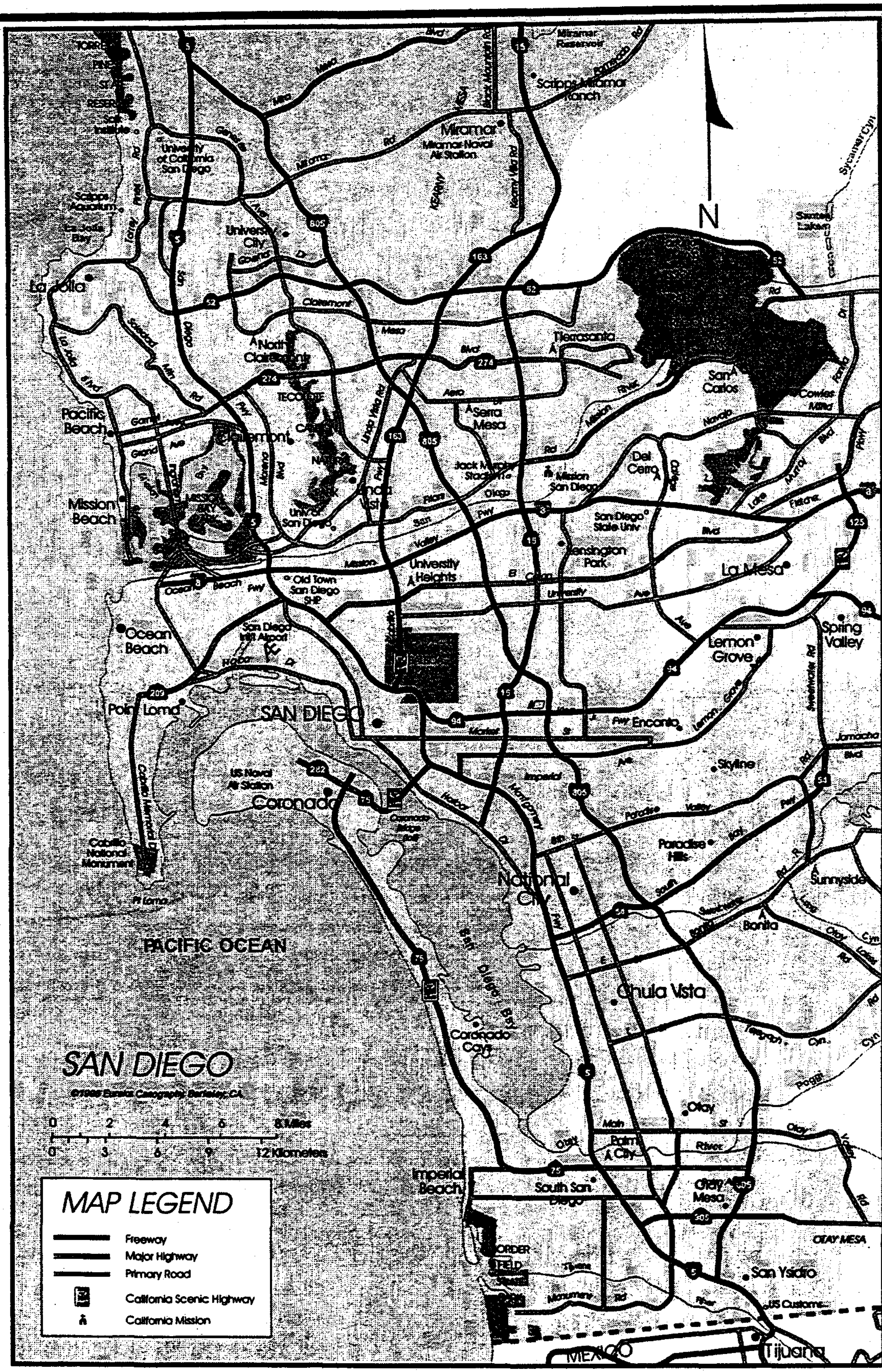


Figure 4.5-1
Study Area Roadway Network

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Table 4.5-2 Intersection Levels of Service and V/C Ratio

Main Route

Intersection	AM Peak Hour				PM Peak Hour			
	Base		Base and Project Construction Traffic		Base		Base and Project Construction Traffic	
	LOS	V/C (1)	LOS	V/C (1)	LOS	V/C (1)	LOS	V/C (1)
Otay Valley Rd/Main St & I-805 NB Ramps	B	0.662	B	0.669	D	0.878	D	0.878
Otay Valley Rd/Main St & I-805 SB Ramps	C	0.743	C	0.750	C	0.768	C	0.774
Main St & Melrose Ave	A	0.416	A	0.423	A	0.412	A	0.418
Main St & Hilltop Dr	A	0.349	A	0.356	A	0.443	A	0.450
Main St & Third Ave/Beyer Wy	A	0.459	A	0.466	B	0.603	B	0.610
Main St & Fourth Ave	A	0.358	A	0.364	A	0.487	A	0.494
Main St & Broadway	A	0.401	A	0.408	A	0.589	A	0.596
Main St & Industrial Blvd	A	0.388	A	0.394	A	0.564	A	0.571
Main St & I-5 NB Ramps (2)	A/C	4.900	B/D	5.100	F	>60	F	>60
Main St & I-5 SB Ramps (2)	A/B	4.500	A/B	4.900	C/D	12.800	C/E	16.000
24th St & I-5 NB Ramps	B	0.614	B	0.614	B	0.626	B	0.626
24th St & I-5 SB Ramps	A	0.468	A	0.483	E	0.907	E	0.922
24th St & Tidelands Ave (2)	A/A	1.800	A/A	2.200	A/A	1.700	A/A	1.700
19th St & Tidelands Ave	A	0.226	A	0.239	A	0.136	A	0.149

Notes:
(1) Volume/capacity ratio for signalized intersections; delay per vehicle for unsignalized intersections
(2) Designates unsignalized intersection; all others are signalized

Alternate Route

Intersection	AM Peak Hour				PM Peak Hour			
	Base		Base and Project Construction Traffic I-905		Base		Base and Project Construction Traffic I-905	
	LOS	V/C (1)	LOS	V/C (1)	LOS	V/C (1)	LOS	V/C (1)
Heritage Road & Otay Mesa Road	B	0.673	B	0.692	F	1.099	F	1.127
Main St & I-5 NB Ramps (2)	A/C	4.9	A/C	4.9	F	>60	F	>60
Main St & I-5 SB Ramps (2)	A/B	4.5	A/B	4.5	C/D	12.8	C/D	12.8
24th St & I-5 NB Ramps	B	0.614	B	0.614	B	0.626	B	0.626
24th St & I-5 SB Ramps	A	0.468	A	0.483	E	0.907	E	0.922
24th St & Tidelands Ave (2)	A/A	1.8	A/A	2.2	A/A	1.7	A/A	1.7
19th St & Tidelands Ave	A	0.226	A	0.239	A	0.136	A	0.149

Notes:
(1) Volume/capacity ratio for signalized intersections; delay per vehicle for unsignalized intersections
(2) Designates unsignalized intersection; all others are signalized

Table 4.5-3 Intersection Levels of Service

Intersection	AM Peak Hour						PM Peak Hour					
	Base		Base and Project Construction Traffic				Base		Base and Project Construction Traffic			
			Route 1		Route 2				Route 1		Route 2	
	LOS (1)	Delay	LOS (1)	Delay	LOS (1)	Delay	LOS (1)	Delay	LOS (1)	Delay	LOS (1)	Delay
Alameda Street & Sepulveda Boulevard	B	6.3	B	6.7			B	9.5	B	10.0		
Willow Street & Terminal Island Freeway (State Route 103)	B	9.6	B	9.6			B	12.7	B	12.7		
Willow Street & Santa Fe Avenue	C	18.7	C	18.7			D	25.4	D	25.6		
Pier B Street/Pico Avenue & Harbor Scenic Drive Interchange	C	16.7	C	17.7			C	15.1	C	16.4		
Pico Avenue & Pier D Street	B/B	7.2	B/B	8.5	B/B	7.4	B	9.4	B	9.2	B	8.4
Pico Avenue & Broadway / Harbor Scenic Drive Southbound Ramps	A/D	1.3			A/D	1.4	A/C	0.7			A/C	0.7
Pico Avenue & Ocean Boulevard Westbound Ramps	A/E	3.5			A/E	3.7	A/F	2.7			A/F	2.8
Pico Avenue & Pier E Street	F/F	62.6			F/F	73.5	F/F	108			F/F	160
Ocean Boulevard & Golden Shore Avenue	A	2.9			A	2.9	B	5.4			B	5.3
Ocean Boulevard & Magnolia Avenue	B	5.7			B	5.7	D	35.0			D	34.5
Ocean Boulevard & Long Beach Boulevard	B	7.0			B	7.0	B	5.4			B	5.4
Ocean Boulevard & Atlantic Avenue	A	3.4			A	3.5	A	3.0			A/F	3.0
Ocean Boulevard & Shoreline Drive / Alamitos Avenue	C	24.7			C	25.0	B	13.4			B	13.4
Ocean Boulevard & Cherry Avenue	A	2.9			A	3.4	A	4.0			A/F	4.5
Cherry Avenue & Broadway	A	3.5			A	3.8	B	5.3			B	5.6
Cherry Avenue & 7th Street	B	8.1			B	8.5	B	9.5			B	10.1
Cherry Avenue & Anaheim Street	B	6.6			B	6.8	B	11.5			B	12.3
Cherry Avenue & Pacific Coast Highway	F	96.4			F	102	D	26.4			D	27.2
Cherry Avenue & Willow Street	C	19.6			C	19.7	C	23.6			C	23.7
Cherry Avenue & 29th Street	A/E	0.4			A/E	0.5	A/F	1.0			A/F	1.1

Note:
(1) For Signalized Intersections: (Average Intersection Delay)
For Unsignalized Intersections: (Average Intersection Delay/Worst Movement Delay)

Table 4.5-4 Freeway Operations Peak Hour V/C Ratio

Main Route										
			AM Peak Hour V/C Ratio				AM Peak Hour V/C Ratio			
Route	From	To	North Bound		South Bound		North Bound		South Bound	
			Base	Base and Construction Traffic	Base	Base and Construction Traffic	Base	Base and Construction Traffic	Base	Base and Construction Traffic
I-5	Main Street	Palomar Street	0.992	0.995	0.471	0.474	0.567	0.570	0.897	0.899
	Palomar Street	L Street	0.963	0.966	0.463	0.466	0.556	0.558	0.871	0.874
	L Street	J Street	1.000	1.003	0.488	0.491	0.582	0.585	0.906	0.908
	J Street	H Street	1.004	1.007	0.496	0.499	0.590	0.593	0.910	0.913
	H Street	E Street	1.056	1.059	0.529	0.532	0.627	0.630	0.959	0.962
	E Street	State Route 54	0.951	0.954	0.476	0.479	0.564	0.567	0.863	0.866
	State Route 54	24th Street	0.967	0.970	0.485	0.487	0.574	0.576	0.878	0.880
Alternate Route										
			AM Peak Hour V/C Ratio				PM Peak Hour V/C Ratio			
Route	From	To	East Bound		West Bound		East Bound		West Bound	
			Base	Base and Construction Traffic	Base	Base and Construction Traffic	Base	Base and Construction Traffic	Base	Base and Construction Traffic
I-905	I-5	Beyer Boulevard	0.310	0.315	0.372	0.378	0.363	0.369	0.319	0.324
	Beyer Blvd	Picador Blvd	0.366	0.372	0.441	0.446	0.430	0.435	0.377	0.382
	Picador Blvd	I-805	0.366	0.372	0.441	0.446	0.430	0.435	0.377	0.382
	I-805	Otay Mesa Road	0.387	0.392	0.465	0.471	0.454	0.460	0.398	0.404
Route	From	To	North Bound		South Bound		North Bound		South Bound	
			Base	Base and Construction Traffic	Base	Base and Construction Traffic	Base	Base and Construction Traffic	Base	Base and Construction Traffic
I-5	I-905	Coronado Ave	0.673	0.676	0.315	0.318	0.381	0.384	0.607	0.610
	Coronado Ave	Palm Avenue	0.748	0.750	0.350	0.353	0.423	0.426	0.675	0.677
	Palm Avenue	Main Street	0.988	0.991	0.463	0.466	0.559	0.562	0.892	0.895
	Main Street	Palomar Street	0.992	0.995	0.471	0.474	0.567	0.570	0.897	0.899
	Palomar Street	L Street	0.963	0.966	0.463	0.466	0.556	0.558	0.871	0.874
	L Street	J Street	1.000	1.003	0.488	0.491	0.582	0.585	0.906	0.908
	J Street	H Street	1.004	1.007	0.496	0.499	0.590	0.593	0.910	0.913
	H Street	E Street	1.056	1.059	0.529	0.532	0.627	0.630	0.959	0.962
	E Street	State Route 54	0.951	0.954	0.476	0.479	0.564	0.567	0.863	0.866
	State Route 54	24th Street	0.967	0.970	0.485	0.487	0.574	0.576	0.878	0.880

Table 4.5-5 Freeway Operations Peak Hour Level of Service

Main Route

			AM Peak Hour Level of Service						PM Peak Hour Level of Service					
Route	From	To	North Bound			South Bound			North Bound			South Bound		
			Base	Experimental	Mitigation	Base	Experimental	Mitigation	Base	Experimental	Mitigation	Base	Experimental	Mitigation
I-5	Main Street	Palomar Street	E	E	E	B	B	B	C	C	C	E	E	E
	Palomar Street	L Street	E	E	E	B	B	B	C	C	C	D	D	E
	L Street	J Street	E	F	F	C	C	C	C	C	C	E	E	E
	J Street	H Street	F	F	F	C	C	C	C	C	C	E	E	E
	H Street	E Street	F	F	F	C	C	C	C	C	C	E	E	E
	E Street	State Route 54	E	E	E	B	B	B	C	C	C	D	D	D
	State Route 54	24th Street	E	E	E	B	B	C	C	C	C	E	E	E

Alternate Route

			AM Peak Hour Level Of Service						PM Peak Hour Level Of Service					
Route	From	To	East Bound			West Bound			East Bound			West Bound		
			Base	Experimental	Mitigation	Base	Experimental	Mitigation	Base	Experimental	Mitigation	Base	Experimental	Mitigation
I-905	I-5	Beyer Blvd	A	A	B	B	B	B	B	B	B	A	B	B
	Beyer Blvd	Picador Blvd	B	B	B	B	B	B	B	B	B	B	B	B
	Picador Blvd	I-805	B	B	B	B	B	B	B	B	B	B	B	B
	I-805	Otay Mesa Road	B	B	B	B	B	B	B	B	B	B	B	B
Route	From	To	North Bound			South Bound			North Bound			South Bound		
			Base	Experimental	Mitigation	Base	Experimental	Mitigation	Base	Experimental	Mitigation	Base	Experimental	Mitigation
I-5	I-905	Coronado Ave	C	C	C	B	B	B	B	B	B	C	C	C
	Coronado Ave	Palm Avenue	D	D	D	B	B	B	B	B	B	C	C	C
	Palm Avenue	Main Street	E	E	E	B	B	B	C	C	C	E	E	E
	Main Street	Palomar Street	E	E	E	B	B	B	C	C	C	E	E	E
	Palomar Street	L Street	E	E	E	B	B	B	C	C	C	D	D	E
	L Street	J Street	E	F	F	C	C	C	C	C	C	E	E	E
	J Street	H Street	F	F	F	C	C	C	C	C	C	E	E	E
	H Street	E Street	F	F	F	C	C	C	C	C	C	E	E	E
	E Street	State Route 54	E	E	E	B	B	B	C	C	C	D	D	D
	State Route 54	24th Street	E	E	E	B	B	C	C	C	C	E	E	E

Table 4.5-6 Freeway Operations Peak Hour Traffic Volume

Main Route										
			AM Peak Hour Traffic Volume				PM Peak Hour Traffic Volume			
Route	From	To	North Bound		South Bound		North Bound		South Bound	
			Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic
I-5	Main Street	Palomar Street	8,138	8,162	3,862	3,886	4,649	4,673	7,351	7,375
	Palomar Street	L Street	7,900	7,924	3,800	3,824	4,556	4,580	7,144	7,168
	L Street	J Street	8,201	8,225	3,999	4,023	4,774	4,798	7,426	7,450
	J Street	H Street	8,232	8,256	4,068	4,092	4,838	4,862	7,462	7,486
	H Street	E Street	8,662	8,686	4,338	4,362	5,139	5,163	7,861	7,885
	E Street	State Route 54	7,796	7,820	3,904	3,928	4,625	4,649	7,075	7,099
	State Route 54	24th Street	10,061	10,085	5,039	5,063	5,969	5,993	9,131	9,155
Alternate Route										
			AM Peak Hour Traffic Volume				PM Peak Hour Volume			
Route	From	To	East Bound		West Bound		East Bound		West Bound	
			Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic
I-905	I-5	Beyer Blvd	1,362	1,386	1,638	1,662	1,598	1,622	1,402	1,426
	Beyer Blvd	Picador Blvd	1,612	1,636	1,938	1,962	1,891	1,915	1,659	1,683
	Picador Blvd	I-805	1,612	1,636	1,938	1,962	1,891	1,915	1,659	1,683
	I-805	Otay Mesa Road	1,703	1,727	2,048	2,072	1,998	2,022	1,752	1,776
Route	From	To	North Bound		South Bound		North Bound		South Bound	
			Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic
I-5	I-905	Coronado Ave	5,517	5,541	2,583	2,607	3,122	3,146	4,978	5,002
	Coronado Ave	Palm Avenue	6,130	6,154	2,870	2,894	3,469	3,493	5,531	5,555
	Palm Avenue	Main Street	8,105	8,129	3,795	3,819	4,586	4,610	7,314	7,338
	Main Street	Palomar Street	8,138	8,162	3,862	3,886	4,649	4,673	7,351	7,375
	Palomar Street	L Street	7,900	7,924	3,800	3,824	4,556	4,580	7,144	7,168
	L Street	J Street	8,201	8,225	3,999	4,023	4,774	4,798	7,426	7,450
	J Street	H Street	8,232	8,256	4,068	4,092	4,838	4,862	7,462	7,486
	H Street	E Street	8,662	8,686	4,338	4,362	5,139	5,163	7,861	7,885
	E Street	State Route 54	7,796	7,820	3,904	3,928	4,625	4,649	7,075	7,099
	State Route 54	24th Street	10,061	10,085	5,039	5,063	5,969	5,993	9,131	9,155

4.5.1.2 Waterborne Transportation

Commercial and recreational vessels, ranging from deep-draft cargo vessels to small sailboats and excursion charters, utilize the ocean waters of the proposed lease area. Navigation within the study area is facilitated by charts, aids to navigation such as buoys, Port District information and regulations, and information published by the Coast Guard and the National Oceanic and Atmospheric Administration (NOAA). The U.S. Coast Guard distributes the most current local information in its Monthly Notice to Mariners and weekly updates. The study area is shown on Nautical Chart No. 18740, San Diego to Santa Rosa Island, 1995, and is described, from north to south, in the following paragraphs.

The Port of Los Angeles and the Port of Long Beach adjoin one another within San Pedro Bay, in the northernmost part of the project study area. The Port of Los Angeles is managed and operated by the Los Angeles Harbor Department. The Port of Long Beach, managed and operated by the Long Beach Harbor Department, is the busiest cargo container port in the United States. Water depths in the Port of Los Angeles range from 45 feet mean-low low water (MLLW) to 81 feet MLLW; those in the Port of Long Beach range from 36 to 76 feet MLLW adjacent to berths to 50 to 90 feet MLLW within the channels (Port of Los Angeles 1979; Port of Long Beach 1990). The barges carrying project materials would likely travel out through San Pedro Bay and past the breakwater, then follow the southbound coastwise traffic lane toward the lease area. The tugboats and barges coming from these ports would travel approximately 51 nautical miles (59 miles) to the project site.

The central part of the study area includes Santa Catalina Island and the waters between the island and the project site. Vessels ranging in size from private and chartered yachts to large passenger vessels travel between Catalina Island and nearby harbors. Tugs and barges traveling to the lease area from Catalina Island would traverse about 50 nautical miles (58 miles) across the Gulf of Santa Catalina.

Most of the area in the immediate vicinity of the project lease area is navigated primarily by small craft, although the nearest marina is about five miles away at Dana Point. Dana Point Harbor contains two marinas, with about 2,500 boat slips, behind a 1.5-mile jetty. The harbor, which includes three yacht clubs, four boat brokers, and the Aventura Sailing Association, is used by sailboats, small powerboats, and personal watercraft. Charters on larger boats are available, and include whale watching and sport fishing excursions in the lease area. Whale watching excursions are popular in the project vicinity during the months of December through March. In addition, several boat races and regattas are held annually in the Dana Point area.

The proposed experimental and mitigation reefs would be constructed 0.6 mile off the coast at a depth ranging from 39 to 47 feet. The ocean waters in the immediate vicinity of the project site are used primarily by commercial fishermen and recreational boaters and fishermen. No harbor or launching facilities are located in the immediate project vicinity.

South of the proposed project lease area near Camp Pendleton is a designated military exercise area, where the ocean waters are used for a variety of military maneuvers by the U.S. Navy and Marine Corps. Travel is frequently restricted in parts of this area due to military training exercises.

In contrast, the Port of San Diego, 60 nautical miles (69 miles) from the project site, accommodates a wide variety of vessels, and is one of the busiest ports on the West Coast. The port, managed and operated by the San Diego Unified Port District, is divided into commercial, industrial, fishing and leisure ports. The project materials would likely be shipped through the National City Bayfront, a marine industrial area of the Port of San Diego. The National City Bayfront area is dedicated primarily to marine industrial and terminal use, with some commercial recreation, a park, and recreational boat berthing (Port District 1981). The U.S. Naval Station, San Diego is also located nearby (Port District 1981).

From the marine terminal, tugs would tow barges loaded with project construction materials out of San Diego Bay through the main ship channel of the Port of San Diego's ship navigation corridor. The Port District prohibits incompatible aquatic activities in marked ship and boat channels, and requires ship corridors to be maintained at adequate widths and depths to eliminate hazardous conditions among ships, small craft and structures; to avoid groundings; and to avoid accident-caused environmental damage. Water depth alongside the National City Marine Terminal and in the South Bay channel is a minimum 35 feet MLLW; within the main ship channel the depth increases to 40 feet in the central bay channel and 42 feet at the entrance (Port District 1981). The main ship channel varies in width from 600 to 2,000 feet overall, with widths ranging from 600 to 1,350 feet at the National City Marine Terminal.

4.5.1.3 Project-Related Traffic and Materials Transport Routes

Project construction would involve the conveyance of both quarry rock and concrete for the experimental reef and either quarry rock or concrete for the mitigation reef. The recycled concrete for both the experimental and mitigation reefs is anticipated to originate from a brokerage within 20 miles of either the Port of Los Angeles, the Port of Long Beach, or the Port of San Diego, as discussed in the Project Description. The project proponent would obtain quarry rock from either Catalina Island or a quarry within a 20-mile radius of the Port of San Diego. From the selected source(s), the materials would be transported by tugboat and barge to the lease area. For both the experimental and mitigation reefs, three barges and three tugboats, including an attending tug, would be used for transport and construction activities. In addition, a derrick barge used for materials placement activities would be brought to the lease area from either the Port of Los Angeles, the Port of Long Beach, or the Port of San Diego, and offshore construction crew members not arriving by barge or tugboat would commute from Dana Point Harbor on small watercraft.

For the purposes of analysis in the PEIR, a probable worst-case scenario (as described in the Project Description, Chapter 3) was evaluated in this chapter. The probable worst-case scenario assumes all concrete and rock would be shipped from the Port of San

Diego, as this port is the greatest distance from the project lease site. However, because of the nature of transportation impacts, it is necessary for this section to analyze all of the possible transportation corridors that may be used for construction of the proposed project. This includes materials coming from the Ports of Los Angeles and Long Beach and Catalina Island. The following paragraphs briefly summarize the construction-related transportation activities.

- ***Quarry Rock Transport***

Quarry rock for the reef would originate either at a Catalina Island quarry or from an inland quarry in the San Diego region. Quarry rock from Catalina Island would require a minimal amount of trucking of up to a quarter mile from the quarries to the loading dock. These trucks operate on property and roads owned by the quarries and are part of the existing permitted operations. The rock would be transported in 802 trips for the experimental reef. The mitigation reef would require between 16,240 trips (127.6-acre scenario) and 35,331 trips (277.6-acre scenario). The material would be hauled by 22-ton capacity semi end-dump trucks from a broker's yard to the Port San Diego for loading onto barges. From the San Diego area, the tugboats and barges would travel northward about 60 nautical miles (69 miles) to the project site. The rock would be moved to the site in nine barge loads for the experimental reef, and between 177 and 389 barge loads for the mitigation reef. Six barges and three tugboats, including an attending tug, would be used for transport and construction activities.

- ***Concrete Transport***

Concrete reef material would be transported, in 630 trips for the experimental reef. The mitigation reef would require between 12,760 trips (127.6-acre scenario) and 27,760 (277.6-acre scenario). The material would be hauled by 22-ton capacity semi end-dump trucks from a broker's yard to the Ports of Los Angeles, Long Beach or San Diego for loading onto barges. The likely scenario envisioned would involve the movement of materials by truck on one of the principal routes, each of which would involve travel on both surface streets and highways in either the Los Angeles/Long Beach area or the San Diego area.' From the Port of Los Angeles or Long Beach, a tugboat would tow concrete-laden barges, one at a time, about 51 nautical miles (59 miles) south to the project site. From the Port of San Diego, a tugboat would tow concrete-laden barges, one at a time, 60 nautical miles (69 miles) north to the project site. The concrete hauling for the experimental reef project requires seven barge trips and between 141 and 306 trips for the mitigation reef.

4.5.1.4 Applicable Plans and Policies

Agencies with environmental or planning responsibility for the study area ground transportation routes include the Federal Highway Administration, the California Department of Transportation (Caltrans), San Diego County, and the Cities of Los Angeles, Long Beach, San Diego and National City. Waterborne transportation is overseen by the U.S. Coast Guard, and the San Diego Unified Port District. Applicable transportation policies are found primarily in the San Diego County General Plan, the

City of San Diego General Plan, and the San Diego Unified Port District's *Port Master Plan*. Pertinent guidance from these plans emphasizes the maintenance of safe and acceptable transportation conditions both on area roadways and within port areas.

4.5.2 Impacts and Mitigation Measures

4.5.2.1 Methodology

Transportation impacts are typically evaluated on a regional, as well as site-specific, level as traffic generated by an action contributes to the overall conditions on area roadways. The project site's location in ocean waters and the phasing of construction activities led to consideration of certain factors in this analysis. Specifically: 1) no land-based vehicles could approach or leave the construction site, which is the lease area; 2) a minimal number of workers would be involved in the construction of the experimental and mitigation reefs; and 3) the post-construction condition of the project site warranted no human presence other than occasional monitoring activities. It was therefore determined that the operational effects of the project were likely to be limited to any impacts the proposed monitoring activities might have upon ground transportation and navigation. Furthermore, the project's transportation impacts would occur outside the immediate vicinity of the lease area and would primarily be construction-related, as the proposed project by nature would not generate traffic in the project vicinity.

With these conditions in mind, the following calculations and assumptions were used to determine the impacts of project construction on the project study area transportation conditions.

- ***Traffic Counts***

Traffic counts for intersections and freeway segments were used to determine existing conditions on study area roadways. Intersection turning movement counts were collected at each of the San Diego area study intersections during the week of July 20, 1998, and at each of the Los Angeles/Long Beach study area intersections during the week of October 5, 1998. Counts were conducted during peak hours, from 7:00 to 9:00 a.m. and from 4:00 to 6:00 p.m. Based upon the 15-minute interval counts, a.m. and p.m. peak hour intersection turning volumes were established. Freeway segment counts were derived from the Caltrans publication *1997 Traffic Volumes on California State Highways*. To develop a.m. and p.m. peak hour volumes on each roadway segment in each roadway direction, the two-way peak hour counts reported in the *1997 Traffic Volumes* report were multiplied by the a.m. and p.m. peak hour directional factors also published in that document.

- ***Capacity Analysis Techniques***

The capacity of study area roadways was identified for signalized and unsignalized intersections as well as freeway segments. For signalized intersections, the ICU (Intersection Capacity Utilization) method was employed. This method is the predominant analysis technique for San Diego County communities. A saturation flow rate of 1,800 vehicles per hour was utilized for each lane, except for exclusive turning lanes, where a saturation flow of 1,600 vehicles per hour was used. Loss time equal to 10 percent of the signal cycle length was assumed. For unsignalized intersections, the *1994 Highway Capacity Manual* Unsignalized Intersection Method was utilized. For freeway segments, a saturation flow rate of 2,200 vehicles per mainline lane per hour was used, with a value of 1,600 vehicles per lane per hour utilized for auxiliary lanes. Relationships between volume-to-capacity ratios and level of service were taken from the *1994 Highway Capacity Manual* Freeway chapter. All haul traffic was assumed to be equal to two passenger car equivalents.

- ***Haul Traffic Trips***

Construction-related truck trips were calculated using the values outlined in the Project Description. For both the experimental and mitigation reef, 91 truckloads would be conveyed per day. This equates to about 12 truckloads per hour. Assuming that empty trucks will return along the same route to be reloaded, this produces 12 truck trips per direction per hour. These hourly truck trip rates were added to both the existing 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. peak hour traffic volumes.

Using the information described above, existing capacity deficiencies for study area intersections and roadway segments were identified, to facilitate analysis of traffic conditions with construction traffic added. Deficiencies, as identified in this analysis, are expected intersection levels of service in excess of LOS C and highway levels of service in excess of LOS D.

4.5.2.2 Significance Criteria

For the purposes of this analysis, navigation impacts are considered significant if implementation of a proposed action would create a substantial hazard to navigation or substantially affect the ease of navigation in the project study area. Transportation impacts are typically considered significant if implementation of the proposed action would: 1) cause an increase in traffic which is substantial in relation to the existing traffic volume and capacity of the roadway system; 2) generate substantial additional vehicular movement; 3) substantially affect existing parking facilities, or create a demand for new parking; 4) substantially alter present patterns of circulation or movement of people and/or goods; 5) substantially alter rail or air traffic; or 6) substantially increase traffic hazards to motor vehicles, bicyclists, or pedestrians.

A circulation impact on local roadways is deemed to be significant when the level of service (LOS) deteriorates below LOS C conditions, or an increase in V/C ratio of 0.02 occurs at study intersections operating below LOS C conditions. An impact to the regional highway system is deemed to be significant when the level of service deteriorates below LOS D conditions.

The evaluation of growth-inducing and socioeconomic impacts in Section 4.2 in the document determined that the project would not create significant population growth in either the project vicinity or the transportation study area. Therefore there would be no growth-related indirect impacts of the proposed reef project upon transportation.

4.5.2.3 Roadway Conditions with Project-Related Traffic

- ***Experimental Reef Construction***

Construction activities associated with the experimental reef would add a maximum of 91 truck trips per day to either Los Angeles or San Diego area roadways. In addition, approximately 40 commute trips per day are expected in the southern Orange County area in association with workers traveling to the Dana Point Harbor. This construction traffic would occur over 32 days while the 22.4-acre experimental reef is under construction.

Intersection Levels of Service. Table 4.5-2 summarizes the projected LOS and V/C operations at San Diego area construction travel route intersections when project-related traffic is added to the existing traffic conditions; Table 4.5-3 provides comparable information for the Los Angeles/Long Beach study area.

Los Angeles/Long Beach Area. During the a.m. peak hour, all but five of the Los Angeles/Long Beach area study intersections are currently operating at acceptable or better levels of service (see Table 4.5-3); the addition of experimental reef construction traffic would not alter the LOS to an unacceptable level during the a.m. peak hour at any intersection. During the p.m. peak hour, all but six of the Los Angeles/Long Beach area study intersections operate at acceptable or better levels of service (see Table 4.5-3). As indicated in Table 4.5-3, project construction traffic during the p.m. peak hour would reduce the LOS at two intersections, Ocean Boulevard and Atlantic Avenue, and Ocean Boulevard and Cherry Avenue, to unacceptable levels. This is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- The project proponent and all project contractors shall restrict truck trips to off-peak travel hours (9:00 a.m. to 4:00 p.m.).

The rescheduling of truck traffic to off-peak travel hours ensures that construction-related truck trips would not exacerbate existing, or cause new, capacity deficiencies on study area roadways.

San Diego Area. During the a.m. peak hour, all of the San Diego area study intersections are currently operating at acceptable or better levels of service; the addition of experimental reef construction traffic would not alter the LOS to an unacceptable level during the a.m. peak hour at any intersection. During the p.m. peak hour, all but three of the San Diego area study intersections operate at acceptable or better levels of service: Heritage Road and Otay Mesa Road; Main Street and the I-5 northbound ramps; and 24th Street and the I-5 southbound ramps. As indicated in Table 4.5-2, project construction traffic during the p.m. peak hour would not alter the LOS at these or any other intersections below an acceptable level. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

Freeway Operations. Table 4.5-5 presents the projected LOS for affected San Diego area freeway segments when project-related traffic is added to the existing traffic conditions; Table 4.5-7 presents this information for the Los Angeles/Long Beach study area.

Los Angeles/Long Beach Area. With the exception of p.m. peak hour traffic on northbound I-710 between Pacific Coast Highway and Willow Street, all Los Angeles/Long Beach area freeway segments considered are currently operating at acceptable or better levels of service. As indicated in Table 4.5-7, the addition of experimental reef construction traffic would alter the level of service during the a.m. peak hour on southbound I-710 between Pacific Coast Highway and Willow Street from LOS D to LOS E. This is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- The project proponent and all project contractors shall restrict truck trips to off-peak travel hours (9:00 a.m. to 4:00 p.m.).

The rescheduling of truck traffic to off-peak travel hours ensures that construction-related truck trips would not exacerbate existing, or cause new, capacity deficiencies on study area roadways.

San Diego Area. With the exception of a.m. peak hour traffic on northbound I-5 between Palm Avenue and 24th Street and p.m. peak hour traffic on the same segment of southbound I-5, all project study area freeways considered are currently operating at acceptable or better levels of service. As indicated in Table 4.5-5, the addition of experimental reef construction traffic would alter the level of service during the a.m. peak hour on northbound I-5 between L and J Streets from LOS E to LOS F. This exacerbation of an existing deficiency on I-5 is considered a significant impact.

Table 4.5-7 Freeway Operations

Peak Hour Volume

			AM Peak Hour Volume				PM Peak Hour Volume			
Route	From	To	North Bound		South Bound		North Bound		South Bound	
			Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic
I-710	Anaheim	PCH	4,647	4,671	5,353	5,377	5,580	5,604	4,420	4,444
	PCH	Willow	5,251	5,275	6,049	6,073	6,305	6,329	4,995	5,019

Peak Hour Volume/Capacity Ratio

			AM Peak Hour Volume/Capacity Ratio				PM Peak Hour Volume/Capacity Ratio			
Route	From	To	North Bound		South Bound		North Bound		South Bound	
			Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic
I-710	Anaheim	PCH	0.704	0.708	0.811	0.815	0.845	0.849	0.670	0.673
	PCH	Willow	0.796	0.799	0.916	0.920	0.955	0.959	0.757	0.760

Peak Hour Level of Service

			AM Peak Hour Level Of Service				PM Peak Hour Level Of Service			
Route	From	To	North Bound		South Bound		North Bound		South Bound	
			Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic	Base	Base and Project Construction Traffic
I-710	Anaheim	PCH	C	C	D	D	D	D	C	C
	PCH	Willow	D	D	D	E	E	E	D	D

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- The project proponent and all project contractors shall restrict truck trips to off-peak travel hours (9:00 a.m. to 4:00 p.m.).

The rescheduling of truck traffic to off-peak travel hours ensures that construction-related truck trips would not exacerbate existing, or cause new, capacity deficiencies on study area roadways.

- ***Mitigation Reef Construction***

Construction activities associated with the experimental reef would add a maximum of 91 truck trips per day to either Los Angeles or San Diego area roadways for a total of 16 days (every other work day). In addition, approximately 12 commute trips per day are expected in the southern Orange County area in association with workers traveling to and from the Dana Point Harbor. The construction traffic impacts for the mitigation reef would occur over 141 to 306 days if the mitigation reef is built of concrete, or 177 to 389 days if the mitigation reef is built of quarry rock. These days would occur over several years during the May to September construction seasons.

Intersection Levels of Service. Table 4.5-2 summarizes the projected LOS and V/C operations at San Diego area construction travel route intersections when project-related traffic is added to the existing traffic conditions; Table 4.5-3 provides this information for the Los Angeles/Long Beach study area.

Los Angeles/Long Beach Area. During the a.m. peak hour, all but five of the Los Angeles/Long Beach area study intersections are currently operating at acceptable or better levels of service (see Table 4.5-3); the addition of mitigation reef construction traffic would not alter the LOS to an unacceptable level during the a.m. peak hour at any intersection. During the p.m. peak hour, all but six of the Los Angeles/Long Beach area study intersections operate at acceptable or better levels of service (see Table 4.5-3). As indicated in Table 4.5-3, project construction traffic during the p.m. peak hour would reduce the LOS at two intersections, Ocean Boulevard and Atlantic Avenue, and Ocean Boulevard and Cherry Avenue, to unacceptable levels. This is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- The project proponent and all project contractors shall restrict truck trips to off-peak travel hours (9:00 a.m. to 4:00 p.m.).

The rescheduling of truck traffic to off-peak travel hours ensures that construction-related truck trips would not exacerbate existing, or cause new, capacity deficiencies on study area roadways.

San Diego Area. During the a.m. peak hour, all of the San Diego area study intersections are currently operating at acceptable or better levels of service; the addition of mitigation reef construction traffic would not alter the LOS to an unacceptable level during the a.m. peak hour at any intersection. During the p.m. peak hour, all but three of the San Diego area study intersections operate at acceptable or better levels of service: Heritage Road and Otay Mesa Road; Main Street and the I-5 northbound ramps; and 24th Street and the I-5 southbound ramps. As indicated in Table 4.5-2, project construction traffic during the p.m. peak hour would not alter the LOS at these or any other intersections below an acceptable level. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

Freeway Operations. Table 4.5-5 presents the projected LOS for affected San Diego area freeway segments when project-related traffic is added to the existing traffic conditions; Table 4.5-7 presents this information for the Los Angeles/Long Beach area.

Los Angeles/Long Beach Area. With the exception of p.m. peak hour traffic on northbound I-710 between Pacific Coast Highway and Willow Street, all Los Angeles/Long Beach area freeway segments considered are currently operating at acceptable or better levels of service. As indicated in Table 4.5-7, the addition of mitigation reef construction traffic would alter the level of service during the a.m. peak hour on southbound I-710 between Pacific Coast Highway and Willow Street from LOS D to LOS E. This is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- The project proponent and all project contractors shall restrict truck trips to off-peak travel hours (9:00 a.m. to 4:00 p.m.).

The rescheduling of truck traffic to off-peak travel hours ensures that construction-related truck trips would not exacerbate existing, or cause new, capacity deficiencies on study area roadways.

San Diego Area. With the exception of a.m. peak hour traffic on northbound I-5 between Palm Avenue and 24th Street and p.m. peak hour traffic on the same segment of southbound I-5, all project study area freeways considered are currently operating at acceptable or better levels of service. As indicated in Table 4.5-5, the addition of mitigation reef construction traffic would alter the level of service during the a.m. peak hour on northbound I-5 between L and J Streets from LOS E to LOS F. This exacerbation of an existing deficiency on I-5 is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- The project proponent and all project contractors shall restrict truck trips to off-peak travel hours (9:00 a.m. to 4:00 p.m.).

The rescheduling of truck traffic to off-peak travel hours ensures that construction-related truck trips would not exacerbate existing, or cause new, capacity deficiencies on study area roadways.

4.5.2.4 Traffic Hazards

- ***Experimental Reef Construction***

Although the construction-related traffic would not cause decreases in the levels of service of the affected roadways, the presence of numerous slow-moving trucks typically represents a safety hazard. However, this hazard would only be apparent in areas presently characterized by ongoing traffic hazards of this sort, such as the driveway of the materials broker's yard and the turns into and within either the Port of Los Angeles, the Port of Long Beach, or the Port of San Diego. As the proposed project would not contribute to an increased hazardous condition, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Mitigation Reef Construction***

Construction of the mitigation reef would place numerous slow-moving trucks, typically considered a safety hazard, on project area roadways. However, this hazard would only be apparent in areas presently characterized by ongoing traffic hazards of this sort, such as the driveway of the materials broker's yard and the turns into and within either the Port of Los Angeles, the Port of Long Beach, or the Port of San Diego. As the proposed project would not contribute to an increased hazardous condition, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.5.2.5 Impacts to Waterborne Transportation

- ***Experimental and Mitigation Reef Construction***

Construction of the proposed experimental and mitigation reefs would involve the movement of a derrick barge with crane and attending tugboat to the project site 0.6 mile offshore of San Clemente where it would remain for the construction period. In addition, three tugboats would tow one barge at a time of rock and/or concrete from the source of material to the project site and would then return to the point of origin. The experimental reef would require a total of 16 barge loads delivered. Depending on the final mitigation reef design, this phase would require between 141 and 389 barge loads of material. However, construction would be spread out over several years and would only occur during the months of May through September. The vessels would travel primarily along existing shipping routes to the San Clemente site.

These vessels would be temporarily present, along with marker buoys, within the project site during materials placement activities. Small watercraft would also transport workers between Dana Point Harbor and the project site. Construction activities would occur during summer months, to avoid conflicting with commercial fishing uses of the project area. Travel to the site and the presence of the vessels would not interfere with existing waterborne traffic, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Experimental and Mitigation Reefs***

The proposed 22.4-acre experimental reef and the full build out of the mitigation reef (between 127.6 acres and 277.6 acres) would be located 0.6 mile offshore of the City of San Clemente, approximately 39 to 47 feet below the ocean surface. The project site lies in an area used primarily by small watercraft for recreational boating and commercial fishing activities, and occasionally by emergency response vessels. The presence of the reefs and a kelp forest community would not alter navigation in the area from present conditions. The reefs are not expected to interfere with the navigation of vessels. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Experimental and Mitigation Reef Monitoring***

Monitoring activities associated with the experimental reef would entail the presence of one or two small watercraft and several divers within the project site at various times during the year. Although the monitored area would be marked by buoys during such activities, the presence of buoys and a monitoring team would not substantially affect the continued use of the project area by other small watercraft. Monitoring activities associated with the mitigation reef are expected to be comparable to those proposed for the experimental reef. These activities would not substantially interfere with navigation in the project study area. Therefore, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.6 Biological Resources

4.6 Biological Resources

This section describes the environmental setting and potential impacts for important biological resources of the project study area. The biological resources addressed are those considered potentially vulnerable to impacts of the proposed actions. They include three types of ecological communities - the subtidal sand-bottom community, the kelp forest community, and the beach community - and species assemblages of marine mammals, birds and turtles. The resources addressed also include the habitats of the potentially vulnerable ecological communities and species.

The study area for biological resources is the geographic area potentially affected by the project. The study area varies with the type of biological resource considered and is defined at the beginning of the environmental setting section for each type of resource.

The following description of the environmental setting consists of several related subsections. While together they describe the existing environmental conditions, they are separated into individually numbered sections for ease of review. The regional setting is described first, in the following

4.6.1 Regional Setting

The lease area is located in the coastal zone of the Southern California Bight (SCB), which extends from Point Conception to the Mexican border. This is a region of abundant and valuable biological resources, particularly in the shallow coastal zone. However, the region has experienced intense growth and development, which threatens many of the region's resources. The following discussion provides the regional setting for the lease area. The discussion includes a brief description of the principal physical characteristics of the SCB and provides an account of the region's major biological resources and the environmental factors that affect these resources.

4.6.1.1 Physical Description

- ***Climate***

The climate of the SCB is characterized by short, mild winters and warm, dry summers. Annual precipitation averages 18 inches, 90 percent of which falls between November and April. Monthly air temperatures along the coast range from about 8°C in winter to over 20°C in summer. Sea breezes combine with the prevailing winds from the northwest during summer months to produce strong onshore winds. In winter, coastal winds tend to be from the southeast. The land area is drained by many relatively short streams that normally flow only during rainstorms. Most of this flow is currently impounded by dams or is diverted for other uses before it reaches the sea (Marine Biological Consultants Applied Environmental Sciences 1995).

- ***Ocean Currents***

The California Current, a diffuse and meandering water mass, flows south along the California coast. South of Point Conception, the current moves offshore, following the edges of the continental borderland. It approaches the coast again near Baja California. From that point, the Southern California Countercurrent, flows north along the coast. The flow fluctuates seasonally, developing most strongly in summer and autumn. Nearshore currents are strongly influenced by a combination of wind, tides, local physiography, and density structure (i.e., gradients in the density of the water due to differences in temperature and salinity) (Marine Biological Consultants Applied Environmental Sciences 1995).

Predominant northwesterly winds are responsible for large scale upwelling along the California coast. Upwelling is the displacement of surface water by water from lower depths. From about February to October, the winds induce offshore movement of surface water that is replaced by the upwelled deeper ocean waters. The upwelled water is colder, more saline, lower in dissolved oxygen, and higher in nutrients than surface water. Upwelling greatly enhances biological productivity in the coastal waters (Marine Biological Consultants Applied Environmental Sciences 1995).

- ***Water Temperature***

Water temperatures fluctuate throughout the year in response to seasonal and diurnal variations in currents, wind, air temperature, relative humidity, cloud cover, waves, and turbulence. Surface water temperatures of coastal waters may vary as much as two degrees Celsius in a single day, depending on the time of year and prevailing oceanographic and meteorological conditions. When surface and bottom temperatures differ substantially, a thermocline may develop, which is a temperature gradient between depth layers with relatively uniform water temperature. A thermocline typically develops during summer off the southern California coast (Marine Biological Consultants Applied Environmental Sciences 1995).

- ***Salinity***

Salinity is relatively constant in the open ocean, but it varies in the nearshore environment as a result of freshwater runoff, direct rainfall, and evaporation. Maximum salinities occur in summer and minimum salinities occur during winter storms (Marine Biological Consultants Applied Environmental Sciences 1995).

4.6.1.2 Major Biological Resources

- ***Generalized Food Web***

Phytoplankton, which consists of single-celled algae suspended in the water, comprises the base of most food chains in the SCB (Dailey et al. 1993), although benthic macroalgae, including kelp, are often more important locally. Zooplankton, consisting of small animals such as copepods and the larval stages of macroinvertebrates and fish, consume phytoplankton. Invertebrates and fish consume zooplankton, and also eat each other. Benthic invertebrates and demersal fish, which live on the sea bottom, graze on benthic algae, filter plankton from the water, and prey on other invertebrates and fish. Many benthic organisms feed entirely on dead material that accumulates on the bottom or is suspended in the water. Marine mammals, birds, and turtles prey on invertebrates and fish. Over 5,000 species of benthic invertebrates, 481 fish species, 200 bird species, and 40 species of marine mammals inhabit the SCB (Dailey et al. 1993). The number is high because a mixture of northern and southern fauna occurs in the SCB and because the region has a wide range of habitats.

- ***Major Habitat Types and Ecological Communities***

Ecological communities are groups of plant and animal populations that live together, interact, and influence each other. Communities tend to be associated with certain habitat types. Important terrestrial habitat types of the SCB include beaches and wetlands. Important marine habitat types include embayments, rocky intertidal and subtidal habitats, sand-bottom intertidal and subtidal habitats, deep rocky substrate habitats, deep soft sediment habitats, and the pelagic (open water) zone (Dailey et al. 1993).

Subtidal sand-bottom habitat is the principal habitat of the project site. Subtidal rocky habitat is also important in the project vicinity, and supports kelp forest, a productive and sensitive community type that is abundant near the lease site. Beach habitat occupies the shore near the lease site.

4.6.1.3 Major Environmental Factors of the Project Area

A variety of environmental factors influence the biological resources of the lease area. The most fundamental are those that affect plants, because all food webs ultimately depend on plants. The principle problem for plant production in the sea is to bring together light from above and dissolved nutrients from deep water (MRC 1989). At the sea surface, there is usually plenty of light, but the nutrients present are mostly incorporated into living plant tissues and therefore are not readily available for new plant growth. In deeper water there is less light, but dissolved nutrients are more available as a result of decay of dead plant and animal material settling from above.

- ***Light***

Light intensity in seawater declines rapidly with depth. This decline results from absorption of light by water and dissolved pigments, and scattering by suspended material. Levels of suspended material are higher nearshore than offshore, so the rate of decline in light intensity with depth increases toward shore. Suspended materials include plankton and organic detritus as well as suspended mineral particles. Erosion and runoff supply mineral sediments and waves and currents keep these materials in suspension. Light is generally low during periods of storms because clouds reduce the incident light, stormwater runoff supplies sediments, and large waves resuspend sediments from the bottom.

- ***Nutrients***

Nitrogen is the principal nutrient limiting plant growth in the surface waters of the SCB (MRC 1989; Dailey et al. 1993). Nitrogen compounds used by plants, especially nitrates, have very low concentrations in the photic zone. The photic zone is the surface layer where light intensity is sufficient for plant growth. Below the photic zone, which averages about 20 meters in depth near the coast, nitrate levels increase with depth. Temperature-depth gradients closely parallel the nitrate gradients, and it has been found that nitrate levels are generally adequate or good for plant growth in water colder than 14°C, uncertain and variable in water between 14°C and 16°C, and inadequate in water warmer than 16°C. (MRC 1989).

The gradient of nitrate concentration with depth changes rapidly as a result of waves, surface runoff, and upwelling and downwelling. Upwelling is the upward movement of deep water to the surface and downwelling is the downward movement of surface water. Waves cause turbulent mixing of deeper water layers with the photic zone, increasing nitrate concentrations near the surface. Surface runoff supplies some nutrients, but is not a major contributor. Upwelling results from winds blowing or currents flowing downcoast (in a southeasterly direction); downwelling results from winds and currents moving upcoast. Upwelling brings cold, nutrient-rich water from lower depths to the surface, while downwelling drives the cold, nutrient-rich water away from the surface. Upwellings and downwellings may happen in any season, but nearshore upwellings are most prevalent in spring and early summer and downwellings occur most often in the late summer and fall. Consequently, spring and early summer are generally the best times for plant growth and late summer and fall are the worst times (MRC 1989).

- ***El Niño***

El Niño events are deep, persistent downwellings that occur at intervals of years in the eastern Pacific Ocean. During El Niños, warm westerly winds cause downwellings along the coast in southern California and bring powerful storms (MRC 1989). El Niños can lead to drastic reductions in plant production because downwellings deprive the surface waters of nutrients, while the frequent storms destroy benthic macroalgae. Storm waves also cause deep mixing and thus may reduce the time that phytoplankton resides in the photic zone. Light level may not be a factor, however, because the offshore surface water masses pushed toward shore by El Niño winds are unusually clear.

4.6.2 The Subtidal Sand-Bottom Community

The subtidal sand-bottom community is the predominant community type of the project site. The habitat of this community type typically consists of sand or sand interspersed with occasional rocks and cobbles, and includes the overlying layer of water. An estimated 96 percent of the substrate of the lease site consists of sand (SCE 1997a). The habitat occupies depths from the lowest extent of the tide to roughly 30 meters (Dailey et al. 1993). Because of wave action and shifting sand, the sand-bottom habitat is generally a physically rigorous and structurally unstable environment, particularly in shallow water. As a result, diversity and abundances of species are relatively low.

The following discusses the ecological and economic importance and the historical trends and current status of subtidal sand-bottom communities in the SCB. The characteristic assemblage of plants and animals that make up these communities is described and the biota found at the lease site is detailed. The ecological roles and interactions of the major species are discussed and the important physical and biological regulating factors of the communities are noted. Finally, documented effects of artificial reefs on sand-bottom communities are reviewed. For the subtidal sand-bottom community, the study area is the lease site and its immediate vicinity because the impacts to this community would be limited to these locations.

4.6.2.1 Ecological and Economic Importance

Because of their low species diversity and productivity, subtidal sand-bottom communities are often considered to be ecologically less important than other communities in the SCB and they have received relatively little scientific attention. There are no special status species known to inhabit the subtidal sand-bottom communities of the SCB. However, some species, such as sand dollars (*Dendraster excentricus*), sand stars (*Astropecten* spp.), sea pens (*Stylatula* spp.), sea pansies (*Renilla kollikeri*), many species of polychaetes and crustaceans, stingrays, and flatfishes are adapted to soft-bottom communities and would be adversely affected by any significant loss of this community type.

The subtidal sand-bottom habitats are economically important to nearshore fisheries. Unlike reefs and other habitats, the sand-bottom habitat can be trawled with little risk of damage to nets. California halibut, white croaker and other major fisheries species are fished in sand-bottom communities. However, trawling is not conducted in the lease area because regulations prohibit trawling close to shore. Fishing for lobster (*Panulirus* *interruptus*) and red sea urchins (*Strongylocetrotus franciscanus*) is carried out along neighboring reefs.

Bays and estuaries in the SCB are small and few in number, so the nearshore zone is a nursery area of major importance. The abundance of larvae of coastal fishes increases nearshore. Concentrations of older larvae of white croaker, queenfish, and California halibut are greatest close to shore, just above the bottom (Dailey et al. 1993).

4.6.2.2 Historical Trends and Current Status of Subtidal Sand-Bottom Communities in the SCB

Subtidal sand-bottom habitats are common throughout the SCB. In the intertidal zone, about 80 percent of the shoreline is sandy or a mixture of sand and loose rock (Dailey et al. 1993). Sand is probably similarly predominant in the substrate of the subtidal zone. The prevalence of sand in substrates generally increases from north to south in the SCB.

No region-wide studies have examined trends in the extent of subtidal sand-bottom communities in the SCB. The amount of subtidal sand-bottom habitat in the SCB has probably changed little during this century. However, the condition of this habitat type, like other nearshore habitat types in the SCB, has been affected by the rapid urban and industrial development that has occurred in southern California during the past half century. Contaminant loading is the most important direct impact of this development on the subtidal sand-bottom communities, and the lease site is located within a portion of the SCB that has received particularly high levels of contaminants (Dailey et al. 1993). Important contaminant pathways include municipal and industrial wastewater discharge, river and storm runoff, atmospheric fallout, oil spills, and ocean dumping. Contaminants continue to be a problem in this region, but concentrations of nearly all major contaminants have declined substantially in recent years (Dailey et al. 1993).

Contaminants strongly influence sand-bottom communities because most contaminants collect in the sediments and the species of these communities live in close contact with the sediments (Stull et al. 1986). A survey conducted in the 1970s estimated that contaminants had affected invertebrate species composition in sediments of about 4.6 percent or 168 square kilometers of the mainland continental shelf of southern California (Dailey et al. 1993). Contaminants affect species composition because some species are more tolerant of contaminants than others. The area affected had greatly contracted by 1988 because of reductions in contaminant levels (Dailey et al. 1993). Abundance and species diversity of fish in the SCB may have declined during the past decade or two, but the declines may be transitory and related to El Niño events (Hague 1992).

Species composition of soft bottom invertebrates in several undisturbed areas of the SCB changed little between the 1970s and late 1980s (Dailey et al. 1993). Both species composition and abundance of epifaunal invertebrates were relatively constant on a sand plain in the La Jolla Bight between 1957 and 1963 (Fager 1968), but later surveys in the same area found large fluctuations in abundance of several species, including sea pansies, sand dollars, sea pens, the sea urchin, *Lovenia cordiformis*, two polychaete species and four species of brachyuran crab (Davis and VanBlaricom 1978). At least some of these fluctuations apparently resulted from high variability in recruitment success. Although many populations in subtidal sand-bottom communities appear to alternate between periods of constant abundance and periods of rapid change, species composition of these communities appears to persist over long periods (Morin et al. 1985).

In addition to contaminants, impacts that have affected sand-bottom communities in the SCB include entrainment of fish and invertebrates by power plants; thermal discharges from power plants; construction of jetties and marinas; loss of wetland habitats that serve as nurseries for fish species; and reductions in fisheries species as a result commercial and sport fishing.

4.6.2.3 Characteristic Biota of Subtidal Sand-Bottom Communities

- ***Plankton***

Plankton consists of algae (phytoplankton) and animals (zooplankton) small enough to be suspended in the water column. Plankton is transported from place to place by currents and, therefore, is not closely associated with any particular bottom type. Thus the plankton of subtidal sand-bottom communities is similar to that found in other habitats of the near shore open coast in southern California.

- ***Benthic algae***

Subtidal sand-bottom communities generally include few macrophytes, because there are few substrates with secure attachment sites. Diatoms (single-celled algae) often form a thin layer over the sand in protected areas or in deeper water where sand is less disturbed by wave surge (Morin et al. 1985). Scattered rocks and cobbles support kelp and other macroalgae, but survival on these substrates is often brief because the stones are rolled by waves and scoured by sand. In protected areas of open coast, such as that near Santa Barbara, some giant kelp attaches directly to sandy bottom. It has been reported that stands of this sand-dwelling kelp grew near the lease area prior to the 1957 to 1959 El Niño (SCE 1994).

- ***Macroinvertebrates***

Macroinvertebrates are ordinarily the most abundant and conspicuous members of subtidal soft-bottom communities. Table 4.6-1 lists common invertebrate species found in subtidal sand-bottom communities of the SCB. Macroinvertebrates generally can be described as either epifaunal organisms, which live on the surface of the sediment, or infaunal organisms, which live in the sediment. Common epifaunal invertebrates include

Table 4.6-1 Scientific and Common Names of Macroinvertebrate Species Commonly Found in Sandy Subtidal Communities in the SCB

Scientific Name	Common Name
<u>Anthozoans</u>	
Harenactis attenuata	burrowing anemone
Renilla kollikeri	sea pansy
Stylatula elongata	sea pen
<u>Nemerteans</u>	
Paranemertes sp.	
Zygeupolia sp.	
<u>Polychaetes</u>	
Aricidea wassi	
Chaetozone setosa	
Diopatra ornata	architect worm
Diopatra splendidissima	
Goniada littorea	
Mediomastus acutus	
Mediomastus californiensis	
Nepthys parva	
Nothria elegans	
Owenia collaris	
Owenia fusiformia	
Paraprionospio pinnata	
Pherusa inflata	
Prionospio pygmaea	
Spiophanes missionensis	
<u>Amphipods</u>	
Acuminodeutopus heteruropus	
Ampelisca agassizi	
Megaluropus longimerus	
Paraphoxus abronius	
Rhepoxynius abronius	
Rhepoxynius menziensi	
Synchelidium shoemakeri	
Tiron biocellata	
<u>Isopods</u>	
Ancinus granulatus	
Edotea sublittoralis	
<u>Anomurans</u>	
Isocheles pilosus	hermit crab
<u>Brachyurans</u>	
Cancer gracilis	crab
Heterocrypta occidentalis	elbow crab

Table 4.6-1 Scientific and Common Names of Macroinvertebrate Species Commonly Found in Sandy Subtidal Communities in the SCB (continued)

Scientific Name	Common Name
Loxorhynchus grandis	sheep crab
Randallia ornata	
Cumaceans	
Diastylopsis tenuis	
Barnacles	
Balanus pacificus	
Bivalves	
Tellina modesta	clam
Tivela stultorum	Pismo clam
Gastropods	
Armina californica	nudibranch
Coryphella sabulicola	
Kellettia kellettii	Kellett's whelk
Nassarius fossatus	channeled dog whelk
Polinices altus	sea snail
Olivella biplicata	purple olive snail
Ophiuroids	
Amphiodia occidentalis	brittle star
Asteroids	
Astropecten armatus	shallow-water sand star
Astropecten verrilli	
Patiria miniata	bat star
Echinoids	
Dendraster excentricus	sand dollar
Lovenia cordiformis	heart urcin

Table 4.6-2 Scientific and Common Names of Common Fishes of Sandy Subtidal Communities in the SCB

Scientific Name	Common Name
Citharichthys stigmaeus	speckled sanddab
Citharichthys sordidus	Pacific sanddab
Pleuronichthys ritteri	spotted turbot
Pleuronichthys verticalis	hornyhead turbot
Hypsopsetta guttulata	diamond turbot
Paralichthys californicus	California halibut
Synodus lucioceps	lizard fish
Genyonemus lineatus	white croaker
Paralabrax nebulifer	barred sand bass
Cymatogaster aggregata	shiner surfperch
Hyperprosopon argenteum	walleye surfperch
Phanerodon furcatus	white seaperch
Seriphus politus	queenfish
Sebastes saxicola	stripetail rockfish
Engraulis mordax	northern anchovy
Scorpaena guttata	California scorpionfish
Ophidion scrippsae	basketweave cusk-eel
Symphurus atricauda	California tonguefish
Platyrhinoidis triseriata	thornback
Rhinobatos productus	shovelnose guitarfish
Urolophus halleri	round stingray
Myliobatis californica	bat ray

sea pens, sea pansies, sea snails, sand dollars, crabs, hermit crabs, sea stars, and brittle stars (Table 4.6-1). The infaunal invertebrates are primarily polychaetes and other worms, and amphipods and other small crustaceans (Table 4.6-1) (MEC 1987; Ambrosa and Anderson 1990; Dailey et al. 1993; SLC 1994). The distinction between epifauna and infauna is somewhat arbitrary for animals such as sand dollars and brittle stars that burrow into the sediments to varying degrees depending on current and substrate conditions (Morin et al. 1985).

- ***Fish***

Many types of fish commonly occur in subtidal sand-bottom communities (Table 4.6-2). These include sand-dwelling species such as flatfishes that are adapted to soft substrate habitats, pelagic species such as northern anchovy that are adapted to the open water and range over many types of substrates, generalist species such as California scorpionfish that inhabit a wide range of habitats, and species such as barred sand bass (*Paralabrax nebulifer*) that are more commonly found in hard bottom habitats, but frequently visit adjoining sandy habitats (Morin et al. 1985; Dailey et al. 1993; Johnson et al. 1994). In general, the biomass of fish in subtidal sand-bottom communities is relatively low (Johnson et al. 1994; Eco-M 1997). Species that dominate biomass of trawl catches in sand-bottom habitats typically include white croaker, California halibut, shovelnose guitarfish, basketweave cusk-eel, lizardfish, barred sandbass, northern anchovy, queenfish, white seaperch, walleye surfperch, and several species of sanddab, sole and turbot (Hague 1992; Johnson et al. 1994). California halibut, northern anchovy, and white croaker are important fishery species.

4.6.2.4 The Subtidal Sand-Bottom Community at the Project Site

The boundaries of the project encompass 356 acres where bottom depths range between 12 and 15 meters (39 to 49 feet). Most of the substrate consists of a layer of sand less than about 0.5 m in thickness lying over hard bottom (SCE 1997a). The depth of the project site puts it in the offshore, relatively stable zone of the community depth gradient. Based on the information gathered from studies of subtidal sand-bottom communities in other areas, the sediments at this depth are not strongly affected by wave surge under most conditions and infaunal animals dominate the biomass. Results of recent surveys of the project site indicate that the architect worm, an infaunal polychaete, is the most abundant and widespread species in the area, by far (Table 4.6-3) (SCE 1997a; 1997c; Eco-M 1997). Estimates of the average density of this worm from two surveys were 3.7 and 16.9 per square meter (SCE 1997a; Eco-M 1997). These estimates are relatively low as compared to estimates from sand-bottom communities in other areas of southern California (SCE 1997a; Eco-M 1997). No dense beds of architect worms that could provide habitat for other invertebrate species were reported. Estimates from the surveys of the density of sea stars, which were primarily the shallow water sand star (*Astropecten*

Table 4.6-3 Mean Densities of Benthic Invertebrates Surveyed in the Project Site

Taxon	Mean Density (number per square meter) *	
	Coastal Resources Associates (1997)	EcoSystems Management Associates (1997)
Diopatra sp.	3.68	16.89
Pherusa sp.	---	1.75
Owenia collaris	---	0.31
Nothria sp.	---	0.49
Unidentified worms	1.49	---
Unidentified spionidae	---	1.86
Astropecten sp.	0.10	0.13
Unidentified sea urchins	0.29	---
Kelletia sp.	0.10	---
Unidentified snails	0.06	---
Coryphella sabulicola	---	0.04
Unidentified crabs	0.22	---
Sylatula elongata	0.10	---
Renilla kollikeri	0.06	0.08
Harenactis attenata	---	0.04

* Dashes indicate none were collected or the taxonomic category was not employed in that survey.

armatus), were 0.10 and 0.13 per square meter; while estimates for sea pansies were 0.01 and 0.08 per square meter. A single estimate for sea pens was 0.007 per square meter (SCE 1997a; Eco-M 1997). Estimates of the average densities of other frequently sighted invertebrate species are included in Table 4.6-3. Pits dug by rays as described in the previous section were frequently observed in the lease area (Eco-M 1997). Fewer than ten fish and no sand dollars were seen during the surveys.

Density estimates reported for some species were quite different between the two project site surveys (Table 4.6-3). For instances, densities of *Diopatra* were more than four times as high in the EcoSystems Management Associates survey as in the Coastal Resources Associates survey. These differences may be related to differences in sampling sites. In the Coastal Resources Associates survey, sites in the vicinity of hard substrate were avoided (Deysher 1998), whereas in the EcoSystems Management Associates survey, some of the sand-bottom sites were adjacent to areas of hard substrate (Eco-M 1997). As noted earlier, *Diopatra* densities tend to be elevated in areas adjacent to reefs.

4.6.2.5 Structure and Dynamics of Subtidal Sand-Bottom Communities

The structure and dynamics of a community refers to the species that live together and their abundances, distributions, ecological roles, and interactions. Four aspects of the structure and dynamics of the subtidal sand-bottom community are discussed below: the food web, the principal modes of feeding, the distribution of the community with respect to depth, and seasonal changes in species distribution and abundance.

- ***Food Web***

The base of the food web of subtidal sand-bottom communities consists of phytoplankton in the overlying water and organic detritus that settles out of the water or is swept in by currents from other communities. The productivity of phytoplankton in the SCB is low when compared to that of many other coastal areas (Dailey et al. 1993). Availability of nitrogen appears to control the growth of many of the phytoplankton species. Abundances increase in response to upwelling of cold, nitrogen-rich water from lower depths. Phytoplankton populations are generally more abundant in the spring and, to a lesser extent, in the fall than at other times.

The zooplankton is a major component of the food web in the nearshore communities. Zooplankton are the major consumers of phytoplankton and are the major prey of many types of animals. The zooplankton serves, therefore, as the primary conduit for energy transfer from the phytoplankton to higher trophic levels of the food web.

Macrophytes are largely absent from the subtidal sand-bottom communities because substrates are too unstable to support them, but pieces of kelp and other plants that drift in from other areas may be important food sources (Fager 1968; Morin et al. 1985; Kim 1992). Dead animals and material washed in from shore may also be important. Invertebrates and fishes that feed on plankton and detritus, and their invertebrate and fish predators occupy the higher trophic levels of the food web. Seals and sea lions prey on some of the fish and macroinvertebrates (see below, "Marine Mammals, Birds and Turtles").

- ***Feeding Modes***

Animals of subtidal sand-bottom communities subsist by a variety of feeding modes. A common mode is suspension feeding, where suspended plankton and detritus are strained from the water. Suspension feeders include sea pansies, sea pens, brittle stars, sand dollars, and clams. Other important feeding modes are deposit feeding, which includes ingestion of detritus-laden sediments, and scavenging, which means feeding on larger dead plants and animal parts. Animals with these feeding modes include many fish, snail, and crab species, as well as most of the infaunal invertebrates. Predation, the other major feeding mode, is important among fishes and many invertebrates, including sea stars, gastropods, and polychaetes. Epifaunal invertebrates are generally suspension feeders, predators, or scavengers, whereas infaunal species tend to be opportunistic detrivores or selective deposit feeders. Herbivory, feeding on live plant material, is not important in this community because few plants inhabit the sand-bottom habitats (Morin et al. 1988).

- ***Depth Gradient***

Subtidal sand-bottom communities are structured along a gradient that extends from the shallow, turbulent environment near the surf zone to a more stable environment farther from shore. Sediment stability increases and sediment grain size generally declines along this gradient (MEC 1987). The gradient is maintained as a result of the decreasing influence with depth of the wave surge on sediments (Morin et al. 1985).

The changes in sediment stability and structure along the depth gradient affect the distribution of species. The shallow water zone is a biologically sparse area dominated by suspension feeding epifauna or rapidly burrowing infauna. The abundance of most epifaunal animals declines with depth, and in water deeper than about 10 meters most of those present are predators and scavengers (Morin et al. 1985, 1988; Dailey et al. 1993). In contrast, the abundance of infaunal animals, particularly polychaetes, increases with depth. Overall species diversity and the abundance of predators also increase with depth (Morin et al. 1985, 1988; Dailey et al. 1993).

The difference between the epifauna and infauna with respect to the effect of depth on abundance apparently stems from differences in their adaptations to sediment structure and stability. Most infaunal species construct semi-permanent burrows or tubes, which cannot be successfully maintained in the coarse-grained, shifting sediments of the shallow water zone. In contrast, the epifaunal animals are generally mobile and adapt more quickly to shifting sands. The infaunal species fare better than the epifaunal species in deeper water presumably because they are better able to escape predation. As previously noted, predator abundance increases with depth. Sand dollars, if present, predominate at intermediate depths where significant effects of wave surge extend to the bottom only during storm events (Merrill and Hobson 1970; Morin et al. 1985, 1988). When sand dollars are present, their biomass may exceed the total biomass of the other members of the community (Morin et al. 1985; 1988). The fish species assemblage also varies with depth. Schooling midwater species dominate just beyond the surf zone, while flatfishes are increasingly prevalent further out (Dailey et al. 1993).

- ***Seasonality***

Seasonal factors may play an important role in subtidal sand-bottom communities, but have been little studied. Average wave height is generally higher during winter, which may lead to an offshore shift in the distribution of the community (see discussion of storms in the following section, "Physical and Biological Factors Regulating Sandy Subtidal Communities"). Drift algae and food material transported from land generally increase during winter as a result of increased storm activity. Many species show seasonal variations in abundance, but the causes of these variations are rarely understood (Morin et al. 1985). Many fish species make seasonal inshore-offshore migrations as part of their breeding cycles. Recruitment of new young fish to the nearshore zone peaks during winter through spring (Dailey et al. 1993).

4.6.2.6 Physical and Biological Factors Regulating Subtidal Sand-Bottom Communities

Little is known about factors that regulate species abundances and community dynamics in subtidal sand-bottom communities of the SCB. As noted previously, many populations in these communities alternate between periods of constant abundance and periods of rapid change, but species composition of these communities appears to persist over long periods (Morin et al. 1985). This pattern of variability apparently results because many of the species of these communities are long lived with infrequent periods of successful recruitment (Davis and VanBlaricom 1978). The causes of recruitment failure are not known, but are probably related to vulnerability of the young life stages to wave surge and/or predation.

The following section summarizes available information about the effects of storms, water temperature, and species interactions on these communities.

- ***Storms***

Wave surge, as described in the previous section, has a profound effect on the subtidal sand-bottom community. Wave surge varies with depth, but also with the size of the surface waves. Therefore, larger waves probably cause a downward shift in the depth distribution of the community. Wave size is affected by factors such as exposure to prevailing winds and storm events. During winter, when periods of stormy weather tend to be frequent, sand dollars are carried by wave surge to deeper water (Merrill and Hobson 1970; Morin et al. 1985).

Extreme storm events may devastate sand dollar beds and populations of other sand-dwelling species. Storms are most likely to affect species that cannot move offshore, particularly relatively sessile species, such as sand dollars and sea pens, and species that are restricted to the nearshore zone because of specific habitat requirements. Populations of fish and other predators could be indirectly affected by storms because of a loss of forage.

Storms also benefit the subtidal sand-bottom communities by bringing in new food material. After a storm, the sand-bottom may be littered with pieces of formerly attached algae and surf grass, and the animals clinging to them (Fager 1968).

- ***Water Temperature***

Water temperature regimes in the SCB change substantially from year to year. These changes profoundly affect water movements and nutrient supplies and, as described in the section "Kelp Forest Community", they ultimately affect giant kelp. Fish are also affected by changes in water temperatures. Fish populations, including populations of sand-dwelling species, have generally declined during warm-water periods associated with El Niño events (Hague 1992; Dailey et al. 1993). The effects of water temperature on macroinvertebrates of the subtidal sand-bottom communities are unknown, but they may be substantial because water temperatures in the subtidal zone often vary abruptly as a result of upwelling (VanBlaricom 1982).

- ***Biological Interactions***

Biological interactions strongly influence the structure and dynamics of subtidal sand-bottom communities. As noted earlier, predation strongly affects the depth distribution of many species. Various sea star and sea snail predators, for instance, limit the offshore distribution of sand dollars (Dailey et al. 1993). The sand dollars, in turn, crowd out sea pansies, sea pens, and sea snails and other potential competitors. Dense beds formed by sand dollars, as well as those formed by architect worms (*Diopatra ornata*) and other polychaetes, essentially change the character of the sand-bottom habitat, creating opportunities for habitation by species that would not normally inhabit the subtidal sand-bottom community (Merrill and Hobson 1970; Morin et al. 1985; Ambrose and Anderson

1990). The beds may stabilize sediments, offer protection from predators, and provide hard substrate for attachment of small barnacles and algae.

In some circumstances, predators in subtidal sand-bottom communities may indirectly benefit some of their prey species (VanBlaricom 1982). Round stingrays and bat rays dig pits in pursuing their infaunal prey. The disturbance to the sediments apparently increases the availability of detrital food resources, which results in greater abundance of infaunal organisms. These increased abundances are ephemeral because the new food resources are quickly exhausted.

4.6.2.7 Artificial Reefs

This section reviews information about existing artificial reefs in the SCB to evaluate the effects of these reefs on other biological resources. In particular, the section examines effects of artificial reefs on the subtidal sand-bottom community, which is generally the community type displaced by artificial reefs.

In 1990, the California Department of Fish and Game identified 50 artificial reefs and reef augmentations that had been constructed in the SCB, mostly to enhance populations of sport fish (CDFG 1990). These reefs have been constructed from a variety of materials including quarry rock, concrete riprap, automobiles, streetcars, and scuttled ships. In addition, breakwaters, jetties, man-made islands, bridge piers, and other artificial structures function as reefs (Dailey et al. 1993). While some of these structures have been sporadically studied over the years, few have been researched intensively (Ambrose 1986; Bohnsack 1997; Lindberg 1997). Several post-construction studies of artificial reefs have identified indirect effects on the near-reef environment, including physical and biological changes. These are discussed below.

- ***Physical Changes in the Near-Reef Community***

Sand-bottom communities are sensitive to changes in sediment characteristics. Studies conducted at the Pendleton Artificial Reef (PAR) and several smaller artificial reefs documented changes in sediment characteristics surrounding the reefs (Davis et al. 1982; Ambrose and Anderson 1990). Sediments adjacent to the reefs had coarser particle sizes than those further from the reefs, but major changes in sediments were limited to a distance of less than about five meters from the reefs. These physical alterations in the near-reef environment were attributed to effects of the reefs on water currents and wave surge. Organic carbon content of sediments near the reefs were not different from organic carbon content of sediments further out.

- ***Biological Changes in the Near-Reef Community***

Studies of sand-bottom communities surrounding artificial reefs have found differences in the biota between sand-bottom habitat close to and more distant from the artificial reefs. Some small differences in biota have been attributed to effects of the reefs on sediment characteristics (Davis et al. 1982; Ambrose and Anderson 1990). More substantial differences have generally been associated with increased predation and food resources from the reefs.

Fish and invertebrate predators associated with reefs prey to varying degrees on animals living in the surrounding sand-bottom community (Davis et al. 1982; Ambrose and Anderson 1990; Dailey et al. 1993; Johnson et al. 1994). Predation by three reef-associated fish species dramatically reduced abundance of the sea pen, *Stylatula elongata*, in the sand-bottom habitat surrounding an artificial reef near San Diego (Davis et al. 1992). The area of reduced sea pen density extended more than 200 meters from the reef.

Artificial reefs generally increase the supply of detrital food material available to the sand-bottom community remaining in and around the reef. Plant production is low in sand-bottom communities, so these communities are dependent on food material exported from other communities. Pieces of kelp and other macrophytes that drift in from kelp forests are particularly important in the sand-bottom communities of southern California. Drift kelp promotes the development of dense mats of the polychaete, *Diopatra ornata*, near kelp reefs (Kim 1992). This worm dominates the ecotone between kelp reefs and sand-bottom habitats along much of the California coast, and forms mats next to several artificial reefs in southern California (Davis et al. 1982; Ambrose and Anderson 1990; Kim 1992). *D. ornata* mats change the character of the sand-bottom habitat, creating new opportunities for habitation by species that would normally not be present (Ambrose and Anderson 1990; Kim 1992).

4.6.3 Kelp Forest Community

Giant kelp (*Macrocystis pyrifera*) occurs along the west coast of North America from Baja California to central California, primarily in subtidal rocky habitats (Foster and Schiel 1985). Within the SCB, giant kelp occurs along the coast and near the Channel Islands in waters that range from about eight to 20 meters in depth (Wilson and North 1983). Giant kelp grows in large beds or forests and it forms the principal structural component of the kelp forest community.

Kelp forests provide important habitat for a variety of invertebrates, fishes, birds and mammals, as well as other types of macroalgae (Foster and Schiel 1985). The following is a brief description of the kelp forest community, including the ecological and economic importance of kelp forests, the status and trends of kelp forests within the SCB, a general biological description of kelp forest communities, and factors influencing the abundance of kelp and extent of kelp forests within the SCB.

The study area is the geographic area potentially affected by the project. For purposes of evaluating project effects on kelp forest communities, the study area extends from about San Clemente to the southern extent of the San Mateo kelp reef. More distant kelp reefs would be little affected by the project.

4.6.3.1 Ecological and Economic Importance

Kelp forests, like coral reefs and tropical forests, are highly complex and productive biological systems. And like coral reefs and rain forests, kelp forests are recognized as major centers of biological diversity and productivity (Foster and Schiel 1985; Dailey et al. 1993). The kelp forests of the SCB are among the most productive and species rich environments in the coastal wasters of southern California. Over 50 fish species, 130 species of plants, and almost 800 species of invertebrates are known to inhabit kelp forests in southern California and northern Baja California (Foster and Schiel 1985). Most fish and invertebrate species found in kelp forests also occur in rocky habitats lacking kelp, but these species are generally more abundant when kelp is present (Foster and Schiel 1985; Dailey et al. 1993). Kelp forests are important nurseries and/or major foraging centers for many species of invertebrates, fish, birds, and marine mammals.

Kelp forests of the SCB have great economic value because they support the production of many commercially important species and attract recreational fishermen and divers. Giant kelp plants have been harvested since the early part of this century, originally for potash production and more recently for algin production (Foster and Schiel 1985). Algin is an emulsifying and binding agent used in the pharmaceutical and food industries. Kelp harvesting appears to have no adverse affect on the kelp forest community (Foster and Schiel 1985). Fish species taken by commercial and/or recreational fishermen in or near kelp forests in the SCB include barred sand bass (*Paralalrax nebulifer*), kelp bass (*Paralabrax clathratus*), and California sheephead (*Semicossyphus pulcher*). Invertebrate species taken include abalone, spiny lobster (*Panulirus interruptus*) and the red sea urchin (*Strongylocentrotus franciscanus*) (Foster and Schiel 1985).

4.6.3.2 Historical Trends and Current Status of Kelp Forests within the SCB

The earliest records of reduction in kelp forest coverage in the SCB date to the 1940s, when a decline was noted for the kelp forests close to large metropolitan areas. This decline has been attributed to higher levels of wastewater discharge and overgrazing by sea urchins (Wilson and North 1983; Tegner and Dayton 1991). Overgrazing by sea urchins probably stemmed from population increases that resulted from heavy fishing on their predators, particularly California sheephead and spiny lobster. As their food supply dwindled, the urchins formed feeding aggregations that further reduced the kelp forests. The stress on the kelp forests was greatly exacerbated by a major El Niño during 1957-1959. Kelp forest restoration efforts were initiated in the 1960s at sites where kelp forests had previously occurred. Improved sewage disposal practices and a growing fishery for red sea urchins further improved conditions for kelp.

Recent trends in kelp forest status in the SCB have been assessed by aerial photography of kelp beds over a 25-year span (North et al. 1993). Surface areas of the canopies of 20 kelp beds along the coasts of Orange and San Diego Counties were surveyed from 1967 to 1991. Results of these surveys indicated that kelp forests are naturally highly dynamic systems with substantial year to year variations in size. Over the course of the survey period, the area of kelp bed canopies varied several fold, and most canopies disappeared entirely for a year or more. However, the surveys showed no general increase or decrease in kelp forest coverage. The greatest reductions in the area of kelp bed canopies have generally been related to major storms and El Nino conditions (Tegner and Dayton 1987, 1991; North et al. 1993; Tegner et al. 1997).

Although there is no evidence of a general trend in kelp forest coverage in the SCB, the condition of kelp forests have probably been affected by the rapid urban and industrial development that has occurred in southern California during the past half century. In addition to municipal and industrial wastewater discharge, potential impacts of urban and industrial development on kelp forests include increased erosion and sedimentation, oil spills, ocean dumping, and discharge from power plants.

4.6.3.3 Biological Description of the Giant Kelp Forest Community

Giant kelp dominates the kelp forest community and forms the forest canopy, but many other macroalgal species inhabit these communities and increase their structural complexity. Kelp forests typically have several strata or horizontal layers consisting of different types of macroalgae, which has led some researchers to compare kelp forests to tropical rain forests. This layering provides a diversity of microhabitats (Foster and Schiel 1985; DeMartini and Roberts 1990; Dailey et al. 1993). Animals living in the kelp forest include bryozoans and other invertebrates that live on the kelp plants, sessile invertebrates attached to rocks or living in the sand within the reef, and motile fish and invertebrates that reside on the bottom or in the water column.

Animals in the kelp forest community obtain their food from a number of different sources. Giant kelp and other plants are important food sources for many fish and invertebrate species. Some species feed directly on the living plant tissue, while others feed on dead plant material. Many of the invertebrate species in the kelp forest are suspension feeders, filtering microscopic animals and other particles from the water column. Suspension feeders include sea fans, bryozoans, sponges, tunicates, polychaetes, brittle stars, barnacles, and bivalves. The predators of the kelp forest include starfish, crabs, lobsters, octopus, cowries, cones and many fish species. Many of the kelp forest animals that do not rely on kelp for food rely on it for attachment sites or shelter.

The life cycle of kelp is complex, but a general understanding of the life cycle is useful because different environmental factors affect different life stages of kelp. A mature kelp plant has of a holdfast, which attaches the plant to the substrate, and long fronds suspended by floats (Foster and Schiel 1985). A frond consists of a stem-like stipe and leaf-like blades. This life stage is known as the adult sporophyte. Reproductive adult sporophytes release microscopic zoospores that settle nearby and develop into male and female gametophytes (MRC 1989). The male gametophytes fertilize the females to form embryonic sporophytes, which develop, after several months, into juvenile kelp plants. The juveniles grow to adult size within a year. The life span of a kelp plant is typically about two years (Foster and Schiel 1985).

4.6.3.4 Physical and Biological Factors Influencing Kelp Abundance in the SCB

Kelp forests are regulated both by physical factors and biotic interactions. The physical factors include substrate, wave exposure, sedimentation, nutrients, temperature, and light availability. Biotic interactions include herbivory, competition, and habitat area effects. The following is a brief overview of these factors.

- ***Substrate***

Giant kelp must attach to hard, stable substrates to keep from being swept away by strong waves and currents. Typical substrates include cobbles, rocks and boulders, and consolidated substrates (Dailey et al. 1993). An exception to the hard substrate requirement occurs along the relatively protected coastline between Point Conception and Santa Barbara, where a variety of giant kelp grows on sand (Dailey et al. 1993). At San Onofre, where kelp attaches to cobbles, storm waves often move entire kelp plants with attached cobbles to other locations, including the beach (Foster and Schiel 1985).

- ***Wave Exposure***

Wave exposure refers to the degree of exposure of an area to powerful storm-generated waves. Large storm events can be a significant disturbance to kelp forests. During storm events, high velocity waves have been reported to destroy the canopy of giant kelp forests and remove entire kelp plants from substantial substrates (Epeling et al. 1985). Storm surge increases as depth decreases and the inner edge of a kelp forest appears to be set by the effect of storm surge on kelp plants (Seymour et al. 1989). Once the kelp plants are removed from the substrate, the blade and stipe becomes entangled in other plants, increasing drag and resulting in the widespread removal of the forest (Dailey et al. 1993). The large piles of kelp that wash up on beaches following storm events demonstrate the devastating effects of storm surge on kelp forests. However, wave exposure can also benefit giant kelp by reducing kelp herbivores such as urchins and opening the canopy to light, which improves growth and survival of young kelp plants (Epeling et al. 1985;

Foster and Schiel 1985). Wave exposure can be particularly significant during major storm events and El Niños.

- ***Sedimentation***

Sedimentation affects all life stages of giant kelp and other macroalgae. Sedimentation can interfere with attachment of young kelp and smothers kelp spores, gametophytes and young sporophytes (Devinny and Volse 1978). Adult plants may be damaged or killed by partial burial (Foster and Schiel 1985). Wave driven sediments scour kelp and damage tissues. Under certain conditions, sediment scour may benefit kelp forests by eliminating sessile invertebrates such as sea fans that compete with kelp plants for attachment sites (MEC 1994). Suspended sediments also increase turbidity, which reduces light availability for kelp and other algae.

Suspension of sediments in the water is strongly affected by currents. The speed of coastal currents flowing through a kelp forest is reduced by the drag of the kelp plants, and part of the flow is diverted around the forest (Jackson and Winant 1983; Elwany et al. 1998). The kelp-induced reduction in current speed results in the deposition of a portion of the suspended sediment load in the kelp forest. A study at the North Carlsbad Kelp Bed found a 63 percent reduction of current speed within the bed that resulted in deposition of fine sediment (Elwany et al. 1998). Increased sedimentation may cause local kelp mortalities, but waves, which are not significantly affected by kelp presumably clear the sediments from the beds before the sediments cause extensive damage (Elwany et al. 1998).

- ***Water Temperature and Nutrients***

Water temperature and nutrients, which strongly affect growth and recruitment of giant kelp, are treated together because they are related: cold water generally has an adequate supply of nutrients, while warm water generally has an inadequate supply. As previously described in the "Regional Setting" section, water temperatures and nutrient concentrations are strongly affected by water movements.

Nutrient limitation is often considered to be the most important constraint on the growth of kelp (Jackson 1977). Growth and survival of kelp is generally highly seasonal because of seasonal patterns of nutrient supply by currents. During summer and fall, kelp is exposed to warm, nutrient-poor water and the canopy is reduced, while during winter and spring, cold, nutrient-rich water supports rapid growth (Dailey et al. 1993). This seasonal pattern is interrupted on a periodic basis by El Niño and La Niña events. During El Niños, nutrient-poor water is present all year and often results in drastic declines in kelp canopy. La Niñas result in unseasonably cold, nutrient-rich flows that encourage rapid kelp growth (North et al. 1993).

Water movement is also important in distributing nutrients and food materials within a kelp forest. As noted above, the coastal currents that transport nutrients and other materials to the kelp forest are substantially diverted around the forest. Therefore, kelp plants on the forest edge should be in faster flowing water than those in the interior, and nutrient uptake, suspension feeding and predation on zooplankton may be reduced in the forest interior (Jackson and Winant 1983; Tegner and Dayton 1987). The reductions in longshore currents may be effectively countered by cross-shore currents, potentially resulting in little net effect on nutrient uptake and food supply in the forest interior, but the relative importance of the longshore and cross-shore currents is unclear at this time (Jackson 1998).

- ***Light Availability***

Giant kelp, like other plants, depends on light for growth and survival. Light availability is controlled by water depth, turbidity and shading effects of the canopy from both giant kelp and other macrophytes (Dean et al. 1985). The reduction of light with depth is the primary control on the lower depth limit of the kelp, which is typically about 20 meters. Giant kelp recruitment is dependent on light availability for survival of young sporophytes.

- ***Herbivory***

When populations of fish and invertebrates that feed on living kelp are high, they may greatly reduce the kelp forest canopy. Species that feed on living kelp plants include sea urchins, snails and the fish species, opaleye (*Girella nigricans*) and halfmoon (*Medialuna californiensis*) (Foster and Schiel 1985; Dayton et al. 1992). Other fish species, such as senorita (*Oxyjulis californicus*) and garibaldi (*Hypsypops rubicundus*), browse on kelp to remove the invertebrates that reside on the plants, but may severely damage the kelp plants in the process (Bernstein and Jung 1979; Foster and Schiel 1985). Senoritas, however, may also benefit kelp by removing detrimental species that feed on or encrust the kelp plants. A variety of fish predators generally control the fish herbivore populations, and California sheephead and spiny lobster control the urchin populations. Kelp grazing by urchins is also related to the availability of detrital food material. When urchins have an adequate supply of algal drift, they tend to remain within reef crevices and not feed on living kelp. However, when the drift is less available, the urchins may emerge from the safety of the crevices and form feeding aggregations that remove entire kelp stands (Tegner and Dayton 1991; Dayton et al. 1992)

Grazing pressure on kelp by fish herbivores appears to be related to the height of the kelp forest reef. The abundance of fish in kelp forests is somewhat correlated with reef height. Fish are less common on reefs of low relief (less than one meter) than on higher relief reefs, which may be due to the lack of structural complexity in low relief reefs (Patton et al. 1994). A reduction in the abundance of herbivorous fish may help to explain why kelp tends to survive better on low relief reefs. Urchins are generally present on both high and low relief reefs.

- ***Competition***

Interspecific and intraspecific competition influence the structure of the kelp forest community. Macroalgae compete for light, and macroalgae and sessile invertebrates such as sea fans compete for attachment sites. Adult giant kelp shade lower stature plants within the kelp bed, including juvenile kelp.

Pterygophora californica, an understory kelp that is common in the San Onofre kelp forest and can be expected to colonize the project reef, is an important competitor of giant kelp (Dailey et al. 1993). Giant kelp and *Pterygophora* compete for attachment sites and light, and dense stands of *Pterygophora* have been shown to inhibit the recruitment of giant kelp (Dailey et al. 1993). Despite their competitive relationship, however, recruitment of giant kelp was positively correlated with the presence of *Pterygophora* during studies of kelp recruitment in the San Onofre kelp forest (Dean et al. 1985). The reason for this positive correlation was unknown.

- ***Habitat Area Effects***

The area of habitat available to a natural community affects many important and interrelated properties of the community, including species diversity, genetic diversity, and the rate of local extinctions (Rickels 1973). Isolated communities are particularly sensitive to habitat area effects. Kelp reefs are essentially habitat islands, relatively isolated from other kelp reefs, so the effects of reef size on the kelp forest community are likely to be very important. Although the effects of reef size on kelp forests are poorly understood, it is believed that small kelp forests are more readily destroyed than larger forests by fish or invertebrates grazing (Bernstein and Jung 1979; Dailey et al. 1993). In general, large reefs are more persistent and contain greater numbers of and more populous species than small reefs. It is likely that increased size generally benefits kelp forest communities.

4.6.4 Marine Mammals, Birds and Turtles

This section provides an outline of the general biology of mammal, bird and turtle species that are likely to occur within and near the lease area. The section begins with a discussion of the marine mammals found in the SCB and includes a brief description of the species that may be affected by project activities. Next is a discussion of the bird species that are likely to occur in the area, followed by a description of avian use of kelp forests in California. Finally, there is a short section on sensitive turtle species that have the potential to occur in the lease area.

The study area for marine mammals, birds, and turtles encompasses the marine waters from Los Angeles to San Diego because this area includes all probable shipping routes for transporting reef materials. In depth discussion, however, will focus on species that would likely occur within the project vicinity as those species would more likely be influenced by project activities.

4.6.4.1 Marine Mammals

The SCB provides habitat for one of the most diverse assemblages of marine mammals in the world. Nearly 40 different species of marine mammals have been recorded in the Bight (see Table 4.6-4). Of these, 32 are cetaceans (whales, dolphins and porpoises), six are pinnipeds (sea lions and seals) and one is a fissiped, the sea otter (Dailey et al. 1993). Most of these species either are occasional visitors or are migratory. The species that are most likely to occur within the lease area are the California sea lion (*Zalophus californianus*), the Pacific harbor seal (*Phoca vitulina*), the bottlenose dolphin (*Tursiops truncatus,* a.k.a. *T.gilli*) and the gray whale (*Eschrichtius robustus)* (Lagomarsion 1997).

- ***Status and Trends of Marine Mammals***

All marine mammals are protected by the federal Marine Mammal Protection Act of 1972 (MMPA). The MMPA prohibits the intentional taking, import or export of any marine mammal without a permit. Several of the species that occur within the SCB are also protected under the federal Endangered Species Act of 1973 (ESA) (see Table 4.6-4). A species that is listed as threatened or endangered under the ESA is categorized as depleted under the MMPA. Unintentional take of a depleted species is allowed by permit only if the activity is determined to have a negligible impact. Intentional take of a depleted species is only allowed under a scientific research permit.

None of the four species most likely to occur within the lease area are currently listed as threatened or endangered or as depleted under the MMPA. The gray whale, which migrates through the lease area, was removed from the endangered species list in June 1994.

- ***Life History and Feeding Ecology of Marine Mammals in the Project Area***

California Sea Lion. The California sea lion is the most abundant pinniped in the SCB (Dailey et al. 1993). This species is a year-round resident of the SCB with a peak summer population of approximately 87,000 individuals (Dailey et al. 1993). Within the Bight, the California sea lion breeds in large colonies, or rookeries, on San Miguel and San Nicolas Islands and has smaller breeding colonies on Santa Barbara and San Clemente Islands. Breeding occurs from May to August. Most males migrate northward in late summer after the breeding season and return to the rookeries in early spring. Females and young tend to remain near the rookeries or migrate southward at the end of the summer. The mean population size from January through March in the SCB is approximately 43,000 (Bonnell and Ford 1987, as cited in Dailey et al. 1993).

Table 4.6-4 Marine Mammals of the Eastern North Pacific and Their Status in the SCB

Species	Status	Likely to Occur in the Project Area[a]	Status and Size of Population in SCB
Order Cetacea			
Baleen Whales (Suborder Mysticeti)			
Blue whale *(Balaenoptera musculus)*	E	N	Migratory population. Reaches peak numbers in summer as population moves northward from subtropical wintering grounds.
Fin whale *(Balaenoptera physalus)*	E	N	Migratory population. A few are present in the SCB year- round; population reaches peak numbers in summer.
Sei whale *(Balaenoptera borealis)*	E	N	Migratory population. Seen only in summer months, primarily in offshore waters; uncommon in SCB.
Bryde's whale *(Balaenoptera edeni)*	—	N	Rare; represented in SCB by single sighting near San Diego.
Minke whale *(Balaenoptera acutorostrata)*	—	N	Migratory population. Common in SCB throughout the year, but reaches peak numbers in spring and summer.
Humpback whale *(Megaptera novaeangliae)*	E	N	Migratory population. Uncommon in SCB; peak abundance in summer and autumn.
Gray whale *(Eschrichtius robustus)*	downlisted in 1994	Y	Most of world population passes through SCB in winter and spring.
Northern right-whale *(Balaena glacialis)* (Also referred to as *Eubalaena glacialis)*	E	N	Occasional visitor. Represented in SCB by two sightings. Rare.
Toothed Whales (Suborder Odontoceti)			
Sperm whale *(Physeter macrocephalus)*	E	N	Occasional visitor; typically inhabits offshore waters. Uncommon in SCB.
Common dolphin *(Delphinus delphis)*	—	N	Year-round resident; mean population of 57,000 in summer and autumn. Common.
Northern right-whale dolphin *(Lissodelphis borealis)*	—	N	Seasonal resident population in winter and spring (<16,000). Common.

Table 4.6-4 Marine Mammals of the Eastern North Pacific and Their Status in the SCB (continued)

Species	Status	Likely to Occur in the Project Area[a]	Status and Size of Population in SCB
Pacific white-sided dolphin *(Lagenorhynchus obliquidens)*	—	N	Year-round resident; population in SCB may reach 12,000 animals. Common.
Risso's dolphin *(Grampus griseus)*	—	N	Year-round resident; peak population of about 4,000 in summer and autumn. Common.
Dall's porpoise *(Phocoenoides dalli)*	—	N	Year-round resident; present throughout the year, but is at peak abundance in SCB in autumn and winter (<1000). Common.
Bottlenose dolphin *(Tursiops truncatus* also referred to as *T. gilli)*	—	Y	Year-round resident; two populations may be present in the SCB (<1000). Common.
Harbor porpoise *(Phocoena phocoena)*	—	N	Occasional visitor. Stranding records from Santa Barbara to Los Angeles. Rare in SCB.
Short-finned pilot whale *(Globicephala macro-rhynchus;* also referred to as *G. scammonii)*	—	N	Year-round resident population of about 400 animals; increases to about 600 in winter. Common prior to 1982.
Killer whale *(Orcinus orca)*	—	N	Occasional visitor, most often present in summer and winter. Uncommon.
False killer whale *(Pseudorca crassidens)*	—	N	Occasional visitor; possible mass stranding represented by skeletal remains; several sightings in SCB and offshore waters; widely distributed in eastern North Pacific. Rare.
Cuvier's beaked whale *(Ziphius cavirostris)*	—	N	Occasional visitor; known in the SCB from sightings and strandings. Uncommon
Baird's beaked whale *(Berardius bairdii)*	—	N	Occasional visitor; several sightings in SCB or pelagic waters. Rare.

Table 4.6-4 Marine Mammals of the Eastern North Pacific and Their Status in the SCB (continued)

Species	Status	Likely to Occur in the Project Area[a]	Status and Size of Population in SCB
Toothed Whales (Suborder Odontoceti) (continued)			
Hubb's beaked whale *(Mesoplodon carlhubbsi)*	—	N	Occasional visitor; represented in SCB by strandings (several sightings at sea of *Mesoplodon* sp. may be this species). Uncommon.
Ginkgo-toothed beaked whale *(Mesoplodon ginkgodens)*	—	N	Possible visitor; represented in SCB by single stranding record.
Hector's beaked whale *(Mesoplodon hectori)*	—	N	Occasional visitor; represented in SCB by strandings and probable sightings. Rare.
Blainville's beaked whale *(Mesoplodon densirostris)*	—	N	Possible visitor; typically found in central North Pacific.
Bering Sea beaked whale *(Mesoplodon stejnegeri)*	—	N	Possible visitor; typically found in Bering Sea and Gulf of Alaska.
Dwarf sperm whale *(Kogia simus)*	—	N	Possible visitor; known from strandings in central California and Mexico.
Pygmy sperm whale *(Kogia breviceps)*	—	N	Occasional visitor; known from strandings only. Rare.
Striped dolphin *(Stenella coeruleoalba)*	—	N	Occasional visitor; known from strandings and sightings. Rare.
Spinner dolphin *(Stenella longirostris)*	—	N	Possible visitor; eastern tropical Pacific species.
Spotted dolphin *(Stenella attenuata)*	—	N	Possible visitor; eastern tropical Pacific species.
Rough-toothed dolphin *(Steno bredanensis)*	—	N	Possible visitor; eastern tropical Pacific species.
Order Carnivora Pinnipeds (Suborder Pinnipedia)			
California sea lion *(Zalophus californianus)*	—	Y	Year-round resident; peak summer population of about 87,000. Abundant.
Northern (Steller's) sea lion *(Eumetopias jubatus)*	T	N	Occasional visitor; no longer breeds in SCB, but a few males usually present in summer. Uncommon.

Table 4.6-4 Marine Mammals of the Eastern North Pacific and Their Status in the SCB (continued)

Species	Status	Likely to Occur in the Project Area[a]	Status and Size of Population in SCB
Order Carnivora Pinnipeds (Suborder Pinnipedia) (continued)			
Northern fur seal *(Callorhinus ursinus)*	—	N	Year-round resident. San Miguel colony reaches peak of 4,000 in summer; pelagic population of about 5,000 off SCB in winter and spring. Common.
Guadalupe fur seal *(Arctocephalus townsendi)*	T	N	Occasional visitor. Presently breeds only on Isla de Guadalupe, Mexico; winter pelagic range includes SCB. Uncommon.
Northern elephant seal *(Mirounga angustirostris)*	—	N	Year-round resident; winter breeding population of about 27,000 on land. Common on land; uncommon at sea.
Pacific harbor seal *(Phoca vitulina)*	—	Y	Year-round resident; population of up to 5,000 in SCB during early summer (1987 est.). Common.
Fissipeds (Suborder Fissipedia)			
Sea otter *(Enhydra lutris)*	T	N	Year-round resident. Locally around San Nicolas Is.; a few wanderers near mainland and other islands. Total of 40-60 in SCB (1987 est.).

E=Designated as endangered under the Endangered Species Act of 1973 (ESA).

T=Designated as threatened under the Endangered Species Act of 1973.

[a] As determined by the National Marine Fisheries Service (NMFS) in their consultation letter dated December 10, 1997

Source: Dailey et al. 1993.

California sea lions are gregarious and are often observed in small groups swimming, porpoising, surfing waves, or resting on shore (Zeiner et al. 1990). They tend to prefer haul-out sites that have limited human access, and the appearance of a person can frighten the group into the water (Peterson and Bartholomew 1967). Sea lions seem to be habituated to constant or low frequency sounds, but have been known to be alarmed by sudden loud noises.

Sea lions are opportunistic feeders, foraging mainly on fish and cephalopods such as Pacific whiting, market squid, rockfish, anchovy, mackerel, octopus and several pelagic squid (Dailey et al. 1993; Zeiner et al. 1990). The composition of the diet varies by season, location and fluctuations in average water temperatures caused by El Niño events. Groups of California sea lions have occasionally been observed passing through or foraging along the fringe of kelp forests (Foster and Schiel 1985). This behavior is likely transitory since this species tends to prefer pelagic prey species.

Pacific Harbor Seal. The harbor seal is the most common pinniped in the world, occurring both in the Atlantic and Pacific Oceans. The Pacific harbor seal ranges from Hershcel Island in Alaska south to Baja California (Dailey et al. 1993). The eastern Pacific harbor seal (*Phoca vitulina richardsi*) is the subspecies that occurs within the SCB. The population in the SCB was estimated at approximately 4,100 individuals in 1983 by the National Marine Fisheries Service (NMFS) (Hansen 1983, as cited in Dailey et al. 1993). Breeding season for this species in California is from March to June; peak pupping occurs in April and May (Zeiner et al. 1990). Harbor seals maintain haul-out sites on both mainland and island coasts that have unrestricted access to the water. They are sensitive to human disturbance but will reoccupy a site once they no longer feel threatened.

The Pacific harbor seal forages alone or in small groups close to shore in relatively shallow coastal waters (less than 200 m). For prey items, they tend to prefer benthic and epibenthic fish (Dailey et al. 1993). Harbor seals have often been observed foraging in kelp forests, particularly when this habitat is located near coastal haul-out sites (Foster and Schiel 1985). Harbor seals are thought to be one of the top-level consumers in the kelp forest ecosystem (Zeiner et al. 1990).

Bottlenose Dolphin. The bottlenose dolphin (*Tursiops truncatus,* a.k.a. *T.gilli*) occurs in the eastern north Pacific Ocean from the equator north to central California (Dailey et al. 1993). Two distinct populations occur in the SCB, one coastal and one offshore (Norris and Prescott 1961, as cited in Dailey et al. 1993). The coastal form of the bottlenose dolphin generally inhabits waters within one kilometer (km) of the shore and would be most likely to occur within the affected area. This species is known to form small resident groups that occupy a distinctive home range, with little overlap between groups (Dailey et al. 1993). Bottlenose dolphins remain within the Bight year-round, with seasonal shifts in population size and distribution between Orange County and Ensenada, Mexico. The coastal population was estimated to have 240 bottlenose dolphins in 1983 by NMFS (Hansen 1983, as cited in Dailey et al. 1993).

There has not been a comprehensive study of the feeding habits of bottlenose dolphins in the SCB. However, they are believed to feed opportunistically on a wide variety of fish, cephalopods and crustaceans (Dailey et al. 1993). This species has also been observed to associate with shrimp boats in the Gulf of California.

Gray Whale. Two distinct populations of gray whales occur in the north Pacific Ocean, a western and an eastern stock. The eastern stock occurs along the eastern Pacific coastline and is known as the California gray whale. In June 1994, the eastern Pacific population of this species was removed from the federal endangered species list, due to the recovery of population numbers to near the estimated original population size (Federal Register 1994).

The California gray whale migrates through the SCB twice each year, traveling between its feeding grounds in Alaska and breeding lagoons in Baja California. The southern migration through the Bight occurs from December through February, with pregnant females moving through the area first. The northward migration begins in February and lasts through May, peaking in March (Leatherwood 1974, as cited in Dailey et al. 1993). Solitary animals generally lead the northbound migration with cow-calf pairs following one to two months later (Foster and Schiel 1985). Gray whales generally migrate within 200 km of the shoreline and many are sighted within 15 km of the shore (Dailey et al. 1993). On the northbound migration, cow-calf pairs are believed to more closely follow the shoreline rather than the offshore route (Dailey et al. 1993; Foster and Shiel 1985). Gray whales have been observed within the project vicinity (Hughes 1997).

Gray whales feed primarily on benthic organisms, although migrating whales will also feed opportunistically on large schools of fish, such as anchovies. To feed, the whale rolls on one side and then skims the ocean bottom, screening the sediment through its baleen for food items. In general, gray whales are not known to feed while migrating to and from the summer breeding lagoons. However, there have been several reports of juvenile gray whales and cow-calf pairs skimming dense kelp beds for food while passing through the SCB (Dailey et al. 1993; Foster and Schiel 1985). Cow-calf pairs may also utilize kelp forests for escape cover from predatory killer whales (Foster and Schiel 1985).

4.6.4.2 Marine Birds

The coastline along the SCB provides habitat for a wide variety of bird species. Almost 200 different species of birds have been recorded utilizing the Bight. Some of these species are present in the area year-round but the majority are migratory. The habitats that these species frequent can be grouped into three categories: ocean, shoreline and wetland. Ocean species include birds that are most often observed more than one km offshore and rarely utilize inland habitats. Shoreline bird species include those that are found within one km of the coast and utilize bays and harbors, or are found along beaches, rocky shores or jetties. For purposes of this report, wetland habitat includes marshes, estuaries and mudflats that have the potential to be affected by the proposed project. The closest wetland habitat to the lease area is the natural preserve at the outlet of San Mateo Creek, located approximately 0.75 mile east of the southern end of the lease area. Table 4.6-5 contains a list of avian species that are most likely to occur within or near the lease area. The list includes the more commonly observed birds of the area along with sensitive species that have the potential to occur in the lease area. Bird species that may be closely associated with kelp are discussed later.

- ***Status and Trends of Marine Birds***

Special-status marine birds are those species that fall under one or more of the following categories:

- Officially listed by California or the Federal Government as Endangered, Threatened, or Rare under the California Endangered Species Act (CESA) or federal Endangered Species Act (ESA);
- Candidates for State or federal listing under the ESA or CESA;
- Species which meet the criteria for listing, even if not currently listed, as described in Section 15380 of the CEQA Guidelines;
- Species that are biologically rare, have limited distribution, or are currently declining throughout their range;
- Populations that are threatened with extinction in California, even if widely distributed outside of California; and
- Species closely associated with a habitat that is in rapid decline, threatened, or rare (CDFG 1997b, 1997c).

Table 4.6-5 Marine Birds in or near the Proposed Experimental Reef Project Area

Species	Status [a]	Habitat [b]	Season of Use
Pied-billed Grebe	--	S,W	year-round
Horned Grebe	--	S	winter
Eared Grebe	--	S,W	year-round
Western Grebe	--	S	winter, spring, fall
Northern Fulmar	--	O	winter, spring, fall
Pink-footed Shearwater	--	O	spring, summer
Sooty Shearwater	--	O	spring, summer
Black-vented Shearwater	--	O,S	spring, summer
Black Storm-Petrel	CSC	O	summer
California Brown Pelican	SE/FE	O,S	year-round
Double-crested Cormorant	CSC	O,S,W	year-round
Brandt's Cormorant	--	O,S	year-round
Pelagic Comorant	--	O,S	winter, spring
Great Blue Heron	--	S,W	year-round
Great Egret	--	W	winter, spring, fall
Snowy Egret	--	W	winter, spring, fall
Green Heron	--	W	winter, fall
Black-crowned Night-Heron	--	W	year-round
White-faced Ibis	CSC/FSC	W	occasional
Wood Stork	CSC	W	occasional
Brant	--	S,W	winter, spring
Canada Goose	--	W	winter
American Wigeon	--	W	winter, spring, fall
Gadwall	--	W	winter, spring, fall
Green-winged Teal	--	W	winter, spring, fall
Mallard	--	W	winter, fall
Common Pintail	--	W	winter, fall
Cinnamon Teal	--	W	winter, summer, fall
Northern Shoveler	--	W	winter, spring, fall
Lesser Scaup	--	W	winter, spring
Surf Scoter	--	S,W	winter, spring
Bufflehead	--	W	winter, spring
Red-breasted Merganser	--	S	winter, spring, fall
Ruddy Duck	--	W	year-round

Table 4.6-5 Marine Birds in or near the Proposed Experimental Reef Project Area (continued)

Species	Status [a]	Habitat [b]	Season of Use
White-tailed Kite	--	W	year-round
Northern Harrier	--	W	winter, fall
Yellow Rail	CSC	W	occasional
Black Rail	ST/FSC	W	occasional
Light-footed Clapper Rail	SE/FE	W	year-round
Virginia Rail	--	W	winter, spring, fall
Sora	--	W	winter, spring, fall
American Coot	--	W	year-round
Black-necked Stilt	--	W	spring, summer
American Avocet	--	W	spring, fall
Black-bellied Plover	--	W	year-round
Western Snowy Plover	CSC/FT	S	year-round
Semipalmated Plover	--	S,W	spring, fall
Killdeer	--	W	year-round
Greater Yellowlegs	--	W	year-round
Spotted Sandpiper	--	S	year-round
Wandering Tattler	--	S	spring
Willet	--	S,W	year-round
Whimbrel	--	S,W	year-round
Long-billed Curlew	CSC	W	year-round
Marbled Godwit	--	S,W	year-round
Ruddy Turnstone	--	S,W	spring, summer
Black Turnstone	--	S	winter, spring, fall
Sanderling	--	S,W	year-round
Western Sandpiper	--	W	year-round
Least Sandpiper	--	S,W	year-round
Dunlin	--	S,W	winter, spring, fall
Short-billed Dowitcher	--	W	spring, summer
Long-billed Dowitcher	--	W	year-round
Common Snipe	--	W	winter, spring, fall
Northern Phalarope	--	S,W	summer, fall
Pomerine Jaeger	--	O,S	summer, fall
Parasitic Jaeger	--	S	spring, fall
Bonaparte's Gull	--	S,W	winter, spring

Table 4.6-5 Marine Birds in or near the Proposed Experimental Reef Project Area (continued)

Species	Status [a]	Habitat [b]	Season of Use
Heermann's Gull	--	O,S,W	winter, summer, fall
Mew Gull	--	O,S,W	winter, spring
Ring-billed Gull	--	O,S,W	year-round
California Gull	CSC	O,S,W	year-round
Herring Gull	--	S	winter, spring
Western Gull	--	O,S,W	year-round
Glaucous Gull	--	O,S,W	winter, spring
Black-legged Kittiwake	--	O,S,W	winter, spring
Caspian Tern	--	O,S,W	spring, summer
Royal Tern	--	O,S,W	winter,
Elegant Tern	CSC/FSC	S,W	fall
Common Tern	--	S,W	spring, fall
Arctic Tern	--	O	fall
Forster's Tern	--	S,W	year-round
Least Tern	SE/FE	S,W	spring, summer
Black Skimmer	CSC	W	occasional
Common Murre	--	O,S	winter, spring
Red-throated Loon	--	S	winter, spring
Pacific Loon	--	S	winter, spring
Common Loon	CSC	S	winter, spring

[a] Status: CSC=California Species of Special Concern, ST=California State Threatened, SE=California State Endangered, FT=Federally Threatened, FE=Federally Endangered

[b] Habitat: O=Ocean, S=Shoreline, W=Wetland

Source: Garrett and Dunn 1981

Two federally endangered species that have the potential to occur within the lease area: California least tern (*Sterna antillarum browni*) and brown pelican (*Pelecanus occidentalis*) (USFWS 1997). These species are also listed as endangered by the State of California (CDFG 1997b). A review of the CNDDB list of "Special Animals" also identified several California species of special concern that may occur within the lease area or that have the potential to be affected by project activities (CDFG 1998). These species are black storm-petrel (*Oceanodroma melania*), double-crested cormorant (*Phalacrocorax auritus*), western snowy plover (*Charadrius alexandrinus nivosus*), California gull (*Larus californicus*), elegant tern (*Sterna elegans*), common loon (*Gavia immer*) white-faced ibis (*Plegadis chihi*), wood stork (*Mycteria americana*), yellow rail (*Coturnicops noveboracensis*), California black rail (*Laterallus jamaicensis coturniculus*), light-footed clapper rail (*Rallus longirostris levipes*) and long-billed curlew (*Numenius americanus*).

- ***Life History and Feeding Ecology of Special-Status Bird Species***

Special-status bird species with a potential to be affected by the project can be categorized by the habitat in which they are most commonly observed. The biology of these species is discussed below.

- ***Ocean***

Ocean species are those birds which spend most of their time more than one km offshore, and rarely utilize inland habitats. These species have the potential to be directly affected by project activities. The only special-status ocean species that may occur within the lease area is the black storm-petrel (*Oceanodroma melania*).

Black Storm-Petrel. The black storm-petrel is listed as a California Species of Special Concern (CDFG 1994). The black storm-petrel is found year-round in the SCB, with the peak population occurring late summer to fall (Dailey et al. 1993). This species generally prefers to forage within 20 km of the shoreline and, therefore, is the most commonly observed storm-petrel (Garrett and Dunn 1981). Storm-petrels forage by capturing small invertebrates and fish at the water surface. The only known nesting colony of black storm-petrels in the United States is located on Santa Barbara Island, well to the west of the lease area (Garrett and Dunn 1981).

- ***Shoreline***

Shoreline habitat includes beaches, rocky coastline, jetties and the waters within one km of the coast. Several of the species listed in this category are also found in other habitats, but are primarily observed along the shoreline. Special-status species that occur in this habitat and have the potential to be affected by project activities include: brown pelican (*Pelecanus occidentalis californicus*), double-crested cormorant (*Phalacrocorax auritus*), western snowy plover (*Charadrius alexandrinus nivosus*), California gull (*Larus californicus*), elegant tern (*Sterna elegans*), least tern (*Sterna antillarum browni*), and common loon (*Gavia immer*).

Brown Pelican. The brown pelican is listed both federally and by the State of California as endangered. The brown pelican occurs year-round along the coast of southern California, but is most common from June to October (Zeiner et al. 1990). Nesting takes place from March to early August on the Channel Islands where the young are tended by both parents. After breeding, adults disperse from nesting colonies along the entire California coastline. Brown pelicans forage in warm shallow water, generally within 20 km of the coastline (Dailey et al. 1993). Anchovies are their main prey. Pelicans are often observed foraging at the seaward fringe of coastal kelp forests (Foster and Shiel 1985). They feed most often in the early morning or late afternoon and roost during other periods on the rocky coasts of both the mainland and the Channel Islands.

Double-crested Cormorant. The double-crested cormorant is listed as a California Species of Special Concern. This species is common year-round along the SCB coastline. The double-crested cormorant has been known to nest on rocky cliffs of the mainland coast and the Channel Islands, but nesting has declined in recent years (Zeiner et al. 1990; Dailey et al. 1993). Nesting occurs from April to July or August, with the young being tended by both parents. This species feeds mainly on fish but will also take crustaceans and amphibians (Zeiner et al. 1990). Foraging generally occurs in waters less than nine m (30 feet) deep where the cormorant will dive and pursue prey for up to 30 seconds. This species may forage opportunistically at the edge of a kelp forest (Foster and Scheil 1985).

Western Snowy Plover. The western snowy plover is federally listed as a threatened species and is a California Species of Special Concern. This species occurs year-round along the sand and cobble beaches of the SCB. The snowy plover builds shallow nests on beach habitat and is present at the nesting sites from April through August. The nesting habitat for this species has been severely disturbed by human development and occupation of historic nest sites (Zeiner et al. 1990; Dailey et al. 1993). Nest sites are presently found at undisturbed sites in San Diego County, at Vandenberg Air Force Base and on some of the Channel Islands (Dailey et al. 1993). Snowy plovers feed in small groups along the beach surf line. The main prey items for this species are insects, small crustaceans and marine worms (Dailey et al. 1993).

California Gull. The California gull is a California Species of Special Concern. This species is common along the SCB coast during the fall and winter, with numbers peaking from January through March. In the spring, most California gulls leave the coast for inland breeding sites (Dailey et al. 1993). The main threat to this species is from the lowering of Mono Lake which has opened their nesting island to predators. California gulls are opportunistic foragers that will feed on garbage, carrion, various invertebrates and fish (Zeiner et al. 1990). When foraging in coastal waters, this species will generally be found within 20 km of the shoreline.

Elegant Tern. The elegant tern is listed as a California Species of Special Concern. This species arrives in the SCB from Mexican breeding grounds in June and is common in coastal areas through October. The only know breeding site in the United States is located at the southern end of San Diego Bay (Zeiner et al. 1990). Elegant terns are most often observed along the beaches of Southern California and are rarely seen more than four km offshore (Dailey et al. 1993). This species forages by diving into shallow ocean water for small fish. Elegant terns have been observed roosting and foraging in kelp forests off the coast of California (Foster and Schiel 1985).

California Least Tern. The California least tern is federally listed and is listed by the State of California as endangered. This species arrives in California in late April to breed and is fairly common along the coastline near estuaries and lagoons through August (Garrett and Dunn 1981). Breeding colonies in southern California are located along

4.6.5 *The Beach Community*

The only terrestrial ecological community that would be potentially affected by the project is the terrestrial surf zone (beach) community. The surf zone habitat comprises expanses of barren sand that extend landward from the high tide line transitioning into the more stable foredunes and includes the beach. The sand within this zone is eroded each winter during storm events and replaced each spring by calmer tides. In addition, this fringe of land between the ocean and the dunes is characterized by regular salt spray and surf. These inhospitable conditions preclude the establishment of vascular plants. Bird use of the surf zone is very high. A high level of invertebrate production within this area, which is supported by kelp wrack and other organic matter washed in from the sea, provides foraging habitat for a variety of shorebirds, including gulls, sandpipers, and plovers.

The study area is the geographic area potentially affected by the project. For purposes of evaluating project effects on the beach community, the study area is the beach area that parallels the lease site onshore.

4.6.5.1 Physical Factors Affecting Beach Habitat

The persistence and stability of beach habitat depend on sand accumulation and depletion, which are determined by the local sediment budget, which is the balance between sediment coming into the area versus the sediments lost to adjacent areas. Along the coast from Dana Point to La Jolla, the sediment budget is mostly self-contained. The major sediment sources within this area are derived from stream discharge into the ocean and the erosion of oceanside bluffs. The major sediment sinks are the submarine canyons of Carlsbad and La Jolla (Moffatt and Nichol 1990).

On reaching the ocean, the sediments first enter the littoral zone. The littoral zone is the area where the seasonal fluctuations in sediment volume affect beach width. Both cross-shore (on- and off-shore) and longshore (up- and downshore) processes transport the sediments and determine the shoreline condition.

On a seasonal basis, larger waves during the winter months erode sand from the beach and deposit it offshore. This results in a narrower beach. During the summer months, gentler waves tend to carry sand shoreward and build-up the beach, so the beach typically becomes wider. Over the course of a year, littoral zone sediment tends to move towards the north in the summer months and south during the winter. However, the annual and long-term net longshore sediment transport is predominantly towards the south.

4.6.6 *Regulatory Framework*

Biological resources are protected by a number of local, State and federal statutes, regulations and rules. Several different agencies are responsible for monitoring these regulations including but limited to US Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), Environmental Protection Agency (EPA), California Department of Fish and Game (CDFG), California Coastal Commission (CCC) and California State Water Resources Board (SWRB). The following is a brief summary of the legislation and policies applicable to the protection of biological resources in the project vicinity.

4.6.6.1 Local Policy

According to the California Coastal Commission (CCC), Local Coastal Plans (LCP) have been prepared by the cities of San Clemente, Carlsbad, Encinitas and Mission Beach and the County of San Diego. Most of theses plans do not contain guidelines specific to the management of marine biological resources. However, the LCP's were reviewed by the CCC for consistency with the California Coastal Act, which requires the protection, enhancement and restoration of environmentally sensitive habitats, including intertidal and nearshore waters and habitat for rare or endangered plants or animals.

4.6.6.2 State Policy

Biological resources in the project vicinity are protected in the State of California by statutes and policies included in the California Endangered Species Act, the California Coastal Act and the California Native Plant Protection Act and in the Fish and Game Code. The following is a brief description of regulations included in those acts that apply to the proposed project.

- ***California Endangered Species Act***

The California Endangered Species Act (Fish and Game Code 2050 *et seq.*) recognizes the importance of endangered and threatened fish, wildlife and plant species and their habitats. Sections 2052-2098 of the Fish and Game Code prohibit the "taking" of any endangered, threatened, or rare plant and/or animal species unless specifically permitted for education or management purposes.

- ***California Coastal Act***

The California Coastal Act of 1976 provides for the long-term protection of California's coastline to maintain and enhance coastal resources. Section 30230 states the "marine resources shall be maintained, enhanced and where feasible, restored." The maintenance of the biological productivity and the quality of coastal water to maintain optimum populations of marine organisms is required under Section 30231. The placement of artificial reef material shall be planned to "avoid significant disruption to marine and wildlife habitats and water circulation" (Section 30323).

- ***California Native Plant Protection Act***

Under Section 1908 of the Fish and Game Code, the California Native Plant Protection Act prohibits the take of any native plant or part that is determined to be endangered or rare by the State Fish and Game Commission.

- ***Fish and Game Code***

There are additional regulations contained in the Fish and Game Code that apply to the project and are not included in any of the above listed acts. The following is a summary of applicable regulations.

Section 1700:

> *It is the policy of the state to encourage the conservation, utilization and maintenance of ocean biological resources under their jurisdiction for the public's benefit. The state will also promote the development of local and distant-water fisheries based in California under international law. Objectives include the maintenance of populations of all species of aquatic organisms to insure their continued existence and support reasonable use.*

Sections 1755 and 1801:

> *It is the policy of the state to maintain sufficient populations of all species of wildlife and native plants and the habitat necessary to insure their continued existence for the beneficial use and enjoyment of the public. In addition, all species of wildlife and native plants will be perpetuated for their intrinsic and ecological values, as well as for their direct benefits to man.*

Sections 3511 and 4700:

> *Fully protected birds and/or mammals or parts thereof may not be taken or possessed at any time and no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take any fully protected bird and/or mammals and not such permits or licenses heretofore issued shall have any force or effect for any such purpose. Fully protected birds that may occur in the project area include California brown pelican and California least tern. Fully protected mammals that have the potential to occur in the study area include northern elephant seal, Guadalupe fur seal and Pacific right whale.*

4.6.6.3 Federal Policy

Biological resources in the project area are protected federally by the following laws: Endangered Species Act, Coastal Zone Management Act, Migratory Bird Treaty Act, Marine Mammal Act and the Clean Water Act. The following is a brief description of regulations included in those acts that apply to the proposed project.

- ***Endangered Species Act***

No person subject to U.S. jurisdiction may "take" listed endangered or threatened species within the U.S., its territorial seas, or on high seas.

- ***Coastal Zone Management Act***

The Coastal Zone Management Act declares that it will be the national policy to: "(1) preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations; and (2) encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological values." Programs should provide for "the protection of natural resources, including wetlands, flood plains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat, within the coastal zone."

- ***Migratory Bird Treaty Act***

The Migratory Bird Treaty Act states that "it is unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill… any migratory bird, any part, nest, or eggs of any such bird…included in the terms of the conventions between the United States and Great Britain for the protection of migratory birds concluded August 16, 1916 (39 Stat. 1702), the United States and the United Mexican States for the protection of migratory birds and game mammals concluded February 7, 1936, and the United States and the Government of Japan for the protection of migratory birds and birds in danger of extinction, and their environment concluded March 4, 1972."

- ***Marine Mammal Protection Act***

It is unlawful for any person subject to the jurisdiction of the United States or any vessel or other conveyance subject to the jurisdiction of the United States to "take" any marine mammal on the high seas. "Take" is defined to include harassment as well as hunting, killing, and capturing. The 1994 amendments to the MMPA further define harassment as "any act of pursuit, torment, or annoyance which has the potential" to (A) " injure a marine mammal or marine mammal stock in the wild", or (B) "disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering".

- ***Clean Water Act***

Additional criteria for significance have been identified from the Section 404(b)(1) of the Clean Water Act pertaining to dredged or fill materials. These include the following.

- In regards to threatened or endangered species, smothering, impairment or destruction of the habitat to which the species is limited. These include water quality, spawning, and rearing areas, cover, food supply, salinity, circulation patterns, and physical removal of habitat.

- A reduction in food web organisms by exposure to contaminants, promoting undesirable competitive species at the expense of indigenous species, smothering, exposure to high levels of suspended particles, destruction of spawning grounds and elimination of the lower trophic levels.

- Damage to or destruction of habitats resulting in adverse effects on the biological productivity of wetland ecosystems by smothering organisms, altering hydrology, modifying substrate elevations, altering periodicity or water movement, causing successional change in vegetation, reducing nutrient exchange capacity, and altering current velocity.

- Loss of values of recreational and commercial fisheries including harvestable fish, crustaceans, shellfish, and other aquatic organisms used by man.

- Degrading water quality by obstructing circulation patterns.

4.6.7 Impacts Methodology and Significance Criteria

This section provides analyses of the effects of the proposed project on biological resources. The biological resources considered vulnerable to project-related effects are: (1) the subtidal sand-bottom community; (2) the kelp forest community; (3) beach and wetland communities; and (4) the marine mammal, bird, and turtle species assemblages. The methodology and significance criteria for evaluating impacts to these resources are presented first, followed by a discussion of the project's potential impacts on these resources.

4.6.7.1 Methodology

Information on the status and sensitivities of the biological resources in the project study area were obtained from a review of existing literature, interviews with local experts and consultations with regulatory agencies. The list of special-status species and natural communities that have the potential to be affected by the project were derived by a search of the California Natural Diversity Database (CNDDB) and by consultations with CDFG, NMFS and FWS.

4.6.7.2 Significance Criteria

Pursuant to CEQA, significant effects, or impacts, may occur on biological resources under conditions identified in Section 15065(a) and Appendix G. Specifically, an impact is considered significant for the proposed project if activities have the potential to substantially degrade habitat for; reduce the population below self-sustaining levels; threaten to eliminate a community of; or reduce or restrict the range of a plant, animal or fish that is proposed for or listed as threatened or endangered, or is considered rare. An impact is also considered significant if it interferes substantially with the movement of any resident or migratory fish or wildlife species or substantially diminishes habitat for fish, wildlife or plants.

In keeping with the regulatory framework of the project, impact analysis for biological resources was based on thresholds of significance related to the laws, statues, and regulations that are listed above as being germane to the project.

The proposed project has the potential to influence several physical and biotic factors that may affect biological resources in the project vicinity. The impacts discussion will evaluate the effects of construction, kelp forest development and monitoring of both the experimental phase and mitigation phase of the project on the following resources: 1) Subtidal Sand-Bottom Community; 2) Kelp Forest Community; 3) Marine Mammals and Birds; and 4) Beach Community. The potential impacts, their significance and appropriate mitigation measures for each resource impact are provided below.

4.6.8 The Subtidal Sand-Bottom Community

The proposed artificial kelp reef and its construction would affect the sand-bottom community currently present in the project site. Reef construction could also affect hard substrate habitat that is scattered over the sand-bottom of the project site. This habitat supports some commercially important fishery species and is important to local fishermen (see Section 4.2, Socioeconomics). Potential effects include dragging by the anchors of the derrick barge, increased levels of suspended sediments and burial of biota and habitat during reef construction; and changes in sediment characteristics, food resources, and predation rates resulting from interactions with the artificial kelp reef. These potential effects, their significance, and proposed mitigation measures for any significant impacts are discussed below with respect to both the experimental reef and the mitigation reef.

4.6.8.1 Reef Construction

- ***Derrick Barge***

The derrick barge used to place the reef material at the project site would be held in place with a system of four to six anchors on chains 250-300 feet long, or four to five times the depth of the water. The chains and anchors are moved and adjusted by tightening and loosening winches, with the assistance of an attending tugboat. Inevitably the anchors and up to 80 feet of the chains would drag along the bottom, destroying sand-bottom habitat and biota in the process. The anchors and chains could also disturb some existing hard substrate habitat and biota.

The effects of the anchors and chains on the sand-bottom community would be primarily limited to the immediate construction areas, which total 22.4 acres for the experimental reef and an additional 127.6 to 277.6 acres for the mitigation reef. The sand-bottom habitat and subtidal hard substrate habitat found in the project site is extensive in the SCB. The biological species identified at the project site (Table 4.6.3) are abundant and widely distributed elsewhere in the SCB. In fact, except for the polychaetes, *Diopatra* and *Pherusa*, abundances at the project site are low compared to those of sand-bottom communities surveyed elsewhere in the SCB (Eco-M 1997; SCCE 1997a). None of the species at the project site is federally or state listed as threatened or endangered. Accordingly, the sand-bottom habitat at the project site is mostly unproductive, and the area affected is very small compared to the area of similar habitat occurring elsewhere in the SCB. Therefore, the impact of the derrick barge on the sand-bottom community is considered to be less-than-significant for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required. Recommended Mitigation:
- Buoys will be used to keep the amount of chain length dragging on the ocean bottom to a minimum.

- ***Suspended Sediments***

The construction of the experimental reef and mitigation reef could affect the levels of suspended sediments and the turbidity of the water in the lease site. The construction of the 22.4-acre experimental reef would involve the placement of 17,640tons of quarry rock and 13,860 tons of concrete at the project site. The construction of the proposed 127.6-acre to 277.6-acre mitigation reef would involve the placement of much more material: 357,280 to 777,280 tons of quarry rock, or 280,720 to 610,720 tons of concrete, as a worst case. The placement of these materials would disturb bottom sediments and increase turbidity of the water near the construction site. Additionally, it is likely that the concrete and quarry rock would contain some fine materials, which would become suspended in the water.

Increased turbidity and suspended sediments can have both adverse and beneficial effects on plants and animals. Increased turbidity reduces light penetration, which may reduce primary production and the predation rates of visual predators, including most fish species. High levels of suspended sediments often clog the feeding structures of planktonic and benthic suspension feeders, and the gills of fish and many invertebrates (Sherk et al. 1974; Velagic 1995). Fish eggs and larvae are particularly sensitive to smothering by suspended sediments. The potential benefits of increased turbidity and suspended sediments include higher primary production in areas where nutrients are limiting, if the suspended materials contain and release the limiting nutrients (Odum and Wilson 1962). Disturbance of the sediments may also benefit infaunal invertebrates by increasing the availability of detrital food material (VanBlaricom 1982). Reduced light levels help prey species, including early life stages of fish and macroinvertebrates, escape notice by predators.

The increased levels of suspended sediments and turbidity resulting from the construction of the experimental reef are expected to be localized and to involve relatively minor amounts of sediment. The predominantly sand-sized bottom sediments in the project site are expected to settle out quickly, and to travel only short distances from the construction site. There may be fine materials mixed in with the reef materials and these may take longer to settle out, and they may travel farther, but their quantity is expected to be small. Effects on suspended sediments and turbidity resulting from construction of the additional 127.6 to 277.6 acres for the mitigation reef are expected to be similar to those of the experimental reef, but would extend over a much larger area. The areas of sand-bottom habitat affected by increased levels of suspended sediments and turbidity would be approximately 22.4 acres for the experimental reef and 127.6 to 277.6 acres for the mitigation reef.

Sand-bottom habitat similar to that in the 356-acre project site is extensive in the SCB and the species identified at the project site (Table 4.6.3) are abundant and widely distributed elsewhere. In fact, except for the polychaetes, *Diopatra* and *Pherusa*, abundances at the project site are low compared to those of sand-bottom communities surveyed elsewhere in the SCB (Eco-M 1997; SCCE 1997a). None of the species at the project site are federally or state listed as threatened or endangered. This is considered a less-than-significant impact for both the experimental reef and mitigation reef.

Mitigation Measures

- None required.

- ***Burial by Construction Materials***

The placement of concrete and quarry rock on the project site for construction of the experimental reef modules and the mitigation reef would result in the permanent burial of the existing sand-dwelling biota and their habitat. The biota would be killed and the habitat would be replaced by the hard substrate created by the concrete and quarry rock.

The total area of the experimental reef would be 22.4 acres. This area would be equally divided among modules having concrete or rock at 17, 34, and 67 percent coverage densities. Half of this area would be modules having concrete or rock with a 34 percent coverage density and the other half would be equally divided among modules having rock or concrete at 17 and 67 percent coverage density. Therefore, the actual area of sand-bottom habitat buried by the reef material would be about 8.5 acres. The additional area of the mitigation reef would be 127.6 to 277.6 acres. Assuming the highest density, 67 percent of this area would be covered with concrete or rock. Therefore, the actual area of sand-bottom habitat buried by the reef material would be about 85 to 186.0 acres.

The sand-bottom habitat at the project site is relatively unproductive and similar habitat is extensive elsewhere in the SCB. None of the species identified at the project site (Table 4.6-3) is federally or state listed as threatened or endangered. Therefore, the loss of sand-bottom community biota and habitat through burial by concrete and quarry rock is considered to be a less-than-significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

4.6.8.2 Effects of the Reefs

- ***Sediment characteristics***

The experimental reef and mitigation reef would be expected to affect local currents adjacent to the reef material, which could affect sediment movement and sediment-size composition of the nearby sand-bottom habitat. Sand-bottom communities are sensitive to changes in sediment characteristics, and changes related to the experimental reef and mitigation reef could lead to losses beyond those caused by direct burial by concrete or quarry rock.

The effects of the reefs on sediment characteristics of the surrounding sand-bottom habitat would be minor and habitat similar to the sand-bottom habitat of the lease site is extensive elsewhere in the SCB. Therefore, the impact on sediment characteristics is considered to be a less-than-significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

- ***Food Resources***

Establishment of the experimental reef and mitigation reef would increase the supply of detrital food material available to the sand-bottom community remaining within and in the vicinity of the installed concrete and quarry rock. Plant production is low in sand-bottom communities, so these communities are dependent on food material exported from other communities. Pieces of kelp and other macrophytes that drift in from kelp forests are particularly important in the sand-bottom communities of southern California. Drift kelp helps promote the development of dense mats of the polychaete, *Diopatra ornata*, near kelp reefs, which change the character of the sand-bottom habitat, creating new opportunities for habitation by species that would normally not be present. *D. ornata* is currently the most abundant organism in the sand-bottom community in the project site, but it is not so abundant as to form mats. The increase in drift kelp originating from the experimental reef and mitigation reef could lead to the formation of *D. ornata* mats near the reef, which would be expected to result in a greater diversity of species and higher productivity of the community. Even if *D. ornata* mats did not form, increased food material from the kelp beds would be expected to alter the structure and increase the productivity of the sand-bottom community. Because of its much greater size, the mitigation reef would produce much more food material than the experimental reef and would have a much great effect on community structure and productivity of the sand-bottom community.

Increased production is among the goals of the proposed actions, and would be considered a benefit of the project. The sand-bottom community that now occurs within the project area is extensive within the SCB, and none of the associated species is federally or state listed as threatened or endangered. The effect of increased food resources on community structure is considered to be a less-than-significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

- ***Predation***

The abundance of predators in the proposed experimental reef and mitigation reef would be expected to be much higher than that in the existing sand-bottom community. Fish and invertebrate predators associated with reefs prey to varying degrees on animals living in the surrounding sand-bottom community. The sea pen, *Stylatula elongata*, appears to be particularly vulnerable to such predation. The establishment of the experimental reef and the mitigation reef would be expected to result in a reduction of this species and perhaps other large epifaunal species such as the sea pansy, *Renilla kollikeri*, in the sand-bottom community of the project site. Because the mitigation reef would be much larger than the experimental reef, predator abundance in the mitigation reef would be much greater and predation effects would extend over a much larger area of the sand-bottom community. However, *S. elongata*, *R. kollikeri* and other sand-bottom fauna of the project site are abundant and widely distributed in the SCB. Therefore, increased predation from the experimental reef and the mitigation reef is considered to be a less-than-significant impact.

Mitigation Measures

- None required.

4.6.8.3 Reef Monitoring

The five-year monitoring program for the experimental reef, and the subsequent longer-term monitoring of the mitigation reef would likely consist of side-scan sonar surveys and diver surveys on permanently marked transects and quadrats. The monitoring would not include excavation or other bottom-disturbing activities. This is considered a less-than-significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

4.6.9 Existing Kelp Forest Community

The proposed project actions have the potential to influence several physical and biotic factors that may affect existing kelp forest communities in the vicinity of the lease area. These factors include: (1) turbidity; (2) wave surge; (3) kelp entanglement; (4) sedimentation; and (5) proximity of reefs. The potential effects of these factors on the existing kelp forests, the significance of these effects, and proposed mitigation measures for any significant impacts are discussed below with respect to both the experimental reef and the mitigation reef.

4.6.9.1 Reef Construction

- ***Turbidity***

Construction of the proposed experimental reef and mitigation reef could affect levels of suspended sediments and turbidity of the water at the lease site. Construction of the 22.4-acre experimental reef would involve placement of 17,640 tons of quarry rock and 13,860 tons of concrete, while construction of an additional 127.6 to 277.6 acres for the mitigation reef would involve placement, as a worst case, of 357,280 to 777,280 tons of quarry rock or 280,720 to 610,720 tons of concrete. Placement of these materials would disturb bottom sediments and increase turbidity of the water near the construction site. Additionally, it is likely that the concrete and quarry rock would contain some fine materials, which would become suspended in the water. Increased turbidity could adversely affect the San Mateo kelp community and other nearby existing kelp forests by reducing light levels needed for production and recruitment of kelp and other algae.

The increased levels of suspended sediments and turbidity resulting from the construction of the experimental reef would probably be minor and quite local. As noted in Section 4.3, Geology, grain sizes of bottom sediments in the project area are generally too large to remain suspended in the water for very long. There may be fine materials mixed in with the reef materials and these may take longer to settle out and they may travel further, but their quantity is expected to be small. Therefore, it is unlikely that the increased suspended sediments and turbidity due to construction would be extensive enough to affect the San Mateo kelp forest or other kelp forests. The levels of suspended sediments and turbidity resulting from the construction of the mitigation reef would be greater than those resulting from construction of the experimental reef, but they would probably remain well below levels that would substantially affect turbidity of water in the existing kelp forest communities. The impact of turbidity on existing kelp forest communities is considered to be less-than-significant for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

4.6.9.2 Experimental and Mitigation Reefs

- ***Wave Surge***

If kelp beds absorb energy from waves passing through them, they may reduce the destructive power of the waves on kelp further inshore. A portion of the San Mateo kelp reef and smaller kelp beds lie immediately inshore of several of the experimental reef modules. Therefore, kelp growing on the experimental reef could shelter portions of the San Mateo kelp reef from the full force of storms. The mitigation reef would provide considerably more shelter because of its much greater size. However, kelp principally affects short period waves and has little effect on destructive large period, high amplitude storm waves (see Section 4.3, Geology). It seems unlikely, therefore, that the experimental reef would afford significant protection from storm waves to the San Mateo kelp forest or other kelp forests. Both the experimental reef and the mitigation reef would have a less-than-significant impact on wave surge.

Mitigation Measures

- None required.

- ***Kelp Entanglement***

An important factor in the destruction of kelp during storms is the entanglement of broken and detached pieces of kelp with kelp plants that are still attached to the bottom. These entangled masses increase drag forces and result in further tearing of plants from the substratum, which causes great damage to the kelp forest. Detached kelp from the experimental reef modules could entangle kelp in the San Mateo kelp reef and other kelp reefs, aggravating adverse effects of storm waves on these kelp forests. The mitigation reef would produce much more kelp than the experimental reef, so damage to other kelp reefs resulting from entanglement with detached kelp would be much greater with the mitigation reef. However, any loss of kelp in the San Mateo kelp community resulting from entanglement with kelp from the experimental reef or mitigation reef would probably be far less than the increased kelp production of the reefs. Therefore, damage to existing kelp forest communities caused by kelp entanglement is considered to be a less-than-significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

- ***Sedimentation***

Sedimentation can adversely affect kelp forests. Potential effects of sedimentation on kelp forests were described in the environmental setting portion of this section, under "Kelp Forest Community". Kelp forests attenuate local currents, which causes suspended sediments to settle out. Low relief dune-like deposits of very fine-grained sands lie within and south of existing kelp beds in the project vicinity (see Section 4.3, Geology). These deposits presumably result from the attenuation of sediment-laden currents by the kelp forests. If the experimental reef modules were to result in similar patterns of sand deposition, modules lying immediately north of the San Mateo kelp reef and other kelp reefs in the lease area could adversely affect these reefs. However, only a few of the experimental reef modules would be close enough to the existing kelp reefs to affect them. The mitigation reef, because of its much greater size, would result in much greater sand disposition than the experimental reef and could effect a greater portion of the San Mateo kelp reef and other reefs. Over an extended period of time, accumulations of sand could adversely affect these reefs. However, waves would probably clear the sediments from the kelp reefs before the sediments caused extensive damage (Elwany et al. 1998). Even if sedimentation were to result in a loss of kelp in the San Mateo kelp forest or other kelp forests, the loss would be more than compensated by increased kelp production of the artificial reefs. Damage from sedimentation to existing kelp communities is considered to be a less-than-significant impact both the experimental reef and mitigation reef.

Mitigation Measures

- None required.

- ***Proximity of Reefs***

The proximity of the proposed project to the San Mateo kelp forest could result in both adverse impacts and benefits. Adverse impacts could occur as a result of effects of the artificial kelp reefs on longshore currents, while benefits could result from an increase in kelp forest habitat area.

Longshore currents that transport nutrients and plankton to a kelp forest are substantially diverted around the forest, which may affect rates of nutrient uptake and concentrations of plankton in the forest interior. The prevailing current in the lease area is southward flowing, particularly during summer when nutrient levels are often low, and portions of the San Mateo kelp reef lie immediately south of the lease area. The kelp forests associated with the experimental reef and the mitigation reef could divert longshore currents from the San Mateo kelp forest, reducing current velocities and rates of material nutrient uptake in the forest, as well as the abundances of planktonic food material. These reductions could result in damage to the existing kelp forest.

The surface area of kelp that could grow on the experimental reef modules is too small to significantly affect longshore currents. Therefore, the proximity of the experimental reef to the San Mateo Kelp reef is expected to result in no adverse effects.

The surface area of the mitigation reef would be large enough to affect longshore currents, although how much the currents would be affected is not known. Substantial reductions in flows entering the San Mateo Kelp forest and in current velocities within the forest could adversely affect giant kelp and other species in the kelp forest by reducing nutrient uptake and plankton supply. However, effects of currents on kelp forests are complex and poorly understood. Therefore, several professional kelp forest ecologists were interviewed to obtain their opinions regarding the potential effects of reductions in longshore currents on the San Mateo Kelp forest. Most of the ecologists indicated that they considered it unlikely that such reductions would have significant biological effects on the forest (P. Dayton pers. comm.; J. Dixon pers. comm.; D. Reed pers. comm. S. Schroeter pers. comm.; M. Tegner pers. comm.; R. Zimmerman pers. comm.). The most common reason given for this conclusion was as follows: if kelp in the forest interior was adversely affected by reductions in longshore currents, such an effect should be evident in a large kelp forest such as the Point Loma Kelp forest near San Diego, but no evidence of such an effect in the Point Loma Kelp forest has been found. Most of the ecologists felt that effects of a reduction in longshore currents on nutrient uptake and plankton supply would be counteracted by other factors such as cross-shore currents, waves, and increased turbulent mixing.

Potential benefits to the San Mateo kelp reef of the proximity of the mitigation reef would result from the overall increase in kelp forest size. The kelp forest growing on the mitigation reef could ultimately be expected to merge with the San Mateo kelp forest and the two forests would function in some respects as one large kelp forest community. It is likely that an increase in the area of kelp forest would result in increased species diversity. Furthermore, the increased habitat could provide refuge to kelp or other species if their survival in the San Mateo kelp reef was threatened by sea urchin grazing, predation, or disease. The mitigation reef could also serve as a source of new kelp recruitment if the San Mateo kelp community was completely destroyed by a storm or a man-made disaster. In general, the increase in reef size effected by the mitigation reef is expected to benefit existing kelp communities.

Given that the proximity of the mitigation reef to the San Mateo Kelp reef would probably have a minor effect, at most, on nutrient uptake and plankton supply in the San Mateo Kelp forest, and given that the proximity of the reefs would probably ultimately result in benefits related to increased habitat area, the proximity of the reefs is considered to be a less-than-significant impact. However, because of uncertainty regarding potential adverse effects of the mitigation reef on kelp in the San Mateo Kelp forest, mitigation is recommended, as described below.

Mitigation Measures

- None Required. Recommended Mitigation:
- During the experimental reef phase of the project, conduct research to compare growth rates of kelp plants in the perimeter and the interior of a kelp forest. The research shall be conducted in natural kelp forests similar in size and kelp density to the proposed mitigation kelp reef and during periods when nutrient stress of kelp plants would be likely. If the research suggests that the mitigation reef, as currently planned, would adversely affect the San Mateo kelp forest, then the location of the mitigation reef would be shifted north to provide enough separation between the reef and the San Mateo kelp forest to avoid these effects. If the scientific research results indicate that the mitigation reef would have no adverse effect on the San Mateo kelp forest, no further mitigation would be required.

4.6.9.3 Reef Monitoring

The five-year monitoring program for the experimental reef and the longer-term monitoring program for the mitigation reef would consist of side-scan sonar surveys and diver surveys on permanently marked transects and quadrats. The surveys conducted for the experimental reef would be expected to include the monitoring of reference sites in the existing San Mateo and San Onofre kelp forests. Drilling into these reefs would be required to set eyebolts for the permanent transects and quadrats, but the drilling would affect little reef area. The monitoring is considered a less-than-significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

4.6.10 Marine Mammals and Birds

The construction of the experimental and mitigation reefs and the subsequent development of a kelp forest may affect marine mammals and birds in the project vicinity. Potential effects include the disturbance of individuals resulting from construction activities and the conversion of habitat from sand-bottom community to a kelp forest. The level of disturbance and the species that may be affected depend on several factors: (1) the time of year the activities take place; (2) the length of time activities persist; and (3) the type of activity occurring. These effects are discussed below.

4.6.10.1 Reef Construction

- ***Marine Mammals***

The experimental reef and the mitigation reef would be constructed during the period from May 1 to September 30. The experimental reef would be constructed during a single year, while the mitigation reef could require two to four years for construction. The seasonal construction period, May 1 to September 30, is outside of the migratory period for gray whale. The marine mammals that would most likely occur in the area during the construction period are California sea lion, Pacific harbor seal and bottlenose dolphin (Lagomarsino 1997). The lease area may be utilized for foraging by these species, however, the sand-bottom habitat likely does not currently support a substantial prey base.

There are several ways the proposed construction actions could affect marine mammals: collison with water craft, direct injury from falling concrete or quarry rock, injury related to turbidity, and interference with foraging.

Tug boats with barges would transport the materials moving at an average rate of eight knots per hour. At that slow speed, marine mammals within the shipping route would avoid potential collision by moving out of the way of the oncoming barge. The crew vessel that would transport the six-person crew between the derrick barge and Dana Point Harbor would travel at greater speeds, but the risk of collision with marine mammals would still be extremely low. Marine mammals are highly mobile and can avoid boat traffic. Marine mammals in the lease area could also be expected to be habituated to boat traffic, since boating is common in the area.

The mobility of the marine mammals is also important in addressing concern over direct injury from falling concrete or rock, and injury from turbidity. The construction of the experimental reef and the mitigation reef will be localized and limited in extent at any one time. The initiation of construction activities would likely result in a startle response from marine mammals present in the lease area, and they would be expected to avoid the immediate vicinity of the construction. California sea lions and bottlenose dolphins, however, are generally known to be curious and may investigate the activities, but are likely to keep their distance from falling concrete or rock, and turbidity. Pacific harbor seals are more wary in nature and would likely stay well away from the construction site. However, they may return to a site from which they have been frightened once they become accustomed to the noise.

The construction may cause any marine mammals present in the lease area to leave the area during the actual construction activities. There are extensive alternative foraging areas adjacent to the lease area, and the marine mammals can be expected to return to the area upon the completion of the construction.

Therefore, the construction of the experimental reef and the mitigation reef is expected to have less-than-significant impacts upon marine mammals.

Mitigation Measures

- None required.

- ***Marine Birds***

The special-status marine birds most likely to occur in the vicinity of the lease area include black storm-petrel, brown pelican, double-crested cormorant, California gull, elegant tern and, occasionally, California least tern and common loons. All of these species feed on fish and may occasionally utilize the lease area for foraging. No breeding colonies for any of the above listed species exist near the lease area. The construction activities associated with the experimental reef and the mitigation reef may prevent several of the avian species from foraging in the lease area for the duration of construction. In addition, construction activities may scare prey species away from the lease site, so that it would not provide optimal feeding conditions. However, many other foraging areas are available that would provide higher quality habitat for the special-status avian species during construction, and the lease area can be expected to be used by the species after the completion of construction. The disturbance to marine birds is considered a less-than-significant impact for both the experimental reef and the mitigation reef.

Mitigation Measures

- None required.

4.6.10.2 Experimental and Mitigation Reefs

- ***Marine Mammals***

The experimental reef has the potential to create 22.4 acres of kelp forest habitat between San Mateo kelp bed and San Mateo Rocks, while the mitigation reef is expected to create a total of 150 of medium-to-high density kelp forest. Several of the marine mammals that may occur in the project vicinity utilize kelp forest habitat. Pacific harbor seals in particular are known to use kelp forests for foraging and cover. California sea lions and bottlenose dolphins have been observed near kelp forests, although both species tend to prefer pelagic prey. The kelp forest development may increase habitat for some of the prey that dolphins and sea lions would take. Grey whales generally do not forage during their migration, but they have been observed skimming kelp beds for food and utilizing kelp forests for escape cover (Dailey et al. 1993; Foster and Schiel 1985). These areas seem to be particularly important to cow-calf pairs in northern migration during late winter and spring. Accordingly, the presence of a kelp reef would have a beneficial effect upon marine mammals. The presence of the experimental reef in the lease area would likely have benefits that are more limited than the larger mitigation reef. In any event, the presence of the experimental and mitigation reefs would have no adverse effect upon marine mammals.

Mitigation Measures

- None required.

- ***Marine Birds***

The development of 22.4 acres of kelp forest for the experimental reef and a total of 150 acres with the mitigation reef would provide additional foraging and resting habitat for a number of marine birds. Several special-status species present in the vicinity of the lease area are known to depend on the different sub-habitats that a persistent kelp forest can provide. The kelp forest would increase foraging and resting habitat for brown pelican, double-crested cormorant, common loon, California least tern and elegant tern. The kelp wrack that washes up on the beaches near kelp forests provides habitat for many of the prey species preferred by western snowy plover. The kelp forest community provides structural diversity, which promotes increased prey availability and variety for avian species. The development of the experimental reef and mitigation reef would result in a long-term beneficial effect on special-status bird species. The presence of the experimental reef and mitigation reef would have no adverse effect upon marine birds.

Mitigation Measures

- None required.

4.6.10.3 Reef Monitoring

- ***Marine Mammals***

Monitoring activities associated with the experimental reef and mitigation reef have the potential to disturb marine mammals present in the lease area. At this point, the monitoring for the experimental reef is best defined and provides the basis for a reasoned analysis for the mitigation reef as well. Sources of disturbance include the side-scanning sonar surveys and diver surveys, as follows.

A side-scan sonar of the lease area would occur twice each year (February and August) over one to two days. In addition to the side-scan sonar, submerged sonic buoys would be used for the survey to mark the transect lines. Even though there are few published reports studying the impacts of sonar on marine mammals, it is believed that many can hear the sounds emitted from sonar equipment and may be disturbed by the noise (Richardson et al. 1995). Sonar equipment emits a high frequency signal and, therefore, the zone of influence would likely be confined to the lease site. On the one to two days that the sonar equipment would be utilized twice each year for monitoring, marine mammals could avoid the lease site in favor of other areas. The avoidance would not result in a substantial change in migrational or behavioral patterns. The use of a side-scan sonar for monitoring would have a less-than-significant impact on marine mammals.

Monitoring activities involving divers would require one or two small boats transporting four to six divers to the lease site. Various surveys would be implemented in each month of the year and would take from one to eight days to complete each survey. Divers present in the lease area may frighten some marine mammals away from the lease site, however, some species, such as sea lions, seals and dolphins, may approach divers to investigate activities. The boats transporting the divers would have similar impacts as what was described above for the experimental reef construction. The use of divers to monitor the experimental and mitigation reefs would have a less-than-significant impact on marine mammals.

Mitigation Measures

- None required.

- ***Marine Birds***

Most monitoring activities for the experimental reef and mitigation reef would occur below the ocean surface. At most, two boats would be anchored or moving slowly through the lease site during survey work. Monitoring activities may disturb prey species for marine birds but that disturbance would be localized to lease site and avian species could utilize other areas for foraging. The monitoring of the experimental reef and mitigation reef would have a less-than-significant effect on marine birds.

4.6.11 The Beach Community

The proposed experimental and mitigation reefs have the potential to influence coastal sediment processes that could result in indirect impacts to the beach community. There are no construction activities that directly affect the beach areas, nor are there any monitoring-related activities that would take place on the beaches. Therefore, the following impact evaluation addresses the effects that the kelp reefs might have upon coastal sediment processes after they become established in the water column.

- ***Sedimentation Processes***

The experimental and mitigation reefs have the potential to affect waves and currents and thereby affect littoral zone sedimentation processes and beach habitat. The mitigation reef has a greater potential for effects because it would cover about 150 to 300 acres, compared with the 22.4 acres of the experimental reef. The littoral zone is where wave energy results in the transport of coastal sediment, and extends from the beach to a water depth of less than 30 feet in the project vicinity. If waves and currents were altered to such a degree that the project resulted in a substantial change in beach width or sediment volume in the littoral zone, then the project would be considered to have an impact on the beach community. Ewany et al. (1998) reviewed the potential for the experimental and mitigation reefs to affect littoral zone sedimentation process and beach habitat and concluded that there would be no substantial effects. This would be a less-than-significant impact.

Mitigation Measures

- None required.

4.7 Energy and Mineral Resources

4.7 *Energy and Mineral Resources*

CEQA requires that an environmental document evaluate a proposed project for impacts on energy use and conservation and on the use of mineral resources (CEQA Guidelines, Section 15126). This section first describes the existing setting for energy use and conservation, and for mineral resources as they are relevant to the proposed project. This is followed by an examination of potential impacts from the proposed project and the need for any mitigation to reduce significant impacts to a less-than-significant level. The analysis examines the compatibility of the proposed actions with adopted energy conservation plans, the effects of the actions on the use of non-renewable resources and the effects of the actions on the availability of known mineral resources.

4.7.1 Environmental Setting

4.7.1.1 Energy Resources

This discussion is limited to a brief overview of heavy equipment fuel use as part of transportation and construction activities related to the artificial reef. The construction activities include the use of commercial marine transportation, including tugboats and derrick barges with cranes, and other heavy construction equipment, including semi end-dump trucks, crane loaders and front end loaders. All of these are equipped with diesel fuel engines. In California, equipment must use reformulated diesel fuel No. 2, which is produced in compliance with California Air Resources Board's Low Emissions/Clean Fuel Regulations. In recent years, manufacturers of heavy equipment and marine engines have made design changes to engines to increase fuel efficiency and reduce emissions to meet air quality regulations. In the near future, many older less efficient engines may be replaced or rebuilt to meet new stricter standards in continued efforts to improve air quality and reduce fuel use.

4.7.1.2 Mineral Resources

Oil, gas, geothermal and mineral resources between three and twelve miles offshore of California are owned by the federal government and are accessed under lease from the Minerals Management Service (MMS). Alternatively, oil, gas, geothermal and mineral resources that lie within three miles of the shoreline are owned by the State of California and are accessed under lease from the California State Lands Commission (CSLC). The proposed artificial reef site lies within three miles of the shoreline. Therefore, all oil, gas, geothermal and non-fuel mineral resources underlying the project area and in the immediate vicinity are owned by the State of California. These resources as they relate to the proposed project are described further in the following.

- ***Oil, Gas and Geothermal Resources***

Individual well permits and production records for oil, gas and geothermal resources underlying State Lands are administered and maintained by the Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGG). The location of operating and abandoned wells and exploratory coreholes and the boundaries of major oil, gas and geothermal fields underlying and surrounding the project area are depicted on DOGG Reference Maps J and K and on Regional Wildcat Maps W1-4 and W1-7. Neither the Reference Maps nor the Regional Wildcat Maps show any oil, gas, or geothermal wells, exploratory coreholes or fields underlying the project area or in the immediate vicinity, either on shore or off shore.

According to Wildcat Map W1-4, the nearest oil and gas activity in the area occurred on shore, about two miles east and four miles northeast of the City of San Clemente, within and surrounding two small fields referred to as "Cristianitos Creek" and "San Clemente". The Cristianitos Creek Oil Field was abandoned in 1960 after producing a cumulative total of 3,000 barrels of oil (bbl) and 11,000 Mcf (1,000 cubic feet) of gas. The San Clemente Oil field was abandoned in 1955 after producing 1,452 bbl of oil and 446 Mcf of gas. The nearest offshore activity occurred about five miles off of the coast, just south of the Orange/San Diego County border where Mobile drilled and abandoned a dryhole in 1965.

According to Jeff Plank of the CSLC, there has been no historic oil, gas or geothermal activity in the immediate vicinity of the project area and none is expected in the near future (Plank 1997). Furthermore, there are no known oil, gas, or geothermal reservoirs underlying the proposed project site and there are no active or pending leases. This information is consistent with the data contained on the maps and in the records maintained by the DOGG.

- ***Non-fuel Minerals***

Non-fuel minerals include all mineral commodities that are not used to produce energy. In general, the most economically important non-fuel minerals in California include: portland cement, crushed stone, gemstones, sand and gravel, masonry cement, clays, lime, boron minerals, dimension stone, asbestos, gold and silver. Other mineral commodities include diatomite, feldspar, fuller's earth, gypsum, iron ore, kaolin, magnesium compounds, mercury, perlite, potash, pumice, salt, soda ash, sodium sulfate, talc, tungsten and rare earths.

Implementation of the proposed project has the potential to affect non-fuel minerals resources in two ways. First, construction of the reef would involve the use of quarry rock and/or recycled concrete, both of which are considered important mineral resources. The project therefore would diminish, to some extent, the availability of these resources in the region. Second, construction of the reef could bury offshore mineral resources thereby making them unavailable for future use. The remainder of this section focuses on these two issues. Each is discussed separately in the following.

- ***Availability of Quarry Rock in the Region***

As described in the project description of this PEIR, construction of the experimental reef would require 17,640 tons of quarry rock. Alternatively, construction of the 127.6-acre mitigation reef scenario would require 357,280 tons of quarry rock and construction of the 277.6-acre mitigation reef scenario would require 777,280 tons of quarry rock. The rock would be obtained from a quarry located within a 20-mile radius of the Port of San Diego or from one of two quarries located on Catalina Island. The availability and demand for quarry rock in these two regions are discussed in the following subsections.

First, it is important to understand how quarry reserves are described. Quarries are generally categorized as either hard rock deposits or sand and gravel deposits. Typically, sand and gravel is quarried from relatively unconsolidated river deposits. Conversely, hard rock is quarried from consolidated formations comprised of either sedimentary, volcanic or igneous rocks. The material that would be used to construct the artificial reef would be mined from a hard rock quarry located in either San Diego or Los Angeles Counties.

Material mined from hard rock quarries can be used as rip rap or dimension stone. Alternatively, it can be crushed and sorted for use in a variety of construction purposes. The coarse crushed material is usually referred to as ballast and the smaller crushed material is usually referred to as aggregate. Ballast is used for applications such as railroad grades and aggregate is used for road base, trench fill, asphalt and concrete.

Aggregate that is suitable for construction purposes is referred to as Portland Cement Concrete (PCC)-grade aggregate. PCC-grade aggregate is an important resource in California because there is tremendous demand for concrete products and road building materials. This is particularly true in San Diego and Los Angeles Counties where current supplies for high grade aggregate are expected to be depleted by the year 2016. Because of its importance, the California Division of Mines and Geology (DMG) closely tracks the availability and consumption of PCC-grade aggregate resources in the State. The DMG records and evaluates the supply and demand for aggregate by areas referred to as "Production-Consumption (PC) Regions".

San Diego Area Quarries. Quarries within 20 miles of the Port of San Diego lie within an area identified by DMG as the Western San Diego County Production-Consumption (PC) Region, the boundaries of which are identified on Figure 4.7-1. The availability and demand for PCC-grade aggregate in this region are documented in a report prepared by the DMG entitled, *Update of Mineral Land Classification: Aggregate Materials in the Western San Diego County Production-Consumption Region* (1996).

According to the DMG's 1996 report, as of January 1996, 27 mines, 24 of which are active, operated by 16 different mining companies were producing, or permitted to produce, PCC-grade aggregate in western San Diego County. The total permitted PCC-grade aggregate reserves associated with these mines is estimated to be about 352 million tons. In addition, the DMG estimates that the western San Diego PC region contains another 5.7 billion tons of aggregate resources that are not currently permitted. The DMG also identified at least two deposits that lie just outside the San Diego PC region, which can supply significant amounts of aggregate to the western San Diego County area.

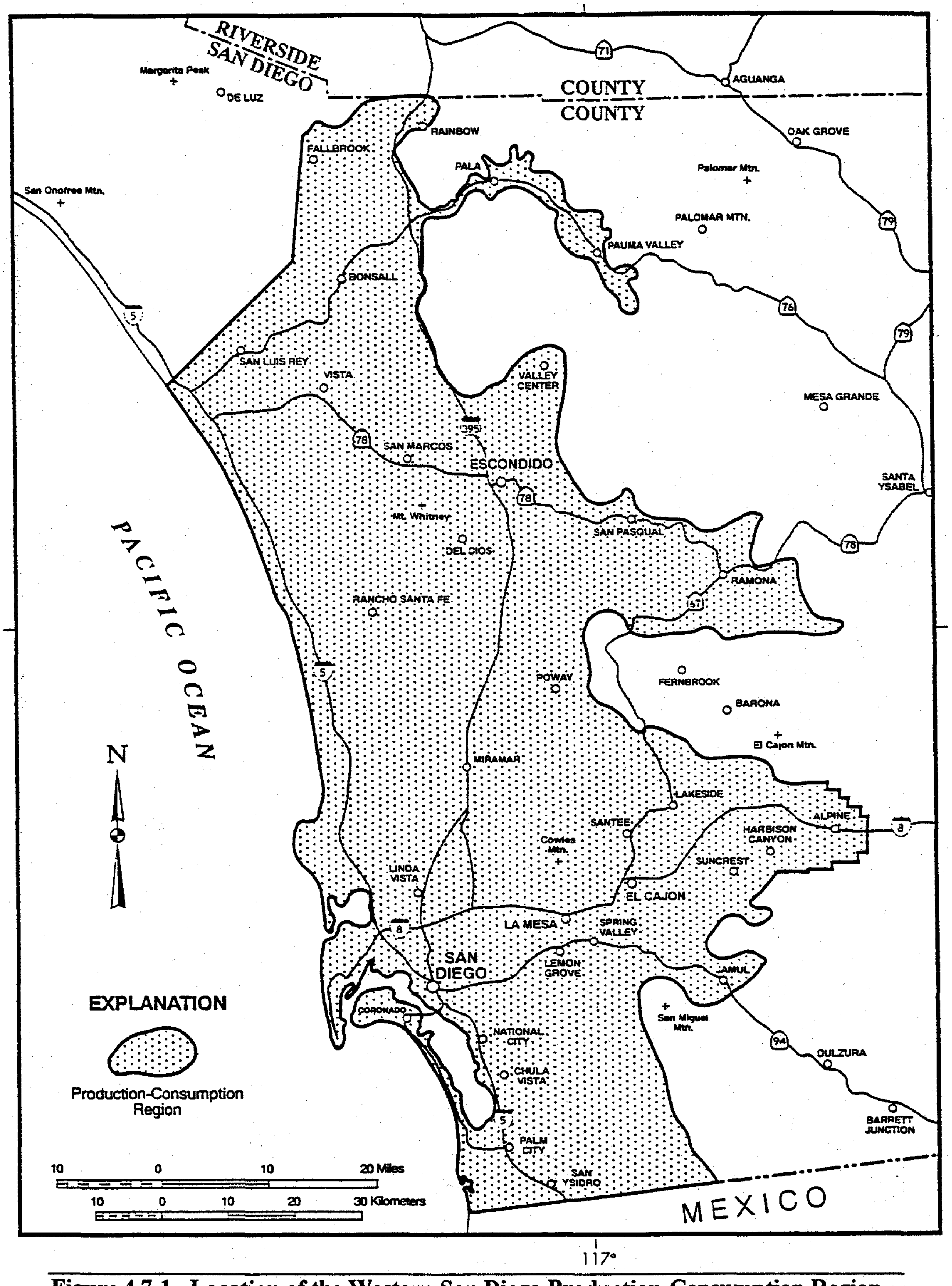

Figure 4.7-1 Location of the Western San Diego Production-Consumption Region

Source: DMG Open Five Report 96-04. 1996.

Table 4.7-1 summarizes 1980 and 1995 data compiled by the DMG on population, aggregate demand, reserves, annual per capita consumption, projected depletion of reserves, resources, number of aggregate mines, number of aggregate companies and the price of aggregate in western San Diego County. As indicated, the annual demand for aggregate is estimated to be about 14 million tons. At the present rate of production, the total PCC-grade reserves of 352 million tons in western San Diego County are projected to last 20 years until the year 2016. According to the U.S. Bureau of Mines aggregate production statistics about 70 percent of the total aggregate consumed in San Diego County was used in PCC. This equates to 735 million tons of PCC-grade aggregate that would be needed within the next 50 years. If all of the PCC-grade aggregate reserves were used exclusively for PCC-grade aggregate, the supply would theoretically last 26 years. In reality, much of the PCC-grade aggregate reserves will be used for other products such as road base and a depletion date of 2016 is more likely (DMG 1996). Exploiting deposits that are currently unpermitted will extend the availability of reserves versus demand. However, it is unlikely that all permitted and unpermitted reserves in the county would be mined due to competing land uses and restrictions related to pending habitat conservation plans.

Los Angeles Area Quarries. Rock for the proposed project could be obtained from one of two quarries located on Catalina Island, the Pebbly Beach Quarry or the Empire Quarry. Both of these quarries are owned and operated by Connolly Pacific Company. Rock from these quarries would be tested prior to use to assure that it meets the specifications outlined in Section 3.4.1 of this PEIR and the Material Specification Guidelines outlined on Table 3-5.

The Pebbly Beach Quarry is located on the southeast end of Catalina Island, at Jewfish Point, south of Avalon. The quarry encompasses about 208 acres of seacliff between Pebbly Beach and Seal Rocks (Connolly Pacific). According to Connolly Pacific's Reclamation Plan, the quarry produces between 250,000 to 1,000,000 tons of rock per year, with total anticipated production expected to be about 70 million tons. Materials from this quarry consist of volcanic breccias and sandstone conglomerates (Connolly Pacific).

The Empire Quarry is located on the northeast end of Catalina Island, near Blue Cavern Point, east of Isthmus Harbor. The Quarry encompasses about 218 acres of chaparral covered seacliff and quarried shoreline. According to Connolly Pacific's Reclamation Plan, the quarry produces between 250,000 to 1,000,000 tons of rock per year, with total anticipated production expected to be about 110 million tons. The material from this quarry consists of volcanic breccias.

Catalina Island lies within Los Angeles County. The DMG has documented the availability and demand for PCC-grade aggregate in Los Angeles County in a report entitled *Update of Mineral Land Classification of Portland Cement Concrete Aggregate in Ventura, Los Angeles and Orange Counties, California* (1994). The mines on Catalina Island do not appear to be included in the DMG's report. However, the information contained in the DMG's report provides perspective on the availability and demand for PCC-grade aggregate within the general region.

Table 4.7-1 Western San Diego County PC Region Aggregate Data

Comparison of:	1980	1995
Population	1,778,469	2,593,562
Calculated Annual Aggregate Demand	11 million tons	14 million tons
Total Permitted Aggregate Reserves	430 million tons	352 million tons
Permitted Instream Sand Reserves	121 million tons	55 million tons
Calculated Annual per Capita Consumption	5.5 tons	5.4 tons
Calculated Years until Depletion	32 years	20 years
Unpermitted Aggregate Resources	5.5 billion tons	5.7 billion tons
PCC Aggregate Mines	48	27 (24 active)
No. of Companies	20	16
Price of Aggregate per Ton	$4.00	$8.00

Source: DMG 1996

For their study, the DMG divided Los Angeles County into five PC regions: San Fernando Valley; San Gabriel Valley; Saugus Newhall; Palmdale; and Claremont-Upland. The estimated unpermitted PCC-grade aggregate resources and aggregate reserves for these five PC regions are summarized in the Table 4.7-2. As indicated, the DMG estimates that Los Angeles County contains approximately 11,179 million tons of PCC-grade resources and 750 million tons of PCC-grade aggregate reserves. Aggregate reserves are those resources that are well documented and permitted.

According to the DMG's report, available production data and population projections indicate that Los Angeles County will need to produce about two billion tons of aggregate during the next 50 years. Of this projected demand, approximately 55 percent, or 1.1 billion tons, must be suitable for use in PCC. Unless new resources are permitted for mining, or alternative resources are utilized, existing reserves may be depleted by the year 2016 (DMG 1994). The DMG's report does not specify the annual demand for aggregate in the combined PC regions. However, the DMG's report indicates that the region will require about 1.1 billion tons of PCC grade aggregate over the next 50 years (through the year 2044). Accordingly, the annual demand for aggregate in the Los Angeles PC region is estimated to be about 22 million tons/year.

- ***Availability of Recycled Concrete in the San Diego Region***

As described in the project description of this PEIR, construction of the experimental reef scenario would require 13,860 tons of recycled concrete. Alternatively, construction of the 127.6-acre mitigation reef scenario would require 280,720 tons of recycled concrete and construction of the 277.6-acre mitigation reef scenario would require 610,720 tons of recycled concrete. The recycled concrete would be obtained from established concrete brokers located within a 20-mile radius of the Port of San Diego or the Port of Los

Angeles. Recycled concrete resources in these two counties are briefly described in the following.

San Diego County. The availability and demand for recycled concrete is not well documented. However, according to the DMG, recycled construction and demolition waste material has become widely used in western San Diego County for class II aggregate base (1996). No figures have been collected for the amount of material recycled, but it is estimated that, at present, less than ten percent of the production of base material is from recycled waste (DMG 1996). Also, there is limited recycling of asphalt paving (RAP) whereby old asphalt is demolished and mixed in small percentages with new asphalt paving at the batch plant (DMG 1996).

Both of these types of recycling operations are important to the supply of PCC-grade aggregate in San Diego County since they reduce the demand on virgin PCC-grade aggregate resources (DMG 1996). When recycled waste is used as base and asphaltic aggregate material, a higher percentage of the virgin material can us used for PCC-grade aggregate applications. This will tend to extend the life of the PCC-grade aggregate resources in the County (DMG 1996).

Table 4.7-2 PCC-grade Aggregate Resources in Los Angeles County in 1994, by PC Region. In Millions of Tons.

Production-Consumption Region	Unpermitted PCC-grade Aggregate Resources	PCC-Grade Aggregate Reserves
San Fernando Valley	259	**
San Gabriel Valley	1,645	334
Saugus-Newhall	7,439	158
Palmdale	1,769	207
Claremont-Upland	67	0
Totals for Los Angeles County	11,179	750+

Source: DMG 1994

Notes: ** Not shown to protect confidential information.

+ Rounded to the nearest 50 million tons to protect confidential information.

Los Angeles County. Recycled construction and demolition waste material has become a significant source of aggregate base material in Los Angeles County (DMG 1994). The DMG estimates, based on conversations with aggregate operators, that as much as 25 percent of the construction aggregate sold in the greater Los Angeles area is produced from recycled material (DMG 1994). Recycled aggregate use is limited to base aggregate; it can not be used to make concrete aggregate. Historically, PCC-grade aggregate resources have been used for base material in southern California because there have been large, high quality aggregate deposits available for mining in most areas (DMG 1994). It has been economic to mine these deposits not only for PCC aggregate, but also for all other grades of aggregate, including base material (DMG 1994). Now that recycled material is supplying a significant amount of base material in Los Angeles County, a higher percentage of the aggregate mined from the virgin aggregate deposits will be used for PCC aggregate. This will extend the life of the PCC-grade aggregate resources in Los Angeles County. (DMG 1994).

- ***Offshore Mineral Resources***

The project site encompasses approximately 356-acres of suitable sand substrate within the 852-acre lease area near the southern end of San Clemente, between San Mateo Point and just north of the San Clemente Pier. Within the site, the proposed experimental reef would occupy about 22.4 total acres scattered throughout the project site; the proposed mitigation reef would ultimately occupy a total of 150 to 300 acres (including the 22.4 acres). Two mineral commodities could potentially occur on the ocean floor, within the 356-acre project site. These include phosphorite and sand and gravel. Each of these resources is briefly discussed in the following.

Phosphorite. Phosphorite occurs on bank tops, shelves and other high areas of the continental borderland. Although not proven, phosphorite is thought to form as colloids from the direct precipitation from sea water in areas of strong upwelling (Emery 1960). About 600-square miles of the seafloor offshore of southern California is believed to be covered by phosphorite. If the average thickness of phosphorite is one inch, the region contains approximately one billion tons of rock, about one-tenth of the phosphate rock reserves of the United States (Emery 1960). The estimated reserve is about 70 times the total 1954 production of the United States, which came mostly from Florida, Tennessee, Idaho and Montana (Emery 1960). If phosphorite exists within the project boundary, it is unlikely that it would be mined given the availability of onshore sources.

Sand and Gravel. Sand and gravel occurs on the ocean floor in enormous quantities. As land-based sand and gravel deposits are depleted and/or lost to competing land uses, offshore sources of sand and gravel are becoming more important. Sand and gravel mined from the ocean floor can be used for the same purposes as sand and gravel mined from land based operations, including construction, road building and specialty purposes. In addition, geologists and engineers agree that offshore sand supplies are the only practical long-term source for the nourishment and restoration of beaches and harbors experiencing erosion (DOBW 1983).

Due to the interest in offshore sand and gravel deposits, the Sedimentary Petrology Laboratory at the University of Southern California, along with the Department of Boating and Waterways (DOBW), the CSLC, the U.S. Army Corps of Engineers, the National Oceanic and Atmospheric Administration and the California State University at Northridge, initiated a sand and gravel study. The study inventoried the sand and gravel deposits along the inner continental shelf from Point Dume at the northwestern extreme of Santa Monica Bay to the international border with Mexico. The study team divided their study area into eight major study segments. One of these study segments, the Dana Point Segment, includes the portion of the continental shelf from Dana Point to San Mateo Point and envelopes the artificial reef lease area.

The purpose of the study was to identify, locate and characterize site-specific borrow areas for sand and gravel on the inner continental shelf of southern California using the following criteria: 1) the deposit must occur in water depths not exceeding approximately 30 meters, the current practical limit for commercial extraction; 2) the deposit must not be covered by more than one meter of fine-grained sediment, which would generate considerable turbidity during extraction; 3) the deposit must represent sedimentary environments capable of yielding considerable sand-and/or gravel-size material with little fine-grained admixture; and 4) the deposit must not be too indurated for dredging operations. The results of the study were published in a report entitled *Report of Potential Offshore Sand and Gravel Resources of the Inner Continental Shelf of Southern California* (DOBW 1983).

The study results indicate that the shelf segment between Dana Point and San Mateo Point does not contain sediment deposits suitable for beach restoration and nourishment. Apparently neither the Holocene sediments nor the underlying Pleistocene formation are suitable for gravel extraction. The Pleistocene material is absent of courser grained sand and gravel and the Holocene sediments are micaceous, silty, very fine-to fine-grained sand. Consequently, mining of sand or gravel from the artificial reef project area is not likely to occur.

4.7.1.3 Applicable Plans and Policies

Statewide policies for fuel use and energy efficiency are developed by the California Energy Commission (CEC) as part of their overall legislative mandate (Division 15 of the California Public Resources Code, Section 25000 et al). The CEC prepares a biennial fuels policy report as part of this mandate. The latest document is the *1997 Fuels (Policy) Report,* which includes policies for transportation fuel use and conservation.

4.7.2 Impacts and Mitigation Measures

4.7.2.1 Methodology

- ***Energy Resources***

The evaluation of energy use for the experimental and mitigation reefs project is limited to fuel consumption during construction activities. This is based on an estimate of the construction fuel use for the probable worst-case scenario described in Chapter 3. Project Description, and on assumptions made about equipment fuel consumption in the Section 4.4 Air Quality, of this chapter.

- ***Mineral Resources***

The CEQA checklist indicates that mineral resources should be examined with respect to the following question: *Would the proposal result in the loss of availability of a known mineral resource that would be of future value to the region and the residents of the State?* Accordingly, the impact analysis conducted for this PEIR focuses on evaluating whether implementation of any phase of the proposed project would reduce the availability of mineral resources. The analysis was conducted by first reviewing existing information on the occurrence, availability, and demand for mineral resources in the region. Annual consumption of material needed for this project was then compared against the existing supply and demand in the region.

4.7.2.2 Significance Criteria

The significance criteria for impacts related to energy and minerals resulting from the proposed project are based on guidance from the CEQA Guidelines, Section 15126 and Appendix G: *"A project will normally have a significant effect on the environment if it will: (n) encourage activities which result in the use of large amounts of fuel, water or, energy; and (o) use fuel, water, or energy in a wasteful manner."* Specific significance criteria used in this evaluation are discussed in the following.

- ***Energy Use and Conservation***

For the purposes of this PEIR, a significant impact is defined as the inefficient and wasteful use of fuel during the construction activities of the SONGS artificial reef project.

- ***Mineral Resources***

Oil, Gas and Geothermal Resources. The construction of an artificial reef offshore could render oil, gas and geothermal resources underlying the project site inaccessible to exploration and development. For the purposes of this PEIR, creating a situation where oil, gas and geothermal resources can not be accessed or developed is considered a significant impact.

However, there are no active or abandoned oil, gas, or geothermal wells or fields underlying the proposed reef site or in the immediate area. Furthermore, there are no active or pending State leases. Upon issuing a permit to construct the reef, the CSLC would retain their rights to all oil, gas and geothermal resources beneath the site. In the event oil, gas, or geothermal resources are discovered beneath the site in the future, the site is small enough that any potential reserves underlying the site could be accessed by nearby wells or using directional drilling techniques.

Non-fuel Minerals. Implementation of the proposed project has the potential to affect non-fuel mineral resources. First, construction of the reef would involve the use of quarry rock, an important mineral resource. The project would diminish, to some extent, the availability of quarry rock in the region. As indicated earlier in this chapter, both San Diego and Los Angeles Counties contain relatively large amounts of PCC-grade aggregate resources. However, the DMG estimates that the existing reserves in these two regions could be depleted by the year 2016. Given the importance of PCC-grade aggregate to the region and the fact that this resource could be depleted in 20 years, reducing the annual supply of PCC-grade aggregate in either San Diego or Los Angeles Counties by five percent is considered a significant impact. Currently, there are no State standards dictating the rate at which aggregate resources can be consumed. Therefore, the five percent criteria was set for comparison purposes. This threshold is considered conservative and allows for error in the accounting of aggregate production and consumption.

Second, construction of the reef would involve the use of recycled concrete obtained from sources in San Diego and Los Angeles Counties. Recycled concrete is an important resource in these counties because it can be used in place of quarry materials for non-PCC applications. The use of recycled concrete in place of non-PCC applications could extend the life of current aggregate reserves in the San Diego and Los Angeles regions. There are no firm numbers on the availability or demand for recycled concrete. Therefore, the analysis in this PEIR treats recycled concrete as if it were quarry material. Consequently, the same significance criterion was applied. That is, reducing the annual supply of recycled concrete relative to the annual demand for PCC-grade aggregate by five percent is considered a significant impact. This criterion is appropriate because recycled concrete can be used in place of aggregate reserves.

Finally, construction of the reef could bury offshore mineral resources thereby making them unavailable for future use. For the purposes of this PEIR, creating a situation where non-fuel mineral resources can not be accessed or developed is considered a significant impact. Two mineral commodities, phosphorite and sand and gravel could occur within the proposed project site. However, neither commodity is expected to occur in quantities that would be feasible or economic to mine. As such, construction of the experimental reef or the mitigation reef would not reduce the availability of either phosphate or sand and gravel. Therefore, implementation of the proposed project, in any phase, would have no effect on offshore mineral resources and need not be discussed further.

4.7.2.3 Energy Use and Conservation

- ***Experimental Reef Construction***

Fuel use related to the experimental reef includes construction activities in the loading, transportation, and placement of quarry rock and recycled concrete material. Reformulated diesel fuel No. 2 would be used by all of the heavy equipment described in the project description. It would take approximately 32 days to complete the placement of rock and concrete reef material. This includes 1,432 truck trips and 16 barge loads and tugboat trips. It is estimated that for all the equipment involved approximately 1,243 gallons of diesel fuel would be used per day on average for the reef construction activities. This makes the total fuel consumption for the experimental reef approximately 39,781 gallons over the 32 days. If quarry rock were obtained at Catalina Island, this would reduce the overall fuel use by 6,444 gallons.

Contractors would organize the construction activities to make the most efficient use of time, equipment and materials. This would also result in efficient fuel use. Fuel use associated with construction of the experimental reef is very small relative to fuel use in the region and California. This would not result in any inefficient or wasteful use of resources and is considered a less-than-significant impact.

Mitigation Measure

- None required.

- ***Experimental Reef Monitoring***

The experimental reef monitoring program involves the use of outboard motorboats (using gasoline) for 20 to 30 trips per year from Dana Point Harbor to the project site (approximately 30 to 40 miles round trip) to conduct side sonar and diver surveys through out the five year period. This represents a very small use of fuel and is considered a less-than-significant impact.

Mitigation Measure

- None required.

- ***Mitigation Reef Construction***

Fuel use related to the construction of the full mitigation reef includes the loading, transportation and placement of quarry rock and/or recycled concrete material. Reformulated diesel fuel No. 2 would be used by all heavy equipment described in the project description. It is estimated that for all the equipment involved approximately 2,177 gallons of diesel fuel would be used per day on average for the reef construction activities with the placement of one barge load of material each work day. It is assumed that the mitigation reef would be constructed with either all concrete or all rock at 67 percent coverage and would be a minimum of 127.6 acres in size and up to 277.6 acres. Table 4.7-3 shows the fuel use for each of the build out scenarios. Construction of the mitigation reef with quarry rock would require approximately 1.3 times the amount of fuel use as that with recycled concrete. If the rock were purchased at Catalina Island there would be a minimal amount of trucking involved and fuel use would be reduced by about 30 percent.

The maximum mitigation reef build out of 277.6 acres with all rock would use approximately 846,853 gallons of diesel fuel, over a four year period. This represents a relatively small amount of diesel fuel use within the region and California. The use of concrete would conserve more fuel and would be preferred if the experimental reef shows concrete can meet the SONGS Permit performance standards. Contractors would organize the construction activities to make the most efficient use of time, equipment, and materials. This would also reduce fuel use and air emissions. The proposed project would not result in an inefficient or wasteful use of resources and is considered a less-than-significant impact.

Table 4.7-3 Construction Fuel Use
(Gallons of Diesel Fuel)

	Experimental Reef	Mitigation Reef (67% Coverage)	
	(22.4 Acres)	(127.6 Acres)	(277.6 Acres)
Rock/Concrete	39,781		
All Rock		385,280	846,853
All Concrete		306,957	666,162

Note: Includes all truck loading, hauling and unloading, tugboat/barge shipping and offloading with derrick barge, crane and attending tugboat.

Mitigation Measure

- None Required

- ***Mitigation Reef Monitoring***

The full mitigation reef would be monitored at least annually involving boat trips for surveys over a period equivalent to the life of SONGS. However, the use of fuel for this would be very minimal and is considered a less-than-significant impact.

Mitigation Measure

- None required.

4.7.2.4 Oil, Gas and Geothermal Resources

There are no active or abandoned oil, gas, or geothermal wells or fields underlying the proposed reef site or in the immediate area. Furthermore, there are no active or pending State leases. Upon issuing a permit to construct the reef, the CSLC would retain their rights to all oil, gas and geothermal resources beneath the site. In the event oil, gas or geothermal resources are discovered beneath the site in the future, the site is small enough that any potential reserves underlying the site could be accessed by nearby wells or using directional drilling techniques. Consequently, implementation of any phase of the proposed project is not expected to adversely affect the availability of oil, gas, or geothermal resources and no mitigation is required.

4.7.2.5 Non-Fuel Minerals

- ***Availability of Quarry Rock in the San Diego and Los Angeles County Regions***

- ***Experimental Reef Construction***

The experimental reef would require about 17,640 tons of quarry rock. The rock would be utilized during one year and would be obtained from western San Diego County or from one of two mines on Catalina Island, in Los Angeles County. The DMG estimates the total available reserves of PCC-grade aggregate in the western San Diego PC region to be about 352 million tons. The total available reserves of PCC-grade aggregate in the combined Los Angeles County PC regions are estimated to be about 750 million tons. Consequently, the amount of quarry rock required to construct the experimental reef represents about .005 percent of San Diego County's available aggregate reserves and about .002 percent of Los Angeles County's reserves. Annual consumption in the San Diego and Los Angeles regions is estimated to be about 14 million tons and 22 million tons, respectively. Therefore, the 17,640 tons of material that would be utilized for the experimental reef represents about 0.13 percent of the annual consumption in San Diego County and about 0.08 percent of the annual estimated consumption in Los Angeles county.

PCC-grade aggregate reserves in San Diego and Los Angeles Counties are expected to be depleted by the year 2016. Using quarry rock to construct the experimental reef could exacerbate this condition. However, the amount of material needed to construct the experimental reef is negligible compared to the amount of material available in the region. Furthermore, the amount of material needed annually does not exceed five percent of the annual demand for PCC-grade aggregate in either Los Angeles or San Diego Counties. As such, use of quarry rock for the experimental reef would have a less-than-significant impact on the availability of quarry rock in the region.

Mitigation Measures

- None required.

- ***Mitigation Reef Construction***

The mitigation reef scenarios would include a minimum of 127.6 acres and up to a maximum of 277.6 acres of additional reef construction. The 127.6 acres would require about 357,280 tons of quarry rock. Construction would occur during 177 days spread over two years. The 277.6 acres would require 777,280 tons and construction for this scenario would require 389 days spread out over four years. The quarry rock would be obtained from western San Diego County or from one of two mines on Catalina Island, in Los Angeles County. The DMG estimates the total available reserves of PCC-grade aggregate in the western San Diego PC region to about 352 million tons. The total available reserves of PCC-grade aggregate in the combined Los Angeles County PC regions are estimated to be about 750 million tons.

Consequently, the amount of quarry rock required to construct the 127.6-acre mitigation reef represents about 0.1 percent of San Diego County's available aggregate reserves and about 0.05 percent of Los Angeles County's reserves. Annual consumption in the San Diego and Los Angeles regions is estimated to be about 14 million tons and 22 million tons, respectively. Construction of the reef would require about 178,640 tons of quarry rock a year (over two years), or about 1.3 percent of the total demand in the San Diego region and 0.8 percent of the total annual demand in the Los Angeles region.

The amount of quarry rock required to construct the 277.6-acre mitigation reef represents about 0.2 percent of San Diego County's available aggregate reserves and about 0.1 percent of Los Angeles County's reserves. Annual consumption in the San Diego and Los Angeles regions is estimated to be about 14 million tons and 22 million tons, respectively. Construction of the reef would require about 194,320 (over four years) tons of quarry rock a year, or about 1.4 percent of the total demand in the San Diego region and 0.9 percent of the total annual demand in the Los Angeles region.

The DMG estimates that the total available reserves in both regions would be depleted by the year 2016. Using quarry rock to construct the mitigation reef could exacerbate this condition. However, the amount of material needed to construct the mitigation reef is small compared to amount of material available in the region. Furthermore, the amount of material needed annually does not exceed five percent of the annual demand for PCC-grade aggregate in either Los Angeles or San Diego Counties. As such, use of quarry rock for the mitigation reef would have a less-than-significant impact on the availability of quarry rock in the region.

Mitigation Measures

- None required.

- ***Availability of Recycled Concrete in the San Diego and Los Angeles Regions***

- ***Experimental Reef Construction***

The experimental reef would require about 13,860 tons of recycled concrete. The recycled concrete would be obtained from established recycled concrete brokers within 20 miles of the Port of San Diego or the Port of Los Angeles. There are no firm numbers on the availability or demand for recycled concrete. However, the DMG considers concrete recycling operations important to the supply of PCC-grade aggregate in the San Diego and Los Angeles regions because the production of aggregate from recycled sources reduces the demand on virgin PCC-grade sources. Existing available reserves of PCC-grade aggregate in San Diego and Los Angeles Counties are expected to be depleted by the year 2016. The use of recycled concrete for non-PCC applications could extend the life of existing reserves.

The relatively small amount of recycled concrete needed to construct the experimental reef is not expected to substantially effect the availability of recycled concrete in the region. If the 13,860 tons of recycled concrete were PCC-grade aggregate, it would represent about 0.004 of the total available reserves in San Diego County and about less than .002 percent of the total available resources in Los Angeles County. In addition, the use of recycled concrete for the experimental reef would not exceed five percent of the total annual consumption of aggregate in either San Diego or Los Angeles Counties. As such, use of recycled concrete for the experimental reef would have a less-than-significant impact on the availability of recycled concrete and/or aggregate in the region.

Mitigation Measures

- None required.

- ***Mitigation Reef Construction***

Construction of the 127.6-acre mitigation reef would require about 280,720 tons of recycled concrete. The reef would be constructed during 141 days over a two year period. The 277.6-acre mitigation reef would require about 610,720 tons of recycled concrete. The reef would be constructed during 306 days spread out over three years. Consequently, the mitigation reef would require about 140,360 tons of recycled concrete annually for the 127.6-acre reef and 203,573 tons of concrete annually for the 277.6-acre reef.

The relatively small amount of recycled concrete needed to construct the mitigation reef is not expected to substantially affect the availability of recycled concrete in the region. If the 280,720 tons of recycled concrete for the 127.6-acre reef were substituted with quarry rock it would represent about .08 percent of the total available PCC-grade aggregate available in the San Diego County and about .04 percent of the PCC-grade aggregate available in the Los Angeles region. In addition, using recycled concrete at a rate of 140,360 tons per year would not exceed five percent of the total annual consumption of aggregate in San Diego or Los Angeles Counties. Likewise, if the 610,720 tons of recycled concrete for the 277.6-acre mitigation reef were substituted with quarry rock it would represent about 0.2 percent of the total available PCC-grade aggregate available in the San Diego County and about .08 percent of the PCC-grade aggregate available in the Los Angeles region. In addition, using recycled concrete at a rate of 203,573 tons per year would not exceed five percent of the total annual consumption of aggregate in San Diego or Los Angeles Counties. The use of recycled concrete for the mitigation reef would have a less-than-significant impact on the availability of recycled concrete and/or aggregate in the region.

Mitigation Measures

- None required.

4.8 Hazards

4.8 Hazards

This chapter describes the existing conditions and applicable regulations and plans for hazardous materials use, emergency response plans, and health hazards in the vicinity of the lease area. Impacts are analyzed by applying the regulatory and planning constraints to construction activities. The impact analysis includes consideration of the issues identified within the CEQA Guidelines, Environmental Checklist Form, which lists the following potential concerns relating to hazards: "Would the proposal involve: a risk of accidental explosion or release of hazardous substances (including but not limited to: oil, pesticides, chemicals, or radiation), possible interference with an emergency response plan or emergency evacuation plan, the creation of any health hazards or potential health hazards, the exposure of people to existing sources of potential health hazards, or increased fire hazards in areas with flammable brush, grass, or trees?" (CEQA Guidelines 1997). Since the project area is located in a marine environment, the potential concern of increased fire hazard included on the CEQA checklist does not apply and therefore will not be further considered. The following is a discussion of those impact areas pertinent to the proposed project.

4.8.1 Environmental Setting

4.8.1.1 Hazardous Materials

Hazardous materials include all flammable, reactive, corrosive, or toxic substances that, when put in contact with the environment, can adversely affect living organisms. Implementation of the proposed project would involve the transportation of recycled concrete and quarry rock to the project site located approximately 0.6 mile off the coast of San Clemente. The quarry rock would be obtained from an existing quarry in the San Diego area or from Catalina Island. The recycled concrete would be obtained from established brokers located within 20 miles of the Ports of Los Angeles/Long Beach, or the Port of San Diego. Recycled concrete obtained for the project would be free of contaminants and would meet California Department of Fish and Game (CDFG) cleanliness requirements. The concrete and quarry rock would be transported by truck to barges that would carry the materials to the project site. These barges and trucks would have a primary fuel tank to run the engine and typically would have additional fuel stored on board.

The health of workers and the general public are potentially at risk of exposure whenever hazardous materials are used. It is necessary to differentiate between the "hazards" of these materials and the "risk" they pose to human health and the environment. A hazard is any situation that has the potential to cause damage to human health and the environment. The risk to human health and the environment is determined by the probability of exposure to hazardous material and the severity of harm such exposure would pose.

State and local agencies with hazardous material responsibilities for the project vicinity include the United States Coast Guard (USCG), the CDFG, Los Angeles County, the City of Long Beach, the City of San Diego, Orange County and the City of San Clemente. Applicable regulations include the Federal Water Pollution Control Act (section 311[c][2]), the Shipboard Oil Pollution Emergency Procedure, and the Federal Water Pollution Control Act. Project related activities, such as construction operations and the transportation of project materials, involved in the construction and monitoring of both the experimental and mitigation reef must comply with the State and local agency regulations and guidelines.

4.8.1.2 Emergency Response/Evacuation Plans

The agencies responsible for emergency response and evacuation plans in the project vicinity are the USCG, the Orange County Fire Authority, the Orange County Sheriff's Harbor Patrol Office, and the Marine Safety Division. The Orange County Fire Authority responds to hazardous material spills. See Section 4.10, Public Services and Utilities, for additional discussion on emergency response services.

4.8.1.3 Applicable Plans and Policies

The *City of San Clemente General Plan* sets goals and standards for the management of the City's marine safety. Through its General Plan, the City seeks to provide and maintain a safe and healthy beach for the enjoyable utilization of marine environments; provide adequate marine safety and medical aid services, provide a clean and enjoyable marine environment that sufficiently meets the needs of beach users; maintain and enhance the City's beaches and marine resources; and maintain a healthy coastline, preventing degradation of the community's visual and environmental resources (City of San Clemente 1993a). The goals and standards for the management of the City's emergency response are to continue coordinating and providing emergency response for spills, illegal dumping, and other incidents involving hazardous materials and wastes through the San Clemente Fire Department and/or other appropriate public agencies (City of San Clemente 1993a).

4.8.2 Impacts and Mitigation Measures

The following discusses the potential for releases of hazardous materials, interference with emergency response plans, and exposure of people to potential health hazards.

4.8.2.1 Methodology

Information about the project-related use of hazardous materials, spill prevention plans, and emergency response plans were obtained through review of State and local policy and interviews with local authorities. In addition, tug and barge operators were interviewed. The impacts of the project were determined by comparing regulatory constraints with the changes resulting from project activities.

4.8.2.2 Significance Criteria

The criteria used to determine whether identified impacts are significant and adverse were developed through a review of the CEQA Guidelines, Environmental Checklist Form. For the purpose of this analysis, an action would have a significant effect if it would result in: 1) a risk of accidental explosion or release of hazardous substances (including, but not limited to: oil, pesticides, chemicals or radiation); 2) possible interference with an emergency response plan or emergency evacuation plan; 3) the creation of any health hazards or potential health hazards; or 4) exposure of people to existing sources of potential health hazards.

4.8.2.3 Release of Hazardous Materials

- ***Reef Construction***

The construction of the experimental and mitigation reefs requires the use of watercraft, vehicles, and equipment powered by diesel fuel and lubricated by oil, and other mechanical fluids, which are considered hazardous substances. Accidents involving these craft, vehicles, and equipment would have the potential to adversely affect the environment through the release of these hazardous substances.

The safe operation of the watercraft, vehicles, and equipment is necessary to limit the potential for an accident to occur. This requires licensed, trained personnel, and the adoption of a regular, comprehensive maintenance program. Beyond safe operation, there are several factors that reduce the potential effect of a spill, if one were to occur.

First, all construction watercraft, vehicles, and equipment would carry supplies of fuel and other mechanical fluids only in the quantities needed for their operation. None of the craft, vehicles, or equipment would transport such substances in quantities in excess of their operating requirements. Second, all of the ocean going vessels used would maintain emergency response plans, equipment and supplies for implementation in the event of a spill, in compliance with State and federal regulations. Finally, the USCG and local emergency agencies have response plans and regulatory programs in place to contain and clean up potential fuel spills. Therefore, this is a less-than-significant impact.

Mitigation Measures

- None required.

- ***Experimental and Mitigation Reefs***

Recycled concrete used for the experimental reef and mitigation reef would be obtained from sources that meet Material Specification Guidelines set by the CDFG (see Table 3-5 in Chapter 3. Project Description). No hazardous substances would be expected to be released during the construction of the reefs nor from the concrete if it should decompose after placement. Therefore, this is a less-than-significant impact.

Mitigation Measures

- None required.

- ***Reef Monitoring***

The monitoring of the experimental reef and mitigation reef would involve the use of small motor boats to travel to and from the project site. The CCC will contract with the University of California or another similar type of operator to provide boats and diving equipment. These would be licensed operators and all equipment would be in compliance with regulatory requirements. The motorboats would have most likely have sealed outboard motors carrying about 40 gallons of refined gasoline. If small amounts of fuel were to leak into the water, it would be in minimal amounts and would disperse quickly. This does present a low risk of exposure to the public. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.8.2.4 Interference with Emergency Response/Evacuation Plans

- ***Experimental and Mitigation Reef Construction, Presence and Monitoring***

The proposed project would not interfere with implementation of emergency response plans or emergency evacuation plans in the project area. Therefore, there would be no impact. A further discussion of emergency response services is found in Section 4.10, Public Services and Utilities.

4.8.2.5 Health Hazards

The experimental reef and mitigation reef may have an impact on hazards by the presence of artificial reef materials offshore of San Clemente. The experimental reef has the potential to introduce quarry rock and concrete onto the beaches or into the surf zone nearest to the lease site. Kelp plants attached to rock or concrete would increase the buoyancy of the reef material and possible movement during large storm events. The rock or concrete could present a hazard to beach users. Large wave events have been observed to lift and move entire boulders with kelp plants attached at least several hundred feet, including onto the beach (Dailey et al. 1993). Observations on local beaches from a 1941 study showed that pebbles and small rocks have been washed ashore under these conditions (Emery and Tschudy 1941; Elwany et al. 1998). However, in this study the largest rocks observed onshore with kelp holdfasts attached weighed just 13 pounds.

According to Elwany et al. (1998), the transport of concrete or quarry rock from the lease area to the beach or surf zone would be unlikely. This conclusion appears to be supported by the personal experience of the Mission Beach Maintenance Manager, who has not found any artificial reef material along the beaches adjacent to the CDFG Mission Beach artificial reef, constructed of recycled concrete (Simmons 1998). In concept, however, large wave events could result in the transport of some kelp and reef material onshore and into the surf zone. Furthermore, the City of San Clemente has experienced problems periodically with large rocks washing onshore or into the shallow surf after major storm events (Hughes 1997a).

Concrete and quarry rocks are not natural components of the beach environment, and the presence of concrete pieces on the shoreline would potentially affect the safety of the beach environment. People walking on the beach could be injured by an unexpected blocks of concrete or rock. People wading, swimming, or surfing could be injured and become incapacitated in the water, leading to drowning. This is considered a significant impact.

Mitigation Measures

- Both the experimental reef and the mitigation reef will be monitored for the movement of construction material during storm events. The monitoring will be on a biweekly basis from the months of November through March and monthly during the rest of the year, consistent with the program outlined in the mitigation measures found in Section 4.10.2.4 of this chapter. Any recycled concrete or quarry rock from the experimental or mitigation reefs, which is found on the beaches or shallow surf, would be removed by the project proponent.

4.9 Noise

4.9 Noise

This section provides an analysis of the project-related noise effects, focusing upon the issues raised in the CEQA Guidelines, Environmental Checklist Form. The analysis includes: 1) a description of the existing noise environment; 2) an evaluation as to whether the project would increase existing noise levels or expose people to severe noise levels; 3) a determination of the significance of any identified effects; and 4) recommendations for mitigation for any identified significant adverse impacts.

The analysis is relatively concise since the noise relating to the use of construction vessels, trucks, and equipment is well understood, and is subject to existing, comprehensive noise control standards, regulations, and requirements that protect both local residents and project construction workers.

In general, the construction of the project has the potential to generate substantial noise, which could increase existing noise levels and cause construction workers and others to be exposed to severe noise levels. Construction noise would be generated by the use of: 1) equipment to load trucks; 2) trucks to transport concrete and rock to the port; 3) equipment to unload the trucks and to load the material onto barges; 4) tugboats to transport the barges to the lease area; and 5) equipment to unload and place material.

A limited amount of post-construction noise would occur during monitoring activities, with the use of small motor boats for divers and monitoring equipment. Noise produced by motor boats at the lease site would be minimal and consistent with current boating use in the area, and is not considered further in this analysis.

4.9.1 Environmental Setting

4.9.1.1 Existing Ambient Noise Levels

Noise levels within the project lease area are high because of the nearby, onshore traffic noise and passing trains. The average daily ambient noise levels in the lease area are estimated at Community Noise Equivalent Level (CNEL) values of between 60 and 63 dBA, based on the distance of the area from the existing onshore sources of noise.

Onshore, the average CNEL value is 65 dBA for the general San Clemente coastal area (the areas between the surf line and Interstate 5). The majority of development in this area is residential with some commercial. Vehicle traffic on Interstate 5 (I-5) is the most important local source of noise. Existing data shows a 70 dBA noise contour 900 feet away from the highway. Passing AMTRAK trains cause strong noise level peaks of 80 to 90 dBA immediately adjacent to the railroad right-of-way. In addition, the sound produced by the ocean surf contributes to the measured noise levels of the coastal zone. The sound of the ocean surf can vary depending on the tides and weather conditions. At a point 50 feet from the surf line, gentle lapping waves would produce about 20 dBA, while huge waves and surf would produce about 55 dBA. The nominal level is approximately 40 dBA under average weather conditions. When I-5 and railroad traffic are absent, the noise levels along the coastal area are dominated by the sounds of the ocean surf.

The rock quarry and docks at Catalina Island are developed industrial facilities that are currently operated under the regulatory oversight of the County of Los Angeles, including the County's noise control ordinances. In general, the median noise level in the vicinity of the quarry is expected to be about 45 dBA when equipment is not being operated. When equipment is being operated, the median noise levels would be expected to increase to levels of about 50 to 60 dBA.

The onshore concrete brokerages and rock quarries are developed facilities that are currently being operated within appropriate industrial zoning, and in compliance with the San Diego or Los Angeles County noise control ordinances. The industrial land uses in the ports are generally characterized by CNEL values between 60 and 70 dBA. The median nighttime noise levels in these areas are generally about 50 to 60 dBA.

The project trucks would follow truck routes to and from their respective ports. Along these arterial roadways, the CNEL levels generally range between 60 and 70 dBA.

4.9.1.2 Applicable Plans, Policies and Regulations

Noise levels in California are regulated through State, county, and municipal standards and regulations. California has required each local government to perform noise studies and implement a noise element as part of their general plan. California Administrative Code, Title 4, has guidelines for evaluating the compatibility of various land uses as a function of community noise exposure. In addition, Occupational Health and Safety Administration (OSHA) has regulations to protect the hearing of workers from excessive noise levels.

The City of San Clemente has a noise ordinance to implement requirements in the General Plan Noise Element. The Community Development Director has responsibility for enforcing the ordinance. Specific activities have been identified as capable of producing loud noise and are prohibited. In addition, criteria are given for determining when exterior or interior noise increments from these or any other activities will result in prohibited noise levels. The tolerances are defined in terms of noise increments over a specified duration.

The most restrictive land use in the City of San Clemente is residential. Noise levels in exterior spaces are not to exceed 55 dBA between 7 a.m. and 10 p.m. and 50 dBA during nighttime hours. Higher average noise levels are allowed in commercial areas, however, there are no commercial areas along the shore opposite the project site. The residential areas between the surf line and I-5 currently exceed the residential noise criteria because of significant noise from the Interstate. Construction is limited to the daytime hours between 7 a.m. and 6 p.m., Monday through Saturday. Noise levels during construction may not exceed 70 dBA at the property line.

Orange County also has an ordinance that establishes legal limits for noise within the county boundaries. The noise control ordinance includes community noise criteria and places specific limits on construction noise. According to the ordinance, the exterior noise standard for residential areas is 55 dBA during daytime hours (7 a.m. to 10 p.m.), the same as in the City of San Clemente noise ordinance.

Los Angeles County has adopted ordinances to control noise and vibration. They are administered by the County's Hazardous Materials group in the Department of Health Services (DHS). The County noise control ordinance includes community noise criteria and places specific limits on construction noise. According to the ordinance, the exterior noise standard for residential areas is 50 dBA during daytime (7 a.m. to 10 p.m.) and 45 dBA during nighttime (10 p.m. to 7 a.m.) hours. Intrusive noises are prohibited from causing the exterior noise levels measured at the affected property to exceed the noise level standards or the median noise level, whichever is highest, for a cumulative period of more than 30 minutes in any hour. For shorter time durations, higher noise level increments are allowed.

Construction activities are prohibited by Los Angeles County ordinance from creating a noise disturbance across any residential or commercial property line during the weekday hours of 7 p.m. to 7 a.m., or at any time on Sunday. The ordinance also specifies the maximum noise levels that may not be exceeded at affected buildings. For mobile equipment operating intermittently and for less than ten days, the maximum noise level at single-family residential structures is 75 dBA during weekdays (excluding legal holidays) from 7 a.m. to 8 p.m. and 60 dBA daily including Sundays and holidays from 8 p.m. to 7 a.m. At multifamily residences, the 7 a.m. to 8 p.m. and 8 p.m. to 7 a.m. maximum noise levels are 80 and 64 dBA, respectively. For stationary equipment operating repetitively and for ten days or more, the maximum noise levels at single-family residences may not exceed 60 dBA daily (except Sundays and legal holidays) from 7 a.m. to 8 p.m. and 50 dBA daily from 8 p.m. to 7 a.m. At multi-family residences, the maximum noise levels for the 7 a.m. to 8 p.m. and 8 p.m. to 7 a.m. periods are 65 and 55 dBA, respectively.

Both San Diego County and the City of San Diego have noise ordinances that prescribe noise regulations for a wide variety of noise sources. Both ordinances set an the exterior noise standard for residential areas of 50 dBA during daytime (7 a.m. to 7 p.m.), 45 dBA during the evening (7 p.m. to 10 p.m.), and 40 dBA during nighttime (10 p.m. to 7 a.m.) hours. San Diego County's ordinance provides allowances for sounds lasting less than an hour. An additional 3 dBA is allowed for up to one-half hour per hour, while an additional 15 dBA is allowed for up to two minutes per hour.

The County of San Diego's noise ordinance set commercial noise standards of 60 dBA during the day (7 a.m. to 7 p.m.), 55 dBA during the evening (7 p.m. to 10 p.m.), and 55 dBA during the night (10 p.m. to 7 a.m.). The City sets these same standards five dBA higher for each time period. The County sets the an industrial noise standard of 75 dBA at anytime. The City sets the same standard for some industrial uses, but has a 70 dBA standard for light industrial uses.

4.9.2 Impacts and Mitigation

4.9.2.1 Methodology

The analysis relied on existing information regarding noise levels for construction equipment. The collection of new noise data was not necessary to characterize the existing noise conditions. In several instances, ambient noise levels were estimated from data in EPA (1971), correlating land uses with ranges in environmental noise. Published studies containing noise data for similar areas were also reviewed for the analysis. The ambient noise levels for sites with nearby traffic were estimated on the basis of the traffic levels and terrain.

The type of noise source, relative distance between source and receptor, and terrain characteristics have a strong bearing on the effective noise level at a sensitive receptor. Noise levels typically decrease by at least three decibels with each doubling of distance from a noise "line source," such as a roadway, and by six decibels or more when the source is highly localized. Irregularly shaped surfaces or those with sound absorbing surfaces (e.g. vegetation) will result in an increased noise attenuation with distance. Terrain can act as a barrier between a noise source and a sensitive receptor. Noise levels will be reduced whenever an obstacle breaks the line of sight between them. The degree of noise reduction depends upon several factors, but most important are height and continuity of the barrier (but unlike visible light, audible sound "wraps around" or goes over a barrier). Generally, the higher the barrier, the greater the noise reduction, and a relatively long, continuous barrier is notably more effective than a broken barrier. Buildings and landscaping between source and receptor are a broken barrier to sound propagation.

Accordingly, the prediction of noise levels and the subsequent estimation of impacts at receptor points in the vicinity of the proposed actions involved consideration of the following factors: 1) identification and location of construction equipment or operations that are significant noise sources; 2) distances between the project noise sources and noise-sensitive receptors; and 3) intervening obstacles or barriers to sound propagation.

Data on noise levels from construction equipment were used in a noise propagation model to estimate the noise levels at sensitive receptor points. The model takes into account the physical aspects of the intervening distance and barriers.

4.9.2.2 Definition and Use of Significance Criteria

There are two criteria for judging noise impacts: 1) conformity of the project with the regulatory framework; and 2) physical and psychological effects of project noise upon sensitive receptors. Each is discussed in the following.

Noise levels resulting from the proposed project actions must comply with the relevant federal, State, and municipal standards and regulations. This compliance is the basis for determining whether a noise effect is a significant impact. Compliance involves meeting a combination of the following local standards: 1) threshold Ldn or CNEL levels permissible at various land uses that have been classified by sensitivity to noise; 2) permissible changes in noise levels relative to measured or estimated ambient baseline levels; and 3) specific quantitative maximum noise levels permissible for each zoning district in the jurisdiction.

Conformity with the regulatory framework also includes compliance with the State standards for noise levels in the workplace. Construction contractors will be permitted and licensed operators who will comply with the requirements under OSHA 29CFR1910.120, which guide workplace noise control, and, therefore, further detailed discussion of potential effects on workers is not required. As part of this compliance, contractors will maintain proper mufflers on all internal combustion and vehicle engines to reduce noise to the maximum feasible extent.

Significance criteria relating to physical and psychological impacts on people are more subjective. They involve increases in noise levels above the existing ambient no level, as a result of the introduction of a new source of noise. The degree of impact is difficult to assess precisely because of the subjective character of individuals' reactions to changes in noise. Empirical studies have shown that persons in an urban environment begin to distinguish changes in noise level of approximately 5 dBA (BLM, 1977). Thus, average changes in noise levels lower than 5 dBA may be considered as producing little or no adverse impact. For changes in level above 5 dBA, it is difficult to quantify impact beyond the obvious: the greater the noise level change, the greater the impact. While analysis of noise impacts is highly subjective, judgment among noise experts commonly used in community noise impact analyses associates noise increases of 5 to 15 dBA with "some impact." Noise level increases of more than 15 dBA are generally considered severe. These noise-averaged thresholds are to be lowered when the noise level fluctuates, or the noise has an irritating character with considerable high frequency energy, or if it is accompanied by subsonic vibration. In these cases, the impact must be individually estimated.

Accordingly, the effects of the proposed actions relating to noise are considered to be significant impacts if the following conditions occur: 1) adopted local standards, noise element, or ordinance would be exceeded in noise level, timing, or duration; 2) existing ambient noise levels at noise-sensitive receptors would increase by 3 dBA while exceeding a day-night average sound pressure level Ldn (24-hour average noise level with measured values between 10 p.m. and 7 a.m. increased by 10 dB) of 60 dBA; 3) there would occur a substantial increase on the order of 15 dB in noise levels at a sensitive receptor at any ambient noise level even if the increase would occur for as short a period as one-half day; increases of 10 dB that would be permanent would also be significant; 4) long term noise would conflict with State or local guidelines, specified interior noise levels or 24-hour averages, and specifically, noise levels exceeding a Ldn level of 60 dBA at the nearest noise sensitive receptor (California Office of Noise

Control); and 5) noise increments to the ambient noise level that are as low as 5 dB would be significant if they occur during quieter hours at night (between 10 p.m. and 7 a.m.) in the presence of sensitive receptors. There is no precise threshold for this last factor as the character of the noise is also important.

4.9.2.3 Impact of Construction Noise

This evaluation of potential noise impacts considers the actions related to both the experimental reef and the mitigation reef within: 1) the lease area; 2) the rock quarry; 3) concrete broker staging sites; 4) truck hauling routes; and 5) the ports. The impact statements and the mitigation measures apply equally to the experimental reef and the mitigation reef because they involve the same number of daily vessels, trucks, and equipment, and are regulated under the same standards and regulations. The noise effects in the lease area are discussed first.

- ***Lease Area***

The concern for noise generated in the lease area is the effect on City of San Clemente residents and sensitive land uses that are located approximately 0.6 mile from the proposed construction activities. The ambient noise levels within the project lease area are estimated at CNEL values between 60 and 63 dBA, more than 15 dB above the level that would occur if I-5 were not present along the coast. Simultaneous operation of a tugboat and either a crane or a tracked loader would produce 85 dBA, or less, of noise at a reference distance of 50 feet. This noise would propagate toward shore with continuously decreasing energy. After traveling 0.6 mile, this construction noise would decrease at the shoreline to approximately 49 dBA. At the shoreline ambient noise varies between an average 70 dBA during midday to about 60 dBA in the early morning hours. Project noise would be produced during eight daytime hours and would be masked by ambient noise onshore. This is a less-than-significant impact.

Mitigation Measures

- None required.

- ***Rock Quarries***

Rock quarries on Catalina Island and in inland San Diego County are existing industrial facilities. Quarrying, rock loading, and shipping or trucking are routine operations and the related equipment noise is part of the existing environment. The sites are on-going quarry operations that are controlled either by the County of Los Angeles or the County and City of San Diego noise control ordinances. The rock used for the experimental reef or the mitigation reef would be loaded onto project barges or trucks consistent with these existing regulatory controls. This is a less-than-significant impact.

Mitigation Measures

- None required.

- ***Concrete Brokers/Port Facilities***

Concrete brokers providing recycled concrete material for the project will be existing, permitted operations, which must comply with local noise control ordinances for industrial zoning. The ports at Los Angeles/Long Beach and San Diego are also existing, permitted facilities that must comply with local noise ordinances. A truck and wheeled loader produces up to 85 dBA of noise at a distance of 50 feet. The noise level at the property line is expected to lie within a range of 65 to 75 dBA, depending on the distance between the concrete piles and property lines. These noise levels are consistent with heavy industrial zoning. The recycled concrete used for the experimental reef or the mitigation reef would be loaded during daylight hours onto project barges or trucks consistent with these existing regulatory controls. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Truck Routes***

The noise created by project trucks is subject to maximum noise emission limits set by the Motor Vehicle Code. Among other things, the Motor Vehicle Code requires the trucks to be equipped with an adequate muffler to prevent excessive noise. Nevertheless, the short duration increases in noise associated with passing project trucks have the potential to conflict with residential land uses in the County of Los Angeles, County of San Diego, and City of San Diego, particularly during nighttime hours.

The use of project trucks within manufacturing, industrial, and agricultural zones would be consistent with the applicable noise control ordinances for these zones, which allow short duration (less than two minutes) increases in noise up to 90 dBA, depending upon the location. The daytime and nighttime thresholds are the same in these zones. The use of project trucks within these zones would create less-than-significant impacts regardless of the time-of-day of use.

Mitigation Measures

- None required.

The use of project trucks within residential and commercial zones would conflict with the applicable noise control ordinances for these zones. The conflict would be particularly substantial during the nighttime, when more restrictive thresholds apply. The use of truck routes within residential and commercial zones would create noise levels in conflict with the County of Los Angeles, County of San Diego, and City of San Diego noise control ordinances. This is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level.

- Contractors will be directed to avoid the use of routes within areas zoned for residential and commercial uses. In the event such routes cannot be avoided, the contractor will be directed to avoid use of these routes during the weekday hours of 7 p.m. to 7 a.m., and all day Sunday.

4.10 Public Services And Utilities

4.10 Public Services and Utilities

This section presents a focused discussion on the provision of public services in the vicinity of the proposed lease site that may be affected by the experimental reef and the subsequent mitigation reef. A general description of services is followed by an evaluation of the potential environmental effects of the two reefs, and any mitigation measures necessary to alleviate or reduce significant adverse impacts to a less-than-significant level. The analysis evaluates whether the proposed project would create any substantial changes in or new demand for public services.

A number of public services are not discussed because they would clearly not be affected by the construction, presence, or monitoring of the offshore artificial reef. Such services include onshore public utility providers, including San Diego Gas and Electric, Southern California Gas, Pacific Bell and Cox Communications. In addition, there would be no effect on most city services, such as stormwater drainage, water, or wastewater facilities (Del Campo 1997). The environmental setting describes the services that could potentially be affected, as follows.

4.10.1 Environmental Setting

4.10.1.1 Offshore Emergency Response

Offshore emergency response services are provided for events such as fires, collisions, or other accidents onboard boats or barges, and for emergencies involving recreational swimmers, divers, or surfers. In southern Orange County, these services are provided by the U.S. Coast Guard, the Orange County Sheriff's Harbor Patrol Office (at Dana Point Harbor), the City of San Clemente Marine Safety Division, and the California Department of Parks and Recreation (CDPR) Lifeguards. While these organizations all work together, each has a different role.

The U.S. Coast Guard is the federal government's primary maritime law enforcement agency and is responsible for ensuring overall safety and security in the marine environment. The agency responds to all boat emergencies more than three miles offshore. The closest Coast Guard stations to the project site are located in Oceanside and Newport Beach. The Coast Guard would assist within the three-mile zone only if there were a major event, such as a tanker sinking or a plane crash.

The Orange County Sheriff's Harbor Patrol responds to all emergencies within three miles of the Orange County shoreline and is the first point of contact for boat emergencies. The Harbor Patrol regularly patrols the offshore area and has a fire boat on duty 24 hours a day. If a physical injury occurs, the Patrol calls paramedics to assist either onshore or at the site of the accident. The Patrol also calls the City of San Clemente and State beach lifeguards for help as necessary. The Patrol does not have special equipment for SCUBA diving accidents (Wilson 1998). Anyone requiring decompression would be airlifted to the nearest facility at Catalina Island (Long 1998).

Lifeguards at City of San Clemente and State beaches respond to distress calls primarily from people swimming or surfing near the shore, as well as to some boaters. State beach lifeguards use a rescue boat to respond to accidents, but they do not have equipment to assist with SCUBA-diving accidents (Long 1998).

Non-emergency boating problems, such as engine problems or equipment failure, are handled through a private service in the area.

4.10.1.2 Beach Maintenance

Kelp strands and fronds often detach from living plants during storms and have the potential to be deposited on beaches nearby. The dead kelp, also called kelp wrack, can be considered a nuisance because of its pungent odor and tendency to attract flies and birds. Kelp on the beach usually persists for about two weeks before disintegrating.

Generally, loose kelp plants wash onshore fairly close to their point of origin. The direction that kelp travels in the ocean can be affected by the prevailing surface current near the kelp forest of origin and the prevailing winds. The prevailing current along the southern California coastline travels in a southerly direction. The prevailing winds come out of the north/northwest, which would also result in a southerly surface current. These conditions can shift with different storm events and at different times of the year.

Along the San Diego County coastline, many of the beaches are located near existing persistent kelp forests and the beaches experience moderate-to-heavy deposits of kelp during the year. The City of San Diego manages nine beaches along 18 miles of the coast. The City grooms five of these beaches on a regular basis. The kelp is removed with front-end loaders equipped with rakes and forks and then deposited on Fiesta Island. When the kelp has disintegrated, the sand is returned to the beaches for replenishment. The City of San Diego finds that north facing beaches receive more kelp in winter, while south facing beaches receive more kelp in summer (Simmons 1998).

The City of Coronado buries all of the kelp accumulating on their shore in the beach sand on a daily basis. They use a specially adapted caterpillar with a rake to cover the kelp with six inches of sand. They also create sand dunes using kelp covered with sand. The kelp disintegrates within a few days and this has proven to be a very effective way of preventing beach erosion (Seibuhr 1998).

The City of Encinitas jointly manages 6.5 miles of beach with the CDPR. Most beaches are left natural, but kelp is removed from Moonlight Beach periodically as needed. The kelp is removed using a front loader with a rake and is taken to a local land-fill for disposal (Cotton 1998).

The Carlsbad State Beach and South Carlsbad State Beach are managed by the CDPR. These beaches experience a fair amount of kelp particularly after large storms. However, it is the State's philosophy not to clean kelp off the beaches so they may remain as natural as possible. CDPR does some litter clean up, but does not maintain any special equipment. Last year after a particularly large storm, a special kelp clean up was carried out by hand crews (CDPR 1998).

The City of Oceanside manages three miles of beach along the coast. They remove accumulated kelp on a regular basis using a tractor with a rake. The kelp is taken to a local land-fill for disposal. They experience the most kelp in the winter months (Kwan 1998).

Approximately eight acres of persistent kelp forest currently exists between the San Clemente Municipal Pier and San Mateo Point. The City of San Clemente does not have a problem with kelp washing onshore at present, however, kelp is occasionally removed from the beach during regular garbage pick-up. This is necessary primarily after large storms (Hughes 1997b).

CDPR generally does not consider kelp on State beaches a problem as it is part of the natural coastal ecosystem. Kelp on the San Clemente and San Onofre State Beaches has not been a problem and the State does not clean it up. It is difficult to get equipment on these beaches due to limited access (Roggenbuck 1997).

Neither CDPR nor the City of San Clemente keeps records of the amount of kelp that accumulates on their beaches and they do not maintain any special equipment for kelp removal.

The City of San Clemente has also experienced problems periodically with large rocks washing onshore or into the shallow surf after major storm events. The rocks present a hazard to people walking on the beach and the City has issued warnings occasionally (Hughes 1997b).

4.10.1.3 Applicable Plans and Policies

The *City of San Clemente General Plan* sets goals and standards to: 1) maintain a safe and healthy beach for the enjoyable utilization of marine environments; 2) provide adequate marine safety and medical aid services; 3) maintain and enhance the City's beaches and marine resources; and 4) maintain a healthy coastline, preventing degradation of the community's visual and environmental resources (City of San Clemente 1993a). The Orange County General Plan states the need to maintain adequate levels of service for the County Sheriff's Department (1987 Safety Element, SAF-4-2).

4.10.2 Impacts and Mitigation Measures

4.10.2.1 Methodology

A review was done of existing literature related to studies on the frequency and quantity of kelp wrack found on beaches in San Diego County. Two studies by ZoBell (1959 and 1971) made estimates from field observations. The first study gathered data from 49 beach observation points along the San Diego coast on a bi-weekly basis for 12 years. This study provides data about the frequency of kelp accumulation at different times during the year. The second study observed the annual kelp accumulation at beaches opposite the La Jolla Kelp Bed over a three-year period.

The results of these studies were then used to estimate the annual amount of kelp wrack that can be expected from each additional acre of persistent kelp bed created by the artificial mitigation reef at San Clemente. This represents a conservative estimate since the La Jolla Kelp Bed is one of the largest and densest kelp canopies along the coast. The density of plants at La Jolla (10 to 25 plants per 100 m^2) is much higher than the medium-to-high density required at San Clemente (a minimum of four plants per 100 m^2).

A review of literature also found a study that examined the possibility of pebbles and cobbles washing onto the beach where kelp is attached. The study found that kelp attached to the pebbles and cobbles creates greater buoyancy allowing movement onto shore (Emery and Tschudy 1941). This study gives some insight on the potential for rocks and concrete pieces from the artificial reef to wash onshore at San Clemente.

The details of these analyses are found in Appendix F: *Possible Impacts of the Southern California Edison Kelp Reef Off San Clemente on the Marine Environment* (Elwany et al. 1998).

In addition, a number of beach managers in San Diego County were surveyed by phone about maintenance of beaches located near existing persistent kelp beds. Information was gathered on the frequency of kelp accumulation and current practices for kelp clean up and disposal. This included the CDPR, the City of San Diego, the City of Oceanside, the City of Encinitas, and the City of Coronado.

4.10.2.2 Significance Criteria

CEQA suggests projects that create substantial changes in or create a new demand for public services should be considered to have a significant affect. In addition, CEQA Guidelines Appendix G(z) suggests a significant effect may result if a project would "*interfere with emergency response plans or emergency evacuation plans.*"

The significance criteria used to evaluate the impact on public services from the artificial reef project in this document are defined as follows:

- Emergency response services required during construction of the experimental or mitigation artificial reefs beyond the level of service available. This would require calling in additional response units from outside the area to respond to an emergency.

- An increase in the need for beach cleanup due to accumulated kelp wrack, rock, or concrete due to the artificial reef at either the City of San Clemente beaches or the State beaches. This would mean: 1) creating the need to hire additional personnel for beach maintenance and clean up; 2) requiring the purchase of special equipment for beach maintenance and clean up; or 3) increasing the costs for land fill or other disposal by more than ten percent.

4.10.2.3 Offshore Emergency Response

- ***Reef Construction***

The need for offshore emergency response services could occur during the construction of the experimental reef or the mitigation reef. For example, tugboats and barges could be involved in an accident or have a fire on board. The proposed lease area would be located approximately 0.6 mile offshore, within the Orange County Harbor Patrol's jurisdiction. However, tugboats and barges traveling to the project site could potentially go more than three miles offshore while in transit requiring Coast Guard assistance.

Construction of the experimental reef would involve three barges and three tugboats for delivery of materials, as well as one attending tugboat to assist the derrick barge and crane. The delivery of 17,640 tons of quarry rock for 28 of the experimental modules would require 9 barge loads. The delivery of 13,860tons of recycled concrete for the other 28 modules would require 7 barge loads. Barges would be unloaded at a rate of one barge every two days. Construction activities would be marked with buoys and other signals according to permit requirements outlined by the U.S. Army Corps of Engineers and in compliance with Coast Guard regulations.

Construction activities associated with the mitigation reef would require the same equipment as the experimental reef, while construction would involve unloading material at the rate of one barge per day. The duration of construction would be considerably longer for the 127.6-acre to 277.6-acre mitigation reef build outs, ranging from two to four construction seasons (May 1 to September 30). Construction activities would be marked with buoys and other signals according to permit requirements outlined by the U.S. Army Corps of Engineers and in compliance with Coast Guard regulations.

The Orange County Harbor Patrol Officer expressed an opinion that their equipment and emergency response services would be adequate to handle any problems incurred during the construction phase of both the experimental and mitigation reefs. In addition, the construction activities would not create problems or interfere with the Harbor Patrol in carrying out their other duties (Wilson 1998).

Tugboat/barge operators are licensed and must comply with Coast Guard regulations. It is expected that current Coast Guard emergency services would be adequate for any problems that might occur. As a result, the construction of the experimental and mitigation reefs would have a less-than-significant impact for these services.

Mitigation Measures

- None Required. Recommended Mitigation.

  The Harbor Patrol requested that they be notified when any construction plans/ schedules for the artificial reef are finalized. The Harbor Patrol will be given notification two weeks prior to the start of construction activities for both the experimental and mitigation reefs.

- ***Reef Monitoring***

Monitoring activities for the experimental and mitigation reef involve both diver surveys and sonar-scan surveys by boat. Emergency services could be required for these activities, but the existing available services would be adequate. This would be a less-than-significant impact.

Mitigation Measures

- None required.

4.10.2.4 Kelp and Beach Maintenance

- ***Experimental Reef***

The 22.4-acre experimental artificial reef could potentially add two to three times the current amount of persistent kelp beds to the project area. For the purposes of this document, an estimate of additional kelp wrack has been made based on the findings of the Zobel studies (1959 and 1971). These studies shows that each acre of kelp bed could result in up to 20 yd^3 of kelp wrack washing onto the shore per year. This would mean a total of up to 448 yd^3 (22.4 x 20 yd^3) of kelp wrack annually that could potentially wash onto the beaches. The majority of kelp wrack occurs over a small number of days after big storms, primarily during the months of November through February. It is expected that most kelp wrack would be deposited on the City of San Clemente beaches and San Clemente and San Onofre State Beaches.

The additional kelp wrack washing on shore from the experimental reef represents a relatively small increase in kelp wrack and would not be likely to increase the need for clean up services. This represents a less-then-significant impact.

There is a very small chance some rocks or pieces of concrete used to construct the experimental reef could wash onshore or into the surf zone because of added buoyancy from attached kelp plants. The reef construction materials are intended to be large rocks and pieces of concrete, however some smaller fragments could result from handling. These fragments are likely to be dispersed and buried before kelp can attach and grow on them. The remaining larger rocks and concrete pieces would remain stable and are unlikely to wash onshore or into the surf zone. However, due to the hazard to the public this would pose, the possibility of rocks and concrete washing on shore or into the shallow surf is considered a significant impact.

Mitigation Measures

- A monitoring program will be initiated upon the construction of the experimental reef and continued for the following five years to determine the amount of kelp wrack currently washing onto the beaches. Because the City of San Clemente and CDPR do not collect data on the amount of kelp washing onto beaches currently, monitoring would establish a baseline. The monitoring of the experimental reef should also observe whether concrete or quarry rock are moved toward the beach during strong wave events. This monitoring would make it easier to compare changes due to the experimental reef or to the subsequent build out of the mitigation reef, as outlined below. The beach monitoring would be done on a bi-weekly basis throughout the months of November through March and on a monthly basis during the other months. The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day). The beach monitoring would include: 1) observations of the amount of kelp wrack on the beach (cubic yards and/or percentage coverage); 2) tracking beach clean up schedules and costs (including disposal); and 3) tracking the number of complaints from beach users or nearby residents and businesses due to kelp or rocks/concrete on the beaches. The movement of the concrete and quarry rock would be monitored as a component of the larger performance monitoring effort.

- ***Mitigation Reef***

The second phase of this project would involve the construction of a minimum of 127.6 acres or up to 277.6 acres of artificial reef to provide a 150 acres of persistent, medium- to high-density kelp forest. The mitigation reef would provide 19 times the current coverage of kelp canopy in the area between just north of the San Clemente Municipal Pier and San Mateo Point.

For the purposes of this document, an estimate of additional kelp wrack has been made based on the findings of the Zobel studies (1959 and 1971). These studies shows that each additional acre of kelp bed could result in up to 20 yd^3 of kelp wrack washing onto shore per year. This would mean up to 3,000 yd^3 (150 x 20 yd^3) of kelp wrack that could potentially wash onto the beaches each year from the 150 acres of medium-to-high density kelp bed. The majority of kelp wrack would occur over a small number of days after big storms primarily during the months of November through February. Most of the kelp would be deposited on the City of San Clemente beaches and San Clemente and San Onofre State Beaches.

If a significant increase in the amount of kelp wrack reaching the beaches occurs, there could be a need for additional public services to clean up the kelp. This represents a potentially significant impact.

In addition, there is a small chance some small rocks or pieces of concrete used to construct the mitigation reef could wash onshore or into the surf zone because of the added buoyancy from attached kelp plants. The reef construction materials are intended to be large rocks and concrete pieces, however, some smaller fragments could result from handling. These fragments are likely to be dispersed and buried before kelp can attach and grow on them. The remaining larger rocks and concrete would be stable and would not wash onshore or into the surf zone. However, the possibility of rocks and concrete washing onshore or into the shallow surf is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measures would reduce these impacts to a less-than-significant level

- Due to uncertainty regarding the amount, frequency and location of increased kelp washing onshore, kelp on the beaches shall be monitored as part of the experimental reef (as discussed above) and the larger mitigation reef. Although rocks and concrete used in constructing the reef are not likely to wash onshore or into the shallow surf, the monitoring program shall also observe this possibility. Monitoring shall be conducted for five years or as long as needed after construction of the mitigation reef is completed, or until a conclusion can be reached regarding the impacts of kelp and other materials washing onto the beaches. This would be done on a bi-weekly basis throughout the months of November through March and on a monthly basis during the other months. The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day). The monitoring would include: 1) observations of the amount of kelp wrack on the beach (cubic yards and/or percentage coverage) and of potential rocks/concrete; 2) tracking beach clean up schedules and costs (including disposal); and 3) tracking the number of complaints from beach users or nearby residents and businesses due to kelp and rocks/concrete on the beaches.

- Based on the results during the monitoring period, it would be determined if additional clean up services are needed as a result of the artificial reef. This clean up would occur at any time it is determined it is necessary during monitoring. Possible mitigation includes the project proponents establishing a trust fund to pay for: 1) leasing or purchasing special equipment for clean up, or possibly to bury kelp in the sand; 2) additional personnel for beach clean up; and/or 3) landfill or other disposal costs for kelp and rocks/concrete removed.

4.11 Aesthetics

4.11 Aesthetics

This chapter addresses aesthetic issues related to implementation of the proposed experimental reef and mitigation reef. The environmental setting documents the existing visual characteristics of the project site and vicinity. Sensitive receptors and key observation points are identified. Standards used to judge visual sensitivity are presented, and relevant scenic resources plans and policies are reviewed. The evaluation addresses potential effects of the proposed reef project on the visual quality of the site vicinity and analyzes the project's support of applicable goals and policies of local planning documents.

4.11.1 Environmental Setting

4.11.1.1 Visual Character of the Project Site and Vicinity

The lease area and project site lie off the southern Orange County coast, a predominantly urban area characterized by sweeping ocean views, sandy beaches and steep coastal bluffs cut by canyons. The vast expanse of the Pacific Ocean dominates the region's coastal viewshed, greatly influencing the character of onshore development. Much of the project area's residential, commercial and recreational development is sited and designed to take advantage of the ocean views. The City of San Clemente considers these views important enough to require the preservation of a number of public view corridors to the ocean (City of San Clemente 1993a).

A series of flat sandy beaches line the coast between the project site and upland areas. A single track Orange County Transportation Authority (OCTA) rail line separates the beaches and ocean from the steep coastal bluffs and canyons that characterize the project area coastline. Sheer coastal bluffs abruptly rise up to 100 feet above the beaches in some areas. From the project site northward, the coastal bluffs and canyons of San Clemente, Capistrano Beach and Dana Point are intensively urbanized. Numerous public and private coastal accesses, parks and beaches punctuate the residential and commercial development along the coastline. These areas interject patches of vegetation and open space into the urban landscape. The coastline south of the project site, devoted largely to the Camp Pendleton Marine Corps Base, the San Onofre Nuclear Generating Station and the San Onofre State Beach, retains a relatively rural atmosphere. Coastal views south of the project site, while displaying the project area's characteristic bluffs and canyons, also encompass a vast amount of open space.

Views of the project site consist of an unbroken expanse of ocean, demarcated by the San Mateo Rocks on the north and San Mateo Point on the south. Ships, fishing boats, and recreational boats occasionally pass through the viewshed. U.S. military maneuvers are sometimes visible in the waters south of the project site. Westward background views consist solely of the ocean, horizon, and sky.

4.11.1.2 Visual Sensitivity

Visual sensitivity is typically characterized as high, moderate or low, and measures a group's concern for the visual environment. Certain populations are typically considered more sensitive to visual change than others, e.g. homeowners versus employees at an industrial site; these people are called sensitive receptors. Although distinct sensitive receptors are determined on a project-specific basis, certain general characteristics determine the sensitivity of particular receptors. Key Observation Points (KOPs) indicate locations deemed particularly representative of project-specific sensitive receptors' views. The following paragraphs outline the sensitive receptors and KOPs pertinent to the proposed SONGS artificial reef project.

- ***Sensitive Receptors***

Receptors ordinarily considered most sensitive to visual change include local residents, recreationists, and people using scenic roadways and view corridors. Such receptors are also generally presumed sensitive to locally increased amounts of light and glare, such as light from vessels operating offshore at the project site. The receptor's sensitivity depends upon a variety of factors. Local residents are considered sensitive due to the duration of their exposure to any change, their familiarity with the existing landscape and their ability to detect change. Scenic quality also carries importance to recreational users enjoying beach- and ocean-dependent activities. People using scenic corridors are considered sensitive because these routes or views have been identified as areas of outstanding scenic quality. Commuters and other travelers on area roadways are presumed to have moderate concern, as the views are of secondary importance to the primary purpose of their presence. Receptors considered most sensitive to project-related visual effects are described in the following paragraphs.

Local Residents. Much of the San Clemente's coast is residential development. Residents along the bluffs and coastal areas are considered sensitive visual receptors, as many of them would have views of project construction activities. While much of the coastal area would experience views of project construction activities, the southernmost area of San Clemente, immediately onshore of the project site, would be within one mile of the proposed project activities. Local residents with direct views of the project site are considered highly sensitive to project-related visual change.

Recreational Users. Much of the recreational activity in the project vicinity centers on beach and ocean resources. The San Clemente coastline boasts 14 public and four private improved coastal access points, many of which incorporate developed recreational amenities. Project area beaches draw two million visitors each year (City of San Clemente 1993b). The City of San Clemente's Coastal Element notes the importance of the beaches to local recreational activities. In addition, Dana Point Harbor, approximately five miles north of the site, includes over 2,500 boat slips and several excursion boat businesses for sport fishing and whale watching in the area. Whale watching activities typically occur from December to March (Orange County 1980).

Recreational users considered sensitive to project-related visual change include beachgoers throughout the area, but especially those at beaches nearest the project site; surfers between the San Clemente Pier and San Onofre State Beach; recreational boaters, recreational fishers and passengers on nearby excursion boats.

Scenic Routes. The southern Orange/northern San Diego County region contains several state- and locally-designated scenic routes, some of which are located in or near the project area. Due to the far-reaching nature of coastal vistas, the view corridors (area visible from the road) of these scenic routes may include the proposed project site within their background views. The California Department of Transportation (Caltrans), the County of Orange, the County of San Diego and the City of San Clemente have identified scenic routes within their respective jurisdictions and have adopted a variety of policies and programs related to scenic routes and corridors.

The 1996 Caltrans *Guidelines for the Official Designation of Scenic Highways* designates the Interstate 5 freeway in the project area as part of the state scenic highway system. In addition, the *County of Orange General Plan Transportation Element* identifies the Pacific Coast Highway/San Diego Freeway (including Interstate 5) in the project area as a County-designated scenic highway viewscape corridor. The Scenic Highways Element of the *San Diego County General Plan* includes Interstate 5, south of the project area, in its Scenic Highway System. The *City of San Clemente General Plan Scenic Highways Element* indicates no scenic roadway corridors in the immediate project vicinity; Avenida Pico, located about one mile north of the project site, is the nearest to the site. The *City of San Clemente Coastal Element*, however, also designates El Camino Real/Pacific Coast Highway, Ola Vista, and El Camino Real in the project area as scenic corridors.

In addition to the designated scenic routes, an OCTA rail line parallels the project area coastline, separating the beaches from the coastal bluffs and canyons. A total of 16 Amtrak intercity passenger trains and three Metrolink commuter rail trains utilize the railroad line daily (City of San Clemente 1995).

Travelers on the designated scenic roadways and passengers on the Amtrak and Metrolink trains are considered sensitive to activities in the project area.

- ***Key Observation Points***

Three KOPs have been identified (Figure 4.11-1) that correlate with the types of sensitive receptors discussed above. KOPs were determined during project area field visits and incorporate a variety of sites, including public lands and associated recreation uses, as well as residential areas and travel routes. Because of the project site's distance from the coastline, all of the KOPs are more than 0.6 mile from the proposed project site.

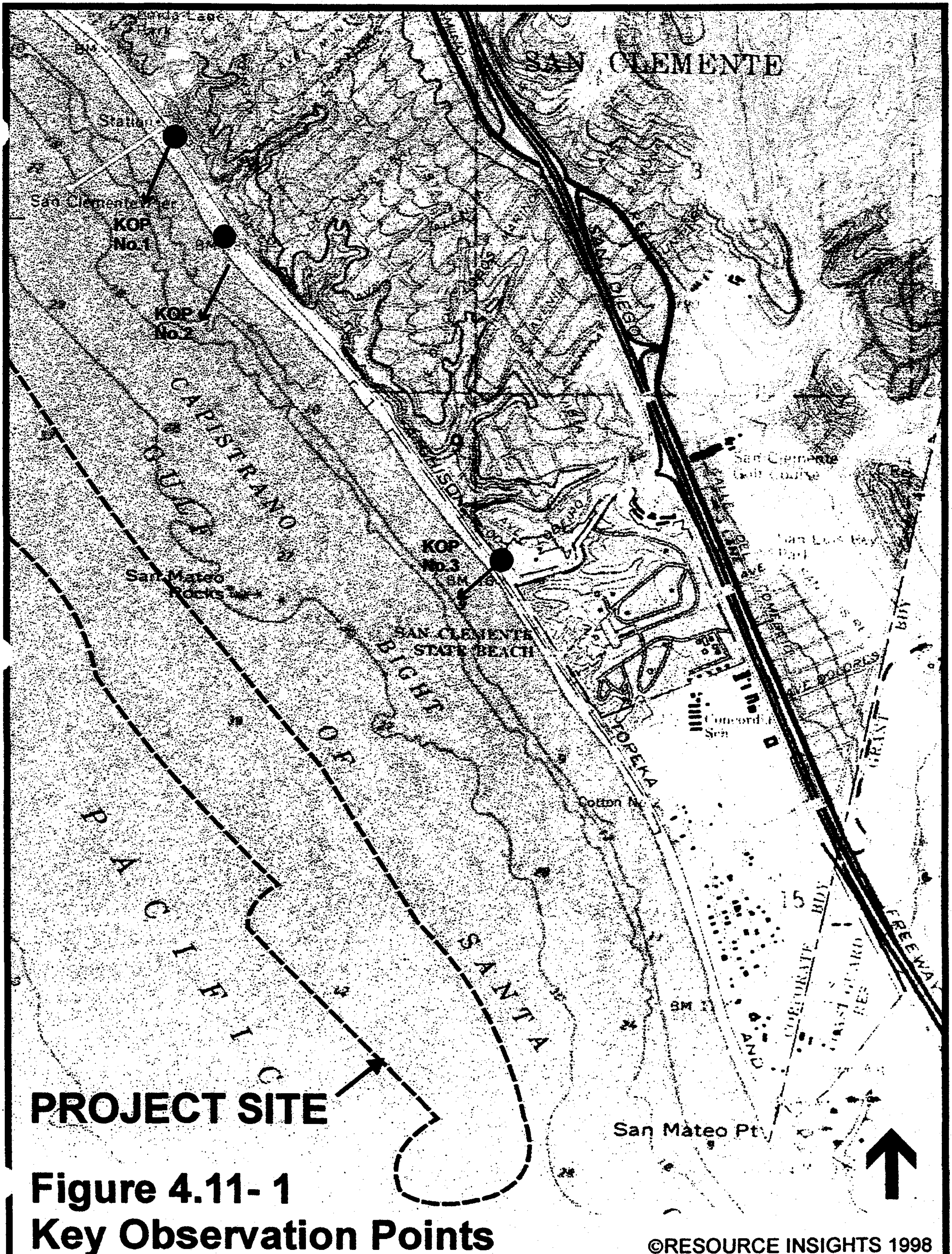

Figure 4.11- 1
Key Observation Points

The KOPs were selected to reflect representative viewing conditions and viewer types for areas considered sensitive to project activities. KOP No. 1 presents the view southwestward toward the proposed lease area from the Pier Bowl area. KOP No. 2 illustrates the view westward toward the project site from the "T" Street beach access, and KOP No. 3 represents the view westward toward the project site from the southern coastal areas of the City, including Calafia Beach and San Clemente State Beach. It should be noted that access to the gated residential areas in the southernmost part of the City was infeasible for this evaluation and, therefore, an approximation of the views from those areas is incorporated into KOP No. 3. Figures 4.11-2 through 4.11-4 present the views toward the project site from these KOPs.

4.11.1.3 Applicable Plans, Goals and Policies

Local visual quality goals, objectives and policies applicable to the proposed project center primarily on three issues: public view corridors; scenic roadways; and the protection of the area's visual character and aesthetic resources. Discussions of scenic roadway classifications and scenic resources in the project vicinity appear in the *San Onofre State Beach Revised General Plan*, the Scenic Highways Element and the Natural and Historic/Cultural Resources Element of the *San Clemente General Plan* and in the *San Clemente Coastal Element* (Local Coastal Plan). Relevant guidance from these plans is summarized below.

- ***San Onofre State Beach Revised General Plan***

Policies in the *San Onofre State Beach Revised General Plan* call for the protection of scenic resources from "all degrading and undesirable intrusions," and require "highly visible management practices to be conducted so as to minimize impact on the unit's scenery" (Resource Agency 1984).

- ***San Clemente General Plan***

Two elements of the *San Clemente General Plan*, the Scenic Highways Element and the Natural and Historic/Cultural Resources Element, address aesthetics issues relevant to the proposed project.

The Scenic Highways Element of the *San Clemente General Plan* presents the City's goals, objectives, policies and implementation measures for the maintenance and protection of scenic highways and roadway corridors. The policies of the Scenic Highways Element direct the creation and preservation of visual corridors and the integration of scenic highways with open spaces and recreational corridors.

As previously indicated, the Scenic Highways Element identifies scenic roadway corridors in the City, but none in the immediate project vicinity.

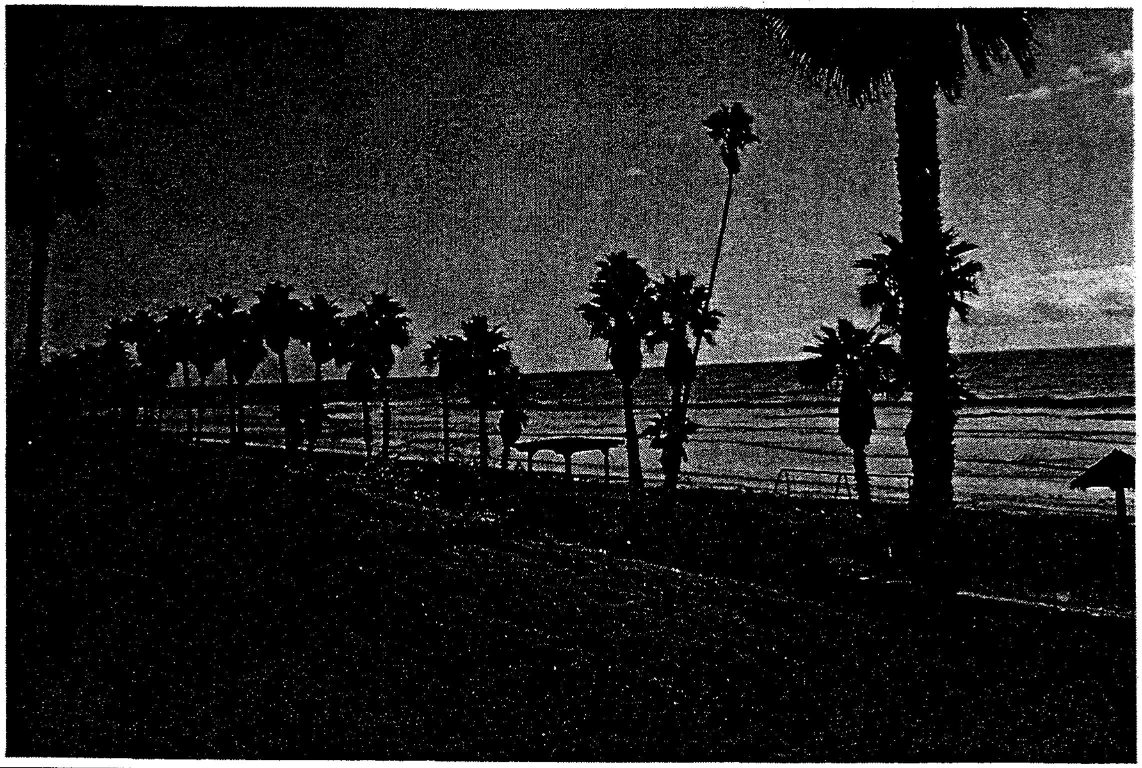

Figure 4.11-2 KOP No. 1 - View Toward Project Site from Pier Bowl

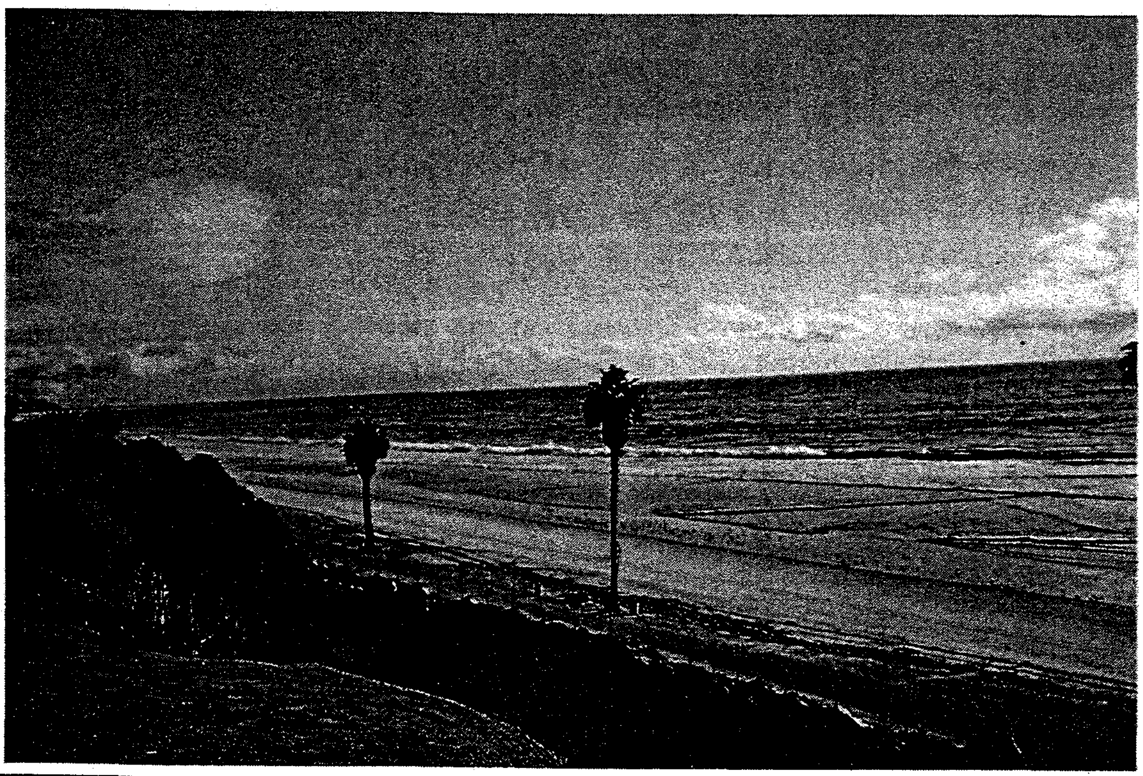

Figure 4.11-3 KOP No. 2 - View Toward Project Site from "T" Street Beach Access

Figure 4.11-4 KOP No. 3 - View Toward Project Site from Calafia Beach

The Natural and Historic/Cultural Resources Element of the *San Clemente General Plan* identifies the preservation of scenic resources and the protection of public view corridors among its primary visual resources issues. The Element's stated aesthetic resources goal is to "maintain the visual character of the City" (City of San Clemente 1993a). In addition to restrictions on blufftop, ridgeline, and hillside development, and measures aimed at the preservation of coastal canyons, policy direction involves the preservation of significant public view corridors to the ocean.

- ***San Clemente Coastal Element (Local Coastal Plan)***

The *San Clemente Coastal Element* serves as the California Coastal Commission (CCC) - approved Local Coastal Plan for San Clemente. As such, the Coastal Element incorporates a combination of goals and policies derived from the California Coastal Act of 1976 and from the City's General Plan. These goals and policies provide guidance for the management of aesthetic resources in the City's coastal zone, and address both onshore and offshore aspects of those resources.

The Coastal Element encourages protection of the coastal zone's visual quality, aesthetic qualities and scenic public views. The Element includes Coastal Act policies requiring the protection of scenic and visual qualities of coastal areas and the preservation of special communities (PRC 30251 and 30253[5]). In addition, as described above, the Coastal Element calls for the maintenance and preservation of El Camino Real/Pacific Coast Highway, Ola Vista and El Camino Real as scenic corridors in conformance with the General Plan's Scenic Highways Element. Coastal Element policy also includes recommendations for preserving the City-identified significant public view corridors to the ocean, and working with the CCC to develop implementation measures for the preservation and maintenance of coastal zone bluffs, canyons and beaches.

The Coastal Element incorporates Coastal Act policies requiring the preservation, enhancement and restoration of water and marine resources (PRC §§ 30230 and 30231). The Element notes that the marine environment functions as a recreational and visual resource. City policies related to offshore aesthetic resources prescribe the maintenance of a healthy coastline, preventing degradation of the community's visual and environmental resources. Coastal Element policy opposes offshore oil drilling in ocean waters, "where visual and environmental quality have the potential to be severely impacted for residents and beach users" (City of San Clemente 1995).

4.11.2 Impacts and Mitigation Measures

4.11.2.1 Methodology

Visual impacts are generally subjective, as sensitivity to change in the visual environment varies and individuals respond differently to these changes. Consequently, this analysis can only address the visual impacts of the proposed project on a qualitative level, based on the textual and graphic descriptions provided. However, despite individual predispositions, certain concepts are fundamental to any consideration of visual change, as follows: 1) for a visual change to be perceived a "norm" must first be established; 2) viewers tend to group objects by proximity or similarity; 3) an area perceived as a figure contrasts more with its surroundings than one regarded as background; 4) perceived size of an object is a function of visual angle – the lower the viewer relative to the object, the larger the object appears; and 5) light or bright objects appear to advance; dark ones recede.

Similarly, an evaluation of light and glare takes into account the following general rules: 1) the amount of light reflected from an object is determined by the surface reflectance and the illumination falling on the object; and 2) the location or orientation of a surface would affect the intensity of illumination falling on it.

Using the principles outlined above, potential visual impacts of the project on the identified sensitive receptors have been assessed relative to the preservation of views and the creation of possibly intrusive light and glare. Project impacts on visual quality were also determined by analyzing the relationship between the general visual attributes of the proposed project, associated construction activities, and the characteristics of existing area uses, including the KOPs identified above.

4.11.2.2 Significance Criteria

In accordance with the CEQA Guidelines and for the purposes of this analysis, impacts are considered significant if implementation of the proposed project would: 1) affect a scenic vista or scenic highway; 2) have a demonstrable negative aesthetic effect; or 3) create light or glare. Policy direction of applicable local planning documents was considered in determining the significance of these impacts.

4.11.2.3 Effects on Scenic Vistas or Scenic Highways

- ***Reef Construction***

The presence of nearby residences and several designated scenic routes and view corridors, as well as the recreational popularity of the project area coastline, contribute to a high degree of visual sensitivity to project area activities. Consequently, a variety of sensitive receptors, including travelers on nearby scenic routes, residents and recreationists using locally-designated scenic view corridors, could observe the project construction activities. The sensitive receptors are primarily located on land that is higher than the project site, so the view is looking down and out toward sea. In addition, the project site is approximately 0.6 mile offshore. Downward views and distance tend to diminish the perceived scale of objects, thereby reducing the perceptible changes. Furthermore, the area's existing mixture of man-made and natural visual attributes accommodates some degree of change. There are currently many types of boats and equipment traveling offshore, including military ships and tanks from Camp Pendleton on the textual and graphic descriptions provided. However, despite individual predispositions, certain concepts are fundamental to any consideration of visual change, as follows: 1) for a visual change to be perceived a "norm" must first be established; 2) viewers tend to group objects by proximity or similarity; 3) an area perceived as a figure contrasts more with its surroundings than one regarded as background; 4) perceived size of an object is a function of visual angle – the lower the viewer relative to the object, the larger the object appears; and 5) light or bright objects appear to advance; dark ones recede.

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Mitigation Measures

- None required. *Mitigation Recommended:*

  It is recommended that the project proponent conduct an educational outreach program to inform the public about the project and the construction activities. This would include notifying the media and residents about the type and duration of construction activities a month prior to beginning construction. Temporary notices would also be posted along the shore at the San Clemente Pier and near the mouth of San Mateo Creek.

- ***Experimental Reef and Mitigation Reef***

The experimental reef modules would occupy a total of 22.4 acres spread over the submerged lands within the 356-acre project site. The mitigation reef would cover an additional 127.6 to 277.6 acres of submerged lands within the same area. The reefs would be situated 0.6 mile from the coastline, approximately 39 to 47 feet below the ocean surface. Upon successful colonization of the reef by a giant kelp community, the only project feature that might be visible offshore to sensitive receptors would be darker-looking areas in which the kelp might reach just below the ocean surface. However, the high waves that occur during winter storms may detach kelp from the proposed kelp bed, causing quantities of kelp wrack to wash ashore annually between Dana Point and San Mateo Point (Elwany et al. 1998). The experimental reef may produce approximately 448 yd^3 of kelp wrack per year, while the mitigation reef may produce up to an additional 2,552 yd^3 per year. The presence of additional kelp on area beaches during the winter months is not expected to greatly alter the beaches' visual character. Therefore, the presence of the experimental and mitigation reefs would not substantially degrade views from any designated scenic routes or view corridors. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Reef Monitoring***

Monitoring activities associated with the experimental reef and the mitigation reef would entail the presence of one to two small watercraft and several divers within the project site at various times during the year. These activities would not affect the area's visual integrity as seen from any designated scenic routes or view corridors. Therefore, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

<u>*4.11.2.4 Demonstrable Negative Aesthetic Effects*</u>

- ***Reef Construction***

The experimental and mitigation reefs would both be submerged and would be unlikely to visually intrude on the surrounding area. However, the construction activities could temporarily affect the seascape's appearance to sensitive receptors, such as residents, recreation users, and travelers on scenic routes. Barges would be visible to these sensitive receptors for the duration of reef construction activities. Construction of the experimental reef would take a total of 32 days during the late spring or summer. The mitigation reef construction could take anywhere from two to four years during the months of May through September. The appearance of project-related barges operating approximately 0.6 mile offshore would resemble existing offshore vessel activities, which include commercial fishing and shipping, and U.S. military exercises (see Figures 4.11-5). Consequently, project construction activities are not expected to diminish the project area's visual quality substantially. This is considered a less-than-significant impact.

Mitigation Measures

- None required. ***Recommended Mitigation***:

  It is recommended that the project proponent conduct an educational outreach program to inform the public about the project and the construction activities. This would include notifying the media and residents about the type and duration of construction activities a month prior to beginning construction. Temporary notices would also be posted along the shore at the San Clemente Pier and near the mouth of San Mateo Creek.

- ***Experimental Reef and Mitigation Reef***

The 22.4 acres of experimental reef modules and the 127.6 to 277.6 acres of mitigation reef would be submerged and unlikely to visually intrude on the surrounding area. The reefs would be located 0.6 mile offshore under approximately 39 to 47 feet of water, and would therefore not be visible to sensitive receptors. Dark patches kelp beneath the ocean surface could be visible to some sensitive receptors upon successful kelp colonization; however, the presence of these areas is not expected to negatively alter the appearance of the project site. In addition, kelp wrack could potentially wash onto local beaches under heavy winter surf conditions (Elwany et al. 1998). However, the wintertime presence of this kelp wrack on area beaches is not expected to negatively affect the beaches' existing visual character. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Reef Monitoring***

Monitoring activities associated with the experimental reef and mitigation reef would necessitate the presence of one to two small watercraft and several divers within the project site at various times during the year. These activities would not lessen the project area's visual quality. Consequently, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.11.2.5 Creation of Light or Glare

- ***Reef Construction***

Little additional light or glare is likely to accompany the placement of reef materials within the project site. As the project site is undeveloped and offshore, it has no permanent sources of artificial illumination; however, small points of light are temporarily visible when vessels pass through nearby ocean waters at night. Barges carrying project materials would be traveling back and forth at all hours with navigational lighting. The derrick barge, tugboats and materials barges would also be moored at the project site overnight with navigation and hazard lighting. However, these would be small points of light similar to what is found in the area currently.

Due to the highly reflective nature of water, a substantial amount of glare is currently evident in the project area during daylight hours, particularly on clear days. The project site's distance offshore minimizes the potential for construction-related glare to be transmitted to sensitive receptors. Material placement activities would occur only during daylight hours. The barges would tend to appear darker than the surrounding reflective water, and would be unlikely to bring any new glare into the area. Furthermore, due to the proximity and abundance of onshore sources of light and glare such as established development, and existing offshore glare from the ocean surface, nearby sensitive receptors would experience little or no change in the amount of perceptible light or glare. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Experimental Reef and Mitigation Reef***

The 22.4 acres of experimental reef modules and 127.6 to 277.6 acres of mitigation reef would be submerged 0.6 mile offshore and indiscernible to the sensitive receptors. Because the reefs would contain no sources of light or glare, its presence would not alter the amount of perceptible light or glare in the project area. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

- ***Reef Monitoring***

The monitoring activities associated with the experimental reef would require the presence of one to two small watercraft and several divers within the project site at various times during the year. These activities are not expected to introduce any new light or glare into the project area. Consequently, this is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.12 Cultural Resources

4.12 Cultural Resources

This section analyzes the potential impacts of the proposed project on cultural resources including paleontological, archaeological, historical and ethnographic resources. Cultural resources consist of places or objects that are valued for scientific, historical or religious reasons. Cultural resources include prehistoric archaeological sites, architectural remains, historic remains, shipwrecks, isolated artifacts and other material objects which provide evidence of past human activities. Certain places may be protected as important cultural resources because of their value to a culture for traditional and religious reasons. The data sources and environmental setting are described first in this section, followed by a discussion of the regulatory framework designed to protect cultural resources. The section concludes with an evaluation of the potential impacts and recommended mitigation measures.

Cultural resources were evaluated for the proposed project site only. Cultural resources at the rock quarries, recycled concrete brokers and shipping ports were not evaluated because these are all existing, permitted operations.

4.12.1 Environmental Setting

The project site is located approximately 0.6 mile off the coast of the City of San Clemente in Orange County, California. The area of potential effect (APE) consists of all of the 862-acre lease area, located near the southern end of the City of San Clemente, just north of San Mateo Point to just north of the San Clemente Pier. The entire APE is located in the Pacific Ocean, entirely within the USGS San Clemente and Dana Point Quadrangles. The proposed project would involve placing quarry rock and/or recycled cement on the ocean floor in water ranging from about 39 to 47 feet deep. Quarry rock and recycled concrete would be obtained from commercial sources that are in compliance with environmental permitting requirements. The environmental setting for each resource area is described below.

4.12.1.1 Paleontological Resources

The proposed lease site is situated on the San Onofre Shelf. The San Onofre Shelf runs between Dana Point and Oceanside and is about three to five miles wide and extends seaward to about 300 feet in depth. According to a report prepared by Eco-M (1997), Map Sheet No. 26 of the California Division of Mines and Geology's (DMG) *Offshore Surficial Geology of California* (1975) indicates that the surficial deposits in water depths of less than 105 feet are dominated by fine to coarse sand and gravel of late Pleistocene age and lenses of Holocene mud deposits. Most of the sediment originated from the outflow of large river deltas, with additional material coming from coastal erosion. Evidence suggests that sea level may have been about 100 meters (330 feet) lower during the Pleistocene glacial stage (Norris and Webb 1990). The present sea level was reached about 3,000 to 5,000 years ago (Nardin et al. 1981).

The Capistrano formation was deposited in the Capistrano Embayment. According to the DMG, the Capistrano formation contains late Miocene to early Pliocene foraminifera and megafossils are sparse (1974). However, fossil brown alga (kelp) was collected from the Late Miocene Capistrano formation one kilometer (km) south of Capistrano Beach Pier (Emery 1960). In addition, a fossil baleen whale was discovered in the Capistrano formation in Laguna Hills, California. The latter was likely collected from the Oso member of the Capistrano formation from which sharks' teeth and marine vertebrate remains were recovered (DMG 1974). The Oso member was deposited in the northeastern part of the Capistrano Embayment and is not believed to be present beneath the project site.

4.12.1.2 Archaeological Resources

- ***Regional Overview***

Two major cultural groups are known to have occupied the territory in the region of the project site. The San Dieguito were the first known inhabitants of the southern California coastal region. It is generally accepted that they occupied the area as early as 9,000 years ago (Gallegos and Strudwick 1994). Ancestors of the Juaneño/Luiseño moved into the region during the Late Period, starting about 1,300 years ago, as part of a large immigration of Shoshonean-speaking people. The occupation of southern California during the Early Period, from about 13,000 to 9,000 years ago, is highly controversial and not well documented (Moratto 1984; Gallegos and Strudwick 1994).

It is generally believed the San Dieguito occupied the south coastal region continuously from about 9,000 to 1,300 years ago. This occupation is termed the La Jolla and Pauma Complexes (Gallegos and Strudwick 1994). They hunted, fished, milled plant foods and collected and processed shellfish. Most of the archaeological sites associated with the San Dieguito are coastal shell habitation sites, inland hunting and milling campsites and quarry sites.

Occupation of the project vicinity post-1,300 years ago (Late Period) is well demonstrated by the numerous Shoshonean habitation sites, presumably ancestral to the ethnographic Juaneño/Luiseño (Bean and Shipek 1978; Gallegos and Strudwick 1994). The territory of the Juaneño/Luiseño comprised 1,500 square miles of coastal southern California (Bean and Shipek 1978). Their territory extended from about Agua Hedionda Creek in San Diego County on the southern boundary, inland to Lake Henshaw, north into Riverside County and along the coast to Aliso Creek (near Laguna Beach). This territory crosses numerous ecological zones and includes the ocean, sandy beaches, shallow inlets, marshes, coastal chaparral, lush interior grassy valleys, extensive oak groves and pines and cedars on top of Mt. Palomar (Bean and Shipek 1978).

- ***Prehistoric Offshore Setting***

During the Pleistocene epoch or Ice Age, from about 70,000 years before the present (B.P.) until 10,000 B.P., the southern California shoreline underwent numerous changes. As the ice shields in the northern hemisphere expanded, so much water was trapped in the glaciers that the sea levels dropped and continental shelves were exposed around the world (Hopkins 1979). During the late Pleistocene, approximately 10,000 years ago, the southern California shoreline stood almost 500 feet (ft) offshore from where it is today (Masters and Flemming 1983) and the sea level was about 180 ft (60 m) below the present level (Emery 1969).

Evidence of the first human occupation of southern California is the subject of debate. However, it is generally accepted that California was occupied during the late Pleistocene epoch. Moratto (1984) states that "there can be little doubt that California was inhabited, albeit sparsely, between 15,000 and 10,000 years ago."

Some evidence indicates that the first people to locate along the southern California coastline settled in places that are now submerged beneath the ocean (Moriarty 1961; Hudson 1976). A number of submerged archaeological sites have been located off the coast of southern California. Many of these sites contain a variety of prehistoric artifacts, including manos, metates, choppers and pestles (Moriarty 1961; Bickel 1978; URS 1986). Some of these *in situ* preserved prehistoric sites off the shoreline of southern California occur in water as deep as 492 feet (URS 1986). However, most of the known submerged archaeological sites and associated artifacts are located in relatively shallow water.

Many of the shallow water sites may be the result of cliff erosion and are most likely associated with archaeological sites located on the cliffs above. Other submerged artifacts are the consequence of random loss and some may have been purposefully discarded in association with ceremonial rituals or other events.

Investigations of the southern California coastline have turned up submerged archaeological material at Solana Beach, Cardiff, Encinitas and Oceanside and numerous sites have been documented in the Santa Barbara Channel (Moriarty 1961). The majority of the known *in situ* submerged prehistoric sites in California are located in relatively calm waters, such as estuarine environments or in the lee of a point of land (URS 1986; Hudson 1976).

As noted earlier, a literature search was conducted through the South Central Coast Information Center (SCCIC) to identify the location of cultural resources in the project area. There are no known submerged prehistoric sites located within the APE of the proposed project or in close vicinity to the project site. There has not been a systematic survey of the project site; however, the project site does not have the necessary preservation conditions for submerged prehistoric sites as outlined by Hudson in the book *Marine archaeology along the Southern California coast* (1976).

Preservation of submerged prehistoric sites depends on relatively calm, protected water. The proposed project is located in an open water environment with very little protection from the constant storm surges and swells of the southern California coast. The sandy bottom sediments are constantly shifting, making it extremely unlikely that prehistoric artifacts would be present *in situ* in such settings.

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According to Bickel (1978), the most sensitive areas for offshore and submerged archaeological sites in San Diego County occur around large bays or lagoons where fresh water was prehistorically available year round. The closest major freshwater source to the project site is San Mateo Creek and its estuary. This drainage is located south of the project site well outside of the project APE. However, it is possible that the perennial San Mateo Creek flowed in the project vicinity during the late Pleistocene epoch, making the southern boundary of the project site moderately sensitive for submerged archaeological sites.

Four onshore prehistoric archaeological sites and one isolate were identified within a one-mile radius of the project site. These sites include 30-000022, 30-000101, 30-000103 and 30-000599. All of these sites are located well outside the project APE.

4.12.1.3 Historic Resources

Submerged historic properties include sunken ships, boats and other vessels such as barges, cargo or fittings (e.g., anchors) lost from vessels, sunken navigational equipment such as buoys, sunken aircraft and various sorts of industrial equipment related to activities such as offshore oil development.

Spanish colonial period shipping in the area would have been infrequent, although ships may have anchored near Dana Point to bring passengers or supplies to Mission San Juan Capistrano. According to Richard Henry Dana (1840), pirate ships reportedly visited the area in the late eighteenth and early nineteenth centuries. There is also limited evidence of Chinese junks or other Asian vessels having been swept to the California coast and sunk, although this has been questioned (Moriarty 1975; Stickel 1983).

Historic shipwrecks and other submerged historic resources within the project vicinity are enumerated in a database maintained by the California State Lands Commission (CSLC), as detailed below (also see Table 4.12-1). A SCCIC records search failed to reveal any additional data. Other data sources examined included Michel (1975); Pierson (1980); and Pierson, Shiller and Slater (1987).

Three known historic shipwrecks lie within five miles of the project site:

- The *Agram* is recorded as having sunk at San Clemente in 1940 (Marshall 1978); no particulars on the vessel are available. The plotted location directly along the beach is assessed as probably being within 2,000 meters of the actual location. This distance would potentially place the wreck within the project site (CSLC database). However, the wreck may have been salvaged (Pierson 1980).

- The *Kitty-A* is recorded as having sunk "at San Mateo Pt." in 1941 (Pierson, Shiller and Slater 1987); the only additional information on this vessel is that she was built in 1856.

Table 4.12-1 Shipwrecks

Shipwrecks					
Vessel Name	**Vessel Type**	**Built**	**Lost**	**Displacement (tons)**	**Location/Loss Situation**
Agram	---	---	5/18/40	---	Wrecked at San Clemente
Ace #1	Barge	1944	4/28/48	96	Foundered off Dana Point
Stranger	Oil Screw	1918	7/17/48	90	4 miles west of San Onofre
New Saturnia	Screw MS	1936	11/4/55	116	Foundered two miles west of Dana Point
Onward	---	---	---	---	---
Western Pilot	---	---	---	---	8 miles ssw of Dana Pt.
Kitty-A		1856	1941		Sunk at San Mateo Point
New Rex	Oil Screw	1919	1952	113-ton	3.5 miles off of Laguna
Nerda	Barge	1918	1936	53-ton	6 miles off of San Clemente

- The *Stranger* is recorded as having sunk four miles west of San Onofre in 1948 (Marshall 1978). This 90-ton oil screw vessel was built in 1918; no other particulars are available, except that Pierson (1980) indicates part of the cargo was salvaged. The plotted location is assessed as probably being within 2,000 meters of the actual location. This distance would potentially place the wreck within the project site (CSLC database). According to Pierson (1980), however, the wreck has only been pinpointed within ten nautical miles.

Seven additional wrecks and submerged resources are recorded within ten miles of the project site:

- The *Western Pilot*, a 113-ton oil screw vessel, was built in 1933 and burned and sank eight miles south-southwest of Dana Point in 1953 (CSLC database). In some records *Western Pilot* is referred to as *Western Point* (Pierson, Shiller and Slater 1987).

- The *Onward*, a 51-ton oil screw vessel, was built in 1919 and burned and sank in 1950; latitude and longitude readings place it near the *Western Pilot* (CSLC database). If this is correct, the location description "5 miles southwest of Catalina Harbor" (CSLC database) is incorrect; it would be more than 20 miles east of Catalina Harbor.

- The *Nerda*, a 53-ton barge, was built in 1918 and lost in 1936, six miles off San Clemente (Pierson, Shiller and Slater 1987).

- The *New Saturnia*, a 116-ton screw vessel, was built in 1936 and sunk in 1955, two miles west of Dana Point (CSLC database).

- The *Ace #l*, a 96-ton barge, was built in 1944 and sank in 1948 in ten feet of water off Dana Point (CSLC database).

- The *New Rex*, a 113-ton oil screw vessel, was built in 1936 and sank in 1952, 3.5 miles off Laguna (CSLC database).

- A Japanese aircraft sank in 90 feet of water northwest of Dana Point (CSLC database).

The lease site has been directly examined by several teams of divers and has been subjected to extensive side scan sonar testing. The project site was found to be 96 percent clear sand bottom with no visible interruptions (SCE 1997a). Coastal Resources Associates, the firm that conducted the surveys, indicated that their team has performed underwater archaeological surveys in the past and is very familiar with underwater historic materials. Although these surveys were not specifically conducted to examine cultural resources, the team confirmed that no cultural resources were observed in the area during their surveys (Dean 1997). No magnetometer surveys have been conducted in the area, and with strong sea surges such as characterize the southern California coast, it is possible that wreck remains could be obscured by sand. Nonetheless, the sand veneer is shallow in the project site (0.5 to 1 m), and obvious wreck remains are not present within the lease site.

4.12.1.4 Ethnographic Resources

The experimental reef and mitigation reef would be located off the shoreline of San Clemente, within the traditional territory of the Luiseño people. In earlier years, ethnographers such as Kroeber (1925), Strong (1929) and Harrington (1934) drew a distinction between the Juaneño, attached to Mission San Juan in San Juan Capistrano, and the Luiseño, associated with Mission San Luis Rey near Oceanside. By that division, the project site is within Juaneño territory. Later authorities (White 1963; Bean and Shipek 1978) decided that on both ethnological and linguistic grounds, the Juaneño and Luiseño people should be considered as a single ethnic group. Literature pertaining to the broader group of people has been examined in order to assess the likelihood of offshore cultural resources of ethnographic importance.

The Juaneño/Luiseño peoples lived not only along the coast but also in inland valleys and up to the crests of the Sierra, Santa Ana and Mt. Palomar. In coastal villages, people hunted and fished for finfish, crustaceans, mollusks (especially abalones) and sea mammals (Sparkman 1908). Lightweight tule rush boats (balsas) or canoes were used for fishing, and both dipnets and seines were used, as well as basketry fish traps, bone and haliotis shell hooks and harpoons (Kroeber 1925; Bean and Shipek 1978). Kroeber (1925) indicates that the canoes were dugouts carved from yellow pine that differed from the plank-built boats of the Gabrielino and Chumash peoples to the north. Juaneño/Luiseño people were brought into the missions in the late eighteenth century and it is likely that their indigenous maritime activities effectively ceased at that time.

Gabrielino territory extended north of Aliso Creek, between Laguna Beach and San Juan Capistrano (Bean and Smith 1978). Another Takic-speaking group, the Gabrielino, occupied a large territory extending east to San Bernardino, north to San Fernando and west to Malibu. The Gabrielino would be of little concern for present purposes, except that they also occupied several of the Channel Islands, including San Nicolas, Santa Barbara, Santa Catalina and perhaps San Clemente. People who lived on the islands depended heavily upon sea mammals, shellfish and finfish (Meighan and Eberhart 1953; Meighan 1959). Harpoons, spearthrowers and clubs were used in hunting sea mammals, and people traveled back and forth between the mainland and the islands in planked boats fastened with lashing and asphaltum (Blackburn 1962-63; Bean and Smith 1978). Villages at Redondo and San Pedro were intimately involved in trade with the islands (Kroeber 1925), and the Gabrielino were major suppliers of shell, dried fish, sea mammal pelts and steatite from Santa Catalina, important materials in trade networks that extended well into Arizona (Ruby 1970).

The planked boats of the Chumash people, who lived still farther north along the coast and occupied the islands of San Miguel, Santa Rosa, Santa Cruz and Anacapa, are better documented than those of the Gabrielino (Bolton 1930; Heizer 1938; Robinson 1942). Known as *tomol*, the boats were large (up to 30 feet long), holding between 12 and 20 people. Because of their plank construction, they were light and swift (Kroeber 1925). An eighteenth century *tomol* is illustrated with a sketch in Grant (1978).

Sinkings of maritime canoes at sea are considered likely, but it is unlikely that any evidence of such accidents would have been preserved in the high-energy offshore environment (Hudson et al. 1978; Continental Shelf Associates 1994). The more likely material associated with ethnographic fishing and mainland-to-island canoe voyages would be isolated artifacts lost overboard; one common example is stone fishnet sinkers (Hudson 1976; Horne and Barnette 1982). There is also some indication that stone vessels may have been thrown into the sea for sacrificial purposes (Hudson 1976).

4.12.1.5 Regulatory Framework

A number of federal statutes, regulations and rules govern the protection of cultural resources in the project area. These include the following:

- Federal antiquities legislation including the Antiquities Act of 1906; National Historic Preservation Act of 1966; Executive Order 11593; and the Archaeological and Historic Preservation Act of 1979.

- American Indian Religious Freedom Act of 1978.

- Shipwreck Preservation Act of 1987.

The pertinent State legislation and local plans that govern the protection of cultural resources in the project area include the following:

- The California Environmental Quality Act (CEQA) and the CEQA Guidelines (Sections 21083.2 and 21084.1 and Appendix K).
- CCC Guidelines for Permitting Archaeological Investigations.
- CSLC policies and procedures.
- Orange County Coastal Plan, Archaeological and Historical Resources Policies.
- Orange County General Plan Historical and Archaeological Site Policies.
- Native American Heritage Commission Guidelines (1989).
- The State Historic Preservation Officer (SHPO) has published a number of checklists which are broadly applicable: 1) adequacy of archaeological testing programs; 2) determinations of site significance and uniqueness; and 3) mitigation reports.

4.12.2 Impacts and Mitigation Measures

The potential environmental impacts of the proposed experimental and mitigation reef projects are discussed below. The section begins with a discussion of the methodology and follows with a description of the significance criteria used to determine the potential impacts of the proposed project. The final section is an evaluation of the potential direct and indirect impacts of the proposed project on paleontological, archaeological, historical and ethnographic resources.

4.12.2.1 Methodology

A literature search was conducted to identify documented offshore cultural resources and to assess areas of sensitivity within the project site. This information was gathered from several sources, including references from the California State Library and the library at California State University, Sacramento. Information on the location of shipwrecks was developed through a review of the CSLC shipwreck database and consultation with the National Park Service submerged cultural resources unit in Santa Fe, New Mexico.

A records search was conducted, through the SCCIC, of the California Historical Resources Information System at UCLA. This search included an examination of all recorded historic and prehistoric archaeological sites within a one-mile radius of the project site, as well as a review of all known cultural resource survey and excavation reports. The search also included a review of the California State Historic Resources Inventory, the National Register of Historic Places (NRHP), the listing of California Historical Landmarks, the California Points of Historical Interest and the CSLC

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The potential impacts of the proposed project were assessed through the following process: 1) defining the agents or causes of impact from the proposed project; 2) outlining the APE of the proposed project; 3) identifying the location of any known cultural resources in the project vicinity; 4) identifying the sensitivity or likelihood of the occurrence of significant cultural resources within the APE; and 5) evaluating the significance of those resources and assessing the degree to which the project would affect their significant aspects.

The APE includes the 862-acre lease area and within this the 356 acres of the project site for the construction of the experimental reef and mitigation reef.

4.12.2.2 Significance Criteria

For the purposes of this environmental assessment, an impact would be considered significant if the project would adversely affect an important archaeological resource, as defined in Appendix K of the CEQA Guidelines and 36 CFR 60.4. Important cultural resources include recognized sites of national, State and local importance that are listed on or eligible for the NRHP or are designated as National Historical Landmarks, California Historical Landmarks, or local Landmarks.

Specifically, the CEQA Guidelines indicate that an impact would be considered significant if an action would: 1) disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic social group; 2) disrupt a paleontological site except as a part of a scientific study; 3) have the potential to cause a physical change, which would affect unique ethnic cultural values; or 4) restrict existing religious or sacred uses within the potential impact area.

Appendix K of the CEQA Guidelines defines an "*important paleontological, archaeological, ethnographic, or historic resource*" as one which: 1) is associated with an event or person of either recognized significance in California and American history, or recognized scientific importance in prehistory; 2) can provide information which is both of demonstrable public interest and useful in addressing scientifically consequential and reasonable or archaeological research questions; 3) has a special or particular quality such as oldest, best example, largest or last surviving example of its kind; 4) is at least 100 years old and possesses substantial stratigraphic integrity; or 5) involves important research questions that historical research has shown can be answered only with archaeological methods.

Any damage to a cultural resource determined to be "important" based on the criteria outlined above would be considered a significant impact.

4.12.2.3 Paleontological Resources

Construction of the experimental reef and mitigation reef would involve the placement of concrete and rock upon unconsolidated Quaternary sediments and/or Upper Miocene - Lower Pliocene age sedimentary bedrock. Potential impacts to paleontological resources involve the possibility that construction of the reef could bury significant fossils contained in these formations. However, neither the Quaternary sediments nor the bedrock is expected to contain important or significant micro- or megafossils. Construction of the proposed reefs would not involve excavation. Consequently, the subsurface and any potential fossil remains would not be disturbed. If fossils do exist in sediments and bedrock beneath the site, they would not be destroyed or removed. Following construction, neither the presence of the reefs nor the monitoring would disturb sediments or bedrock. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.12.2.4 Archaeological, Historic and Ethnographic Resources

Although there are no known archaeological resources in the APE, two types of prehistoric remains may occur within the water depths associated with the experimental reef and mitigation reef project lease site. These are:

(1) *in situ* prehistoric remains that pre-date the Holocene Transgression and that are situated on relict, submerged landforms, either mantled with unconsolidated marine sediments or exposed on bedrock outcrops; and

(2) remains deposited subsequent to the Holocene Transgression and situated on the seafloor or within unconsolidated recent sediments. These remains would consist primarily of isolated prehistoric and historic artifacts (CSLC 1986).

Although three historic shipwrecks are recorded within the project vicinity, none has been physically located. Potential NRHP eligibility of the wrecks of the Agram, the Stranger, and the Kitty A. has not been determined and cannot be determined on the basis of available data. All three are more than 50 years old, but neither the precise location nor the condition of the wrecks is known, nor is the extent of possible salvage known. None of the wrecks has been physically located and the project site has been examined by side-scan sonar and divers without the identification of potential submerged resource locations. It is likely that remains of the wrecks lie outside of the project site.

The likelihood of unrecorded wrecks within the project site is relatively low. The project site is not located on an approach to a major shipping or fishing port, which diminishes the probability of ship or fishing boat wrecks. There is, however, a small boat harbor at Dana Point. Thus, aside from the larger vessels for which records are likely to have been kept, numerous small recreational boats (e.g., sailboats, motorboats) have frequented this stretch of the coast and continue to do so. Sinkings may have occurred, but it is likely that most would be less than 50 years old.

Underwater surveys conducted by Coastal Resources Associates, which included side-scan sonar, did not identify historic resources in the lease area (Dean 1997). No magnetometer survey has been conducted in the area, and with strong sea surges such as characterize the southern California coast, it is possible that wreck remains could be obscured by sand. This is unlikely due to the shallow sand in the project area, and obvious wreck remains are not present within the project site.

The only possible ethnographic resources are archeaological resources deposited subsequent to the Holocene Transgression. As previously noted, these are unlikely to occur *in situ* in the project environment.

The proposed experimental reef and mitigation reef would be constructed in areas that are underlain by bedrock and thinly covered by sand. The lease area is a high energy dynamic environment in which the thin cover of sand is readily moved by waves and currents. These physical conditions essentially preclude the presence of *in situ* cultural remains from the Holocene. Furthermore, due to the high energy environment of the project area, isolated prehistoric and historic artifacts potentially found in the project area would not be *in situ*. Restricting the proposed project actions to areas that have these physical conditions is an important element in meeting the biological goals and objectives of the project. This is also important to assuring that archaeological resources are not affected. This key element applies to all phases of the project, including construction, the presence of the reefs and the monitoring of the reefs.

Construction of the proposed reefs would not involve excavation. Thus, the subsurface and any isolated artifactual remains, fragmentary shipwreck remains and archaeological remains of ethnographic significance that might be buried in the shallow sands would not be destroyed or removed. This is considered a less-than-significant impact.

Mitigation Measures

- None required.

4.13 Recreation

4.13 Recreation

This section addresses recreation issues related to implementation of the proposed actions. The environmental setting describes the existing recreational uses and facilities, along with any applicable plans and policies. The impacts and mitigation section evaluates the proposed project's potential effects on recreational uses, facilities and plans, and recommends mitigation where necessary to reduce or eliminate any significant adverse impacts identified.

4.13.1 Environmental Setting

The southern California coast is a unique natural resource attracting thousands of recreational users due to its aesthetic beauty, wildlife, surf and temperate climate. The beaches of southern California are some of the most famous recreation areas in the world. The popularity of the region puts increasing pressure and demands on the recreational resources within the coastal areas. The beaches of the San Clemente area are easily accessible to the surrounding major population centers including Orange County, immediately onshore from the proposed lease site, Los Angeles County to the north and San Diego County to the south. Over two million visitors each year are drawn to the beaches of the San Clemente region and demand for beach-related recreation has historically risen faster than the rates of population increase (City of San Clemente 1993b). Popular recreation activities include surfing, camping, boating, fishing, diving, swimming, walking and jogging.

4.13.1.1 Recreation Facilities

The study area considered in this analysis includes the coastline from Linda Lane Park in the City of San Clemente to the San Onofre Nuclear Generating Station. This length of coastline, approximately four miles long, includes all of the existing recreation areas that could potentially be affected by the construction within the project lease area, and those recreation areas from which the project lease area may be observed (see Figures 4.13-1 and 2).

- ***City of San Clemente Facilities***

The City of San Clemente manages 20 acres of beach along a 2-mile stretch of coastline (City of San Clemente 1988a). There are 12 beach access points within the City limits of San Clemente, six of which access City beaches located within one-half mile of the proposed project site. These access points, from north to south, include: Linda Lane City Park; Parque Del Mar/San Clemente Municipal Pier; "T" Street; Leslie Park, also known as Calle De Los Alamos; Riviera; and Calafia Beach Park. The facilities are discussed in publications developed by the City of San Clemente (1988b, 1997), and are briefly summarized in the following.

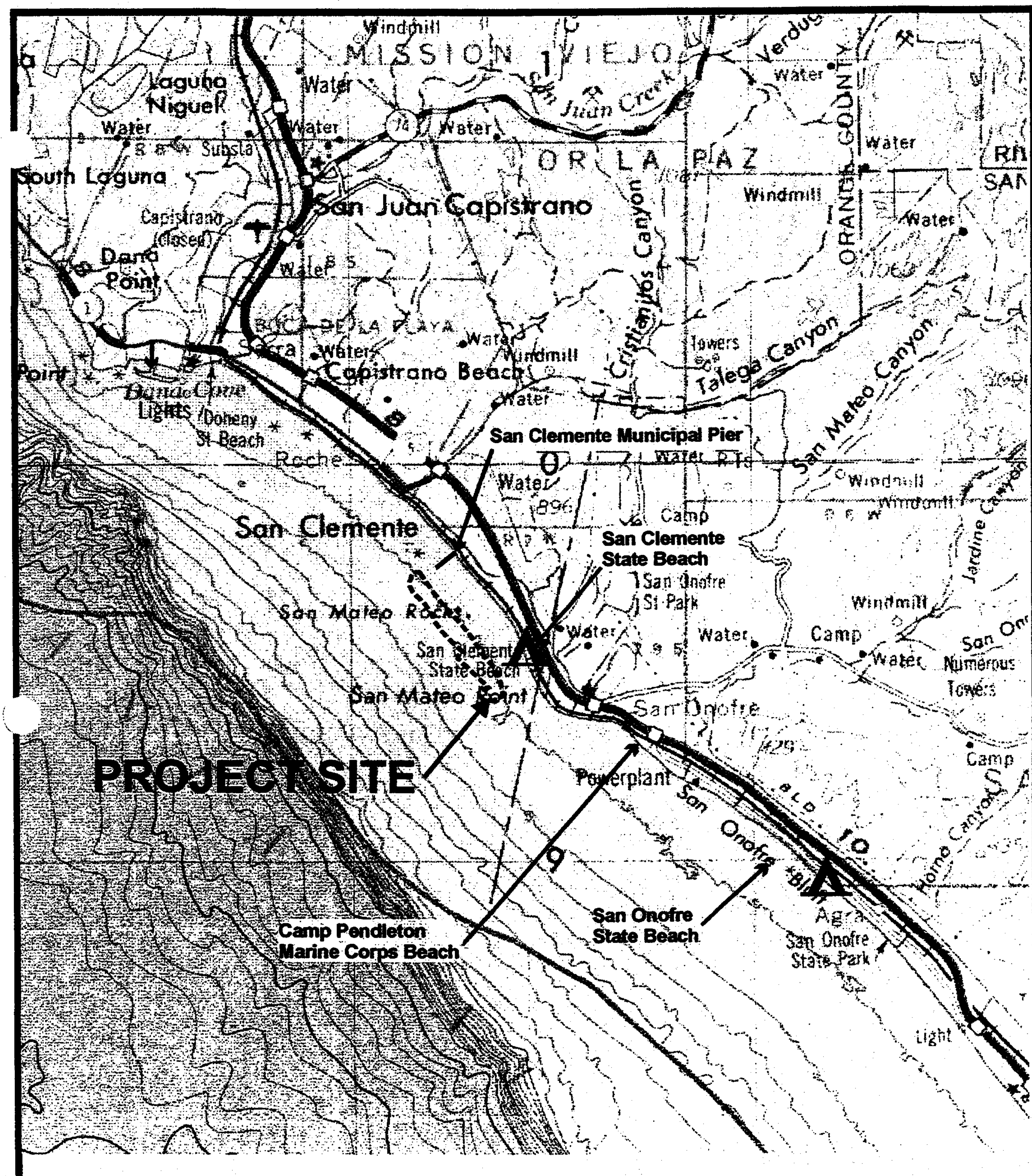

Figure 4.13-1
Recreational Resources Study Area Map

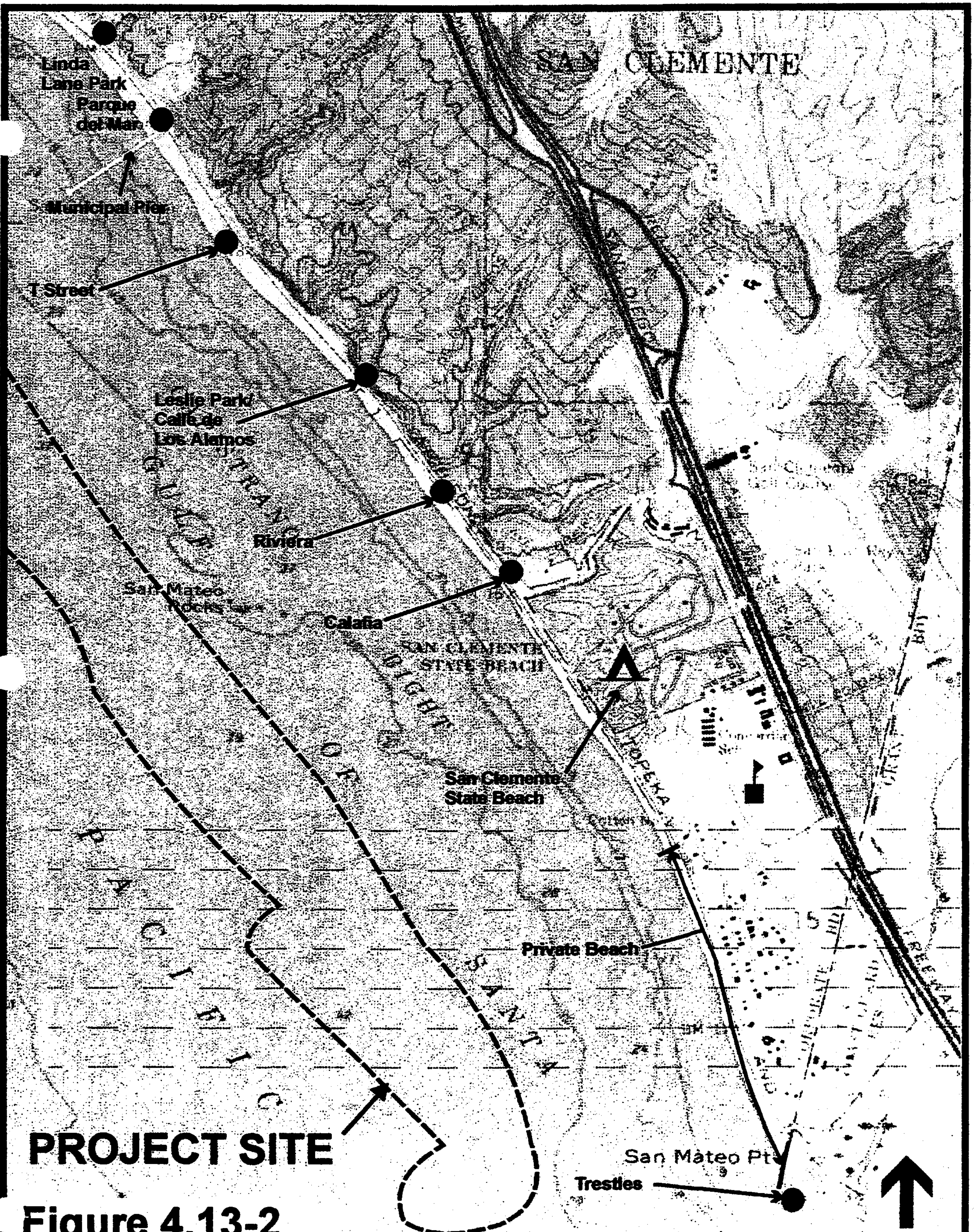

Figure 4.13-2
Beach Access Points

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Linda Lane City Park. Linda Lane City Park is located on the coastline approximately 0.6 mile east of the proposed project area. The park represents the northern limit of the recreation study area boundary. Facilities available at the four-acre park include approximately 135 metered parking spaces, a children's play area, picnic tables and restrooms.

Parque Del Mar. Parque Del Mar includes parking and amenities associated with the San Clemente Municipal Pier. The 1,200-foot pier is considered the focal point of the San Clemente beach area. A bait and tackle shop and a restaurant are located at the end of the pier. The beach area adjacent to the pier provides volleyball courts, barbecues/firerings, a children's play area and approximately 270 metered parking spaces. Facilities include picnic tables, restrooms and food concessions available near the beach access point.

"T" Street Beach. The "T" Street beach access is located at the foot of Avenida Esplanade, but is named after the nearby Trafalgar Lane. This beach is considered the second most popular beach along the San Clemente coast. This site provides barbecues/firerings, a children's play area, picnic tables, restrooms, showers and food concession for recreationists. A total of 150 metered and non-metered parking spaces are available, with beach access provided by a pedestrian railway overpass.

Leslie Park/Calle de Los Alamos. Leslie Park, or Calle de Los Alamos, is a small grassy area with an ocean view located within a residential neighborhood. Access to the beach is provided by an easement between two residences that continues down a ravine to the beach. Approximately 50 on-street parking spaces are available.

Riviera Beach. The Riviera beach access is located in a residential area just south of Leslie Park. A concrete footpath and stairway lead to a tunnel underneath the railroad tracks, providing access to the beach. There are picnic tables and approximately 50 on-street parking spaces.

Calafia Beach. Calafia Beach is located adjacent to and north of San Clemente State Beach. Picnic tables, restrooms, showers and food concessions are available at the site. There are approximately 190 non-metered parking spaces available. The proposed lease area is located approximately 0.6 mile directly offshore of Calafia Beach Park.

4.13.1.2 California State Parks

Two California State Parks, San Clemente and San Onofre State Beaches, are located in the proposed project vicinity. These parks are managed by the California Department of Parks and Recreation (CDPR) for their ecological and recreational values. The parks are described in dated and undated CDPR publications (CDPR 1984, n.d.) and in publications developed by the City of San Clemente (1988b). These are summarized in the following. Generally speaking, the most popular uses of San Clemente State Beach includes camping and surfing. The uses at San Onofre State Beach are primarily swimming and surfing.

San Clemente State Beach. The San Clemente State Beach consists of 110 acres of beach and upland area with 6,000 feet of coastline. The beach and the upland areas are separated by seventy feet of sandstone cliff. Most of the improvements at the site are located on top of the bluff overlooking the ocean. Facilities provided include 157 family campsites with barbecues and firerings, one 50-person group campsite, 60 picnic sites, restrooms, showers and nature trails. There are approximately 200 day-use parking spaces available at the State Beach. The proposed project is located approximately 0.6 mile offshore of San Clemente State Beach.

San Onofre State Beach. The San Onofre State Beach is divided into two beaches by a stretch of shore under the jurisdiction of the Camp Pendleton Marine Corps Base. The area from Camp Pendleton north is known as Trestles Beach and the area from Camp Pendleton south to the SONGS property is known as the San Onofre Surf Beach.

There are no improvements at Trestles Beach, which is accessible via a 1.5-mile bike/pedestrian trail. There are portable toilets and trash cans located at the end of the access trail. Trestles is a popular surfing beach. There are approximately 145 available parking spaces located east of I-5 at Cristianitos Road. The southern edge of the project site is located 0.6 mile offshore and just north of San Onofre State Beach.

San Onofre Surf Beach has day-use parking, picnic tables, barbecues, firerings, drinking water, showers and restrooms. The southern edge of the project site is located 0.6 mile offshore and north of San Onofre State Beach.

4.13.1.3 Harbors

Many of the offshore recreationists who use the project lease area, including boaters, fishermen, sailors and SCUBA divers, access the area from nearby harbors. Harbors provide boat ramps and storage slips, fuel and tourist information, which are important to the offshore recreation in the area. The most important harbor in the project vicinity is Dana Point Harbor.

Dana Point Harbor is located approximately five miles northwest of the project lease area and is the closest access point to the lease area. The harbor is a full service facility offering a marina with 2,500 vessel slips, 50 guest slips for transiting boats, a ten-lane launch ramp, dry boat storage, fishing pier, shipyard, marine fuel dock, three yacht clubs and a recreational sport fishing business (Dana Point Harbor 1997). The recreational sport fishing business also offers whale watching tours during the appropriate seasons. The Orange County Marine Institute is located at Dana Point Harbor, and provides daily cruises to the public to observe marine life offshore. Also located at the Institute are a museum displaying marine life and a replica of the brig “Pilgrim” on which Richard Henry Dana first sailed into Dana Cove.

The harbor facilities at Oceanside, Newport Harbor and the Port of Long Beach are also used to access the project vicinity (Hughes 1997a). Oceanside Harbor is 17 miles south of the project area, Newport Harbor is 23 miles north of the project area and the Port of Long Beach is located 59 miles north of the project area.

4.13.1.4 Recreation Activities

Most of the recreation activities in the proposed project vicinity are water-dependent, i.e. boating, diving, fishing, surfing, sea kayaking and swimming; or water-enhanced, such as camping, picnicking, sunbathing, walking and scenic and wildlife observation. Families and individuals in the area often spend the day or the weekend at the beach engaged in a number of recreational activities, as briefly described in the following.

Beach Activities. Recreationists enjoy a variety of activities on the sandy beaches near the project site. Sunbathing is a popular summertime activity, as are beach combing, volleyball, walking, jogging, picnicking, tidepooling, diving and swimming. During the colder winter months recreationists enjoy wildlife viewing, jogging and walking along the beach.

SCUBA Diving. There is very little SCUBA diving off the sandy beaches near San Clemente. Most of the good SCUBA diving locations are found at least one-third mile offshore, therefore most divers access the diving sites by boat from Dana Point, Newport and Long Beach Harbors. The majority of the boats are privately owned, but some commercial operators charter dive trips to the nearby San Mateo Rocks. The diving conditions are often murky with low visibility, which limits the number of SCUBA divers in the area.

Camping. Overnight camping facilities are located at the San Clemente State Beach. Many families spend the evening camping and the daytime playing on the beach. The campground is often full during the summer months between Memorial Day and Labor Day weekends.

Boating. The types of vessels used in the project vicinity include sailboats, motor boats and sea kayaks. Jet skis are not common in the project area because the closest access point is the Dana Point Harbor and most of the jet skis do not have the fuel tank capacity to reach the lease area from Dana Point Harbor. According to Jack Roggenbuck of the CDPR, sea kayaking is becoming increasingly popular in the San Clemente area (Roggenbuck 1997).

Fishing. Sport fishing is a popular year-round activity in the project vicinity, involving the use of private vessels and commercial passenger-carrying fishing vessels. Most of the fishing vessels that use the project area depart from Dana Point, Newport and Long Beach Harbors. Weekends and summer days are the busiest times for the sport fishing recreationists, but some private vessels utilize the area at all times of the year.

The majority of the fishing in the project vicinity occurs from motor boats and most of the boat fishing is done inside the San Mateo kelp bed where the bass live. Sand bass and calico bass are the primary target species with some bonita and yellow tail caught now and then.

There is some onshore fishing from San Clemente State and City beaches, however the majority of onshore fishing in the project vicinity occurs from the San Clemente Pier.

- ***Surfing***

Surfing is a popular sport constituting a large portion of the recreational use in the project vicinity. The coastline adjacent to the proposed artificial reef site offers some of the highest quality surfing conditions in California. San Mateo Point and San Onofre State Beach are major destinations for surfers.

The following is a description of the surfing locations in the project vicinity. Much of this information is derived from *The Surf Report, A Journal of Worldwide Surfing Destinations* (Orange County-California, Vol. 6, No. 10, October 1985, Revised 4/95), and from Stearn and Cleary (1977).

City of San Clemente Beaches. Conditions at the San Clemente beaches are optimal during late summer southwesterly swells. Beaches to the south are more popular with beginning surfers. The breaks of Lasuen/Lost Winds and Riviera are located between T Street and San Clemente State Park. This section of beach generally does not offer high quality waves and accordingly is often a less popular destination for surfers.

Experienced surfers prefer "T" Street beach and the pier, both of which generally offer the best-shaped waves along this stretch of coastline. Surfing is allowed at all times on the north side of the pier, but is restricted on the south side of the pier between 10am and 6pm during the summer months. .

San Clemente State Beach. The beach along San Clemente State Beach between Calafia and San Mateo Point picks up most swells, but generally does not offer high quality surfing waves.

Trestles Beach. The breaks on the point can be very crowded, especially during summer months. Access to the site is: 1) via the 1.5 mile trail from the Cristianitos Road; 2) by walking along the coast from San Onofre Surf Beach to the south; or 3) by walking from San Clemente State Beach to the north. The lack of access results in surfers being the almost exclusive users of these beaches.

Trestles beach is considered "One of the premier point breaks in California" (Surf Report 1995), and is a very popular destination for all kinds of surfers. Upper Trestles is situated immediately north of the outlet of San Mateo Creek and can be surfed at all tides on any swell. Lower Trestles is located just south of the outlet of San Mateo Creek. Often more crowded than Upper Trestles, Lower Trestles is the site of professional and amateur surfing competitions.

Church's. Church's is located south on the point from Lower Trestles and is often crowded. Many of the surfers at Church's park on the north side of San Onofre State Surf Beach and walk along the beach to reach the break.

Cotton's Point. Cotton's Point is located at the north end of San Mateo Point on the Orange/San Diego County Line. Cotton's Point is less consistent surf, and is often less crowded.

San Onofre Surf Beach. San Onofre is a portion of San Onofre State Beach, which is limited to day use. The beach offers one of the best long board surfing waves in California and is especially popular on summer swells. San Onofre is equally popular among experienced and beginners.

There are several separate breaks along the beach, with the two most popular and best breaks being The Point and Old Man's. The Point is located on the northern end of the beach and has beachbreak-like surf. Old Man's is the classic longboard break of southern California. Located in the middle of San Onofre Surf Beach, Old Man's is very popular on summer weekends.

4.13.1.5 Applicable Plans and Policies

The onshore recreation areas fall under a variety of local, State, and federal plans, policies and laws, including the *San Clemente State Beach General Development Plan*, the *San Onofre State Beach Revised General Plan*, the *City of San Clemente Parks and Recreation Master Plan*, the *City of San Clemente General Plan*, the *Orange County General Plan: Advance Planning Program Recreation Element*, the *California Coastal Act*, and the *Coastal Zone Management Act*. All of these plans and policies were reviewed for consistency with the proposed actions.

4.13.2 Impacts and Mitigation Measures

4.13.2.1 Methodology

Information was gathered on recreation sites and activities in the vicinity of the project by reviewing existing literature and local planning documents and by interviewing recreation managers at sites within the study area. In addition, managers at several southern California beaches that have persistent kelp forests offshore were contacted to obtain information about kelp clean-up. The report by Elwany et al, 1998, contained in Appendix F, was prepared for this analysis to collect information about effects of the project on wave action, beach erosion, and of kelp wrack on beaches.

The elements of the proposed project were compared to the applicable goals and policies found in relevant local planning documents, and State and federal law. The evaluation focuses upon whether the proposed experimental reef and mitigation reef support the general intent of the planning documents, and determines whether any of the proposed actions would preclude goals from being achieved.

4.13.2.2 Significance Criteria

For this analysis, recreational impacts are considered significant if they cause interference with coastal access, recreational facilities or recreational use. Specifically, this would be significant if the project resulted in recreationists abandoning a site within the project vicinity in favor of another area due to project-related impacts. An impact would also be considered significant if it has the potential to cause the degradation of a significant recreational resource.

4.13.2.3 Proximity of Reef Construction to the Beaches

The construction of the experimental reef and the mitigation reef at distances of 0.6 mile or greater would be visible to people using the adjacent beaches. The aesthetics evaluation conducted for this PEIR (see Section 4.11) concluded that presence of the project-related tugboats, barges, and cranes would be consistent with the current vessel use in the area, which includes naval operations off Camp Pendleton. The noise estimates developed for this PEIR concluded that the noise associated with the construction of the experimental reef and the mitigation reef would not raise existing noise levels at the beaches. The effects of the construction on people using the adjacent beaches are considered to be less-than-significant.

Mitigation Measures

- None required.

4.13.2.4 Effects of Reef Construction on Boaters

People in boats could view and hear the experimental reef and mitigation reef construction activities at closer distances than 0.6 mile, where the tugboats, barges and cranes could be much more noticeable than onshore. However, the viewing of other vessels during boating, including working vessels, is common in this area and is an expected part of the recreation experience. Furthermore, boat operators would have the ability to avoid close proximity with other vessels, and they could turn away in multiple directions to avoid viewing and hearing the construction activities at the lease area. Because the project lease area is far from the existing harbors, boat operators would not be forced to come close to the construction activities. They would be able to adjust their headings early as they approach the project lease area to avoid the construction. The effects of the construction activities on people boating in the area is considered to be less-than-significant.

Mitigation Measures

- None required.

4.13.2.5 Effects of Excluding Other Uses During Reef Construction

Construction activities in the project lease area would make portions of the site unavailable for recreation for short periods of time. This includes the water surface immediately surrounding the tugboats, barges and cranes, and the subsurface within a safe radius of the construction activities. Excluding recreation from the water surface immediately adjacent to the construction vessels is necessary to assure safe navigation. Excluding recreation from the submerged areas is necessary to assure that people are not injured by falling concrete and quarry rock. The exclusion of recreational uses in the immediate vicinity of the construction activities affects a small area relative to the other opportunities for boating and diving that are available in close proximity. This is considered a less-than-significant impact.

Mitigation Measures

- None required. Recommended Mitigation.

  A Notice to Mariners should be published with the U.S. Coast Guard Waterways Branch. The notice should include information about the purpose of the project, construction activities and any safety hazards to the public.

  A similar notice should be posted at several locations at the Dana Point Harbor, including providing copies to the Sheriff's Harbor Patrol, charter boat businesses and dive shops. Temporary signs should also be posted at recreation sites, such as the San Clemente Pier and at the mouth of San Mateo Creek. Signs would provide information about the project purpose, the dates and times of construction and any potential safety hazards to the public.

4.13.2.6 Effects of Kelp and Reef Materials on the Beach

As discussed in Section 4.10, kelp strands typically become detached from living plants during storms and the resulting kelp wrack has the potential to be washed up on the beaches adjacent to the project lease area. The City of San Clemente occasionally removes kelp from their beaches during scheduled garbage pick-ups (Hughes 1997a, 1998), but the city does not consider the current supply of kelp wrack to be a problem. Similarly, the State beaches are currently subject to some kelp wrack. The State beaches manage the current amount of kelp wrack as a part of the natural coastline setting, allowing natural processes to degrade and remove the kelp from the beaches (Roggenbuck 1997, 1998). Most of the kelp washes onshore during the winter months, November to February. Kelp wrack generally persists for about two weeks and then disintegrates. Kelp wrack is reportedly considered a nuisance by some recreational users due to its pungent odor and because it attracts flies.

- ***Experimental Reef***

The 22.4-acre experimental artificial reef could potentially add two to three times the current amount of persistent kelp beds to the project area. For the purposes of this document, an estimate of additional kelp wrack has been made based on the findings of the Zobel studies (1959 and 1971). These studies shows that each acre of kelp bed could result in up to 20 yd^3 of kelp wrack washing onto the shore per year. This would mean a total of up to 448 yd^3 (22.4 by 20 yd^3) of kelp wrack annually that could potentially wash onto the beaches. The majority of kelp wrack occurs over a small number of days after big storms, primarily during the months of November through February. It is expected that most kelp wrack would be deposited on the City of San Clemente beaches and San Clemente and San Onofre State Beaches.

The additional kelp wrack washing onshore from the experimental reef represents a relatively small increase in kelp wrack and is not likely to affect recreational use of the beach. This represents a less-then-significant impact.

There is a very small chance some rocks or pieces of concrete used to construct the experimental reef could wash onshore or into the surf zone because of added buoyancy from attached kelp plants. The reef construction materials are intended to be large rocks and pieces of concrete, however some smaller fragments could result from handling. These fragments are likely to be dispersed and buried before kelp can attach and grow on them. The remaining larger rocks and concrete pieces would remain stable and are unlikely to wash onshore or into the surf zone. However, due to the hazard to the public this would pose, the possibility of rocks and concrete washing on shore is considered a significant impact.

Mitigation Measures

- A monitoring program would be initiated upon the construction of the experimental reef and continued for the following five years to determine the amount of kelp wrack currently washing onto the beaches. Because the City of San Clemente and CDPR do not collect data on the amount of kelp on beaches, this monitoring would establish a baseline data base. The monitoring of the experimental reef would also observe whether concrete or quarry rock are moved toward the beach during strong wave events. This monitoring would make it easier to compare changes due to the experimental reef or to the subsequent build out of the mitigation reef, as outlined below. The beach monitoring would be done on a bi-weekly basis throughout the months of November through March and on a monthly basis during the other months. The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day). The beach monitoring would include: 1) observations of the amount of kelp wrack on the beach (cubic yards and/or percentage coverage); 2) tracking beach clean up schedules and costs (including disposal); and 3) tracking the number of complaints from beach users or nearby residents and businesses due to kelp or rocks/concrete on the beaches. The movement of the concrete and quarry rock from the artificial reef would be monitored as a component of the larger performance monitoring effort.

- ***Mitigation Reef***

The second phase of this project would involve the construction of a minimum of 127.6 acres or up to 277.6 acres of artificial reef to provide a 150 acres of persistent, medium- to high-density kelp forest. The 150-acre kelp bed would provide 19 times the current coverage of kelp canopy in the area between the San Clemente Municipal Pier and San Mateo Point.

For the purposes of this document, an estimate of additional kelp wrack has been made based on the findings of the Zobel studies (1959 and 1971). These studies show that each additional acre of kelp bed could result in up to 20 yd^3 of kelp wrack washing onto shore per year. This would mean up to 3,000 yd^3 (150 x 20 yd^3) of kelp wrack that could potentially wash onto the beaches each year from the mitigation reef (Elwany et al. 1998). The majority of kelp wrack would occur over a small number of days after big storms primarily during the months of November through February. Most of the kelp would be deposited on the City of San Clemente beaches and San Clemente and San

Onofre State Beaches. This could potentially force recreational users to find other beaches due to the large amounts of kelp resulting in a significant impact.

There is a small chance some rocks or pieces of concrete used to construct the mitigation reef could wash onshore or into the surf zone because of the added buoyancy from attached kelp plants. The reef construction materials are intended to be large rocks and concrete pieces, however, some smaller fragments could result from handling. These fragments are likely to be dispersed and buried before kelp can attach and grow on them. The remaining larger rocks and concrete would be stable and would not wash onshore or into the surf zone.

According to Elwany et al. (1998), the transport of concrete or quarry rock from the project lease area to the beach or surf zone would be unlikely. This conclusion appears to be supported by the personal experience of the Mission Beach Maintenance Manager, who has not found any artificial reef material along the beaches adjacent to the CDFG Mission Beach artificial reef, constructed of recycled concrete (Simmons 1998). In concept, however, large wave events could result in the transport of some reef material onshore or into the shallow surf. Furthermore, the City of San Clemente has experienced problems periodically with large rocks washing onshore or into the shallow surf after major storm events (Hughes 1997a).

Concrete and quarry rocks are not natural components of the beach environment, and the presence of concrete pieces on the shoreline would potentially affect the safety of the beach environment. People walking on the beach could be injured by an unexpected block of concrete or rock. People wading, swimming, or surfing could be injured and become incapacitated in the water, leading to drowning. This is considered a significant impact.

Mitigation Measures

Implementation of the following mitigation measures would reduce this impact to a less-than-significant level.

- Due to uncertainty regarding the amount, frequency and location of increased kelp washing onshore, kelp on the beaches shall be monitored as part of the experimental reef (as discussed above) and the larger mitigation reef. Although rocks and concrete used in constructing the reef are not likely to wash onshore or into the shallow surf, the monitoring program shall also observe this possibility. Monitoring shall be conducted for at least five years after construction of the mitigation reef is completed or until a conclusion can be reached regarding the impacts of kelp and other materials washing onto the beaches. This would be done on a bi-weekly basis throughout the months of November through March and on a monthly basis during the other months. The monitoring visits would be coordinated to occur immediately after any large storm events (by the next day). The monitoring would include: 1) observations of the amount of kelp wrack on the beach (cubic yards and/or percentage coverage) and of potential rocks/concrete; 2) tracking beach clean up schedules and costs (including disposal); and 3) tracking the number of complaints from beach users or nearby residents and businesses due to kelp and rocks/concrete on the beaches.

Based on observations during monitoring, it would be determined if additional clean up services are needed as a result of the artificial reef. Clean up could begin at any time during this monitoring period as needed. Possible mitigation includes the project proponents establishing a trust fund to pay for: 1) leasing or purchasing special equipment for clean up, or possibly to bury kelp in the sand; 2) additional personnel for beach clean up; and/or 3) land-fill or other disposal costs for kelp and rocks/concrete removed.

4.13.2.7 Potential Effects on Waves and Surfing

Any substantial direct or indirect effects of the experimental reef and mitigation reef on waves at beaches in the vicinity of the lease area could adversely affect recreation. Direct effects would involve changes in the size or direction of waves due to the effects of the kelp forest in the water column. Indirect effects on waves would be changes in wave size or direction caused as a result of the effects of the reefs on sediment transport and deposition.

Studies carried out by Elwany et al. (1998) concluded that the experimental and mitigation reefs, and the resulting kelp forests, would create no measurable attenuation of height or energy of long-period swell waves, and would not affect the propagation or direction of swell waves. They also concluded that the experimental and mitigation reefs would not substantially affect the distribution and transport of sediment in the littoral zone, nor the width of the beach. All of these potential effects are of concern with respect to maintaining the characteristics of the existing waves for surfing and other recreation. Elwany et al. (1998) concluded that the presence of a kelp forest would have a damping effect on high frequency sea waves. These waves are generated by local onshore winds, and are characterized as surface chop or roughness. High frequency sea waves generated by local onshore winds generally do not result in surfable waves. Waves that are surfed are typically longer period swell waves generated by winds or storms outside of the region. Local onshore wind generated seas commonly degrade surfing conditions; surfing conditions are considered optimal during glassy conditions, when there is no local wind or surface roughness. Therefore, any reduction in high frequency sea waves would likely have a beneficial effect on surfing conditions. The experimental and mitigation reefs would have a less-than-significant impact on waves and wave-related recreation.

Mitigation Measures

- None required.

4.13.2.8 Conflicts with Plans and Policies

Several existing planning documents and governmental plans encourage adequate public access to the beaches and other recreation areas, and generally encourage activities that complement the natural features of the area and serve the needs of residents and tourists. These include: 1) *San Clemente State Beach General Development Plan*; 2) *San Onofre State Beach Revised General Plan*; 3) *City of San Clemente Parks and Recreation Master Plan;* 4) *City of San Clemente General Plan;* and 5) *Orange County General Plan: Advance Planning Program Recreation Element.* Any substantial conflict between the proposed project actions and the goals and objectives of these plans and policies would be considered a significant impact.

The creation of kelp wrack and the potential for concrete and quarry rock to be washed up onshore or into the shallow surf are two project effects that could conflict with the general goals and objectives of these applicable plans and policies. Both excessive kelp wrack and the presence of concrete and rock could discourage the use of the local beaches for recreation. Therefore, these potential project effects would be considered significant impacts.

Mitigation Measures

- The mitigation measures described above for kelp wrack and concrete and quarry rock washing onshore or into the shallow surf are also required to assure consistency with the existing applicable plans and policies. The implementation of the recommended mitigation would reduce the effects to less-than-significant levels.

4.14 Water Quality

4.14 Water Quality

This section addresses issues involving potential impacts on water quality of the experimental reef and mitigation reef. The description of the environmental setting provides information on existing regional water quality characteristics in the Southern California Bight. The impacts evaluation focuses on potential effects of the experimental reef and mitigation reef on water quality in the project area. The environmental setting is briefly described first, as follows.

4.14.1 Environmental Setting

Little information exists on water quality specific to the proposed lease area, so this section presents a description of the regional water quality characteristics for the Southern California Bight (SCB). This treatment should be adequate for characterizing water quality of the project area because variations in water quality among regions within the SCB are generally small in comparison to local variations related to factors such as depth, river and stream discharge, or sources of pollution (SCCWRP 1973). Local effects of stream discharge and pollution are small in the lease area because the project site was selected to avoid stream outflows or point sources of pollution (MEC 1994).

Water quality is greatly affected by local currents and upwelling, so these water movements are briefly described for the project area. The longshore currents within the project area tend to be consistent with the prevailing wind direction. The result is a predominant southward flowing current along the shoreline in every season, with the strongest southerly flow occurring in the summer months (Dailey et al. 1993). Upwelling occurs in the project area when cold, dense subsurface water replaces surface water that is displaced by the prevailing wind. This colder water contains relatively high concentrations of nutrients such as nitrate and phosphate, resulting in greater biological productivity (SCCWRP 1973). Upwelling in the project area is most common during the spring and early summer due to stronger and more consistent northwest winds (Hickey 1979).

4.14.1.1 Water Quality Parameters

The following description of water quality parameters in the SCB relies heavily on information presented in two Draft EIRs prepared by Continental Shelf Associates (1993; 1994). Supplemental information was obtained from several other sources, as referenced below.

- ***Temperature***

Ocean water temperatures are determined by solar radiation, distribution of surface currents, atmospheric circulation, and the mixing and stratification of water masses, such as upwelling. Near the lease area, the mean water temperature ranged from about 15°C at the surface and 14°C at a depth of 60 m during winter to about 22°C at the surface and

12°C at 60 m during summer (SCCWRP 1973). During May through December, 1993, water temperatures were measured at two meters above the bottom at a depth of about 14 m at the proposed project site. The temperatures ranged from about 12°C to 22°C (SCE 1994).

- ***Salinity***

Seawater contains a mixture of dissolved salts and other material. The most abundant salt in seawater is sodium chloride. Common elements in seawater include magnesium, sulfur, calcium, potassium, and carbon.

Except in nearshore areas adjacent to river mouths or treatment plants, salinity is fairly constant in the SCB (Continental Shelf Associates 1993; Carlucci et al. 1986). Salinity increases slightly during the summer months in nearshore waters due to greater evaporation of surface waters, and decreases slightly during the winter with increased fresh water run-off. Variations in salinity are generally limited to surface waters above 15 m. Below 15 m salinity concentrations are essentially constant (SCCWRP 1973). Salinity typically ranged from 33.6 ppt to 33.8 ppt in the vicinity of the project area, and varied little with depth (SCCWRP 1973).

- ***Density***

The stratification of seawater into gradients of density can result from differences in temperature or salinity. Salinity concentrations in the SCB are generally uniform; so density gradients within the water column generally result from temperature differences. Within the project area, pronounced temperature gradients (thermoclines) develop as a result of warming of the ocean surface during the late spring, summer, and early fall. The formation of thermoclines affects the distribution of water quality parameters and the dilution and dispersion of discharged materials (Continental Shelf Associates 1993).

- ***Dissolved Oxygen***

Dissolved oxygen (DO) is essential for plant and animal respiration. DO concentrations equal to or above 5 ppm is a general standard of acceptable water quality for aquatic life (EPA 1986). Variability in the concentration of DO in seawater results from both natural mixing (from waves, winds, tides, currents, and upwelling) and biological processes (photosynthesis, respiration, and biochemical oxidation of organic matter). Contaminants such as dredge or drilling spoils, sanitary sewage, or oil can locally decrease DO levels.

Atmospheric exchange and photosynthetic production of oxygen by phytoplankton and benthic algae maintain DO concentrations near saturation in the upper 10 m of the water column. Concentrations tend to peak in late spring/early summer (SCCWRP 1973). In the project vicinity, the mean DO concentration at the surface ranged from about 9 ppm during summer, fall and winter to nearly 12 ppm during spring. Mean DO concentrations at a depth of 90 m were nearly constant at about 7 ppm (SCCWRP 1973).

- ***Hydrogen Ion Concentration***

pH is the logarithmic measurement of the hydrogen (acidic) and hydroxyl (alkaline) ion activity in a solution, and is measured on a scale of 0-14. One unit change in pH corresponds to a ten fold change in relative ion concentrations. A neutral solution has a pH of 7.0. Seawater is well buffered; consequently, oceanic pH levels are relatively uniform and normally alkaline. Higher pH levels occur near the surface due to photosynthetic reduction of carbon dioxide. pH levels in the SCB normally range between 7.5 and 8.6 (Continental Shelf Associates 1993).

- ***Light Availability***

Light penetrating the ocean is reflected, scattered or absorbed. The depth of light penetration is a critical factor for photosynthesis and the vertical distribution of plants in the ocean. The depth zone where light energy is sufficient for photosynthesis is termed the photic zone. The concentration of suspended matter or particles in seawater is the most important factor in the determination of light penetration (Continental Shelf Associates 1994). Seasonal variability in water clarity occurs as a result of increased concentrations of particulate matter from biological production (phytoplankton blooms), land runoff, and the resuspension of bottom sediments from winds, waves and upwelling events. Most of these agents are more prevalent in coastal or nearshore areas; consequently, particulate concentrations usually increase approaching shore. Light levels in nearshore areas strongly affect production and recruitment of kelp and other benthic algae (see Section 4.6.3 "Kelp Forest Community").

The primary sources of river input and suspended particles in the project area are San Juan Creek to the north and San Mateo Creek to the south. Anthropogenic influences that affect light transparency include erosion and sedimentation resulting from land clearing and construction, wastewater discharges, oil spills and overboard discharges from vessels.

- ***Nutrients***

Marine plants, including phytoplankton and kelp, must obtain a variety of substances from their surrounding environment in order to survive and reproduce. The most important of these are inorganic nutrients such as nitrate, phosphate, and silicate. Sources of these nutrients to coastal waters include freshwater runoff from land, upwelling events, current transport and sewage discharges. Nutrients are also introduced into coastal waters by diffusion and mixing of sedimentary organic material by winds and waves. The concentrations of these nutrients vary seasonally in relation to the level of primary production and the number of other sources of nutrients to coastal waters (Continental Shelf Associates 1993). Typical ranges of nutrient concentrations in surface waters (0 to 20 m) of the SCB are 0.3-12 μg/L for nitrate, 9.5-47.5 μg/L for phosphate, and less than 0.5 mg/L for silicate (Dailey et al. 1993).

- ***Hydrocarbons In Sediments***

Concentrations of hydrocarbons in sediments reported here are normalized to total organic carbon (OC) to compensate for the effects of varying sediment grain size (Dailey et al. 1993). Fine sediments such as silts and clays can adsorb greater concentrations of hydrocarbons than coarser sediments such as gravels and sands. In 1976 to 1977, the concentration of hydrocarbon in surface sediments in the project vicinity was 2.0 mg per gram OC (Dailey et al. 1993). This value is low compared to most others in nearshore sediments of the SCB (see Figure 3.17, Dailey et al. 1993). Natural petroleum seepage has been reported from many areas of the SCB. These natural seeps have been documented on both the mainland shelf and around the Channel Islands (Dailey et al. 1993).

- ***Trace Metals In Seawater and Sediments***

Most trace metals occur naturally in both seawater and marine sediments, and are essential for biological productivity. Trace metals in the marine environment include zinc, manganese, copper, cadmium, cobalt, iron and silver (Continental Shelf Associates 1993). These trace metals are introduced into coastal waters by rock weathering, land runoff, currents, municipal and industrial effluents, and atmospheric fallout. Elevated concentrations of trace metals are often responsible for negative impacts to marine organisms. The mean background concentrations of trace metals in sediments at 38 sites in the SCB ranging in depth from 30 m to 150 m are reported in Table 4.14-1.

- ***Point Source Discharges***

Point source discharges originate from known sources and generally flow through pipes or channels. In 1989, a combined daily total of approximately 7.25 billion gallons of treated sewage, cooling water and processing water were discharged between Goleta and San Diego (Continental Shelf Associates 1993). Point sources for this waste included municipal wastewater plants, electrical generating stations and petroleum refineries. Although the volume of effluents discharged through marine outfalls has increased 30 percent since 1973, emissions of solids have declined 70 percent due to source control and improved treatment methods (Continental Shelf Associates 1993). Federal, State and local legislation that require the application of discharge permits and the implementation of monitoring programs regulate point source discharges.

4.14.1.2 Applicable Plans, Policies and Regulations

The actions associated with the experimental reef and mitigation reef were reviewed for consistency with the State Water Resources Control Board's 1997 *Water Quality Control Plan for Ocean Waters of California* (Ocean Plan). The Ocean Plan is applicable to the proposed actions because it establishes standards for various measures of water quality and concentrations of various contaminants and pollutants (SWRCB 1997), in compliance with the federal Clean Water Act (CWA) and the State of California Water Code (CWC).

Table 4.14-1 "Background" Concentrations (ppm) of Various Heavy Metals in Sediments of the SCB

Metal	Surface Sediments
Silver	0.03
Cadmium	0.14
Chromium	25.4
Copper	10.4
Nickel	12.9
Lead	4.8
Zinc	48.0

Source: Dailey et al. 1993.

According to the Ocean Plan, waste discharged into the ocean must be essentially free of: 1) material that is floatable or will become floatable upon discharge; 3) settleable material or substances that may form sediments that will degrade benthic communities or other aquatic life; 3) substances that will accumulate to toxic levels in marine waters, sediments, or biota; 4) substances that significantly decrease the natural light to benthic communities and other marine life; and 5) materials that result in aesthetically undesirable discoloration of the ocean surface.

4.14.2 Impacts and Mitigation Measures

4.14.2.1 Methodology

The evaluation of the consistency of the proposed project with the Ocean Plan relied upon the project proponents plans to construct the experimental reef and mitigation reef with materials that do not contain harmful substances and that maintain their integrity in ocean water.

4.14.2.2 Significance Criteria

The proposed experimental reef and mitigation reef are considered to have a significant impact on water quality if existing regulatory standards are exceeded, or if there is substantial conflict with the Ocean Plan or with the CDFG's *"Material Specification Guidelines and Notification Procedure for Augmentation of Artificial Reefs with Surplus Materials"* (see Table 3-5 in Chapter 3, Project Description).

4.14.2.3 Contaminants

The construction of the experimental reef and mitigation reef would use recycled concrete materials or quarry rock that comply with the CDFG's *"Material Specification Guidelines and Notification Procedure for Augmentation of Artificial Reefs with Surplus Materials*".

Mitigation Measures

- None required.

4.14.2.4 Turbidity

During construction, the placement of recycled concrete pieces and quarry rock at the project site would temporarily disturb the fine sands and silts of the ocean floor, and would resuspend these particles, causing a local increase in turbidity. In addition, some sediment may be introduced into the water from material on the recycled concrete or quarry rock. The sand-sized particles would fall out of suspension in a matter of seconds or minutes, and would likely be redeposited in the immediate vicinity. Silt-sized particles could remain in suspension for a period of several hours, and clays could remain in suspension for several days before settling. Currents and waves could retain the particles in suspension for longer periods, and transport material away from the project site. The suspension of the finer particles would increase the local turbidity.

Increased turbidity is a concern since it would lead to a reduction in light transmissivity and reduced irradiance, which could adversely affect the existing biological resources. As kelp and other primary producers in the biological communities in the project vicinity rely on sunlight for production, substantial increased turbidity could negatively affect biological productivity. Increased turbidity would reduce the reproduction and productivity of marine organisms due to smothering, and reduced light and nutrients.

The potential for adverse effects relating to turbidity is low because the reef construction materials must meet the CDFG guidelines and sands predominate in the lease area. Once disturbed, the sand-sized particles will not remain in suspension for more than several hours. Some size-classes of sand will settle out in seconds or minutes. Finer particles that remained in suspension would be transported away by ocean currents and mixed with clearer water elsewhere, keeping turbidity from increasing significantly above background levels. Therefore, the project actions are expected to result in less-than-significant impacts relating to turbidity.

Mitigation Measures

- None required.

5.0 CEQA Considerations

5.0 CEQA Considerations

5.1 Cumulative Impacts

The following analysis of cumulative impacts has been prepared in keeping with Section 15130 of the CEQA Guidelines. It includes a list of past, present, and reasonably foreseeable future projects that would create impacts in combination with the proposed artificial reef project. A summary of the impacts associated with these projects is included and an analysis of the combined effects with the proposed project. Projects included within this analysis were identified in consultation with agency representatives from local, State, and federal governments, as well as a review of other related EIRs.

The projects discussed first are located near the proposed project site in the San Clemente coastal area, which includes southern Orange County and northern San Diego County. The marine and shoreline environments in this area are managed for a variety of uses including open space, recreation, commercial fishing and military training. The other projects examined, include onshore projects near the reef transportation sites. These are located near the Ports of Los Angeles, Long Beach and San Diego, and relate to cumulative impacts on transportation.

5.1.1 Projects in the San Clemente Coastal Area

Projects identified in the San Clemente area include onshore projects and marine projects that may result in cumulative impacts when combined with the proposed reef project. There are a limited number of projects that have occurred within the last ten years or are planned in the foreseeable future along the San Clemente coastal area. The projects identified for this analysis are scattered within the region, with no particular marine environment being the focus of development. The following is a list of the past, present, and future projects identified for consideration of potential cumulative effects.

- Carlsbad/Batiquitos Lagoon Artificial Reef,
- Batiquitos Lagoon Enhancement Project
- Aqua Hedionda Dredging Project
- Bolsa Chica Artificial Reef Augmentation,
- Beach Replenishment at South Oceanside and Cardiff/Solana Beach,
- Beach Replenishment at North Carlsbad, South Carlsbad, Encinitas, and Torrey Pines, California,
- Oceanside Harbor Dredging,
- Upper Newport Bay Unit III Sediment Control and Enhancement Project,

- San Mateo Point Officer Housing Project,
- Camp Pendleton Wastewater Treatment Facilities Expansion,
- Marblehead Development Project, and
- Pacifica Plaza Shopping Center.

Each of these projects is described briefly in the following.

5.1.1.1 Carlsbad/Batiquitos Lagoon Artificial Reef

This artificial reef was constructed in 1990. It includes 12 modules (measuring 50 feet by 50 feet by 6 feet high) located one-half mile offshore of Carlsbad in northern San Diego County, near the mouth of Batiquitos Lagoon in water depths of 30 to 57 feet. The reef was constructed with 10,000 tons clean quarry rock placed on sand substrate, covering 0.75 acres. The reef provides habitat for typical reef associated fishes, invertebrates, and plants and complements the restoration of the lagoon. Construction of the proposed reef was not expected to result in significant impacts on the environment, however, the staff report states concerns for local beach erosion (CCC 1989).

5.1.1.2 Batiquitos Lagoon Enhancement Project

This project was completed in January 1997, and included the construction of the following enhancement elements for the Lagoon and adjacent areas:

- Physical reconfiguration of the lagoon through dreading/excavation and contouring to restore tidal inflows;
- Construction of a rock non-navigable tidal inlet structure at the mouth of the lagoon to allow uninterrupted tidal access;
- Construction of 32 acres of California least tern nesting sites using dredge material from the lagoon;
- Replenishment of ocean beaches at Batiquitos Lagoon and Encinas Creek;
- Disposal and capping of the fine sediments dredged from the east basin into the central basin;
- Reconstruction of the aging West Carlsbad Bridge at the same site with similar structure (with additional emergency vehicle and pedestrian access);
- Placement of riprap on the channel under the I-5 structure to protect the footing and bracing and minor upgrades to the railroad bridge and East Carlsbad Bridge;

- Construction of a 33-acre freshwater pond with dike in the northeast section of the East Basin; and

- Construction of appropriate facilities to control sediment delivery into the lagoon.

Project construction resulted in short-term adverse impacts on biological resources, water quality, and recreation (City of Carlsbad 1990).

5.1.1.3 Aqua Hedionda Dredging Project

This dredging project is being conducted by San Diego Gas and Electric Company as part their Aqua Hedionda Power Plant operations (the plant has recently been sold, but SDG&E is completing the project). There are four separate phases to the dredging operation. The first phase was started in the October 1998 with a temporary clean up of the outer lagoon. The second phase of dredging involved the middle lagoon and began in December 1998. The 60,000 cubic yards of sand removed was placed on Carlsbad Beach. The third phase commenced in February 1998 and was completed in February 1999. This phase involved dredging of 905,000 cubic yards of material from the inner lagoon, some of which was used for beach replenishment. The final phase of the project began in February 1999 and should be completed by the end of April 1999. This involves dredging 160,000 cubic yards of sand to be placed on North Carlsbad Beach. There will be routine maintenance dredging every two to three years to maintain the lagoon.

5.1.1.4 Reef Bolsa Chica Artificial Reef Augmentation

This project is located approximately 3.0 to 4.4 nautical miles offshore from Bolsa Chica State Beach in Orange County. The project includes the additional placement of up to 120,000 tons of clean quarry rock or concrete rubble to the existing 220-acre reef site. As will previous reef construction at this site, the material will be placed in several modules measuring 6 to 10 feet high. In previous actions, the CCC approved the placement of 40,400 tons of material at this site, covering approximately 5.5 acres (or 2.5 percent of the reef area). The placement of an additional 120,000 tons of material would cover a total of 10 percent of the reef site. The site is located in waters that range in depth from 85 to 100 feet. The staff report identified concerns for the following potentially adverse conditions: (1) concerns for over harvesting of fish; and (2) loss by burial of benthic animal and plant life at affected portions of the sea floor (CCC 1995).

5.1.1.5 Beach Replenishment at South Oceanside and Cardiff/Solana Beach

This project involves onshore placement of dredge material from San Diego Bay on the south Oceanside and Cardiff/Solana beaches as part of the homeporting of the NIMITZ class aircraft carrier and to comply with the San Diego Association of Government's Shoreline Preservation Strategy for the San Diego Region. Beach replenishment was proposed for one site in South Oceanside and two sites in Solana Beach. South Oceanside would receive a total of 530,082 cubic yards of material. A total of 570,091 cubic yards of material would be placed on Solana Beach. The project has been partially completed. During implementation, several short-term effects are expected, including temporary displacement at recreational areas, short-term hazards to public safety, short-term changes in aesthetics, short-term noise level, and short-term increases in turbidity. The evaluation of the project identified potential post-construction effects on the following resources: coastal wetlands, near shore and surf organisms, offshore kelp and surfgrass beds, rocky reef habitat, spawning habitat for California grunion, foraging habitat for special-status bird species (California pelican, California least tern, and snowy plover), and structures and utilities (USN 1997a). This project was discontinued when ordinances were found within the dredged material.

5.1.1.6 Beach Replenishment at North Carlsbad, South Carlsbad, Encinitas and Torrey Pines, California

This project includes the onshore placement of dredged material from the dredging of San Diego Bay for the homeporting of a NIMITZ class air craft carrier on the beaches of northern San Diego County. The expected placement of material would include 2,209,610 cubic meters of material on the following five beaches: North Carlsbad, South Carlsbad, Encinitas, North Torrey Pines, and South Torrey Pines. The evaluation of the project included construction related disturbances and post construction related effects. Short-term effects include changes in beach profile, localized increases in turbidity, burial of intertidal and subtidal organisms, displacement at recreational areas, hazardous conditions due to heavy equipment, temporary changes of the aesthetic environment, and increased noise levels during placement. The project would potentially result in the following post-construction conditions: nearshore sediment accumulation; reduced coastal wetland hydrology; sedimentation of giant kelp beds; sedimentation on rocky intertidal reefs, subtidal vegetated reefs, and near shore reefs; changes to spawning habitat for California grunion and foraging habitat for special-status birds (California brown pelican, California least tern, and snowy plover), and changes in conditions for structures and utilities.

5.1.1.7 Oceanside Harbor Dredging

The US Army Corps (ACOE) conducts regular maintenance dredging of the Oceanside Harbor. The effects of these activities were evaluated as part of a six-year programmatic environmental assessment (ACOE 1994). Starting in December 1994, the program involves the semi-annual removal of littoral drift material from the entrance and navigation channels of the Oceanside and Camp Pendleton Harbor vicinity. Under ideal conditions, dredging takes place in the fall and winter months (September 15 through March 15) for the entire six-year program. (Although, regulatory delays and weather conditions may force some activities past May 15.) The total amount dredged each year is expected to range between 200,000 and 400,000 cubic yards. Dredged material is deposited at a nearshore site, or on the beach south of Oceanside Public Pier. This beach experiences significant erosion and the harbor disrupts natural replenishment from upcurrent sources. The implementation of this program is expected to result in both short-term and long-term effects at the harbor and the receiver site.

The short-term effects include the following changes in water quality (decreased oxygen levels, increased turbidity), disturbance to fisheries, bird and harbor seal populations, disturbance of special-status species (California brown pelican, California least tern, western snowy plover), generation of air pollution, disturbance of recreational areas, short-term navigation hazards. The proposed project would also result in longer-term impacts including the following: increased beach nourishment, loss of infaunal, planktonic, and benthic organisms, alteration of habitat for spawning grunion, and reduced aesthetic conditions (ACOE 1994).

5.1.1.8 Upper Newport Bay Unit III Sediment Control and Enhancement Project

As proposed by the County of Orange and the City of Newport Beach Public Works Department, the project includes the implementation of a sediment control and enhancement project in portions of Upper Newport Bay and adjacent onshore and offshore areas located in the City of Newport Beach. The project involves dredging between approximately 725,000 and 825,000 cubic yards of accumulated material from portions of the upper bay and main access channel, disposal of dredged material in an existing and approved offshore disposal site, and the repair and modification of the Jamboree Road stabilizer structure located at the Upper Newport Bay/San Diego Creek interface. An initial study and mitigated negative declaration were prepared for the project. While many of the project activities occurred within Newport Bay, this review focused on the project related effects on marine resource that would occur offshore due to dredged material disposal. The project identified less-than-significant impacts on several marine resources, including short-term disturbances of wildlife dispersal due to disposal of dredged material in offshore areas (County of Orange 1996).

5.1.1.9 San Mateo Point Officer Housing Project

The San Mateo Point officer housing project is located in northern San Diego County, bordering the City of San Clemente at Camp Pendleton. Situated along San Mateo Creek, the project would be constructed in two phases, including 120 units on a 32-acre site. Phase I includes the construction of 76 units, Phase II would include 44 units. The project includes approximately 7.5 acres of open space (coastal bluffs) (USN 1997). Implementation of this project may result in erosion and sedimentation contributions within the San Mateo Creek watershed associated construction, and urban runoff following construction.

5.1.1.10 Camp Pendleton Wastewater Treatment Facilities Expansion

The proposed action includes the construction of storage basins in place of the existing oxidation ponds at STP 12, approximately 12,500 linear feet of pipeline, and percolation basins covering approximately 35 acres of land. In addition, a pipeline connector approximately 5,100 feet in length would convey excess secondary sewage from the San Onofre pipeline to the San Mateo percolation basins (USN1996). This project is currently under construction. Implementation of this project may result in erosion and sedimentation within the San Mateo Creek watershed following construction.

5.1.1.11 Marblehead Development Project

The 250.6-acre Marblehead Coastal project site lies seaward of the San Diego Freeway (I-5) and inland of the El Camino Real within the City of San Clemente. The proposed project will amend the City's General Plan to include specific land use designations for the site that would permit the future development of the site as proposed in the Master Plan. This plan includes the development of the following land uses on the site: residential (116.7 acres), commercial (61.4 acres), open space (58.9 acres), and circulation (13.6 acres). Implementation of the proposed project will include the development of a stormwater drainage system including drainage lines up to 63-inches in diameter and a stormwater detention basin. Several mitigation measures will be implemented to reduce off-site movement of sediment and heavy metals (City of San Clemente 1998).

5.1.1.12 Pacifica Plaza Shopping Center

The proposed project site is located on Avenida Pico and includes the development of approximately 78.6 acres comprised of retail commercial and residential land uses. The project site also includes 51.5 acres of public right-of-ways, landscaped areas, and natural open space. Construction is expected to begin within the next year (Matt Everling, pers. comm). The project area is within the Segunda Deshecha watershed. Grading and construction of the site may result in erosion and sedimentation within the watershed. Operation of the facility would contribute urban runoff into the drainage.

5.1.2 Onshore Projects Near Project Transportation Sites

Because the construction of the reef may cause indirect effects on local and regional transportation resources, we investigated the potential for project-related cumulative effects on the transportation resources along the proposed haul routes to the Port of Long Beach and the Port of San Diego. This investigation identified the following projects within the region:

- US Navy Homeporting Project
- Port of Long Beach United Terminal Expansion Project
- Port of LA - Port 2000 Project

Each of these projects is described briefly in the following:

5.1.2.1 CVN Homeporting EIS

The overall purpose of this project is to provide facilities to support and maintain a NIMITZ class aircraft carrier, including wharf, industrial facilities, ship maintenance facilities, and maintenance support facilities, as well as channel access and a turning basin within San Diego Bay. The channel and turning basin dredging has been completed, and included the removal of 9,055,000 cubic yards of material. This material was disposed of primarily at a designated ocean disposal site (LA No 5), but some material was also used for beach replenishment and fill area. The wharf and support facilities were established on the Silver Strand within the City of Coronado. The construction of these facilities is underway and expected continue through December 1998. The analysis of project-related traffic determined that due to staff reductions at the base from 1992 to 1999, implementation of the project would not significantly change the level of service at key intersections near the base (USN 1995).

5.1.2.2 Port of Long Beach United Terminals Expansion Project

The proposed United Terminals Expansion Project is composed of the following key elements: 1) construction of a 30-acre landfill to increase storage space and enhance operation efficiency; 2) construction of a new 20-acre rail yard facility that includes loading/unloading and storage areas; 3) the removal of the US Coast Guard and TOPKO warehouse and storage facilities; and 4) the relocation of the Port of Long Beach maintenance facility to Pier B Street or Pier C Street. Construction of these elements would start in the first quart of 1999 and be completed in the fourth quarter of 2001. It is estimated that the construction of these facilities would generate an additional 500 daily worker/employee trips and 570 daily truck trips. During construction, traffic control plans would be implemented to ensure that construction traffic is handled in a safe and efficient manner both on and off-site. Construction related traffic was not identified as significant (POLB 1998)

5.1.2.3 Los Angeles and Long Harbors Deep Draft Navigation Improvements

The primary purpose of the proposed navigation improvement project is to modify and improve existing navigation channels and turning basins, create new channels to existing lands to meet existing and estimated demands on the Port's facilities, and to relocation existing hazardous cargo and liquid and dry bulk facilities. The proposed construction elements of the project are currently in-progress and are scheduled for completion in 2009. Project-related ground traffic was analyzed in the EIR/EIS, including traffic related to construction and operation. Although the project itself may reduce double handling and not create unacceptable traffic levels, project-related vehicles will, at least temporarily, use overcrowded routes with inadequate capacity to meet current and/or future loads. The following mitigation measures were developed to reduce traffic-related impacts: 1) development of a Cooperative Traffic Management Plan; 2) complete implementation of the Port's Access Demonstration Project improvements; and 3) implementation of the Alameda Corridor Project. With the implementation of these measures, project-related effects remain potentially significant (ACOE and LAHD 1992).

5.1.3 Cumulative Impacts

5.1.3.1 Experimental Reef Cumulative Impacts

- ***Project Site***

At the proposed project site, construction of the experimental reef project would occur over a 32-day period, potentially affecting local resources of the marine environment, water related traffic and dispersed water quality and air quality. Along this portion of the Coast, twelve projects were identified that may also affect the resources at the project site. The following is an analysis of the potential for cumulative impacts on these resources.

A number of marine projects were identified in the area, which include:

- Carlsbad/Batiquitos Lagoon Artificial Reef;
- Batiquitos Lagoon Enhancement Project;
- Aqua Hedionda Dredging Project;
- Bolsa Chica Artificial Reef Augmentation;
- Beach Replenishment at South Oceanside and Cardiff/Solana Beach;
- Beach Replenishment at North Carlsbad, South Carlsbad, Encinitas, and Torrey Pines, California;
- Oceanside Harbor Dredging; and
- Upper Newport Bay Unit III Sediment Control and Enhancement Project.

Many of the marine projects are located well away from the proposed experimental reef site. The Upper Newport Bay project would be located 25 miles away from the proposed project lease area. The closest project is the Oceanside Harbor Dredging Project, which is located 15 miles away. These distances preclude any direct combined effects for water quality from these projects and the proposed artificial reef project. However, these construction projects all contribute to cumulative air quality and transportation effects.

While the SONGS experimental reef would be only 22.4 acres, the eventual mitigation reef build out would be 150 acres to 300 acres. The other artificial reef projects are much smaller in scale than the proposed SONGS mitigation reef. The Carlsbad/Batiquitos Lagoon Artificial Reef covers only 0.75 acres. The Bolsa Chica Artificial Reef Augmentation project would cover about 28 acres. These projects can be expected to have similar effects on the local marine environment as the SONGS experimental reef. These effects would include: 1) local, minor changes in physical processes, such as currents and sedimentation; 2) losses of some biological resources and their replacement by more productive biological systems; and 3) the creation of air emissions during construction.

Several beach replenishment projects, including the Oceanside Harbor maintenance dredging, Batiquitos Lagoon Enhancement Project, and Aqua Hedionda Dredging Project focus on removing sediment build up and controlling beach erosion by adding sediments to the beaches. These have a different purpose from the proposed reef project, which focuses on establishing a kelp bed and associated biota to replace lost resources at SOK. The kelp beds associated with the proposed experimental and mitigation reefs would have a minor effect on the physical processes associated with beach formation, and would not cause changes in beach width. The distance of these other artificial reef projects from the SONGS reef lease area, and their development in marine environments of different depths and processes, precludes cumulative effects.

Onshore development projects in San Clemente and at Camp Pendleton are adjacent to the project site and include:

- San Mateo Point Officer Housing Project,
- Camp Pendleton Wastewater Treatment Facilities Expansion,
- Marblehead Development Project, and
- Pacifica Plaza Shopping Center.

These developments may cause increased sediment and pollution loading within the watersheds in the immediate vicinity of the experimental reef. These potential effects would be most pronounced during the winter following heavy storms. These projects total less than 500 acres and represent less than one percent of the watershed area within the vicinity of the project. The 32-day construction period for the experimental reef would occur during the summer months. The relative magnitude of the combined effects of these projects is low and the cumulative effects on water quality are not expected to be significant.

All of the projects identified for this cumulative impact scenario would generate additional emissions within the South Coast Air Basin (SCAB) and the San Diego Air Basin (SDAB). These air basins are in nonattainment for State and federal ozone standards, and State PM_{10} standards. The SCAB is also in non-attainment for federal PM_{10} standards, and is described as in extreme non-attainment for federal ozone standards. Although the air emissions for the experimental reef project will be mitigated to a less-than-significant level, the remaining project related emissions can be considered significant and unavoidable within these basins, because they would contribute to the non-attainment status of these air basins. Therefore, these cumulative emissions are considered a significant unavoidable impact.

- *Off Site*

The review of related projects determined that during construction, off site impacts may occur due to the truck transport of reef materials to the ports for shipment to the experimental reef site.

- US Navy Homeporting Project
- Port of Long Beach United Terminal Expansion Project
- Port of LA - Port 2000 Project

These activities may affect local transportation and air quality in Los Angeles and San Diego counties. Cumulative air quality impacts related to the project have been determined to have a significant unavoidable impact. The following is a brief review of the cumulative transportation-related affects of the experimental project.

During the 32-day construction period, several major construction projects will be occurring within the ports identified for shipping materials to the site. These projects would generate additional construction-related traffic at each port. The additional 91 truck trips per day plus the up to 25 workers commuting to construction activity sites may result in minor, short-term congestion at some intersections. However, because the duration of the construction is limited to 32 days, these effects would be considered less than significant.

Mitigation Measures

- No mitigation measures beyond those already identified in the PEIR are necessary to address the potential for cumulative impacts.

5.1.3.2 Mitigation Reef Cumulative Impacts

For the purposes of the PEIR, it is possible to discuss in general terms the 150-acre to 300-acre construction scenarios that have been evaluated and consider cumulative impacts based on the information known to date. The much larger scale of the full mitigation reef generates considerably more air quality, water quality and transportation impacts that could be considered significant on a cumulative basis.

The non-attainment air quality status of the SCAB and SDAB is not likely to improve dramatically in the next ten years. While stricter regulations and technological improvements bring modest reductions in air emissions, these improvements are being undermined by continued high levels of growth in the regions. The mitigation reef could take up to four years to construct and would contribute to cumulative significant unavoidable air quality impacts.

There are a number of development projects currently being approved in San Clemente and additional growth can be expected of a similar nature over the next ten years. These projects may cause increased sediment and pollution loading within the watersheds in the immediate vicinity of the mitigation reef. These potential effects would be most pronounced during the winter following heavy storms. The placement of material for the mitigation reef would create temporary impacts of increased turbidity and the introduction of additional sediments. These impacts could extend over as many as four years, May through September. These impacts could be result in significant impacts on a cumulative basis.

Transportation effects in the port areas would potentially be significant if the construction time for the mitigation reef extends over as many as four years (from May through September each year). These areas are currently very congested with many roads and intersections at levels of service below standard. It is possible that improvements will be made in the port areas to alleviate this situation or the proposed mitigation reef project proponents would work with local traffic engineers to implement mitigation that would reduce the cumulative impacts to a less-than-significant level.

Mitigation Measures

- No mitigation is recommended at this time. The mitigation reef will be reviewed for approval at a later date once the final design has been developed.

5.2 Growth Inducing Impacts

The construction, presence and monitoring of the experimental and full mitigation artificial reefs would not have any growth inducing impacts for the project area or for the larger southern California region. There would be a small economic benefit in the Los Angeles or San Diego regions during the construction phase of the reef, as materials are purchased, transported and placed. The project construction involves a small number of employees that could be easily hired from the existing labor force of these large economic regions. The temporary income generated by construction activities would not be large enough to generate significant additional growth in either of these counties.

5.3 Significant Unavoidable Impacts

The proposed project would result in cumulative significant unavoidable impacts to air quality, during the construction of both the experimental and mitigation reefs. Hauling rock and concrete material from inland sources to the ports in Los Angeles, Long Beach or San Diego by truck results in both daily and quarterly PM_{10} emissions above the thresholds of significance. In addition, barge transportation from the ports to the project site and the placement of material by crane and derrick barge results in significant NOx air emissions on a daily and quarterly basis.

6.0 Alternatives to the Proposed Action

6.0 Alternatives to the Proposed Action

6.1 Introduction

In accordance with Section 15126(d) of the CEQA Guidelines, an EIR must, "*Describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project, but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives.*" The CEQA Guidelines also require that a No Project Alternative be evaluated and that an environmentally superior alternative be designated, other than the No Project Alternative. There are differences in the conclusions regarding alternatives from the Draft PEIR to the Final PEIR as discussed below.

6.1.1 Draft PEIR Alternatives Analysis

This is a PEIR, involving two phases of development for the proposed project. The alternatives considered in the Draft PEIR were broken out for discussion in the same way. The first phase of the proposed project is an experimental artificial reef at the San Clemente site, which would be developed immediately upon approval by the agencies. The design details for this phase have been identified and fully evaluated. Three development alternatives to the proposed project experimental reef were evaluated in the Draft PEIR. These alternatives considered different sites, designs and phasing of the project. In order to meet the project objectives for the experimental reef, all of the alternatives included both quarry rock and recycled concrete construction, as well as different levels of material coverage. The same probable worst-case scenarios for construction assumptions were used to evaluate the experimental reef alternatives as were used for the proposed project (described in Section 3.4.3).

The design and construction details for the full mitigation artificial reef have not been determined at this time. As discussed in the project description, the second phase of the proposed project is described in broad terms based on a range of possible designs for the mitigation reef and the type of construction activities that could occur in the project lease area. The second phase of the project would be reviewed again after evaluating the results of the experimental reef, and once a detailed design for the mitigation reef is developed. Similarly, the alternatives for the full mitigation reef evaluated in the Draft PEIR were discussed in broad terms that looked at a range of reef sizes and configurations. In order to compare the alternatives with the proposed project on an equal basis, all of the mitigation reef alternatives were evaluated for: (1) a range of 150 acres up to 300 acres of construction (including the experimental reef); and (2) the use of either all recycled concrete or all quarry rock at 67 percent coverage. Again, the same probable worst-case scenarios for construction assumptions were used to evaluate the mitigation reef alternatives

The alternatives evaluated in the Draft PEIR were selected to address comments received from agencies and the public during the formal scoping process for the PEIR (see Appendix B). Other proposals were not evaluated as project alternatives, because they did not adequately meet the project objectives or were not considered feasible, as discussed below in Section 6.3. The comparative evaluation of alternatives presented in the Draft PEIR focused on: (1) how well the alternatives met the project objectives as outlined in the SONGS Permit, Condition C (see Chapter 3. Project Description); and (2) how well the significant impacts identified for the proposed project might be reduced or eliminated.

Each of the significant impacts identified for the proposed project was listed and discussed under each alternative. In addition, the comparison of alternatives also looked at those impacts that were found to be less-than-significant for the proposed project. Where those impacts differed considerably for the alternatives as compared to the proposed project, the findings were summarized. Finally, the alternatives were evaluated to determine if they might result in significant impacts that were not presented for the proposed project. These impacts were also identified in the comparative discussions.

6.1.2 Final PEIR Alternatives Analysis

As part of the public review of the Draft PEIR, comments were received stating the experimental reef should be expanded to include one or more of the alternative locations evaluated in the Draft PEIR. The comments indicated this would help provide additional information regarding the success of various locations and provide a back up if the San Clemente site did not succeed in growing kelp as expected. In addition, sites closer to the Port of San Diego would help reduce the significant air quality impacts of construction.

In response to these comments, consideration was given to adding an experimental reef at another site as part of the preferred project. The project proponent, the CCC staff and CSLC staff studied the possible sites and different design options. The first choice for another experimental reef location was the South Carlsbad site, and after that the North Carlsbad site, due to the proximity of these locations to the San Onofre Kelp bed and their expected site characteristics. The North and South Carlsbad sites were included in the Draft PEIR based on earlier studies, which had identified areas of sandy bottom and a lack of persistent kelp reef interspersed within existing kelp beds. These earlier studies were also the basis for identifying the two 25-acre sites at Leucadia and Encinitas. However, the designation of acres with suitable sand substrate for reef construction were only estimates, as the sites were not part of the sonar surveys done in recent years for the artificial reef siting studies.

Additional work was done to verify the present conditions in the Carlsbad area and the actual suitable sand-bottom acreage for reef development. Consultants to the project proponent conducted sonar surveys in early March 1999, along three miles offshore from the City of Carlsbad. These sonar surveys found small areas of sandy bottom interspersed with patches of hard substrate all along the coast. The surveys found only a very small, narrow band of ocean bottom with the appropriate veneer of sand (0 to 0.5

meters) for artificial reef construction. The larger sandy bottom areas were found to have depths of 0.5 to 1 meter, which includes approximately 60 to 100 acres near South Carlsbad and about 20 acres near the Encina Treatment Plant discharge pipe. With a sand veneer of 0.5 to 1 m, artificial reef material would be at high risk of subsidence and burial.

Given the results of the March 1999 sonar surveys, adding experimental reef modules offshore from Carlsbad was abandoned. It is felt that the Leucadia and Encinitas sites would have similar characteristics to Carlsbad. Also, given the small size of these sites, they do not provide a real alternative for the mitigation reef and have likewise been abandoned.

Consideration was also given to adding an experimental reef at the Mission Beach site. However, after further discussions with CCC staff scientists and the California Department of Fish and Game (CDFG) Coordinator for the Artificial Reef Program (see letter from Dennis Bedford in Appendix I), Mission Beach was rejected. The agencies concluded that the Mission Beach site is too far from San Onofre Kelp bed to provide replacement for lost resources at San Onofre. As stated in the SONGS Permit, the mitigation should be "in kind" and "as close as practical to the impact site."

As a result of the new information, all of the alternative sites evaluated in the Draft PEIR are no longer considered viable, given the differences in site characteristics from the San Clemente site and/or the distance from the San Onofre Kelp bed. However, for the sake of consistency all of the alternative discussions and comparative analyses have been maintained in the Final PEIR as proposed in the Draft PEIR. The alternatives have been revised to reflect the revisions in concrete and quarry rock weight estimates and to reflect the new, slightly larger acreage of the proposed project experimental reef at San Clemente. It is too speculative at this time to say whether these alternative sites might be reconsidered for the mitigation reef depending on the results of the experiment at San Clemente.

6.2 Alternatives Proposed for Consideration in the PEIR

The following project alternatives were proposed for consideration in the PEIR, in addition to the mandatory No Project Alternative. Several of these alternatives were eliminated from further consideration because they did not meet the project objectives or were not considered feasible, as discussed in Section 6.3. The alternatives are divided into experimental reef alternatives and mitigation reef alternatives:

6.2.1 Experimental Reef Alternatives

- ***Experimental Reef at Multiple Locations.*** This experimental reef alternative would test both rock and concrete at 34 and 67 percent coverage at San Clemente, South Carlsbad, and Mission Beach. This would provide information on different project sites that could be used for the mitigation reef build out. This alternative has larger experimental modules that are placed closer together. The effect of these changes would be to provide larger experimental kelp reefs than the proposed project. The experiment would be monitored for five years.

- ***150-Acre Reef Built Now with an Experiment.*** This alternative proposes that a 150-acre artificial reef be constructed right away at the San Clemente site using all recycled concrete at 17 percent coverage. An experimental project would be embedded in the larger artificial reef to test both quarry rock and concrete at 17, 34 and 67 percent coverage.

- ***Experimental Compound Reefs (High and Low Relief) at Multiple Locations.*** This alternative would involve building an experimental reef project at the South Carlsbad and Mission Beach sites. The experiment would test eight reef designs using quarry rock and recycled concrete material replicated six times, for a total of 48 modules at each site. Each module would be 0.4 acre bringing the size of the experimental reef phase to 38.4 acres. The designs include two low-relief modules of concrete and two of rock at 34 and 67 percent coverage, and two compound reef modules of concrete and two of rock having high-relief centers (12 feet) and low-relief perimeters with 34 and 67 percent coverage.

- ***Kelp Planting Experiment.*** This alternative would rely on planting juvenile kelp plants on existing sand and rock substrate rather than constructing an artificial reef. This includes a 20-acre experimental phase at the San Clemente site with two years of monitoring.

6.2.2 Mitigation Reef Alternatives

- ***Mitigation Reef at Multiple Locations.*** All of the following sites were suggested for locating the mitigation reef in part or in whole.

    - **North Carlsbad** (30 acres), **South Carlsbad** (64 acres), **Leucadia** (25 acres), **Encinitas** (25 acres), and **Mission Beach** (85 acres). These offshore sites are located between San Onofre and Point Loma. Since none of the sites provides the number of acres needed for the mitigation reef build out, it would be necessary to combine several sites and possibly include part of the San Clementes site to achieve the necessary acreage.

- ***Northern San Clemente Site*** (300 acres). This alternative site was suggested by local commercial fishing groups and would locate the artificial reef to an area just north of the San Clemente Pier and the current proposed project site.

- ***San Clemente Site Farther Offshore*** (200 acres). This alternative site was suggested by local commercial fishing groups and would situate the artificial reef farther offshore from San Clemente (at a depth of 50-55 feet), just west and adjacent to the proposed project site.

- ***150-Acre Reef Built Now with Possible Remediation and Additional Construction.*** This alternative proposes that a 150-acre artificial reef be constructed right away at the San Clemente site using all recycled concrete at 17 percent coverage, with an experiment embedded in the design. Depending on the success of the reef additional reef remediation and construction (for a total of up to 300 acres) could be needed in a second phase.

- ***Compound Reefs (High and Low Relief) at Multiple Locations.*** This alternative would involve building the mitigation reef at the South Carlsbad and Mission Beach sites, and possibly at other sites as well, based on the results of the experiment listed above in Section 6.2.1. The build out phase would include from 111.6 acres up to 261.6 additional acres of construction for a total of 150 to 300 acres of artificial reef.

- ***Compound Reefs at Big Sycamore Canyon (inside and outside the preserve) and/or Pitas Point.*** Alternative sites proposed by the United Anglers Association.

- ***Kelp Planting.*** This alternative would rely on planting juvenile kelp plants on plastic floats and lines anchored to existing sand and rock substrate rather than constructing an artificial reef. Following a 20-acre experimental phase at the San Clemente site and two years of monitoring, an additional 130 acres of kelp would be planted at San Clemente and/or Mission Beach.

6.2.3 Other Alternatives Proposed

- ***Decommissioning of SONGS.*** This would require closing down San Onofre Units 2 and 3 to remove the source of damage to the SOK.

6.3 Alternatives Eliminated from Further Consideration

The primary purpose of the first phase of the proposed project is to create an experimental artificial reef project to test quarry rock and recycled concrete materials, levels of materials coverage and location factors. The primary purpose of the second phase of the project is to create an artificial reef with a minimum 150 acres of medium-to-high density kelp bed and associated biota. Several of the alternative sites and alternative proposals were considered, but eliminated from further detailed analysis because they did not meet the project purposes. These include:

- ***Northern San Clemente Site.*** This alternative site was suggested by local commercial fishing groups and would locate the artificial reef to an area just north of the San Clemente Pier. The fishermen felt there could be more existing hard substrate within the proposed project site then has been identified and they are concerned about covering over known fishing grounds. During the site selection process for the artificial mitigation reef, this area was evaluated. It was determined that kelp beds were less likely to be successful in this area because of the close proximity to San Juan Creek. It was felt that sedimentation from San Juan Creek would reduce the success for growing sustainable kelp in this location. In addition, there were greater navigation hazards associated with the site due to the close proximity of Dana Point Harbor and the use of the area by recreational boaters.

- ***San Clemente Site Farther Offshore.*** This alternative site was suggested by local commercial fishing groups and would situate the artificial reef farther offshore from San Clemente (at a depth of 50-55 feet), adjacent to the proposed project site. The fisherman felt there could be more existing hard substrate within the proposed site then has been identified and they are concerned about covering over known fishing groundss. However, this site was eliminated for construction of the artificial reef because of the depth of water. The deeper water in this area reduces light levels, which in turn reduces the chance that kelp will recruit and grow. In addition, the greater depth of sand cover on the ocean bottom could require that more reef material be placed to avoid the reef being covered over by sand.

- ***Experimental Projects at Big Sycamore Canyon (inside and outside the preserve) and Pitas Point.*** These sites were proposed by the United Anglers Association as the location for an experimental project combining high and low relief artificial reefs. Big Sycamore Canyon is near Oxnard in Ventura County, which is approximately 96 miles from the SOK. This site is too far removed from San Onofre to provide in-kind mitigation for the lost kelp resources, and does not meet the criteria outlined in the CCC permit conditions for artificial reef mitigation. Pitas Point is even farther north up the coast, and as a result, would also not meet the CCC permit conditions.

- ***Kelp Planting Experimental Project and Mitigation Project.*** A kelp planting project was proposed by the Marine Forests Society to mitigate for lost kelp forest resources without requiring placement of quarry rock or recycled concrete on the sea bottom. This project would involve planting 150 acres of juvenile kelp plants at the San Clemente site (and possibly at Mission Beach) on existing rock and sand substrate. The planting methods involve anchoring flexible floats that remain one meter (3.3 ft) above the sea bottom to avoid disturbance by sediments and bottom feeders. Planting would occur in two phases, with an initial experiment of 20 acres that would be planted the first year. This would include 10 acres planted on rock substrate and 10 acres on sand substrate. The 20 acres would be monitored for two years to observe the planting methods' success and to study the effects on fish and invertebrates. Artificial substrates would be installed on the bottom to enhance fish and invertebrate production, if necessary.

- Kelp sporophytes used for planting would be cultured on lines in a laboratory located onshore. At least one of the plants on the sporophyte line would be transplanted or would naturally affix itself to each float. The goal would be to have one mature giant kelp plant growing on each float. This plant would be a source of spores for recruitment to the surrounding rocky or sandy bottom.

The experimental planting project would be monitored for two years by independent experts to determine if the kelp planting project met the performance criteria of the SONGS Permit and to determine if the lost and damaged resources from the San Onofre kelp bed had been replaced. Based on these results, an additional 130 acres would be planted on existing rock and sand substrate at San Clemente and/or Mission Beach.

The kelp planting proposal offers some potential advantages over other mitigation alternatives. In particular, it would largely mitigate the air quality impacts which result from the proposed project and alternatives. However, this proposal does not adequately address the project purposes as described in the SONGS Permit conditions adopted by the CCC. In particular, the project would not provide adequate conditions for a community of reef-associated biota similar in composition, diversity and abundance to the San Onofre kelp bed. The habitat of the San Onofre kelp bed consists of kelp forest on low-relief, cobble-boulder reef. The habitat produced by the kelp planting project would be quite different, consisting of a large grid of floats supporting giant kelp plants. Therefore, the algae, invertebrate and fish species associated with this project would likely be quite different from the assemblage of species found in the San Onofre kelp bed. Finally, the kelp planting project would not create a rock reef, as required by the permit, and would result in a project more similar in appearance to a kelp farm than to a natural kelp forest ecosystem.

Although the kelp planting proposal does not adequately satisfy the project objectives, some of the methods described could prove useful as remediation in case of failure of a mitigation reef project. For example, various forms of kelp planting methods may be done, if natural recruitment of kelp to the reef is inadequate.

- ***Decommissioning of SONGS.*** This proposal and other types of out-of-kind mitigation measures for damages at the SOK were debated in public hearing before the CCC. This proposal was evaluated and ultimately rejected by the CCC. Instead, the SONGS Permit conditions adopted by the CCC require that an artificial reef be constructed to provide in-kind mitigation to replace losses at the SOK. As a result, it is not required by CEQA to be considered further in this PEIR.

6.4 Alternatives Evaluated in the PEIR

Three experimental and mitigation reef alternatives have been evaluated in this chapter as follows: (1) Experimental and Mitigation Reef at Multiple Locations; (2) 150-Acre Reef Built Now with Experiment; and (3) Compound Reefs (High and Low Relief) at Multiple Locations. Each of the three experimental reef alternatives is naturally linked to a mitigation reef build out. The first section in this chapter provides a description of the environmental setting for the alternative sites included in the experimental and mitigation reef alternatives evaluated for the PEIR. This is followed by a detailed description of the experimental and mitigation reef alternatives, and a comparative evaluation of each.

6.4.1 Environmental Setting for Alternative Sites

All of the alternatives evaluated in this chapter are located at one or more of the sites described in this section, or at the proposed project San Clemente site. Alternative locations were considered in the PEIR for several reasons: (1) if the experimental reef at the San Clemente site is not successful in growing kelp, other sites might be considered for the full build out; or (2) if significant environmental impacts can not be mitigated at the San Clemente site, alternative sites might be considered to reduce impacts. While none of the alternative sites provides adequate acreage to fully accommodate the mitigation artificial reef required by the SONGS Permit, these sites could be combined with one another or the San Clemente site to achieve the necessary acreage.

The Alternative Locations Maps (Figures 6-1 to 6-4) designate the five alternative locations that have been considered for construction of the experimental reef and mitigation reef. The sites are all located in San Diego County south of SONGS. The criteria used in selecting these alternative sites is discussed in the report, *Review of Site Selection Process for Southern California Edison's Mitigation Reef*, prepared by Coastal Environments and Coastal Resources and is contained in Appendix F of this PEIR. The criteria used are those found in the SONGS Permit, Condition C, Section 1.2. The siting criteria are as follows:

1. Location as close as possible to the SOK, and preferably between Dana Point (Orange Co.) and Carlsbad (San Diego Co.), but outside the influence of the SONGS discharge plume and water intake, and away from Camp Pendleton.

2. Minimal disruption of natural reef or cobble habitats and sensitive or rare biotic communities.

3. Suitable substrate with low mud and/or silt content (e.g., hard-packed fine to coarse grain sand, exposed cobble or bedrock without a persistent kelp biological community, or cobble or bedrock covered with a thin layer of sand)

4. Location at a depth locally suitable for kelp growth and recruitment.

5. Location near a persistent natural kelp bed.

6. Location away from sites of major sediment deposition.

7. Minimal interference with uses such as vessel traffic, vessel anchorages, commercial fishing, mariculture, mineral resource extraction, cable or pipeline corridors.

8. Location away from power plant discharges, waste discharges, dredge spoil deposition sites, and activities of the U.S. Marine Corps.

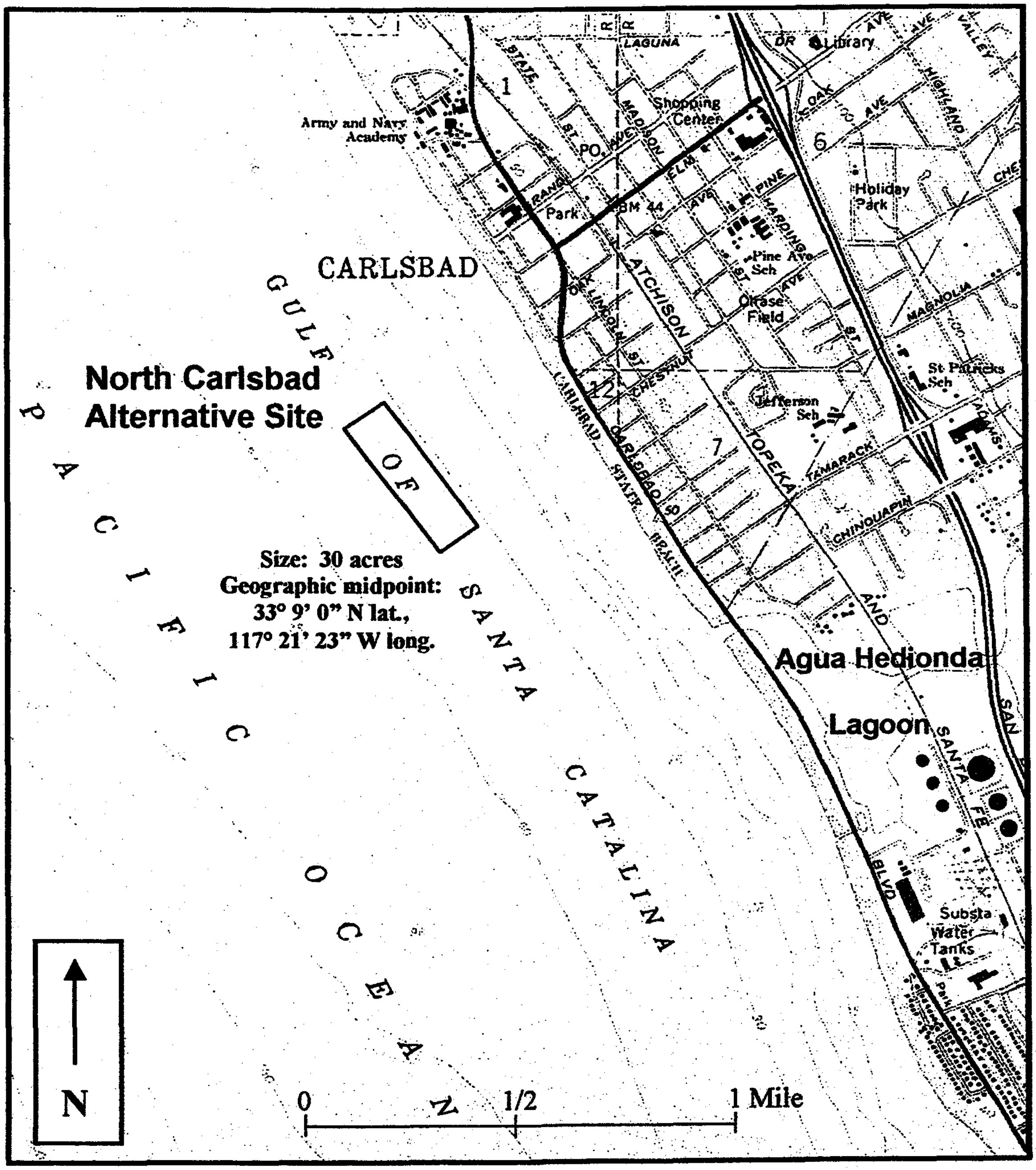

Figure 6-1. North Carlsbad alternative reef site.

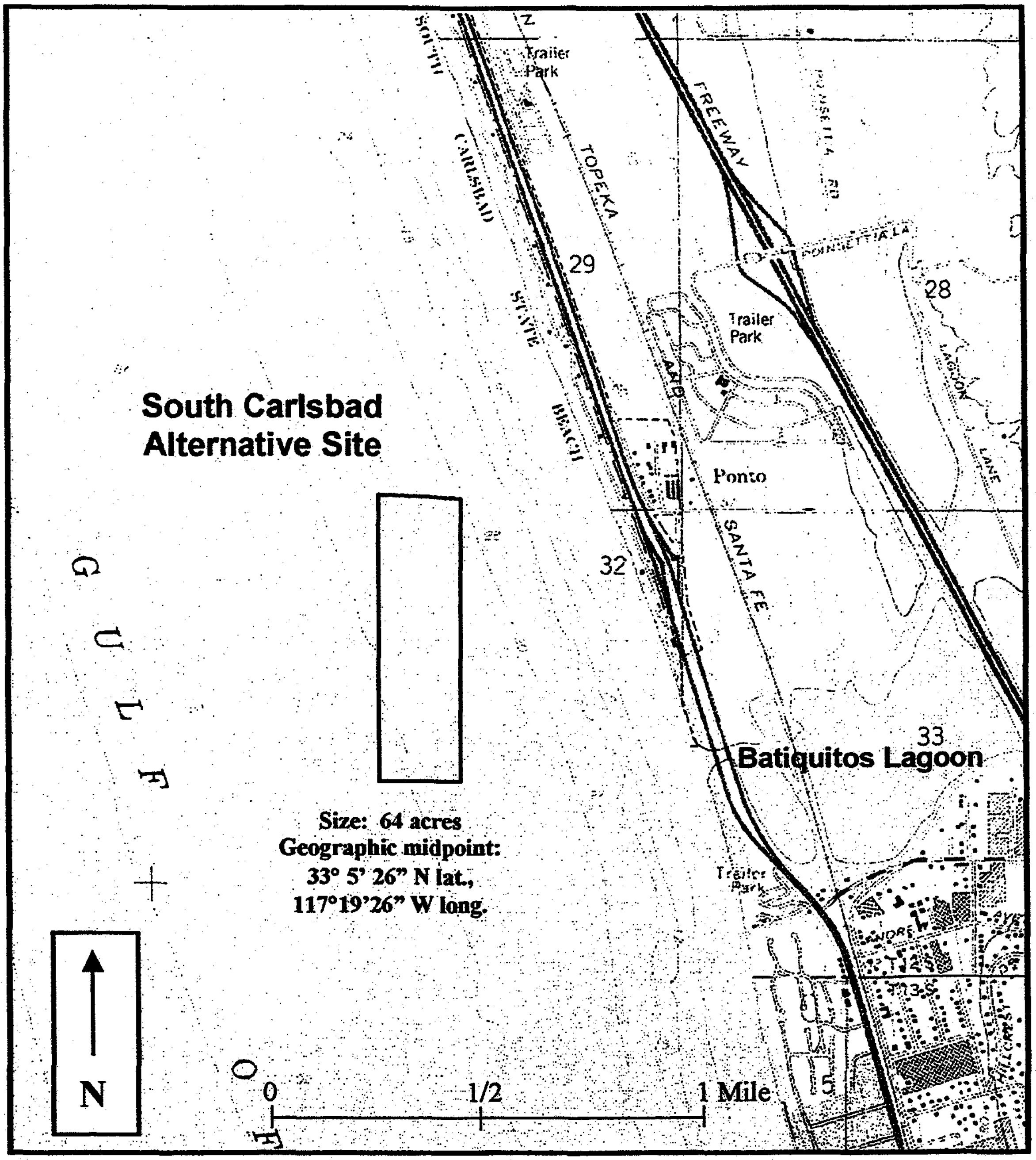

Figure 6-2. South Carlsbad alternative reef site.

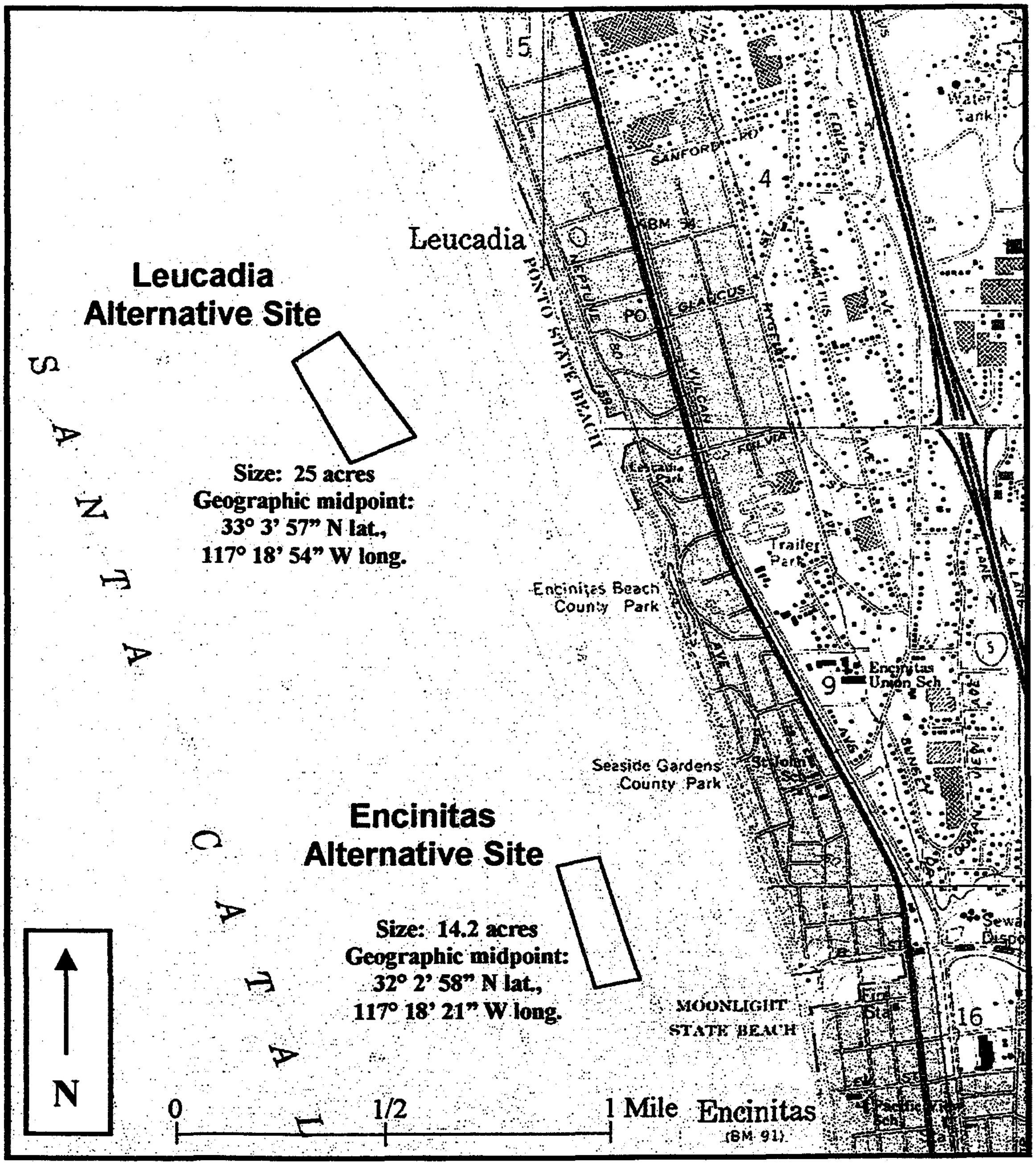

Figure 6-3. Leucadia and Encinitas alternative reef sites.

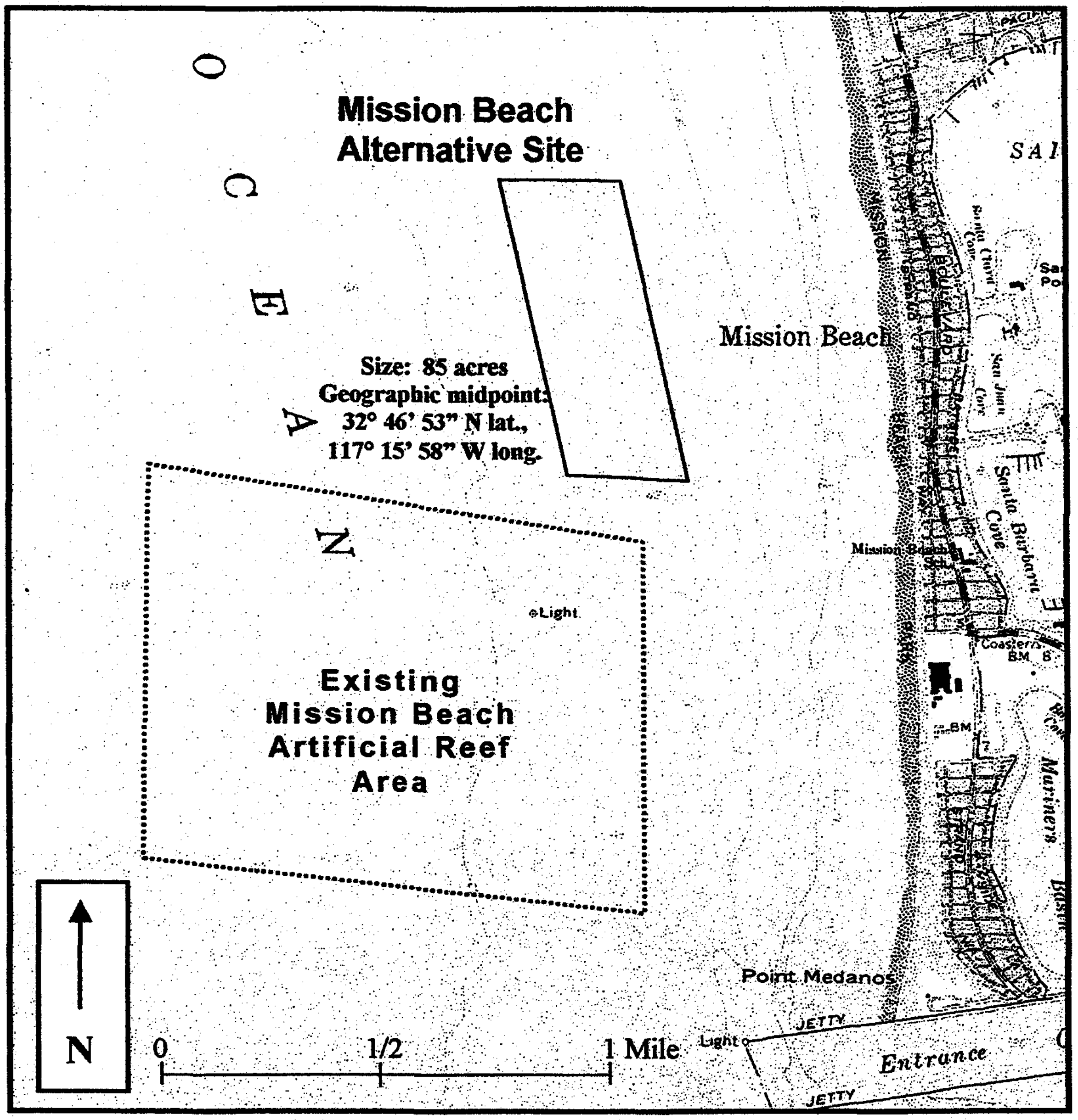

Figure 6-4. Mission Bay alternative reef site and area of existing artificial reef.

9. Location that will not interfere with or adversely affect resources of historical or cultural significance such as shipwrecks and archeological sites.

The North and South Carlsbad, Leucadia and Encinitas sites were identified as having suitable substrate and depth characteristics for artificial reef development similar to the San Clemente site and are fairly near to SOK. The Mission Beach site has different substrate characteristics and is farther from SOK, but was included because it currently has a low-relief concrete reef that has shown promising results for growing kelp. In addition, Mission Beach has the largest available acreage for constructing an artificial reef. All of these sites are located near existing, persistent kelp beds.

- ***North Carlsbad***

This site includes 30 acres of suitable substrate located about 0.4 mile offshore from the northern portion of the City of Carlsbad and Carlsbad State Beach. (Figure 6-1). The site is approximately 20 miles south of the SOK. Land uses nearby include residential and tourist-related commercial and recreational uses. The site has sand bottom habitat at depths of 10 to 17 meters. Surveys of the biota in subtidal sand bottom habitat at the North Carlsbad site were conducted in 1992 (Ecosystems Management Associates 1995). Some species, such as sea stars, had similar densities at the San Clemente and North Carlsbad sites. Other species that were common at San Clemente, such as sea pansies and sea pens (see Table 4.6-3, in Section 4.6), were not found at the North Carlsbad site. The North Carlsbad site is also similar to the San Clemente site in that it includes scattered hard substrate on the sand bottom and it is located near existing kelp reefs.

- ***South Carlsbad***

This site includes 64 acres of suitable substrate about 0.5 mile offshore from the southern portion of the City of Carlsbad (Figure 6-2). The site is near the South Carlsbad State Beach and just south of the entrance to Batiquitos Lagoon. The site is approximately 23 miles south of SOK. Coastal areas near the South Carlsbad site consist primarily of open space and residential development, with some industrial and commercial uses. This site consists of sand bottom habitat at depths of 10 to 17 meters. No surveys have been conducted of the biota at the site, but it is likely that the principle species present are largely the same as those present at the North Carlsbad site, and the same or similar to those at the San Clemente site (see Table 4.6-3, in Section 4.6 of Chapter 4). The South Carlsbad site is also similar to the San Clemente site in that it includes scattered hard substrate on the sand bottom and it is located near existing kelp reefs.

- ***Leucadia***

This site includes 25 acres of suitable substrate about 0.5 mile offshore from the City of Leucadia and the Leucadia City Beach (Figure 6-3). The site is approximately 25 miles south of SOK. Land uses near the Leucadia site are similar to those near the San Clemente site, with mostly residential and commercial development. This site consists of

Table 6-1 ALTERNATIVE 2. EXPERIMENTAL REEF AT MULITPLE LOCATIONS
Construction of 48 Acres

	San Clemente	Mission Beach	South Carlsbad	Total
Distance from Port of San Diego	69	21	44	
Reef Size (acre)	16	16	16	48
Number of Modules	16	16	16	48
Tons of Material	40,000	40,000	40,000	120,000
Rock	22,400	22,400	22,400	67,200
Concrete	17,600	17,600	17,600	52,800
Truck Trips (RT) (22 tons each, 91 loads in a day)	1,818	1,818	1,818	5,455
Barge Loads (2,002 tons each, loading 1 barge in a day)	20	20	20	60
Tugboat Trips (RT) (1 tug with 1 barge, leaving every other day)	20	20	20	60
Placement Time with Crane (days) (1/2 barge per day)	40	40	40	120

The experimental reef would be monitored for five years to test the different reef sites and designs. The monitoring program and performance criteria would be similar to those of the proposed project. The results of the monitoring program would be used to determine the location and design of the full build-out reef.

Phase 2. Mitigation Reef at Multiple Locations

Following the completion of an experimental reef and monitoring program, it could be determined that the mitigation reef should be built at multiple locations. The reasons for this could be that: (1) the results show that certain locations perform better than others and better meet the SONGS Permit performance standards; or (2) it may be more desirable to spread the construction out to other sites in order to reduce the environmental impacts, particularly air quality impacts.

For the purposes of this analysis, it is assumed that the full build out for this alternative would require an additional 102 to 252 acres of construction with either all rock or all concrete at 67 percent coverage. With the 48 acres of experimental reef, this would result in 150 to 300 acres of mitigation reef. This alternative would require an additional 285,600 to 705,600 tons of rock or 224,400 to 554,400 tons of concrete, respectively.

Five alternative sites have been identified as capable of supporting the same type of low-relief artificial reef as the proposed project at San Clemente. The results of the experimental reef at multiple locations would provide information on how the San Clemente, South Carlsbad and Mission Beach sites perform. However, of these three sites only the San Clemente site has enough surface area with suitable substrate and depth characteristics to fully accommodate the additional 102 to 252 acres needed to complete the full build out reef.

The South Carlsbad site has just 64 acres and the Mission Beach site has 85 acres (Elwany and Deysher 1998). The experimental reefs would occupy 16 acres at each site, leaving 48 acres at South Carlsbad and 69 acres at Mission Beach for further construction. The three sites closest to South Carlsbad are North Carlsbad, Leucadia, and Encinitas, which are similar to South Carlsbad in most respects (see Table 2, Elwany and Deysher 1998). These three sites provide another 80 acres of suitable area. The five alternative sites would have a total of 197 acres available for the mitigation reef build out.

In combination with the experimental reefs, the overall total would be 229 acres of reef at the alternative locations. This would be more than adequate for a minimum 150-acre reef, but still does not provide the up to 300 acres that could be needed.

There are numerous scenarios for how these alternative sites might be combined with one another and/or San Clemente to provide an artificial reef that achieves 150 acres of medium-to-high density kelp bed and associated biota. This would depend on the particular reasons for selecting alternative sites. For example, if the objective was to reduce NOx air emissions related to construction barges, the sites closest to the Port of San Diego would be prefered, or if San Clemente is not as successful as hoped, other sites might be selected that are closest to the SOK to meet that Permit objective.

The following evaluates the environmental impacts of the five alternative sites in comparison to the proposed project if all of the available acreage at each site were used to construct the mitigation reef build out. For South Carlsbad and Mission Beach, this is the acreage available after constructing the 16-acre experimental reefs at each site. Tables 6-2 and 6-3 outline the assumptions used to calculate construction impacts at each of the five sites. A probable worst-case scenario was used, which assumes materials shipped from the Port of San Diego.

6.4.3.1 Consistency with Project Objectives

Both the experimental and mitigation reef in this alternative meet the basic project purposes and objectives to create an artificial reef to replace resource losses at SOK. The experimental reef meets the project objectives of testing recycled concrete and quarry rock, and of testing different levels of coverage of the reef material. The San Clemente, North Carlsbad and South Carlsbad sites meet all of the siting criteria including proximity to SOK. The Leucadia and Encinitas sites are slightly farther from SOK, but have the same basic characteristics required for the artificial reef. The Mission Beach site is even farther from SOK and has somewhat different substrate conditions. While an

This alternative would have a greater potential for reef material to cover existing hard substrate at the San Clemente and South Carlsbad sites than with the proposed project. The concentration of the test modules in one area at each site (rather than being spread out as in the proposed project) could make it more difficult to avoid existing hard substrate. The South Carlsbad site offers less available substrate and area to select from. This would not be a problem at Mission Beach as the bottom is all sand cover. In compliance with the SONGS Permit every effort would be made to avoid existing hard substrate.

Mitigation Reef. The mitigation reef build out for this alternative would differ from the proposed project with construction taking place at some combination of the five alternative sites and possibly part at San Clemente. This would depend on the size of the mitigation reef build out and the objectives of the final design. The five alternative sites could accommodate the 102-acre scenario, but the 252-acre scenario would require some portion of the reef to be located at San Clemente (a minimum of 55 acres).

There are numerous recreational sportfishing businesses in San Diego County located at San Diego Harbor, Point Loma and Oceanside Harbor. Construction activities for the mitigation reef at North and South Carlsbad, Leucadia and Encinitas could affect fishing charters in the area by temporarily restricting access to the site. The Mission Beach site would be less likely to affect sportfishing businesses, because of its sand bottom substrate does not provide prime fishing habitat. The mitigation reef at North and South Carlsbad, Leucadia and Encinitas would require the same mitigation for noticing sportfishing operators that would be applied to the proposed project at San Clemente.

The same socioeconomic impacts identified for the proposed project mitigation reef would also be present for all five alternative sites. The North and South Carlsbad, Encinitas and Leucadia sites are important commercial fishing locations for lobster, crab and sea urchins. Construction activities could disrupt habitat and fishing activities. The Mission Beach site is not a fishing location for these species due to the depth of sand and lack of hard substrate, but it is close to important lobster sites near the entrance to Mission Bay along the jetty. Construction tugboat and barge traffic could interfere with fishing at these locations. As with the proposed project, the mitigation reef at the alternative sites would need to be constructed between May and September to avoid the lobster season and a significant impact.

This alternative would have a greater potential for reef material to cover existing hard substrate at the North and South Carlsbad, Leucadia and Encinitas sites as with the proposed project. These sites are smaller and offer less choices for where to place material than the 355-acre San Clemente site. This is not a problem at Mission Beach where the bottom is all sand cover. In compliance with the SONGS Permit every effort would be made to avoid existing hard substrate.

- ***Air Quality: Significant Impacts for:***

    - *Experimental Reef*: daily emissions for NOx and PM_{10} ; and quarterly emissions for NOx

    - *Mitigation Reef*: daily and quarterly emissions for NOx and PM_{10}

Experimental Reef. This alternative experimental reef would require more than three times the amount of material for reef construction as the proposed project. This is due to both the larger size (48 acres) and the levels of coverage being tested (only 34 and 67 percent). This would result in 5,455 truck trips and 60 tugboat trips and barge loads over 120 days in comparison to the 1,432 truck trips and 16 tugboat trips and barge loads over 32 days for the proposed project. As a result, the total air emissions generated during construction are considerably greater.

The construction assumptions for equipment operations are the same for the proposed project and all of the alternative sites, with the exception of the distance tugboats with barges must travel from the Port of San Diego to the sites. As a result, the daily air emissions for tugboat shipping are less for each of the alternative sites. This is important as it results in a reduction to significant levels of NOx emissions. Table 6-4 compares the daily NOx and PM_{10} emissions for tugboat shipping and total construction activities for each of the six reef sites. Tugboat shipping daily NOx emissions for the Mission Beach site are 66 percent less than the daily emissions for the San Clemente site, while total daily NOx emissions are reduced by 37 percent. The tugboat shipping and total daily NOx emissions for the South Carlsbad site are reduced by 38 percent and 21 percent respectively. PM_{10} emissions are not a major factor in the tugboat shipping activity.

These differences among sites reduce the daily and quarterly NOx emissions for the experimental reef at the Mission Beach and South Carlsbad sites as compared to the San Clemente site, as shown in Table 6-5. The construction emissions for all sites combined with this alternative would still generate significant daily NOx and PM_{10} emissions, and quarterly NOx emissions. In addition, this experimental reef alternative also generates quarterly PM_{10} emissions that exceed the thresholds of significance (see Table 4.4-6, in Chapter 4). The same mitigation measures as were recommended for the proposed project would be required to reduce these impacts to less-than-significant.

Mitigation Reef. The build out of the mitigation reef at some combination of the five alternative sites and possibly at San Clemente would have varying effects on air quality. As shown in Table 6-4 and discussed above, the daily NOx emissions at the alternative sites are less than for the San Clemente site. Tables 6-6 and 6-7 show the daily and quarterly emissions generated for the maximum build out at each of the five alternative sites using either all rock or all concrete. These sites could be combined with one another and San Clemente to achieve a minimum of 150 and up to 300 acres of artificial reef.

Table 6-4 Daily Comparison of Tugboat Shipping and Total Construction Daily NOx and PM_{10} Emissions per Roundtrip from Port of San Diego to Each Reef Site

Site	Distance from Port (one-way)	Hours for RT	Tugboat Towing Emissions Only (lbs/day)		Total[1] Construction Emissions (lbs/day)	
			NOx	PM_{10}	NOx	PM_{10}
Mission Beach	24	5.9	94.4	2.0	302.67	584.95
Encinitas	39	9.6	153.6	3.4	361.87	586.35
Leucadia	41	10.1	161.6	3.4	369.87	586.3
South Carlsbad	43	10.6	169.6	3.6	377.87	586.55
North Carlsbad	46	11.3	180.8	3.8	389.07	586.7
San Clemente	69	17	272.1	5.84	480.37	588.79

[1] All sites exceed the daily emissions thresholds for significance for NOx (100 lbs/day) and for PM_{10} (150 lbs/day). Total daily emissions includes all activities occurring on one day. However the loading, truck hauling and tugboat shipping would occur every other day, while placement and working commuting would occur every day.

Table 6-5 ALTERNATIVE 2. EXPERIMENTAL REEF AT MULITPLE LOCATIONS Daily and Quarterly Emissions for NOx and PM_{10}

	San Clemente	Mission Beach	South Carlsbad	Total
Acres	16	16	16	48
Days of Construction[1]	40	40	40	120
<u>Daily Emissions</u>[2] (lbs/day)				
NOx	480.37	302.67	377.87	
PM_{10}	588.79	584.95	586.55	
<u>Quarterly Emissions</u>[3] (lbs/qtr)				
NOx	10,087.77	6,356.07	7,935.27	24,379.11
PM_{10}	12,364.59	12,283.95	12,317.55	36,966.09
<u>Total Emissions</u>[4]				
NOx	10,087.77	6,356.07	7,935.27	24,379.11
PM_{10}	12,364.59	12,283.95	12,317.55	36,966.09

[1] Assumes only one site is constructed at a time.

[2] Daily emissions thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

3 A quarter includes 78 days of emissions. Quarterly emission thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

4 Quarterly emission are the same as total project emissions for individual sites as construction could be completed in one quarter.

Table 6-6 ALTERNATIVE 2. MITIGATION REEF AT MULTIPLE LOCATIONS

Comparison of Daily and Quarterly Emissions For NOx and PM_{10} Maximum Build Out at Each Site - All Rock

	Mission Beach	South Carlsbad	North Carlsbad	Leucadia[3]	Encinitas[3]
Acres of Construction	69	48	30	25	25
Days of Construction	97	68	42	351	35
Daily Emissions[1] (lbs/day)					
NOx	302.67	377.87	389.07	369.87	361.87
PM_{10}	584.95	586.55	586.75	586.35	586.35
Quarterly Emissions[2] (lbs/qtr)					
NOx	23,608.26	25,695.16	16,340.94	12,945.45	12,665.48
PM_{10}	45,626.10	39,885.40	24,643.5	20,522.25	20,522.25
Total Emissions					
NOx	29,358.93	25,695.16	16,340.94	12,945.45	12,665.48
PM_{10}	56,740.15	39,885.40	24,643.5	20,522.25	20,522.25

[1] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[2] A quarter includes 78 days of emissions.Quarterly emission thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

[3] All sites except Mission Beach could be constructed in one quarter.

Table 6-7 ALTERNATIVE 2. MITIGATION REEF AT MULTIPLE LOCATIONS

Comparison of Daily and Quarterly Emissions For NOx and PM_{10} Maximum Build Out at Each Site - All Concrete

	Mission Beach	South Carlsbad	North Carlsbad	Leucadia[3]	Encinitas[3]
Acres of Construction	69	48	30	25	25
Days of Construction	76	53	33	28	28
Daily Emissions[1] (lbs/day)					
NOx	302.67	377.87	389.07	369.87	361.87
PM_{10}	584.95	586.55	586.75	586.35	586.35
Quarterly Emissions[32] (lbs/qtr)					
NOx	23,002.92	20,027.11	12,839.31	10,356.36	10,132.36
PM_{10}	44,456.2	31,087.15	19,362.75	16,417.8	16,417.8
Total Emissions					
NOx	23,002.92	20,027.11	12,839.31	10,356.36	10,132.36
PM_{10}	44,456.2	31,087.15	19,362.75	16,417.8	16,417.8

1

2 Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

3 A quarter includes 78 days of emissions.Quarterly emissions thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

4 All sites could be constructed in one quarter.

The experimental reef for this alternative would be 25.6 acres larger than the experimental reef for the proposed project. Therefore, assuming adequate performance of the experimental reef, the mitigation reef build out would use less rock or concrete material for this alternative than for the proposed project. If the build out occurred primarily at the alternative sites, this would further reduce NOx emissions. However, this alternative would still generate significant daily and quarterly NOx and PM_{10} emissions.

- ***Transportation and Noise*: Significant Impacts from Truck Traffic on:**

  - *Level of Service*: at intersections in San Diego and Los Angeles Counties near the ports during peak hours

  - *Noise Levels:* for residences within 150 feet of truck routes

Experimental Reef. This alternative experimental reef would require more than three times the amount of material for reef construction as the proposed project. This is due to both the larger size (48 acres) and the levels of coverage being tested (only 34 and 67 percent). This would result in 5,455 truck trips over 60 days in comparison to the 1,432 truck trips over 16 days for the proposed project. However, on a daily basis both projects would result in the same number of truck trips (91 trucks a day to load one barge). As a result, the same significant impacts would occur for level of service at intersections and for noise in residential areas. The same mitigation measures would be required.

Mitigation Reef. Full build out of the mitigation reef at the five alternative sites or at the San Clemente site would result in materials being transported at the same rate on a daily basis (91 trucks a day to load one barge). As a result, the same significant impacts would occur for level of service at intersections and for noise in residential areas. The same mitigation measures would be required.

The difference between this alternative and the proposed project would be the overall duration of the construction and the total number of truck trips. Because more acreage would be constructed in the experimental phase of this alternative, less construction would be required in the build out phase. However, the number of truck trips for this alternative would be the same regardless of the sites chosen to build the artificial reef. The important factors would be the overall size of the reef, the level of coverage and the choice of materials.

- ***Geology, Hazards, Public Services, and Recreation*: Significant Impact from Rocks/Concrete Washing Onshore**

  - *Hazard to Human Health:* rocks/concrete on the beach would create a hazard for people

  - *Need for Beach Maintenance Services:* the need to remove rocks/concrete could increase the level of service and costs required for beach maintenance

Experimental Reef. The quantity of quarry rock and recycled concrete placed in the ocean for the experimental reef in this alternative would be almost three times as much as for the proposed project. Although, the reef would be distributed along the coast at several sites, this would not change the potential for large storms to wash rock or concrete ashore. This alternative would create the same impacts for beach maintenance services and hazards to human health as were identified for the proposed project.

Mitigation Reef. Reef materials placed at any of the five alternative sites or San Clemente would have the same potential for large storms to wash rock or concrete ashore. This would create the same impacts for beach maintenance services, recreation and hazards to human health as identified for the proposed project.

- ***<u>Public Services and Recreation</u>: Potentially Significant Impact from Kelp Wrack Washing Onshore***

    - *Need for Beach Maintenance Services:* the need to remove kelp wrack could increase the level of service and costs required for beach maintenance

    - *Deterrent to Recreation Users:* kelp on the beach could cause recreation users to go to other areas

Experimental Reef. The experimental reef in this alternative would potentially increase kelp wrack on the beach at San Clemente, South Carlsbad and Mission Beach. The maximum expected would be 320 yd^3 annually at each site with most of this occurring in the winter months. As with the proposed project, this would not be enough kelp wrack to create a need for additional beach maintenance services or to create a problem for recreational users on the beach.

Mitigation Reef. The full mitigation reef would require some combination of alternative sites and possibly part of San Clemente for additional construction of between 102 to 252 acres of reef. All of the five alternative sites are located between or near to major kelp beds and are adjacent to public beaches. The North and South Carlsbad sites are located offshore from the Carlsbad State Beach and South Carlsbad State Beach respectively and are managed by the CDPR. The State beaches currently experience a fair amount of kelp wrack onshore, particularly after large storms. However, it is the CDPR philosophy and policy not to clean kelp off the beaches and to maintain them in their natural state. The City of Encinitas and the State jointly manage Moonlite Beach opposite the Leucadia site and periodically remove kelp as needed. Other beaches in this area are narrow and inaccessible. The City of San Diego grooms Mission Beach daily and removes all kelp for disposal at Fiesta Island.

Estimates of the amount of kelp wrack that might be generated annually at each site with full build out (including the acres from the experimental reef at South Carlsbad and Mission Beach) are as follows. This assumes a maximum of 20 yd^3 per additional acre of artificial reef (Elwany 1998, Appendix F):

North Carlsbad with 30 acres – 600 yd^3

South Carlsbad with 64 acres – 1,280 yd^3

Leucadia with 25 acres – 500 yd^3

Encinitas with 25 acres – 500 yd^3

Mission Beach with 85 acres – 1,700 yd^3

The build out of the mitigation reef at the alternative sites would be expected to have fewer impacts on beach maintenance services than the proposed project, because the impacts would be spread out along the coast rather than occurring all at one site. In addition, these communities already have equipment, personnel and beach maintenance programs for the major beaches, or in the case of the State beaches, a policy to leave the kelp in place. As most of the kelp wrack would occur in the winter months this would have less impact on recreational users. This alternative would reduce the significant impacts on beach maintenance services and recreation to a less-than-significant impact and eliminate the need for the mitigation discussed for the proposed project.

If the mitigation reef were to require up to 252 acres of additional construction, then at least 55 acres of reef would be built at San Clemente. This would create up to 1,100 yd^3 of kelp wrack washing onshore annually. This could potentially be a significant impact at this site.

6.4.3.3 Comparison of Less-Than-Significant Impacts

The experimental and mitigation reefs in Alternative 2 would be expected to have comparable less-than-significant affects as described for the proposed project in all areas except as described below:

- ***Socioeconomics***

The alternative sites included here are all located between or near to major kelp beds where kelp harvesting could occur. There is a greater potential for construction and monitoring of the experimental and mitigation reefs at these sites to interfere with on-going kelp harvesting in the area. As a result, this alternative would have more impacts than the proposed project for this commercial activity, but this would still be a less-than-significant impact.

- ***Transportation and Circulation***

Reef materials for the experimental reef and possibly for the mitigation reef would be transported to alternative sites located closer to the Port of San Diego. As a result, tugboat and barge traffic impacts would be less than those anticipated for the proposed project.

- ***Biology***

Experimental Reef. This alternative would entail nearly three times as much construction activity as the proposed project for the experimental reef. Effects of suspended sediments and burial at each site would be potentially more pronounced because the reef modules would have 34 or 67 percent coverage. The total area of sand bottom habitat that would be buried by reef material at the three sites, including scattered hard substrate at the San Clemente and South Carlsbad sites, would be about 24.3 acres, as opposed to 8.5 acres for the proposed project. As a result, construction of the experimental reef would have more impact on subtidal sand bottom communities for Alternative 2 than the proposed project.

Because the experimental reef modules at each of the three locations are grouped together, the reefs at each site would be more like the mitigation reef, while the proposed project experimental reef would consist of a number of small, separate reef modules. Nonetheless, the experimental reefs for this alternative would be much smaller than the proposed project mitigation reef.

The impacts of the experimental reefs for this alternative would likely be similar to those of the experimental reef for the proposed project for the following reasons. Effects of the reefs on the surrounding sand bottom community resulting from increased food resources and predation would be influenced both by the size of the reefs, as well as, by the amount of interface of the reef with the sand bottom habitat. Whereas large reefs produce more food resources and predators that affect the surrounding sand bottom community than small reefs, the principal interactions of the reef and sand bottom communities occur at the reef-sand interface (Davis et al. 1982; Ambrose and Anderson 1990). Therefore, both reef size and amount of reef-sand interface are important. The total surface area of the experimental reefs would be much greater for this alternative than for the proposed project (48 acres versus 22.4 acres), but the total length of reef-sand interface would be much smaller (4,070 meters versus 8,960 meters). Therefore, the net impact for the two alternatives would probably be similar. Alternative 2 and the proposed project would have similar impacts on subtidal sand bottom communities from the presence of the experimental reef.

The experimental reefs for this alternative, though much larger than the experimental reef modules of the proposed project, would be too small to affect existing kelp reefs in the vicinity. Alternative 2 and the proposed project would have comparable impacts on existing kelp communities from the presence of the experimental reef.

Mitigation Reef. The mitigation reef could be identical to that described for the proposed project or, depending on the results of the experimental reef phase, it could consist of some combination of smaller reefs at San Clemente, Mission Beach, South Carlsbad, North Carlsbad, Leucadia and Encinitas. Therefore, potential impacts of the mitigation reef for this alternative could be spread over several sites, in which case they would be less severe at any one site for subtidal sand bottom communities.

The mitigation reef in this alternative could consist of some combination of smaller reefs at San Clemente, Mission Beach, South Carlsbad, North Carlsbad, Leucadia and Encinitas. Potential impacts of this alternative mitigation reef on the supply of nutrients and plankton to existing kelp beds would be spread over several sites, in which case they would be less severe at any one site.

- ***Energy***

Because the experimental reef project in Alternative 2 is almost three times as large as the proposed project, this alternative would use considerably more fuel. Fuel use for the mitigation build out would be less than the proposed project. However, fuel use for the full build out would be less than the proposed project. This would remain a less-than-significant impact.

<u>6.3.3.4 Significant Impacts with This Alternative, Not Present for the Proposed Project</u>

- ***Offshore Mineral Resources***

The South Carlsbad and Mission Beach reef sites appear to lie at least partially within the boundaries of potential borrow areas as discussed in the alternative sites environmental setting section. Constructing a reef within potential borrow areas could preclude the mining of sand and gravel offshore of South Carlsbad and Mission Beach. These resources have been identified for uses such as beach replenishment and construction materials. This is considered a significant impact, which is not present for the proposed project. Mitigation would require first identifying whether there is currently a demand or planned use for the resources at these sites. If there are known plans for the resources, the project proponents would need to find other borrow sites in the region that could replace the sand and gravel resources at South Carlsbad or Mission Beach.

6.4.4 Alternative 3. 150-Acre Reef Built Now with Experiment

This alternative evaluates the impact of building a 150-acre artificial reef right away at the San Clemente site using recycled concrete at 17 percent coverage. In addition, an experimental project would be embedded into the 150-acre reef to test quarry rock and recycled concrete at coverages of 17, 34 and 67 percent. Depending on the success of the different reef materials and levels of coverage after five years of monitoring, additional concrete or quarry rock could be placed as needed to meet the CCC criteria for medium-to-high density kelp beds.

Phase 1. Experimental Reef Embedded into 150-Acre Reef Built Now

This alternative differs from the proposed project in the following ways:

- this alternative potentially provides immediate mitigation for lost resources at San Onofre kelp beds by constructing 150 acres of reef right away, rather than waiting five years for the results of the experimental phase of the reef;

- the experimental portion of the project is smaller than the proposed project, 14.4 acres versus 22.4 acres;

- the monitoring program is for five years, at which time additional material might be placed to increase the level of coverage of the reef and/or to increase the area of coverage.

- the design of the experimental portion of the project would be similar to that of the proposed project except that treatment modules would be grouped into six blocks rather than seven blocks, and the blocks would be distributed over a 150-acre area, which is the area of the 17 percent coverage by concrete, rather than a 200-acre area. Each experimental block would include six 0.4-acre modules. Three of the modules would be constructed of quarry rock at coverages of 17, 34, and 67 percent and three would be constructed of recycled concrete at the same three coverages. There would be a total of 36 experimental modules covering 14.4 acres.

Following construction of the experimental modules, recycled concrete would be scattered over 135.6 acres of the project site surrounding the modules. Placement of the concrete would be designed to achieve an average coverage of 17 percent and to avoid covering the experimental modules.

Construction of the 14.4-acre experimental portion of the reef would require 9,240 tons of concrete and 11,760 tons of quarry rock. Construction of the surrounding 135.6-acre reef would require an additional 74,580 tons of concrete (see Table 6-8).

Table 6-8 ALTERNATIVE 3. 150-ACRE REEF NOW WITH EXPERIMENT AT SAN CLEMENTE

150 Acres Concrete at 17% and 14.4 Acres of 36 Experimental Modules, 34% and 67%

	17% Cover	Experiment	Total
Reef Size (acre)	135.6	14.4	150
Number of Experimental Modules (0.4 acre each)		36	
Tons of Material			
Rock		11,760	11,760
Concrete	74,580	9,240	83,820
Truck Trips (RT) (22 tons each, 91 loads a day)			4,345
Barge Loads (2,002 tons each, loading 1 barge per day)			48
Tugboat Trips (RT) (1 tug with 1 barge, leaving every day)			48
Placement Time with Crane (days) (1 barge per day)			48

The 36 experimental modules would be monitored for five years to evaluate their success in growing kelp. Surveys also would be conducted over the entire 150-acre artificial reef. If, after five years, the 150-acre reef does not meet the SONGS Permit performance standards, then concrete or quarry rock would be added to increase the level of coverage density as indicated by the results of the experimental portion of the project. In addition, the size of the reef could be increased.

Phase 2. Remediation to 150-Acre Reef and Possible Additional Construction

For the purposes of this analysis, it is assumed that concrete would be added to increase the coverage to 67 percent, or, that quarry rock would be placed over the existing 17 percent coverage of concrete to provide coverage of 67 percent quarry rock (except in the 14.4 acres of the experimental modules). This would require placing an additional 223,740 tons of recycled concrete or 379,680 tons of quarry rock. To estimate the additional tons of concrete that would be needed, it was assumed that coverage would be increased from 17 percent to 67 percent by adding a volume of concrete that, by itself, would provide 50 percent coverage. The amount of concrete needed for 50 percent coverage was computed by subtracting the amount needed for 17 percent coverage from that needed for 67 percent coverage (see Table 3-1). This method may underestimate the additional tons of concrete needed because some of the added concrete would fall onto the concrete already present.

It is possible that to satisfy the SONGS Permit performance criteria the size of the reef would have to be increased. This would require up to a 150 acres of reef construction in addition to the increases in coverage on the initial 150 acres. This would result in a total of 300 acres of reef with 67 percent coverage of concrete or quarry rock and would require adding 553,740 tons of concrete or 799,680 tons of quarry rock (see Tables 6-9 and 6-10).

6.4.4.1 Consistency with Project Objectives

This alternative is unique in that it combines an experimental reef with the lowest impact scenario for the build out of the mitigation reef (17 percent coverage of concrete). The experimental portion of the reef meets the project objective of testing recycled concrete and quarry rock, and of testing different levels of coverage of the reef material. The San Clemente site meets all of the siting criteria. The permit currently calls for the mitigation reef to have 67 percent coverage of quarry rock although based on the results of the experiment this requirement could be changed. This alternative would go ahead with a low coverage, concrete reef on a trial basis. It is not known at this time if this design would be able to achieve the performance standards outlined in the SONGS Permit. However, this alternative does have provisions for further remediation if the original coverage does not achieve the performance standards.

6.4.4.2 Comparison to Significant Impacts Identified for the Proposed Project

- ***Socioeconomics: Potentially Significant Impacts for:***

  (1) *Recreational Fishing Businesses*: by restricting the use of the project site during construction for the experimental and mitigation reefs.

  (2) *Commercial Fishing Activities*: by restricting access to fishing area for species fished year-round by the construction of the experimental and mitigation reefs.

  (3) *Commercial Fishing Sites*: by reef material being placed on existing hard substrate and proven fishing grounds.

Experiment and 150 Acres. This alternative would be located at the proposed project site at San Clemente. However, the first phase of Alternative 3 is entirely different from the proposed project experimental reef, as it would create a 150-acre mitigation reef at 17 percent, all concrete cover and an experimental reef within its boundaries. As seen in Table 6-10. Alternative 3 requires a total of 11,760 tons of rock and 9,240 tons of concrete for the experimental portion of the reef, and an additional 74,580 tons of concrete for the remaining 135.6-acre mitigation reef. This is a total of 95,580 tons of reef material being placed over a 150-acre area in comparison to the proposed project with total of 31,500 tons of material over 22.4 acres.

Table 6-9 ALTERNATIVE 3. 150-ACRE REEF NOW - REMEDIATION

Additional Material to Achieve 67%
All Concrete or All Rock -

	All Concrete	All Rock
Tons of Rock/Concrete	223,740	379,680
Truck Trips (RT) (22 tons each, 91 loads a day)	10,170	17,259
Barge Loads (2,000 tons each, loading 1 barge per day)	112	190
Tugboat Trips (RT) (1 tug with 1 barge, leaving every day)	112	190
Placement Time with Crane (days) (1 barge per day, over 4 years)	112	190

Table 6-10 ALTERNATIVE 3. REMEDIATION AND ADDITIONAL CONSTRUCTION - 300-ACRE BUILD OUT SCENARIO

Additional Material to Achieve 67% and Additional Construction of 150 Acres

All Concrete or All Rock

	All Concrete	All Rock
Tons of Rock/Concrete	553,740	799,680
Truck Trips (RT) (22 tons each, 91 loads a day)	25,170	36,350
Barge Loads (2,000 tons each, loading 1 barge per day)	277	400
Tugboat Trips (RT) (1 tug with 1 barge, leaving every day)	277	400
Placement Time with Crane (days) (1 barge per day, over 8 years)	277	400

The construction of the experiment and 150-acre reef in this alternative would have the same impacts for recreational sportfishing operations as discussed for the proposed project. Construction activities would temporarily restrict the use of the area and notices should be provided to the businesses in advance to reduce this to a less-than-significant level.

This alternative would have more construction impacts for commercial fishing activities than the experimental reef in the proposed project. As with the proposed project, construction would be between May and September to avoid the lobster season and a significant impact. Construction for this alternative would take approximately 48 working days (as compared to 32 days) and could be completed in one year.

This alternative would have a greater potential for reef material to cover existing hard substrate at the San Clemente site because of the greater amount of area being covered. In compliance with the SONGS Permit every effort would be made to avoid existing hard substrate.

If the 150-acre reef at 17 percent coverage were successful in meeting the SONGS Permit performance standards for medium-to-high density kelp and associated biota, no additional construction would be needed. This would result in the mitigation reef requirements being met sooner than with the proposed project and possibly with substantially less construction. This would provide benefits for recreational sportfishing businesses and commercial fishing.

Remediation and Additional Construction. If the initial 17 percent coverage did not meet the SONGS Permit performance standards, remediation would be needed for the 150-acre reef. This could require placing additional material on the reef to achieve 67 percent cover of either concrete or quarry rock. The placement of material on the existing artificial reef would create a temporary loss of lobster, crab and sea urchin habitat and could reduce the catch during construction and for several years after this.

In addition, it could be determined that up to an additional 150 acres of reef construction is needed, bringing the total reef size to 300 acres. The impacts of construction activies on recreational sportfishing businesses and commercial fishing in the area would be about the same as for the proposed project reef buildout. As with the proposed project, the remediation and additional construction would need to take place between May and September to avoid the lobster season and a significant impact.

- ***Air Quality: Significant Impacts for:***

  - *Experimental Reef*: daily emissions for NOx and PM_{10} ; and quarterly emissions for NOx.

  - *(2) Mitigation Reef*: daily and quarterly emissions for NOx and PM_{10}.

Experiment and 150 Acres. This alternative requires about three times the amount of reef construction material as the proposed project and as a result the total air emissions generated during construction are greater (see Table 6-11). However, because the alternative would be located at San Clemente the daily emissions would be the same as the proposed project. This alternative would generate significant daily NOx and PM_{10} emissions and quarterly NOx emissions. In addition, this experimental reef alternative also generates quarterly PM_{10} emissions that exceed the thresholds of significance Mitigation measures would be required to reduce these impacts to less-than-significant.

If this reef were successful and no additional construction was needed, this would substantially reduce air emissions compared to the proposed project mitigation reef using higher levels of concrete coverage or quarry rock.

Remediation and Additional Construction. If the initial 150-acre reef at 17 percent cover of concrete did not meet the SONGS Permit performance standards, additional material coverage could be added to that reef or additional reef construction could be needed. In certain scenarios, the second phase of this alternative would generate emissions that are comparable to the proposed project. However, if quarry rock at 67 percent coverage had to be added on top of the existing 150-acre reef, the emissions would exceed the proposed project. Table 6-12 shows the emissions generated from the placement of additional materials to the initial 150-acre reef. Table 6-13 shows the emissions related to the placement of additional materials to the initial 150-acre reef and

the construction of an additional 150 acres of artificial reef, to achieve a total 300-acre reef build out. All of the scenarios for the second phase of this alternative generate significant daily and quarterly NOx and PM_{10} emissions.

- ***Transportation and Noise:* Significant Impacts from Truck Traffic on:**

  - *Level of Service:* at intersections in San Diego and Los Angeles Counties near the ports during peak hours.

  - *Noise Levels:* for residences within 150 feet of truck routes.

Experiment and 150 Acres. Alternative 3 would involve 4,345 truck trips and 48 barge trips initially to complete a 150-acre concrete reef or almost triple the amount for the proposed project experimental reef (see Table 6-8). However, the daily number of trucks trips and barge trips would be the same as the proposed project assuming the same level of construction activities.

Remediation and Additional Construction. Depending on the results of the first phase, the second phase augmentation and additional construction would require somewhat less truck and tugboat/barge traffic than the proposed project. Under all of these scenarios, truck traffic in the San Diego and Los Angeles areas would still have potentially significant impacts on a daily basis and mitigation would be required.

Table 6-11 ALTERNATIVE 3. 150-ACRE REEF NOW WITH EXPERIMENT AT SAN CLEMENTE
Daily and Quarterly Emissions for NOx and PM_{10}

Acres of Construction	150
Days of Construction	48
Daily Emissions[2] (lbs/day)	
NOx	480.37
PM_{10}	588.79
Quarterly[1] Emissions[3] (lbs/qtr)	
NOx	23,057.76
PM_{10}	28,261.92
Total Emissions	
NOx	23,057.76
PM_{10}	28,261.92

[1] Quarterly emissions are also total project emissions as the 34 days of construction are all within one quarter.

[2] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[3] Quarterly emission thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

Table 6-12 ALTERNATIVE 3. 150-ACRE REEF NOW - REMEDIATION
Additional Material to Achieve 67% All Concrete or All Rock
Daily and Quarterly Emissions of NOx and PM_{10}

	All Concrete	All Rock
Acres of Construction	150	150
Days of Construction	112	190
Daily Emissions[1] (lbs/day)		
NOx	480.37	480.37
PM_{10}	588.79	588.79
Quarterly Emissions[2] (lbs/qtr)		
NOx	37,468.86	37,468.86
PM_{10}	45,925.62	45,925.62
Total Emissions		
NOx	53,801.44	91,270.3
PM_{10}	65,944.48	111,870.1

[1] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[2] A quarter includes 78 days of emissions. uarterly emissions thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

Table 6-13 ALTERNATIVE 3. REMEDIATION AND ADDITIONAL CONSTRUCTION - 300-ACRE BUILD OUT SCENARIO

Additional Material to Achieve 67% and Additional Construction of 150 Acres All Concrete or All Rock Daily and Quarterly Emissions of NOx and PM_{10}

	All Concrete	All Rock
Acres of Construction	300	300
Days of Construction	277	400
Daily Emissions[1] (lbs/day)		
NOx	480.37	480.37
PM_{10}	588.79	588.79
Quarterly Emissions[2] (lbs/qtr)		
NOx	37,468.86	37,468.86
PM_{10}	45,925.62	45,925.62
Total Emissions		
NOx	133,062.49	192.148
PM_{10}	163,094.83	235,516

[1] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[2] A quarter includes 78 days of emissions. Quarterly emission thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

- ***Geology, Hazards, Public Services, and Recreation**: Significant Impact from Rocks/Concrete Washing Onshore*

    - *Hazard to Human Health:* rocks/concrete on the beach would create a hazard for people

    - *Need for Beach Maintenance Services:* the need to remove rocks/concrete could increase the level of service and costs required for beach maintenance

Experiment and 150 Acres. The quantity of quarry rock and recycled concrete placed in the ocean in the first phase of this alternative would be almost double that of the proposed project experimental reef. However, if the first phase of this project were successful, the amount of material that would be needed would be considerably less than that needed for the proposed project mitigation reef. However, the potential for rocks or concrete to wash on shore would remain the same. This would create a hazard to human health and the potential for and increase in beach maintenance services the same as identified for the proposed project. This would be a significant impact.

Remediation and Additional Construction. The second phase of this alternative assumes a build out in terms of coverage, type and quantity of reef materials to about the same level as the proposed project. As a result the impacts would be the same as the proposed project and this remains a significant impact.

- ***Public Services and Recreation**: Potentially Significant Impact from Kelp Wrack Washing Onshore*

    - *Need for Beach Maintenance Services:* the need to remove kelp wrack could increase the level of service and costs required for beach maintenance

    - *Deterrent to Recreation Users:* kelp on the beach could cause recreation users to go to other areas

Experiment and 150 Acres. Under two scenarios, this alternative could be expected to create either more impacts or the about same impacts for kelp wrack as the proposed project experimental reef. This would depend on the success of the initial 150-acre reef. The 14.4-acre experimental portion of this alternative could be expected to produce similar amounts of kelp as the proposed project 22.4-acre experimental reef. The 135.6 acres could produce anywhere from very little kelp up to an amount achieving the SONGS Permit requirements for kelp density. This reef would mostly likely result in somewhat less kelp wrack washing onshore than the maximum estimate of 20 yd^3 of kelp wrack per acre of kelp bed (Elwany et al. 1998). However, the impacts from kelp wrack would occur sooner than with the proposed project mitigation reef. This is still a potentially significant impact that requires the same mitigation.

Remediation and Additional Construction. If the first phase of the mitigation reef proves inadequate, then additional material would be added to achieve 67 percent coverage and possibly additional reef area. The objective would be to produce 150 acres of medium-to-high density kelp beds resulting in the same level of additional kelp wrack as the proposed project (estimated at a maximum of 3,000 yd^3 per year). This is a significant impacts as discussed for the proposed project for recreation and beach maintenance services.

6.4.4.3 Less-Than-Significant Impacts to the Proposed Project

The initial 150-acre reef and second phase augmentation proposed in Alternative 3 would be expected to have comparable less-than-significant affects as described for the proposed project in all areas, except as described below:

- ***Energy***

This alternative would use about twice as much fuel for construction of the experimental reef as the proposed project. However, if this alternative were successful and no additional construction was needed this would require less fuel than would be needed for the proposed project mitigation reef at higher levels of concrete coverage or using all rock. Depending on the results of the first phase additional material would be added up to 67 percent involving fuel use that would be comparable to the proposed project. The overall use of fuel would still be a less-then-significant impact.

- ***Biological Resources***

The presence of low density concrete in the first phase of this alternative would have less impacts on the subtidal sand bottom communities than the proposed project mitigation reef. However, if the reef were augmented to 67 percent coverage the impacts would be the same as the proposed project. The same relationships would also be true for the disturbance to marine mammals and birds.

6.4.5 Alternative 4. Compound Reefs (High and Low Relief) at Multiple Locations

Phase 1. Experimental Compound Reefs (High and Low Relief) at Two Locations

This alternative is designed to evaluate the performance of low relief artificial reefs and compound reefs containing both low and high relief structures. The compound reefs would consist of areas of scattered low-relief quarry rock and recycled concrete surrounding high-relief mounds of rock and concrete. A compound reef has several potential advantages over a reef that is entirely low relief: (1) a compound reef provides increased habitat structure, which is likely to promote greater species diversity; (2) a high relief reef enhances production of many valuable fish and invertebrate species; and (3) a compound reef would support valuable reef fish and invertebrates regardless of whether or not kelp successfully grew on the reef or survived during years of unfavorable environmental conditions. Potential liabilities of a compound reef include the requirement of a very large amount of reef material, and a reef structure that would be different from that of the SOK reef. Therefore, this alternative reef might support different types of associated organisms. A primary project goal is to provide habitat for a community of reef associated biota similar in composition, diversity and abundance to the SOK (see Chapter 3, Project Description).

The alternative includes experimental and mitigation reef phases. The experimental reef phase would be implemented at two sites, South Carlsbad and Mission Beach. The total surface area of the experimental reef at the two sites combined would be 38.4 acres. Based on the outcome of the experimental phase, a 150-acre to 300-acre mitigation reef would be constructed by adding 111.6 to 261.6 acres of reef material at or more sites, including South Carlsbad, Mission Beach and San Clemente. The principal proponent of this alternative (Daniel Frumkes of American Sportfishing Association and United Anglers) considered the San Clemente site less favorable for kelp growth than the other sites (Frumkes 1998). Therefore, the San Clemente site would be used only if the area available at the other sites was insufficient to fully accommodate the mitigation reef.

The experimental phase would differ from that of the proposed project in several respects:

- the experiment would be implemented at two different sites, South Carlsbad and Mission Beach, rather than at San Clemente;

- the experiment would test eight reef designs at each site: four low relief designs (quarry rock and recycled concrete at 34 and 67 percent coverages), and four compound reef designs (quarry rock and recycled concrete having high relief centers with low relief perimeters at 34 and 67 percent coverages);

- six replicate modules would be constructed for each of the eight reef designs at each site, resulting in 48 modules totaling 19.2 acres at each site;

- surface area of the modules would be about 0.4 acre (40 meters by 40 meters); surface area of the high relief centers of the compound reef modules would be about 0.1 acre (20 meters by 20 meters).

The compound reef modules would be constructed in two phases: 1) reef material (quarry rock or concrete) would be spread over the entire module at the nominal design density (34 or 67 percent); and 2) additional material would be piled in the center 0.1 acre of the module to a height of about twelve feet. Twelve feet is the height of the Pendleton Artificial Reef built by California Department of Fish and Game and Southern California Edison in 1980, and is the height used for experimental high relief modules in the Santa Barbara and Santa Monica Bay Artificial Reefs (CDFG 1989; 1990).

The amount of rock that would be needed to build the high relief centers of the quarry rock compound reef modules was estimated from reported weights of quarry rock used to build the Pendleton Artificial Reef (CDFG 1990). The modules of this reef were constructed of quarry rock and have similar dimensions to the high relief centers in this alternative. Similarly, the amount of concrete that would be required to build the high relief centers of the recycled concrete compound reef modules was estimated from reported weights of concrete used to build the Bolsa Chica Artificial Reef and the 1984 augmentation of the Newport Beach Artificial Reef (CDFG 1990). The computed weight per unit volume of quarry rock in the Pendelton Artificial Reef is 1.2262 tons per cubic meter, while the average weight per unit volume of recycled concrete in the Bolsa Chica and Newport Beach reefs is 0.9376 ton per cubic meter. Multiplying these weights by the estimated volume of a high relief center, 1,463 cubic meters, gives 1,794 tons and 1,372 tons as the weight of rock and concrete, respectively, needed for each center. The weights of rock and concrete needed to construct the low relief portions of the modules would be the same as those needed to construct the modules of the proposed project (see Chapter 3, Project Description). The total weight of the reef materials needed to construct the experimental modules for this alternative would be about 78,336 tons of quarry rock and 60,648 tons of recycled concrete (see Tables 6-14).

Placement of the experimental modules at each site would be similar to that of the proposed project at San Clemente, with modules for the eight treatments (i.e., reef designs) grouped into blocks. However, this alternative would employ only six replicate blocks rather than seven blocks as planned for the proposed project. The blocks would be laid out at successively greater distances from the nearest existing substantial kelp bed. The modules would be placed within a depth range of 10.5 to 17 m, and spaced as evenly as possible within each block. Areas of hard substrate would be avoided. Treatments would be randomly assigned to modules within each block, and then reassigned if there were apparent biases in their placement with respect to depth or proximity to existing kelp beds or naturally occurring reef outcrops.

The experimental reef would be monitored for five years to evaluate the different reef sites and designs. The monitoring program and performance criteria would be similar to those of the proposed project. The results of the monitoring program would be used to determine the location and design of the full build-out reef.

Phase 2. Mitigation Compound Reefs (High and Low Relief) at Multiple Locations

Neither South Carlsbad nor Mission Beach has enough surface area with suitable substrate and depth characteristics for the additional 111.6 to 261.6 acres needed to complete the mitigation reef. The South Carlsbad site has 64 acres and the Mission Beach site has 85 acres (Elwany and Deysher 1998). The experimental reefs would occupy 19.2 acres at each site, leaving 44.8 acres at South Carlsbad and 65.8 acres at Mission Beach. The three sites closest to South Carlsbad are North Carlsbad, Leucadia, and Encinitas. These sites are similar to South Carlsbad in most respects and together

Table 6-14 ALTERNATIVE 4. EXPERIMENTAL COMPOUND REEF

Construction of 38.4 Acres

	Mission Beach	South Carlsbad	Total
Reef Size (acres)	19.2	19.2	38.4
Number of Modules	48	48	96
Tons of Material			
Rock	39,168	39,168	78,336
Concrete	30,324	30,324	60,648
Truck Trips (RT) (22 tons each, 91 loads in a day)	3,159	3,159	6,318
Barge Loads (2,000 tons each, loading 1 barge in a day)	35	35	70
Tugboat Trips (RT) (1 tug with 1 barge, leaving every other day)	35	35	70
Placement Time with Crane (days) (1/2 barge per day)	70	70	140

contain 80 acres (see Table 2, Elwany and Deysher 1998). In comparison, the San Clemente site has 355 acres with suitable substrate and depth characteristics. Depending on the results of the experiment and the size of the full build out, the mitigation reef would be placed entirely at South Carlsbad and Mission Beach, or at a combination of the five alternative sites. If these sites can not fully accommodate the entire reef, then part of the reef would be constructed at San Clemente.

The design of the mitigation reef would be determined from the results of the monitoring program for the experimental reef. The reef design that satisfied the performance criteria and employed the least amount of reef material would be selected. If a compound reef design were selected, the mitigation reef would be constructed with 0.1-acre mounds of high relief reef embedded within each acre of the reef. This combination of high and low relief would provide a lower density (10 percent) of high relief reef than that tested in the experimental phase (25 percent high relief), but the density would nonetheless be adequate for integrating the two types of reef because all areas of low relief reef would lie within 35m, at most, of a high relief mound. The reduction in density of high relief reef would reduce the environmental and economic costs of transporting the large quantities of material needed to build high relief reef.

For purposes of this analysis, it is assumed that the mitigation would require an additional 111.6 to 261.6 acres of compound reef construction with quarry rock or concrete at a coverage density of 67 percent in the low relief portions of the reef. This would require an additional 480,366 to 1,127,446 tons of quarry rock or 373,260 to 876,060 tons of concrete to complete the artificial reef (see Tables 6-15, 6-16, 6-17 and 6-18).

Table 6-15 ALTERNATIVE 4. MITIGATION COMPOUND REEF (150-ACRE BUILD OUT)

Additional Construction of 111.6 Acres - All Rock

	Mission Beach	South Carlsbad	North Carlsbad	Total
Reef Size (acre) [1]	65.8	44.8	1	111.6
Tons of Rock	283,227	192,835	4,314	480,366
Truck Trips (RT) (22 tons each, 91 loads a day)	12,874	8,766	197	21,835
Barge Loads (2,002 tons each, loading 1 barge per day)	142	97	3	240
Tugboat Trips (RT) (1 tug with 1 barge, leaving every day)	142	97	3	240
Placement Time with Crane (days) (1 barge per day)	142	97	3	240

[1] The acres for Mission Beach and South Carlsbad are the remainder after the 19.2 acres of experimental reef at each site.

Table 6-16 ALTERNATIVE 4. MITIGATION COMPOUND REEF (150-ACRE BUILD OUT)

Additional Construction of 111.6 Acres - All Concrete

	Mission Beach	South Carlsbad	North Carlsbad	Total
Reef Size (acre)	65.8	44.8	1	111.6
Tons of Concrete	220,760	149,839	3,352	373,260
Truck Trips (RT) (22 tons each, 91 loads a day)	10,004	6,811	153	16,967
Barge Loads (2,002 tons each, loading 1 barge per day)	110	75	2	187
Tugboat Trips (RT) (1 tug with 1 barge, leaving every day)	110	75	2	187
Placement Time with Crane (days) (1 barge per day)	110	75	2	187

Table 6-17 ALTERNATIVE 4. MITIGATION COMPOUND REEF (300-ACRE BUILD OUT)

Additional Construction of 261.6 Acres - All Rock

	San Clemente	Mission Beach	South Carlsbad	North Carlsbad	Leucadia	Encinitas	Total
Reef Size (acre)	71	65.8	44.8	30	25	25	261.6
Tons of Rock	306,002	283,227	192,835	129,297	107,747	107,747	1,127,466
Truck Trips (RT) (22 tons each, 91 loads a day)	13,910	12,874	8,766	5,878	4,898	4,898	51,249
Barge Loads (2,002 tons each, loading 1 barge per day)	153	142	97	65	54	54	564
Tugboat Trips (RT) (1 tug with 1 barge, leaving every day)	153	142	97	65	54	54	564
Placement Time with Crane (days) (1 barge per day)	153	142	97	65	54	54	564

Table 6-18 ALTERNATIVE 4. MITIGATION COMPOUND REEF (300-ACRE BUILD OUT)

Additional Construction of 261.6 Acres - All Concrete

	San Clemente	Mission Beach	South Carlsbad	North Carlsbad	Leucadia	Encinitas	Total
Reef Size (acre)	71	65.8	44.8	30	25	25	261.6
Tons of Rock	237,769	220,076	149,839	100,466	83,721	83,721	876,060
Truck Trips (RT) (22 tons each, 91 loads a day)	10,808	10,004	6,811	4,567	3,806	3,806	39,821
Barge Loads (2,000 tons each, loading 1 barge per day)	119	110	75	51	42	42	438
Tugboat Trips (RT) (1 tug with 1 barge, leaving every day)	119	110	75	51	42	42	438
Placement Time with Crane (days) (1 barge per day)	119	110	75	51	42	42	438

6.4.5.1 Consistency with Project Objectives

Both the experimental and mitigation reef in this alternative meet the basic project purposes and objectives to create an artificial reef to replace resource losses at SOK. The experimental reef also meets the project objective for testing recycled concrete and quarry rock material, and of testing different levels of coverage of the reef material. The North Carlsbad and South Carlsbad sites meet the siting criteria, including proximity to SOK. The Leucadia and Encinitas sites are slightly farther from SOK, but have the same basic characteristics required for the artificial reef. The Mission Beach site is even farther from SOK and has somewhat different substrate conditions. While an artificial reef may be successful at this site, it is possible the reef might not replicate the SOK habitat and diversity of species as well as other sites. The experimental and mitigation reefs in this alternative have the additional feature of high relief mounds mixed in with the low relief reef. While the high relief mounds could increase the number and diversity of fish and other types of species, they would also create a somewhat different habitat from that at SOK. As a result, this alternative may not replicate the resources at SOK as well as other alternatives.

6.4.5.2 Comparison to Significant Impacts Identified for the Proposed Project

- ***Socioeconomics*: Potentially Significant Impacts for:**
    - *Recreational Fishing Businesses*: by restricting the use of the project site during construction for the experimental and mitigation reefs.
    - *Commercial Fishing Activities*: by restricting access to fishing area for species fished year-round by the construction of the experimental and mitigation reefs.
    - *Commercial Fishing Sites*: by reef material being placed on existing hard substrate and proven fishing grounds.

Experimental Reef. The experimental reef phase of this alternative is more than twice as large as the proposed project (38.4 acres vs. 22.4 acres) and is located at the South Carlsbad and Mission Beach sites. There are numerous recreational sportfishing businesses in San Diego County located at San Diego Harbor, Point Loma and Oceanside Harbor. Construction activities for the compound experimental reef at South Carlsbad could affect the fishing charters in this area by temporarily restricting access to the site. The Mission Beach site would be less likely to affect sportfishing businesses, because of the deep sand bottom substrate does not provide prime fishing habitat. The compound experimental reef at South Carlsbad would require the same mitigation for noticing sportfishing operators that would be applied to the proposed project at San Clemente.

Concerns over constructing the reef during lobster season would be the same for both of these sites as for the San Clemente site. South Carlsbad is an important commercial fishing location for lobster, crab and sea urchins. While the Mission Beach site is not a fishing location due to the depth of sand and lack of hard substrate, it is close to important lobster sites near the entrance to Mission Bay along the jetty. Construction tugboat and barge traffic could interfere with fishing at these locations. As with the proposed project, the experimental reef at the alternative sites would need to be constructed between May and September to avoid the lobster season and a significant impact.

This alternative would create the same potential for reef material to cover existing hard substrate at the South Carlsbad site as with the proposed project at the San Clemente site. This is not a problem at Mission Beach where the bottom is all sand cover. In compliance with the SONGS Permit every effort would be made to avoid existing hard substrate.

The high relief experimental modules are intended to attract more fish, which could be beneficial to both to recreational sportfishing businesses and commercial fishing activities in the area of the South Carlsbad and Mission Beach sites.

Mitigation Reef. The mitigation reef build out for this alternative would differ from the proposed project as construction would take place at Mission Beach, South Carlsbad and some combination of the other alternative sites. The San Clemente site would be used only if necessary. This would depend on the size of the mitigation reef build out and the objectives of the final design. The five alternative sites could accommodate the 111.6-acre scenario, but the 261.6-acre scenario would require some portion of the reef to be located at San Clemente (a minimum of 71 acres).

There are numerous recreational sportfishing businesses in San Diego County located at San Diego Harbor, Point Loma and Oceanside Harbor. Construction activities for the compound mitigation reef at North and South Carlsbad, Leucadia and Encinitas could affect fishing charters in the area by temporarily restricting access to the site. The Mission Beach site would be less likely to affect sportfishing businesses, because of its sand bottom substrate does not provide prime fishing habitat. The compound mitigation reef at North and South Carlsbad, Leucadia and Encinitas would require the same mitigation for noticing sportfishing operators that would be applied to the proposed project at San Clemente.

The same socioeconomic impacts identified for the proposed project mitigation reef would also be present for all five alternative sites. The North and South Carlsbad, Encinitas and Leucadia sites are important commercial fishing locations for lobster, crab and sea urchins. Construction activities could disrupt habitat and fishing activities. The Mission Beach site is not a fishing location due to the depth of sand and lack of hard substrate, but it is close to important lobster sites near the entrance to Mission Bay along the jetty. Construction tugboat and barge traffic could interfere with fishing at these locations. As with the proposed project, the mitigation reef at the alternative sites would need to be constructed between May and September to avoid the lobster season and a significant impact.

This alternative would create the same potential for reef material to cover existing hard substrate at the North and South Carlsbad, Leucadia and Encinitas sites as with the proposed project at the San Clemente site. This is not a problem at Mission Beach where the bottom is all sand cover. In compliance with the SONGS Permit every effort would be made to avoid existing hard substrate.

The high relief modules in the design of this mitigation reef are intended to attract more fish, which could be beneficial to both to recreational sportfishing businesses and commercial fishing activities.

- ***Air Quality: Significant Impacts to Daily and Quarterly Emissions***
  - *Experimental Reef*: daily emissions for NOx and PM_{10} ; and quarterly emissions for NOx
  - *(2) Mitigation Reef*: daily and quarterly emissions for NOx and PM_{10}

Experimental Reef. This alternative experimental reef would require about four and one half times the amount of material for reef construction as the proposed project. This is due to the larger reef size (38.4 acres), the levels of coverage being tested (only 34 and 67 percent) and the presence of high relief modules. This experimental reef alternative would result in 6,318 truck trips over 70 days in comparison to the 1,432 truck trips over 16 days for the proposed project. The reef material placement activities would take 140 days with one half barge off-loaded a day. As a result, the air emissions generated during construction are considerably greater (see Table 6-19). However, if reef material were obtained from the San Diego area, the shorter tugboat/barge shipping distances to the South Carlsbad and Mission Beach sites would help reduce daily NOx emissions relative to the San Clemente site. This experimental reef alternative would generate significant daily and quarterly NOx emissions. In addition, this alternative would also generate significant quarterly PM_{10} emissions. Mitigation measures would be required to reduce these impacts to less-than-significant.

Mitigation Reef. The build out of the mitigation reef at some combination of the five alternative sites and possibly San Clemente would have varying affects on air quality. Tables 6-20 and 6-21 estimate emissions generated for the build out of the mitigation reef with all rock and all concrete at Mission Beach, South Carlsbad and North Carlsbad for an additional 111.6 acres of reef. Tables 6-22 and 6-23 show the emissions generated for the build 261.6 acres of additional reef using the maximum acres available at the five alternative sites plus 71 acres at San Clemente. The sites closest to the Port of San Diego reduce the daily NOx emissions related to tugboat shipping.

If the alternative mitigation reef were to include high relief modules, the amount of rock or concrete material used would be greater than for the proposed project. This in turn would result in much higher air emissions than the proposed project both for NOx (from tugboat shipping) and PM_{10} emissions (from truck traffic). This mitigation reef alternative would generate significant daily and quarterly NOx and PM_{10} emissions and would require considerable mitigation measures to be implemented.

Table 6-19 ALTERNATIVE 4. EXPERIMENTAL COMPOUND REEF

Construction of 38.4 Acres
Daily and Quarterly Emissions for NOx and PM_{10}

	Mission Beach	South Carlsbad	Total
Acres of Construction	19.2	19.2	38.4
Days of Construction	48	48	96
Daily Emissions[2] (lbs/day)			
NOx	302.67	377.87	
PM_{10}	584.95	586.55	
Quarterly[1] Emissions[3] (lbs/qtr)			
NOx	14,528.16	18,137.76	
PM_{10}	28,077.60	28,154.40	
Total Emissions			
NOx	14,528.16	18,137.76	32,665.92
PM_{10}	28,077.60	28,154.40	56,232.00

[1] Assumes only one site is constructed at a time.

[2] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[3] Quarterly emission thresholds for significance for NOx 5,00 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

Table 6-20 ALTERNATIVE 4. MITIGATION COMPOUND REEF (150-ACRE BUILD OUT)

Additional Construction of 111.6 Acres - All Rock
Daily and Quarterly Emissions for NOx and PM_{10}

	Mission Beach	South Carlsbad	North Carlsbad	Total
Acres of Construction	65.8	44.8	1	111.6
Days of Construction	142	97	3	240
Daily Emissions[1] (lbs/day)				
NOx	302.67	377.87	389.07	
PM_{10}	584.95	586.55	586.70	
Quarterly Emissions[2] (lbs/qtr)				
NOx	23,608.26	29,473.86	1,167.21	
PM_{10}	45,626.10	45,750.90	1,760.1	
Total Emissions				
NOx	42,979.14	36,652.39	1,167.21	80,799.74
PM_{10}	83,062.9	56,895.35	1,760.1	141,718.35

[1] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[2] A quarter includes 78 days of emissions.

Quarterly emission thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

Table 6-21 ALTERNATIVE 4. MITIGATION COMPOUND REEF (150-ACRE BUILD OUT)

Additional Construction of 111.6 Acres - All Concrete
Daily and Quarterly Emissions for NOx and PM_{10}

	Mission Beach	South Carlsbad	North Carlsbad	Total
Acres of Construction	65.8	44.8	1	111.6
Days of Construction	110	75	2	187
Daily Emissions[1] (lbs/day)				
NOx	302.67	377.87	389.07	
PM_{10}	584.95	586.55	586.70	
Quarterly Emissions[2] (lbs/qtr)				
NOx	23,608.26	28,340.25	778.14	
PM_{10}	45,626.10	43,991.25	1,173.40	
Total Emissions				
NOx	33,293.7	28,340.25	778.14	62,412.09
PM_{10}	64,344.5	43,991.25	1,173.40	99,537.8

[1] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[2]A quarter includes 78 days of emissions.

Quarterly emission thresholds for significance for NOx 5,000 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

Table 6-22 ALTERNATIVE 4. MITIGATION COMPOUND REEF (300-ACRE BUILD OUT)

Additional Construction of 261.6 Acres - All Rock
Daily and Quarterly Emissions for NOx and PM_{10}

	San Clemente	Mission Beach	South Carlsbad	North Carlsbad	Leucadia	Encinitas	Total
Acres of Construction	71	65.8	44.8	30	25	25	261.6
Days of Construction	153	142	97	65	54	54	564
Daily Emissions[1] (lbs/day)							
NOx	480.37	302.67	377.87	389.07	369.87	361.87	
PM_{10}	588.79	584.95	586.55	586.75	586.35	586.30	
Quarterly Emissions[32] (lbs/qtr)							
NOx	37,468.86	23,608.26	29,473.86	25,289.55	19,972.98	19,540.98	
PM_{10}	45,925.62	45,626.10	45,750.90	38,138.75	31,662.9	31,660.2	
Total Emissions							
NOx	73,496.61	42,979.14	36,653.39	25,289.55	19,972.98	19,540.98	217,932.65
PM_{10}	90,084.87	83,062.9	56,895.35	38,138.75	31,662.9	31,660.2	331,507.67

[1] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[2] A quarter includes 78 days of emissions.Quarterly emission thresholds for significance for NOx 5,00 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

Table 6-23 ALTERNATIVE 4. MITIGATION COMPOUND REEF (300-ACRE BUILD OUT)

Additional Construction of 261.6 Acres - All Concrete
Daily and Quarterly Emissions for NOx and PM_{10}

	San Clemente	Mission Beach	South Carlsbad	North Carlsbad	Leucadia	Encinitas	Total
Acres of Construction	71	65.8	44.8	30	25	25	261.6
Days of Construction	119	110	75	51	42	42	438
Daily Emissions[1] (lbs/day)							
NOx	480.37	302.67	377.87	389.07	369.87	361.87	
PM_{10}	588.79	584.95	586.55	586.75	586.35	586.30	
Quarterly Emissions[2](lbs/qtr)							
NOx	37,468.86	23,608.26	28,340.25	19,842.57	15,534.54	15,198.54	
PM_{10}	45,925.62	45,626.10	43,991.25	29,294.25	24,626.7	24,624.60	
Total Emissions							
NOx	57,164.03	33,293.7	28,340.25	19,842.57	15,534.54	15,198.54	169,373.63
PM_{10}	70,066.01	64,344.5	43,991.25	29,924.25	24,626.7	24,624.6	213,624.53

[1] A quarter includes 78 days of emissions.

[2] Daily emission thresholds for significance for NOx 100 lbs/day and for PM_{10} 150 lbs/day.

[3] Quarterly emission thresholds for significance for NOx 5,00 lbs/qtr and for PM_{10} 13,500 lbs/qtr.

- ***Transportation and Noise*: Significant Impacts from Truck Traffic on:**

  - *Level of Service*: at intersections in San Diego and Los Angeles Counties near the ports during peak hours

  - *Noise Levels:* for residences within 150 feet of truck routes

Experimental Reef. This alternative experimental reef would require about four and one half times the amount of material for reef construction as the proposed project. This is due to the larger reef size (38.4 acres), the levels of coverage being tested (only 34 and 67 percent) and the presence of high relief modules. This would result in 6,318 truck trips over 70 days in comparison to the 1,432 truck trips over 16 days for the proposed project. However, on a daily basis both projects would result in the same number of truck trips (91 trucks a day to load one barge). As a result, the same significant impacts would occur for level of service at intersections and for noise in residential areas. The same mitigation measures would be required.

Mitigation Reef. Full build out of the mitigation reef at the five alternative sites would result in materials being transported at the same rate on a daily basis (91 trucks a day to load one barge) as with the proposed project. As a result, the same significant impacts would occur for level of service at intersections and for noise in residential areas. The same mitigation measures would be required.

The difference between this alternative and the proposed project would be the overall duration of the construction and the total number of truck trips. Although less acreage would be constructed in the mitigation phase of this alternative, more rock or concrete material would be needed due to the high relief centers scattered through out the reef sites.

- ***Geology, Hazards, Public Services, and Recreation*: Significant Impact from Rocks/Concrete Washing Onshore**

  - *Hazard to Human Health:* rocks/concrete on the beach would create a hazard for people

  - *Need for Beach Maintenance Services:* the need to remove rocks/concrete could increase the level of service and costs required for beach maintenance

Experimental Reef. The quantity of quarry rock and recycled concrete placed in the ocean for the artificial reef in this alternative would be more than for the proposed project. Although the reef would be distributed along the coast at several sites, this would not change the potential for large storms to wash rock or concrete onshore. This would create the same hazards to human health and need for beach maintenance services as identified for the proposed project.

Mitigation Reef. The quantity of quarry rock and recycled concrete placed in the ocean for the artificial reef in this alternative would be more than the proposed project. Although the reef would be distributed along the coast at several sites, this would not change the potential for large storms to wash rock or concrete onshore. This would create the same hazards to human health and need for beach maintenance services as identified for the proposed project.

- ***Public Services and Utilities and Recreation: Potentially Significant Impact from Kelp Wrack Washing Onshore***
  - *Need for Beach Maintenance Services:* the need to remove kelp wrack could increase the level of service and costs required for beach maintenance
  - *Deterrent to Recreation Users:* kelp on the beach could cause recreation users to go to other areas

Experimental Reef. The experimental reef in this alternative would potentially increase kelp wrack on the beaches at South Carlsbad State Beach and Mission Beach. The State beach has a policy of not removing kelp wrack and Mission Beach is groomed daily by the City of San Diego. The maximum expected additional kelp wrack would be 384 yd^3 annually at each site, with most of this occurring in the winter months. As with the proposed project, this would not be enough kelp wrack to create a need for additional beach maintenance services or to create a problem for recreational uses on the beach.

Mitigation Reef. The full mitigation reef would be built at some combination of five alternative sites, and possibly part of San Clemente. All of the five alternative sites are located between or near to major kelp beds and are adjacent to public beaches. The North and South Carlsbad sites are located offshore from the Carlsbad State Beach and South Carlsbad State Beach respectively and are managed by the CDPR. The State beaches currently experience a fair amount of kelp wrack onshore, particularly after large storms. However, it is the CDPR philosophy and policy not to clean kelp off the beaches and to maintain them in their natural state. The City of Encinitas and the State jointly manage Moonlite Beach opposite the Leucadia site and periodically remove kelp as needed. Other beaches in this area are narrow and inaccessible. The City of San Diego grooms Mission Beach daily and removes all kelp for disposal at Fiesta Island.

Estimates of the amount of kelp wrack that might be generated annually at each site with full build out (including the acres from the experimental reefs at South Carlsbad and Mission Beach) are as follows. This assumes a maximum of 20 yd^3 per additional acre of artificial reef (Elwany 1998, Appendix F):

North Carlsbad with 30 acres – 600 yd^3

South Carlsbad with 64 acres – 1,280 yd^3

Leucadia with 25 acres – 500 yd^3

Encinitas with 25 acres – 500 yd^3

Mission Beach with 85 acres – 1,700 yd^3

The build out of the mitigation reef at the alternative sites would be expected to have fewer impacts on beach maintenance services than the proposed project because the impacts would be spread out along the coast rather than occurring all at one site. In addition, these communities already have equipment, personnel and beach maintenance programs for the major beaches, or in the case of the State beaches, a policy to leave the kelp in place. As most of the kelp wrack would occur in the winter months this would have less impact on recreational users. This alternative would reduce the significant impacts on beach maintenance services and recreation to a less-than-significant impact and eliminate the need for the mitigation discussed for the proposed project.

If the mitigation reef were to require up to 261.6 acres of additional construction, at least 71 acres of artificial reef would be built at San Clemente. This would create up to 142 yd^3 of kelp wrack washing onshore annually. This would be a potentially significant impact at this site.

6.4.5.3 Comparison of Less-Than-Significant Impacts

The experimental and mitigation reefs in Alternative 4 would be expected to have comparable less-than-significant affects as described for the proposed project in all areas except as described below:

- ***Socioeconomics***

The alternative sites included here are all located between or near to major kelp beds where kelp harvesting could occur. There is a greater potential for construction and monitoring of the mitigation reef at these sites to interfere with on-going kelp harvesting in the area. As a result, this alternative would have more impacts than the proposed project for this commercial activity, but this would still be a less-than-significant impact.

- ***Biological Resources***

The mitigation reef would be similar to that described for the proposed project, except this alternative could include about 157 high relief mounds (36 mounds for the experimental reef and an additional 121 for the build out). Depending on the results of the experimental reef phase, the 111.6-acre build out would consist of some combination of smaller reefs at Mission Beach, South Carlsbad, North Carlsbad, Leucadia and Encinitas. If up to 261.6 acres of reef is needed, part of this would be built at San Clemente as well. Production of fish and macroinvertebrate predators would probably be greater with this alternative than with the proposed project because of the high relief centers and, therefore, would result in greater predation on biota of the surrounding biotic communities. Alternative 4 would have somewhat more impact on subtidal sand bottom communities and on existing kelp communities than the proposed project from the presence of the mitigation reef.

This alternative would entail a great deal more construction activity than the proposed project because the total surface area of the experimental reef would be greater (38.4 acres versus 22.4 acres) and construction of the high relief mounds would require placement of a greater volume of reef material. The total area of sand bottom habitat that would be buried by the reef material at the two sites including scattered hard substrate at the South Carlsbad site, would be about 13.5 acres, as opposed to 8.5 acres for the proposed project. Alternative 4 would have somewhat more impact on subtidal sand bottom communities than the proposed project from construction of the experimental reef.

While the experimental reef for this alternative would be similar to that for the proposed project, it would be located at South Carlsbad and Mission Beach rather than San Clemente, and would include many high relief centers. Production of fish and macroinvertebrate predators would probably be greater with this alternative than with the proposed project because of the high relief centers and, therefore, would result in greater predation on biota of other biotic communities in the vicinity. Alternative 4 would have somewhat more impact on subtidal sand bottom communities and on existing kelp communities than the proposed project from the presence of the experimental reef.

The development of compound reefs proposed for Alternative 4 would have similar impacts on marine mammals and birds as what is described for the proposed project at San Clemente (Section 4.6.2). However, the combination of high and low relief reefs has the potential to provide greater beneficial effects due to the greater diversity of species the varied structure may support.

- ***Energy***

This alternative uses more fuel for the construction activities of both the experimental and mitigation reefs due to the 34 and 67 percent coverage levels and the use of high relief modules. The shorter distances that tugboats would travel to the Mission Beach, South Carlsbad and other alternative locations would help to conserve fuel somewhat.

- ***Recreation***

While the recreation impacts of the reef would be similar to that of the proposed project, this alternative is different due to the high relief modules. These modules would likely improve opportunities for recreational fishing at the alternative sites, even if a kelp forest did not develop. Since the mitigation reef would be spread over multiple sites, the impacts to recreation would likely be less at each site than for the proposed project.

6.4.5.4 Significant Impacts with this Alternative, Not Present for the Proposed Project

- ***Offshore Mineral Resources***

The South Carlsbad and Mission Beach reef sites appear to lie at least partially within the boundaries of potential borrow areas discussed in the alternatives environmental setting section. Constructing a reef within potential borrow areas could preclude the mining of sand and gravel offshore of South Carlsbad and Mission Beach. This is considered a significant impact, which is not present for the proposed project. Mitigation would require first identifying whether there is currently a demand or planned use for the resources at these sites. If there are known plans for the resources, the project proponents would need to find other borrow sites in the region that could replace the sand and gravel resources at South Carlsbad or Mission Beach.

6.5 Environmentally Superior Alternative

CEQA Guidelines Section 15126(d)(2) requires that an EIR identify an environmentally superior alternative other than the No Project Alternative. The proposed project evaluated in this PEIR has two phases of development, an experimental reef phase and a mitigation reef build out phase. Only the experimental reef will be considered for approval at this time.

The alternatives to the proposed project all include more construction in the first phase of the project, which could mean less construction in a second phase. Alternatives 2 and 4 have much larger experimental reefs that are located at several sites. The size of the reef at each of the individual sites is more comparable to the proposed project. With one exception, these projects have the same significant impacts as the proposed project. Alternatives 2 and 4 do not create a significant impact to recreation and public services related to kelp wrack washing onshore. This is significant for the proposed project and Alternative 3, but it can be mitigated to a less-than-significant level. Both Alternative 2 and 4 have a significant impact for offshore mineral resources at the South Carlsbad and Mission Beach sites that is not present at the San Clemente site. However, this impact can be mitigated to a less-than-significant level as well.

Alternative 3 is more difficult to compare because it includes both the experimental a mitigation reef phases of the project right away, and it has greater uncertainty regarding the needed for future development. This project has all of the same significant impacts as the proposed project because it is located at the San Clemente site.

The major differences among the project alternatives are in the phasing of the experimental and mitigation reefs and the overall total construction necessary for the two phases. This in turn affects the overall air quality impacts for each alternative in the first and second phases. Because the alternatives involve more construction in the first phase they all have greater air quality impacts initially. However, the second phases of these alternatives involve somewhat less construction and less air emissions under most scenarios. The second phase of Alternative 4 may or may not involve less construction, depending on whether or not the high relief mounds are included in the reef design. The air quality impacts for the mitigation reef/build out of the proposed project and the alternatives may be difficult to mitigate to a less-than-significant level. This will depend on the final size of the reef, the level of coverage required and the choice of materials used.

Based on the experimental reef phase only, the environmentally preferred project would be the proposed project because it involves less construction and less impacts initially.

7.0 EIR Authors and Persons and Agencies Consulted

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