Appendices

Introduction

The appendices to the Salton Sea Species Conservation Habitat Project (SCH Project) Environmental Impact Statement/Environmental Impact Report (EIS/EIR) include information directly needed to assist agencies and the general public in their review of the EIS/EIR. These appendices document that appropriate procedures were followed to develop the scope and contents of the EIS/EIR (Appendices A and B); provide technical information specifically used to support the Project description or provide additional detail regarding Project operations (Appendices C, D, E, and F); and provide substantial evidence that supports the conclusions reached in the EIS/EIR (Appendices G, H, I, J, and K). The list of appendices provided below is followed by a brief description of the purpose of each:

A Scoping Process

B Alternatives Development Process

C Geotechnical Investigations

D Project Operations

E Monitoring and Adaptive Management Framework

F Mosquito Control Plan

G Air Quality Documentation

H Special-Status Species Evaluated but not Affected by the SCH Project

I Selenium Management Strategies

J Summary of Special Studies Supporting the EIS/EIR Impact Analysis

K Corps Section 404 Permit Projects in the HUC 8 Watershed

L Tribal Consultation and Coordination

Appendix A Scoping Process

This appendix includes the Notice of Intent and Notice of Preparation prepared by the United States Army Corps of Engineers (Corps) and California Department of Natural Resources, respectively. These notices provided information regarding the SCH Project's nature and its anticipated impacts, and they informed interested agencies, Stakeholders, and members of the general public of the intent to prepare a joint EIS/EIR assessing the Project impacts. These notices also described the procedures to be followed to submit comments on the scope and contents of the EIS/EIR, either in writing or verbally at four public meetings. This appendix also includes a scoping report that summarizes the comments that were received.

Appendix B Alternatives Development Process

This appendix outlines the procedures that were followed in developing the alternatives that are analyzed in this EIS/EIR. It includes a description of the potential sites and Project components that originally were considered, as well as reasons that some of them were eliminated.

Appendix C Geotechnical Investigations

This report presents the results of the preliminary geotechnical investigation for the SCH Project. The preliminary investigation was intended to provide a general characterization of on-site soil conditions and to provide geotechnical engineering criteria for preliminary design, which is the basis for the Project description in the EIS/EIR. The findings and conclusions presented in this report are not intended for final design. A more detailed investigation would be conducted for the final berm alignment, berm configurations, borrow sources, and anticipated construction methodologies.

Appendix D Project Operations

The SCH ponds are intended to be operated in a manner that would both provide in-kind replacement for some of the near-term habitat losses at the Salton Sea and answer key questions regarding shallow water habitat development and management as part of a long-term Salton Sea restoration program. Operations would have to balance habitat requirements necessary to achieve desired objectives against environmental constraints (physical, water quality, and climatological conditions), potential impacts (e.g., toxicity, disease vectors), and compatibility with adjacent land uses, other habitat values, and applicable regulations. This appendix provides an overview of several operations scenarios that could be used to provide suitable habitat and to test different scenarios as part of the SCH Project's "proof-of-concept" aspect.

Appendix E Monitoring and Adaptive Management Framework

The two goals of the SCH Project are (1) to provide aquatic habitat to support fish and wildlife species dependent on the Salton Sea and (2) to develop and refine information needed to successfully manage the SCH Project. The SCH Project is intended to serve as a proof of concept for the long-term restoration envisioned for the Salton Sea and, therefore, would be developed and operated consistent with the principles of adaptive management. The purpose of this appendix is to present a monitoring and adaptive management framework to guide evaluation and improved management of the newly created habitat, as well as to inform future restoration. Because the SCH Project has not reached final design or construction, this document does not include the detailed protocols and site-specific sampling design necessary for actual implementation. A more detailed monitoring plan and decision-making process would be developed should the SCH Project be constructed.

Appendix G Air Quality/Greenhouse Gases Documentation

This appendix includes the Imperial County Air Pollution Control District, Regulation VIII, Fugitive Dust Control Measures, which are required to be implemented to minimize impacts from fugitive dust emissions. It also includes the emissions calculations used to support both the air quality and greenhouse gas emissions/climate change analyses.

Appendix H Special-Status Species Evaluated but not Affected by the SCH Project

This appendix explains why a number of special-status species that were evaluated would not be affected if the SCH Project were implemented.

Appendix I Selenium Management Strategies

Selenium, a naturally occurring element, is present in the water, sediments, and biota of the Salton Sea ecosystem. Selenium can cause adverse effects when present at elevated concentrations in the food web, especially on the reproduction of birds and fish. One uncertainty is whether the SCH Project could increase the probability and magnitude of selenium impacts relative to existing and expected future conditions. This appendix evaluates the potential selenium exposure and risks from the SCH Project on ecological receptors (primarily aquatic and benthic invertebrates, fish, and birds); identifies measures to avoid, reduce, and mitigate potential impacts; and outlines monitoring that would support adaptive management of selenium risk at the SCH Project.

Appendix J Special Studies Summary

The SCH Project is being designed to support wildlife dependent on the Salton Sea and to minimize negative impacts on wildlife or humans. The Sea's environmental conditions are often extreme and can be challenging for building habitat and maintaining fish and wildlife populations. The State of California contracted for specialized studies to address key uncertainties for the SCH Project's design, impact analysis, and operation. This appendix summarizes various studies including:

- Hydrologic modeling – explored how different potential pond depths and configurations, source waters, and water operations could affect saltwater balance in ponds and expected water quality conditions (temperature, dissolved oxygen).
- Fish tolerance study – A laboratory experiment exposed different tilapia species to various combinations of salinity and temperature to look at survival tolerances to inform design of operational scenarios and selection of fish species for stocking.
- Contaminants in water and sediments – Another issue is potential toxicity impacts from contaminants in sediments or water at the proposed SCH ponds. Sediment and water samples were collected from the alternative SCH sites and concentrations measured for selenium, arsenic, boron, and pesticides.
- Selenium ecorisk modeling – Selenium in the sediment and water could contribute to toxicity risks to the ecosystem and humans through accumulation in the sediment and cycling through the food web. Ecorisk modeling was conducted to evaluate the potential risk of transfer and bioaccumulation in the food web.
- Selenium treatment – Pilot studies are underway to evaluate the potential for using vegetation in constructed wetlands to help remove selenium from water that could supply the SCH ponds.

Appendix K Corps Section 404 Permit Projects in the HUC 8 Watershed

This appendix includes a list of section 404 permits issued by the Corps in the Salton Sea watershed where the SCH Project would be located.

Appendix L Tribal Consultation and Coordination

As part of its Section 106 consultation process, the Corps requested information regarding cultural and Native American resources in the SCH Project area from the Torres Martinez Desert Cahuilla Indians, Quechan Indian Nation, Manzanita Band of the Kumeyaay Nation, La Posta Band of Mission Indians, Kwaaymii Laguna Band of Mission Indians, Kumeyaay Cultural Heritage Preservation, Fort Yuma Quechan Nation, Ewiiaapyaap Tribal Office, Cocopah Museum, Campo Kumeyaay Nation, Augustine Band of Cahuilla Mission Indians, and the Ah-Mut-Pipa Foundation. Appendix L contains copies of the consultation letters sent by the Corps and responses from the tribes received to date.

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APPENDIX A

Scoping Process

ATTACHMENT A

Notice of Intent

PUBLIC NOTICE

US Army Corps of Engineers®

RECEIPT OF APPLICATION FOR A CORPS PERMIT, NOTICE OF INTENT TO PREPARE A DRAFT EIS/EIR AND HOLD A PUBLIC SCOPING MEETING

LOS ANGELES DISTRICT

Public Notice/Application No.: SPL-2010-00142-LLC
Comment Period: June 21, 2010 through July 24, 2010
Project Manager: Lanika Cervantes; 760.602.4838; Lanika.L.Cervantes@usace.army.mil

Applicant and Contact
Kim Nicol
California Department of Fish and Game
78078 Country Club Drive, Suite 109, Bermuda
Dunes, CA 92203
(760) 200-9178

Location

The proposed project would be located within the Salton Sea in Imperial and Riverside County, California.

Activity

The U.S. Army Corps of Engineers (Corps), in conjunction with the California Natural Resources Agency, is preparing an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the construction of the Salton Sea Species Conservation Habitat (SCH) Project. The SCH project consists of the creation of a shallow habitat pond complex that would be constructed in phases depending on funding and land availability. Habitat would be constructed over multiple years, as the Sea recedes, until the targeted acreage of habitat was reached. It is currently anticipated that about 2,400 acres of habitat would be created as part of the SCH Project, although the actual amount may vary depending on the outcome of the alternatives development process. For more information, see page 3 of this notice.

Interested parties are hereby notified that an application has been received for a Department of the Army permit for the activity described herein and shown on the attached drawings. Interested parties are invited to provide their views on the proposed work, which will become a part of the record and will be considered in the decision. This permit will be issued or denied under Section 404 of the Clean Water Act (33 U.S.C. 1344). Written comments should be mailed to:

Comments should be mailed to:

U.S. Army Corps of Engineers, Los Angeles District
Regulatory Division
ATTN: 2010-00142-LLC
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

Alternatively, comments can be sent electronically to: Lanika.L.Cervantes@usace.army.mil

Evaluation Factors

The decision whether to issue a permit will be based on an evaluation of the probable impact including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit that reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors that may be relevant to the proposal will be considered including the cumulative effects thereof. Factors that will be considered include conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food production and, in general, the needs and welfare of the people. In addition, because the proposed action would discharge dredged or fill material into waters of the U.S., the evaluation of the activity will include application of the U.S. Environmental Protection Agency's Section 404(b)(1) Guidelines (40 C.F.R. Part 230) as required by Section 404 (b)(1) of the Clean Water Act.

The Corps of Engineers is soliciting comments from the public; Federal, state, and local agencies and officials; Indian tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition, or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. In this case, comments will be used in the preparation of an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act. Comments are also used to determine the overall public interest of the proposed activity.

Preliminary Review of Selected Factors

EIS Determination- A determination has been made that an environmental impact statement (EIS) is required for the proposed activities, based on the Corps's independent determination that the proposed action could result in potentially significant impacts. It is expected that a Draft EIS will be prepared and published by early-2011.

Water Quality- The applicant is required to obtain water quality certification, under Section 401 of the Clean Water Act, from the California Regional Water Quality Control Board (RWQCB). Section 401 requires that any applicant for an individual Section 404 permit provide proof of water quality certification to the Corps of Engineers prior to permit issuance. For any proposed activity on Tribal land that is subject to Section 404 jurisdiction, the applicant will be required to obtain water quality certification from the U.S. Environmental Protection Agency.

Coastal Zone Management- For those projects in or affecting the coastal zone, the Federal Coastal Zone Management Act requires that prior to issuing the Corps authorization for the project, the applicant must obtain concurrence from the California Coastal Commission that the project is consistent with the State's Coastal Zone Management Plan. This project is located outside the coastal zone and is not expected to affect coastal zone resources.

Cultural Resources- The Corps and the Applicant are still in the process of collecting information of the potential sites and will continue to evaluate potential effects on cultural resources. Consultation with the State Historic Preservation Officer, pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, will occur for any anticipated effects of the proposed activities on cultural resources eligible for listing or listed on the National Register of Historic Places.

Endangered/Threatened Species- Preliminary determinations indicate that the proposed activities may affect federally listed endangered or threatened species, or their critical habitat. Federally listed species known or having high potential to occur in the areas selected around the Salton Sea, based on previous survey results, include least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), desert pupfish (*Cyprinodon macularius*), Yuma Clapper rail (*Rallus longirostris yumanensis*), and California Least tern (*Sterna antillarum browni*). Additional on-site surveys for federally listed species are being conducted at this time to provide current information. Thus, formal consultation under Section 7 of the Endangered Species Act appears to be required.

Public Meeting/Hearing- The Corps and the Natural Resources Agency will jointly conduct a series of public scoping meetings to receive public comments regarding the appropriate scope and content of the SCH Project DEIS/DEIR and to assess public concerns. Parties interested in being added to the electronic mail notification list for any projects associated with the Salton Sea can register at: http://www.spl.usace.army.mil/regulatory/ under the Public Notice tab, Distribution List registration. This list will be used in the future to notify the public about scheduled hearings and availability of future public notices. Parties interested in obtaining additional information about the SCH Project can also visit the Natural Resources Agency website at http://resources.ca.gov/restoring_the_salton_sea.html.

The scoping meetings will be held at:

1. Palm Desert—**July 7, 2010 at 1:00 P.M.** at University of California, 75-080 Frank Sinatra Drive, Room B200, Palm Desert, CA 92211.

2. Thermal—**July 7, 2010 at 6:30 P.M.** at Torrez-Martinez Tribal Administration Building, 66-725 Martinez Road, Thermal, CA 92274.

3. Calipatria—**July 8, 2010 at 1:00 P.M.** at Calipatria Inn and Suites, 700 North Sorenson Avenue, Calipatria, CA 92233.

4. Brawley—**July 8, 2010 at 6:30 P.M.** at Elks Lodge #1420, 161 South Plaza, Brawley, CA 92227.

During these public scoping meetings, anyone wishing to make a statement will be allocated a certain amount of time to provide information on the proposed project. The amount of time each person is allowed will be directly dependent on the number of people who wish to make verbal comments. At this time, we estimate that individuals will be given 2 or 3 minutes to provide their comments verbally. We would like to encourage interest groups to designate an official spokesperson to present the group's views. We will allocate a larger amount of time to official representatives of such groups upon request.

Groups wishing to designate an official representative must notify the Corps in writing prior to, but no later than **July 1, 2010**. The determination of this extended speaking time will be based on the number of responses received by the Corps. This rule will be strictly enforced at the discretion of the Corps' hearing officer.

The public scoping meetings will provide the opportunity for the public to provide comments on the proposal that will be entered into the administrative record. In addition, the Corps will be receiving written comments into the record from anyone who wishes to provide them until **July 24, 2010** (i.e., the close of the comment period for this public notice).

The Corps also anticipates holding a public hearing to obtain input on the Draft EIS/EIR when it becomes available and is circulated to the public (expected by early-2011).

Proposed Activity for Which a Permit is Required

CDFG, as the project applicant, proposes to construct, operate, and maintain the SCH project; approximately 2,400 acres of exposed playa of the Salton Sea will be converted to shallow pond and wetland complexes. The SCH project would impact areas within the Ordinary High Water Mark of the Salton Sea and adjacent wetlands.

Basic Project Purpose- The basic project purpose comprises the fundamental, essential, or irreducible purpose of the proposed project, and is used by the Corps to determine whether the applicant's project is water dependent. The basic purpose of the proposed SCH Project is to create aquatic habitat to protect the fish and wildlife species dependent on the Salton Sea in accordance with California Fish and Game Code, Section 2932. This project is a water dependent activity.

Overall Project Purpose- The overall project purpose serves as the basis for the Corps' Section 404(b)(1) alternatives analysis and is determined by further defining the basic project purpose in a manner that more specifically describes the applicant's goals for the project, and which allows a reasonable range of alternatives to be analyzed. The overall project purpose is to develop a range of aquatic habitats that will support fish and wildlife species dependent on the Salton Sea.

Additional Project Information

Background information- The Salton Sea is located in both Imperial and Riverside counties in southeastern California, approximately 35 miles north of the U.S. Mexico border and 50 miles west of the Colorado River. Preliminary evaluations of potential sites indicate that SCH ponds could be constructed at either the north end of the Salton Sea near the Whitewater River, or the south end of the Salton Sea near the New and Alamo rivers, or in both areas.

As the Sea recedes and becomes more saline, fish species will not be able to survive. Simultaneously, the fish-eating birds, including several species of special concern, will lose their forage base and begin to disappear. As the Sea continues to become more saline, current invertebrate species will become less diverse and be replaced by species tolerant of hyper-saline environments (e.g., brine flies and brine shrimp).

The SCH Project would provide habitat for both fish and invertebrate species, which in turn would provide forage for the numerous bird species dependent on the Salton Sea ecosystem. Salinity would be managed to support various assemblages of invertebrates and fish to diversify the prey base for as wide a variety of bird species as possible. The SCH ponds would be designed to serve those piscivorous bird species that are expected to experience significant declines as functional Salton Sea habitat is lost due to increasing salinity.. For many of these species, a significant proportion of their population uses the Salton Sea.

Project description- The SCH Project is being developed as a proof-of-concept project for future restoration to verify that the core ideas are functional and feasible prior to attempting a full scale restoration of the Salton Sea. The SCH Project would help establish viability, technical issues, and overall direction, as well as providing feedback for costs and requirements of construction, operations and management. The SCH Project would be created in phases as the Sea recedes by constructing dikes below the elevation of -228 feet mean sea level (msl) using material excavated from the sea bed. Rivers, which have better water quality than agricultural drain water, would provide the primary source of water for the ponds.

Habitat ponds would vary in size, and several ponds could be constructed in each phase depending on funding and land availability. Habitat would continue to be constructed in subsequent years as the Sea continues to recede until the targeted acreage of habitat was reached. It is currently anticipated that about 2,400 acres of habitat would be created as part of the SCH Project, although the actual amount may vary depending on the outcome of the alternatives development process.The SCH would be designed with varying ranges of salinity in order to maximize biological productivity and minimize adverse effects associated with water quality. Ponds would be designed to optimize fish habitat and maximize fish productivity to provide a sustainable prey base for piscivorous birds. Ponds could also be managed to optimize invertebrate production to enhance the prey base for shorebirds and wading birds.

The depth of water in the ponds is dependent on the slope of the sea bed, but could range up to approximately 6 feet, depending on the areas available for development as the surface water elevation declines. Deeper areas could be created by excavating materials from within the ponds for construction of the dikes or islands. The dike separating adjacent ponds at similar elevations could also be modified to form larger ponds in the future, with portions of the original dike left intact to form islands.

A sedimentation basin could be constructed on lands above elevation -228 msl, or the first SCH pond could function as a sedimentation basin in addition to providing habitat. The first pond may need to be drained periodically for vegetation management and sediment removal; triggers for such actions will be developed as part of the adaptive management plan. Water discharged from the first pond would flow into other ponds, and from there into further ponds and/or into the Salton Sea.

A variety of methods for managing salinity will be thoroughly evaluated in the EIR/EIS. Several methods are currently under consideration, although additional methods may be identified as part of the scoping process and as a result of special studies that are underway. The method currently being considered is evapo-concentration of salts, which would result in higher salinity in each subsequent pond until the maximum salinity suitable for optimal biological productivity was achieved. Once the maximum desired salinity was achieved, the next series of ponds could again initially be supplied by river water. Saline water from the earlier ponds could be blended with river water to obtain targeted salinities in some of the newer ponds. If not needed for blending in the next phase of ponds, saline water from the ponds would discharge to the Salton Sea. This process would result in a mix of salinities throughout the SCH complex, with salinities being managed by balancing river inflow, evaporation, and discharge. Higher salinities in the initial ponds, if needed, could be achieved by temporarily blending diverted river water with saline water pumped from the Salton Sea. If necessary, temporary pumping could also be used to initially achieve the targeted salinities in subsequent series of ponds, but longer-term salinity management would be maintained by balancing inflows, evaporation, and discharge. If additional salt water were needed in future years to maintain salinity, saline water from the higher salinity ponds could be recirculated to the lower salinity ponds.

Siting SCH ponds adjacent to the confluence of the New, Alamo, or Whitewater rivers and the Salton Sea would minimize the need for conveyance facilities to transport freshwater from these rivers to the ponds. Water flow from the rivers and between the ponds could be controlled with valves to be able to respond to varying evaporation or seepage rates and to allow changes in operations to modify salinity or water depth goals. The precise method of conveying water will be evaluated as part of the engineering design and environmental review process.

Monitoring and evaluation would commence upon completion of the ponds in the first year and would continue thereafter. A monitoring and adaptive management plan would be implemented to monitor and evaluate biological and water quality parameters, habitat function, and engineering performance of the SCH Project. Information obtained from monitoring and evaluation would be used to refine the engineering design, wildlife management criteria, and adaptive strategies for continued development of subsequent phases of the SCH Project. Adaptive and flexible strategies would reduce the risks and uncertainties associated with operating larger complexes and facilitate managing or mitigating observed issues and problems.

Through the EIS/EIR process, feasible environmental mitigation measures will be developed to reduce potential environmental impacts. Measures to reduce construction impacts would be implemented through construction contract specifications and permit requirements.

Issues- There are several potential environmental issues that will be addressed in the Draft EIS/EIR. Additional issues may be identified during the scoping process. Issues initially identified for evaluation in the Draft EIS/EIR as potentially significant or that are believed to be of local concern include:

1. Agricultural Resources: impacts from conversion of farmland to non-agricultural use, and dust due to construction.
2. Air Quality: impacts during construction, operations, and maintenance, and also the beneficial impact on fugitive dust from covering exposed playa with water.
3. Biological Resources: impacts on fish and wildlife during construction, operations, and maintenance.
4. Cultural Resources: potential impacts to archaeological resources, human remains, and sacred sites activities.
5. Environmental Justice: potential effects on the Torres Martinez Desert Cahuilla Indian Tribe and other local communities from construction, operations, and maintenance activities.

6. Geology and Soils: impacts during construction, operations, and maintenance

7. Greenhouse Gas Emissions/Climate Change: impacts during construction, operations, and maintenance.

8. Hazards and Hazardous Materials: impacts during construction, maintenance, and operations.

9. Hydrology and Water Quality: impacts during construction, operations, and maintenance.

10. Indian Trust Assets: effects on Torres Martinez Tribe's trust assets from development of the sites near the Whitewater River.

11. Land Use: potential conflicts with other existing or planned land uses and local plans, policies, and ordinances.

12. Noise: impacts during construction, operations, and maintenance.

13. Paleontological Resources: potential impacts from ground-disturbing activities.

14. Transportation and Traffic: impacts during construction, operations, and maintenance.

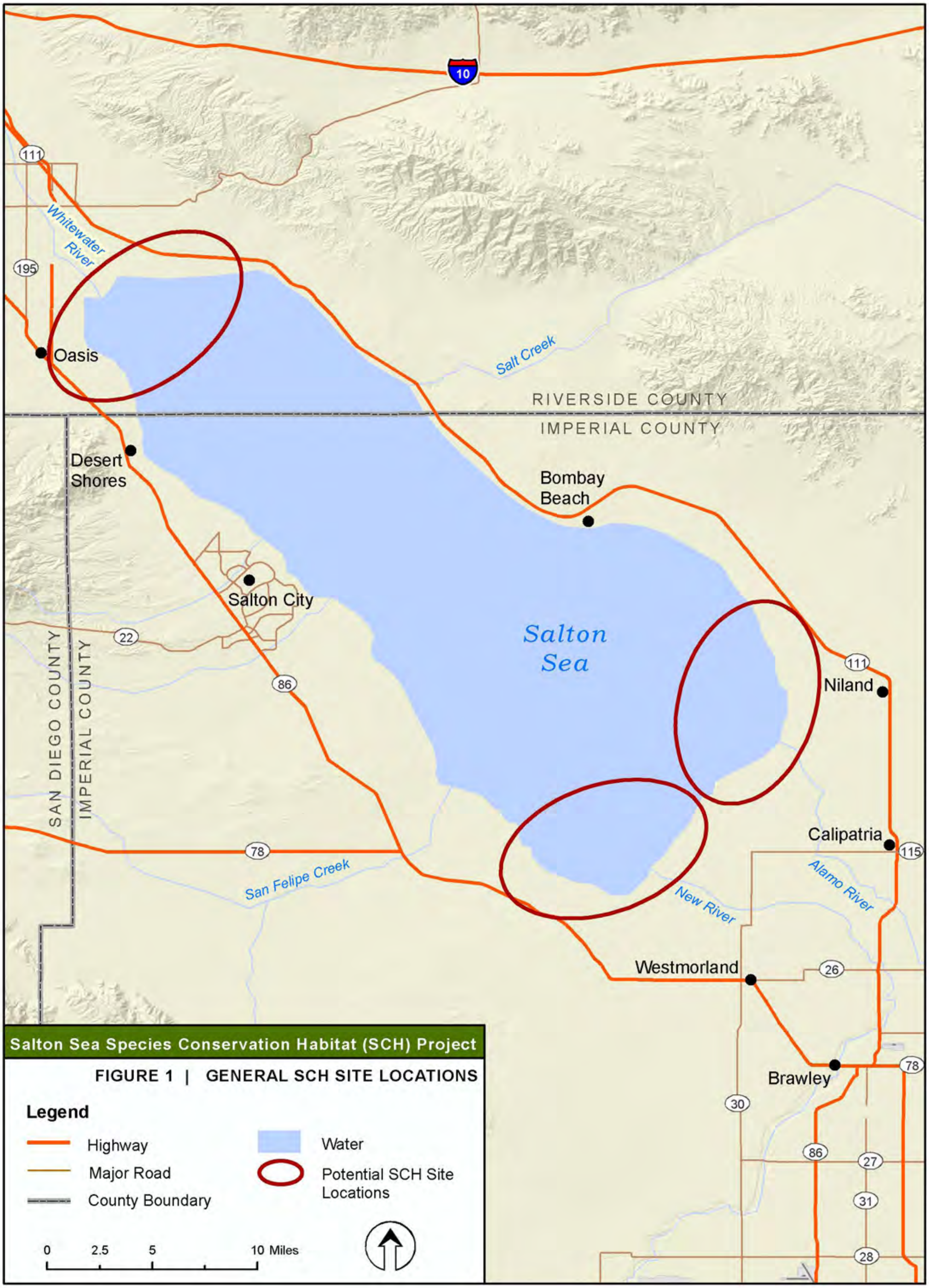
Alternatives- Several alternatives are being considered for the proposed action. The EIS/EIR may include a co-equal analysis of the project alternatives considered. Alternatives initially being considered for the SCH Project include: (a) alternative locations (at the confluence of the New, Alamo, or Whitewater rivers and the Salton Sea, or a combination of sites); (b) different acreages of created habitat; (c) different pond sizes and configurations; (d) different ranges of salinity within the ponds; and (e) no action. The range and characteristics of the alternatives addressed in the EIS/EIR will be further developed based on input from the scoping process and special studies that are underway.

Proposed Mitigation – The proposed mitigation may change as a result of comments received in response to this public notice, the applicant's response to those comments, and/or the need for the project to comply with the Section 404(b)(1) Guidelines. In consideration of the above, the proposed mitigation sequence (avoidance/minimization/compensation), as applied to the proposed project is summarized below:

Avoidance/minimization: The Applicant is still in the conceptual design phase of their project and will be working closely with the Corps and other permitting Agencies to develop designs that will avoid and minimize potentially negative impacts to aquatic resources to the highest extent practicable.

Compensation: The applicant is proposing to compensate for the impacts to waters/wetlands of the U.S. through the creation of wetlands as part of the project design.

For additional information please call Ms. Lanika Cervantes of my staff at (760) 602-4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. This public notice is issued by the Chief, Regulatory Division.



Salton Sea Species Conservation Habitat (SCH) Project

FIGURE 1 | GENERAL SCH SITE LOCATIONS

ATTACHMENT B

Notice of Preparation

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH #

Project Title: Salton Sea Species Conservation Habitat (SCH) Project

Lead Agency: Natural Resources Agency
Contact Person: Kimberly Nicol/DFG Program Mgr
Mailing Address: 78078 Country Club Drive, Suite 109
Phone: (760) 200-9178
City: Bermuda Dunes
Zip: 92203
County: Riverside

Project Location: County: Imperial and Riverside counties
City/Nearest Community: Calipatria, Niland, & Oasis
Cross Streets: See Figure1, General SCH Site Locations
Zip Code: Multiple
Longitude/Latitude (degrees, minutes and seconds): ____° ____′ ____″ N / ____° ____′ ____″ W
Total Acres: approximately 2,400
Assessor's Parcel No.: Multiple
Section: Multiple Twp.: Multiple Range: Multiple Base: Multiple
Within 2 Miles: State Hwy #: 86 and 111
Waterways: New River, Alamo River, and Whitewater River
Airports: None
Railways: Union Pacific
Schools: Oasis Elem. School & Saul Martinez School

Document Type:

CEQA: ☑ NOP ☐ Early Cons ☐ Neg Dec ☐ Mit Neg Dec ☐ Draft EIR ☐ Supplement/Subsequent EIR (Prior SCH No.) ____ Other: ____

NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI

Other: ☐ Joint Document ☐ Final Document ☐ Other: ____

Local Action Type:

☐ General Plan Update ☐ General Plan Amendment ☐ General Plan Element ☐ Community Plan
☐ Specific Plan ☐ Master Plan ☐ Planned Unit Development ☐ Site Plan
☐ Rezone ☐ Prezone ☐ Use Permit ☐ Land Division (Subdivision, etc.)
☐ Annexation ☐ Redevelopment ☐ Coastal Permit ☐ Other: ____

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____
☐ Industrial: Sq.ft. ____ Acres ____ Employees ____
☐ Educational: ____
☐ Recreational: ____
☐ Water Facilities: Type ____ MGD ____
☐ Transportation: Type ____
☐ Mining: Mineral ____
☐ Power: Type ____ MW ____
☐ Waste Treatment: Type ____ MGD ____
☐ Hazardous Waste: Type ____
☑ Other: Habitat Restoration

Project Issues Discussed in Document:

☑ Aesthetic/Visual	☐ Fiscal	☑ Recreation/Parks	☑ Vegetation
☑ Agricultural Land	☑ Flood Plain/Flooding	☐ Schools/Universities	☑ Water Quality
☑ Air Quality	☐ Forest Land/Fire Hazard	☐ Septic Systems	☑ Water Supply/Groundwater
☑ Archeological/Historical	☑ Geologic/Seismic	☐ Sewer Capacity	☑ Wetland/Riparian
☑ Biological Resources	☑ Minerals	☑ Soil Erosion/Compaction/Grading	☑ Growth Inducement
☐ Coastal Zone	☑ Noise	☑ Solid Waste	☑ Land Use
☐ Drainage/Absorption	☑ Population/Housing Balance	☑ Toxic/Hazardous	☑ Cumulative Effects
☑ Economic/Jobs	☑ Public Services/Facilities	☑ Traffic/Circulation	☐ Other: ____

Present Land Use/Zoning/General Plan Designation:

Salton Sea is a repository for agricultural drainage; surrounding areas are predominantly used for agriculture.

Project Description: *(please use a separate page if necessary)*

The SCH Project would construct habitat configured in a series of interconnected shallow ponds at either the north or south ends of the Salton Sea, or in both areas. The Project size at total build-out is currently expected to be approximately 2,400 acres, which may be constructed over a period of several years. The actual total Project size may vary, and SCH ponds would vary in size. The Project's ponds would be created by constructing dikes below the elevation of -228' msl using material excavated from the Sea bed. Rivers would provide the primary source of water for the ponds. The SCH would be designed with varying ranges of salinity to maximize biological productivity and minimize adverse effects from water quality.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

X	Air Resources Board	X	Office of Emergency Services
	Boating & Waterways, Department of	X	Office of Historic Preservation
X	California Highway Patrol		Office of Public School Construction
X	Caltrans District # 11	X	Parks & Recreation, Department of
	Caltrans Division of Aeronautics		Pesticide Regulation, Department of
	Caltrans Planning		Public Utilities Commission
	Central Valley Flood Protection Board	X	Regional WQCB # 7
X	Coachella Valley Mtns. Conservancy	X	Resources Agency
	Coastal Commission		S.F. Bay Conservation & Development Comm.
X	Colorado River Board		San Gabriel & Lower L.A. Rivers & Mtns. Conservancy
X	Conservation, Department of		San Joaquin River Conservancy
	Corrections, Department of		Santa Monica Mtns. Conservancy
	Delta Protection Commission	X	State Lands Commission
	Education, Department of		SWRCB: Clean Water Grants
X	Energy Commission	X	SWRCB: Water Quality
X	Fish & Game Region # 6	X	SWRCB: Water Rights
X	Food & Agriculture, Department of		Tahoe Regional Planning Agency
X	Forestry and Fire Protection, Department of	X	Toxic Substances Control, Department of
	General Services, Department of	X	Water Resources, Department of
X	Health Services, Department of		
	Housing & Community Development		Other:
	Integrated Waste Management Board		Other:
X	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date June 23, 2010 Ending Date July 22, 2010

Lead Agency (Complete if applicable):

Consulting Firm:
Address:
City/State/Zip:
Contact:
Phone:

Applicant:
Address:
City/State/Zip:
Phone:

Signature of Lead Agency Representative: ______ **Date:** ______

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

To: Distribution List

From: State of California,
Natural Resources Agency

Date: June 21, 2010

Re: Notice of Preparation (NOP) of a Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR)

Project: Proposed Salton Sea Species Conservation Habitat (SCH) Project Riverside and Imperial Counties, California

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The California Natural Resources Agency is the Lead Agency for preparation of the Salton Sea SCH Project EIR in accordance with the California Environmental Quality Act (CEQA). Because the SCH Project (Project) involves both State and Federal actions, a joint EIS/EIR will be prepared by DFG, under the direction of the Natural Resources Agency, and the U.S. Army Corps of Engineers (Corps) pursuant to CEQA and the National Environmental Policy Act (NEPA). The joint document is being prepared to optimize efficiency and avoid duplication and is intended to be sufficient in scope to address both the Federal and State requirements. A summary of the SCH Project is included as Attachment A.

For the purposes of the EIS/EIR, the State actions are the implementation of conservation measures necessary to protect the fish and wildlife species dependent on the Salton Sea in accordance with California Fish and Game Code, Section 2932, and the potential issuance of incidental take authorization under the California Endangered Species Act (CESA) California, Section 2081, and a Streambed Alteration Agreement under California Fish and Game Code, Section 1602. The primary Federal action is the potential issuance of a permit under Section 404 of the Clean Water Act, which regulates the discharge of dredged, excavated, or fill material in wetlands, streams, rivers, and other U.S. waters.

We request the views of interested parties as to the scope and content of the environmental documentation, including issues that are of interest to an agency's statutory responsibilities in connection with the SCH Project. Agencies may need to use the EIS/EIR when considering permit(s) or other approval(s) for the Project. An Initial Study was not prepared because the Natural Resources Agency has already determined that a joint EIS/EIR is required (CEQA Guidelines, Section 15063(a)).

Due to time limits mandated by State law, your response must be sent at the earliest possible date, but not later than 30 days after receipt of this notice. Please send responses to Ms. Kimberly Nicol, DFG Program Manager, at 78078 Country Club Drive, Suite 109, Bermuda Dunes, CA 92203, or at knicol@dfg.ca.gov; alternatively, they can be sent to U.S. Army Corps of Engineers, Los Angeles District, Regulatory Division, San Diego Field Office, ATTN: CESPL-RG-SS-2010-00142-LLC, 6010 Hidden Valley Road, Suite 105, Carlsbad, CA 92011, or lanika.l.cervantes@usace.army.mil. If you have questions, please contact Ms. Nicol at (760) 200-9178 or Ms. Lanika Cervantes, Corps Project Manager, at (760) 602-4838. Comment letters sent via electronic mail should include the commenter's name and physical mailing address, and the Project title, “Species Conservation Habitat Project” should be included in the electronic mail’s subject line.

Scoping meetings will be held to obtain input to the Draft EIS/EIR, and a public hearing will be held during the public comment period once the Draft EIS/EIR is released. Parties interested in being added to the electronic mail notification list for the SCH Project can register at: http://www.spl.usace.army.mil/regulatory/ under the Public Notice tab, Distribution List registration. This list will be used in the future to notify the public about scheduled hearings and availability of future public notices. Parties interested in obtaining additional information about the SCH Project can also visit the Natural Resources Agency website at http://resources.ca.gov/restoring_the_salton_sea.html.

The Natural Resources Agency and the Corps will jointly conduct public scoping meetings at the following locations to receive public comment and assess public concerns regarding the appropriate scope of the Draft EIS/EIR.

Community	**Location/Address**	**Date**	**Time**
Palm Desert	University of California at Riverside, Room B200 75-080 Frank Sinatra Drive	July 07, 2010	1:00 P.M.
Thermal	Torrez Martinez, Tribal Administration Building 66-725 Martinez St.	July 07, 2010	6:30 PM
Calipatria	Calipatria Inn and Suites 700 North Sorenson Avenue	July 08, 2010	1:00 P.M.
Brawley	Elks Lodge #1420, 161 South Plaza	July 08, 2010	6:30 PM

Attachment A

1.0 Description of the Project

Overview

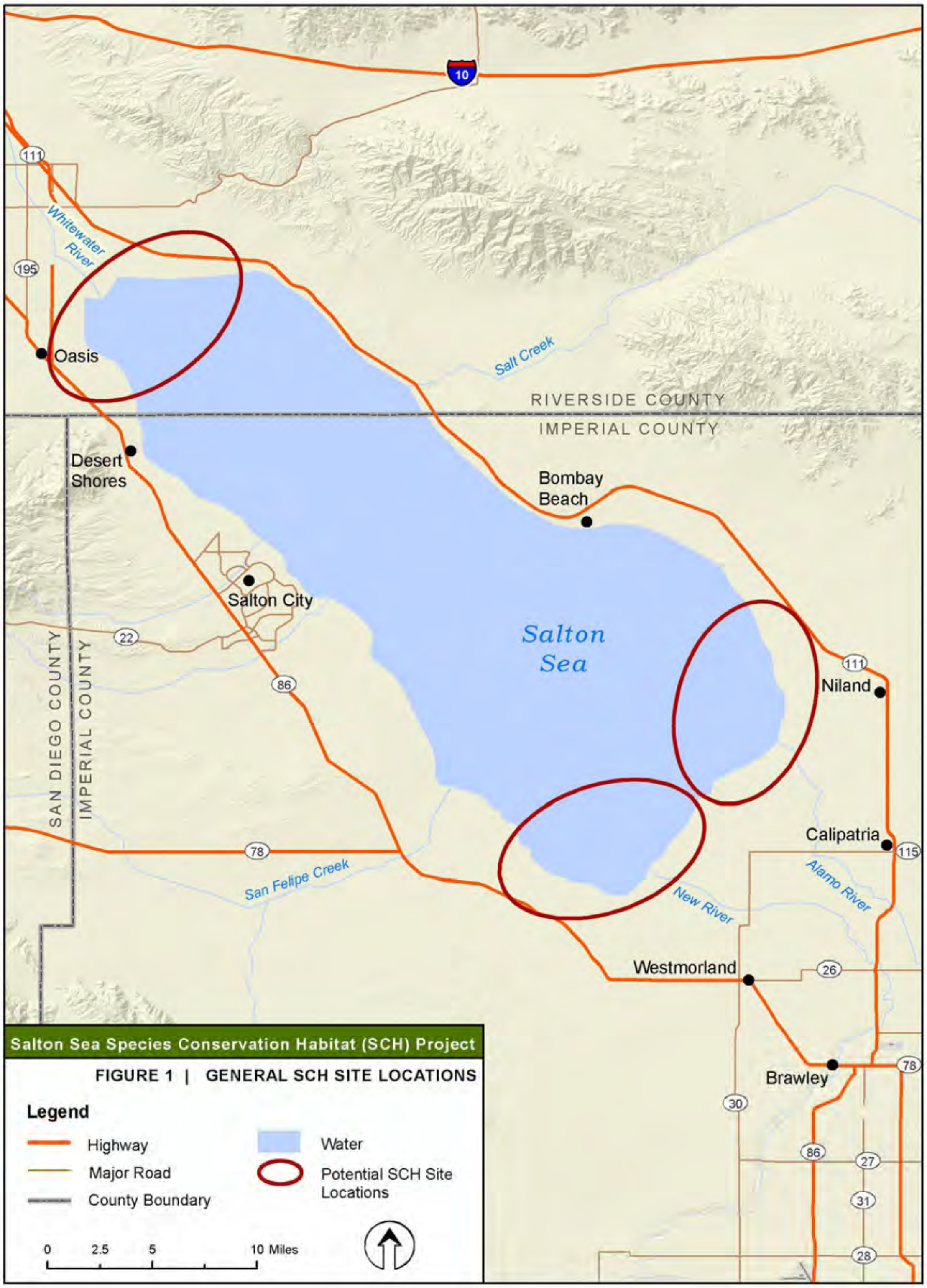
The SCH Project would construct habitat configured in a series of interconnected shallow ponds within the current footprint of the Salton Sea. The Project size at total build-out is currently expected to be approximately 2,400 acres, which may be constructed over a period of several years depending on land availability and cost. The actual total project size may vary depending on the outcome of the alternatives development process. The Project's ponds would be created as the Sea recedes by constructing dikes below the elevation of -228 feet mean sea level (msl) using material excavated from the sea bed. Rivers, which have better water quality than agricultural drain water, would provide the primary source of water for the ponds. Habitat ponds would vary in size, and several ponds could be constructed in each phase depending on land availability. Habitat would continue to be constructed in subsequent years as the Sea continues to recede until the targeted acreage of habitat was reached. Preliminary evaluations of potential siting areas indicate that ponds could be constructed at either the north or south ends of the Salton Sea, or in both areas. Figure 1 shows generalized locations of where the SCH Project could be constructed. The habitat would be designed with varying ranges of salinity in order to maximize biological productivity and minimize adverse effects associated with water quality. Ponds would be designed to optimize fish habitat and maximize fish productivity to provide a sustainable prey base for fish-eating birds. Ponds could also be managed to optimize invertebrate production to enhance the prey base for shorebirds and wading birds. The Project is being developed as a proof-of-concept project with construction planned beginning in late 2011 or early 2012.

Project Purpose, Goals, and Objectives

The SCH Project is being developed as a conservation measure for the protection of the fish and wildlife species dependent on the Salton Sea in accordance with California Fish and Game Code, Section 2932. As the Sea recedes and becomes more saline, fish species will not be able to survive. Simultaneously, the fish-eating birds, including several species of special concern, will lose their forage base and begin to disappear. As the Sea continues to become more saline, current invertebrate species will become less diverse and be replaced by species tolerant of hyper-saline environments (e.g., brine flies and brine shrimp).

The Project goals and the objectives are as follows:

Goal 1	**Develop a range of aquatic habitats that will support fish and wildlife species dependent on the Salton Sea**
Objectives	Provide adequate foraging habitat for piscivorous (fish-eating) bird species
	Develop habitats required to support piscivorous bird species
	Support a sustainable, productive aquatic community
	Provide suitable water quality for fish
	Minimize adverse effects to desert pupfish
	Minimize risk of selenium
	Minimize risk of disease/toxicity impacts


10
111
195
Whitewater River
Oasis
Salt Creek
RIVERSIDE COUNTY
IMPERIAL COUNTY
Desert Shores
Bombay Beach
Salton City
22
SAN DIEGO COUNTY
IMPERIAL COUNTY
Salton Sea
86
111
Niland
Calipatria
115
78
San Felipe Creek
New River
Alamo River
Westmorland
26
78
Brawley
30
86
27
31
28
Salton Sea Species Conservation Habitat (SCH) Project
FIGURE 1 | GENERAL SCH SITE LOCATIONS
Legend
Highway
Major Road
County Boundary
Water
Potential SCH Site Locations
0
2.5
5
10 Miles

Goal 2	**Develop and refine information needed to successfully manage the SCH Project habitat through an adaptive management process**
Objectives	Identify uncertainties in achieving the objectives
	Design science-based means to test alternatives and reduce uncertainty
	Develop and implement a monitoring plan
	Develop a decision-making framework
	Provide proof of concept for future restoration

The SCH Project would provide habitat for both fish and invertebrate species, which in turn would provide forage for the numerous bird species dependent on the Salton Sea ecosystem. Salinity would be managed to support various assemblages of invertebrates and fish to diversify the prey base for as wide a variety of bird species as possible. The SCH ponds would be designed to serve those piscivorous bird species that would experience significant declines if the amount of Salton Sea habitat were substantially reduced. For many of these species, a significant proportion of their population uses the Salton Sea. Examples of those focal species that the SCH ponds would support are American white pelican, black skimmer, Caspian tern, and double-crested cormorant. If the amount of habitat used by these species at the Sea were substantially reduced, some individuals could use other habitats in the region up to their capacity, but it is unlikely that all of the piscivorous birds using the Salton Sea could find suitable habitat elsewhere.

The SCH ponds would also benefit other bird species, such as the eared grebe, gull-billed tern, western snowy plover, ruddy duck, black tern, and California brown pelican. These species are either not piscivorous (i.e., invertebrate prey is easier to support than fish) and/or only a small proportion of their population depends on the Salton Sea. There are also some subspecies or population segments that would likely use the created habitats as well, such as the least tern (interior subspecies of the California least tern or Mexican least tern, whichever is present at the Salton Sea) and Baja population of the California brown pelican which uses the Salton Sea as a post-breeding site. While the SCH ponds would provide ancillary benefits for these species, they are not the principal species served by the SCH Project, and therefore, their habitat needs would not be criteria for design.

Fish currently existing in the Salton Sea or tributaries are the likely candidates for establishment in the SCH ponds. The ponds would not likely provide suitable habitat for the marine species (orangemouth corvina, gulf croaker, and sargo) previously found in the Salton Sea. Tilapia are currently found in large numbers in the Sea, and would likely be the species providing the primary forage base in the ponds for fish eating birds. Since a primary purpose of the ponds is to provide habitat for fish as forage for birds, the ponds would be managed to maximize fish productivity. However, it is likely that desert pupfish would also become established in the ponds, and management implications would be addressed through consultation with appropriate jurisdictional agencies.

Key Project Components

Depth of water in the ponds is dependent on the slope of the sea bed, but could range up to approximately 6 feet, depending on the areas available for development as the surface water elevation declines. Deeper areas could be created by excavating materials from within the ponds for construction of the dikes or islands. The dike separating adjacent ponds at similar elevations could also be modified to form larger ponds in the future, with portions of the original dike left intact to form islands.

A sedimentation basin could be constructed on lands above elevation -228 msl, or the first SCH pond could function as a sedimentation basin in addition to providing habitat. The first pond may need to be drained periodically for vegetation management and sediment removal; triggers for such actions will be developed as part of the adaptive management plan. Water discharged from the first pond would flow into other ponds, and from there into further ponds.

A variety of methods for managing salinity will be thoroughly evaluated in the EIS/EIR. Several methods are currently under consideration, although additional methods may be identified as part of the scoping process and as a result of special studies that are underway. The methods currently being considered include evapo-concentration of salts, which would result in higher salinity in each subsequent pond, until the maximum salinity suitable for optimal biological productivity was achieved. Once the maximum desired salinity was achieved, the next phase of ponds could again initially be supplied by river water. Saline water from the earlier ponds could be blended with river water to obtain targeted salinities in some of the newer ponds. If not needed for blending in the next phase of ponds, saline water from the ponds would discharge to the much more saline Salton Sea. This process would result in a mix of salinities throughout the SCH complex, with salinities being managed by balancing river inflow, evaporation, and discharge. Interspersing ponds with freshwater amongst the more saline ponds would provide a drinking water source for birds, especially young birds unable to fly. Higher salinities in the initial ponds, if needed, also could be achieved by temporarily blending diverted river water with saline water pumped from the Salton Sea. If necessary, temporary pumping could also be used to initially achieve the targeted salinities in the subsequent phases of ponds, but longer-term salinity management would be maintained by balancing inflows, evaporation, and discharge. If additional salt water were needed in future years to maintain salinity, saline water from the higher salinity ponds could be recirculated to the lower salinity ponds.

Siting ponds adjacent to the confluence of the New, Alamo, or Whitewater rivers and the Salton Sea would minimize the need for conveyance facilities to transport freshwater from these rivers to the ponds. Water flow from the rivers and between the ponds could be controlled with valves to be able to respond to varying evaporation or seepage rates and to allow changes in operations to modify salinity or water depth goals. The precise method of conveying water will be evaluated as part of the engineering design and environmental review process.

Monitoring and evaluation would commence upon completion of the ponds in the first year and would continue thereafter. A monitoring and adaptive management plan would be implemented to monitor and evaluate biological and water quality parameters, habitat function, and engineering performance of the SCH Project. Information obtained from monitoring and evaluation would be used to refine the engineering design, wildlife management criteria, and adaptive strategies for continued development of the SCH Project. Adaptive and flexible strategies would reduce the risks and uncertainties associated with operating larger complexes and facilitate managing or mitigating observed issues and problems.

2.0 Other Involved Agencies

The Natural Resources Agency and the Corps are developing the SCH Project in close coordination with other agencies, including the Department of Water Resources, DFG, the State Air Resources Board, and the State Water Resources Control Board. The following permits, approvals, and consultations are expected to be required: Clean Water Act section 404 permit/section 401 water quality certification; Endangered Species Act section 7 consultation; National Historic Preservation Act section 106 consultation; CESA section 2081 incidental take authorization; California Fish and Game Code section 1602, Streambed Alteration Agreement; and air quality permits.

3.0 Project Alternatives

Alternatives initially being considered for the SCH Project include the following: (a) alternative locations (at the confluence of the New, Alamo, or Whitewater rivers and the Salton Sea, or a combination of sites); (b) different acreages of created habitat; (c) different pond sizes and configurations; (d) different ranges of salinity; and (e) no project. The range and characteristics of the alternatives addressed in the EIS/EIR will be further developed based on input from the scoping process and special studies that are underway.

4.0 Probable Environmental Effects of the Project

The Draft EIS/EIR will evaluate the full spectrum of resources potentially affected by the SCH Project. Although additional issues may be identified during the scoping process, issues initially identified as probable environmental effects include:

Agricultural Resources

- Potential conversion of farmland to non-agricultural use.
- Dust from construction.
- Potential zoning conflicts if the Project were implemented on lands zoned for agricultural use.

Air Quality

- Potential exceedance of emissions thresholds from equipment, vehicle traffic, and soil disturbance during construction, operations, and maintenance.
- Beneficial impact on fugitive dust from covering exposed playa with water.
- Potential odors emanating from the ponds, fish kills in the ponds, or bird die-offs.

Biological Resources

- Potential effects on fish and wildlife during construction, operations, and maintenance, such as disruptions from noise and human activity, mortality, effects on nesting birds, and risks to avian and aquatic species and habitat due to selenium and other water quality constituents.
- Potential effects on desert pupfish and other special status species during construction, operations, and maintenance, including mortality, water quality effects, disturbance effects, and effects on movement corridors.
- Removal or degradation of habitat, including riparian vegetation, mudflats, and section 404 and State jurisdictional wetlands.
- Potential for disease (e.g., avian botulism and cholera) and toxicity effects (e.g., from selenium, algal toxins).

Cultural Resources

- Potential for destruction or disturbance of archaeological resources, human remains, and sacred sites activities.

Environmental Justice

- Potential effects on the Torres Martinez Desert Cahuilla Indian Tribe and other local communities from construction, operations, and maintenance activities.

Geology and Soils

- Increased erosion and sedimentation during construction, operations, and maintenance.
- Potential collapse of berms from seismic events, flooding surrounding areas.

Greenhouse Gas Emissions/Climate Change

- Generation of greenhouse gas emissions from equipment and worker vehicles during construction, operations, and maintenance.

Hazards and Hazardous Materials

- Potential accidental release of hazardous materials (e.g., diesel fuel, lubricants) during construction, maintenance, and operations.
- Potential exposure of workers and the public (if public access is allowed) to unexploded ordnance.
- Potential increase in mosquito vectors from standing water.

Hydrology and Water Quality

- Increased erosion and sedimentation in the Salton Sea, nearby rivers, and canals during construction, operations, and maintenance.
- Inadvertent release of hazardous materials into water during construction, construction, operations, and maintenance.
- Changes in water quality of the ponds, including resuspension or dissolution of salts and selenium, seasonal increases or decreases in water temperature, reduced levels of dissolved oxygen, and high concentrations of nutrients.
- Potential reduced freshwater inflow into the Salton Sea, resulting in decreased surface water elevation and increased rate of salination.
- Reduced downstream river flows due to water diversion for ponds.

Indian Trust Assets

- Effects on Torres Martinez Tribe's trust assets from development of the sites near the Whitewater River.

Land Use

- Potential conflicts with other existing or planned land uses and local plans, policies, and ordinances.

Noise

- Noise increases during construction, operations, and maintenance.

Paleontological Resources

- Destruction or alteration of paleontological resources from ground-disturbing activities.

Transportation and Traffic

- Increased traffic during construction, operations, and maintenance.

5.0 Schedule

The joint lead agencies expect the Draft EIS/EIR to be made available to the public by early 2011.

ATTACHMENT C

Scoping Report

Salton Sea Species Conservation Habitat Scoping Report

SUMMARY OF SCOPING MEETING COMMENTS AND RESPONSES TO THE NOTICE OF INTENT AND NOTICE OF PREPARATION

The U.S. Army Corps of Engineers (Corps) and the California Department of Fish and Game (DFG), acting on behalf of the California Natural Resources Agency, have been charged with preparing a joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Salton Sea Species Conservation Habitat (SCH) Project. The SCH Project would restore approximately 2,400 acres of habitat for piscivorous (fish-eating) birds that are dependent on the Salton Sea. In compliance with the National Environmental Policy Act (NEPA), the Corps issued a Notice of Intent (NOI) for the preparation of the EIS/EIR on June 23, 2010. In compliance with the California Environmental Policy Act (CEQA), the Natural Resources Agency issued a Notice of Preparation (NOP) for the EIS/EIR on June 21, 2010. The NOI and NOP were sent to over 1,300 responsible and involved agencies and interested organizations and individuals. To solicit additional comments on the scope and content of the EIS/EIR, the co-lead agencies held four public scoping meetings in the vicinity of the Salton Sea on July 7 and 8, 2010. The following table lists the logical details for each public meeting.

Community	Location/Address	Date	Time	Approximate Attendance
Palm Desert	University of California at Riverside, Room B200 75-080 Frank Sinatra Drive	July 07	1:00 P.M.	32
Thermal	Torrez Martinez, Tribal Administration Building 66-725 Martinez St.	July 07	6:30 PM	8
Calipatria	Calipatria Inn and Suites 700 North Sorenson Avenue Elks Lodge #1420, 161 South Plaza	July 08	1:00 P.M.	11
Brawley	Elks Lodge #1420, 161 South Plaza	July 08	6:30 PM	2

This report summarizes the written responses to the NOI and NOP and the major themes and/or comments from various scoping meetings. The four scoping meetings attracted over 50 people, some of whom provided oral comments on the scope and content of the EIS/EIR, including project design and impacts.

Twelve written responses to the NOI and NOP were received during the comment period which ended on June 24[1]. The written comments received are attached as an appendix to this report. Table 1 is a listing of those agencies and organizations that submitted written comments.

Table 1 Agencies, organizations, and individuals that submitted written comments on the NOI and NOP
Federal Agencies (5)
U.S. Bureau of Reclamation (Reclamation)
U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA), Region IX
U.S. Geological Survey (USGS)
U.S. Environmental Protection Agency (EPA)
U.S. Navy
State of California Agencies (2)
Department of Toxic Substances Control (DTSC)
State Lands Commission
Regional and Local Agencies (4)
Coachella Valley Mosquito and Vector Control District
County of Imperial Public Health Department
Imperial Irrigation District (IID)
San Diego County Water Authority
Organizations (6)[a]
Audubon California
California Outdoor Heritage Alliance
Defenders of Wildlife
Desert Protective Council
Pacific Institute
Sierra Club California
Individuals (1)
Patrick Maloney (on behalf of agricultural landowners in the Imperial Valley)

Note:

a. These organizations submitted a single, joint letter.

The major themes and/or issue areas expressed as part of written and oral comments on the NOI and NOP are summarized below under "Scope and Content of the EIS/EIR—Major Themes or Topics." More specific comments on the scope and content of the NOI and NOP are categorized under "Scope and Content of the EIS/EIR—Specific Comments." Finally, comments or

[1] The organizations listed in Table 1 submitted a single, joint letter.

statements not directly pertinent to the scope and content of the EIS/EIR are summarized under "Other Comments."

SCOPE AND CONTENT OF THE EIS/EIR—MAJOR THEMES OR TOPICS

Several of the written and oral comments on the NOI and NOP can be summarized or grouped into major themes or topics, including expanding the range of species that would be benefited by the SCH Project, addressing issues associated with selenium exposure, and the need to address the potential creation of breeding habitat for mosquitoes, which are disease vectors. Additionally, a number of commenters, including the EPA, Reclamation, SDCWA, and the non-governmental organizations listed above, expressed overall support for the SCH Project.

Range of Targeted Species

The SCH Project is encouraged to develop as much habitat as practical for species other than the targeted bird species that also use the Salton Sea. To maximize biological productivity of the SCH ponds, they should be designed to optimize invertebrate production to enhance the prey base for shorebirds and wading birds, in addition to optimizing production for fish-eating birds. Accordingly, the ponds should be managed to include a greater range of salinities than tolerable by fish, ranging from the roughly 2-3 gallons per liter (g/L) total dissolved solids (TDS) of the rivers to 140+ g/L TDS. This broad range of salinity would greatly increase the diversity of species residing in and visiting the SCH, improving the resilience of the system as a whole. Ponds managed for salinities around 130 g/L TDS could produce a large number of brine flies and brine shrimp, complementing the invertebrate good base found in the other ponds and in the Sea itself. Managing ponds at these higher salinities would also provide valuable monitoring data and experience for the future.

Selenium Exposure

- The SCH plan calls for use of evapo-concentrated, high-salinity water from one pond to provide saline water for another series of salinity gradient ponds. There may be a selenium risk associated with this practice. The EIS/EIR should include an assessment of effects of using waters (including selenium and pesticides) that have been evapo-concentrated for mixing.
- SCH would create habitats that do not currently exist at the Salton Sea; the increased exposure risk related to selenium in this new habitat relative to existing Salton Sea habitat should be assessed.
- A robust ecological analysis of selenium remediation and avoidance technologies (including a definition of specific endpoints for measuring effects and target action levels) should be included.

Mosquito/Vector Control

Concerns were raised that restoration efforts would provide breeding habitat for mosquitoes, leading to a possible increase of mosquito populations at the north and south ends of the Salton Sea. The mosquito, *Culex tarsalis* Coquilett, is a known vector of the West Nile, Saint Louis encephalitis, and western equine encephalomyelitis viruses, which are active in the Coachella and Imperial valleys. According to the University of California Davis Center for Vector-borne Disease Research data, shoreline habitats along the Salton Sea are the focus of yearly virus amplifications, and the breeding habitat of *Culex tarsalis* covers a wide range of water quality (from fresh up to 35 parts per thousand). Moreover, the Salton Sea provides a year-round habitat for breeding due to the climate.

Habitats usually do not support mosquitoes if they have running water, deeper water, and no sloped edges. After several years, many man-made wetlands become overgrown with vegetation, the water settles, and water quality changes; the type of emerging submerged and floating vegetation promotes mosquito breeding. There are considerable costs associated with mosquito control. Using specific types of fish to control mosquitoes is challenging because the birds will feed on the fish. Desert pupfish feed on mosquito larvae more aggressively than mosquitofish. The Coachella Valley Mosquito and Vector Control District has facilities where they could be raised, but this would require a permit from DFG.

The following concerns need to be evaluated:

- Who will be responsible for monitoring and treating mosquito populations? What thresholds will be established?
- What jurisdictions will be encountered and what permitting will be needed to control any vector problems that may result? Will the DFG and/or the Corps have the ultimate authority regarding vector operations in relation to endangered species?
- Is there funding for mosquito control with respect to maintaining and monitoring the facility?
- Will a mosquito abatement plant be developed for the project?
- Will the project have a dedicated vector biologist and supporting staff?
- Will a designated party serve as the contact point with the authority to act in the event of unforeseen circumstances during and after construction?

It is suggested that local health and vector control agencies should be further consulted regarding best management practices to address mosquito vectors.

SCOPE AND CONTENT OF THE EIS/EIR—SPECIFIC COMMENTS

The following comments were provided by individual commenters. They focus primarily on the project design, adaptive management and monitoring program, siting criteria, the appropriate baseline condition to use, and project impacts and mitigation measures.

Project Design

- The proposed location of the initial ponds should be clarified.
- The EIS/EIR should include a discussion of fish species proposed to be the principal project focus (natives, invasives, a combination of both?) This is critical when considering a variety of issues including potential depths of ponds.
- The EIS/EIR should include a discussion of what habitat attributes will be built into SCH to provide for desert pupfish.
- The draft plans call for SCH to create deep holes from borrow pits. Steep-sided pits should be avoided since they may promote stratification and anoxia of the deep water. (Construction equipment tends to make steep sides when excavating.) USGS has observed that traps placed in the deeper holes captured no fish. When placed in the exact same area, but at the surface, the trap came back loaded. Unless adequate mixing of the deep water can be ensured, the holes may not sustain habitat.

- A review and citation of literature justifying proposed depths of ponds in SCH should be conducted.
- Design of the SCH Project should include a variety of substrates to increase invertebrate productivity.
- Standards to which berms will be built will need to be clarified.
- The EIS/EIR should assess the potential use of geothermal energy resources to selectively supplement heating of ponds for temperature-sensitive fish.
- The project should evaluate the potential to harvest shallow groundwater for use in the cells.
- The rationale for use of freshwater for SCH (if proposed to be used) to replace saline water habitat at the Salton Sea should be included.
- Specific information such as number of acres of each specific salinity regime that would be created and size of anticipated freshwater area should be included (freshwater being the river water quality).
- The 2008 Flood Insurance Rate Maps (FIRM) for the project area should be reviewed. All buildings within a riverine floodplain (i.e., Flood Zones A, AO, AH, AE, and A1 through A30 as delineated on the FIRM) must be elevated so that the lowest floor is at or above the Base Flood Elevation level in accordance with the effective FIRM.
- If the area of construction is located within a Regulatory Floodway as delineated on the FIRM, any development must not increase base flood elevation levels. The term "development" means any man-made change to improved or unimproved real estate, including but not limited to, buildings, other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, and storage of equipment and materials. A hydrologic and hydraulic analysis must be performed prior to the start of development and must demonstrate that the development would not cause any rise in base flood levels. No rise is permitted within regulatory floodways.
- The project, including its water conveyance systems, should be designed to minimize impacts on the water delivery and drainage infrastructure in place around the rivers, drains, and other agricultural facilities. Any increase in water surface elevations of the drains or rivers would affect field irrigation infrastructure and drainage. Impounded areas such as the SCH ponds may raise water table elevations in the surrounding areas and affect the tile drainage systems in the farm fields.
- The SCH Project alternatives should not conflict with the goals and objectives of the QSA and pursuant to Fish and Game Code section 2932(b) should be consistent with the Salton Sea Restoration study requirements found in Fish and Game Code section 2081.7.
- Any construction or operation on IID property or within its existing and proposed rights of way or easements will require an encroachment permit. No foundations or buildings will be allowed within the right of way.

Water Supplies

- The EIS/EIR should acknowledge that water in the Alamo, New, and Whitewater rivers is not fresh water, but rather composed primarily of agricultural drainage.
- The EIS/EIR should acknowledge that water from the Colorado River is not available for direct delivery to the SCH Project. The lack of available Colorado River supplies is

documented on page 2-8 of the October 2006 Draft Salton Sea Ecosystem Restoration Programmatic EIR.

- Landowners in the Imperial Valley are entitled to continued water service by virtue of the easements predating governmental intrusion into the waters of the Colorado River. The discussion of water rights in the NOI/NOP and scoping documents fail to reflect such unique rights.
- Any discussion of the cause of the Sea's historic size – a potential factor in assessing fiscal liability – is also absent from the notices and analysis documents thus far.
- The fundamental facts about what the documents refer to as "water rights" (e.g., Section 1.1.2 of the document describing the screening process) are wrong; i.e., much of the water use in the Imperial Valley is not under the jurisdiction of the State Water Resources Control Board since such rights are of the pre-1941 variety (Arizona v. California (2006) 547 US 150, 175 (recognizing 2.6 million acre-feet of present perfected rights as of 1901). Any review of "water rights" involved would necessarily include the public statements of water diversion filed by those who use Colorado River water in Imperial County.

Adaptive Management and Monitoring

- This "proof-of-concept" project relies on adaptive management to make improvements. Detailed information on monitoring plans should be included.
- Science from the literature and recently completed and ongoing studies should be used in establishing the goals, objectives, and triggers included in the adaptive management plan. Adaptive management is not the same as trial and error.
- The SCH Project may benefit by drawing on science published and available from the USGS/Reclamation shallow habitat project as part of the proof of concept.

Siting Criteria

- To the extent practical, habitat should be located in a manner that maximizes mitigation of dust emissions from the playa.
- The project should be compatible with the mitigation planned for the Quantification Settlement Agreement water transfer and other projects.
- The project should be designed to accommodate other land uses such as alternative energy development, agricultural use, and recreational use.
- The extent to which the SCH Project would conflict with or preclude other existing, planned or proposed habitat construction or air quality management projects at and around the Salton Sea should be a factor in determining the location of the shallow habitat pond complexes. Siting the proposed ponds in locations where other parties would otherwise construct habitat would be a waste of limited resources and dramatically reduce the net habitat value of the proposed project. The SCH Project should be sited at locations whether no other habitat or air quality projects are currently planned or proposed.

Baseline Conditions

- The "current" level of the Salton Sea changes daily, and as of July 22, 2010, is ranging about 0.10 foot above and below -231.20 ft.

- A key factor the Corps should use to determine whether to issue a permit for the SCH Project is the benefit of the project relative to no project. Current conditions are not an appropriate baseline for determining the condition of the Salton Sea in the future, nor are they appropriate for determining the relative benefits of the SCH Project.
- The EIS/EIR should include a detailed, comprehensive list and description of every planned and proposed habitat and air quality project at and around the Salton Sea. These constitute a reasonable baseline against which the SCH Project should be measured.
- The EIS/EIR should include a clear demonstration of compliance with the Clean Water Act section 404(b)(l) guidelines. The existing condition of wetlands and waterways should be described in detail. The effects analysis and assessment of existing conditions should use the California Rapid Assessment Methodology (CRAM) or another applicable assessment method.

Project Impacts and Mitigation Measures

- The EIS/EIR should address all of the issues listed in the NOI and NOP, with particular attention to potential effects on existing Quantification Settlement Agreement agreements, land use policies and plans, water use/quality, biological resources, and air quality.

Agricultural Resources

- The project should be planned and implemented to avoid impacts on area farmers and productive agricultural land.

Biological Resources

- Potential environmental consequences of establishing a sedimentation basin should be addressed (for example, components of SCH may develop into habitat capable of supporting Yuma clapper rails [YCR]). An evaluation of selenium exposure risk to YCR should be included.
- Impacts of diversions from the rivers on threatened and endangered species (in the rivers at the diversion points) should be assessed.
- The EIS/EIR should evaluate desert pupfish interactions with non-natives that are being encouraged as a forage base. The role of invasive species, termed "novel species" in the SCH summary documents, should be evaluated to understand interactions of anticipated invasive or exotic species in SCH.
- Potential impacts of invasive species should be analyzed.
- The EIS/EIR should describe proposed mitigation for aquatic, wetland, and habitat impacts, and demonstrate compliance with the Corps' IEPA Wetlands Compensatory Mitigation Rule issued in April 2008 (40 CFR Part 230, page 195941).
- The EIS/EIR should evaluate the direct habitat benefits of the SCH Project.
- The EIS/EIR should evaluate water quality effects on current bird diseases such as botulism.

Air Quality

- The EIS/EIR should evaluate the direct and indirect air quality benefits generated by flooding exposed Salton Sea playa and interrupting wind fetch.

- EPA has a strong interest in ensuring restoration practices are consistent with air quality emission mandates.

Greenhouse Gas Emissions/Climate Change

- Regarding the effects of SCH development on greenhouse gases uptake and emissions relative to existing area of the Salton Sea – it is suggested that an assessment of uptake, including positive or negative rate, be included.
- The climate change section should analyze what may occur during the life of the project and any projected impacts from global warming on the Salton Sea and the SCH areas.

Hazards and Hazardous Materials

- The EIS/EIR should evaluate the potential for the SCH Project to attract and increase local bird populations and thus cause an increase in the potential for bird strikes by aircraft from the Naval Air Facility El Centro training ranges. Both project-specific and cumulative impacts should be evaluated.
- Regarding selenium and public access and recreational activities relative to public health threshold levels – would the SCH Project cause a public health risk to humans consuming fishes or birds from the SCH site? The EIS/EIR should evaluate public access and recreation.
- The EIS/EIR should evaluate whether conditions within the project area may pose a threat to human health or the environment, using the EPA's National Priorities List, Resource Conservation and Recovery Information System, and Comprehensive Environmental Response Compensation and Liability Information System; Envirostor (accessible through DTSC's website), Solid Waste Information System provided by the California Integrated Waste Management Board (currently the Department of Resources Recycling and Recovery); GeoTracker (maintained by the Regional Water Quality Control Boards); lists of hazardous substances cleanup sits and leaking underground storage tanks maintained by local counties and cities; and the Corps' list of Formerly Used Defense Sites.
- The EIS/EIR should identify the mechanism to initiate any required investigation and/or remediation for any site within the proposed Project area that may be contaminated, and the government agency to provide appropriate regulatory oversight. If necessary, DTSC would require an oversight agreement to review such documents.
- Any environment investigations, sampling, and/or remediation should be conducted under a work plan approved and overseen by a regulatory agency that has jurisdiction to oversee hazardous substance cleanup. The findings of any investigations, including any Phase I or II Environmental Site Assessment investigations should be summarized in the document. All sampling results in which hazardous substances were found above regulatory standards should be clearly summarized in a table. All closure, certification, or remediation approval reports by regulatory agencies should be included in the EIS/EIR.
- If buildings, other structures, asphalts or concrete-paved surface areas are being planned to be demolished, an investigation should be conducted for the presence of hazardous materials (chemicals, mercury, asbestos-containing materials), and proper precautions should be taken as needed. Contaminants should be remediated in compliance with California environmental regulations and policies.
- Sampling may be required if construction requires soil excavation or filling. Contaminated soils must be properly disposed of, not relocated onsite. Land Disposal Restrictions may be applicable. Imported soil, if any, should be sampled for contamination.

- Human health and the environment of sensitive receptors should be protected during construction/demolition. If necessary, a health risk assessment overseen and approved by the appropriate government agency should be conducted by a qualified health risk assessor to determine if there have been or will be any releases of hazardous materials that may pose a risk to human health or the environment.
- At sites used for agricultural, livestock, or related activities, onsite soils and groundwater might contain pesticides, agricultural chemical, organic waste, or other related residue. Proper investigation, and remedial actions, if necessary, should be conducted prior to construction.
- If hazardous wastes would be generated by SCH operations, they must be managed in accordance with the California Hazardous Waste Control Law (California Health and Safety Code, Division 20, Chapter 6.5) and the Hazardous Waste Control Regulations (California Code of Regulations, Title 22, Division 4.5). Additionally, the facility should obtain an EPA Identification Number. Certain hazardous waste treatment processes or hazardous materials, handling, storage, or uses may require authorization from the local Certified Unified Program Agency.

Hydrology/Water Quality

- Water quality effects to evaluate include nutrient loading, oxygen depletion, temperature fluctuations, pesticide, selenium, and DDT residues; discharges of agricultural chemicals; effects on total management demand loads (TMDLs), water quality standards, and Coachella and Torres Martinez Tribal water quality goals; effects on current bird diseases such as botulism; and the impact of a sudden release of high salinity water into less saline water if a berm fails. EPA has a strong interest in ensuring restoration practices are consistent with TMDL requirements and water quality standards.
- The EIS/EIR should evaluate the potential to restore seeps, creeks, springs, and the river deltas of the Salton Sea.
- The EIS/EIR should evaluate changes in the surface water elevation of the Salton Sea.

Cumulative Impacts

- The Corps should consider the role of a sustainably restored Salton Sea as a vital part of a thriving, healthy Lower Colorado River watershed. The Lower Colorado River Basin, including the Salton Sea and Colorado River Delta, should be considered in its entirety, especially in regards to preserving at-risk migratory birds, because actions taken in one part of the Lower Colorado River Basin could have significant cumulative impacts on other parts of the Basin. It is questionable whether the entire watershed would remain ecologically viable without a comprehensive approach to its restoration. It is recommended that the EIS/EIR describe the proposed project's impacts and benefits within the regional context of the Lower Colorado River Basin and other restoration efforts such as the Lower Colorado River Multi-species Conservation Program and past and current Salton Sea restoration efforts.
- Several other projects would contribute to a cumulative impact associated with bird air strikes. IID is constructing several thousand acres of managed marsh near the Salton Sea, which is intended to attract and provide habitat for avian species affected by decreased Salton Sea levels resulting from agricultural/urban water transfers. Also, a planned development, the Desert Springs Resort, is proposed for construction on the west side of Imperial Valley less than 4 miles from the perimeter of Naval Air Facility El Centro and directly adjacent to their parachute drop range. This project would include over 100 acres of lakes and associated landscaping (golf course), which the Navy believes would attract large numbers of birds.

Other Issues

- If the Draft EIS/EIR does not contain a preferred alternative, it should describe the eventual selection criteria and processes for selection of the preferred alternative in the Final EIS/EIR.
- The SCH Project should reflect the extensive research already conducted on biotic and abiotic elements of the Salton Sea ecosystem.
- Other issues that should be addressed in the EIS/EIR include funding, project management, and engineering questions such as seismic stability of the constructed berms.
- "Special studies" are cited on pages 5 and 7 of the Public Notice. Some additional information on the goals, objectives, scope, and anticipated contributions of special studies should be included.

OTHER COMMENTS

- Water rights and access to water (paper and wet water) should be addressed and secured prior to construction.
- Additional Stakeholder group meetings should be held to discuss the project as the design progresses.
- IID should be notified once specific sites are located.
- Reclamation requests Cooperating Agency status.
- DTSC can provide cleanup oversight through an Environmental Oversight Agreement for government agencies that are not responsible parties, or a Voluntary Cleanup Agreement for private parties.
- A detailed map or site plan showing exactly where the SCH Project improvements would occur should be provided to the State Lands Commission to enable them to determine the State's interest in these locations.
- Upon completion of any development that changes existing Special Flood Hazard Areas, the National Flood Insurance Program directs all participating communities to submit the appropriate hydrologic and hydraulic data to FEMA for a FIRM revision.
- It is recommended that the wetland assessment data be entered into California's Wetland portal.
- The recovery of the Salton Sea as a whole needs to be funded.
- The focus appears to be wholly piecemeal and likely will not garner support from the public. It is essential that an integrated approach be taken that guarantees a rapid solution and involves the parties directed affected.
- The need for an environmental review may not be necessary or advised under the law. Based on the principles announced in the Nacimiento Regional Water Management Advisory Committee v. Monterey County Water Resources Agency (1993) 15 Cal.App.4th 200 and Reclamation's recommendations for IID's improvement of its management of diversions from the Colorado River (presented in a Decision resulting from a Part 417 process initiated by Reclamation against IID), the Imperial Valley landowners have no obligation to maintain the Salton Sink as a sea, and no EIR or environmental mitigation is required if the landowners choose to reduce the flow of water into the Salton Sea.

- The notice and scoping documents all lack a critical event since the prior review: the water transfer that is at the heart of all Sea discussion was decreed invalid after a lengthy trial in 2009. Thus, the implicit assumptions about water flow, the availability of money under legislation associated with the transfer, the responsibilities of specific parties (e.g., the Metropolitan Water District of Southern California) for liability all remain unresolved. Given the scope of the trial court's decision, the results on appeal – affirming or reversing – may fundamentally alter the status of the Sea, especially what parties may be liable for any cost of remediation thereof.

Appendix

Written Comments Received in Response to the NOI and NOP

Written comments are available on the California Department of Water Resources' website at: http://www.saltonsea.water.ca.gov.

APPENDIX B

Alternatives Development Process

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Appendix B

Salton Sea Species Conservation Habitat Alternatives Development Process

B.1 Introduction

The goals and objectives/purpose for a project could be met in a variety of ways. However, these alternative ways of implementation would likely differ in how well they achieved the project objectives/purpose, their feasibility, and their impacts. The approach and requirements for alternatives analysis are slightly different under Federal and state law.

Both the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) require that an Environmental Impact Statement (EIS) or Environmental Impact Report (EIR), respectively, analyze the impacts of alternative ways of implementing a project. NEPA’s requirements for an alternatives analysis are found in the Council on Environmental Quality’s NEPA Regulations (40 Code of Federal Regulations [CFR] 1502.14), and CEQA’s are found in CEQA Guidelines section 15126.6. Under NEPA, the range of alternatives required to be evaluated by an EIS is governed by the rule of reason, which requires an EIS to set forth only those alternatives necessary to permit a reasoned choice. An EIS must rigorously explore and objectively evaluate a reasonable range of alternatives as defined by the specific facts and circumstances of the proposed action. Alternatives must be feasible and consistent with the statement of purpose and need. Feasible alternatives are those that can be carried out based on technical, economic, and environmental factors, as well as common sense (40 CFR 1502.14; Forty Most Asked Questions Concerning CEQ’s NEPA Regulations No. 2a). If alternatives have been eliminated from detailed study, the EIS must briefly discuss the reasons for their elimination. In addition, under NEPA, the alternatives analysis should present the environmental impacts of the proposed project and the alternatives "in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public" (40 CFR section 1502.14). The “No Federal Action” alternative (no permit issued) must be included among the alternatives analyzed. The Federal lead agency also should identify its preferred alternative.

In addition to the NEPA alternatives analysis, the United States (U.S.) Army Corps of Engineers (Corps) is required to analyze alternatives pursuant to the Clean Water Act section 404(b)(1) Guidelines (40 CFR Part 230). Under those guidelines, the Corps is required to identify and determine the "least environmentally damaging practicable alternative." A Draft Section 404(b)(1) Alternatives Analysis for the proposed project will be prepared pursuant to the Guidelines and included in the Final EIS/EIR. The Draft Section 404(b)(1) Alternatives Analysis is intended to assist the Corps in complying with the guidelines in connection with its decision whether to issue a Clean Water Act section 404 permit for the proposed project or an alternative to the proposed project. Pursuant to the Section 404(b)(1) Guidelines and Corps regulations (33 CFR 320-332), the Corps can issue a permit only for a project that is the least environmentally damaging practicable alternative (focusing primarily on impacts on aquatic resources) and is not contrary to the public interest.

CEQA requires that EIRs examine a reasonable range of alternatives that would feasibly achieve most of the basic project objectives, but would avoid or substantially lessen one or more of a project’s significant environmental impacts. Project alternatives must be feasible based on specific economic, social, legal, and technical considerations. The EIR must explain the rationale for selecting the alternatives to be discussed, identify those that were eliminated as infeasible, and briefly explain why they were eliminated. The range of alternatives required in an EIR is governed by a “rule of reason,” which requires the EIR to set forth only those alternatives necessary to permit a reasoned choice. The EIR need examine in detail only the alternatives that the lead agency determines could feasibly attain most of the project objectives (CEQA Guidelines section 15126.6[f]). An EIR need not consider an alternative whose effects cannot be reasonably ascertained and whose implementation is remote and speculative (CEQA Guidelines section 15126.6[f][3]).

CEQA Guidelines section 15126.6[e][1] indicates that the no project alternative (referred to as the “No Action Alternative” in this document) is not the baseline for determining whether the proposed project’s environmental impacts may be significant unless it is identical to the existing environmental setting. CEQA Guidelines section 15126.6[e][2] further indicates that the no action analysis should discuss the existing conditions at the time the Notice of Preparation is published, as well as what would be reasonably expected to occur in the foreseeable future if the action were not approved, based on current plans and consistent with available infrastructure and community services.

The initial concept for the Salton Sea Species Conservation Habitat (SCH) Project was to restore approximately 2,400 acres of saline habitat, based on available funds. The habitat would be configured in a series of interconnected shallow ponds located within the Sea’s current footprint, consistent with the characteristics of the Early Start Habitat identified in the Programmatic Environmental Impact Report for the Salton Sea Ecosystem Restoration Program (California Department of Water Resources [DWR] and California Department of Fish and Game [DFG] 2007). This appendix describes the process used for developing this initial concept and refining the list of alternatives to be evaluated in the SCH Project EIS/EIR. This process has occurred in a systematic, incremental manner, involving the development of Project goals and objectives/purpose; identification of potential site locations, configurations, and Project components; and the application of exclusionary and evaluative criteria to the potential sites and Project components with the intent of eliminating those that either did not meet the goals and objectives/purpose or were not viable due to cost, technical, or environmental considerations. Additional refinements to the Project alternatives included in the EIS/EIR occurred after this initial analysis, based on information included in the geotechnical analysis, special studies and workshops, land use compatibility issues, budgetary considerations, and input from Stakeholders.

B.1.1 SCH Project Goals and Objectives/Purpose

Feasible alternatives must, at a minimum, meet the Project goals and objectives/purpose, which were developed after consideration of the existing and projected conditions of the Salton Sea ecosystem.

The Salton Sea currently supports a wide variety of bird species and a limited aquatic community. Over many decades, the components of the aquatic-dependent community have shifted in response to receding water levels and increasing salinity. The Salton Sea currently is a hypersaline ecosystem (about 51 parts per thousand [ppt]) (C. Holdren, Reclamation, unpublished data). Without restoration, declining inflows in future years will result in the Sea’s ecosystem collapse due to increasing salinity (expected to exceed 60 ppt by 2018, which is too saline to support fish) and other water quality stresses, such as temperature extremes, eutrophication, and related anoxia due to algal productivity.

The most serious and immediate threat to the Salton Sea ecosystem is the loss of fishery resources that support piscivorous birds. The birds that feed on invertebrates have more options and resources, because the invertebrate fauna has a wider range of salinity tolerances. Piscivorous birds, on the other hand, are at risk of decline. To address this immediate need, the California Legislature appropriated funds for the purpose of implementing “conservation measures necessary to protect the fish and wildlife species dependent on the Salton Sea, including adaptive management measurements” (California Fish and Game

Code section 2932(b)). Therefore, under CEQA the SCH Project's goals are two-fold: (1) develop a range of aquatic habitats that will support fish and wildlife species dependent on the Salton Sea; and (2) develop and refine information needed to successfully manage the SCH Project habitat through an adaptive management process. Specific objectives under each goal are described in detail in Section 1 of this EIS/EIR.

GOAL 1. DEVELOP A RANGE OF AQUATIC HABITATS THAT WILL SUPPORT FISH AND WILDLIFE SPECIES DEPENDENT ON THE SALTON SEA.

The SCH Project's purpose is to provide in-kind replacement for near-term habitat losses. The Project's target species are those piscivorous bird species use the Salton Sea and that are dependent on shallow saline habitat for essential habitat requirements and the viability of a significant portion of their population.

OBJECTIVES FOR GOAL 1:

1. Provide appropriate foraging habitat for piscivorous bird species.
2. Develop habitats required to support piscivorous bird species.
3. Support a sustainable, productive aquatic community.
4. Provide suitable water quality for fish.
5. Minimize adverse effects on desert pupfish.
6. Minimize risk of selenium.
7. Minimize risk of disease/toxicity impacts.

GOAL 2. DEVELOP AND REFINE INFORMATION NEEDED TO SUCCESSFULLY MANAGE THE SCH PROJECT HABITAT THROUGH AN ADAPTIVE MANAGEMENT PROCESS.

The SCH Project's second goal would be to serve as a proof of concept for the restoration of shallow-water habitat that supports fish and wildlife currently dependent upon the Salton Sea. The Project would incorporate an adaptive management framework to guide evaluation and improved management of the newly created habitat as well as to inform future restoration. An adaptive management framework provides a flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation, leading to continuous improvement in management planning and Project implementation to achieve specified objectives. The information obtained would be used to measure Project effectiveness, to refine operations and management of the ponds, to reduce uncertainties about key issues, and to inform subsequent stages of habitat restoration at the Salton Sea.

OBJECTIVES FOR GOAL 2:

1. Identify uncertainties in achieving the objectives of providing habitat and prey for piscivorous birds (e.g., maintaining suitable water temperature and dissolved oxygen) and minimizing impacts on species (e.g., selenium ecorisk).
2. Design science-based means to test alternatives and reduce uncertainty.
3. Develop and implement a monitoring plan.
4. Develop a decision-making framework.
5. Provide proof of concept for future restoration.

The purpose of the Project under NEPA is to develop a range of aquatic habitats that will support and wildlife species dependent on the Salton Sea in Imperial County, California.

B.2 Potential Project Locations, Configurations, and Components

B.2.1 Potential Pond Locations and Configurations

Three generalized locations for the SCH ponds initially were identified by DWR and DFG based on the potential availability of contiguous acreage and the potential availability of a nearby, suitable water supply. The most suitable general areas based on this initial screening were located near the mouths of the New, Alamo, and Whitewater rivers, as shown on Figure B-1. More specific views of areas considered as potential ponds sites are shown on Figures B-2 through B-4.

At the Sea's northern end near the Whitewater River, only about 900 acres are available, while larger areas are available at the Sea's southern end near the Alamo and New rivers. Therefore, several acreage combinations were developed using one or more of the rivers, resulting in habitats that were contiguous or dispersed, as follows.

6. Contiguous SCH Ponds at Whitewater River (900 acres)
7. Contiguous SCH Ponds at New River (2,400 acres)
8. Contiguous SCH Ponds at Alamo River (2,400 acres)
9. Dispersed SCH Ponds at New and Alamo Rivers (4,800 acres)
10. Dispersed SCH Ponds at Whitewater and New Rivers (3,300 acres)
11. Dispersed SCH Ponds at Whitewater and Alamo Rivers (3,300 acres)
12. Dispersed SCH Ponds at Whitewater, New, and Alamo rivers (5,700 acres)

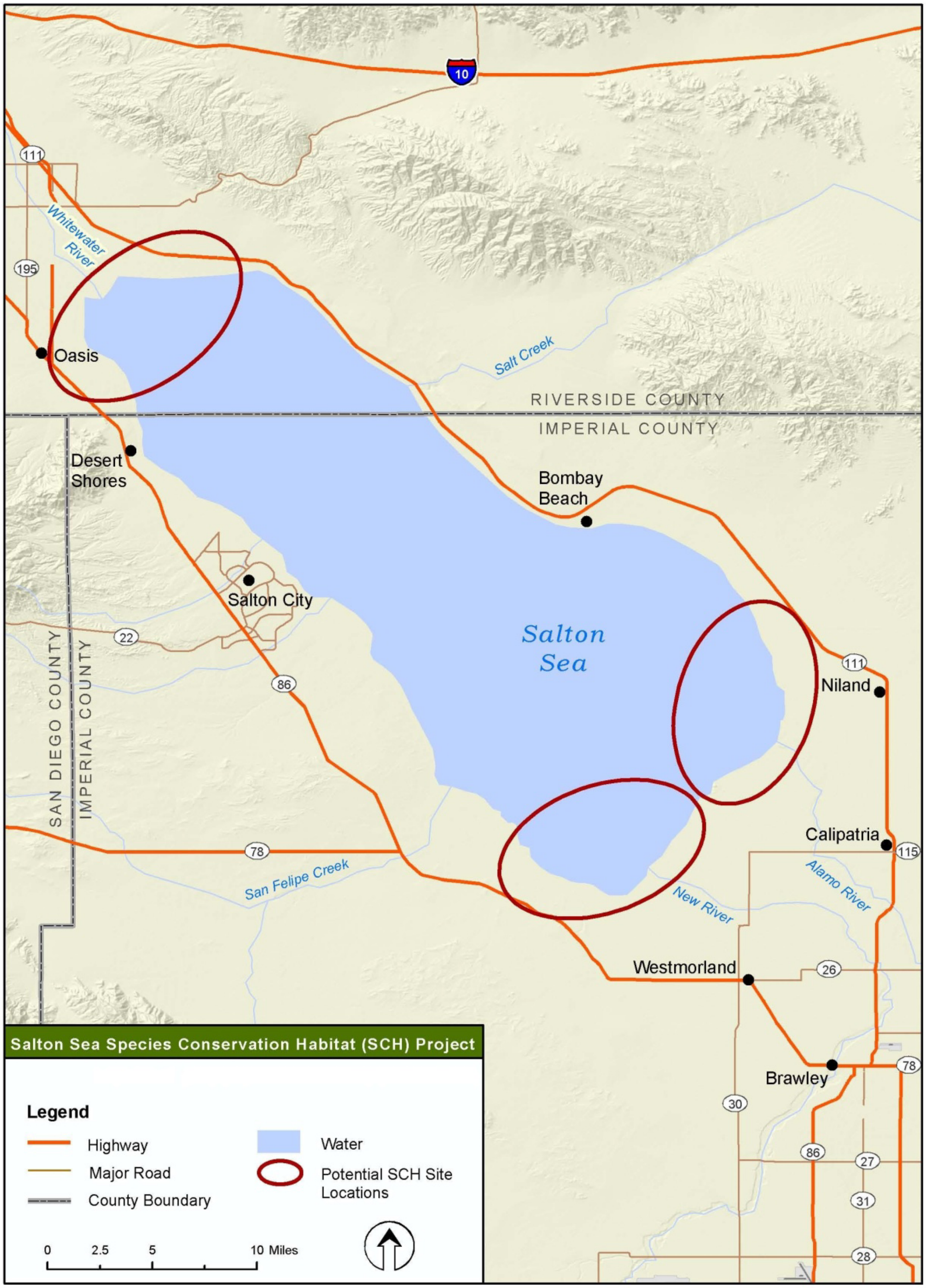

Figure B-1 Regional Setting and Generalized Locations of Potential SCH Alternative Sites

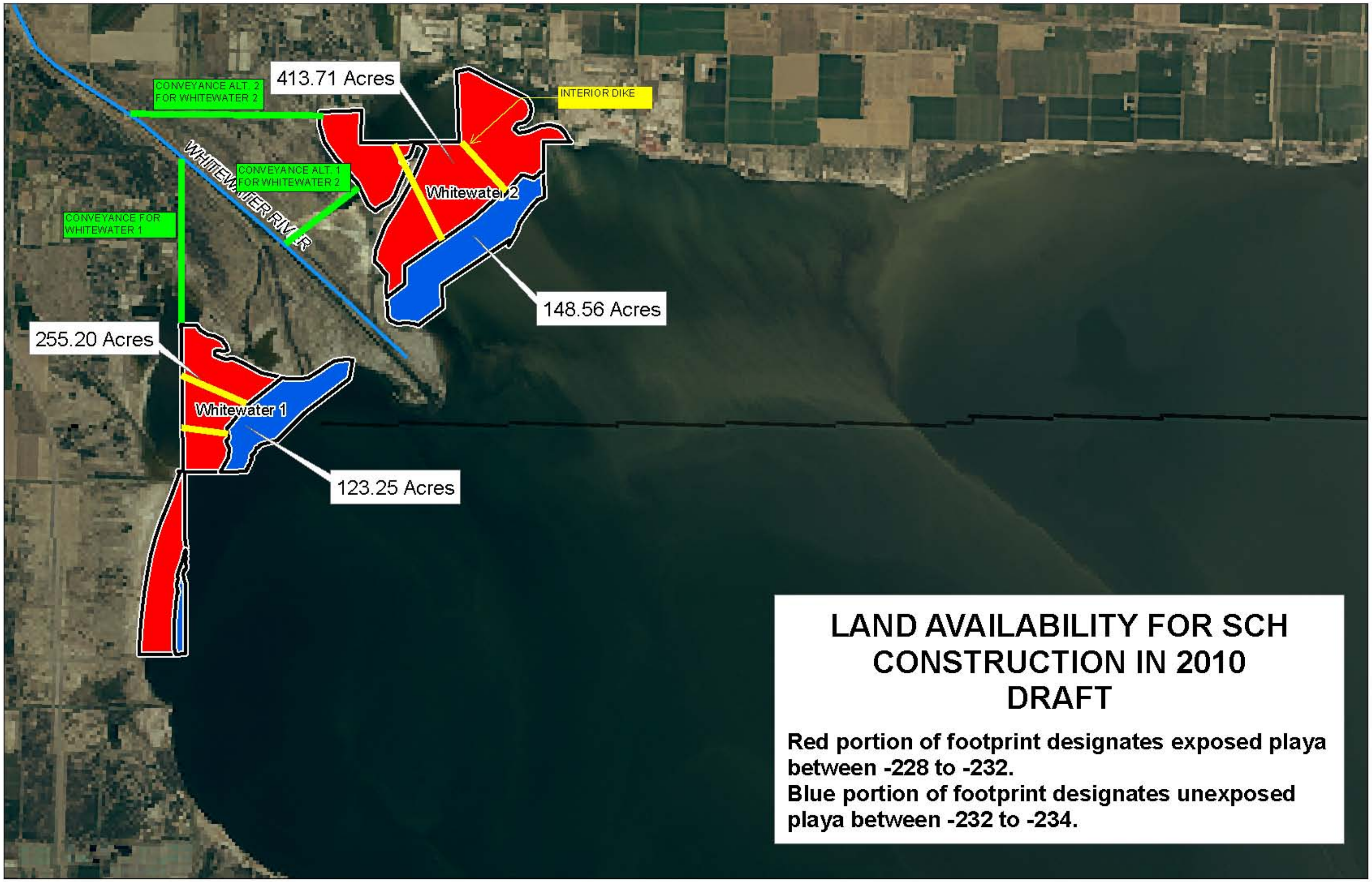

Figure B-2 Conceptual SCH Pond Sites near the Whitewater River Based on DFG and DWR Evaluations

Note: Dikes and conveyances shown on this figure are hypothetical and subject to change

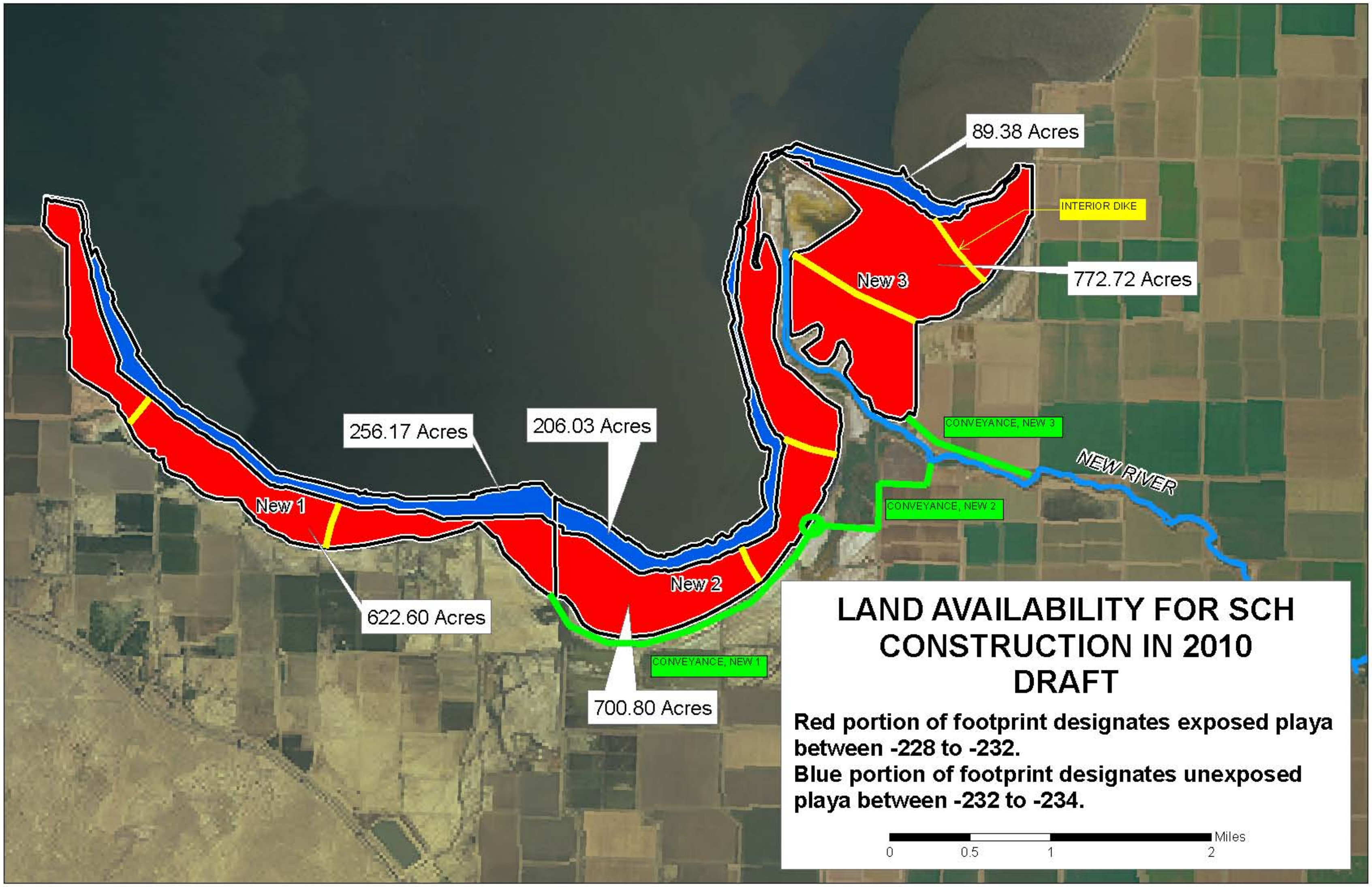

Figure B-3 Conceptual SCH Pond Sites near the New River Based on DFG and DWR Evaluations

Note: Dikes and conveyances shown on this figure are hypothetical and subject to change

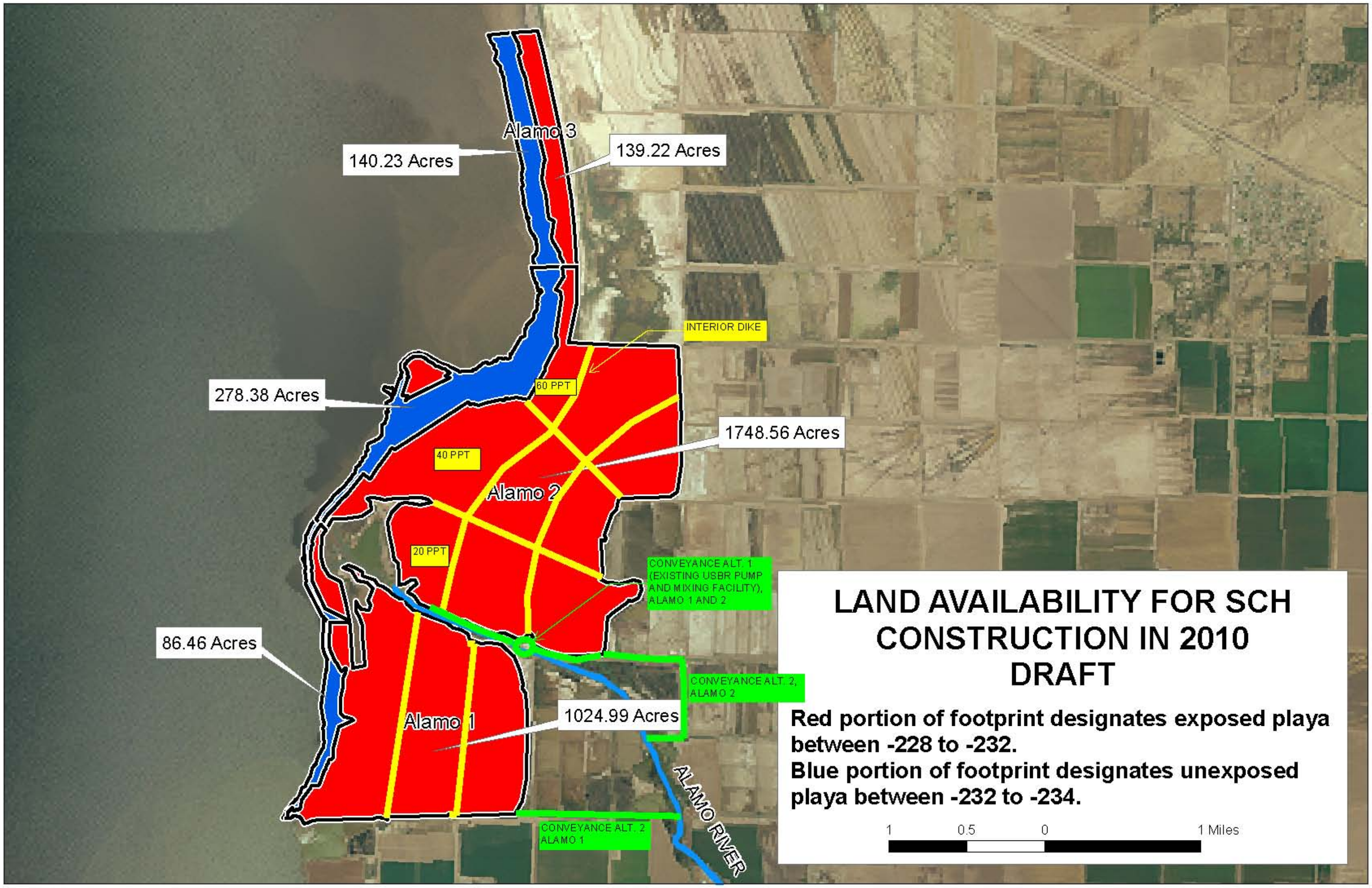

Figure B-4 Conceptual SCH Pond Sites near the Alamo River Based on DFG and DWR Evaluations

Note: Dikes and conveyances shown on this figure are hypothetical and subject to change

A description of each of these configurations is presented below. The pond locations refer to the areas initially identified by DFG and DWR, including areas between elevations -228 to -232 and -232 to -234 feet.

1) **Contiguous SCH Ponds at Whitewater River**

- 900 acres of ponds at Whitewater River using the Whitewater 1 and Whitewater 2 areas.
- Areas with a seabed elevation from -228 to -234 feet.

2) **Contiguous SCH Ponds at New River**

- 2,400 acres of SCH ponds at the New River using New 2 and New 3, and part of New 1.
- Areas with seabed elevations from -228 to -234 feet, with over half the area between -228 and -232 feet.

3) **Contiguous SCH Ponds at Alamo River**

- 2,400 acres of ponds at Alamo River using the Alamo 1 and Alamo 2 areas.
- Areas with a seabed elevations from -228 to -232 feet.

4) **Contiguous SCH Ponds at New River**

- 2,400 acres of SCH ponds at the New River using New 2 and New 3, and part of New 1.
- Areas with seabed elevations from -228 to -234 feet, with over half the area between -228 and -232 feet.

5) **Contiguous SCH Ponds at Alamo River**

- 2,400 acres of ponds at Alamo River using the Alamo 1 and Alamo 2 areas.
- Areas with a seabed elevations from -228 to -232 feet.

6) **Contiguous SCH Ponds at Alamo River**

- 2,400 acres of ponds at Alamo River using the Alamo 1 and Alamo 2 areas.
- Areas with a seabed elevations from -228 to -232 feet.

7) **Contiguous SCH Ponds at New River**

- 2,400 acres of SCH ponds at the New River using New 2 and New 3, and part of New 1.
- Areas with seabed elevations from -228 to -234 feet, with over half the area between -228 and -232 feet.

8) **Contiguous SCH Ponds at Alamo River**

- 2,400 acres of ponds at Alamo River using the Alamo 1 and Alamo 2 areas.
- Areas with a seabed elevations from -228 to -232 feet.

9) **Dispersed SCH Ponds at New and Alamo Rivers**

- 4,800 acres of dispersed SCH ponds at the New and Alamo rivers using New 2, New 3, Alamo 1, and Alamo 2.
- Areas with seabed elevations from -228 to -234 feet, with over half the area between -228 and -23 feet 2.

10) **Dispersed SCH Ponds at Whitewater and New Rivers**

- 3,300 acres of SCH ponds at the Whitewater and New rivers using Whitewater 1, Whitewater 2, New 2, New 3, and a portion of New 1.
- Areas with seabed elevations from -228 to -234 feet.

11) **Dispersed SCH Ponds at Whitewater and Alamo Rivers**

- 3,300 acres of SCH ponds at the Whitewater and Alamo rivers using Whitewater 1, Whitewater 2, Alamo 1, and Alamo 2.
- Areas with seabed elevations from -228 to -232 feet.

12) **Dispersed SCH Ponds at Whitewater and Alamo Rivers**

- 5,700 acres of SCH ponds at the Whitewater, New, and Alamo rivers using Whitewater 1, Whitewater 2, New 2, New 3, Alamo 1, and Alamo 2.
- Areas with seabed elevations from -228 to -234 feet for maximum area or -228 to -232 feet for a smaller area.

B.2.2 Potential Project Components

Basic Project components and alternative ways of constructing those components were identified, including methods of diverting and conveying water from the rivers to the ponds, conveying saline water needed to maintain the appropriate range of salinities in the ponds, and potential means of treating suspended sediment. The components were combined in functional categories to aid in the comparison of components. The functional categories and associated components are as follows:

1) **Diversion Mechanisms**

   a) Inline weir in river (brackish water)
   b) Lateral weir in river (brackish water)
   c) Pump water from the river (brackish water)
   d) Pump shallow groundwater (saline water)
   e) Pump water from the Sea (saline water)

2) **River Water (Brackish) Conveyance**

   a) Open canal
   b) Pipeline
   c) Combination

3) **Saline Water Conveyance**

   a) Pipeline – groundwater
   b) Pipeline – seawater
   c) Backwater channel
   d) Tailwater Return Pump

4) **Suspended Sediment Management**

   a) Sedimentation basin near diversion
   b) Sedimentation basin near SCH ponds
   e) No sediment management

5) **Power Support**

a) Three-phase power
b) Diesel generator
c) Solar power

B.3 Criteria Used to Evaluate Sites and Project Components

Broad screening criteria were developed to allow sites and Project components to be compared, and potentially eliminated where appropriate. This screening was done through a combination of exclusionary criteria and evaluative criteria.

B.3.1 Exclusionary Criteria

Exclusionary criteria relate to those factors that are essential to the successful completion of the SCH Project. These criteria include (1) available water rights, (2) available land (ownership and accessibility), and (3) adequate water supply (quantity, quality, and seasonal availability).

B.3.2 Evaluative Criteria

These criteria were considered when determining the types of components that would included in the alternatives carried forward for detailed analysis and include (1) engineering feasibility/constructability, (2) relative cost-effectiveness (including capital cost and operations and maintenance) measured as cost per acre, (3) potential for physical environmental impacts, (4) compatibility with existing and planned land uses, and (5) ability to meet SCH schedule. Components were eliminated or refined based on these criteria.

B.3.3 Rating Definitions

Exclusionary Criteria

A potential site or component that failed to meet any one of the three exclusionary criteria would automatically be eliminated.

Evaluative Criteria

The purpose of applying the evaluative criteria was to eliminate Project components where appropriate and determine whether individual components would be feasible or practicable at each of the potential sites. The evaluative criteria considered and issues associated with each are described below.

Engineering Feasibility/Constructability

- Complexity of design
- Special equipment needs
- Land acquisition issues

Relative Cost-effectiveness (including Capital Cost and Operations and Maintenance)

- Level of capital expenditures
- Long-term operations and maintenance needs

Potential for Physical Environmental Impacts

- Conversion of Important Farmland to nonagricultural use
- Air emissions during construction, operations, and maintenance
- Impacts on biological resources (selenium ecorisk, special-status species, wetlands)
- Disturbance/destruction of cultural resources
- Unsuitable geologic/soil condition

Compatibility with Existing and Planned Land Uses

- Potential conflicts with future geothermal uses of sites
- Potential conflicts with existing and planned use of Sonny Bono National Wildlife Refuge
- Potential loss of hunting opportunities
- Potential conflicts with use of public recreational facilities at marina
- Potential conflicts with agricultural practices

Ability to Meet SCH Schedule

- Number of construction seasons
- Time required to obtain easements, permits, or approvals

B.4 Screening Process

The screening process for the concept alternatives to be carried forward into the engineering design and considered in the EIS/EIR included the following four steps:

1. Apply exclusionary criteria to eliminate potential sites or Project components that are dependent on land and/ or water availability.
2. Apply evaluative criteria to determine the comparative merits of individual Project components at each site.
3. Apply evaluative criteria to eliminate or retain individual Project components at each site.
4. Combine the sites and Project components into alternatives to be evaluated in the EIS/EIR.

Representatives of the Corps, DFG, DWR, and consultant team met and applied these step to develop an initial set of screened alternatives. Since that time, additional refinements have occurred based on input from the preliminary geotechnical study, Stakeholders, land use compatibility, special studies, the environmental impact analysis, and budgetary considerations. The results of this process are described below.

B.4.1 Exclusionary Criteria Screening Process Results

The results of the exclusionary criteria screening process for the potential SCH sites, including the locations of diversion and conveyance facilities needed to provide water to the SCH ponds, are discussed below.

Water Rights

A water right is legal permission to use a reasonable amount of water for a beneficial purpose such as swimming, fishing, farming, or industry. The Whitewater River is designated by the State Water

Resources Control Board as a fully appropriated stream from the Salton Sea to the headwaters. This distinction relates to the availability of water in the stream to divert for beneficial uses. A fully appropriated stream by definition does not have additional water available for diversion. The Metropolitan Water District of Southern California has applications pending for appropriative rights for essentially all the available water in both New and Alamo rivers. The Whitewater River sites were eliminated based on the lack of available water rights. The New and Alamo river sites were retained for further consideration.

A water right would not be needed to use Salton Sea water, which is carried forward as a source of saline water for the Project. In 1968, the California Legislature adopted a statute declaring the Salton Sea's primary use for the collection of agricultural drainage water, seepage, and other flows (Assembly Bill 461, 1968; Statutes 1968, Chapter 392). Use of water from an agricultural repository does not require a water right.

Available Land

Adequate land appears to be available at the New and Alamo river sites, which contain approximately 2,648 acres and 3,417 acres, respectively (New 1 – 879 acres; New 2 – 907 acres; New 3 – 862 acres) (Alamo 1 – 1,111 acres; Alamo 2 – 2,027 acres; Alamo 3 – 279 acres). Most of this land is owned by public entities, primarily Imperial Irrigation District (IID), which would facilitate its acquisition, although the land in the Wister Beach area is owned by multiple private parties. Land owned by the Torres Martinez Desert Cahuilla Indian Tribe (Torres Martinez Tribe) would be required to convey water to the Whitewater 1 and Whitewater 2 sites; the amount of available land is limited. Based on the larger area of available land, the New and Alamo river sites were retained for further consideration.

Available Water

The SCH ponds could be operated as brackish water, saline water, or blended water habitat. Different ponds could be operated under different salinities to test which salinity regime results in the best combination, or balance, of invertebrate and fish productivity, bird use, and seasonal fish survival (refer to Appendices D, Project Operations and E, Monitoring and Adaptive Management Framework. Sources of brackish water initially considered included river water, water directly from agricultural drains, and groundwater; while sources of saline water included Salton Sea water and groundwater.

River Water[1]

Assuming 6 feet of evaporation annually, the amount of water required to supply each of the SCH pond configurations outlined in Section B.2 each year is as follows:

- 900 acres = 5,400 acre-feet (af) (12 cubic feet per second [cfs] peak month)
- 2,400 acres = 14,400 af (32 cfs peak month)
- 3,300 acres = 19,800 af (44 cfs peak month)
- 4,800 acres = 28,800 af (62 cfs peak month)
- 5,700 acres = 34,200 af (76 cfs peak month)

[1] Water from the Colorado River is not a potential source of water for the SCH Project, as discussed in detail the Salton Sea Ecosystem Restoration Program Programmatic Environmental Impact Report (DWR and DFG 2007). Use of such water would require a change in the authorized uses of Colorado River water for fish and wildlife uses; additionally, the availability of surplus water is not expected to occur frequently, if at all.

Additional water would be required to maintain the salt balance or to flush the SCH ponds. The amount of water available seasonally and annually at each of the three rivers is shown in Table B-1.

Table B-1 Annual Flows in the New, Alamo, and Whitewater Rivers (acre-feet)

	New River		Alamo River		Whitewater River	
	October to March	April to September	October to March	April to September	October to March	April to September
Mean	593	633	780	913	72.5	71.4
Minimum	150	343	288	495	43	40
Maximum	2,000	3,000	4,000	4,500	185	137
Total	443,968		613,320		52,010	

Source: U.S. Geological Survey 2010a, b, c. Gages 10254730 Alamo River near Niland CA; 10255550 New River near Westmorland CA; and 10259540 Whitewater River near Mecca

Based on the information in Table B-2, water in the New and Alamo rivers is adequate to supply the SCH Project, and use of this water was retained for further consideration.

In the Whitewater River, flow is present at the downstream-most gage (Mecca), but is often zero about 7 miles upstream at the Indio gage. DWR has estimated that 58 percent of the flow entering the Salton Sea is from the Coachella Valley (either in the Whitewater River, via direct discharge in drains or via underflow, or effluent from the wastewater treatment plant). In the future, inflows from agricultural uses and treatment plant effluent will decrease because of water reuse occurring in the Coachella Valley. The Coachella Valley Water District (CVWD) is the primary water purveyor in the area, serving water to 60,000 irrigated acres and 102,000 customers (CVWD 2002). The water comes primarily from the Colorado River via the All American Canal and the Coachella Canal. CVWD also obtains water from groundwater, reclaimed wastewater, and a State Water Project contract delivered through the Colorado River Aqueduct. About 15,000 af of recycled wastewater is used within the CVWD service area (CVWD 2002). CVWD has prepared a water management plan that would attempt to reuse some of these return flows, especially the wastewater treatment plant effluent. Therefore, the accretions to the Whitewater River downstream of Indio will decrease as wastewater reuse and irrigation efficiency improves within the CVWD service area. Additionally, the Torres Martinez Tribe has indicated that it will have further need for Whitewater River water for future restoration efforts. Apart from its fully appropriated status, adequate water is not available from the Whitewater River; therefore, it was eliminated from further consideration.

Agricultural Drainwater

Agricultural drainwater was eliminated as a potential water source for a variety of reasons, including poorer water quality than that of the rivers (drainwater is primarily tilewater and not as diluted as river water; thus, its pollutants are more concentrated). Additionally, the availability of drainwater varies seasonally (not as much water is available when agricultural users are not discharging water); thus, it is less reliable than river water. Lastly, the agricultural drains are habitat for the Federally and state-listed desert pupfish (*Cyprinodon macularius*), and use of drainwater would reduce this habitat in violation of Federal and state laws intended to protect such species.

Salton Sea Water

The salinity of Salton Sea water is currently about 51 ppt. For reference, the ocean is about 35 ppt. Water from the Salton Sea is a viable source of saline water because adequate supplies are available now and in the future. Storage will decrease over time, but approximately 1,515,030 af of water are expected to be stored in the Sea in the year 2077 given implementation of the SCH Project (refer to Section 3.11, Hydrology and Water Quality). Even though the Salton Sea is receding, the saline water pipeline could be extended to access this water; therefore, accessing the Sea's saline water is feasible. Thus, this option was retained for further consideration.

Groundwater

The Project area is part of the Imperial Valley Groundwater Basin. Previous studies (Lawrence Livermore National Laboratory [LLNL] 2008) have found that production of groundwater in the central portion of the Imperial Valley is limited because of the low permeability of the aquifer and also poor groundwater quality. The low permeability is a consequence of the deposition of former lakebed sediments that comprise the Imperial Valley soils. Some of these sediments have low transmissivity and, therefore, do not produce significant amounts of groundwater. The groundwater is characterized as occurring in a shallow system (ground surface to 2,000 feet deep) and a deeper system (extending to bedrock). The shallow system in the Imperial Valley Groundwater Basin consists of low permeability lake deposits from 0 to 80 feet, a low-permeability aquitard from 60 to 450 feet, and alluvium down to about 1,500 feet (LLNL 2008). Well production data are limited for the Imperial Valley aquifer, but available data suggest the wells in the central portion of the aquifer (closest to the Project area) have the following characteristics:

- Production rates of less than 100 gallons per minute (0.2 cfs),
- Salinity generally ranged between 1,000 and 2,000 to as high as 15,700 parts per million, and
- Hydraulic conductivity of 0.6 foot/day (LLNL 2008).

Although groundwater in the central Imperial Valley aquifer has high salinity, this source is not a replacement for the Salton Sea as a source of high-salinity water for the Project (the salinity is less than the lowest pond salinity proposed). At this time, it appears that groundwater is not a suitable replacement supply for the river water used in the Project because of inadequate yield of the shallow groundwater and insufficient data regarding this source, including depth to groundwater, salinity, subsidence, and location of cost-effective production wells. Therefore, this option was eliminated from further consideration.

B.4.2 Evaluative Criteria Screening Process Results

The evaluative screening process was applied to the remaining Project components, and the results are summarized in Table B-2. Figures showing potential environmental constraints and land ownership at the three Project areas are presented in Attachment A. Key terms are defined in Attachment B.

Table B-2 Results of Evaluative Screening Process

Component	Status	Rationale
Diversion Mechanisms (Brackish Water)		
Inline weir	E	Construction and maintenance access issues would be extensive, involving an extended time period and specialized equipment needs. A temporary diversion would need to be put in place to construct the facility. A structure in the river with gates would be expensive from the standpoint of capital cost and maintenance. Sediment may accumulate behind the weir; the sediments may contain contaminants. Weir may block the movement of any fish present. Weir would raise the water-surface elevation and may adversely affect the upstream agricultural drains, causing flooding of agricultural land. This Project component must be permitted through a 401 Permit, which may delay the permitting process and Project schedule.
Lateral weir	R	A lateral weir may present construction access issues; however, these access issues would not be as great as constructing an inline weir. Also, the rivers would have no fixed grade control; if the rivers dropped because the Salton Sea dropped, the lateral weir would become less effective. Although the cost for the structure is moderately expensive, the cost considerations are less than for the inline weir. Sediment would not accumulate in the river channel, structure would not impede fish passage, and the weir would not cause as much habitat destruction as an inline weir, nor would the lateral weir back up water into the upstream agricultural drains. Installing a lateral weir would not affect current or planned land uses. The Corps generally considers a lateral weir a more accepted engineering control than an inline weir.
Pump water from river	R	This component involves a basic design of a pump system and associated piping. A large capital expense is involved for the facilities and to bring three-phase power to the Project. Energy use is the only substantive consideration; noise impacts could be mitigated. Installing this component would involve obtaining an easement from IID to bring in electricity, if needed, but would not substantively affect surrounding land uses. The only potential schedule delay could occur in trying to obtain an easement from IID.
River Water Conveyance		
Open canal	E	Would have to go far upstream to provide the head to convey the water to the SCH ponds. Ground and river elevation data suggest a deep channel is needed. The cost of excavation, lining the canal, and operations and maintenance of the canal would be high. A canal would require a large/wide right-of-way (50-60 feet) and a very large footprint during construction and operation. Construction would result in considerable air emissions and could adversely affect cultural resources (areas near rivers are

Table B-2 Results of Evaluative Screening Process

Component	Status	Rationale
		known to be particularly sensitive). The channel could also result in the permanent conversion of Important Farmland to nonagricultural use. Construction would result in temporary disturbance of farming operations. This facility would require extensive negotiations to acquire right-of-way easements from landowners and, therefore, result in a long schedule.
Pipeline	R	The cost would be less than an open channel. A pipeline would have a large footprint during construction and maintenance, thereby potentially affecting cultural resources, and would result in moderate air emissions during construction. Impacts on agricultural resources likely would be temporary because some crops could be planted over the pipeline. A pipeline would have a large footprint during construction and maintenance, but would have little to no permanent land use impacts. As with an open channel, a pipeline would require extensive negotiations with landowners for right-of-way.
Open canal and pipeline	E	This option would have the disadvantages of the open canal and would not result in benefits over the pipeline alone.
Saline Water Conveyance		
Backwater channel	E	Such a facility would require continuous upgrading and maintenance as the Salton Sea recedes. High maintenance costs would be involved because the Sea is receding, so it would be necessary to constantly “chase the Sea” to connect the Sea with the channel. Construction would occur in the “wet;” therefore, the channel has the potential to constantly collapse on itself, requiring reconstruction.
Pipeline	R	A pipeline conveyance from the Salton Sea would be relatively easy to design and construct. This conveyance would be relatively low cost and involve land that was mostly exposed playa. Additional pipe would have to be added as the Sea recedes, but is feasible. This facility would be constructed mostly on exposed playa and cause few impacts. This facility could be constructed quickly, within 6 months.
Tailwater return pump	R	Recirculation is easy to design and construct and would use the facilities that are in place for the SCH ponds. This element is inexpensive, consisting of a relatively short pipe and small pump. The pump may require frequent maintenance because of pond salinity. This facility could be constructed quickly, within 6 months.
Suspended Sediment Management		

Table B-2 Results of Evaluative Screening Process

Component	Status	Rationale
No sediment management	E	Sediment would be deposited in the SCH ponds, thereby affecting habitat function and conflicting with SCH Goal 1. In addition, extensive maintenance would be required to remove built-up sediment within the SCH ponds.
Sedimentation basin near SCH ponds	R	Retained as a necessary component of the alternatives using pumped diversion for river water. Design and construction of a sedimentation pond is not complicated and would not require new construction methods. It can also be designed into the SCH ponds. The cost of a joint facility would be less than a separate facility. A pond near the diversion would use land that is marginal farmland or playa. The settling pond would not be likely to conflict with surrounding land uses. The time required to obtain easements or a lease for a pond would be short.
Sedimentation basin near diversion	R	Retained as a necessary component of the alternatives using a pipeline to divert river water, despite potential impacts on Important Farmland and challenges associated with land acquisition since multiple private parties would be involved.
Selenium Treatment and Management		
Constructed wetlands (treat between river diversion and SCH)	E	Selenium treatment (all methods) was eliminated at this time due to the large cost involved, technical uncertainty associated with each of the methods, and the lack of a significant impact on breeding bird populations that would merit such an undertaking (refer to Section 3.4, Biological Resources, for additional discussion).
Controlled Eutrophication Process (algae) (treat between river diversion and SCH ponds)	E	See above.
Anaerobic bacteria (treat between river diversion and SCH ponds)	E	See above.
Cleaner source water (treat sources that drain into river, upstream of diversion)	E	See above.
Salinity gradient (water management within SCH ponds)	E	See above.
Power Supply		
Three-phase power	R	Adequate power is available nearby.
Diesel generators	E	Because the pumps may run 24 hours per day, a portable diesel generator would not be practical because of the need for

Table B-2 Results of Evaluative Screening Process

Component	Status	Rationale
		constant maintenance of fuel and also the emissions from the motor that drives the generator.
Solar power for pump energy supply	E	This supply would require solar panels, power inverter, transformer, and backup power supply. Solar panels produce from 10-12 watts per square foot of panel (World Watts no date). The saline and river pumps would draw between 100 to 900 kilowatts (100,000-900,000 Watts). At 11 Watts per square foot, this power requirement would necessitate between 0.2 and 1.9 acres of panels). In addition, there would have to be a hard power source for operating the pumps at night or cloudy days, and for accommodating the power surge associated with the start-up of a pump. These factors render the option of solar panels expensive, maintenance intensive, and impractical.
E = Eliminated, R = Retained		

B.5 Development of EIS/EIR Alternatives

Based on the above analysis, six conceptual alternatives were developed that included two different locations and two methods of diverting and conveying the water to the SCH ponds. These alternatives would comply with NEPA and CEQA requirements to evaluate a reasonable range of alternative ways of implementing a project and CEQA's requirement to identify alternatives that would avoid or substantially lessen one or more of a project's significant environmental impacts. For example, those alternatives requiring gravity diversion would result in a significant impact on lands under Williamson Act contracts[2] (refer to Section 3.2, Agricultural Resources), whereas this impact would not occur under the alternatives requiring a pumped diversion. The latter generally would result in greater demand for power, however, as discussed in Section 3.6, Energy Consumption.

The initial alternatives included:

- **Alternative 1 – New River, Gravity Diversion:** 2,460 acres of ponds constructed on either side of the New River, upstream gravity diversion of river water, and independent and cascading pond units.
- **Alternative 2 – New River, Pumped Diversion:** 2,260 acres of ponds constructed on either side of the New River, pumped river diversion at the SCH ponds, and independent ponds.
- **Alternative 3 – Alamo River, Gravity Diversion:** 2,420 acres of ponds constructed on either side of the Alamo River, upstream gravity diversion of river water, and independent and cascading pond units.
- **Alternative 4 – Alamo River, Pumped Diversion:** 2,860 acres of ponds constructed on either side of the Alamo River, pumped river diversion at the SCH ponds, and independent ponds units.
- **Alternative 5 – New and Alamo Rivers, Gravity Diversion:** This alternative is a combination of Alternatives 1 and 3 (4,880 acres).
- **Alternative 6 – New and Alamo Rivers, Pumped Diversion:** This alternative is a combination of Alternatives 2 and 4 (5,120 acres).

These initial alternatives were subsequently refined, based on Stakeholder input, information about existing and proposed land uses in the Project area, special studies, geotechnical information, and budgetary considerations. Results of the preliminary geotechnical study indicated that construction would be more costly than originally anticipated due to soils that had low strength and were dispersive; would be subject to erosion from wave action; had the potential for compressibility, seepage, expansion, and liquefaction; and that could not support conventional construction equipment.

Refinements included modifying the configuration of the New River alternatives involving pumped diversion of river water. The configuration originally included a narrow, roughly 2-mile-long pond on the far western side that was eliminated due to the relatively high cost of berm construction required in order to obtain a comparatively small amount of habitat. Additionally, eliminating this area avoided channels carrying natural drainage. The alternatives that included both New and Alamo river sites were eliminated because the costs to construct habitat in both areas would have greatly exceeded available funds;

[2] Commonly referred to as the Williamson Act, the California Land Conservation Act of 1965 (Government Code sections 51200–51297.4) enables local governments to enter into contracts with private landowners that restrict specific parcels of land to agricultural or related open space use. In return, these landowners receive property tax assessments that are much lower than normal because they are based upon farming and open space uses rather than the property's full market value. Local governments receive an annual subvention of forgone property tax revenues from the State of California via the Open Space Subvention Act of 1971 (Government Code sections 16140–16154).

therefore, they were considered infeasible. Additionally, the portion of the alternatives that included Red Hill Bay was eliminated because the United States Fish and Wildlife Service (USFWS) has plans to develop shallow water habitat in this area as part of the Sonny Bono Salton Sea National Wildlife Refuge (NWR). (The USFWS also has a planned restoration project at the New River, and DWR and DFG are working in close coordination with NWR staff to avoid any conflicts between the two projects.) The refined alternatives being considered in the EIS/EIR are as follows:

- **Alternative 1 – New River, Gravity Diversion + Cascading Ponds:** 3,130 acres of ponds constructed on either side of the New River, upstream gravity diversion of river water, and independent and cascading pond units.
- **Alternative 2 – New River, Pumped Diversion:** 2,670 acres of ponds constructed on either side of the New River, pumped river diversion at the SCH ponds, and independent ponds.
- **Alternative 3 – New River, Pumped Diversion + Cascading Ponds:** 3,770 acres of ponds constructed on either side of the New River, pumped river diversion at the SCH ponds, and independent and cascading pond units.
- **Alternative 4 – Alamo River, Gravity Diversion + Cascading Ponds:** 2,290 acres of ponds constructed on northern side of the Alamo River, upstream gravity diversion of river water, and independent and cascading pond units.
- **Alternative 5 – Alamo River, Pumped Diversion:** 2,080 acres of ponds constructed on northern side of the Alamo River, pumped river diversion at the SCH ponds, and independent ponds units.
- **Alternative 6 – Alamo River, Pumped Diversion + Cascading Ponds:** 2,940 acres of ponds constructed on northern side of the Alamo River, pumped river diversion at the SCH ponds, and independent and cascading ponds units.

The actual design of the ponds and other facilities is being developed based on habitat requirements, results of special studies, bathymetry, engineering requirements, and Division of Safety of Dams requirements. Depths within the ponds would range from 0 to about 10 feet (0 would be at the shoreline and edges of berms and islands). Water deeper than 6 feet would be obtained by excavation within the pond because the maximum water depth at the berm constructed to contain water in the pond would be 6 feet (as measured from the water surface on the upslope side of the berm to the toe of the downstream side of the berm) to avoid Division of Safety of Dams jurisdiction. The berms would have 2 feet of freeboard above the pondwater surface to allow for wave run-up and safety. Based on existing topography, particularly near the New and Alamo rivers, large expanses of very shallow (less-than-1-foot) water are present. These expanses do not provide suitable habitat for fish, so excavation/grading in these areas would be needed to deepen the water, at least over part of the area. The excavated/graded material would be used for constructing islands and berms.

B.6 Other Alternatives Considered but Eliminated

Additional alternatives to the SCH Project were identified during the scoping process, including outreach to individual Stakeholder groups. These included the following:

- Use of agricultural drain water instead of river water (eliminated for reasons described above);
- Use of fresh (brackish) water (eliminated due to the potential for increased impacts associated with the bioaccumulation of selenium and the potential for increased mosquito populations due to growth of emergent vegetation).
- Use of fish hatcheries instead of raising fish in ponds (eliminated because this would not meet either of the two Project goals).

B.7 References

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ATTACHMENT A

Potential Environmental Constraints and Land Ownership

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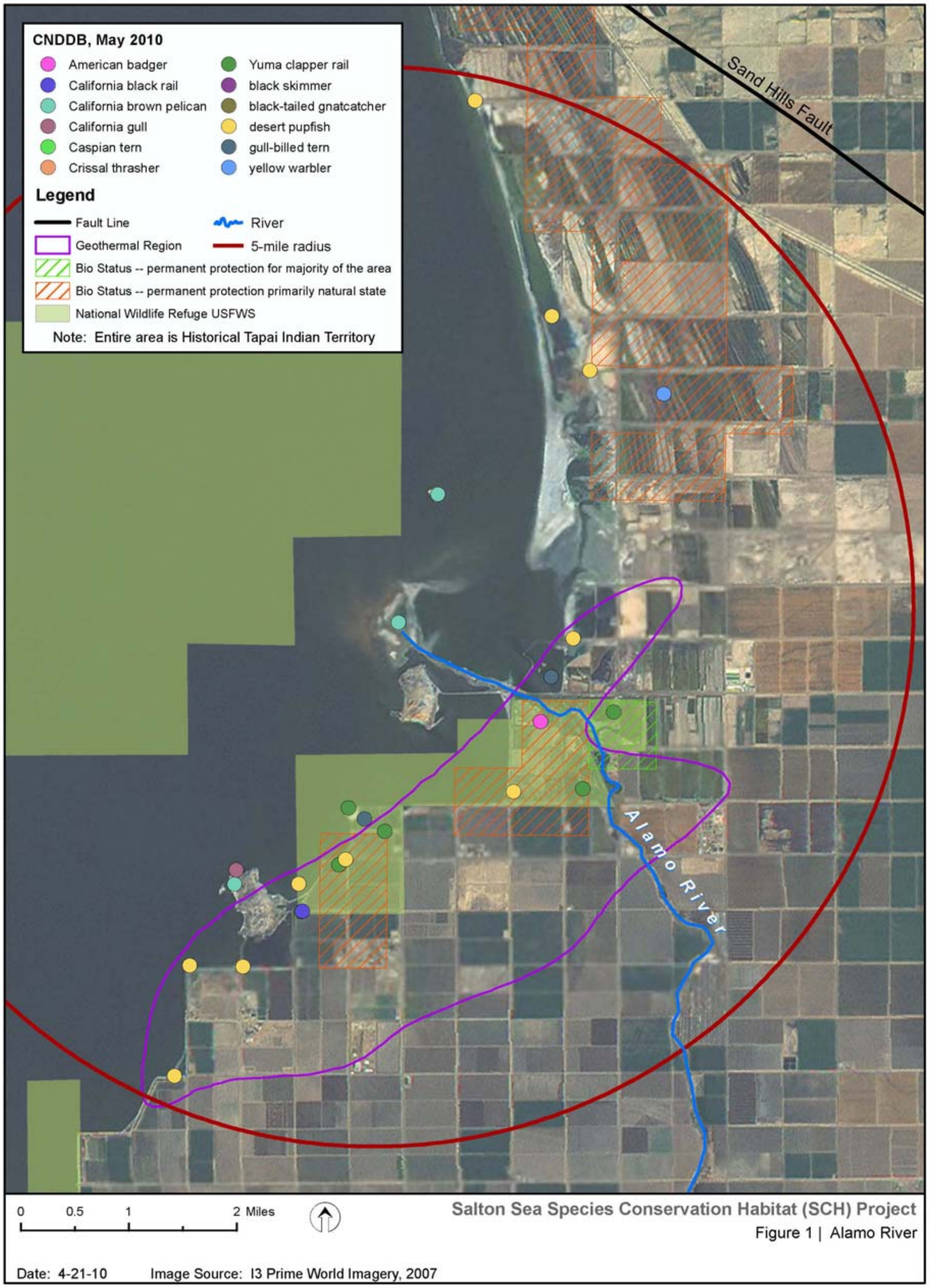


Figure 1 Potential Environmental Constraints at Alamo River Sites

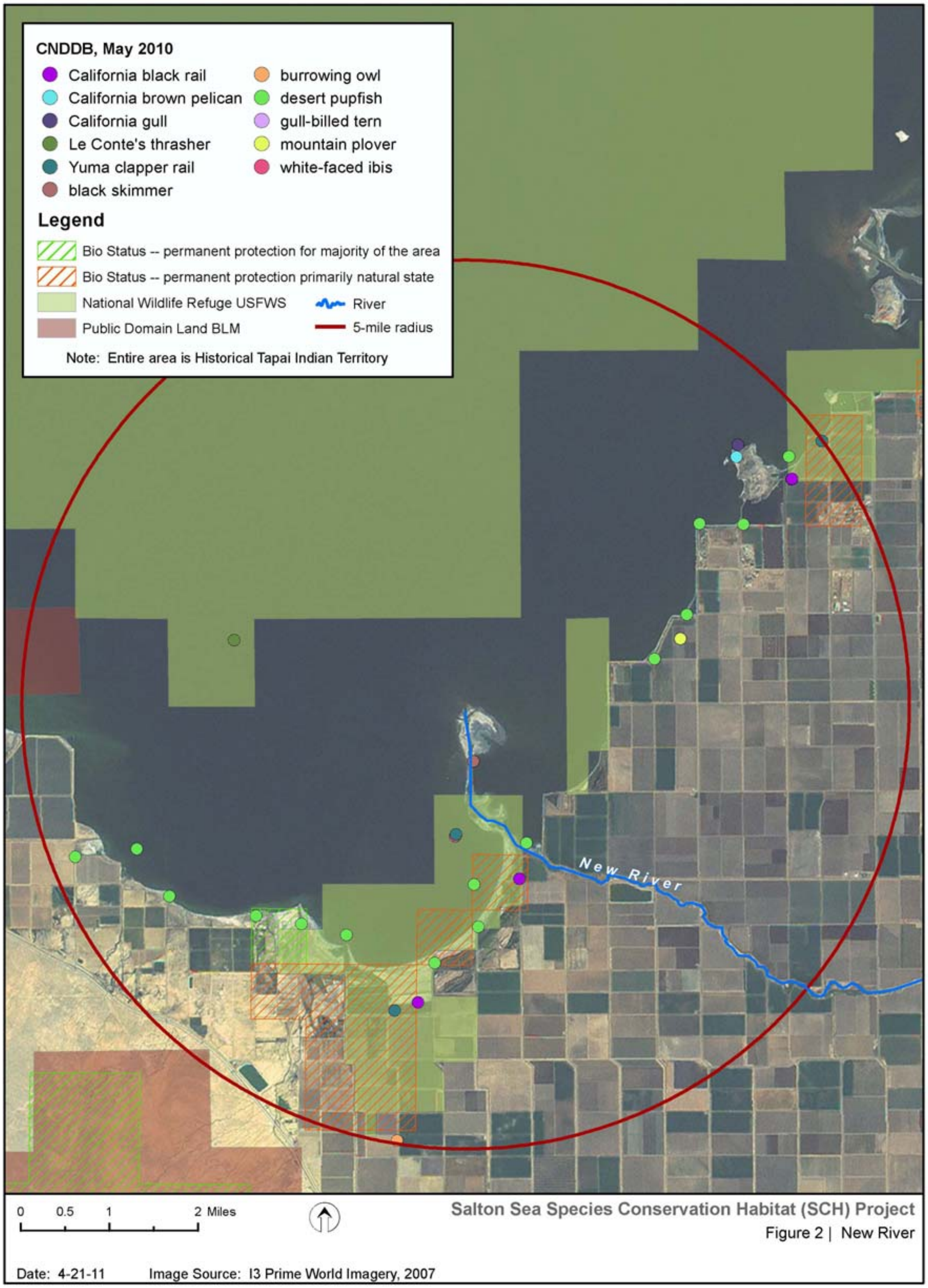


Figure 2 Potential Environmental Constraints at New River Sites

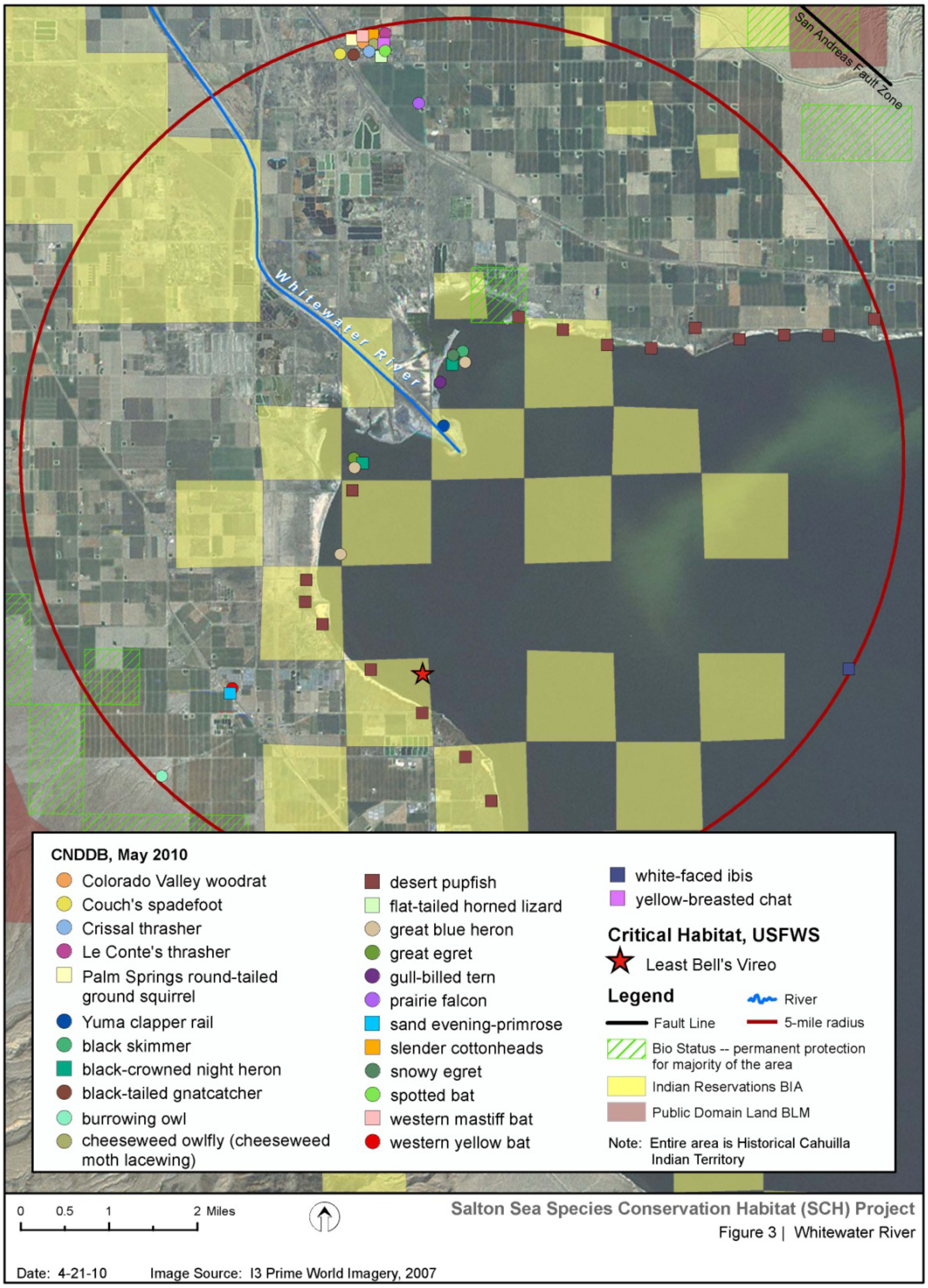


Figure 3 Potential Environmental Constraints at Whitewater River Sites

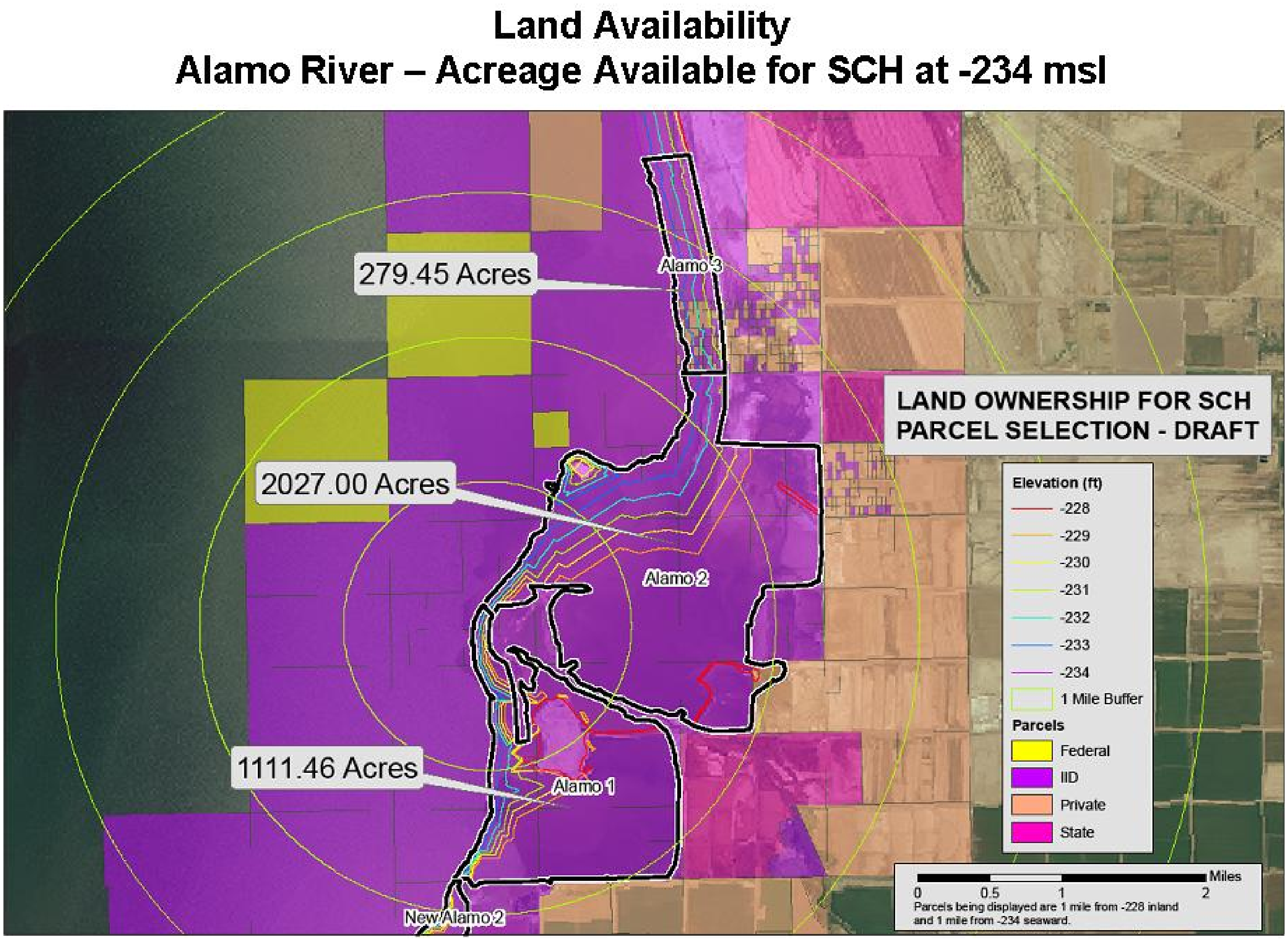
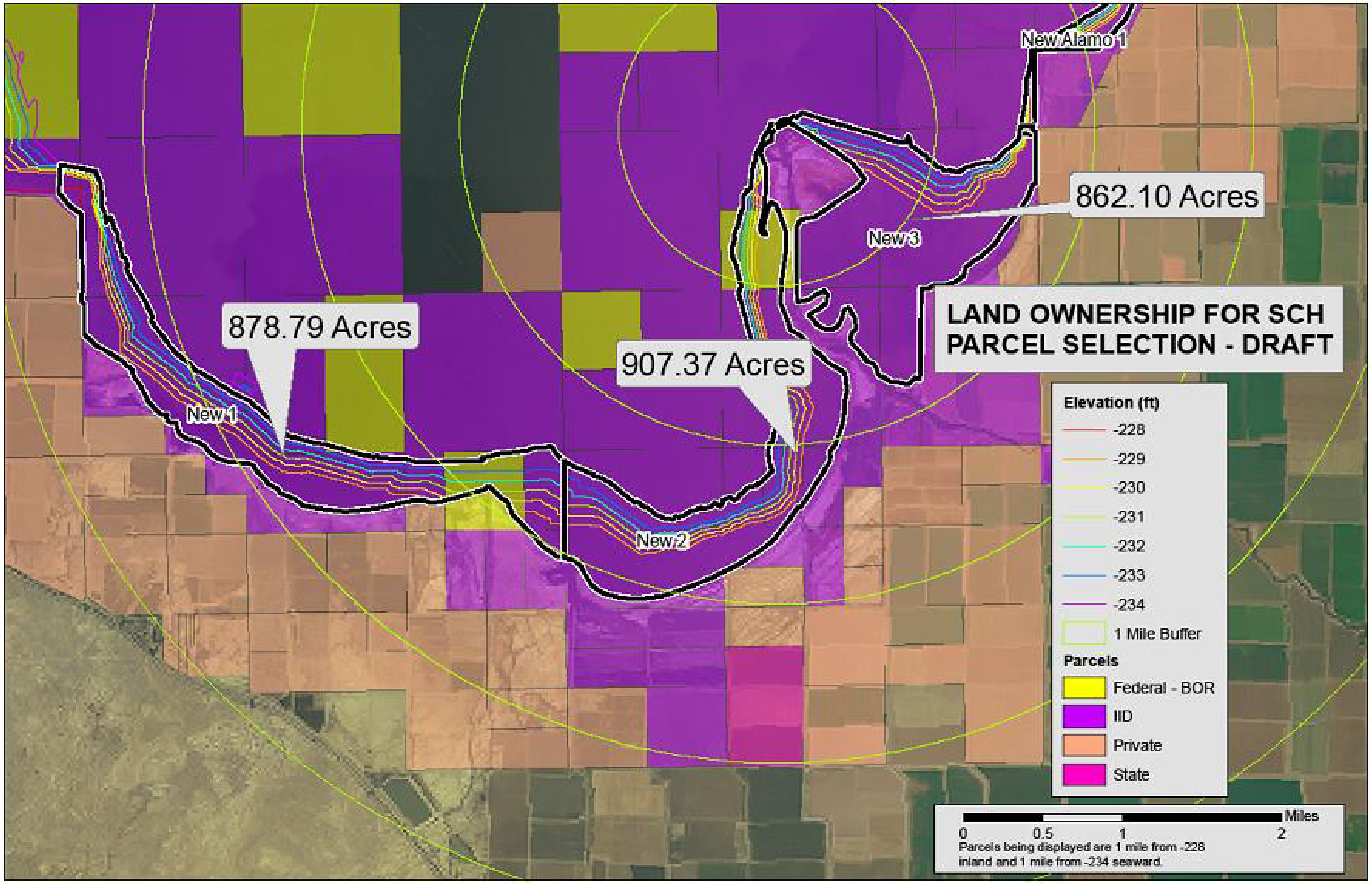


Figure 4 Land Ownership at the Alamo River Sites

Land Availability
New River – Acreage Available for SCH at -234 msl



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2 **Figure 5 Land Ownership and Available Acreage at the New River Sites**

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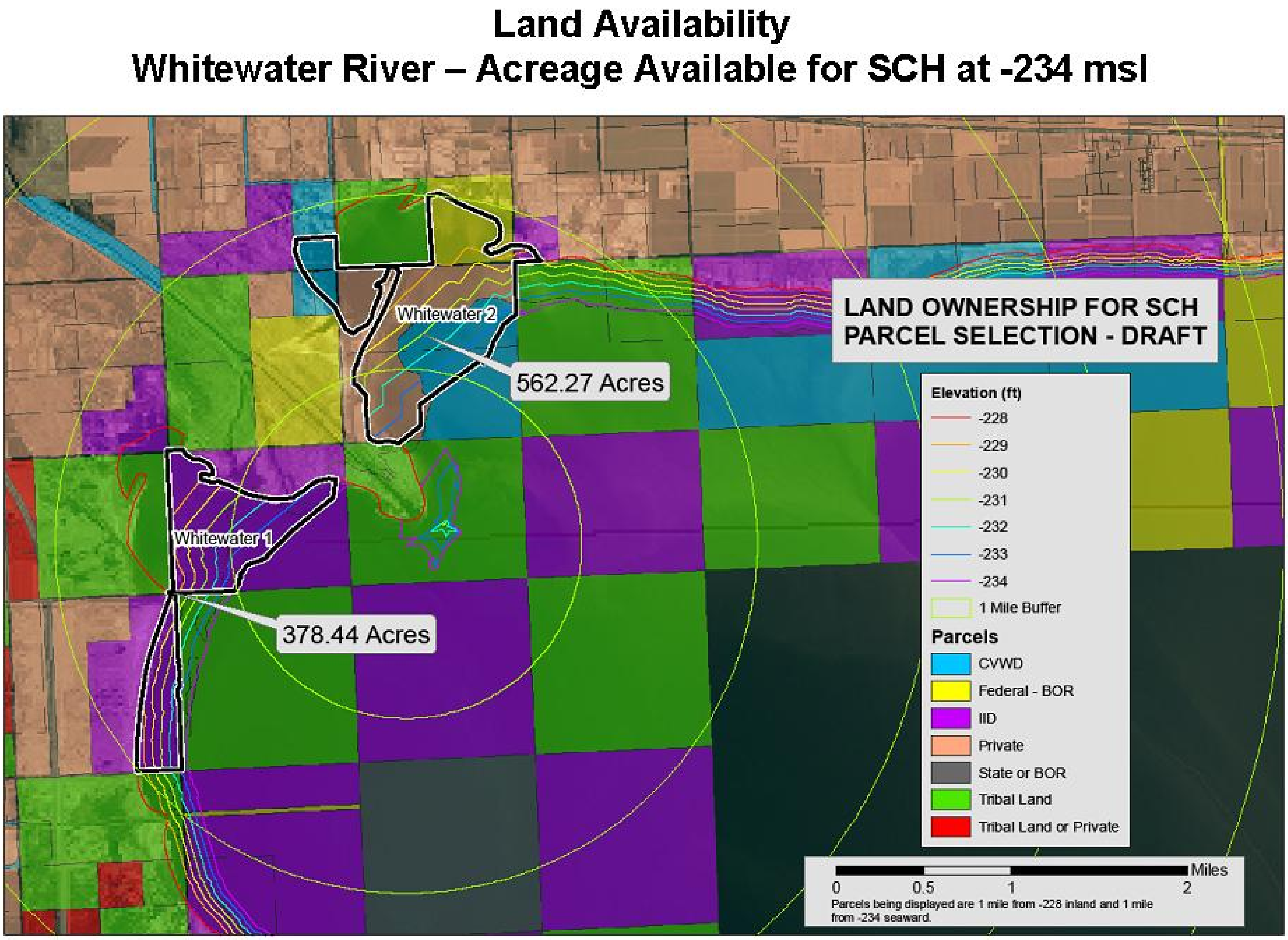

2 **Figure 6** **Land Ownership and Available Acreage at the Whitewater River Sites**

ATTACHMENT B

Definition of Key Terms

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Water Supply (Brackish) – This term refers to the low-salinity water supply that comes from the rivers and how it is delivered to the SCH ponds. The sources initially considered for this water supply were the New, Alamo, and Whitewater rivers. The options for conveying the water include a gravity system (pipeline or channel) from a point on the river upstream of the SCH ponds, a pumped system located near the SCH ponds, or a combination of a low-head lift and gravity flow from an upstream point.

Water Supply (Saline) – This term refers to the high-salinity water from the Salton Sea or saline shallow groundwater and how it is delivered to the SCH ponds to increase their salinity. The options include a pump and a pipeline from the Sea to the SCH ponds or an excavated channel from the Sea to the SCH ponds with a pump lift into the ponds. The excavated channel method was used at the nearby U.S. Geological Survey ponds and involved a channel that was excavated to a depth lower than the current Sea elevation along its entire length. The Sea flowed into this excavated area and was pumped out at a point near the ponds. With either delivery system, changes would be needed as the Sea recedes. With a pipeline, additional sections of pipe would be added to extend the pipeline to the Sea. With the channel method, the channel would need to be excavated deeper as the Sea's elevation declines. The third option for saline water is shallow groundwater that would be pumped from one or more wells near the SCH ponds.

Diversion – This term refers to the type of structure placed on a river used to deliver water to the SCH ponds. The water could be diverted by gravity flow, or it could be lifted by means of a pump. A gravity flow diversion would be a lateral weir where water flows through a structure in the river bank to either a pipeline or channel. The lateral weir structure would use gates or stop logs to control the water flowrate from the river, which would depend on the river's water-surface elevation of the river. As the river flow changed, the river's water-surface elevation would change, and so the differential between the water surface and the diversion structure would change. If the diversion flow rate were to be controlled, the gates or stop logs would need to be actively managed as the river's water surface changed. The other option is a lifted diversion in which the water is raised to a higher elevation than the river's water surface by means of a pump, which requires a power source. The diversion flowrate could be controlled by either staging multiple pumps or with a variable speed pump. An issue that needs to be considered is that as the Sea recedes, the river's elevation will get lower, causing the differential between the river's water surface and the diversion structure to decrease, which in turn would cause the ability to divert flow by gravity to decrease. An inline weir (a structure across the river channel) would raise the water-surface elevation for diversion. An inline weir is essentially a small dam that would fix the water surface upstream at a constant elevation regardless of the downstream (Sea) elevation. The elevation would, however, change relative to flow in the river. The disadvantage of the inline weir is that it is an obstruction in the channel during flood conditions.

Inflow Volume – This term refers to the amount of freshwater needed to moderate salinity during operation of the SCH ponds. The freshwater diversion rate could be equal to the water lost to evaporation, but because the diverted water contains some salt, the SCH salinity would increase over time with this diversion rate. Water could also be diverted in sufficient quantity to maintain a desired salinity. To achieve this desired salinity, the SCH ponds would have a continuous outflow to the Sea to remove saline water, and the diversion would be sufficient to replace evaporation and meet the outflow requirement to maintain the salt balance. A third potential diversion option would allow operators to quickly drain and refill the ponds, essentially flushing the ponds. The quantity of water for this option would be greater than either of the previous amounts. Inflow is what is entering the ponds, not what is coming off the rivers. Diversion volume would be greater than inflow volume.

Treatment – This term refers to treatment of the freshwater supply to remove selenium, suspended sediment, or other water quality constituents that could be detrimental to the Project by using pond treatment or mechanical treatment. The pond system could be operated to allow deposition of suspended sediment or treatment of other water quality constituents. Such a pond would need to be coordinated with the current understanding of selenium treatment. A treatment pond could be located adjacent to the SCH ponds or located near the diversion facility, upstream of the SCH ponds. A mechanical treatment system could be used to remove sediment or other water quality constituents but would typically be limited by the total flow it could reasonably treat.

Pond Design – This term refers to the depth and size of the individual SCH ponds. The size of the individual ponds considered for this analysis could range from approximately 100 acres to over 500 acres. A variety of pond sizes is needed to evaluate what size provides the best habitat for fish and the birds that forage on them, while also facilitating management and maintenance activities.

Depths within the ponds need to range from 0 to about 10 feet with 0 being at the shoreline and edges of berms and islands. Water deeper than 6 feet would be obtained by excavation within the pond because the maximum water depth at the berm constructed to contain water in the pond would be 6 feet (as measured from the water surface on the berm's upslope side to the toe of the berm's downstream side) to avoid Division of Safety of Dams jurisdiction. The berms would have 2 feet of freeboard above the pondwater surface to allow for wave run-up and safety. Based on existing topography, particularly near the New and Alamo rivers, large expanses of very shallow (less-than-1-foot) water are present. These expanses do not provide suitable habitat for fish, so excavation/grading in these areas would be needed to deepen the water, at least over part of the area. The excavated/graded material would be used for constructing islands and berms.

Pond Connectivity – This term reflects how the ponds interconnect and if they are independent or cascading. Independent ponds are self contained with their own water supply and drainage. These ponds would be operated to fill or drain as needed and would be managed for a specified salinity. Cascading ponds are interconnected ponds where one pond outflows to another pond. A control structure would regulate the flow between ponds. The ponds could be constructed with individual fill and drain facilities, or the fill could occur at the pond at the top of the cascade and the drain at the bottom pond. The water-surface elevation would decrease between ponds going down the cascade.

Pond Salinity – Salinity in the ponds could range from approximately 20 to 40 ppt, although this range could occasionally be exceeded depending on how the ponds are managed. Fish that would provide forage for a variety of bird species and that are being considered for use in the SCH ponds are freshwater to brackish water species, most of which can tolerate higher salinities, but those levels are not optimal for their growth. Invertebrates, such as pileworms and barnacles, that have done well in the Salton Sea in the past and could provide forage for fish and birds, are marine species that require salinity near 35 ppt. The risk of selenium accumulation and the resulting toxicity to birds (primarily to species that breed at the Sea) also needs to be considered in selecting salinity levels for the ponds.

APPENDIX C

Geotechnical Investigations

PRELIMINARY GEOTECHNICAL INVESTIGATION

SPECIES CONSERVATION HABITAT PROJECT SALTON SEA, CALIFORNIA

Project No. 758.01
January 21, 2011

Prepared by

Hultgren – Tillis Engineers

A California Corporation
Specializing in Geotechnical Engineering

Hultgren-Tillis Engineers

January 21, 2011
Project No. 758.01

Cardno
701 University Avenue, Suite 200
Sacramento, California 95825

Attention: Mr. Paul Wisheropp

Preliminary Geotechnical Investigation
Species Conservation Habitat Project
Salton Sea, California

Dear Mr. Wisheropp:

We performed a geotechnical investigation for preliminary design of the Species Conservation Habitat Project along the southeast shoreline of the Salton Sea. Our services are part of Cardno Project Number 32676001-5000, Task 5 of the Salton Sea SCH Project. Our task number is HT-DWR-2010-01, dated July 22, 2010. The results of the investigation are presented in the attached report.

It was a pleasure working with you on this project and we look forward to working with you during design development and construction. If you have any questions, please call.

Sincerely,

Hultgren – Tillis Engineers

Edwin M. Hultgren
Geotechnical Engineer

WRC:SKT:EMH:db:la

6 copies submitted

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I. INTRODUCTION

This report presents the results of our preliminary geotechnical investigation for the proposed Salton Sea Species Conservation Habitat Project (SCH Project). The preliminary investigation is intended to provide a general characterization of on-site soil conditions and to provide geotechnical engineering criteria for preliminary design. The preliminary design will be the basis for the project description in the environmental impact documents. The findings and conclusions presented in this report are not intended for final design. A more detailed investigation should be conducted for the final berm alignment, berm configurations, borrow sources and anticipated construction methodologies.

II. PROJECT DESCRIPTION

The SCH Project will be located along the southeast shore of the Salton Sea. A Vicinity Map is presented on Plate 1. The project will consist of creating shallow ponds along the existing shoreline. The ponds will be located on both sides of the mouths of the New River and the Alamo River. The approximate boundaries of the ponds near New River and Alamo River are shown on the Exploration Site Plans, Plates 2 and 3, respectively.

In the area of the New River, the ponds will extend approximately 2.5 miles southwest and 1.5 miles east from the mouth of the river. In the area of the Alamo River, the ponds will extend between 1.5 miles south to about 2 miles northeast of the river mouth. Immediately adjacent to both river mouths, the berms will close off existing bays, and the berms will be approximately 1.5 to 2 miles off shore of the existing levees. Beyond the bays, the seaward-most berms will be approximately 0.5 to 1 mile beyond the existing levees. The total length of seaward berms will be up to approximately 5.5 miles in the vicinity of New River and approximately 3.5 miles in the Alamo River area. These estimates of berm lengths are preliminary as berm alignments continue to be evaluated.

The water depths within the ponds will typically be 6 feet or less. Ponds will contain water with varying degrees of salinity. Interior berms will subdivide the site into smaller ponds for individual salinity control. The target salinities are 20 parts per thousand (ppt) and 35 ppt. Water for the ponds will come from the New River and the Alamo River. Additional water for mixing various salinities in the ponds will come from the Salton Sea.

III. SCOPE OF SERVICES

For this preliminary investigation, our scope of services included reviewing the existing geotechnical data, exploring subsurface conditions at shallow depths along the berm alignments, assigning laboratory testing to be done by others, characterizing the materials encountered, and performing analyses and developing preliminary geotechnical conclusions and recommendations for constructing berms for the ponds.

IV. PREVIOUS INVESTIGATION

Two previous investigations contained geotechnical exploration and testing data.

The September 1972 Federal-State Feasibility Report, Salton Sea Project, California contain a summary of shallow probes drilled between the shoreline and five miles offshore. The thickness of sediment and the material type that refused further penetration are presented on Map 13, “Subaqueous Geology”, in the 1972 report. Map 14, titled “Subaqueous Structure Contours, Top of Foundation” provides bathymetry in 1972 and generalized elevation contours of the top of relatively firm foundation materials.

URS issued a report for the “Preliminary In-Sea Geotechnical Investigation, Salton Sea Restoration Project” in February 2004. One cone penetration test, CPT-13, and one boring, 14, were performed near the SCH Project. Conclusions reached in URS’s report regarding the engineering properties they observed in what they labeled “sea floor deposits” across the length of the sea were similar to our findings and conclusions regarding sea sediments (term used in our report) in the SCH Project area.

V. FIELD EXPLORATION

Methods for exploring subsurface conditions were dependent in part on site accessibility. On the playa (beach) above the water's edge, the site conditions are too soft to support conventional exploration equipment. This portion of the site was explored by hand-augering. At and beyond the water's edge (within the Sea), vibracore samples were taken from an airboat. At each exploration location, the insitu strength was characterized by hand-held vane shear apparatus (Geonor model H-60). Vane shear strength measurements were made at 0.5 foot intervals on the playa and at 1.0 foot intervals beneath the Sea. The vane was advanced between reading depths by pressing the vane further into the formation. In addition to the vane shear measurements taken by continuous advancement of the vane, hand-held vane shear strength measurements were also taken within the hand auger borings at approximately one foot intervals. A cone penetrometer test was conducted adjacent to each of the six hand auger borings. As the hand-held cone penetrometer (Durham model S-214) was pushed, the maximum and minimum penetration resistance was recorded for each 0.5 foot of penetration.

The locations of the exploration points are shown on the Exploration Site Plans, Plates 2 and 3. Logs of the hand auger borings and vibracores are presented on Plates 4 through 18. The key to the logs is presented on Plate 19. The hand-held vane shear tests performed adjacent to the hand auger and vibracore locations are summarized on Plate 20. (To better define the individual vane shear test results, the data points are shown vertically offset, in depth, by up to +/- 0.14 foot. The sole purpose of this arbitrary shift is to avoid having one data point masked by another.) The hand-held vane shear tests taken within the hand auger borings are presented on the logs of borings. Those shown on the logs of vibracores are from the continuous advancement of the vane adjacent to the vibracore. The hand-held cone penetrometer tests are presented on Plates 21 and 22.

VI. LABORATORY TESTING

Samples recovered from the hand augers and vibracores were delivered to the Moore Twining Associates, Inc. laboratory in Fresno, California. Laboratory testing on selected samples from the hand auger borings and vibracores consisted of 46 moisture content tests, 24 sieve analyses, and 18 Atterberg limits. Two bulk samples were collected from the playas near the New and Alamo Rivers (hand auger boring locations HA-1 and HA-4). Two laboratory compaction curves were performed on each bulk sample. One laboratory compaction test used "modified" Proctor compactive effort (ASTM Test D-1557) and the other "standard Proctor" (ASTM Test D-698).

To evaluate the dispersive characteristics of the on-site soils, six samples were selected for additional laboratory testing. They included the two bulk samples (HA-1 and HA-4) and four vibracore composite samples (VC-11, VC-16, VC-20 and VC-28). For each sample, the following laboratory tests were performed: gradation; Atterberg limits; organic content; crumb test; double hydrometer test; percent sodium in saturation extract; and pinhole test.

All of the laboratory testing was performed by Moore Twining Associates, Inc. except the pinhole tests. The pinhole tests were performed by the Department of Water Resources' Bryte Soils and Concrete Laboratory in West Sacramento.

The results of the laboratory testing are presented in Appendix A. A summary of the laboratory test results is presented in Table A-1 in Appendix A. Moisture contents and Atterberg limits are included in the logs of borings. A plot of the Atterberg limit tests and the corresponding in-situ moisture contents is presented on Plate 23. A combined plot of the four compaction tests is presented on Plate 24.

VII. SITE AND SUBSURFACE CONDITIONS

Several processes have gone into creating the feature now known as the Salton Sea. The Salton Sea basin is a northern extension of the Sea of Cortez, a down-dropped block created as Pacific Plate moved northwest and the Gulf of California spread open. The San Andreas Fault system forms a boundary between the low lying Salton Sea basin and mountain range further east. Some active faults may lie beneath the Alamo River portion of the SCH Project.

The Salton Sea basin is now isolated from the Sea of Cortez by an enormous alluvial fan created by the Colorado River. In the past, the Colorado River has flowed into the Salton Sea basin to heights well above those experienced in historic times. Upon European man's arrival in the Imperial Valley, the Salton Sea was a dry sink. Beginning in 1900, irrigation canals were constructed from the Colorado River into the Imperial Valley and northern Mexico. In 1905, control of the river was lost at one of the canal headworks, and the Colorado River flowed uncontrolled into the Salton Sea for one and a half years. The Sea as it is known today was reborn.

Over the subsequent century, the Sea has shrunk, swelled and now is again shrinking, all in response to the extent of irrigation and irrigation practices. Since the flood of 1905 – 1906, much of the site drainage and irrigation tail water has been collected by the New and Alamo Rivers and discharged into the Salton Sea. These waters are fairly high in dissolved solids, about 3 ppt. These rivers also bring suspended sediments. Upon reaching the high salinity of the Salton Sea (currently about 51 ppt), the finer grained sediments (clay size) flocculate and settle out on the floor of the Sea. The coarser grained sediments, including silt and fine sands, settle by normal gravity forces.

The Sea is now receding. On the exposed playa, the sediments are drying, creating a crust strong enough to walk on. However, as one approaches the shoreline, within one to two feet of elevation above the current sea level, the ground remains too soft to walk on in some areas. The surface of the playa is cracked in many areas as the sediments shrink from evaporation. At fairly shallow depths, the sediments remain nearly saturated over much of the playa.

In approximately half of the locations explored within the Sea, the mudline beneath the Sea is very soft and will not support a person wading. Grades are generally very flat.

The thicknesses of sea sediments nominally range from 3 to 8 feet in the areas we explored along and adjacent to the southeast shore of the Salton Sea. The thicknesses probably exceed this range in some areas. Most of these sediments likely accumulated within the last sixty years during the Sea's most recent rise above Elevation -240 feet. The sea sediments consist of very soft to medium stiff fat and lean clays, loose clayey and silty sands and soft to medium stiff silt. Red-brown lean clay, commonly medium stiff to stiff, was encountered below the sea sediment in many areas.

VIII. DISCUSSION OF FINDINGS

A. General

The most significant geotechnical issues for the project include the low strength of the sea sediments, the potential dispersive nature of the sediments and erosion from wave action. Compressibility, seepage and the expansion potential are also significant issues.

In some portions of the currently submerged areas, very flat slopes may be needed to safely construct the planned berms. Over a greater portion of the site, moderate slopes may be used but the ground is too weak to support traditional low-ground-pressure track-mounted construction equipment.

Sea sediments, including those beneath the playa, are predominantly fine grained soils. These soils will readily erode when exposed to even light wave action. The soils are also dispersive in fresh water. Their performance in brackish water is yet to be evaluated. If seepage developed through a berm and daylighted on the downstream slope, the dispersive nature of the soils could lead to fairly rapid development of a piping condition and loss of the embankment.

B. Settlement

The embankments for the berm will settle appreciatively during and following construction. To qualify the potential settlement, we performed one dimensional settlement analysis. This assumes that the loaded area is wide relative to the thickness of the compressible layer and ignores edge effects. We considered varying thicknesses of new fill, from two feet thick to 12 feet thick. The analyses were done for a range of compressible soil thicknesses from two feet to 12 feet. For the preliminary design, no undisturbed samples were taken from which to do consolidation testing. To assess potential settlement, we used estimated values of the compression ratio and coefficient of consolidation in our settlement analysis. We assumed that the sea sediments are normally consolidated and that the virgin compression ratio, C_{ce}, equals 0.3. The alluvial soil beneath the sea sediment over-consolidated relative to the weight of the planned berms and was assumed to be incompressible.

Results of the settlement analyses are summarized on Plate 25. To use this figure, select the thickness of fill along the bottom portion of the chart (for example: 10 feet thickness of fill), go vertically until intercepting the curved line representing the sediment thickness at that location (for example, 4 feet soft soil thickness), then find the estimate of ultimate settlement on the vertical axis (in this case 1.5 feet). For this example, placing 10 feet of fill causes 1.5 feet of settlement resulting in a final embankment height of 8.5 feet. Conceptual design consists of a berm whose crest will be eight feet above the toe of the berm after settlement has occurred. The diagonal line marked on the chart labeled "Fill for Net 8 Feet" shows the combinations of fill thicknesses and thicknesses of soft sediment that result in a berm crest 8 feet above the original ground surface after settlement is complete.

To estimate how quickly this settlement may occur, we ran analyses that assumed single drainage, meaning that the soils beneath the sea sediments are very low in permeability and are considered a impermeable boundary and the soils overlying sea sediments are sufficiently permeable to provide unrestricted drainage. Pore water trying to escape the sea sediments under the weight of the fill is assumed to travel vertically to the top of the sediment layer. Lateral drainage is ignored. These are simplifying assumptions. Fill that will be placed to create the berm will be of low permeability and will inhibit drainage at the surface. Some drainage will likely occur into the underlying alluvial formation and some lateral drainage will occur. For the purpose of these analyses, we have assumed that modeling single vertical drainage and ignoring lateral drainage is offset by ignoring the low permeability of the overlying fill.

In estimating the time rate of consolidation, we assumed a coefficient of consolidation (c_v) of 10 feet squared per year. The estimated time for 50 percent degree of consolidation is less than one to two months. The time requirement for 90 percent of the settlement to occur for varying thicknesses of soft soil sediments are presented on Table 1.

Table 1. Time for 90 Percent Consolidation

Thickness of Compressible Soils (feet)	Time required for 90 percent of Ultimate Settlement (months)
4	3
6	6
8	12
10	18
12	28

The above time rates of settlement as well as the estimated magnitudes of settlement were developed for assumed properties of the sea sediments. The presented results are intended to provide order of magnitude understanding for preliminary planning only.

C. Stability

The results of the vane shear tests at the fifteen exploration locations are summarized on Plate 20. In this plot, the vane shear data taken adjacent to hand auger borings on the exposed playa are shown in warm colors (pale yellow, orange, and brown tones). Those vane shear tests taken from the airboat on the Sea or at its shoreline are shown in cool (lavender and blue) colors. On average, the strength of the materials beneath the Sea are considerably weaker than those beneath the playa.

The strength plots shown on Plate 20 as well as the strengths taken within the hand auger borings are measures of peak strength. No residual strength tests were performed for the preliminary investigation. Because the sediments coming out of the New and Alamo Rivers were essentially coming from a fresh water environment and hitting a highly saline body of water, the clayey materials likely have a flocculated structure. Flocculated clays can be highly sensitive, meaning that the residual strength may be much less than the peak strength.

The strength of the foundation soils (sea sediment) will greatly influence the way in which the berms are constructed. Where the shear strength in the foundation soil is consistently greater than 300 pounds per square feet (psf), the foundation soil can support the berm fill with little risk of foundation failure. (We discuss ability of construction equipment to operate on weak foundation soil in a later section.) At strengths lower than 300 psf, the risk of shear failure in the foundation soils needs to be carefully considered.

There are several states of stress that are commonly considered when assessing the stability of a water retention embankment such as the planned berms. The "end of construction" condition assumes that the soils are undrained and that no consolidation (and corresponding strength gain) has occurred in the weak foundation soils. The "steady state seepage" (or "long-term") condition assumes that the soils are fully consolidated and that the water level in the pond has been in place long enough for the embankment to become saturated up to a stable phreatic surface. "Sudden drawdown" occurs when the pool elevation in the pond is lowered quickly, faster than the embankment soils can drain. "Seismic loading" includes inertial lateral forces from earthquake shaking. Other seismic considerations are liquefaction in cohesionless soil, strength reduction in sensitive cohesive soils, and excessive deformations. The more critical cases for the berms at this site will be the end of construction condition and, for seismic considerations, liquefaction and strength reduction.

To check the capacity of the Salton Sea sediments to support fill for the berms, we performed a series of stability analyses for the end of construction condition. We considered three idealized strength profiles, various thicknesses of sediments, various thickness of berm fill and three slope inclinations.

For soil parameters, we assumed the densities of fill and underlying sea sediments were 110 and 100 pounds per cubic feet (pcf), respectively. Three models for shear strength for the foundation were used. To represent what we judge to be the weakest conditions, we assumed an undrained shear strength (S_u) of 100 psf at the mudline, increasing at 10 psf per foot of depth below the mud line. We note this as S_u*=100+10D psf* in our results summary (discussed below). Several vane shear measurements at one foot depth had strengths less than this "weakest" shear strength model. Under almost any method of fill placement, we concluded that this very weak surficial material will be displaced.

To characterize the mid-range of shear strengths in sea sediments beyond the shoreline, we used a shear strength profile of 200 psf at the mudline, increasing at 10 psf per foot of depth *(*S_u*=200+10D psf)*.

We used one additional strength profile of S_u=*300+10D psf*. This third profile is stronger than most strength measurements taken in the sea sediments beyond the current shoreline, but it was also weaker than essentially all of the vane shear strength data measured beneath the exposed playa. This strength profile was used as a lower bound strength for sediments beneath the playa.

We ran a suite of stability analyses using Spencers method for soft sea sediment thicknesses of 4, 8, and 12 feet. We evaluated three slope inclinations of 3 horizontal to 1 vertical (3H:1V), 5H:1V and 10H:1V. The factor of safety was computed for berm fill thicknesses of between 2 to 12 feet.

The results of stability analyses for the S_u=100+10D psf profile are summarized on Plate 26. Those for the S_u=200+10D psf strength profile are summarized on Plate 27. All of the computed factors of safety were greater than 2.0 for the S_u=300 + 10D psf strength profile and a plot of these results is not presented.

Using the findings of the settlement and stability analyses, we computed factors of safety for the end of construction condition for fill thicknesses that will result in an eight feet high berm after consolidation. The computed factors of safety for the two weaker soil profiles are presented in Table 2.

Table 2. Factor of safety for fills that will yield an eight feet high berm

Depth of Soft Sea Sediments (ft)	Shear Strength S_u=100+10D psf		Shear Strength S_u=200+10D psf	
	5H:1V Slope	10H:1V Slope	5H:1V Slope	10H:1V Slope
4	1.1	1.8	2.0	3.5
8	1.0	1.6	1.7	2.5
12	0.9	1.5	1.6	2.4

For most projects, the minimum factor of safety for an end of construction condition is commonly required to be at least 1.3. As discussed above, the sea sediments at this site are likely to be highly sensitive and may exhibit considerable strength loss once strained beyond their peak strength. To reduce the risk of overstressing the foundation soil and experiencing a strength reduction, a higher target should be set for the minimum end of construction factor of safety. The selection should be made during final design, when the sensitivity of the sea sediment is more fully assessed. We anticipate that the minimum recommended factor of safety may be on the order of 1.5 or higher.

For the steady state seepage (long term) conditions, we checked two profiles whose end of construction factors of safety were between 1.5 and 2.0. For effective stress parameters, we used an angle of internal friction of 27 degrees and zero cohesion. We assumed a phreatic surface that intercepts the toe of the berm. For eight feet high berms (post settlement), we computed factors of safety for the steady state seepage condition of 1.9 for a 5H:1V slope and 3.2 for a 10H:1V slope.

A pseudo-static stability analyses, using consolidated strengths, was not performed at the conceptual design phase. With long-term static factors of safety of 1.9 to 3.2, the application of an inertial force to represent seismic loading would indicate a factor of safety still greater than 1.0. However, during a large earthquake, we believe that some reduction in strength is likely within the foundation soils and that the embankment foundation may fail. This is discussed in the following section.

D. Seismic Performance

Sand, silty sand and sandy silt were encountered at some of the exploration locations. Standard penetration testing was not a part of the preliminary geotechnical investigation, so no definitive measure (SPT blow count) is available to classify the density of these cohesionless soils. The recent disposition history of these soils suggest that these are all loose deposits. With several seismic sources close by, most notably the San Andreas Fault, sandy materials with little to no cohesion are likely to liquefy during a large nearby earthquake. Lateral deformation and/or settlement is likely to occur if the foundation soils liquefy. Lateral deformation and/or settlement could lead to cracking of the berm, which could in turn lead to increased seepage, internal erosion and a piping failure through the berm. The berm settlement and deformation could also lead to overtopping of the berm.

Seismic shaking may strain some portions of cohesive foundation soils beyond their peak strength. If these soils are highly sensitive, the marked reduction in strength within these overstressed zones would put increased demands on adjacent zones, expanding the overstressed area and potentially leading to instability of the foundation.

A detailed risk analyses was not part of the preliminary geotechnical investigation. The consequences of berm failure are not likely to include property damage beyond that of the ponds, and chance of injury or death from berm failure is low. For the purpose of assessing the economic impact of a seismically-induced berm failure, an annual chance of occurrence of between 1 to 2 percent is reasonable. This applies to berms constructed over the sea sediments. If the sea sediments are excavated and the berms are constructed on the underlying alluvium, the risks decrease.

E. Plasticity and Expansion Potential

Half of the samples tested for Atterberg limits had a plasticity index (PI) greater than 30. More than two-thirds classify as fat clays. These classification tests indicate that these materials have a high potential for shrinking and swelling with changes in moisture content. During our field investigation, we had judged the materials to be lower plasticity, observing a more silt-like behavior than the classification tests indicate. The six bulk and composite samples indicated higher plasticity on average compared to the individual sample tests. The bulk/composite samples were for depth intervals of 3.6 to 5.3 feet. The individual samples from the hand auger borings commonly covered a 1.0 to 1.5 foot depth interval. The vibracore samples covered a 2.7 foot depth interval, though some samples were shorter. We suspect that high plasticity clay layers within the longer stratigraphic samples dominated the sample behavior, masking lower plasticity silts within the sample intervals.

As the Sea level falls and the sea sediments become exposed, cracking is observed on the surface of the playa. These cracks extend at least in the range of 1 to 2 feet deep; though no detailed assessment of the depths of the cracks was performed. Water can be seen within some of the cracks. Surface cracking is an indication of the expansive character of the soil. Though cracking was observed, the pervasiveness was not as extensive as one would expect from the Atterberg limit tests.

F. Dispersion

Dispersive clay soils are clays that disaggregate (or deflocculate and lose their cohesion) easily and rapidly in water of low-salt concentration and become susceptible to erosion and piping. Dispersive clay soils can be eroded by slow-moving water, at gradients that would not erode cohesionless fine sands and silts.

Dispersive clay soils cannot be identified by the usual laboratory index tests such as moisture and dry density measurements, grain size distribution or Atterberg limits. Other special laboratory tests (i.e. crumb test, double hydrometer test, percent sodium in saturation extract and pinhole test) were performed as mentioned earlier. Samples for the pinhole tests were compacted to near 95 percent relative compaction using Standard proctor (ASTM Test D-698) as the laboratory compaction reference. The moisture content was near optimum. This results in a moderately compacted clay. We chose this level of compaction to reflect our belief that higher degrees of compaction may not be readily achievable for the soft site conditions. A summary of the dispersion potential from the individual laboratory tests performed for this purpose is shown in Table 3. Each of these samples were logged as gray fat clay (CH). Detailed results of the dispersion tests are included in Appendix A.

Table 3. Summary of Dispersion Potential

Sample	Crumb Test (ATM Test D-6572)	Double Hydrometer Test (ASTM Test D-4221)	Percent Sodium in Saturation Extract (EPA 60103)	Pinhole Test (ASTM Test D-4647)
HA-1	Nondispersive	Nondispersive	Nondispersive	Dispersive
HA-4	Intermediate	Nondispersive	Nondispersive	Dispersive
VC-11	Dispersive	Dispersive	Nondispersive	Dispersive
VC-16	Intermediate	Nondispersive	Nondispersive	Dispersive
VC-20	Nondispersive	Nondispersive	Nondispersive	Dispersive
VC-28	Nondispersive	Nondispersive	Nondispersive	Dispersive

As shown, the results from the individual tests do not agree. Due to the very high TDS, the correlation with Percent Sodium in Solution Extract and dispersion potential were beyond the range used in the Bureau of Reclamation's chart of percent sodium versus total dissolved salts. Extrapolation of that chart suggests the non-dispersive classification. In general, the pinhole test is considered the most reliable since it is a direct physical test. Based on these considerations, it appears likely that the on-site soils would have a tendency to disperse in a fresh water environment. The validity of extending this finding to the SCH Project ponds, which will retain brackish to saline water, is not clear.

The tendency toward dispersive erosion in a dispersive clay depends on the chemistry of the water. The dispersion potential likely decreases with increasing salinity of the water. The ASTM standard for pinhole test uses distilled water. The retained water will have 20 ppt to 35 ppt TDS. These concentrations may not disperse the clays. To further assess the dispersion potential of the on-site soils, additional pinhole tests are being performed using water of various salt concentrations modeling the waters in the planned ponds.

When dispersive clay soils are used for construction of embankments without filters, piping and erosion may occur. Dispersive piping is usually initiated when water flows into small cracks and fissures caused by desiccation and/or differential settlement, particularly if the soils are placed dry of optimum or not well compacted. The water that flows through the cracks will remove the disaggregated particles, with the rate of removal increasing as the seepage velocity and size of opening increase.

The risk of a dispersive erosion induced failure is greatest in areas of higher seepage potential, such as around pipes through the embankments, adjacent to concrete structures, and at the foundation interface where compaction may have been less methodical. Deep gullies may also form on embankment slopes, where dispersive clay soils are exposed to rainwater run-off as well as water retained by the ponds. Severe dispersive erosion can lead to costly and difficult operation and maintenance.

G. Seepage

A wide range of permeabilities likely occurs within the sea sediments. In some hand auger holes, no apparent water seeped into the boring as it was drilled. In other hand auger borings where sandy silt layers were encountered, water percolated into the hole during drilling. Permeability in the undisturbed sea sediment is likely anisotropic. One slug test was performed in hand auger boring HA-4. The transmissivity was too low to develop reliable data from the sensors used. For purposes of estimating seepage through the soil matrix, the permeability correlations with material type and gradation presented in Table 4 may be used.

Table 4. Permeability Estimates for Conceptual Design

Material Type	Vertical Permeability cm/sec	Horizontal Permeability cm/sec
Sand	$1x10^{-4}$	$1x10^{-3}$
Silty Sand and Clayey Sand	$1x10^{-5}$	$1x10^{-4}$
Silt	$1x10^{-6}$	$1x10^{-5}$
Clay	$1x10^{-7}$	$1x10^{-6}$

Where shrinkage cracks have developed, structure of the soil will dominate seepage performance. The cracking will need to be considered when estimating seepage potential beneath the embankments. The tendency of the embankments themselves to develop shrinkage cracks will also need to be considered in evaluating seepage risks.

Seepage may occur through and beneath the berms. The fills used to construct the berms will be predominately fine grained soils of low permeability. Factors with the greatest potential for causing adverse seepage through the berms include less-than-rigorous placement and compaction methods, cracking due to settlement, shrinkage cracking, and dispersion potential. By “adverse seepage”, we refer to conditions that could potentially lead to internal erosion within the berm.

On the playa, the sea sediments have dried on the surface and shrinkage cracks extend at least a couple of feet. These cracks could become seepage paths beneath the berm fill. Having a pre-existing cracking pattern coupled with the dispersive character of the soil creates risk of piping beneath the berm. Leakage through these cracks can be limited by constructing a wide, shallow cutoff trench during site preparation, prior to placing berm fill. The trench will disrupt the interconnected cracks. Using a non-dispersive soil for the cutoff trench backfill would further reduce the risk of an under seepage failure.

Sand and silty sand within the foundation can be a seepage path beneath the berm. Though some water loss may occur at these locations, the sandy soils would not be dispersive, and the risk is low for a berm failure by under seepage in these soils. The magnitude of seepage through an underlying sand layer may be best controlled by an upstream blanket of lower permeability soil.

If local seepage is identified once the ponds are containing water, excavating a trench parallel to the berm's axis and remixing the soils can be an inexpensive method of disrupting a seepage path and controlling seepage.

IX. CONCLUSIONS

A. General

There are several major considerations in assessing what may be the more efficient methods for constructing the berms. Major considerations include:

- Will the toe of the berm be above the water level in the Sea and will the Sea be covering the site?
- What kind of equipment can access the site?
- Will the berm be supported on the existing weak sea sediments or will the berm fill be placed in such a manner as to intentionally displace (fail) the sediments?
- Will soft sea sediments be used to create the berm or will stiffer soils be used?

These and other issues are addressed in this section.

B. Berm Embankments

In much of the currently submerged areas, the sea sediments are quite weak. To avoid failing the ground, the berm embankments will need to have very flat slopes. In these areas, the ground is too weak to support construction equipment, and barge-mounted equipment will be needed. One method to construct berms in those conditions is to excavate sediment immediately adjacent to the berm's alignment and cast it up on the berm. The berm footprint would be quite wide, and it may be most practical to operate draglines (or similar barge-mounted equipment) on both sides of the berm alignment. The saturated soft berm fill material cannot be effectively compacted. Once the surface of the fill extends more than about one foot above the level of the Sea, the dragline bucket can be dropped on the fill as a means of providing some compactive effort.

This is likely the most cost-effective method for constructing some form of berm in these weak foundation areas. However, the berm fill would be weak and have a high moisture content, subject to shrinking and cracking as the fill dries.

The upper several feet of the fill will need to be moisture conditioned and compacted to provide support for service vehicles.

With a fill poorly compacted and having a high potential for shrinkage cracks, there is risk of seepage developing through the berm. If seepage is observed, it can be remediated by excavating a trench partially down through the center of the berm crest. Within the trench, the excavator bucket can be used to remold the soils at depth. Pre-mixing a thick bentonite slurry to the partially excavated trench can aid the remolding process. This technique would be useful for treating local seepage zones. If seepage over long sections develop, a traditional slurry trench cutoff wall may be needed.

An alternate approach for constructing a berm in submerged areas would be to create a berm using moisture conditioned fill. The fill material could be prepared on the higher portions of the site, above the Sea. In many areas, the sediments are only three to four feet thick. The underlying alluvial soils are stiff and can support track-mounted construction equipment. A pad could be developed for spreading the playa sediments in a thin lift (about one foot thick). The sediments could be moisture conditioned by discing and/or rototilling and kneaded until a moisture content suitable for compaction is developed. Another material source could be to excavate (mine) the alluvial soils beneath the sediments.

The stiff fills would be placed by end-dumping from the end of the berm alignment and advancing the berm as additional fill is placed. The fill can either be placed on the soft sediments or the sediments could be excavated to a firm bottom prior to placing the fill. Soft sediments will not support steeper sloped fills in many areas. The weight of the fill will create a “mud wave” as the displaced sediments are heaved up in front of and/or to the sides of the advancing fill. Creating mudwaves is a valid form of berm construction in very weak areas. One drawback is that the weak soils are displaced in a non-uniform manner and the final thickness of fill will vary along the berm alignment. Excavating the soft soil prior to placing the fill can develop a more uniform thickness fill.

Whether placed with mudwaves or in areas where soft soil is removed, the fills below the water will not be compacted. As the fill extends above the water surface, the fills can be compacted. However, in the mudwave case, the compacted fill will be dropping in irregular sections as the foundation soil becomes over-stressed from increasing fill thickness.

On the playa where sediments can support the fill, they still may not be able to support low ground pressure track-mounted construction equipment. Though the vane shear data indicate the shear strength is greater than 300 psf which would normally support low ground pressure equipment, the potential for strength loss when the soils are overloaded suggests to us that using tracked equipment directly on the playa surface would be risky. Dozing 18-inches to two feet of fill out in front of the tracked equipment and keeping this thickness beneath the tracks may spread the contact pressure enough to support light, low ground pressure equipment. (Note - This discussion is not directed toward suggesting to a contractor what it might take to work on the playa. Rather, it is aimed at providing a general understanding of what kinds of methods may need to be considered in preparing environmental documentation.)

The thick initial lift (bridging lift) will not be well compacted. It would likely only be track-walked by the low ground pressure dozer. A poorly compacted zone has increased potential for seepage. A bridging lift, as well as moisture-conditioned soil placed below water in the previously described method, would not be effectively compacted. An upstream blanket of sediment could be used to resist seepage. If seepage develops, a cutoff wall may be needed.

C. Treating Dispersion

Even if it is determined during the next stage of investigation that the majority of the on-site soils may be dispersive when retaining brackish water, there may be no economic alternative other than to use these soils for the construction of the embankments. Embankments can be constructed with dispersive clay soils provided certain precautionary measures are taken. Some of these precautionary measures are discussed below.

Erosion of dispersive clay soils through embankments can be controlled by properly designed and constructed filters. The filter may be part of a downstream seepage berm. Filter material should be placed around the downstream one-third portion of pipes through the embankments, regardless of whether the soils are dispersive or not.

Embankments constructed with dispersive clay soils should be properly compacted; especially if the soils are being placed around pipes, adjacent to concrete structures, at the foundation interface, and if no filters are being provided. Achieving a well-compacted embankment on the soft subgrade may not be feasible.

Risk of seepage induced failures, including those due to dispersive soils can be reduced somewhat by simply making a wider embankment.

Most dispersive clay soils can be rendered non-dispersive by the addition of lime. Lime modification of dispersive clay soils may be considered for the surface of the embankments to provide slope protection (discussed later). Lime-modified dispersive clay soils may also be considered for portions of the interface with rigid structures such as pipes through the embankments.

A cutoff wall to block seepage through the embankments may be considered to lower the risk of piping. The cutoff wall may consist of a soil-bentonite cutoff wall constructed by slurry trench methods and using non-dispersive clay for source fill. As an alternative, plastic sheetpiling may be considered, but would likely be more expensive than a soil-bentonite cut-off.

Impermeable liners placed on the waterside slopes of the ponds may also be considered to reduce seepage through the embankments. Liners may include plastic liners (such as a thick HDPE membrane) or a well-compacted clay blanket comprised of low-permeability non-dispersive soils.

Most of these schemes reduce the potential rate of dispersion, but the risk of an eventual piping failure may still remain.

D. Shoreline Protection

There are two shorelines for the ponds. The interior of each pond will have water lapping against the interior face of the berm. During construction and during the first several years of operation, the seaward-most berm will be exposed to wave action from the Salton Sea.

For the interior face of the berms, the wave height will be fetch-limited with maximum fetches of about two miles for some ponds. Berm faces derived from sediment fill sources will be highly erodible. Some form of shoreline protection will be needed on the interior faces of the berms. The protective facing will need to extend over the portion of slope face that will be exposed to wave action, including the estimated height of run-up.

The traditional scheme for erosion protection is riprap facing. Riprap would be quarried rock material with an angular to subangular shape. Riprap should be placed on slopes no steeper than 2H:1V. Steeper as opposed to flatter slopes will limit the square footage of berm face that needs to be protected with riprap. Riprap would be placed on a geotextile designed for riprap underlayment.

Soil cement can be used for erosion protection and often is a viable option when riprap is not available. Soil cement consists of mixing portland cement with a locally available source of sand or silty sand. For good quality control, it is preferable to mix the soil cement in a pugmill at a central location within the project site and deliver the soil cement by dump truck to the berm. Soil cement is most efficient when there is little to no clay or organic material in the sands to be treated. Identifying a suitable source of sand within the project site may be a challenge. The vibracores near the mouth of Alamo River (VC-22 and 24) indicated about one foot of silty sand over fat clay and silt. No other surficial sand deposits were identified. These thin layers would be difficult to mine. At present there is no readily available source of sand for soil cement.

A hard clay is erosion resistant, though not nearly to the extent of riprap or soil cement. A hard clay can be developed by lime treating on-site clays. Lime is mixed with the clays on the berm slope and compacted. The equipment can safely operate on a 6H:1V slope. A flatter slope may be more appropriate near the still water elevation where most of the erosion action might occur. This erosion method would have a limited service life, perhaps in the range of five years, before major reconstruction is needed.

Geomembrane facing has been used to line reservoirs. The service life of the linings vary considerably with the type of material used and its resistance to degradation under extended sunlight. A geomembrane would have the smoothest surface of the erosion protection systems addressed here, and for similar slope inclinations would have the highest run-up.

On the outward face of the seaward-most berm, waves from across the 40-mile fetch of the Salton Sea will attach the slope. Unprotected fill will readily erode. The installation of shore protection will be complicated by interfacing the berm embankment construction method selected.

As with the pond interiors, riprap would be our first choice. Depending on the embankment construction method used for the seaward berm, placing riprap can be reasonably efficient to quite inefficient. Some embankment construction methods will have flat slopes or heaved up sediments on the seaward side of the berm. These geometries will be inefficient to armor with riprap. Excavating the sediment in front of placing moisture-conditioned soil can develop reasonably steep slopes, likely in the range of 3H:1V to 5H:1V. These slopes allow reasonably efficient use of riprap.

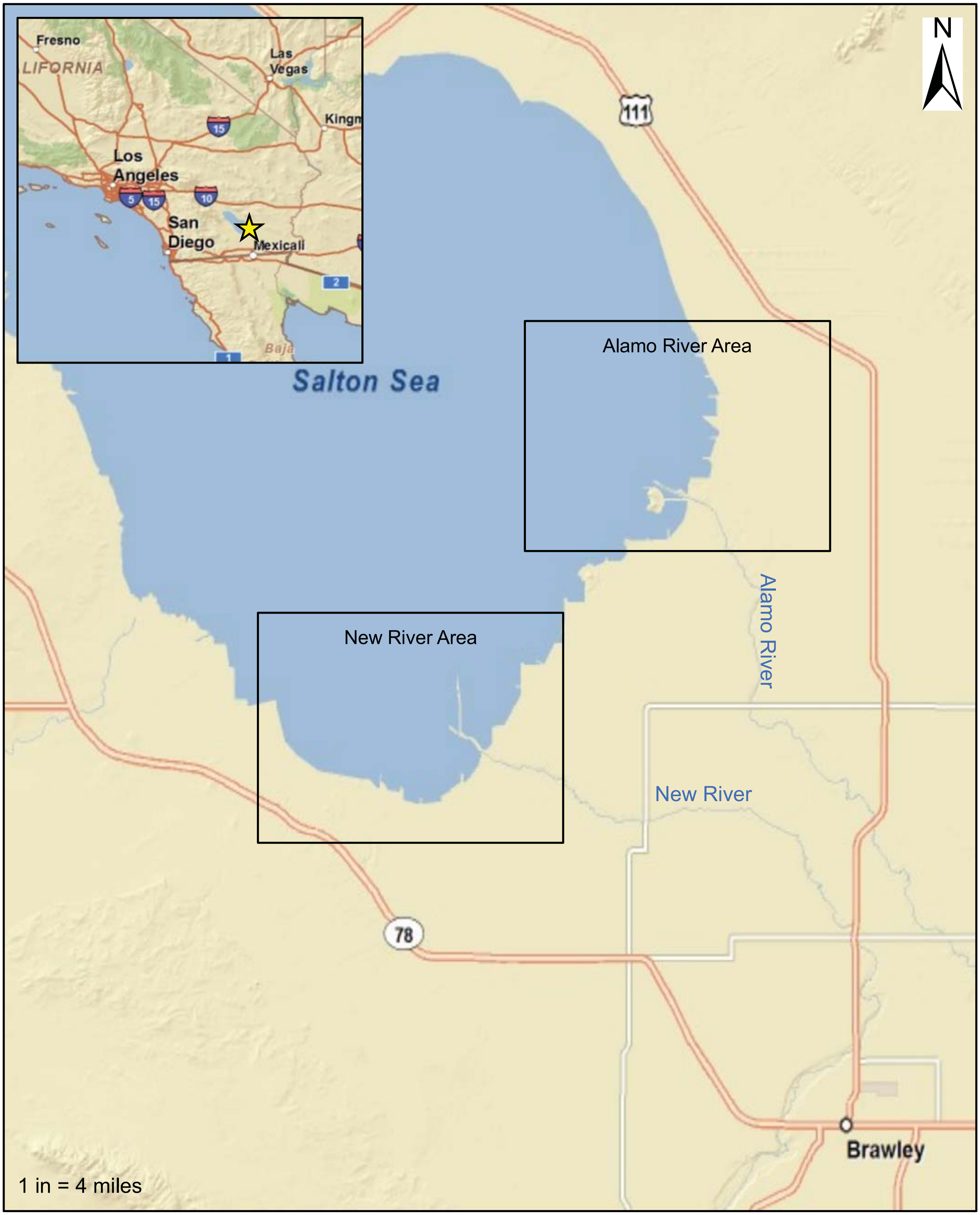
Riprap could be used to create an offshore breakwater, creating a fairly still water pool adjacent to the berm. After the level in the Sea has dropped, the riprap could be more easily salvaged for reuse on future projects if placed against the slope rather than as a separate offshore breakwater.

Other off shore breakwater systems could be considered, including a cable tire system. This system could be relocated further off shore as the Sea level drops.

A geomembrane could be used to wrap the face of fill. Though the material may have a limited service life, the period that sea waves may attack the berm of service would likely be shorter than the service life for many materials. We are not aware of an example of this scheme, suggesting that issues such as how to anchor the geomembrane and how to distribute stresses at anchorage points have not been satisfactorily resolved. Deployment may also be difficult.

A geotube is a large diameter geotextile tube (in the range of 20 to 30 feet in diameter), that is filled by pumping slurried soil into the tube, creating a gravity structure. The more common applications of geotubes include serving as groins to control onshore/offshore and longshore migration of beach sand and as containment structures for fine grained slurries to allow the slurries to drain. The geotube would become the seaward toe of the berm. A geotube would be compatible with the berm construction method of excavating adjacent sediments and casting them up on the landward side of the geotube. Fill for the geotube will need to be sand or silty sand. The material requirements of the sands would not be as strict as those for soil-cement. Material logged as clayey sand in the hand auger borings and vibracores would likely be suitable fill. This material was found in limited locations. Further exploration near the mouths of the New and Alamo Rivers may disclose additional sources of silty sand or sand.

PLATES



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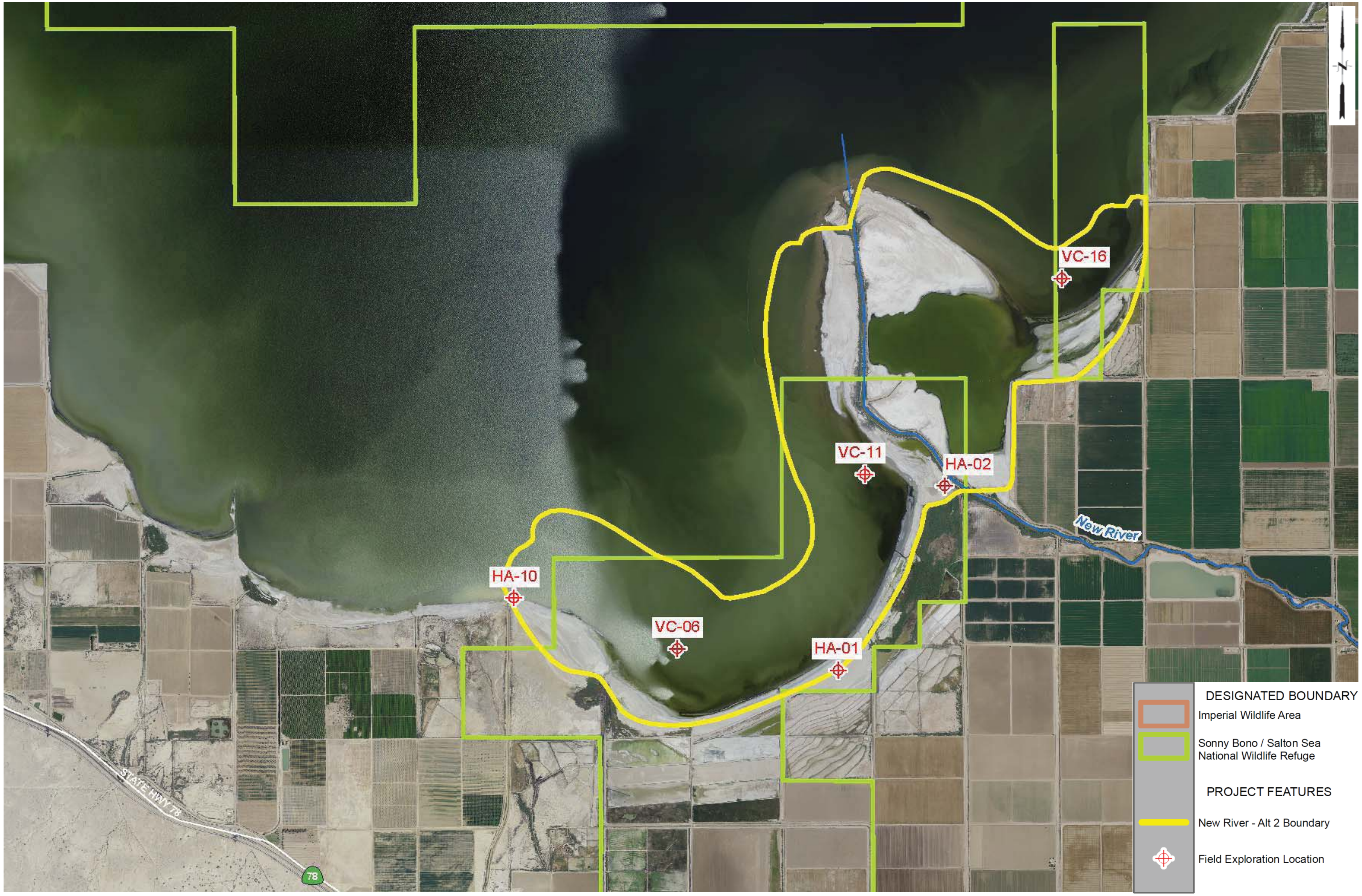
Vicinity Map

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 1



1 inch = 2,700 feet
Approximate Scale

Salton Sea SCH Project Salton Sea, California	**Exploration Site Plan** **New River**	
Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 2

1 inch = 2,700 feet
Approximate Scale

Salton Sea SCH Project Salton Sea, California		**Exploration Site Plan** **Alamo River**
Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 3

Date : 9/15/2010
Drilling Method : Hand Auger
Elevation (Feet) :
Latitude : 33.0949
Longitude : -115.6957

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
						Fat Clay (CH), olive gray, moist, medium stiff, with occassional sand partings			63*	44*	Full Suite**
	B							45			Sieve
1						Becoming wet	0.33				
				CH		Becoming dark gray					
2						Becoming saturated					
	B						0.33	65			Sieve
3	B			CL		Lean Clay (CL), gray, saturated, medium stiff	0.41	35			
						Lean Clay (CL), reddish brown, saturated, stiff					
4	B			CL			0.55	22	42	27	Sieve
5											

Bottom of boring at 5 feet
No groundwater encountered during drilling.
Refusal to vane shear device at 5.2 feet.
*Atterberg Limits measurements on bulk sample (0 - 3.6 feet).
**Full suite of laboratory tests on bulk sample (0 - 3.6 feet).

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 9/16/2010 Drilling Method : Hand Auger Elevation (Feet) : Latitude : 33.1099 Longitude : -115.6855 Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
						Lean Clay (CL), tan brown, moist, medium stiff to soft, with some shell fragments					
	B										
1								31			
							0.32				
						Becoming dark gray, saturated					
2				CL	∇						
	B						0.24	45	43	24	Sieve
3											
							0.21				
	B							54			
4											
	B			ML		Silt (ML), reddish brown, saturated, medium stiff	0.40	41			

Bottom of boring at 4.3 feet
Groundwater encountered during drilling. Refusal to cone penetrometer at 4.3 feet.

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Log of HA-2
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 5

Field	Value
Date	9/14/2010
Drilling Method	Hand Auger
Elevation (Feet)	
Latitude	33.1939
Longitude	-115.6129

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
0–2					Silt (ML), mottled olive brown, moist, stiff to medium stiff, low plasticity			56*	36*	Sieve* Full Suite**
1	B		ML				29			
2–3.5					Lean Clay (CL), gray, moist, soft to medium stiff, with some fine grained sand, low plasticity	0.22				
	B		CL		Becoming wet, with shell fragments		33			Sieve
						0.24				
3.5–7					Fat Clay (CH), dark gray, wet, soft to medium stiff					
						0.21				
	B			▽			46			Sieve
			CH							
						0.23				
	B					0.26	47			
7					Bottom of boring at 7.0 feet	0.24				

Vane shear device used to measure undrained shear strength to a depth of 7.2 feet
Groundwater encountered during drilling.
*Atterberg Limits measurement and sieve analysis on bulk sample (0 - 5.3 feet).
**Full suite of laboratory tests on bulk sample (0 - 5.3 feet).

Date : 9/14/2010
Drilling Method : Hand Auger
Elevation (Feet) :
Latitude : 33.1981
Longitude : -115.5979

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
						Fat Clay (CH), mottled olive gray, moist, meduim stiff, trace of organics, rare salt crystals					
	B							44			
1											
							0.44				
						Becoming moist, thin shell bed at 1.5 feet					
2	B					Sand seams between 1.7 and 2 feet		49	52	28	Sieve
							0.31				
				CH		Becoming dark gray, saturated, soft to medium stiff, organic odor					
3											
						Soft zone between 3 and 3.5 feet					
	B						0.21	55			
4											
						Becoming gray	0.29				
	B							49			
5	B			SM	∇	Silty Sand (SM), dark gray, fine grained, saturated, loose	0.22	20			Sieve

Bottom of boring at 5.3 feet
Groundwater encountered during drilling. Refusal to cone penetrometer at 5.0 feet.

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Log of HA-5
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 7

Date : 9/17/2010
Drilling Method : Hand Auger
Elevation (Feet) :
Latitude : 33.1836
Longitude : -115.6222

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
						Lean Clay (CL), mottled tan and dark gray, wet, medium stiff to soft, with shell fragments					
	B							44			
1				CL							
							0.21				
2						Sandy Lean Clay (CL), wet, medium stiff, organic odor					
	B			CL			0.33	44	31	15	Sieve
						Clayey Sand (SC), gray, saturated, medium dense					
3				SC			0.42				
	B							29			
				CL		Sandy Lean Clay (CL), gray, saturated, stiff					
4						Lean Clay (CL), gray, saturated, stiff					
	B			CL			0.68+	33			
						Lean Clay (CL), reddish brown, saturated, stiff					
	B			CL				31			
5							0.68+				

Bottom of boring at 5 feet
No groundwater enountered.
Refusal to vane shear device at 4.5 feet.
Refusal to cone penetrometer at 6 feet.

Date : 9/16/2010
Drilling Method : Hand Auger
Elevation (Feet) :
Latitude : 33.1009
Longitude : -115.7263

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
	B			ML-CL		Clayey Silt (ML-CL), tan and gray, dry to moist, soft to medium stiff, with sand, abundant shell fragments		25	25	5	Sieve
1					∇	Becoming dark gray to black, saturated	0.29				
2	B			SC		Clayey Sand (SC), tan, saturated, loose to medium dense	0.28	21			Sieve
3	B						0.35	34			
4	B			CL		Sandy Lean Clay (CL), reddish brown, saturated, stiff	0.50	31			
5											

Bottom of boring at 5 feet
Groundwater encountered during drilling. Refusal to vane shear device at 3.3 feet.
Refusal to cone penetrometer at 5.3 feet.

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Log of HA-10
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 758.01 | Plate No. 9

Date : 9/17/2010
Drilling Method : Vibracore
Elevation (Feet) :
Latitude : 33.0968
Longitude : -115.7109

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
1	V			ML		Silt (ML), gray, saturated, soft to stiff, with sand, organic odor	0.12	69	NP	NP	Sieve
2						No recovery below 1.3 feet	0.68+				

Bottom of boring at 2 feet
Water level approximately 2 feet above surface.
Refusal to vane shear device at 1.5 feet.

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Log of VC-6
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 758.01 | Plate No. 10

Date : 9/17/2010
Drilling Method : Vibracore
Elevation (Feet) :
Latitude : 33.1109
Longitude : -115.6931

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
	V					Fat Clay (CH), gray, saturated, very soft, organic odor		31	68*	47*	Sieve* Full Suite**
1							0.05				
2	V			CH			0.11	56			
3							0.11				
						No recovery below 3.6 feet					
4							0.14				
5						Bottom of boring at 5.0 feet	0.22				
6							0.36				
7							0.61				
8							0.68+				

Refusal to vane shear device at 8.5 feet
Vane Shear device used to measure undrained shear strength to a depth of 8.5 feet.
*Atterberg Limits measurements on bulk sample (0 - 3.6 feet).
**Full suite of laboratory tests on bulk sample (0 - 3.6 feet).

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Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 11

Date : 9/17/2010
Drilling Method : Vibracore
Elevation (Feet) :
Latitude : 33.1268
Longitude : -115.6743

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
				CH		Fat Clay (CH), gray, saturated, very soft, organic odor			66*	46*	Sieve* Full Suite**
	V							43			
1							0.05				
2							0.13				
						Becoming soft					
	V							52			
3				CL		Lean Clay (CL), reddish brown, saturated, soft	0.17				
4						No recovery below 4.0 feet	0.12				
5							0.26				
							0.68+				
6											
7											

Bottom of boring at 7.5 feet
Water level approximately 2-feet above surface.
Refusal to vane shear device at 5.5 feet.
*Atterberg Limits measurements and sieve analysis on bulk sample (0 - 3.9 feet).
**Full suite of laboratory tests on bulk sample (0 - 3.9 feet).

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Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 12

Date : 9/14/2010
Drilling Method : Vibracore
Elevation (Feet) :
Latitude : 33.188
Longitude : -115.6184

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
	V			ML		Sandy Silt (ML), gray, saturated, medium stiff, organic odor		44	NP	NP	Sieve
1						Silt (ML), gray, saturated, soft to medium stiff, low plasticity	0.28				
2	V			ML			0.17	34			
3							0.39				
4						Fat Clay (CH), gray, saturated, soft to medium stiff, organic odor	0.25		58	37	
5	V			CH			0.29	38			Sieve
6						Becoming stiff at 6 feet	0.68+				
						No recovery below 6.2 feet					
7											

Bottom of boring at 7.5 feet
Water level on the surface.
Refusal to vane shear device at 6 feet.

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Log of VC-19
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 13

Date : 9/14/2010
Drilling Method : Vibracore
Elevation (Feet) :
Latitude : 33.1891
Longitude : -115.617

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
						Fat Clay (CH), gray, saturated, medium stiff, organic odor			67*	49*	Sieve* Full Suite**
1	V						0.32	29			
2							0.27				
				CH							
3						Becoming soft	0.19				
	V							39			
4							0.17				
						No recovery below 4.7 feet					
5							0.45				
6							0.68+				

Bottom of boring at 6 feet
Water level approximately 1-foot above surface.
Refusal to vane shear device at 6 feet.
*Atterberg Limits measurements and sieve analysis on bulk sample (0 - 4.7 feet).
**Full suite of laboratory tests on bulk sample (0 - 4.7 feet).

Salton Sea
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Salton Sea, California

Log of VC-20
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 14

Date	: 9/14/2010
Drilling Method	: Vibracore
Elevation (Feet)	:
Latitude	: 33.1901
Longitude	: -115.6065

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
						Fat Clay (CH), gray, saturated, very soft, organic odor					
1	V						0.04	56			
2				CH			0.07				
3							0.11				
	V							53	57	38	Sieve
4						Becoming soft to medium stiff	0.18				
5						No recovery below 4.8 feet	0.41				

Bottom of boring at 5.5 feet
Water level on the surface.
Refusal to vane shear device at 5.3 feet.

Salton Sea
SCH Project
Salton Sea, California

Log of VC-21
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 15

Date : 9/14/2010
Drilling Method : Vibracore
Elevation (Feet) :
Latitude : 33.2018
Longitude : -115.6183

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
	V			SM		Silty Sand (SM), gray, saturated, loose to medium dense, organic odor		33			
1							0.11				
						Fat Clay (CH), gray, saturated, soft, with sand					
2							0.14				
	V			CH				32	60	41	Sieve
3							0.19				
4							0.20				
						No recovery below 4.0 feet					
5							0.20				
6							0.21				
7							0.31				

Bottom of boring at 7 feet
Water level approximately 1-foot above surface.
Refusal to vane shear device at 7.2 feet.

Salton Sea
SCH Project
Salton Sea, California

Log of VC-22
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 758.01 | Plate No. 16

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 9/14/2010 Drilling Method : Vibracore Elevation (Feet) : Latitude : 33.2176 Longitude : -115.6115 Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
	V			SM		Silty Sand (SM), gray, saturated, loose		28	NP	NP	Sieve
1							0.27				
						Silt (ML), gray, saturated, medium stiff to soft, organic odor, non-plastic					
2							0.17				
	V			ML				57			
3							0.18				
						Lean Clay (CL), gray, saturated, soft, organic odor					
4							0.16				
5	V			CL			0.20	42	26	10	Sieve
6							0.21				
						No recovery below 6.4 feet					
7							0.60				

Bottom of boring at 7.5 feet
Water level approximately 2-inches above surface.
Refusal to vane shear device at 7 feet.

Salton Sea
SCH Project
Salton Sea, California

Log of VC-24
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 758.01 | Plate No. 17

Date : 9/14/2010
Drilling Method : Vibracore
Elevation (Feet) :
Latitude : 33.2274
Longitude : -115.5999

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Vane Shear (tsf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Other Laboratory Tests
	V					Fat Clay (CH), gray, saturated, very soft, organic odor		48	65*	47*	Sieve* Full Suite**
1							0.10				
	V							45			
2							0.10				
3				CH			0.12				
4							0.11				
	V							64			
5						Becoming soft	0.13				
						No recovery below 5.7 feet					
6							0.14				
7							0.22				

Bottom of boring at 7 feet
Water level approximately 1-foot above surface.
Refusal to vane shear device at 7.3 feet.
*Atterberg Limits measurements and sieve analysis on bulk sample (0.4 - 5.7 feet).
**Full suite of laboratory tests on bulk sample (0.4 - 5.7 feet).

Salton Sea
SCH Project
Salton Sea, California

Log of VC-28
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 18

MAJOR DIVISIONS				GROUP NAMES
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	**GRAVELS** MORE THAN 50% OF COARSE FRACTION IS RETAINED ON NO. 4 SIEVE	**CLEAN GRAVELS** WITH LESS THAN 5% FINES	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SANDS 50% OR MORE OF COARSE FRACTION PASSES NO. 4 SIEVE	**CLEAN SANDS** WITH LESS THAN 5% FINES	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		SANDS WITH OVER 12% FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS 50% OR MORE PASSES NO. 200 SIEVE	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50		ML	SILT
			CL	LEAN CLAY
			OL	ORGANIC CLAY, ORGANIC SILT
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE		MH	ELASTIC SILT
			CH	FAT CLAY
			OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			Pt	PEAT

UNIFIED SOIL CLASSIFICATION SYSTEM- ASTM D 2487

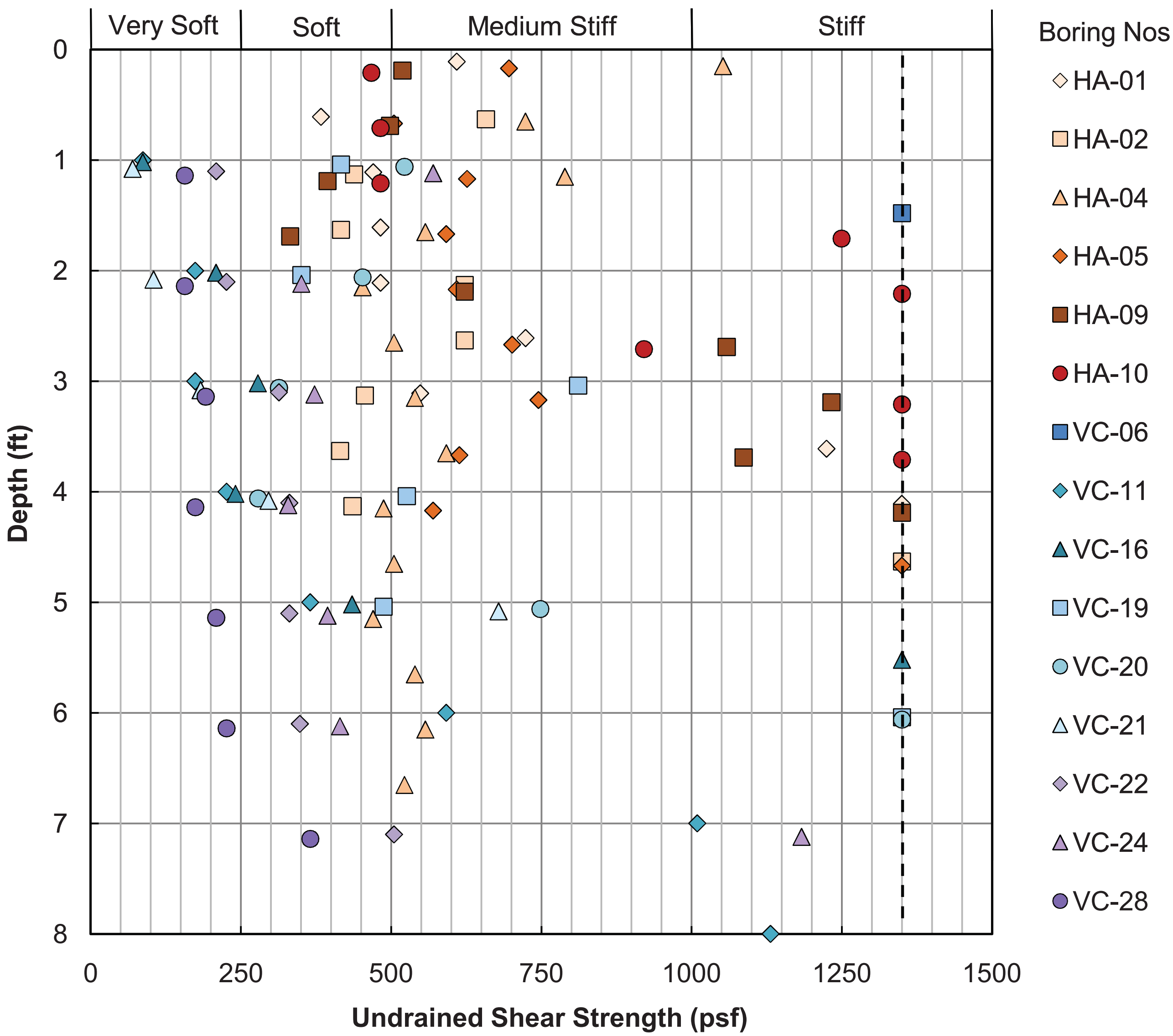
S	- SPT	▽	- Water Level at Time of Drilling	P	- Push
		▼	- Water Level after Drilling (with date measured)	Perm	- Permeability
V	- Vibracore	Consol	- Consolidation	Sieve	- Particle Size Analysis
		Gs	- Specific Gravity	-200	- % Passing No. 200 Sieve
C	- 3.0 inch	TxUU	- Shear Strength (psf) - Unconsolidated Undrained Triaxial Shear		
		TxCU	- Shear Strength (psf) - Consolidated Undrained Triaxial Shear		
T	- Shelby Tube	UC	- Compressive Strength (psf) - Unconfined Compression		
B	- Bag				

KEY TO TEST DATA

Salton Sea
SCH Project
Salton Sea, California

Soil Classification

Hultgren - Tillis Engineers | Project No. 758.01 | Plate No. 19

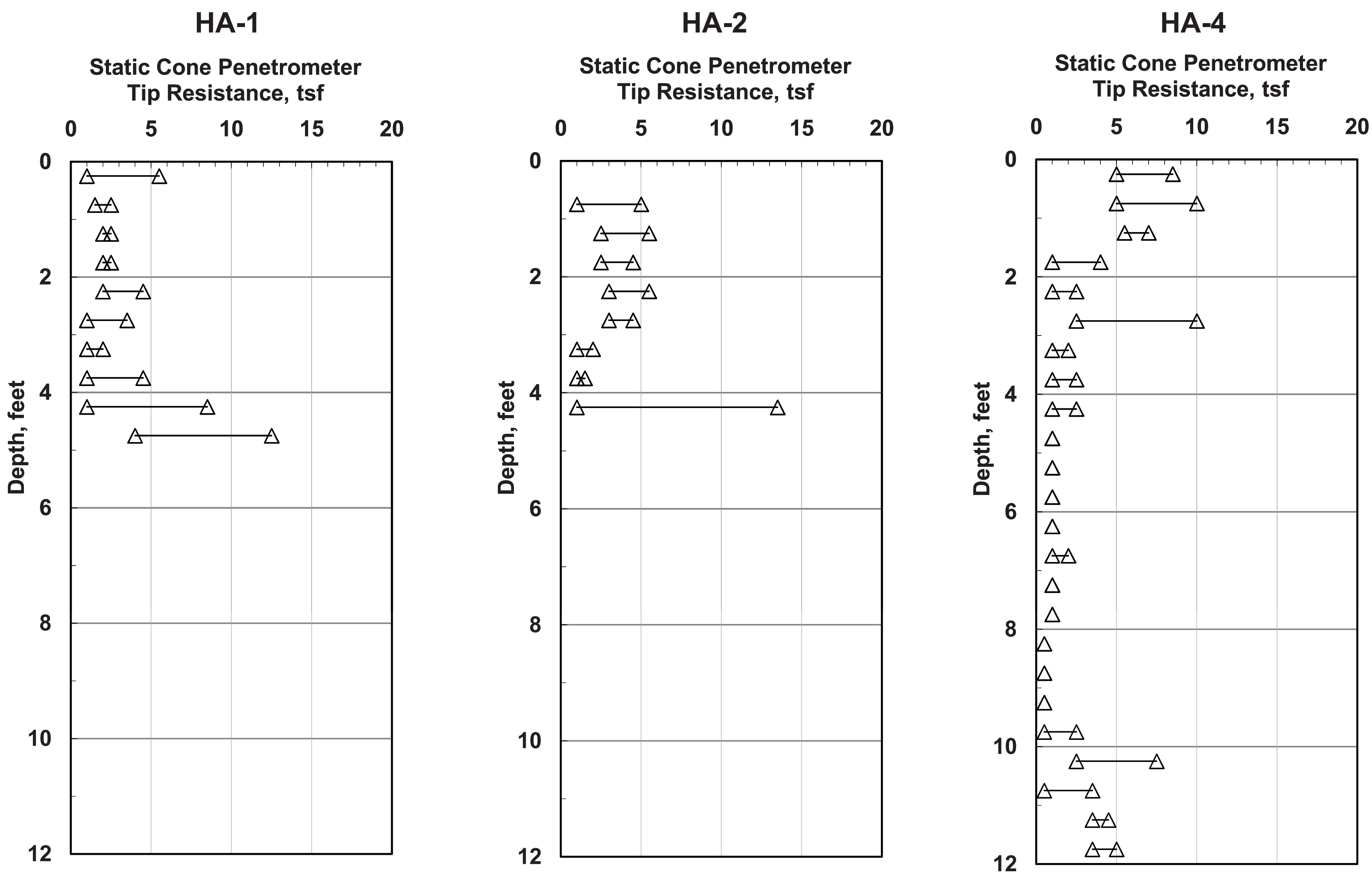


Notes:

1. Undrained shear strength was measured using hand held vane shear device (Model: Geonor H-60) manufactured by Geonor, Inc.
2. Undrained shear strength data shown in the plot above were modified by the Bjerrum's field vane correction factor (μ) in correlation with plastic index (PI).
3. Atterberg limits (LL and PI) measurements were conducted on selected samples only. PI's of soil samples without directly measurements were estimated by soil types accordingly .
4. The Hand Auger (HA) and Vibracore (VC) borings were presented using warm and cold colors, respectively.
5. Data points falling on the vertical dashed gridline indicate the soil samples have an undrained shear strength exceeding 1350 psf (65 kPa), the maximum value for the vane used.

Salton Sea SCH Project Salton Sea, California	**Vane Shear Results**

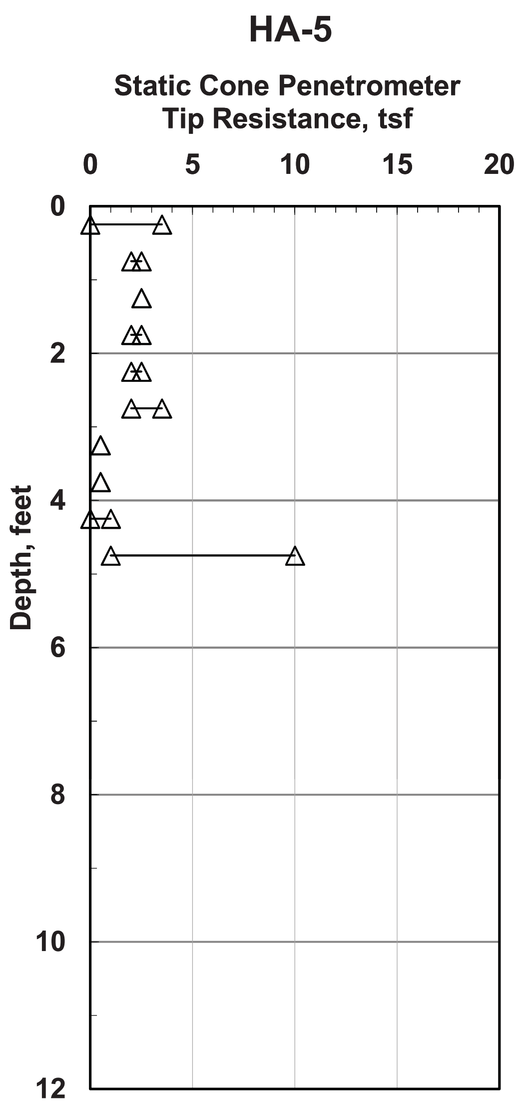
Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 20

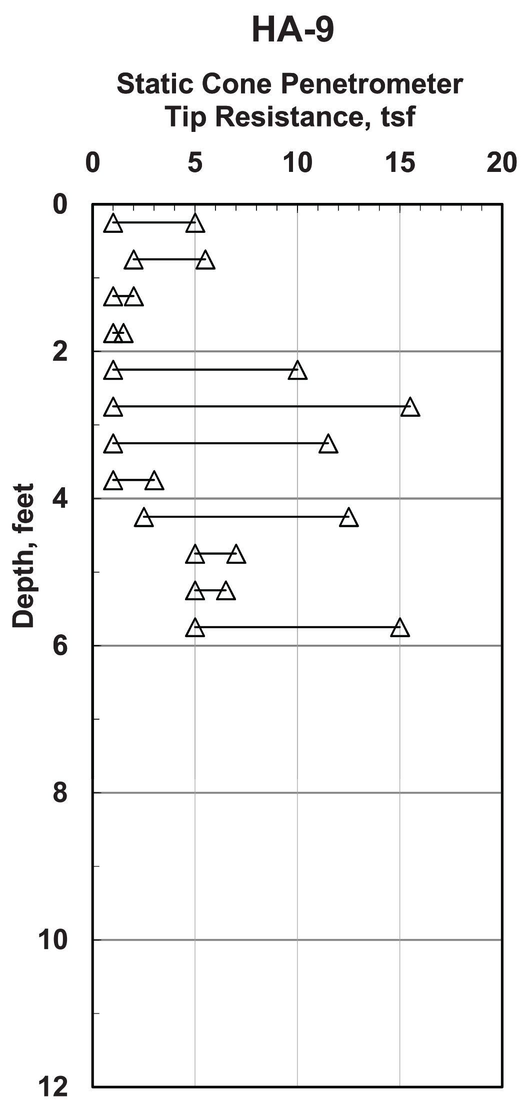


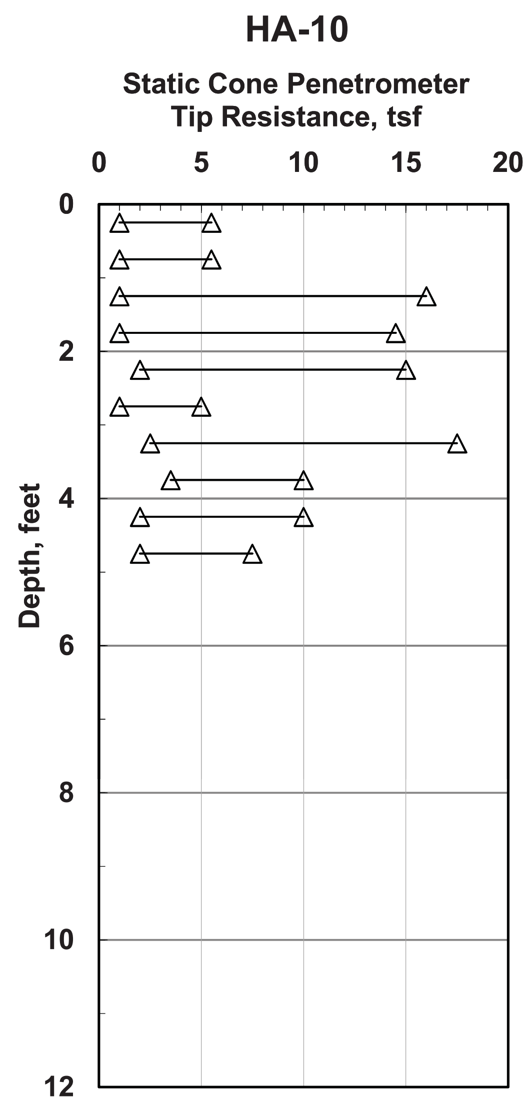
Note:
1. Portable Static Cone Penetrometer (Durham Geo Slope Indicator Model S-214).
2. Range of penetration resistance (max and min) shown for 0.5 feet intervals.

Salton Sea SCH Project Salton Sea, California	**Penetrometer Results**

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 21



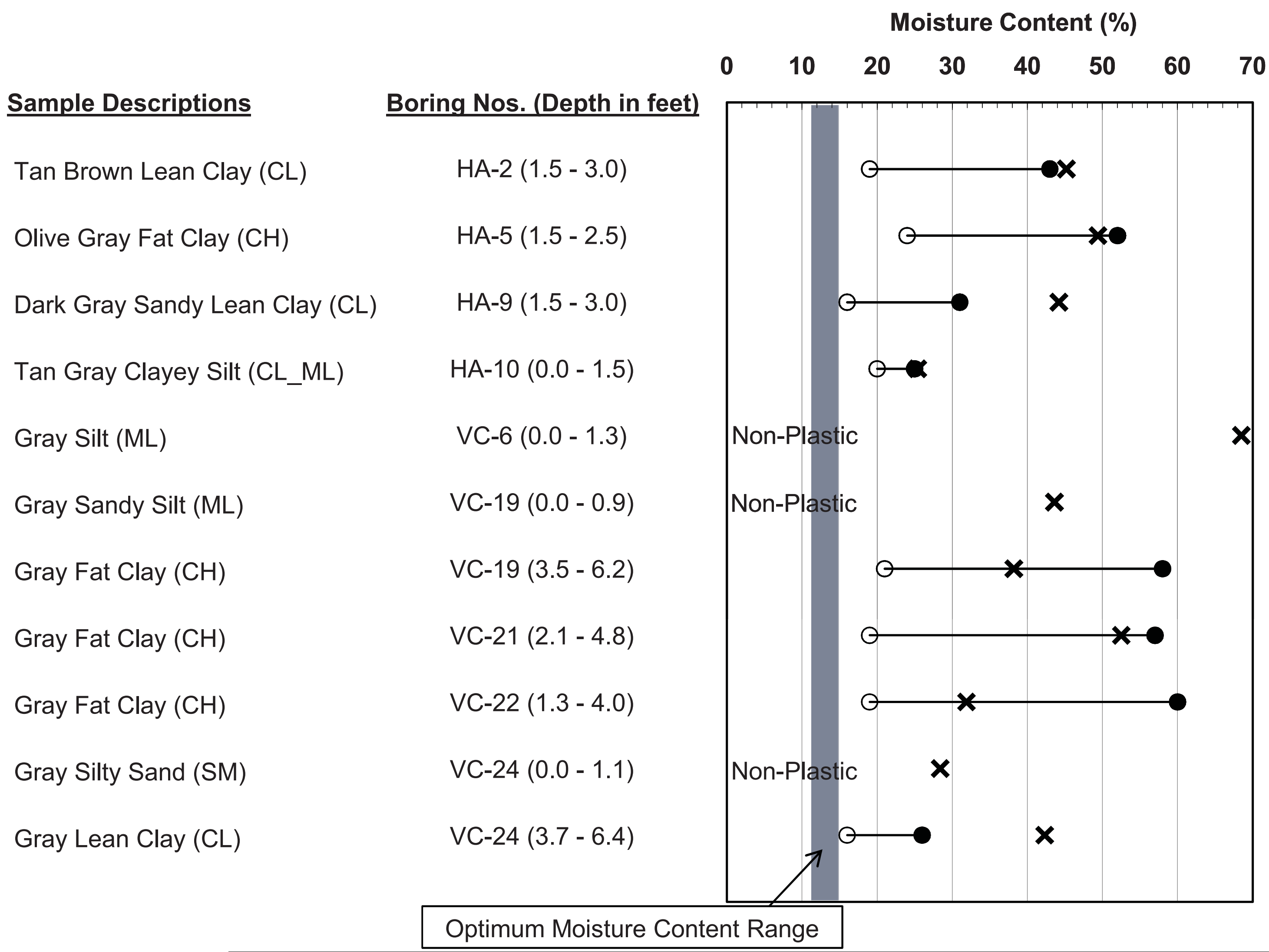


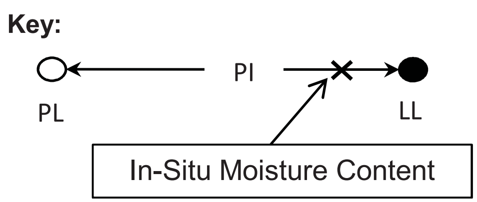


Note:

1. Portable Static Cone Penetrometer (Durham Geo Slope Indicator Model S-214).
2. Range of penetration resistance (max and min) shown for 0.5 feet intervals.

Salton Sea SCH Project Salton Sea, California		**Penetrometer Results**
Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 22

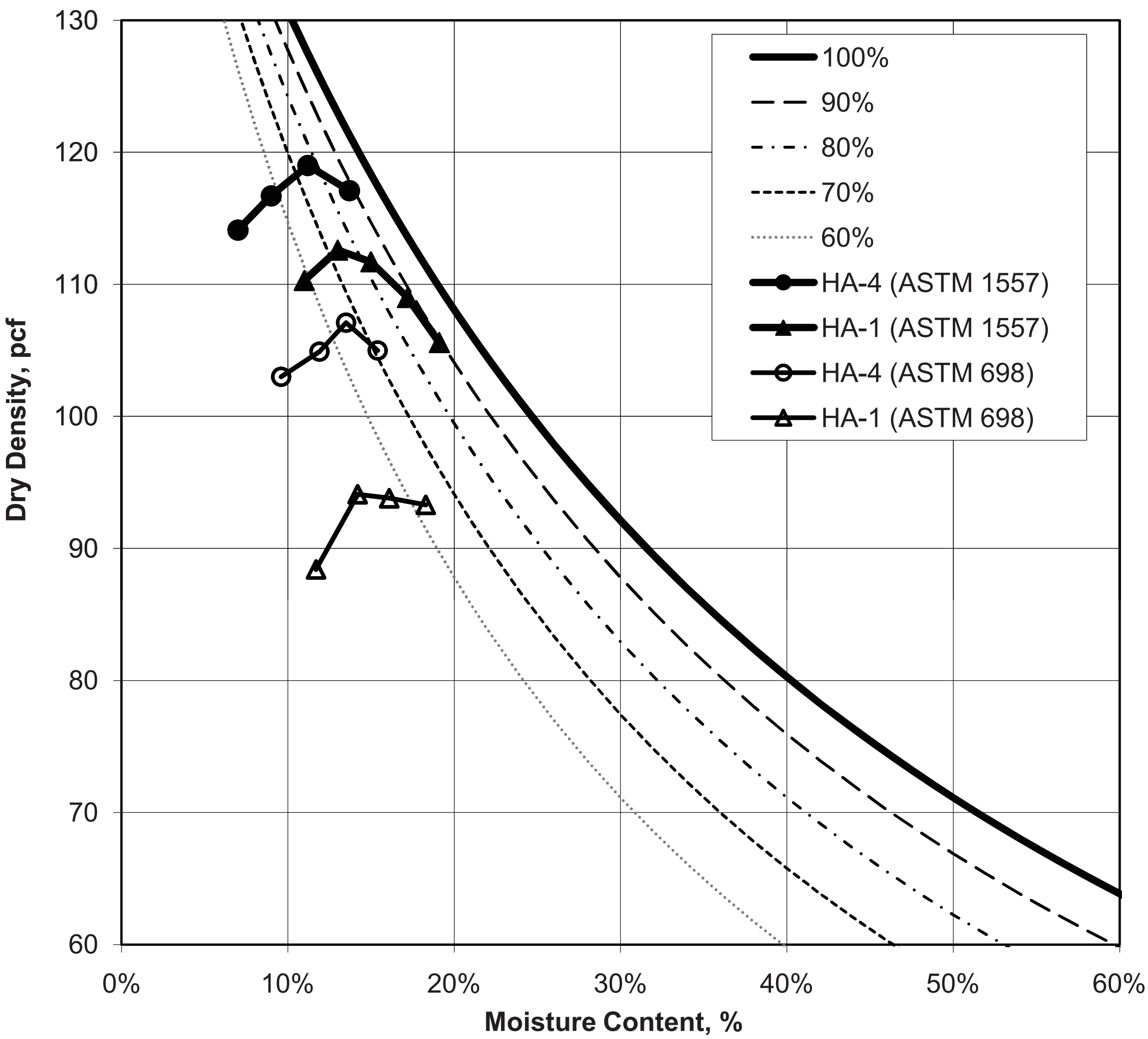




Salton Sea SCH Project Salton Sea, California	**In-Situ Moisture Contents Relative to Atterberg Limts Sea Sediments**

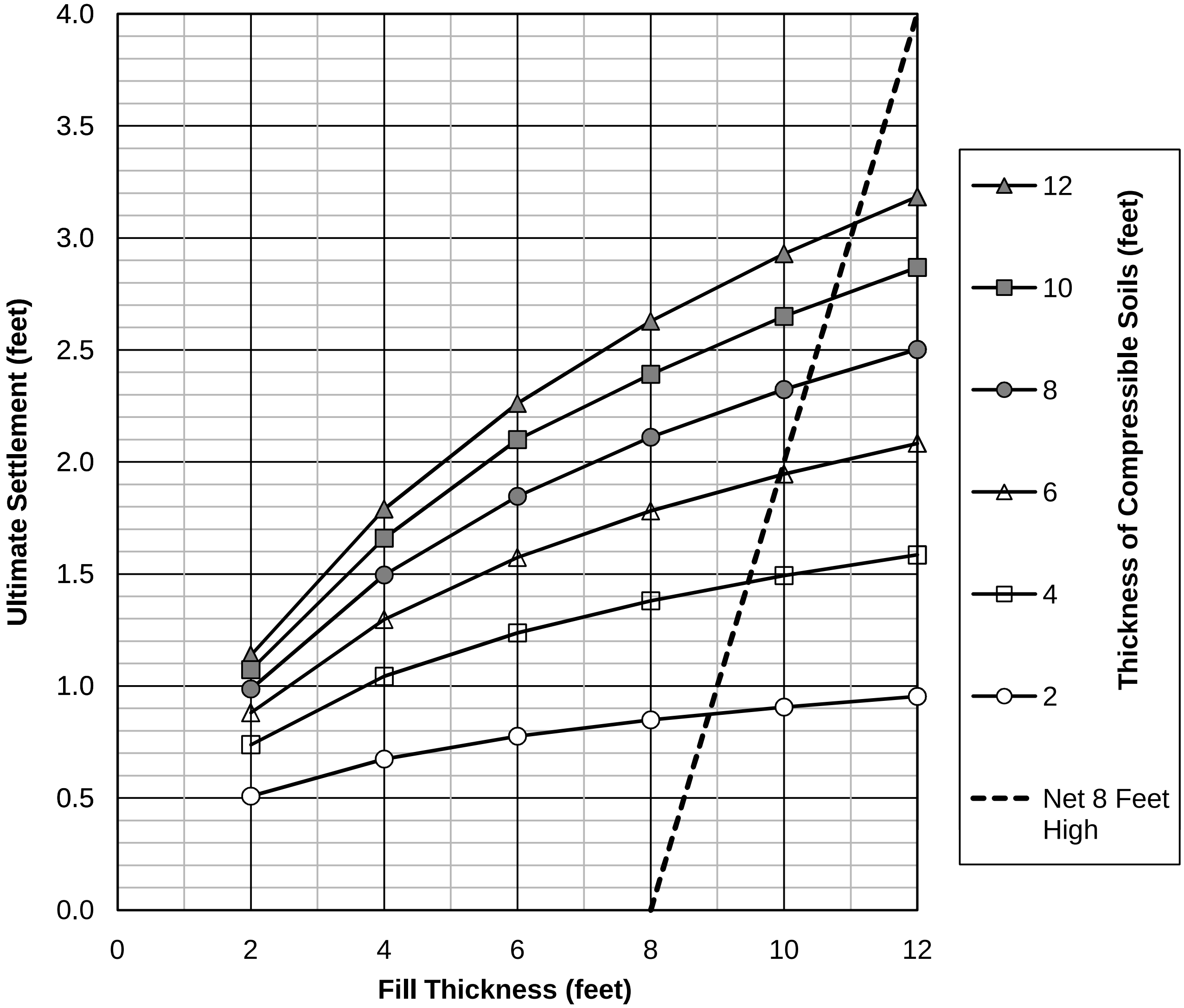
Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 23

Compaction Test Results
(Saturation Curves Assume Specific Gravity = 2.65)



Salton Sea SCH Project Salton Sea, California	**Compaction Test Results**

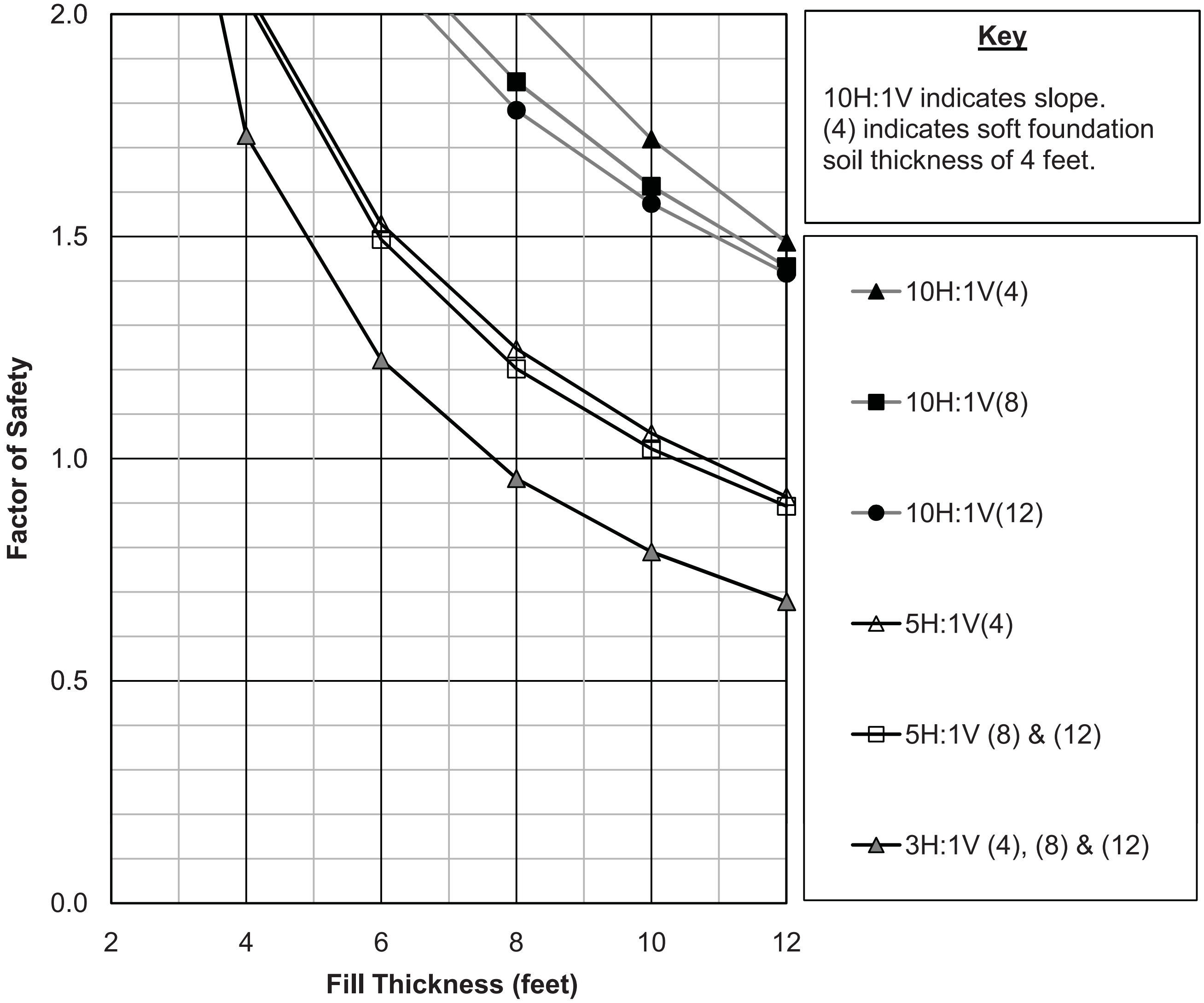
Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 24



Notes:
1. Analyses based on uniform thickness fills placed on top of normally consolidated compressible soils with a thickness varying from 2 to 12 feet.
2. Analyses assume the ground water table at the top of compressible soils.
3. Analyses assume compressible soils with a coefficient of compressibility (C_{ce}) of 0.3 and an unit weight of 100 pcf, and fills with an unit weight of 110 pcf.
4. "Net 8 Feet High" line indicates the thickness of fill needed for final berm to be eight feet above original grade after settlement is complete.

Salton Sea SCH Project Salton Sea, California	**Ultimate Settlement vs Fill Thickness**

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 25

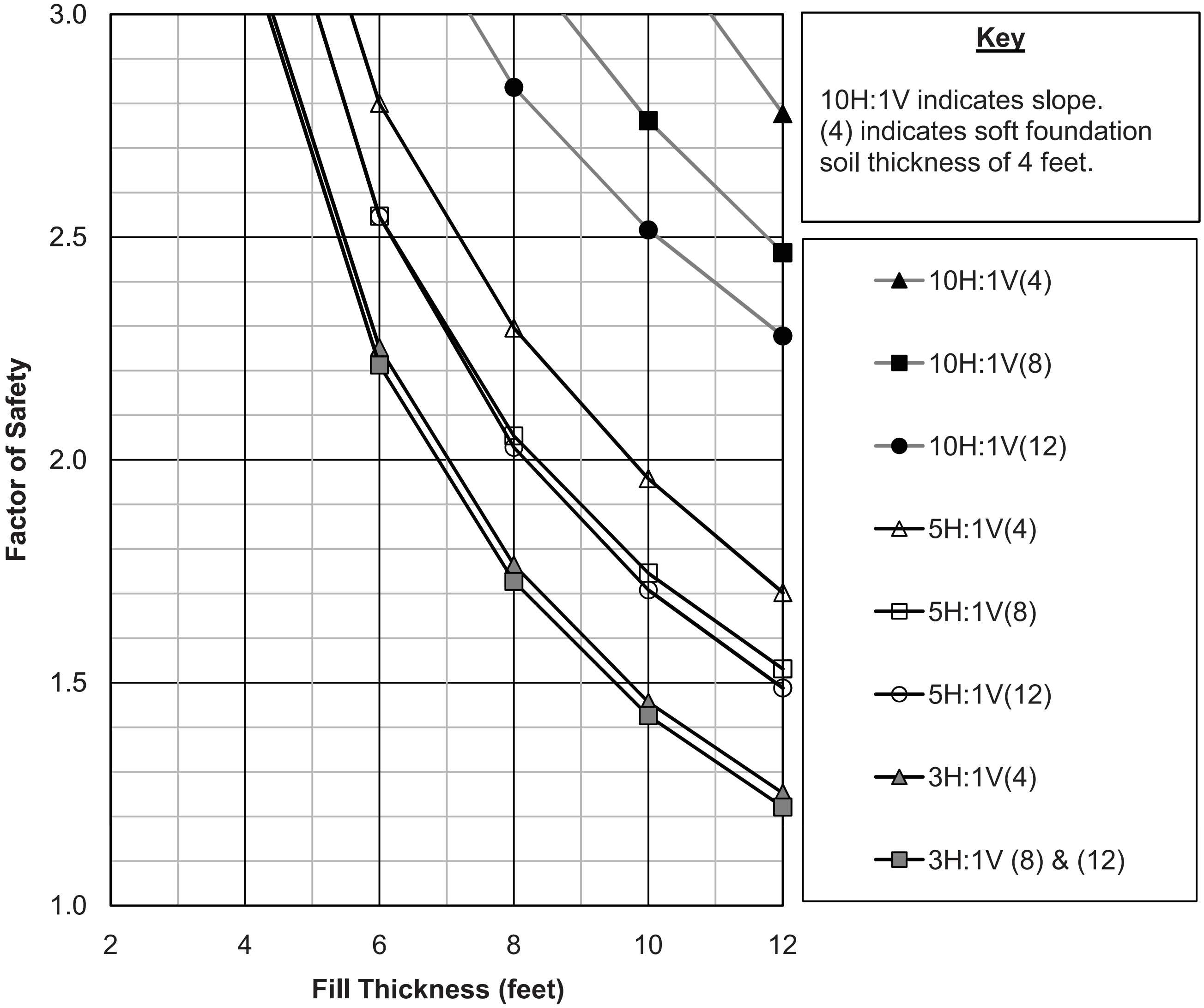


Notes:

1. Factor of Safety represents the Immediately-After-Construction condition.
2. Analyses assume uniform slopes (3H:1V, 5H:1V and 10H:1V) with a maximum slope height varying form 2 to 12 feet, constructed on top of soft foundation soils of 4, 8, and 12 feet in thickness.
3. Analyses assume an undrained strength (Su) of 100 psf at top of the foundation soils and increase 10 psf per foot of depth. Strength Profile (foundation soils): Su = 100+10D (psf).
4. Analyses assume an undrained strength of 100 (psf) of fill.
5. Analyses assume the ground water table at the top of the foundation soils.

Salton Sea SCH Project Salton Sea, California	**Factor of Safety vs Fill Thickness** **Su = 100 + 10 D (psf)**

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 26



Key

10H:1V indicates slope.
(4) indicates soft foundation soil thickness of 4 feet.

Notes:

1. Factor of Safety represents the Immediately-After-Construction condition.
2. Analyses assume uniform slopes (3H:1V, 5H:1V and 10H:1V) with a maximum slope height varying form 2 to 12 feet, constructed on top of soft foundation soils of 4, 8, and 12 feet in thickness.
3. Analyses assume an undrained strength (Su) of 200 psf at top of the foundation soils and increase 10 psf per foot of depth. Strength Profile (foundation soils): Su = 200+10D (psf).
4. Analyses assume an undrained strength of 200 (psf) of fill.
5. Analyses assume the ground water table at the top of the foundation soils.

Salton Sea SCH Project Salton Sea, California	**Factor of Safety vs Fill Thickness** **Su = 200 + 10 D (psf)**

Hultgren - Tillis Engineers	Project No. 758.01	Plate No. 27

APPENDIX A

Laboratory Test Results

APPENDIX A
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- Chemical Analyses .... Plate A-53
- Double Hydrometer and Crumb Tests .... Plate A-61
- Pinhole Tests .... Plate A-67

Summary of Laboratory Test Results

Table A-1

Boring No.	Depth (ft.)	Unified Soil Classification/ Description	In-situ Moisture Content (%)	Soil Fines Passing No. 200 Sieve (%)	Atterberg Limits			Organic Content (%)	Compaction (Stand.)		Compaction (Mod.)		Anion Fracton				Cation				Double Hydrometer Dispersion (%)	Crumb Test (Grade)	Pinhole Test - Dispersive Classification
					LL	PL	PI		Max Dry Density (pcf)	Optimum Moisture Content (%)	Max Dry Density (pcf)	Optimum Moisture Content (%)	Bromide (mg/kg)	Chloride (mg/kg)	Nitrate (mg/kg)	Nitrite (mg/kg)	Calcium (mg/kg)	Magnesium (mg/kg)	Potassium (mg/kg)	Sodium (mg/kg)			
HA-1	0.0 - 1.5	Olive Gray Fat Clay (CH)	45	94																			
HA-1	1.5 - 3.0	Olive Gray Fat Clay (CH)	65	91																			
HA-1	3.0 - 3.6	Gray Lean Clay (CL)	35																				
HA-1	3.6 - 5.0	Reddish Brown Lean Clay (CL)	22	97	42	15	27																
HA-1	0.0 - 3.6	Bulk Sample		89	63	19	44	Non-Organic	94	15	113	13	ND	29000	ND	ND	62000	11000	5900	18000	11	1 - Nondispersive	D1 - Dispersive
HA-2	0.0 - 1.5	Tan Brown Lean Clay (CL)	31																				
HA-2	1.5 - 3.0	Tan Brown Lean Clay (CL)	45	99	43	19	24																
HA-2	3.0 - 4.0	Dark Gray Lean Clay (CL)	54																				
HA-2	4.0 - 4.3	Reddish Brown Silt (ML)	41																				
HA-4	0.0 - 2.0	Olive Brown Silt (ML)	29																				
HA-4	2.0 - 3.5	Gray Lean Clay (CL)	33	85																			
HA-4	3.5 - 5.3	Dark Gray Fat Clay (CH)	46	93																			
HA-4	5.3 - 7.0	Dark Gray Fat Clay (CH)	47																				
HA-4	0.0 - 5.3	Bulk Sample		75	56	20	36	Non-Organic	107	14	119	11	ND	12000	ND	ND	48000	9000	3700	8500	17	2 - Intermediate	D1 - Dispersive
HA-5	0.0 - 1.5	Olive Gray Fat Clay (CH)	44																				
HA-5	1.5 - 2.5	Olive Gray Fat Clay (CH)	49	94	52	24	28																
HA-5	2.5 - 4.0	Dark Gray Fat Clay (CH)	55																				
HA-5	4.0 - 4.9	Gray Fat Clay (CH)	49																				
HA-5	4.9 - 5.3	Dark Gray Sandy Fat Clay (CH)	20	72																			
HA-9	0.0 - 1.5	Tan & Gray Lean Clay (CL)	44																				
HA-9	1.5 - 3.0	Dark Gray Sandy Lean Clay (CL)	44	62	31	16	15																
HA-9	3.0 - 4.0	Gray Clayey Sand (SC)	29																				
HA-9	4.0 - 4.5	Gray Lean Clay (CL)	33																				
HA-9	4.5 - 4.8	Reddish Brown Lean Clay (CL)	31																				
HA-10	0.0 - 1.5	Tan & Gray Clayey Silt (CL-ML)	25	78	25	20	5																
HA-10	1.5 - 3.0	Tan Clayey Sand (SC)	21	42																			
HA-10	3.0 - 4.0	Tan Sandy Lean Clay (CL)	34																				
HA-10	4.0 - 5.0	Reddish Brown Lean Clay (CL)	31																				
VC-6	0.0 - 1.3	Gray Silt (ML)	69	83	NV	NP	NP																
VC-11	0.0 - 0.8	Gray Fat Clay (CH)	31																				
VC-11	0.8 - 3.6	Gray Fat Clay (CH)	56																				
VC-11	0.0 - 3.6	Bulk Sample		90	68	21	47	Non-Organic					ND	5,500	ND	ND	41,000	8,000	3,700	6,400	61	3 - Dispersive	D2 - Dispersive
VC-16	0.0 - 1.3	Gray Fat Clay (CH)	43																				
VC-16	1.3 - 3.9	Gray Fat Clay (CH) & Reddish Brown Lean Clay (CL)	52																				
VC-16	0.0 - 3.9	Bulk Sample		95	66	20	46	Non-Organic					ND	6,900	ND	ND	36,000	7,500	3,500	6,700	9	2 - Intermediate	D1 - Dispersive
VC-19	0.0 - 0.9	Gray Sandy Silt (ML)	44	64	NV	NP	NP																
VC-19	0.9 - 3.5	Gray Silt (ML)	34																				
VC-19	3.5 - 6.2	Gray Fat Clay (CH)	38	93	58	21	37																
VC-20	0.0 - 2.0	Gray Fat Clay (CH)	29																				
VC-20	2.0 - 4.7	Gray Fat Clay (CH)	39																				
VC-20	0.0 - 4.7	Bulk Sample		89	67	18	49	Non-Organic					ND	4,600	ND	ND	40,000	7,600	2,000	4,600	13	1 - Nondispersive	D2 - Dispersive
VC-21	0.0 - 2.1	Gray Fat Clay (CH)	56																				
VC-21	2.1 - 4.8	Gray Fat Clay (CH)	53	98	57	19	38																
VC-22	0.0 - 1.3	Gray Silty Sand (SM)	33																				
VC-22	1.3 - 4.0	Gray Fat Clay (CH)	32	75	60	19	41																
VC-24	0.0 - 1.1	Gray Silty Sand (SM)	28	40	NV	NP	NP																
VC-24	1.1 - 3.7	Gray Silt (ML)	57																				
VC-24	3.7 - 6.4	Gray Lean Clay (CL)	42	89	26	16	10																
VC-28	0.0 - 0.4	Gray Fat Clay (CH)	48																				
VC-28	0.4 - 3.0	Gray Fat Clay (CH)	45																				
VC-28	3.0 - 5.7	Gray Fat Clay (CH)	64																				
VC-28	0.4 - 5.7	Bulk Sample		98	65	18	47	Non-Organic					ND	8,600	ND	ND	48,000	7,900	3,400	8,400	9	1 - Nondispersive	D2 - Dispersive

Note:

1. "Bulk Sample" indicates that lsample was recovered over a wide depth interval. Several additional hand auger borings were drilled immediately adjacent to the logged boring to recover a large quantity of soil for testing. The depth interval is noted.
2. "Composite sample" indicates that a sample that extends more than one 2.7-feet section of vibracore tubing. The depth interval is noted.
3. Abbreviations - NV: No Value, NP: Non Plastic, ND: Not Detected.

Tests on Individual Samples

DENSITY MOISTURE

PROJECT	Hultgren - Tillis Engineers (Salton Sea)	DATE	10/5/2010
PROJECT NUMBER	60	TECHNICIAN	997

BORING NO.	HA-1				HA-2				HA-4	
DEPTH, ft	0-1.5	1.5-3	3-3.6	3.6-5	0-1.5	1.5-3	3-4	4-4.3	0-2	2-3.5
SAMPLE NO.										
LENGTH (IN.)										
TOTAL WT. (g)										
WET WT. (g)	423.1	357.9	400.2	454.4	421.1	465.6	432.3	406.9	609.7	609.4
DRY WT. (g)	291.4	216.7	297.6	371.7	322.6	320.6	281.7	289.6	473.4	457.4
WET DENSITY										
% MOISTURE	**45.2**	**65.2**	**34.5**	**22.2**	**30.5**	**45.2**	**53.5**	**40.5**	**28.8**	**33.2**
DRY DENSITY										

BORING NO.	HA-4		HA-5					HA-9		
DEPTH, ft	3.5-5.3	5.3-7	0-1.5	1.5-2.5	2.5-4	4-4.9	4.9-5.3	0-1.5	1.5-3	3-4
SAMPLE NO.										
LENGTH (IN.)										
TOTAL WT. (g)										
WET WT. (g)	522.2	437.7	455.3	599.2	443	410.4	519.3	550.6	441.7	585.9
DRY WT. (g)	357.1	298.3	316.3	401.1	285.8	276.4	433.6	383.6	306.4	453.2
WET DENSITY										
% MOISTURE	**46.2**	**46.7**	**43.9**	**49.4**	**55.0**	**48.5**	**19.8**	**43.5**	**44.2**	**29.3**
DRY DENSITY										

DENSITY MOISTURE

PROJECT Hultgren - Tillis Engineers (Salton Sea) DATE 10/5/2010

PROJECT NUMBER 60 TECHNICIAN 997

BORING NO.	HA-9		HA-10				VC-6C	VC-11B	VC-11C	VC-16B
DEPTH, ft	4-4.5	4.5-4.8	0-1.5	1.5-3	3-4	4-5	0-1.3	0-0.8	0.8-3.6	0-1.3
SAMPLE NO.										
LENGTH (IN.)										
TOTAL WT. (g)										
WET WT. (g)	518.9	252.4	578.9	583.5	557.8	562.2	442.2	288.8	471.4	480.9
DRY WT. (g)	389.6	192.2	461.7	483.1	416.5	430.4	262.4	220.9	302.9	336.6
WET DENSITY										
% MOISTURE	**33.2**	**31.3**	**25.4**	**20.8**	**33.9**	**30.6**	**68.5**	**30.7**	**55.6**	**42.9**
**							**14/1.5**	**8.5/0.5**	**33/0**	**13/0.5**

** Length of Solid column/Length of Water Column, Respectively, IN

BORING NO.	VC-16C	VC-19A	VC-19B	VC-19C	VC-20B	VC-20C	VC-21B	VC-21C	VC-22B	VC-22C
DEPTH, ft	1.3-3.9	0-0.9	0.9-3.5	3.5-6.2	0-2	2-4.7	0-2.1	2.1-4.8	0-1.3	1.3-4
SAMPLE NO.										
LENGTH (IN.)										
TOTAL WT. (g)										
WET WT. (g)	345.6	220	496.3	325.9	481.7	317.8	523.9	439.8	336.6	482.1
DRY WT. (g)	227.4	153.2	370.1	235.9	374.2	228.7	336.5	288.4	253.3	365.6
WET DENSITY										
% MOISTURE	**52.0**	**43.6**	**34.1**	**38.2**	**28.7**	**39.0**	**55.7**	**52.5**	**32.9**	**31.9**
**	**33/0**	**7.5/0.5**	**32.0**	**33/0**	**21.5/1.0**	**33/0**	**21/2**	**33/0**	**8.5/0**	**31/0.5**

** Length of Solid column/Length of Water Column, Respectively, IN

DENSITY MOISTURE

PROJECT Hultgren - Tillis Engineers (Salton Sea) DATE 10/5/2010

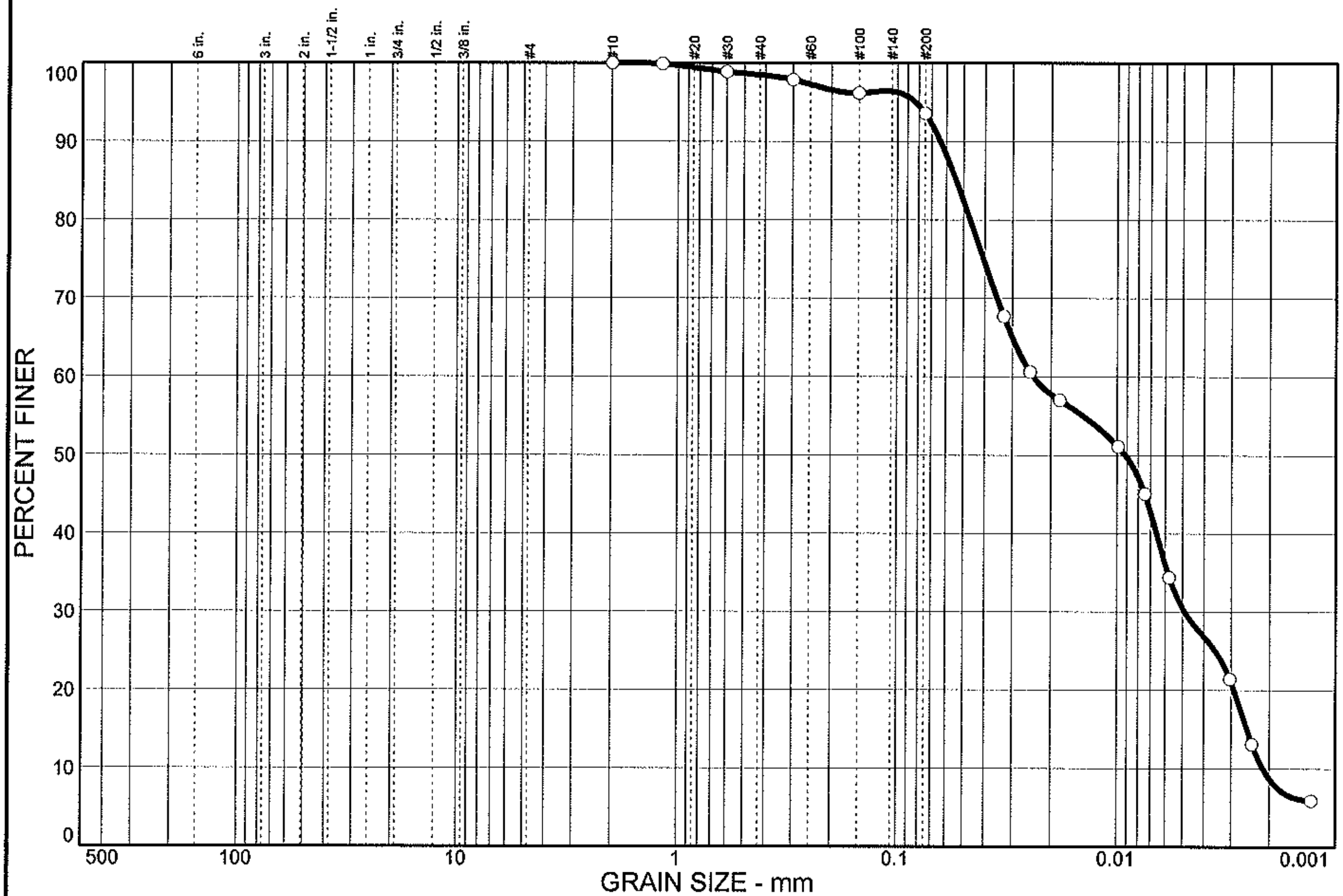
PROJECT NUMBER TECHNICIAN 997

BORING NO.	VC-24A	VC-24B	VC-24C	VC-28A	VC-28B	VC-28C				
DEPTH, ft	0-1.1	1.1-3.7	3.7-6.4	0-0.4	0.4-3	3-5.7				
SAMPLE NO.										
LENGTH (IN.)										
TOTAL WT. (g)										
WET WT. (g)	342.7	440	444.7	306.7	488.6	335.9				
DRY WT. (g)	266.9	280.9	312.4	207.3	337.9	205.5				
WET DENSITY										
% MOISTURE	**28.4**	**56.6**	**42.3**	**47.9**	**44.6**	**63.5**				
**	**10/1**	**31/0**	**32/0**	**3/6**	**32/0**	**28.5/0**				

** Length of Solid column/Length of Water Column, Respectively, IN

BORING NO.										
DEPTH, ft										
SAMPLE NO.										
LENGTH (IN.)										
TOTAL WT. (g)										
WET WT. (g)										
DRY WT. (g)										
WET DENSITY										
% MOISTURE										
DRY DENSITY										

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	1.5	4.9	63.1	30.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	98.9		
#50	97.9		
#100	96.2		
#200	93.6		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.0540 D_{60}= 0.0241 D_{50}= 0.0091
D_{30}= 0.0049 D_{15}= 0.0025 D_{10}= 0.0021
C_u= 11.25 C_c= 0.46

Classification

USCS= AASHTO=

Remarks

F.M.=0.07

Sample No.: HA-1 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 0-1.5 Feet

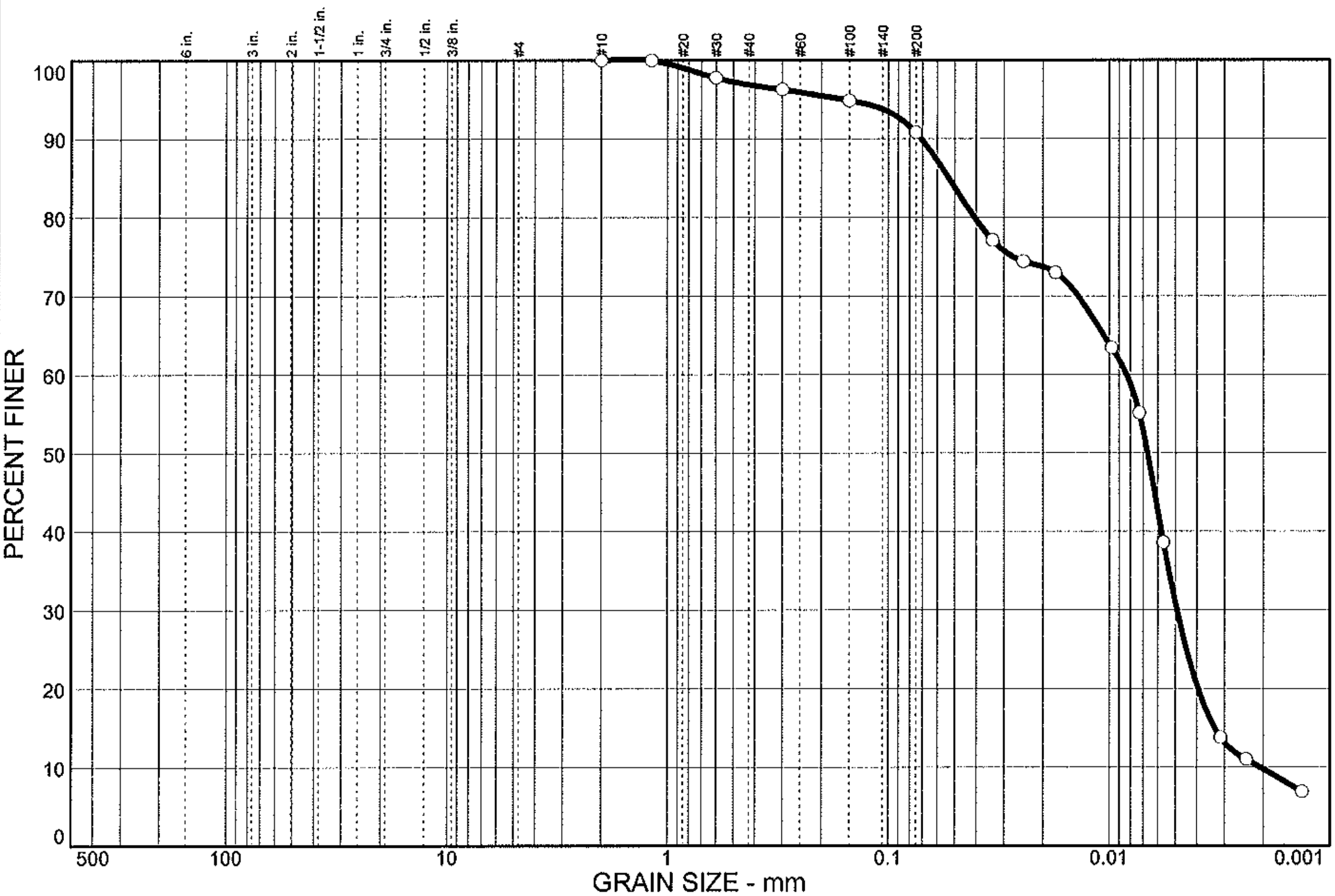
Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea

Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	3.1	6.1	59.9	30.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	97.8		
#50	96.3		
#100	94.9		
#200	90.8		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.0532 D_{60}= 0.0083 D_{50}= 0.0067
D_{30}= 0.0049 D_{15}= 0.0033 D_{10}= 0.0021
C_u= 4.02 C_c= 1.41

Classification

USCS= AASHTO=

Remarks

F.M.=0.11

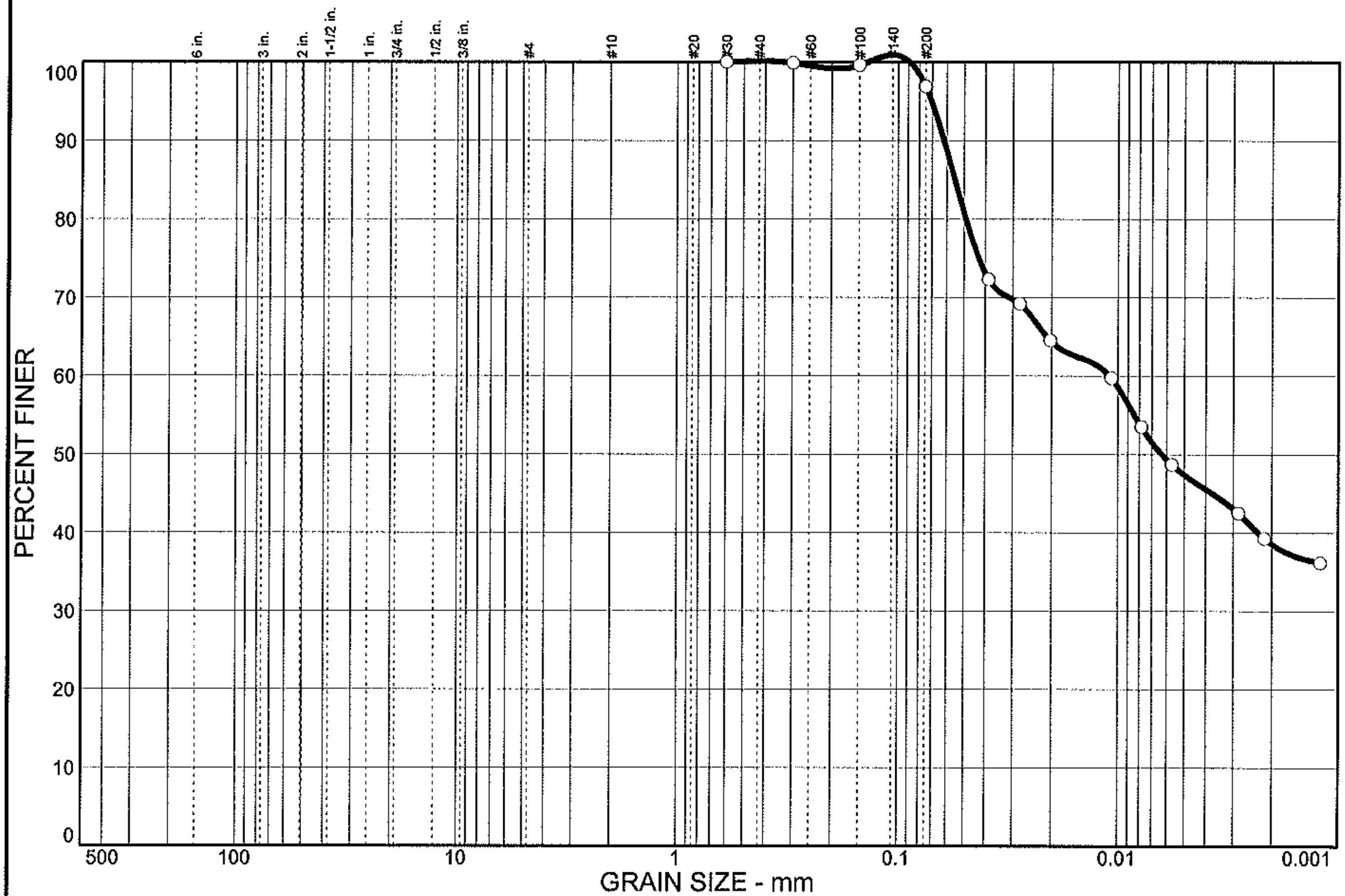
Sample No.: HA-1 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 1.5-3 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0		3.2	49.5	47.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#50	99.9		
#100	99.6		
#200	96.9		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.0551 D_{60}= 0.0109 D_{50}= 0.0063
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.00

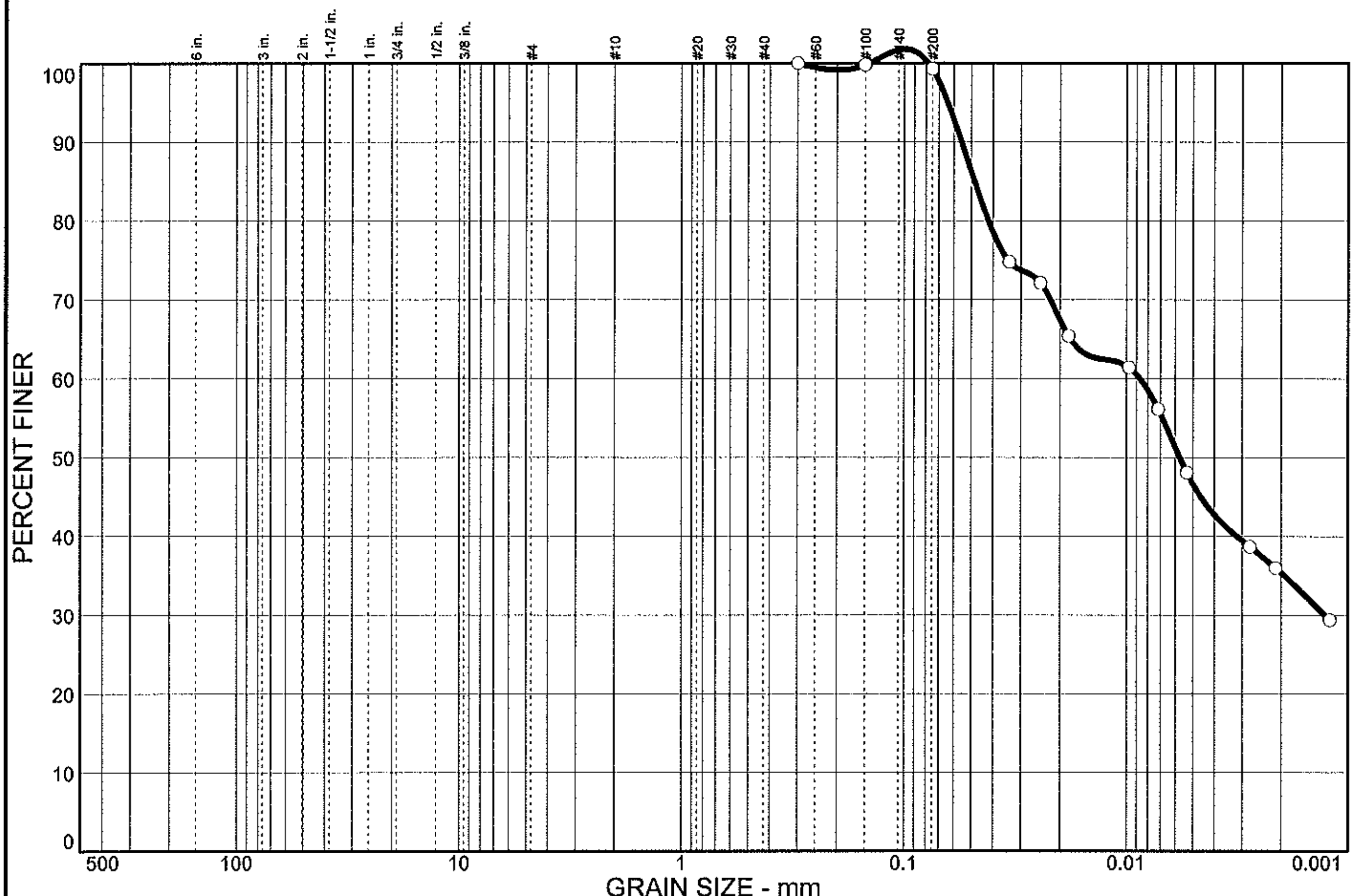
Sample No.: HA-1 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 3.5-5 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.0	0.7	52.6	46.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#50	100.0		
#100	99.8		
#200	99.3		

* (no specification provided)

Material Description

Atterberg Limits

PL= 19 LL= 43 PI= 24

Coefficients

D_{85}= 0.0485 D_{60}= 0.0087 D_{50}= 0.0057
D_{30}= 0.0013 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

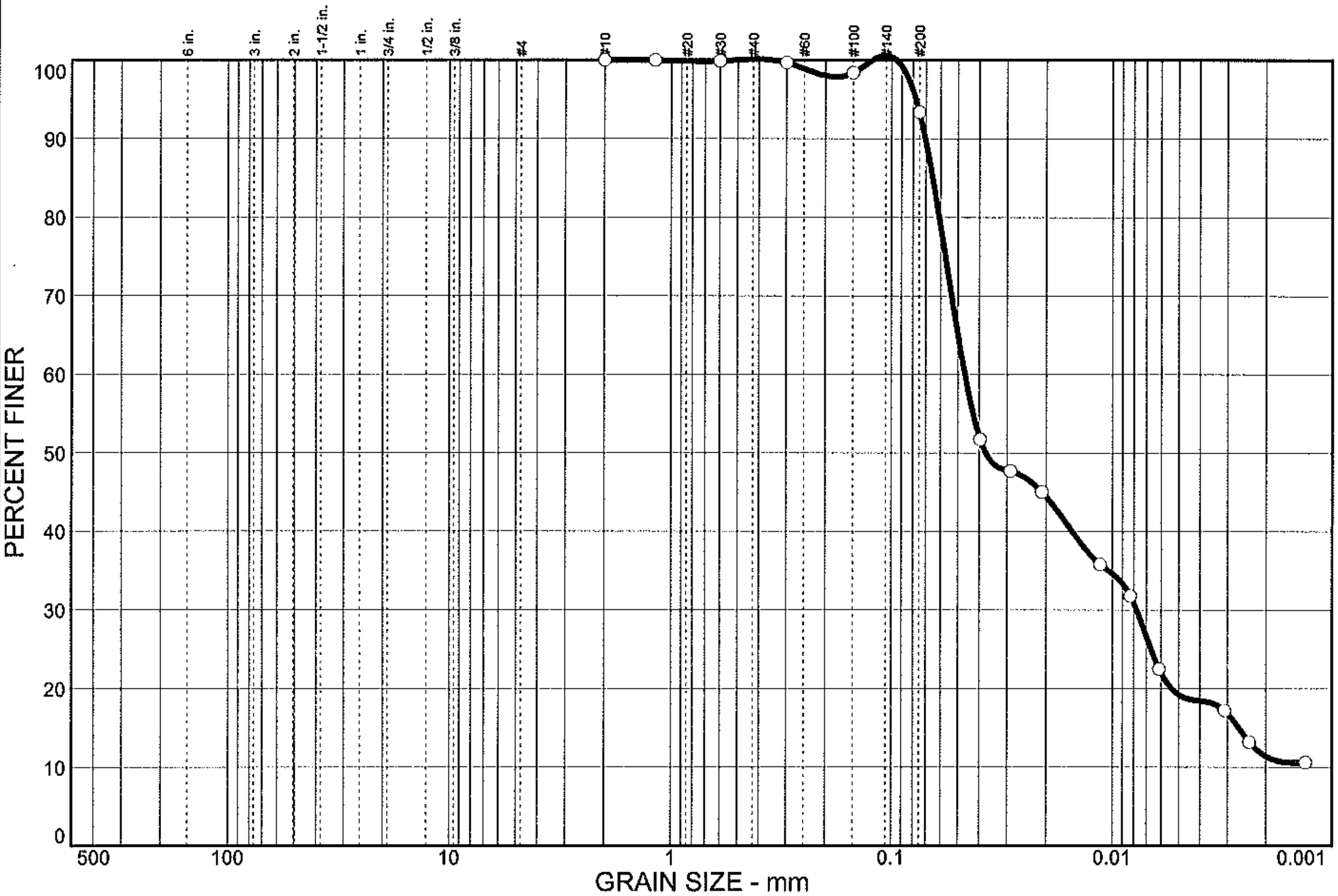
F.M.=0.00

Sample No.: HA-2 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 1.5-3 Feet

Moore Twining Associates, Inc.
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0		6.7	74.2	19.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	99.9		
#50	99.7		
#100	98.4		
#200	93.4		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.0652 D_{60}= 0.0465 D_{50}= 0.0374
D_{30}= 0.0078 D_{15}= 0.0027 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

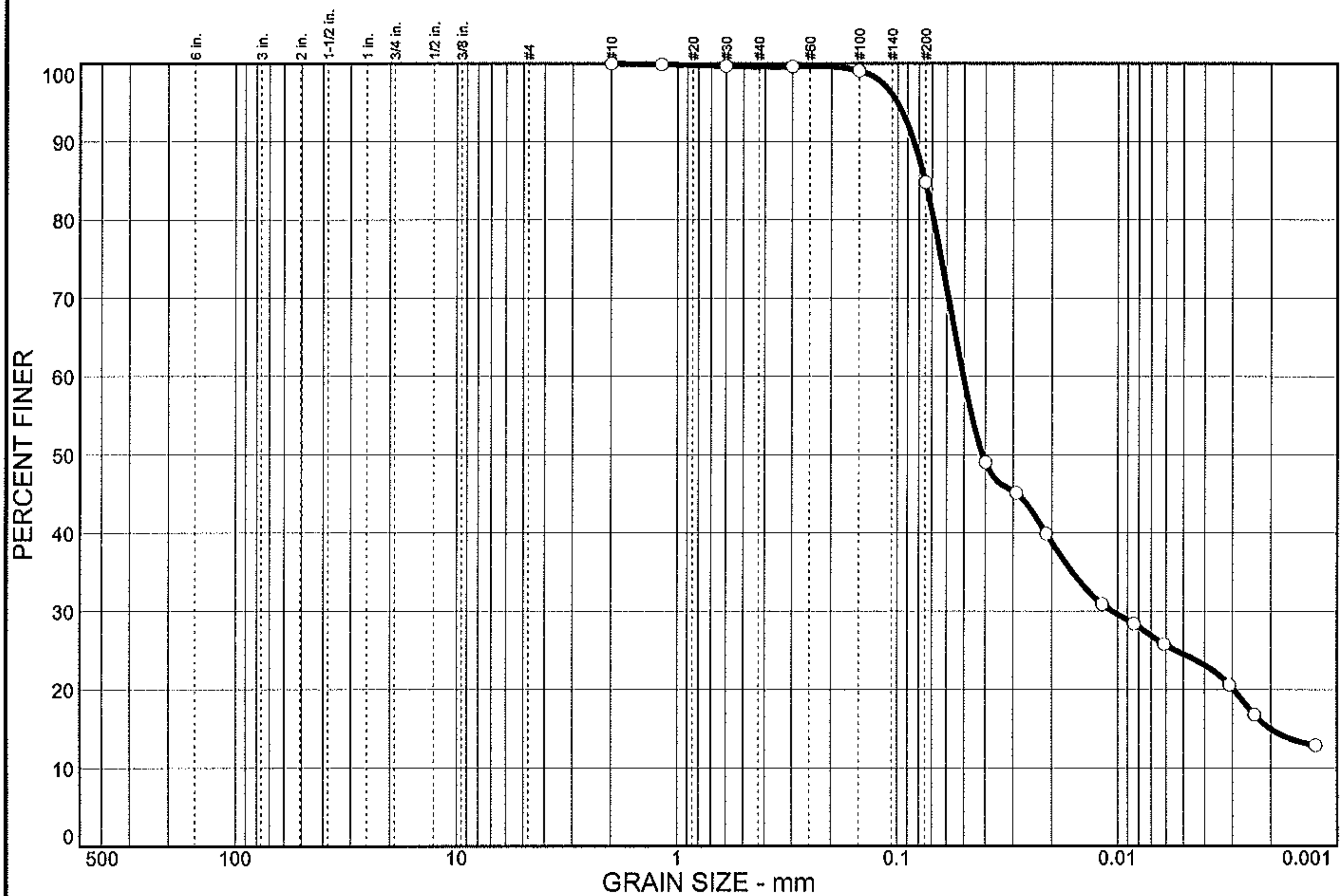
F.M.=0.02

Sample No.: HA-4 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 3.5-5.3 Feet

Moore Twining Associates, Inc.
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.4	14.8	60.3	24.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	99.7		
#50	99.6		
#100	99.1		
#200	84.8		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.0753 D_{60}= 0.0505 D_{50}= 0.0412
D_{30}= 0.0105 D_{15}= 0.0020 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

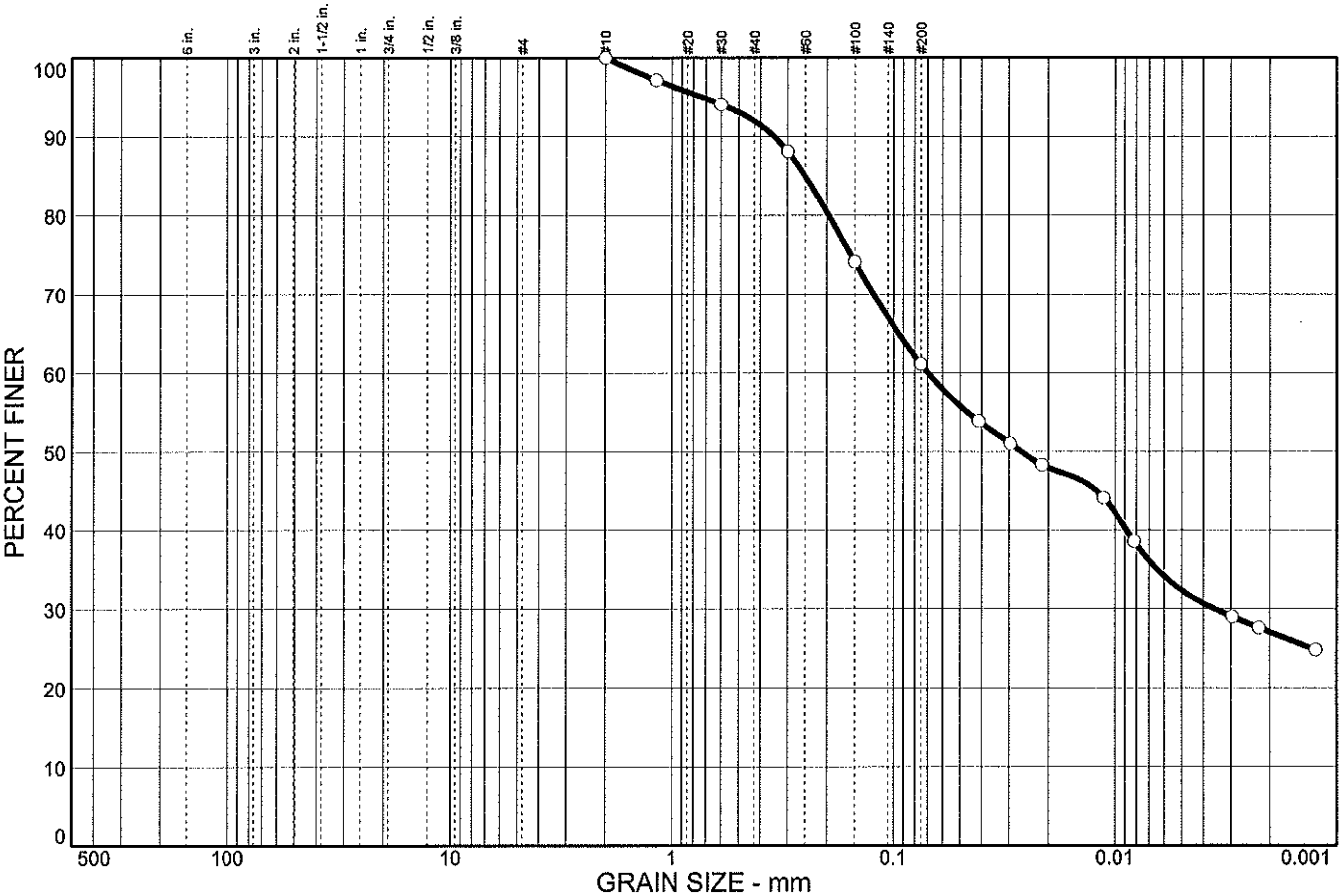
F.M.=0.02

Sample No.: HA-4 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 2-3.5 Feet

Moore Twining Associates, Inc.
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	8.0	30.9	28.7	32.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	97.2		
#30	94.1		
#50	88.1		
#100	74.1		
#200	61.1		

* (no specification provided)

Material Description

Atterberg Limits

PL= 16 LL= 31 PI= 15

Coefficients

D_{85}= 0.250 D_{60}= 0.0697 D_{50}= 0.0265
D_{30}= 0.0036 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.47

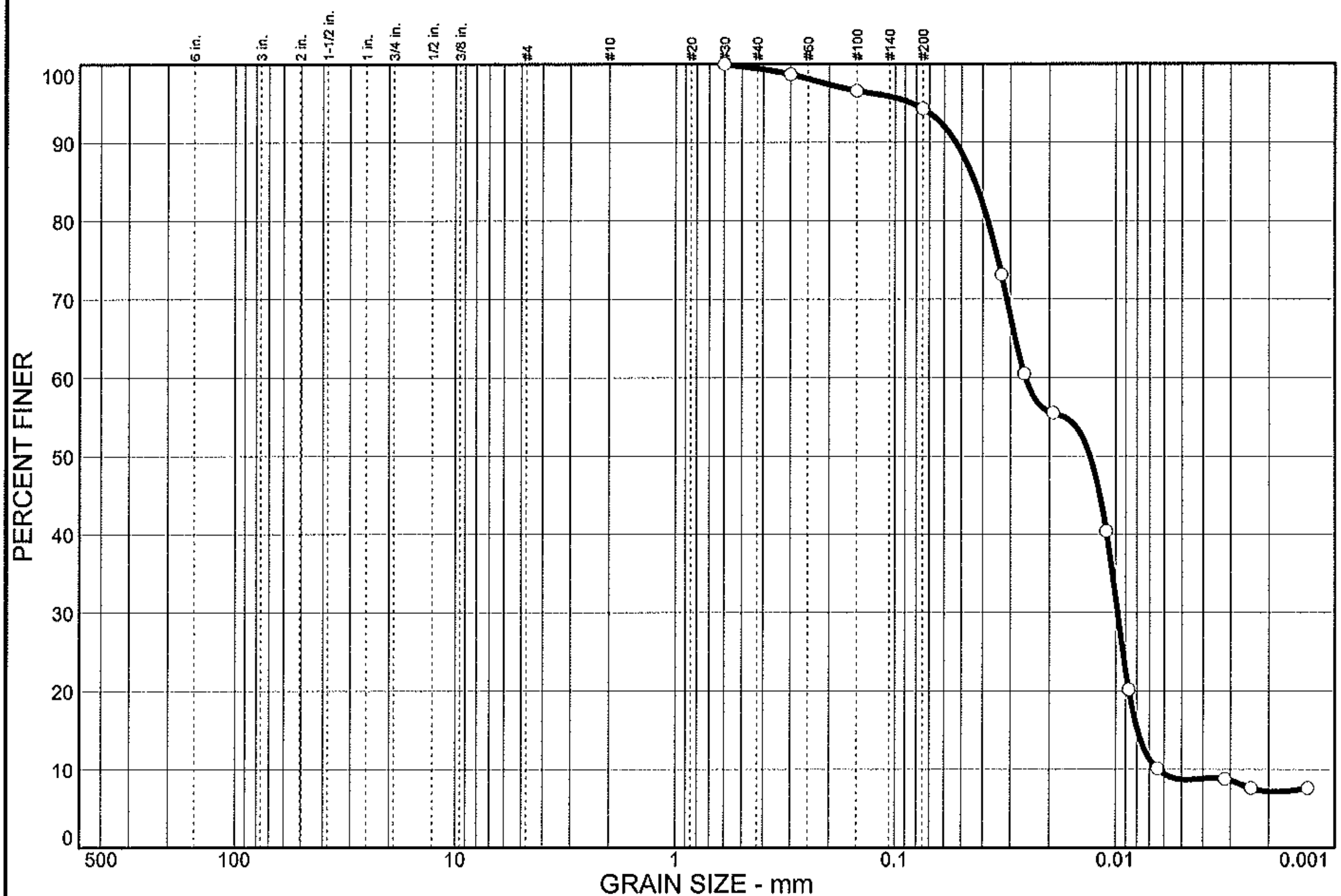
Sample No.: HA-9 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 1.5-3 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.5	5.2	85.6	8.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#50	98.7		
#100	96.6		
#200	94.3		

* (no specification provided)

Material Description

Atterberg Limits

PL= 24 LL= 52 PI= 28

Coefficients

D_{85}= 0.0436 D_{60}= 0.0256 D_{50}= 0.0131
D_{30}= 0.0098 D_{15}= 0.0079 D_{10}= 0.0064
C_u= 4.02 C_c= 0.59

Classification

USCS= AASHTO=

Remarks

F.M.=0.05

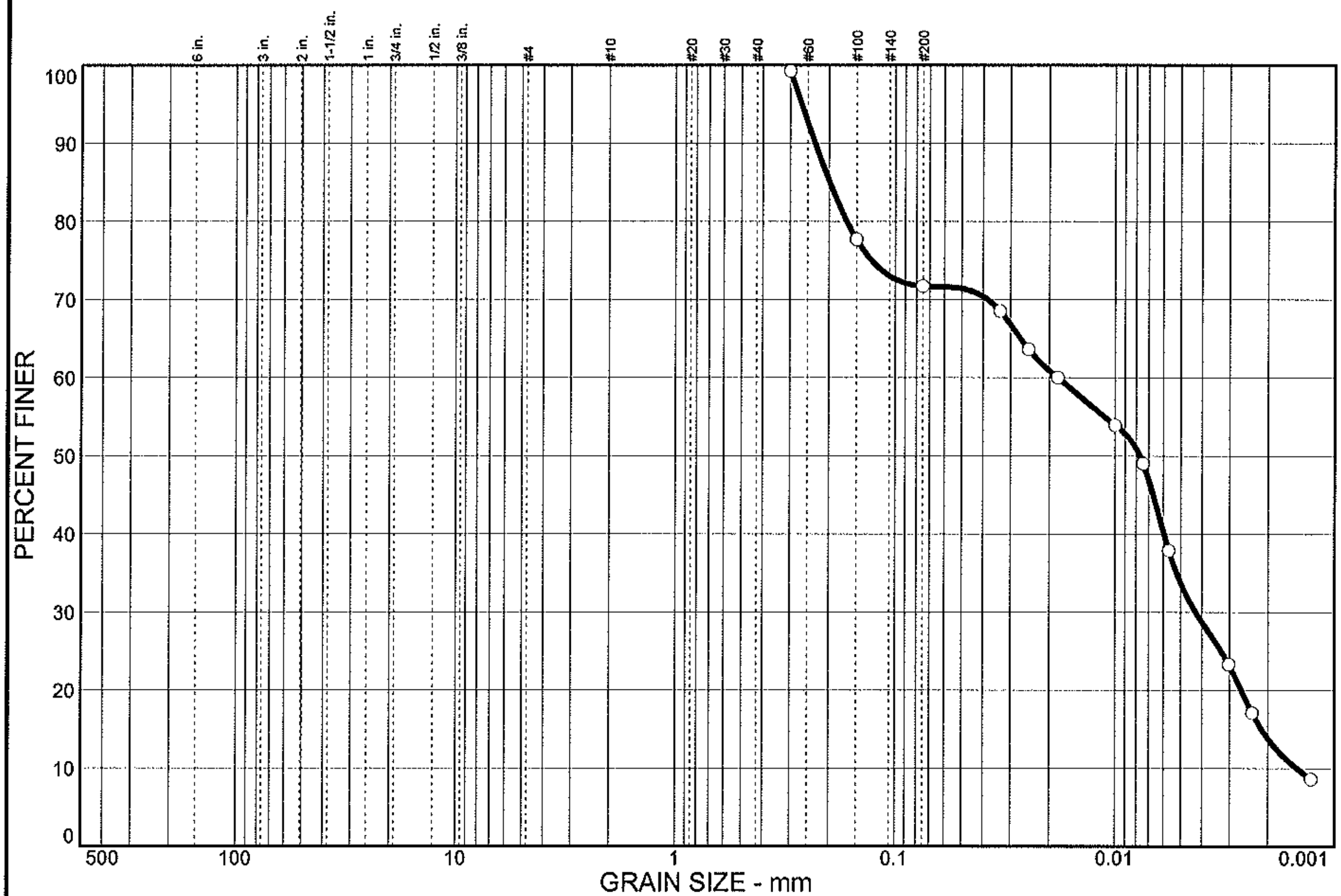
Sample No.: HA-5 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 1.5-2.5 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
						37.9	33.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#50	99.3		
#100	77.7		
#200	71.7		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.198 D_{60}= 0.0183 D_{50}= 0.0077
D_{30}= 0.0043 D_{15}= 0.0021 D_{10}= 0.0015
C_u= 12.33 C_c= 0.67

Classification

USCS= AASHTO=

Remarks

F.M.=0.23

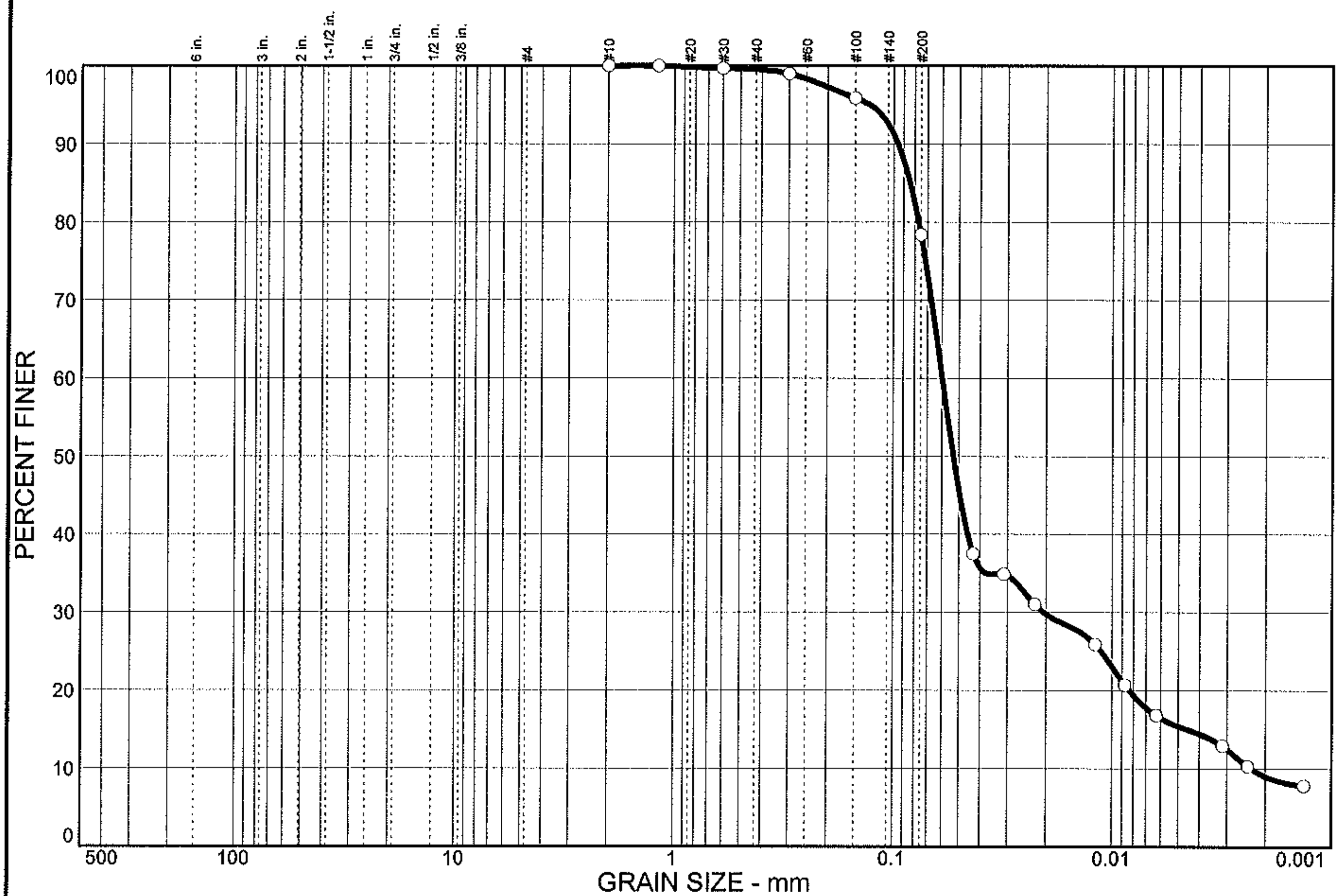
Sample No.: HA-5 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:** 4.9-5.3 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.4	21.2	63.0	15.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	99.7		
#50	99.0		
#100	95.9		
#200	78.4		

* (no specification provided)

Material Description

*

Atterberg Limits

PL= 20 LL= 25 PI= 5

Coefficients

D_{85}= 0.0841 D_{60}= 0.0597 D_{50}= 0.0530
D_{30}= 0.0205 D_{15}= 0.0045 D_{10}= 0.0023
C_u= 25.70 C_c= 3.03

Classification

USCS= AASHTO=

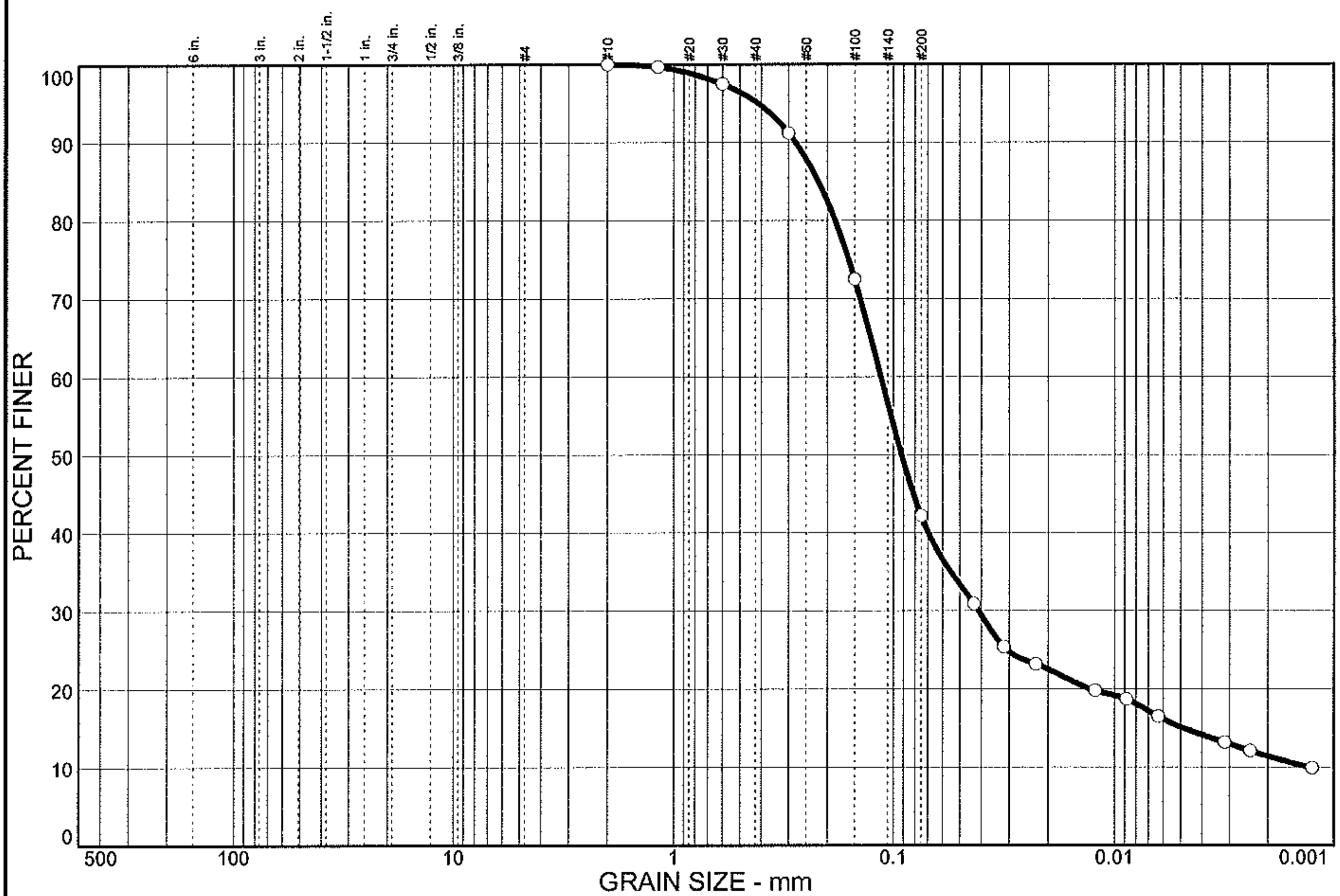
Remarks

F.M.=0.05

Sample No.: HA-10 **Source of Sample:** **Date:** 10/13/10
Location: **Elev./Depth:** 0-1.5 Feet

Moore Twining Associates, Inc. **Fresno, CA**	**Client:** Hultgren - Tillis Engineers **Project:** Salton Sea **Project No:** 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	4.7	53.1	27.0	15.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.7		
#30	97.5		
#50	91.2		
#100	72.5		
#200	42.2		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.220 D_{60}= 0.114 D_{50}= 0.0919
D_{30}= 0.0412 D_{15}= 0.0048 D_{10}= 0.0013
C_u= 87.63 C_c= 11.46

Classification

USCS= AASHTO=

Remarks

F.M.=0.39

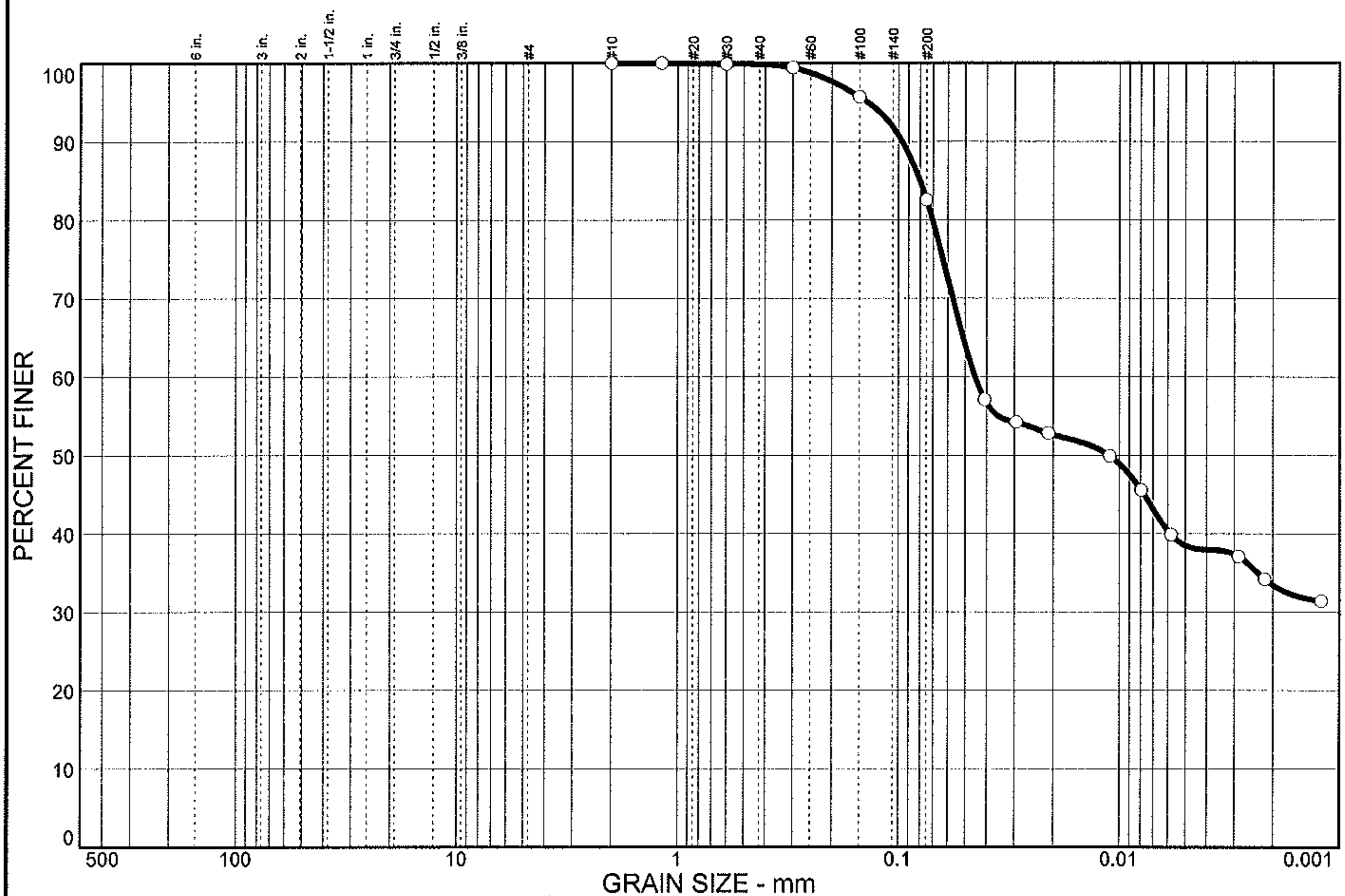
Sample No.: HA-10 **Source of Sample:** **Date:** 12/13/10
Location: **Elev./Depth:** 1.3-3 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	17.3	44.1	38.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	99.9		
#50	99.4		
#100	95.7		
#200	82.6		

* (no specification provided)

Material Description

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.0801 D_{60}= 0.0452 D_{50}= 0.0111
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.05

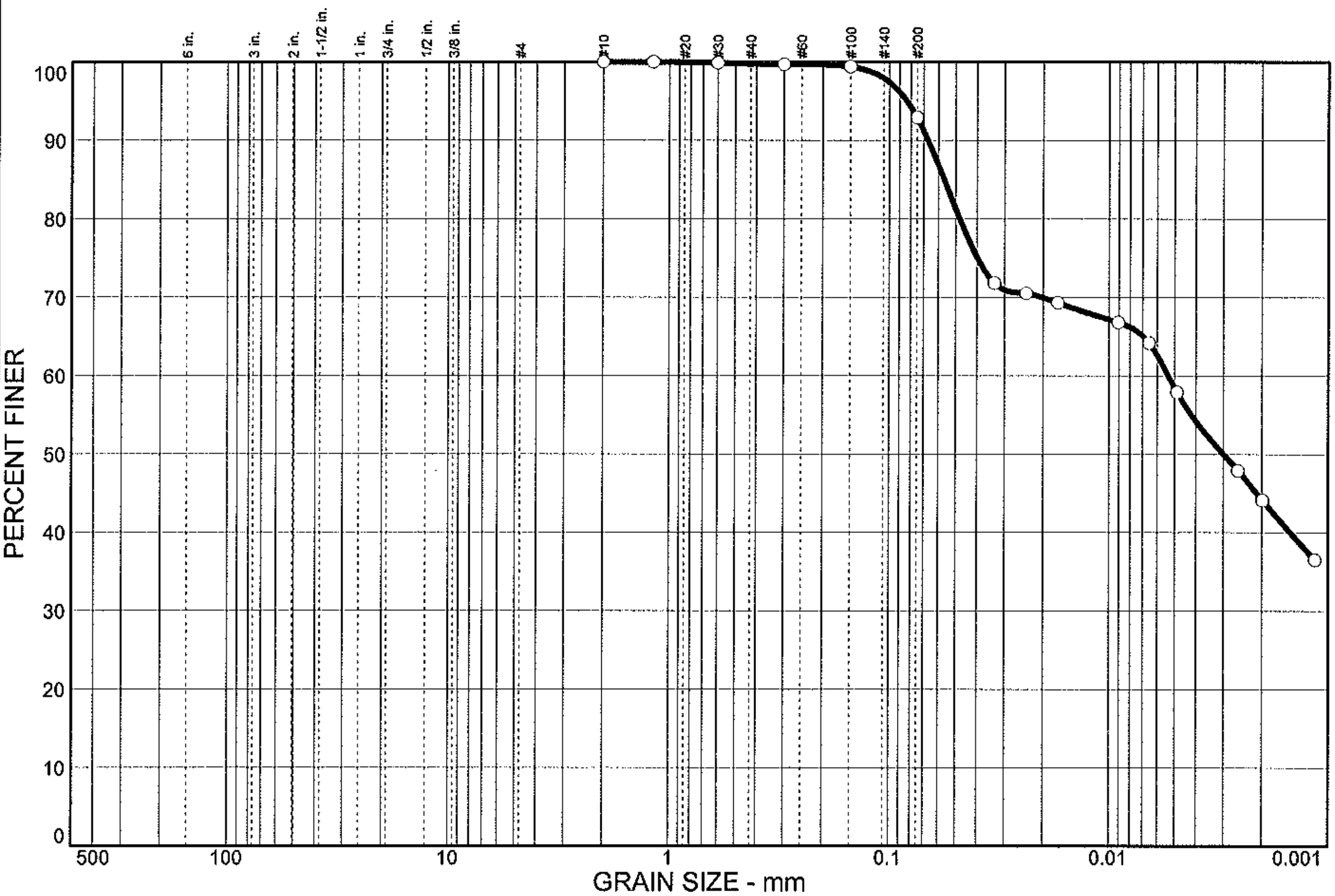
Sample No.: VC-6C **Source of Sample:** **Date:** 10/13/10
Location: **Elev./Depth:** 0-1.3 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	6.9	34.4	58.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	99.9		
#50	99.7		
#100	99.4		
#200	92.9		

* (no specification provided)

Material Description

Atterberg Limits

PL= 21 LL= 58 PI= 37

Coefficients

D_{85}= 0.0564 D_{60}= 0.0053 D_{50}= 0.0030
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.01

Sample No.: VC-19C **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 3.5-6.2 Feet

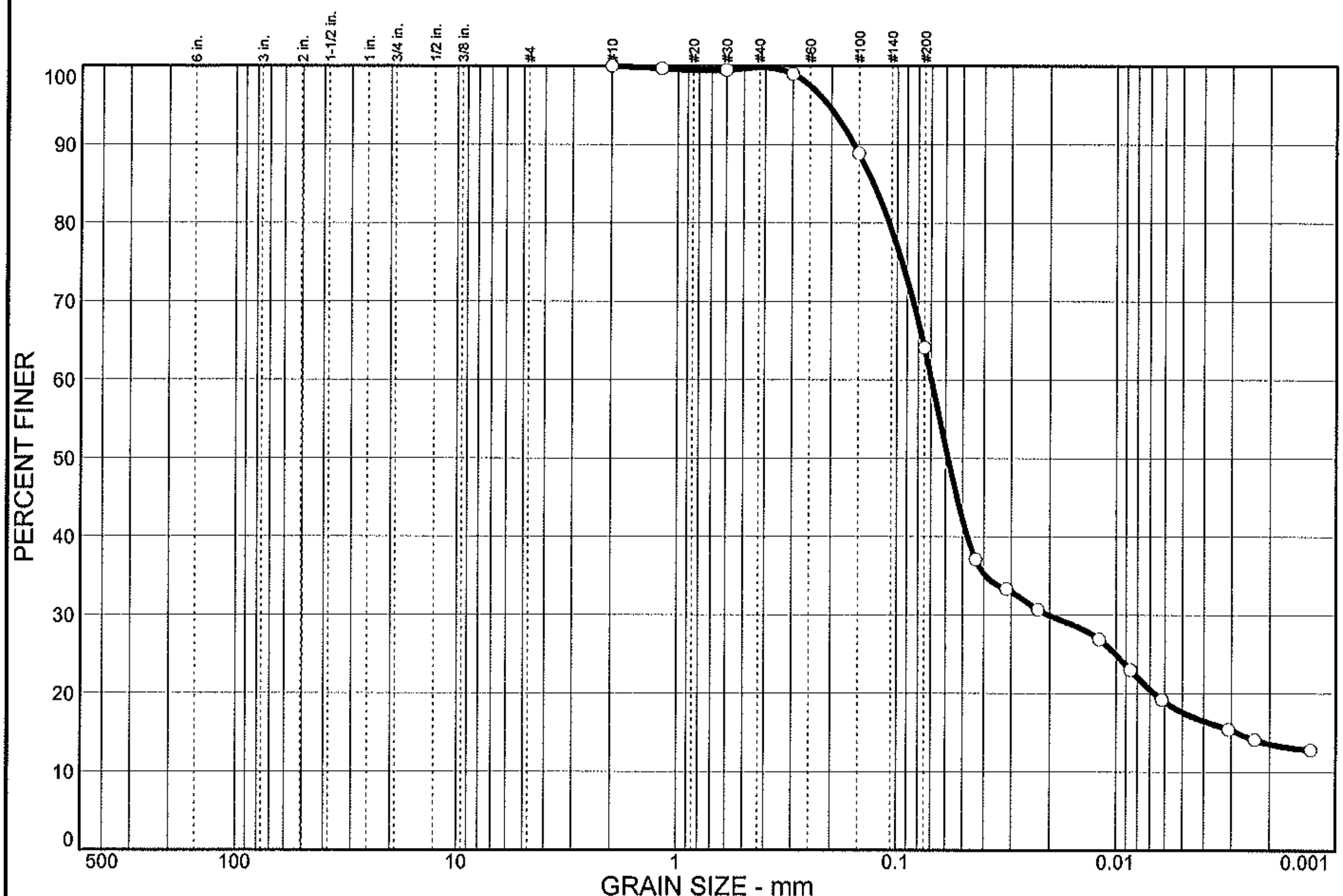
Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea

Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	35.7	46.5	17.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.7		
#30	99.5		
#50	99.0		
#100	88.9		
#200	64.1		

* (no specification provided)

Material Description

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.128 D_{60}= 0.0696 D_{50}= 0.0584
D_{30}= 0.0202 D_{15}= 0.0028 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.13

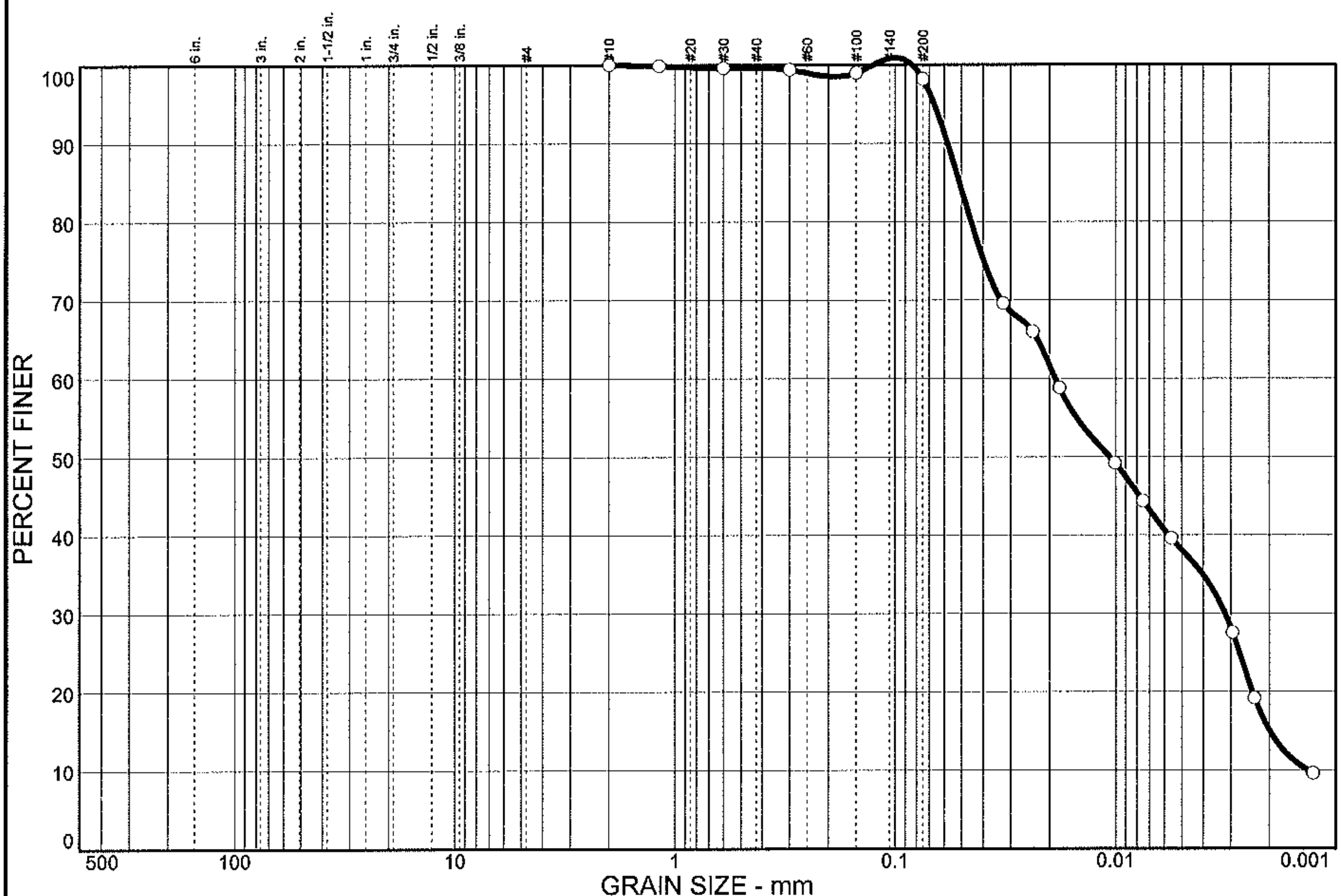
Sample No.: VC-19A **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 0-0.9 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.3	1.5	60.1	38.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	99.6		
#50	99.4		
#100	99.0		
#200	98.2		

* (no specification provided)

Material Description

Atterberg Limits

PL= 19 LL= 57 PI= 38

Coefficients

D_{85}= 0.0512 D_{60}= 0.0188 D_{50}= 0.0106
D_{30}= 0.0032 D_{15}= 0.0020 D_{10}= 0.0013
C_u= 14.06 C_c= 0.40

Classification

USCS= AASHTO=

Remarks

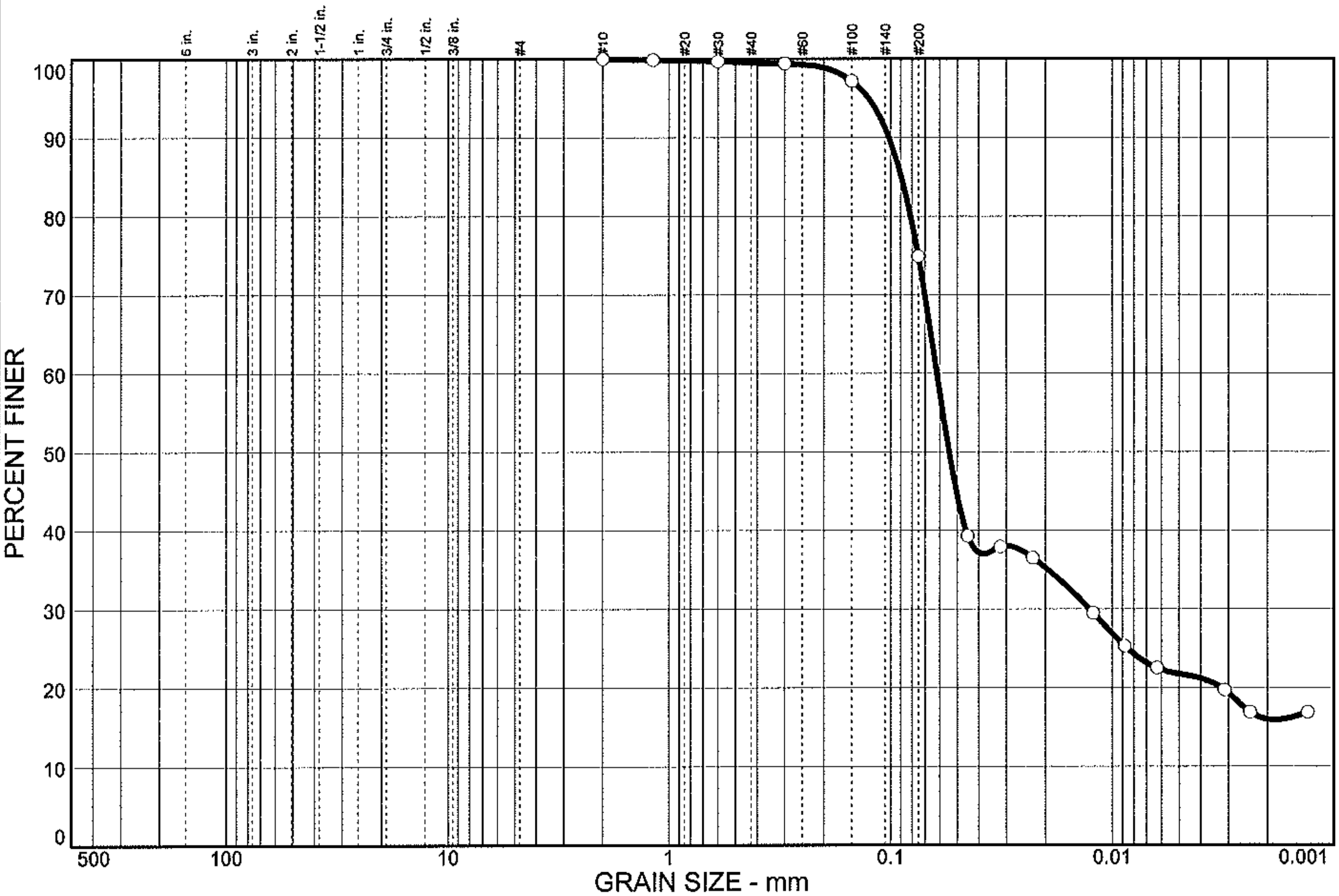
F.M.=0.02

Sample No.: VC-21C **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 2.1-4.8 Feet

Moore Twining Associates, Inc.
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.5	24.6	53.2	21.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	99.7		
#50	99.4		
#100	97.2		
#200	74.9		

* (no specification provided)

Material Description

Atterberg Limits

PL= 19 LL= 60 PI= 41

Coefficients

D_{85}= 0.0896 D_{60}= 0.0619 D_{50}= 0.0545
D_{30}= 0.0126 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

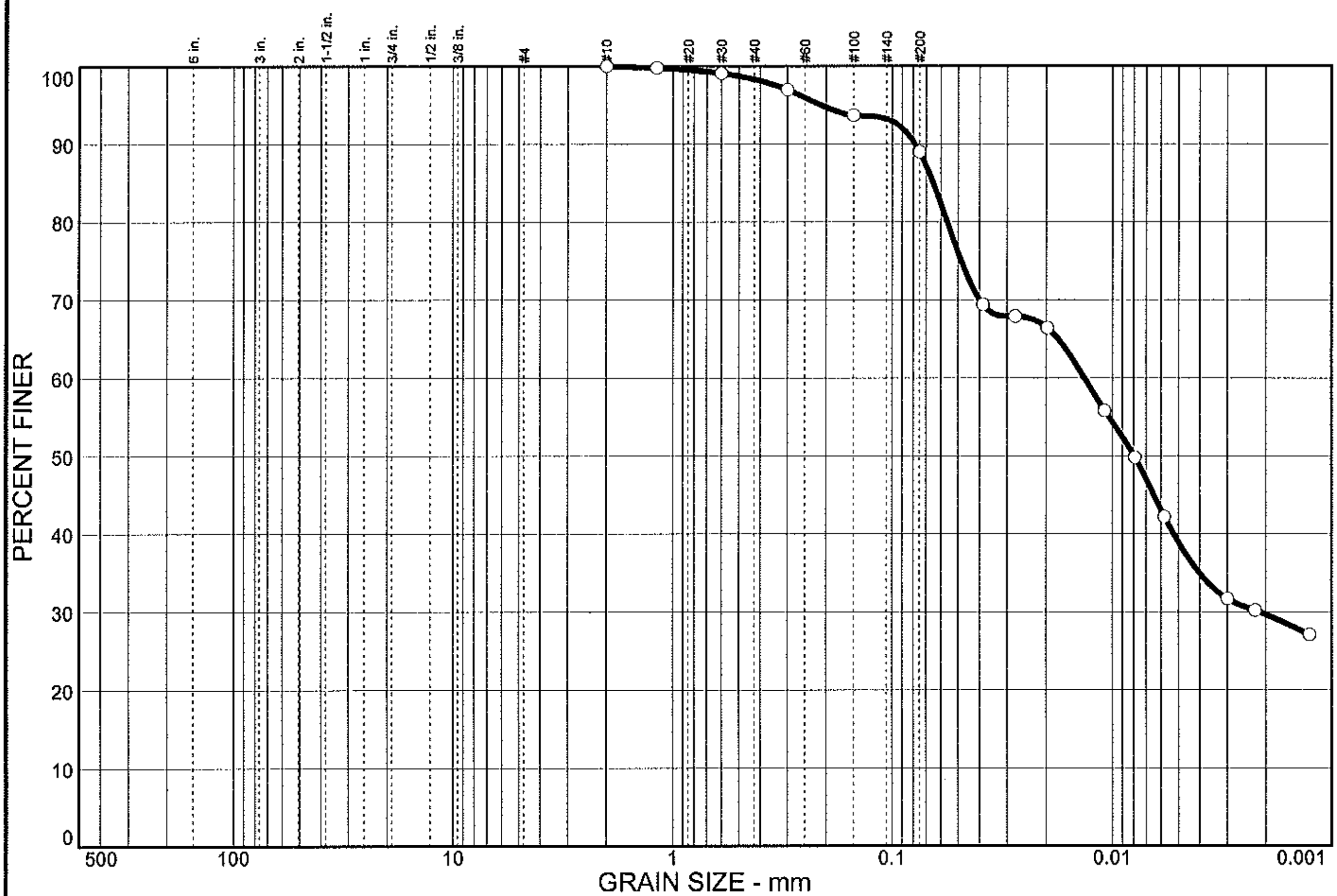
F.M.=0.04

Sample No.: VC-22C **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 1.3-4 Feet

Moore Twining Associates, Inc.
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	1.7	9.3	50.1	38.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.8		
#30	99.1		
#50	97.0		
#100	93.7		
#200	89.0		

* (no specification provided)

Material Description

Atterberg Limits

PL= 16 LL= 26 PI= 10

Coefficients

D_{85}= 0.0650 D_{60}= 0.0134 D_{50}= 0.0080
D_{30}= 0.0021 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

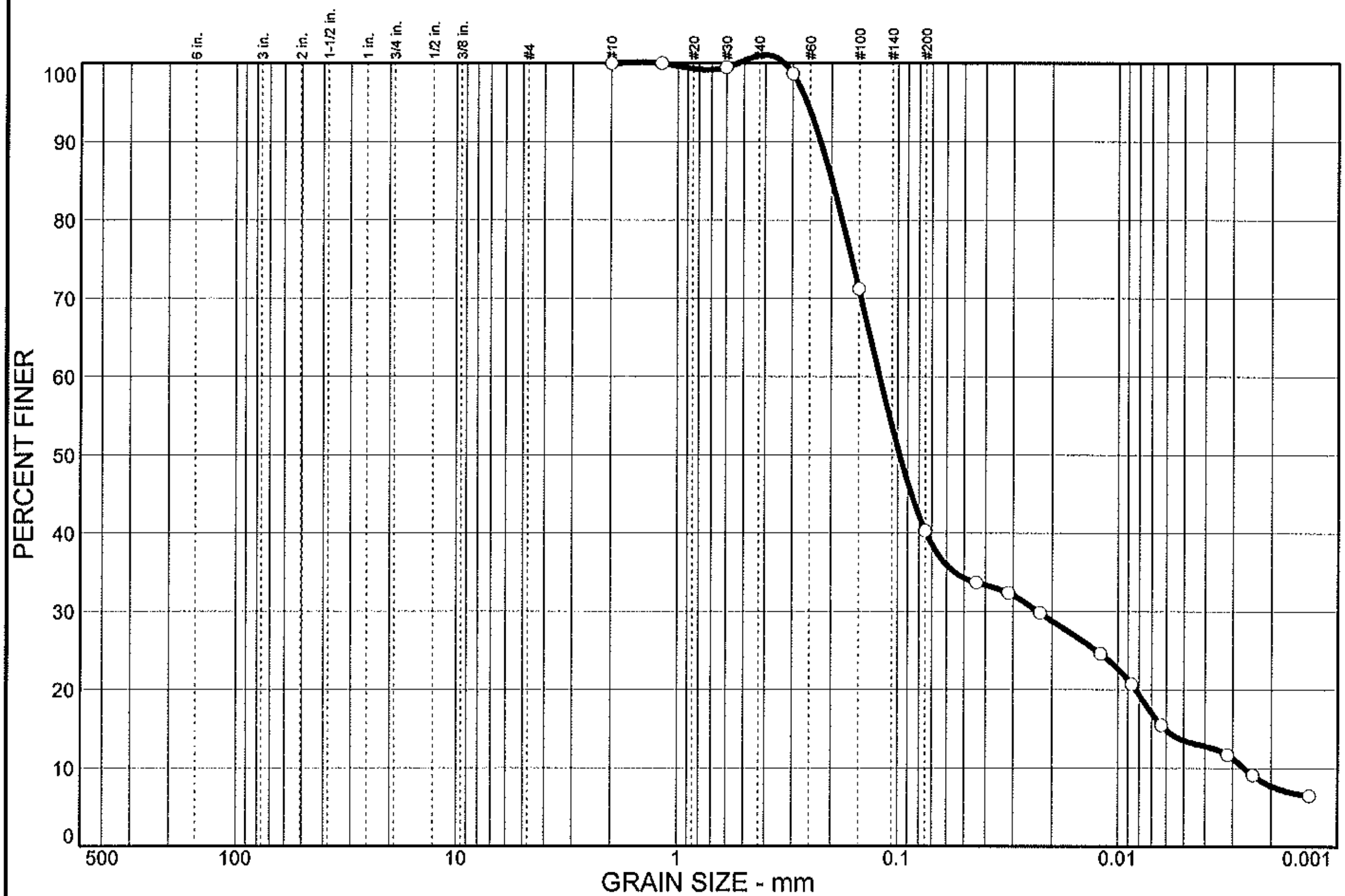
F.M.=0.10

Sample No.: VC-24C **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 3.7-6.4 Feet

Moore Twining Associates, Inc.
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0		60.7	26.7	13.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	99.5		
#50	98.7		
#100	71.2		
#200	40.3		

* (no specification provided)

Material Description

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.199 D_{60}= 0.121 D_{50}= 0.0979
D_{30}= 0.0231 D_{15}= 0.0061 D_{10}= 0.0027
C_u= 45.57 C_c= 1.67

Classification

USCS= AASHTO=

Remarks

F.M.=0.31

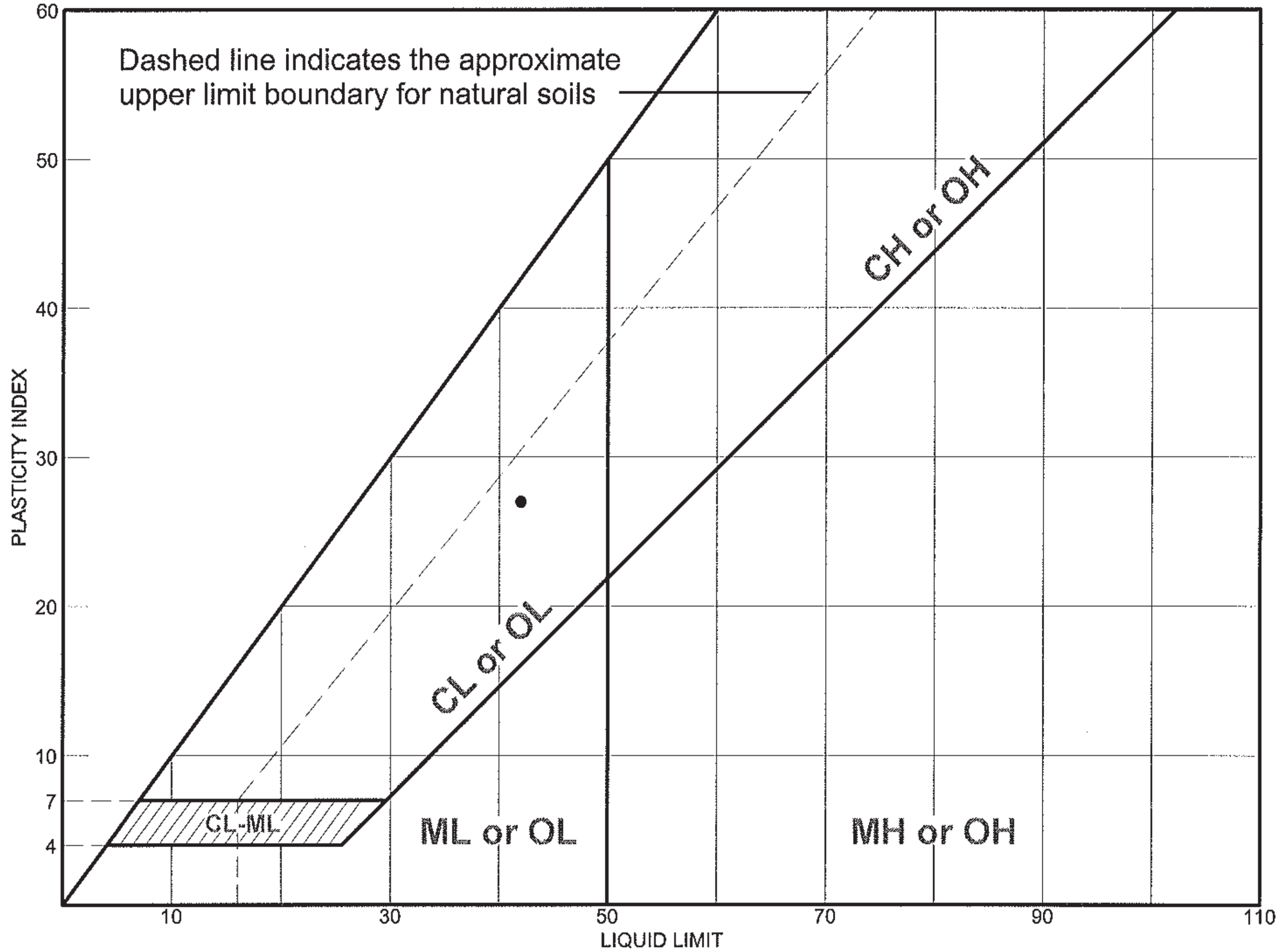
Sample No.: VC-24A **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 0-1.1 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		42	15	27			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** HA-1 **Elev./Depth:** 3.6-5 Feet

Remarks:

●

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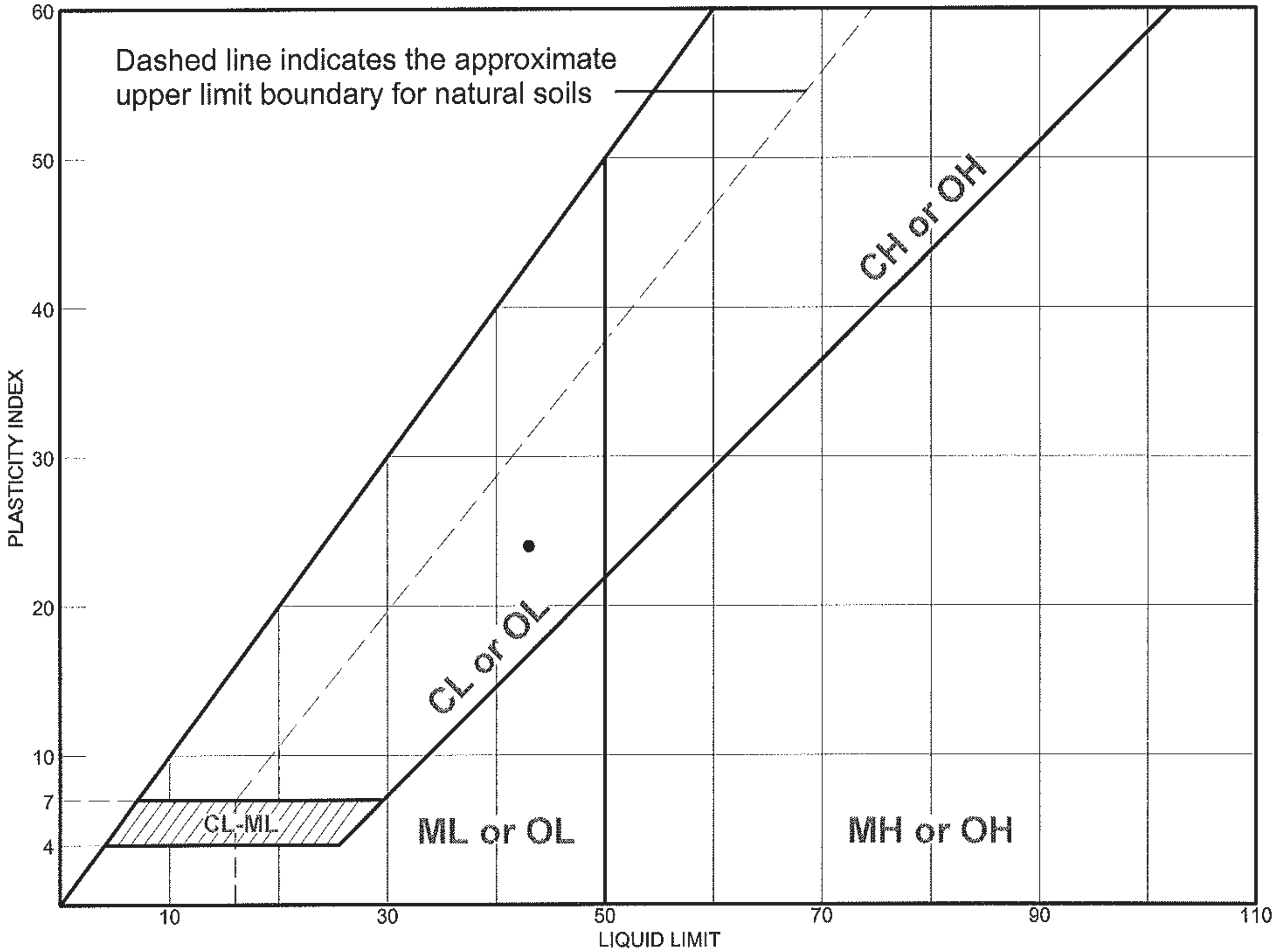
Fresno, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		43	19	24			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** HA-2 **Elev./Depth:** 1.5-3 Feet

Remarks:

●

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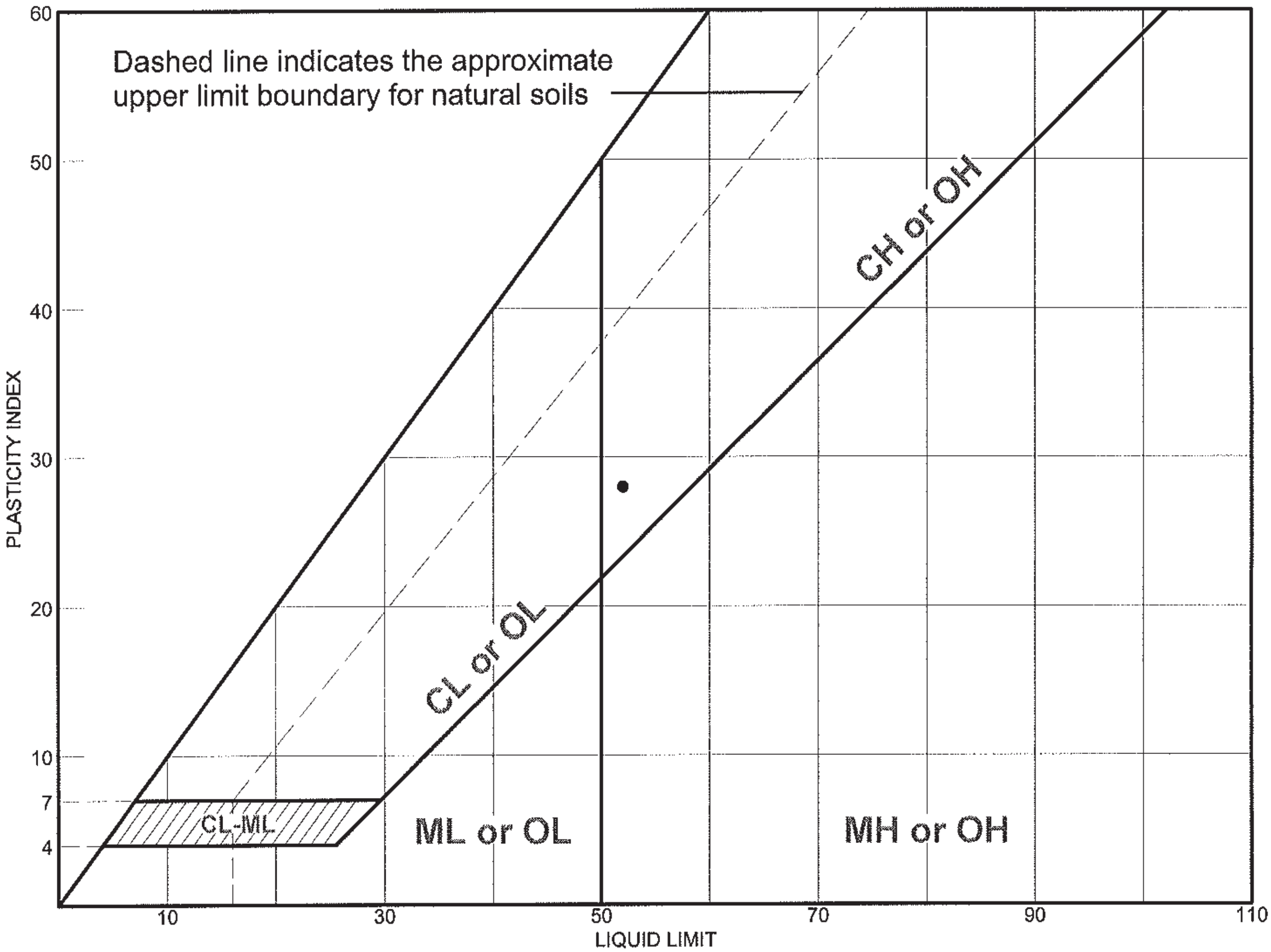
Fresno, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		52	24	28			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** HA-5 **Elev./Depth:** 1.5-2.5 Feet

Remarks:

●

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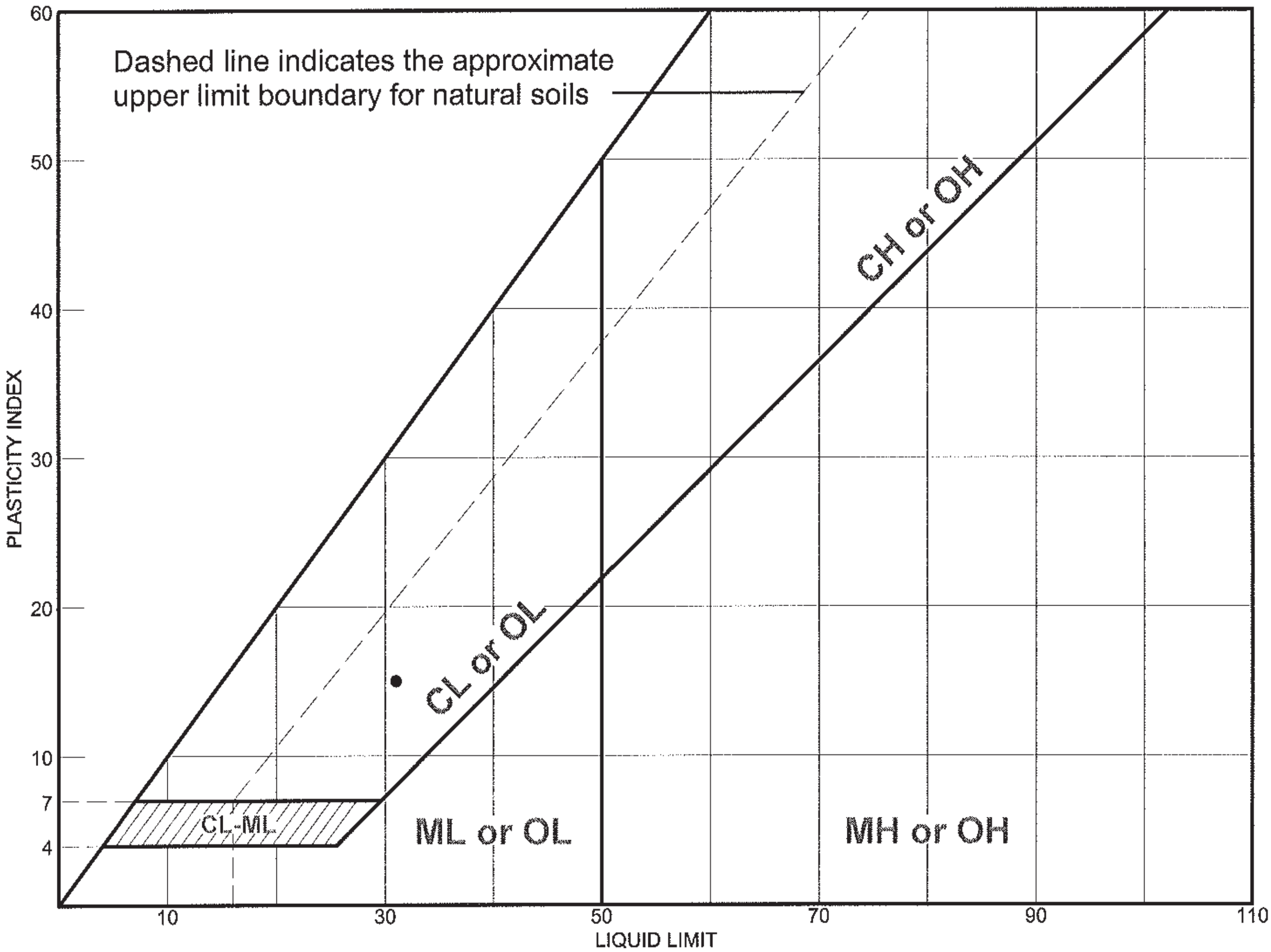
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		31	16	15			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** HA-9 **Elev./Depth:** 1.5-3 Feet

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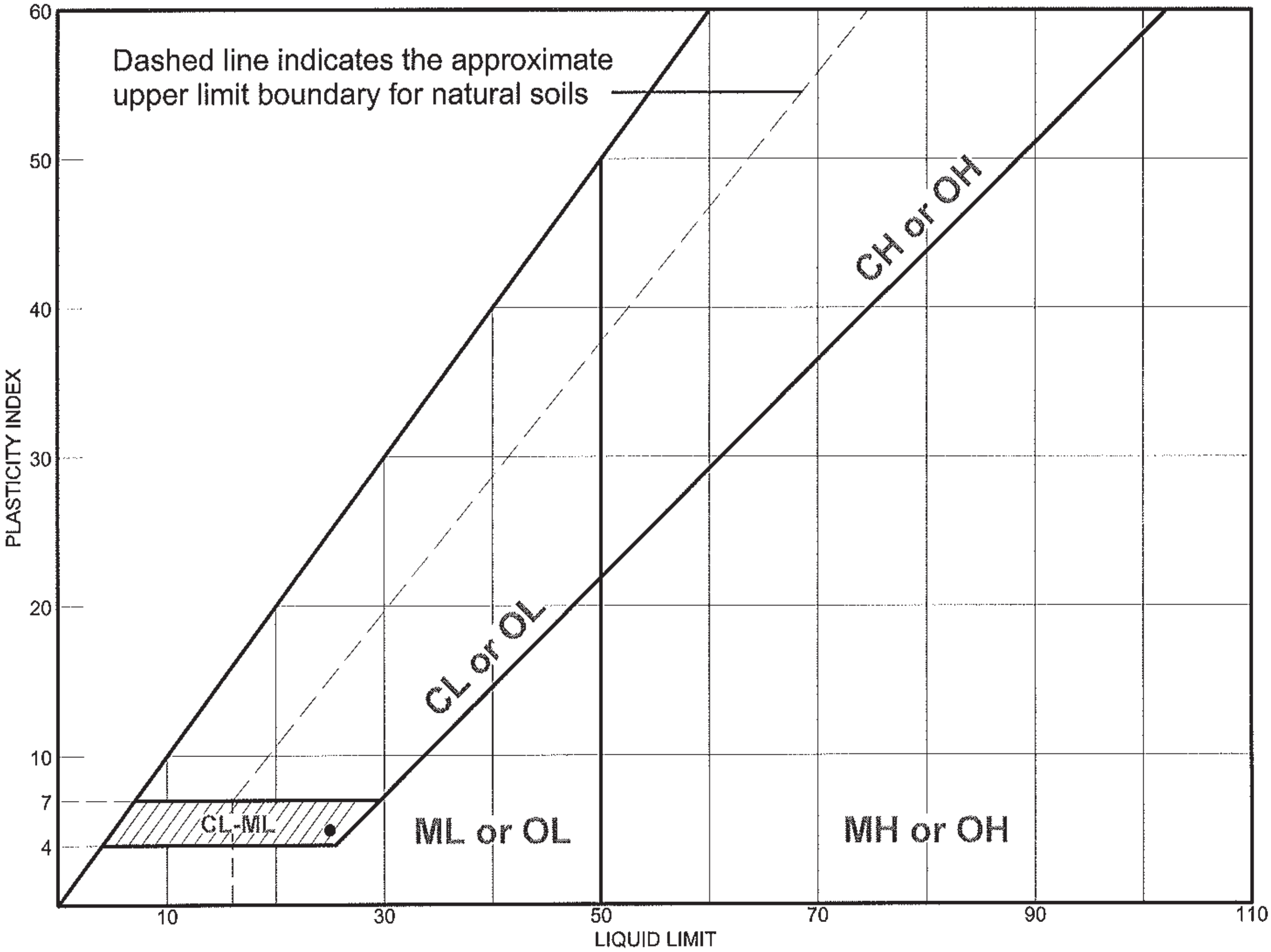
Remarks:

●

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		25	20	5			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** HA-10 **Elev./Depth:** 0-1.5 Feet

Remarks:

●

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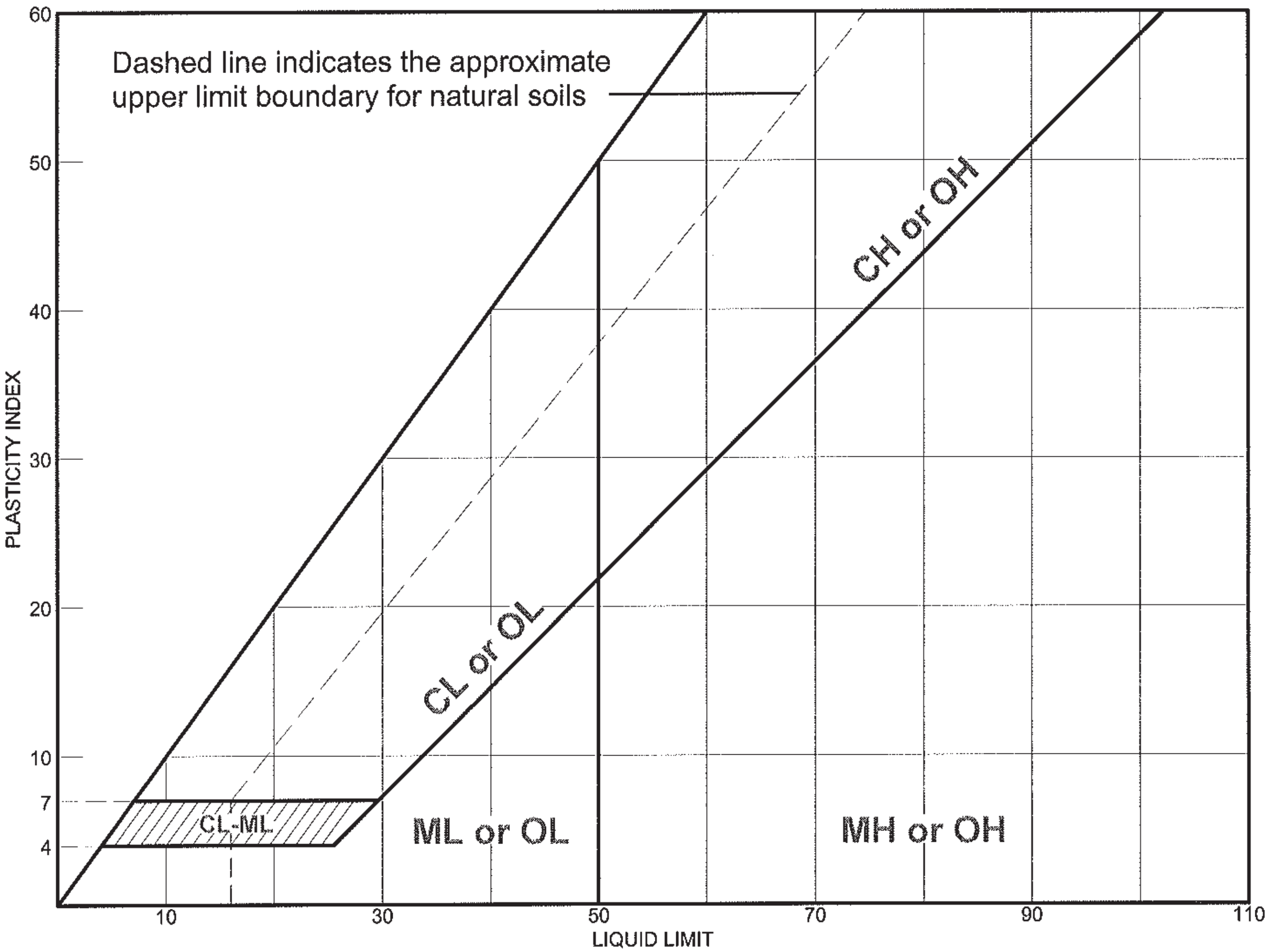
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		NV	NP	NP			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-6C **Elev./Depth:** 0-1.3 Feet

Remarks:

●

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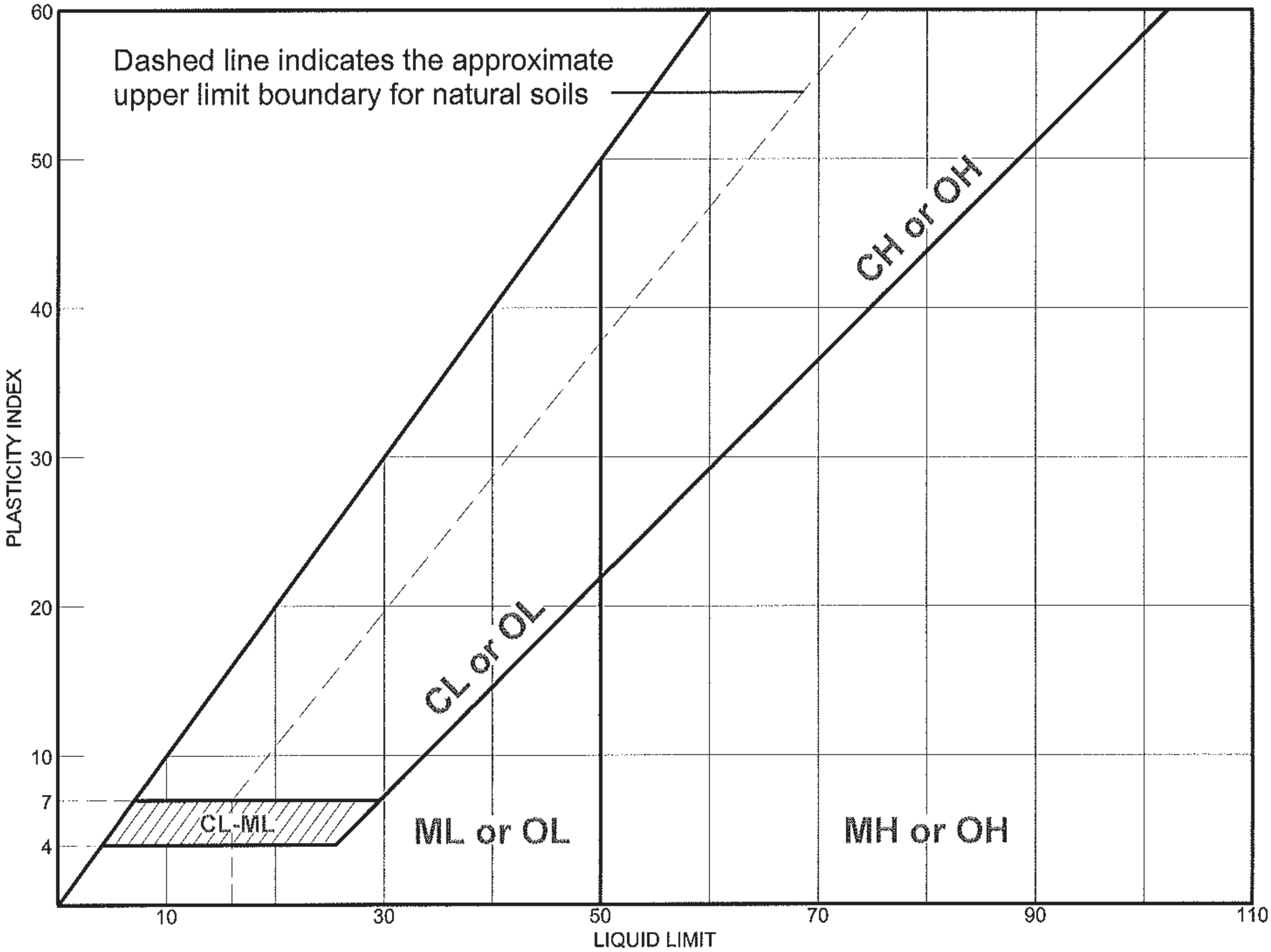
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		NV	NP	NP			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-19A **Elev./Depth:** 0-0.9 Feet

Remarks:

●

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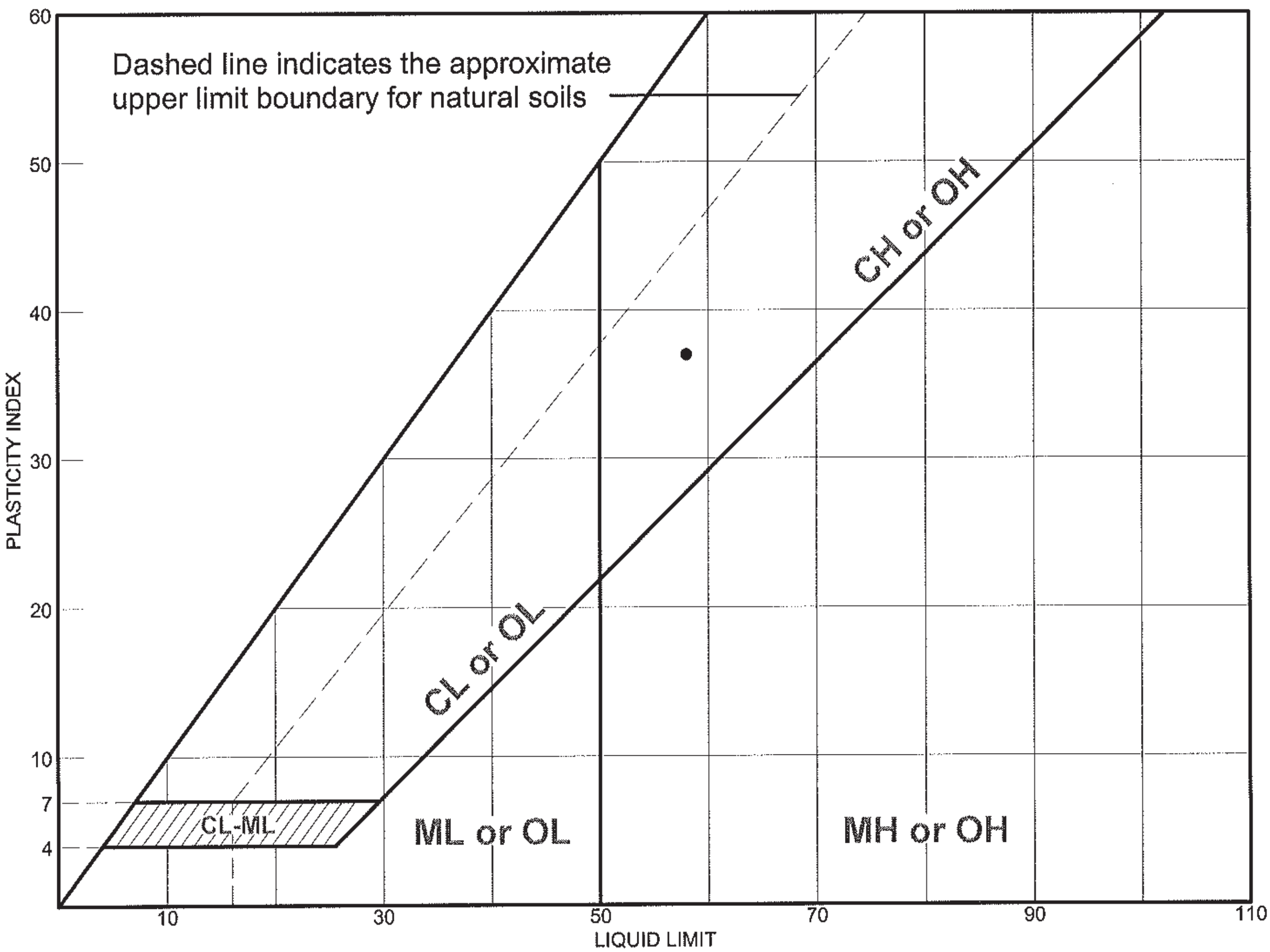
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		58	21	37			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-19C **Elev./Depth:** 3.5-6.2 Feet

Remarks:

●

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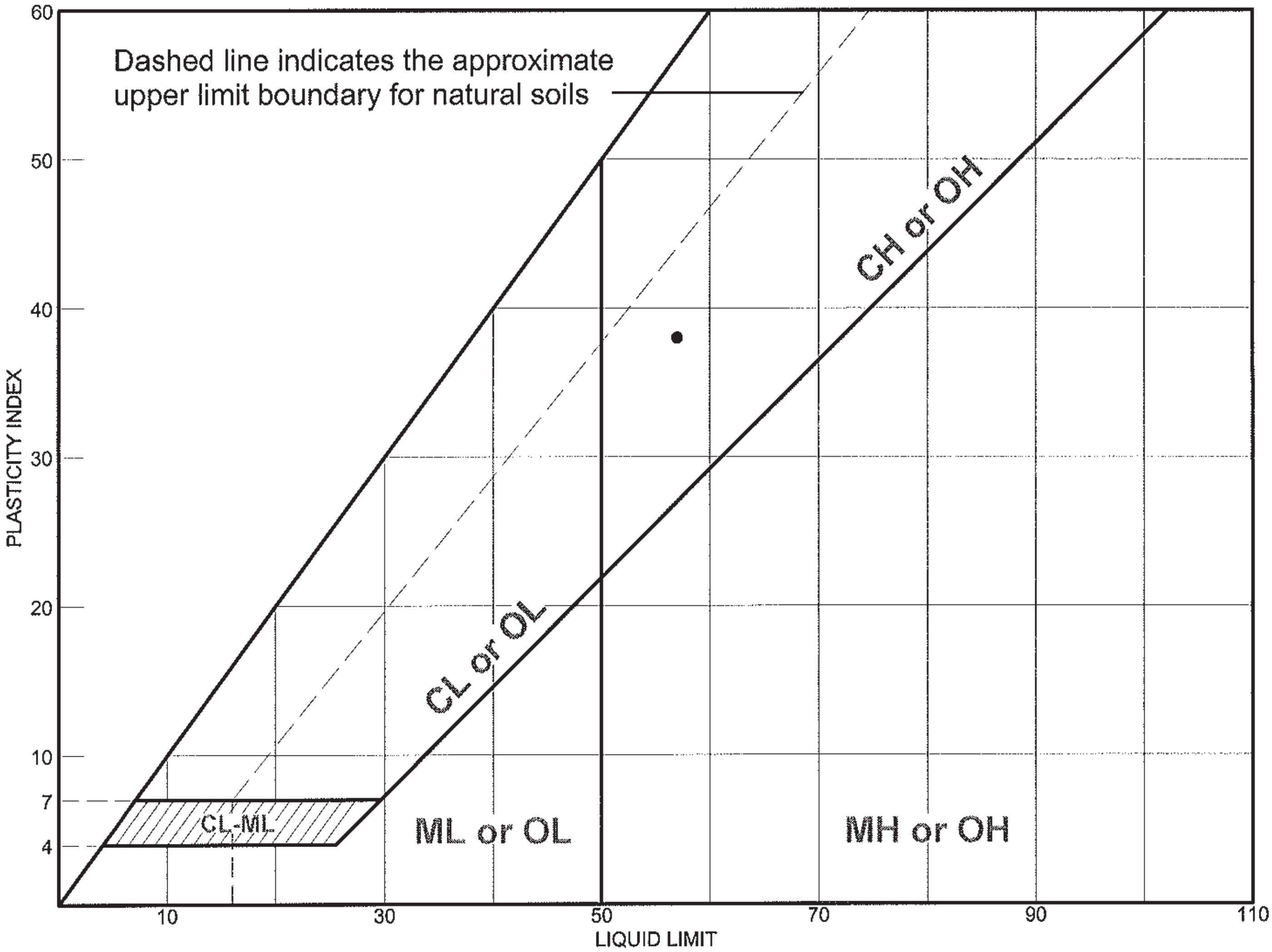
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		57	19	38			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-21C **Elev./Depth:** 2.1-4.8 Feet

Remarks:

●

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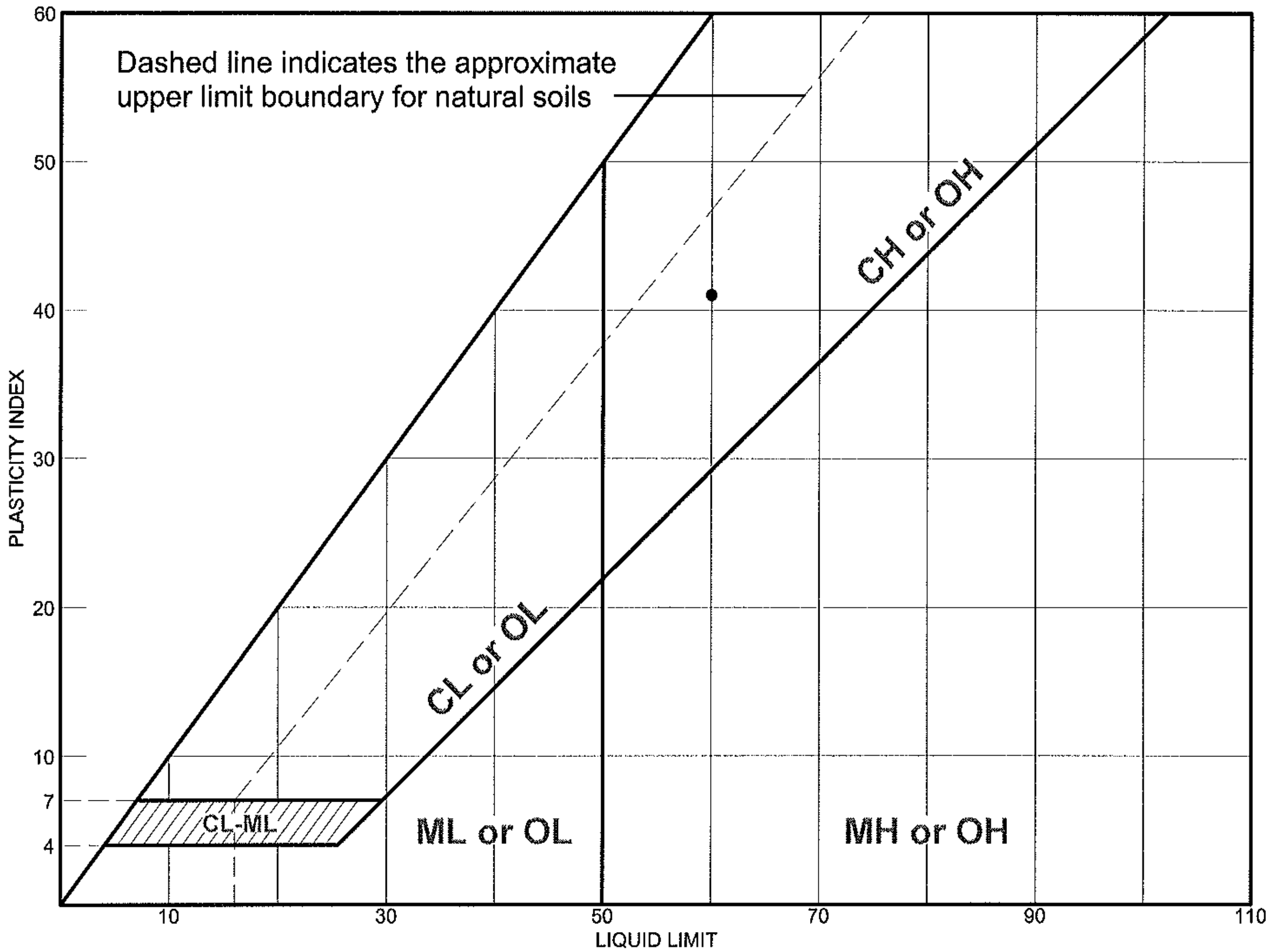
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		60	19	41			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-22C **Elev./Depth:** 1.3-4 Feet

Remarks:

●

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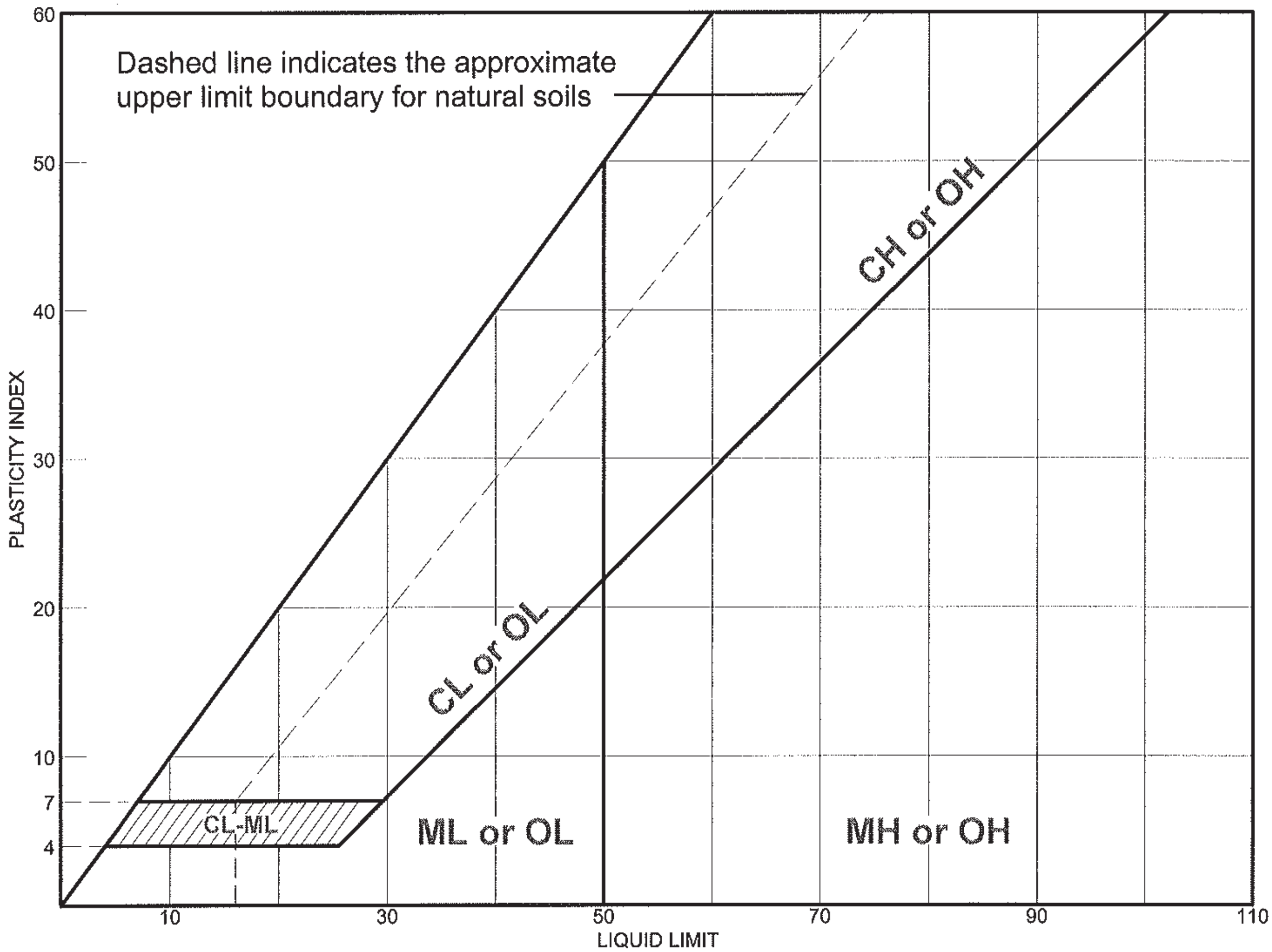
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		NV	NP	NP			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-24A **Elev./Depth:** 0-1.1 Feet

Remarks:

●

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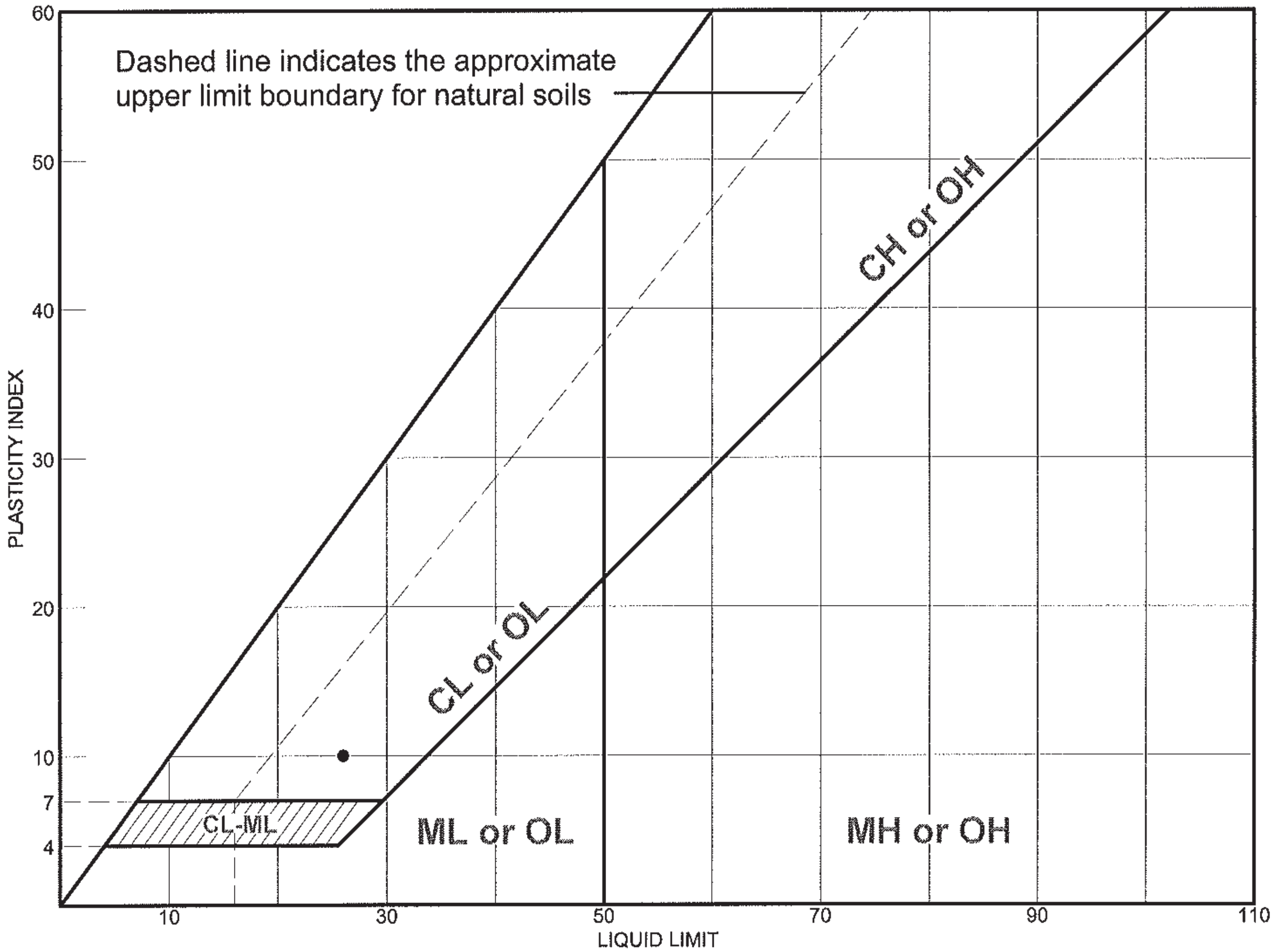
Fresno, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		26	16	10			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-24C **Elev./Depth:** 3.7-6.4 Feet

Remarks:

●

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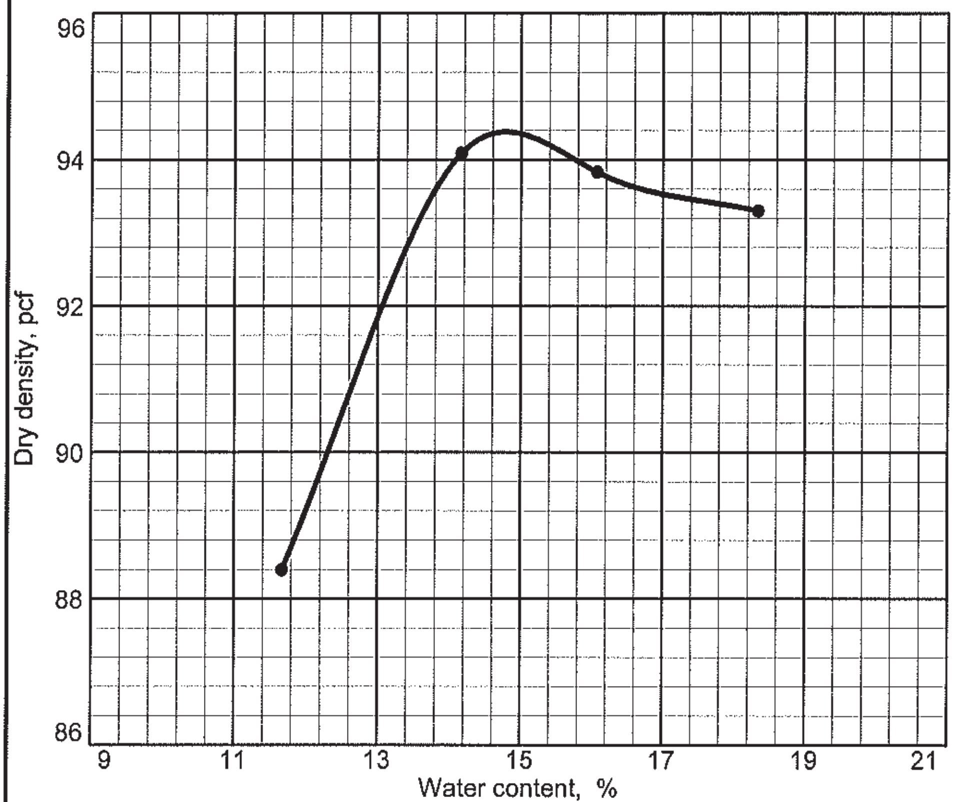
Figure

Test on Bulk and Composite Samples

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 698-07 Procedure A Standard

Hammer Wt.: 5.5 lb.
Hammer Drop: 12 in.
Number of Layers: three
Blows per Layer: 25
Mold Size: .03333 cu.ft.
Test Performed on Material Passing No.4 **Sieve**

Soil Data

NM ____ **Sp.G.** ____
LL ____ **PI** ____
%>No.4 ____ **%<#200** ____
USCS ____ **AASHTO** ____

TESTING DATA

	1	2	3	4	5	6
WM + WS	7.91	7.96	7.62	8.01		
WM	4.33	4.33	4.33	4.33		
WW + T #1	269.30	262.20	285.20	263.30		
WD + T #1	235.90	225.90	255.40	222.50		
TARE #1	0.00	0.00	0.00	0.00		
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	14.2	16.1	11.7	18.3		
DRY DENSITY	94.1	93.8	88.4	93.3		

TEST RESULTS

Maximum dry density = 94.4 pcf

Optimum moisture = 14.8 %

Material Description

Project No. 60 **Client:** Hultgren - Tillis Engineers
Project: Salton Sea

● **Source:** **Sample No.:** HA-1

Remarks:

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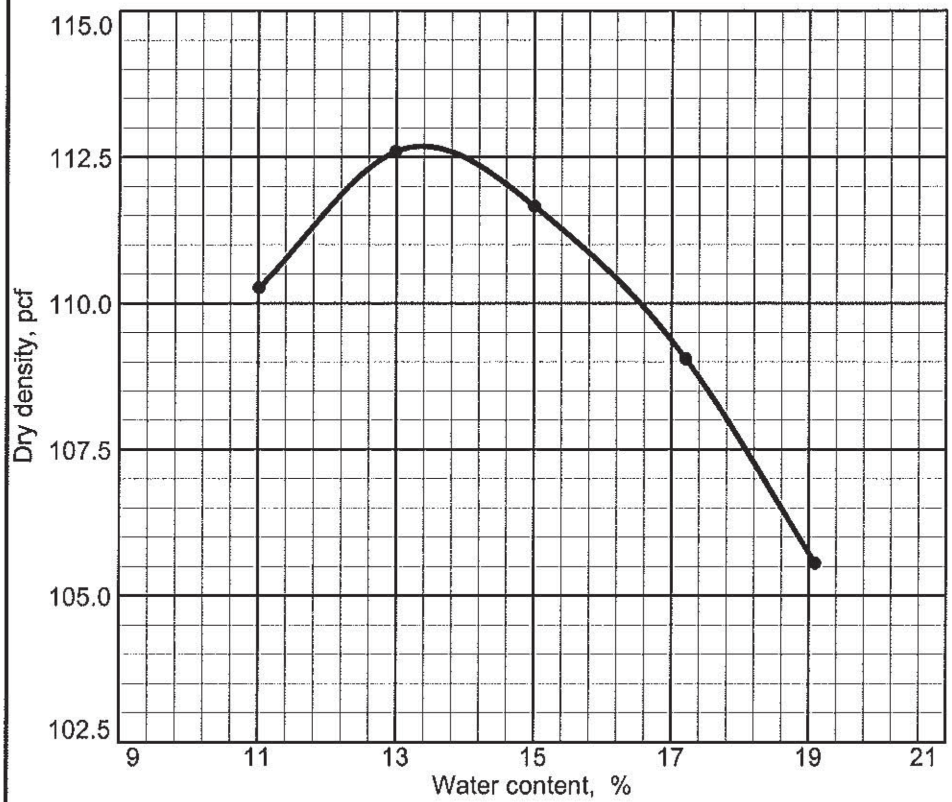
Fresno, CA

Figure

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 1557-07 Method A Modified

Hammer Wt.: 10 lb.
Hammer Drop: 18 in.
Number of Layers: five
Blows per Layer: 25
Mold Size: .03333 cu.ft.
Test Performed on Material Passing No.4 **Sieve**

Soil Data

NM ______ **Sp.G.** ______
LL ______ **PI** ______
%>No.4 ______ **%<#200** ______
USCS ______ **AASHTO** ______

TESTING DATA

	1	2	3	4	5	6
WM + WS	8.59	8.52	8.61	8.57	8.41	
WM	4.33	4.33	4.33	4.33	4.33	
WW + T #1	506.10	260.70	262.90	253.20	250.00	
WD + T #1	431.80	218.90	228.60	224.10	225.20	
TARE #1	0.00	0.00	0.00	0.00	0.00	
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	17.2	19.1	15.0	13.0	11.0	
DRY DENSITY	109.0	105.6	111.7	112.6	110.3	

TEST RESULTS

Maximum dry density = 112.7 pcf

Optimum moisture = 13.4 %

Material Description

Project No. 60 **Client:** Hultgren - Tillis Engineers
Project: Salton Sea

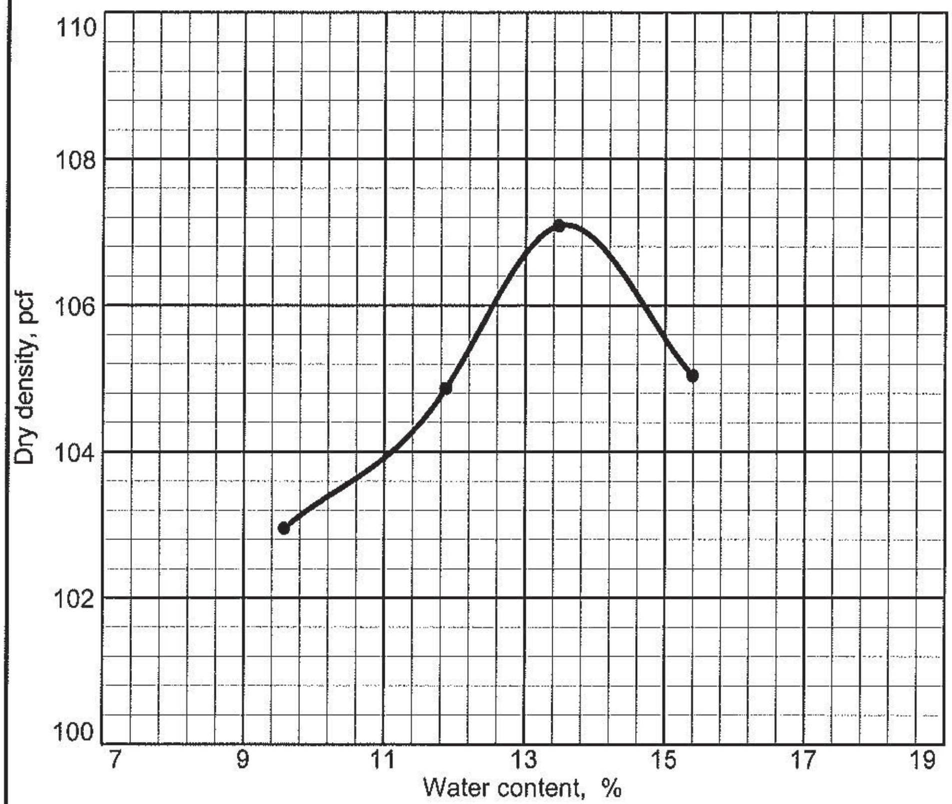
● **Source:** **Sample No.:** HA-1

Remarks:

Moore Twining Associates, Inc.
Fresno, CA

Figure

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 698-07 Procedure A Standard

Hammer Wt.: 5.5 lb.
Hammer Drop: 12 in.
Number of Layers: three
Blows per Layer: 25
Mold Size: .03333 cu.ft.
Test Performed on Material Passing No.4 **Sieve**

Soil Data

NM ______ **Sp.G.** ______
LL ______ **PI** ______
%>No.4 ______ **%<#200** ______
USCS ______ **AASHTO** ______

TESTING DATA

	1	2	3	4	5	6
WM + WS	8.24	8.38	8.09	8.37		
WM	4.33	4.33	4.33	4.33		
WW + T #1	279.90	274.60	273.50	268.40		
WD + T #1	250.20	242.00	249.60	232.60		
TARE #1	0.00	0.00	0.00	0.00		
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	11.9	13.5	9.6	15.4		
DRY DENSITY	104.9	107.1	103.0	105.0		

TEST RESULTS

Maximum dry density = 107.1 pcf

Optimum moisture = 13.6 %

Material Description

Project No. 60 **Client:** Hultgren - Tillis Engineers
Project: Salton Sea

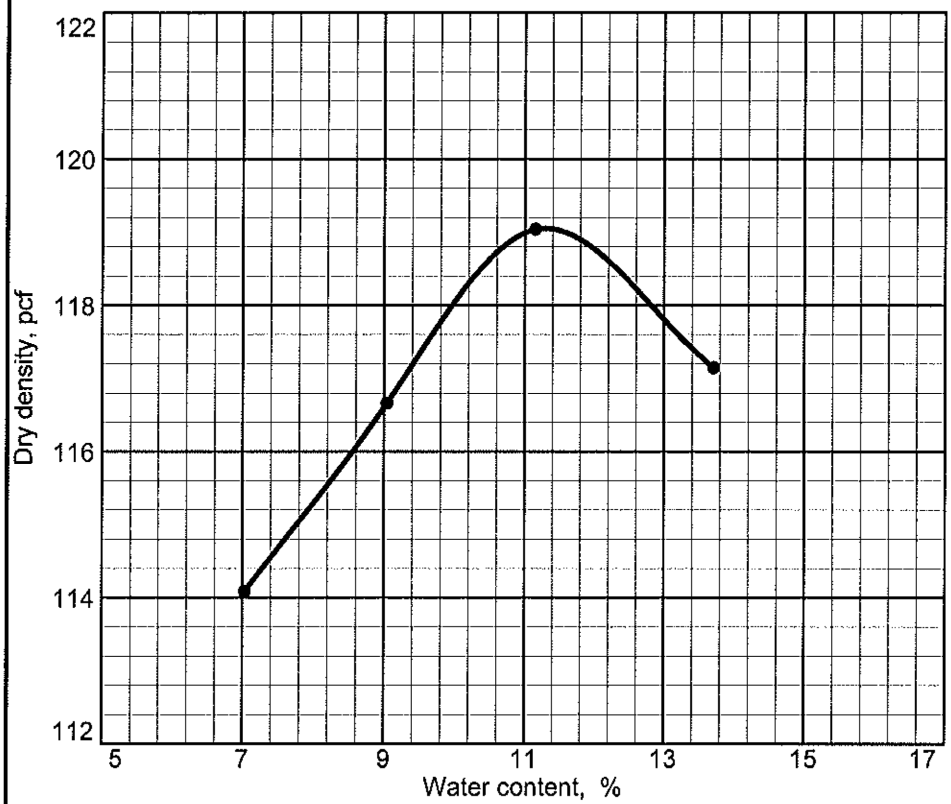
● **Source:** **Sample No.:** HA-4

Remarks:

Moore Twining Associates, Inc.
Fresno, CA

Figure

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 1557-07 Method A Modified

Hammer Wt.: 10 lb.
Hammer Drop: 18 in.
Number of Layers: five
Blows per Layer: 25
Mold Size: .03333 cu.ft.
Test Performed on Material Passing No.4 **Sieve**

Soil Data

NM ____ **Sp.G.** ____
LL ____ **PI** ____
%>No.4 ____ **%<#200** ____
USCS ____ **AASHTO** ____

TESTING DATA

	1	2	3	4	5	6
WM + WS	8.57	8.40	8.74	8.77		
WM	4.33	4.33	4.33	4.33		
WW + T #1	255.70	274.00	266.10	260.40		
WD + T #1	234.50	256.00	239.40	229.00		
TARE #1	0.00	0.00	0.00	0.00		
WW + T #2						
WD + T #2						
TARE #2						
MOISTURE	9.0	7.0	11.2	13.7		
DRY DENSITY	116.7	114.1	119.0	117.1		

TEST RESULTS

Maximum dry density = 119.1 pcf

Optimum moisture = 11.3 %

Material Description

Project No. 60 **Client:** Hultgren - Tillis Engineers
Project: Salton Sea

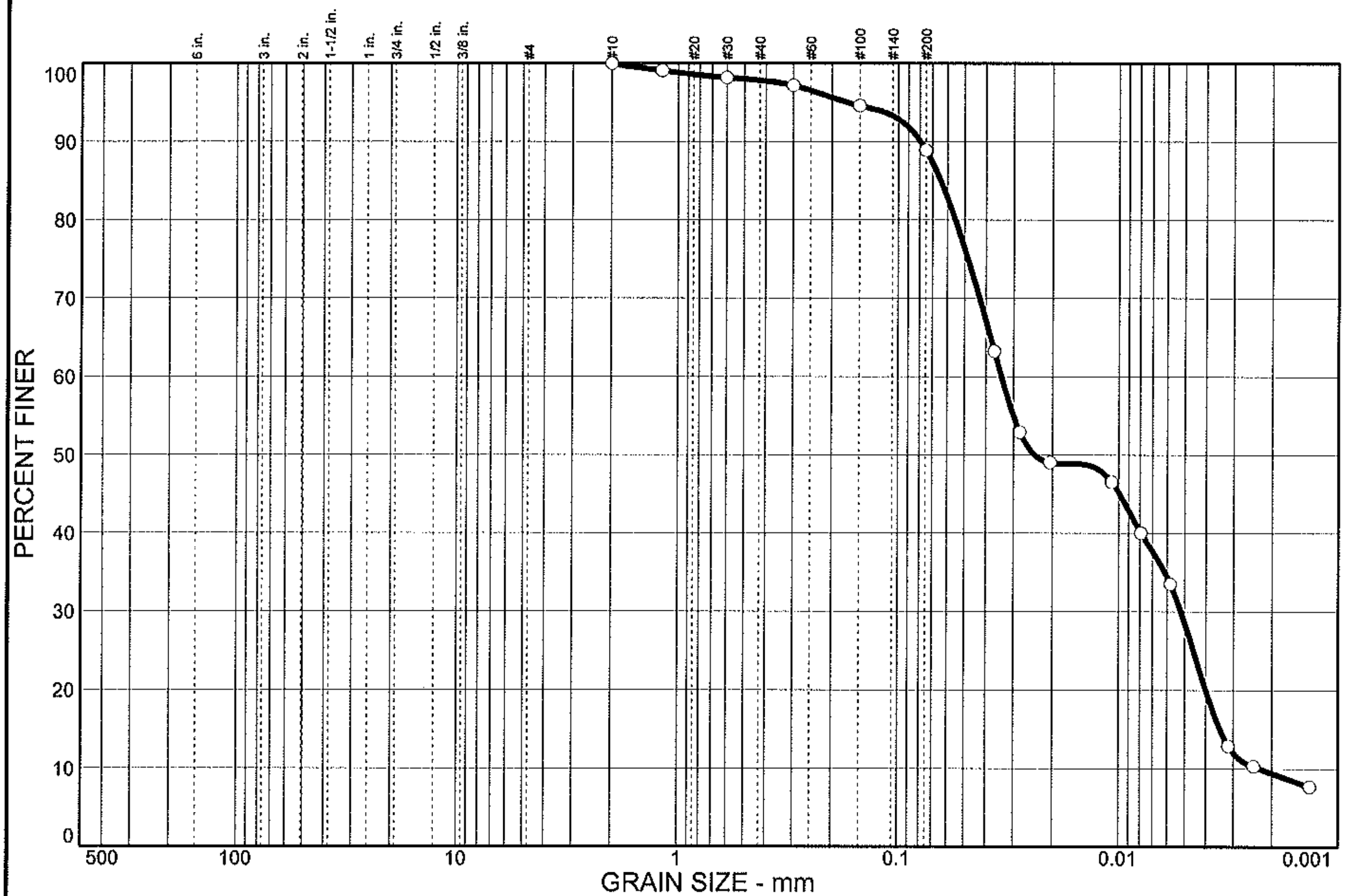
• **Source:** **Sample No.:** HA-4

Remarks:

Moore Twining Associates, Inc.
Fresno, CA

Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	2.1	9.0	60.3	28.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.1		
#30	98.2		
#50	97.2		
#100	94.6		
#200	88.9		

* (no specification provided)

Material Description

Atterberg Limits

PL= 19 LL= 63 PI= 44

Coefficients

D_{85}= 0.0643 D_{60}= 0.0340 D_{50}= 0.0241
D_{30}= 0.0052 D_{15}= 0.0034 D_{10}= 0.0023
C_u= 15.00 C_c= 0.35

Classification

USCS= AASHTO=

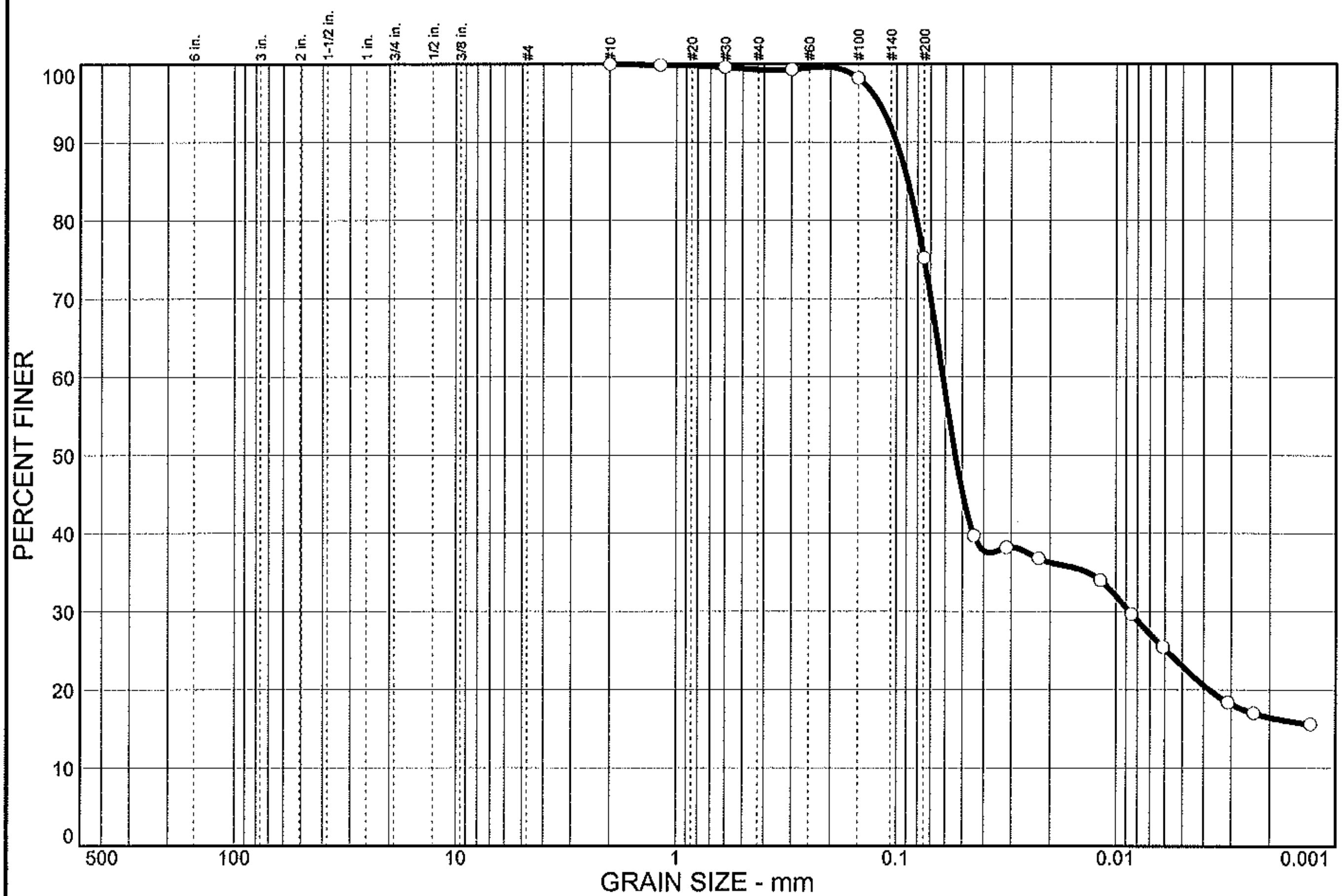
Remarks

F.M.=0.11

Sample No.: HA-1 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:**

Moore Twining Associates, Inc.	**Client:** Hultgren - Tillis Engineers
	Project: Salton Sea
Fresno, CA	**Project No:** 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.7	24.1	52.2	23.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	99.6		
#50	99.3		
#100	98.2		
#200	75.2		

* (no specification provided)

Material Description

Atterberg Limits

PL= 20 LL= 56 PI= 36

Coefficients

D_{85}= 0.0889 D_{60}= 0.0614 D_{50}= 0.0538
D_{30}= 0.0087 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

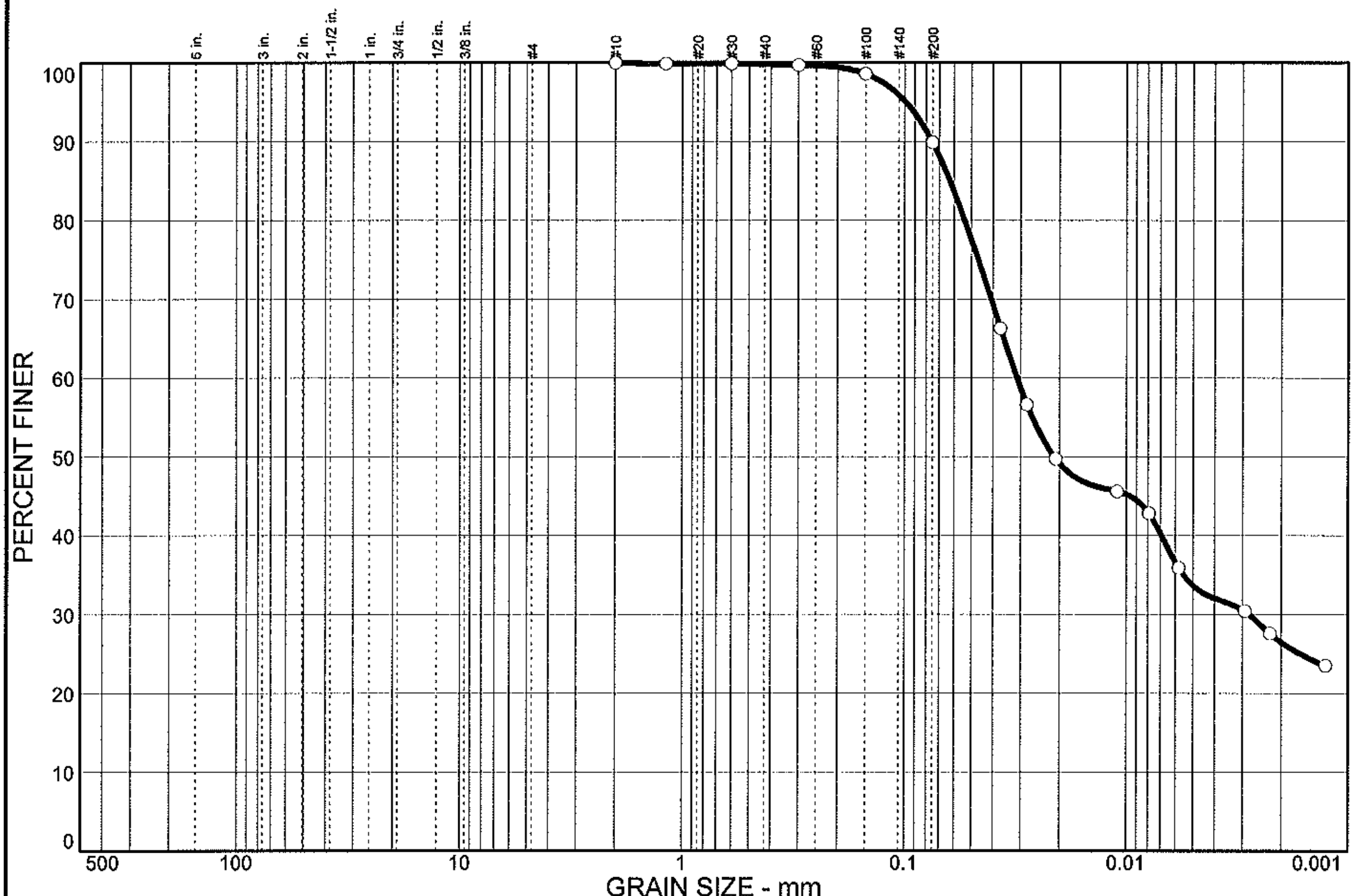
Remarks

F.M.=0.03

Sample No.: HA-4 **Source of Sample:** **Date:** 10/12/10
Location: **Elev./Depth:**

Moore Twining Associates, Inc. Fresno, CA	**Client:** Hultgren - Tillis Engineers **Project:** Salton Sea **Project No:** 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	9.9	56.2	33.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	99.9		
#50	99.7		
#100	98.6		
#200	89.9		

* (no specification provided)

Material Description

Atterberg Limits

PL= 21 LL= 68 PI= 47

Coefficients

D_{85}= 0.0627 D_{60}= 0.0311 D_{50}= 0.0211
D_{30}= 0.0028 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

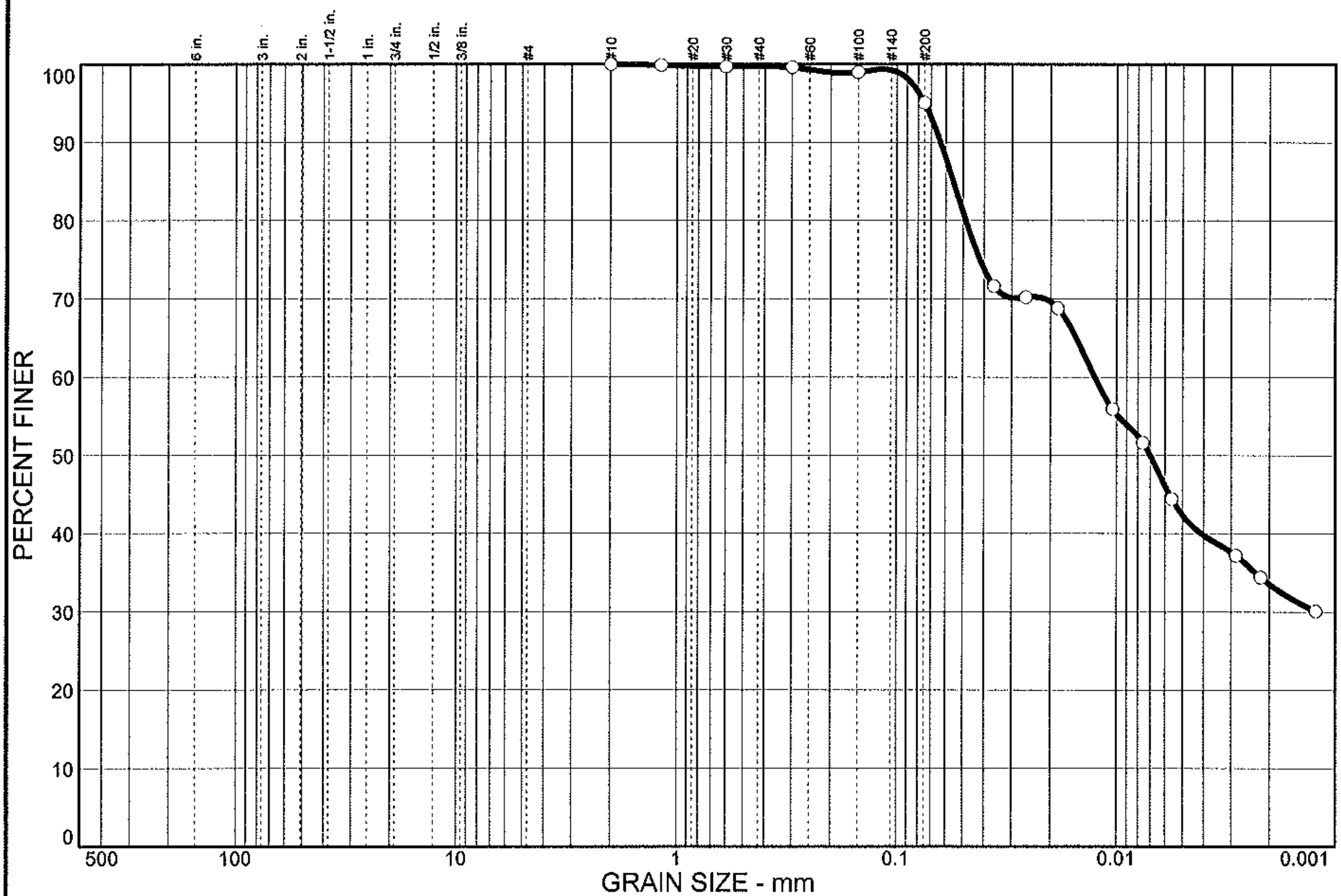
F.M.=0.02

Sample No.: VC-11 (B&C) **Source of Sample:** **Date:** 10/13/10
Location: **Elev./Depth:** 0-3.5 Feet

Moore Twining Associates, Inc.
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	4.7	52.7	42.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	99.7		
#50	99.6		
#100	99.0		
#200	95.1		

* (no specification provided)

Material Description

Atterberg Limits

PL= 20 LL= 66 PI= 46

Coefficients

D_{85}= 0.0554 D_{60}= 0.0126 D_{50}= 0.0070
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.02

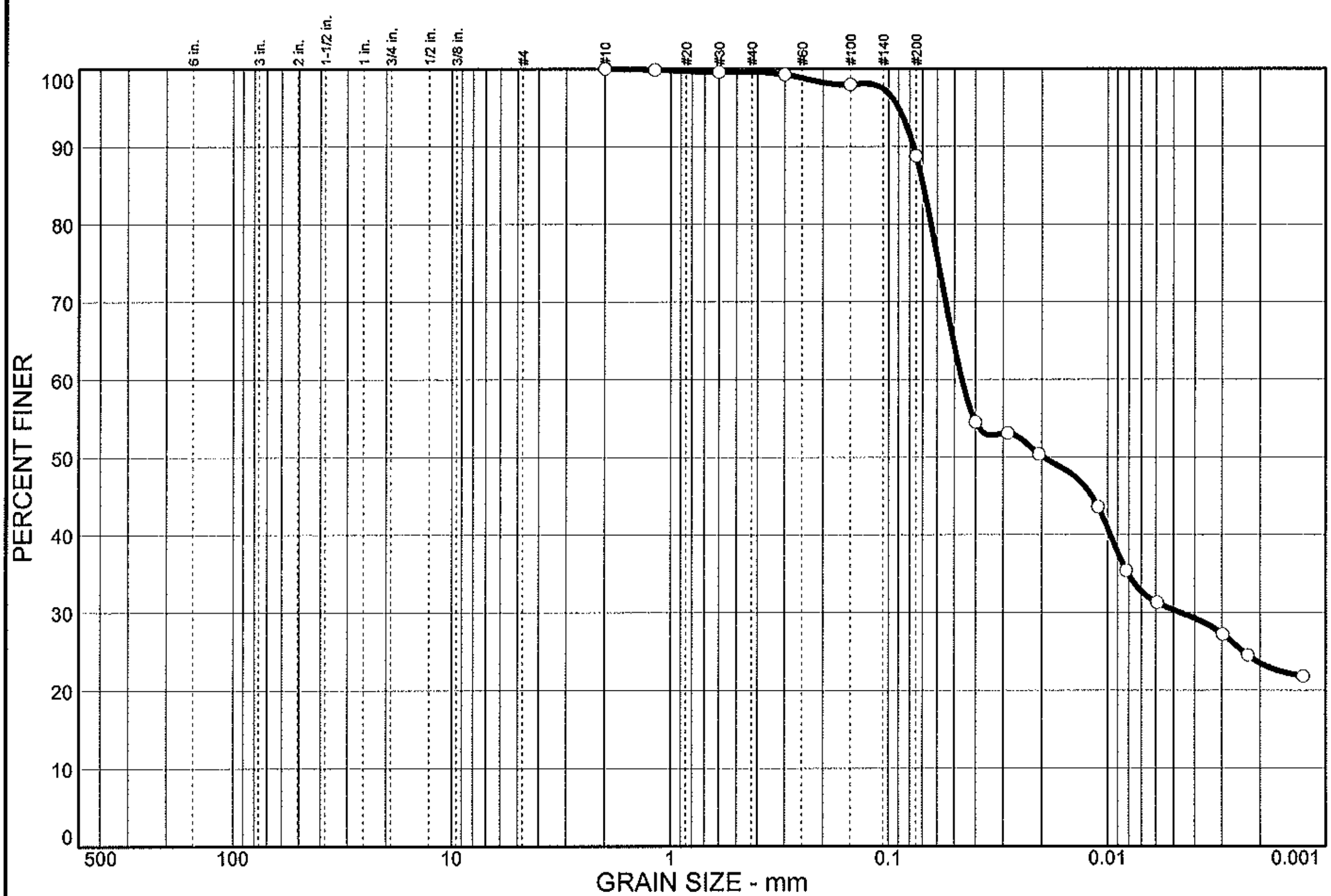
Sample No.: VC-16 (B&C) **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 0-3.9 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.4	10.8	58.5	30.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	99.9		
#30	99.6		
#50	99.3		
#100	98.0		
#200	88.8		

* (no specification provided)

Material Description

Atterberg Limits

PL= 18 LL= 67 PI= 49

Coefficients

D_{85}= 0.0696 D_{60}= 0.0463 D_{50}= 0.0196
D_{30}= 0.0047 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.03

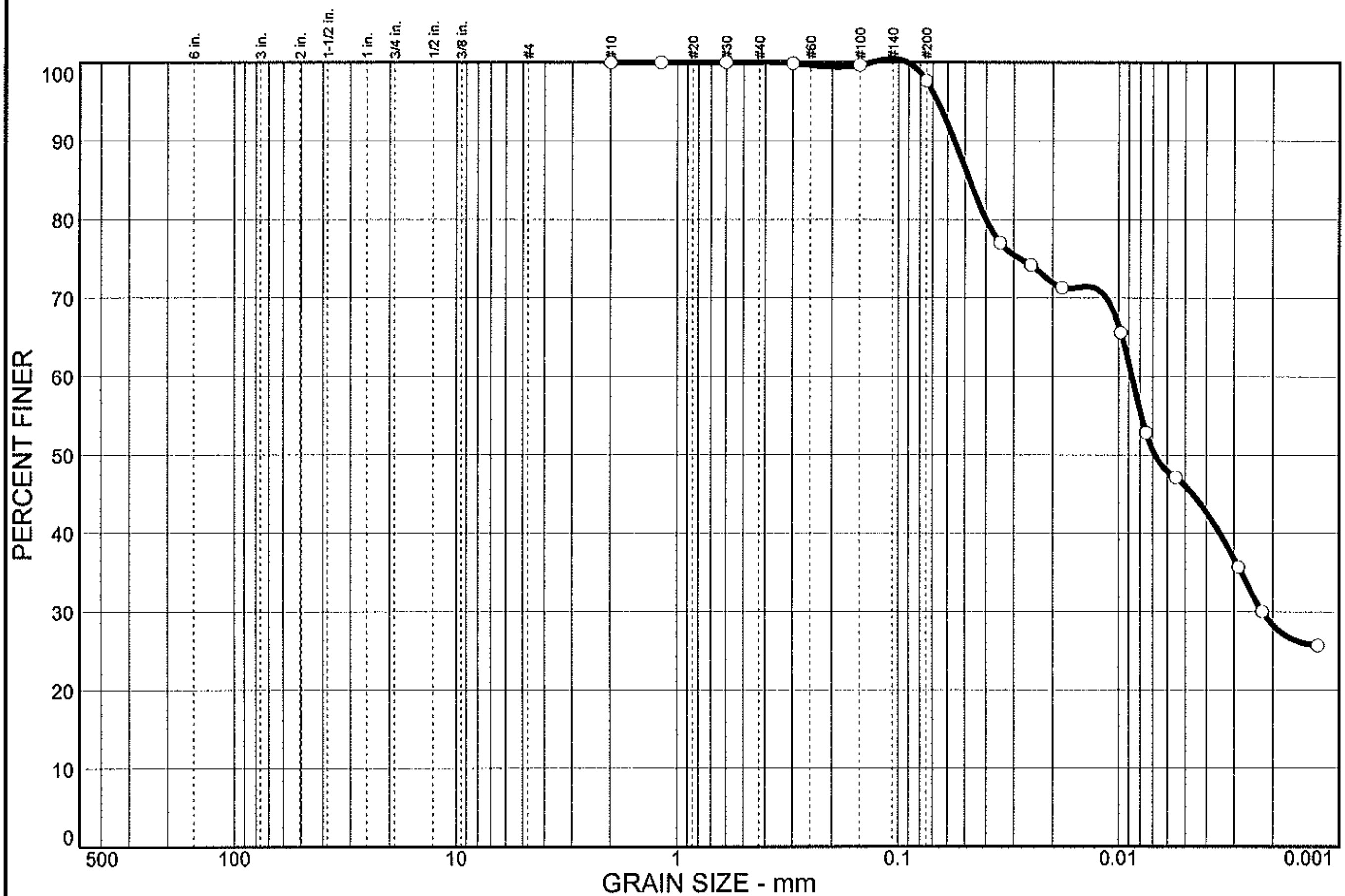
Sample No.: VC-20 (B&C) **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 0-4.7 Feet

Moore Twining Associates, Inc.

Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea
Project No: 60 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0		2.3	51.6	46.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	100.0		
#50	99.9		
#100	99.7		
#200	97.7		

* (no specification provided)

Material Description

Atterberg Limits

PL= 18 LL= 65 PI= 47

Coefficients

D_{85}= 0.0476 D_{60}= 0.0087 D_{50}= 0.0068
D_{30}= 0.0022 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=0.00

Sample No.: VC-28 (B&C) **Source of Sample:** **Date:** 10/14/10
Location: **Elev./Depth:** 0.4-5.7 Feet

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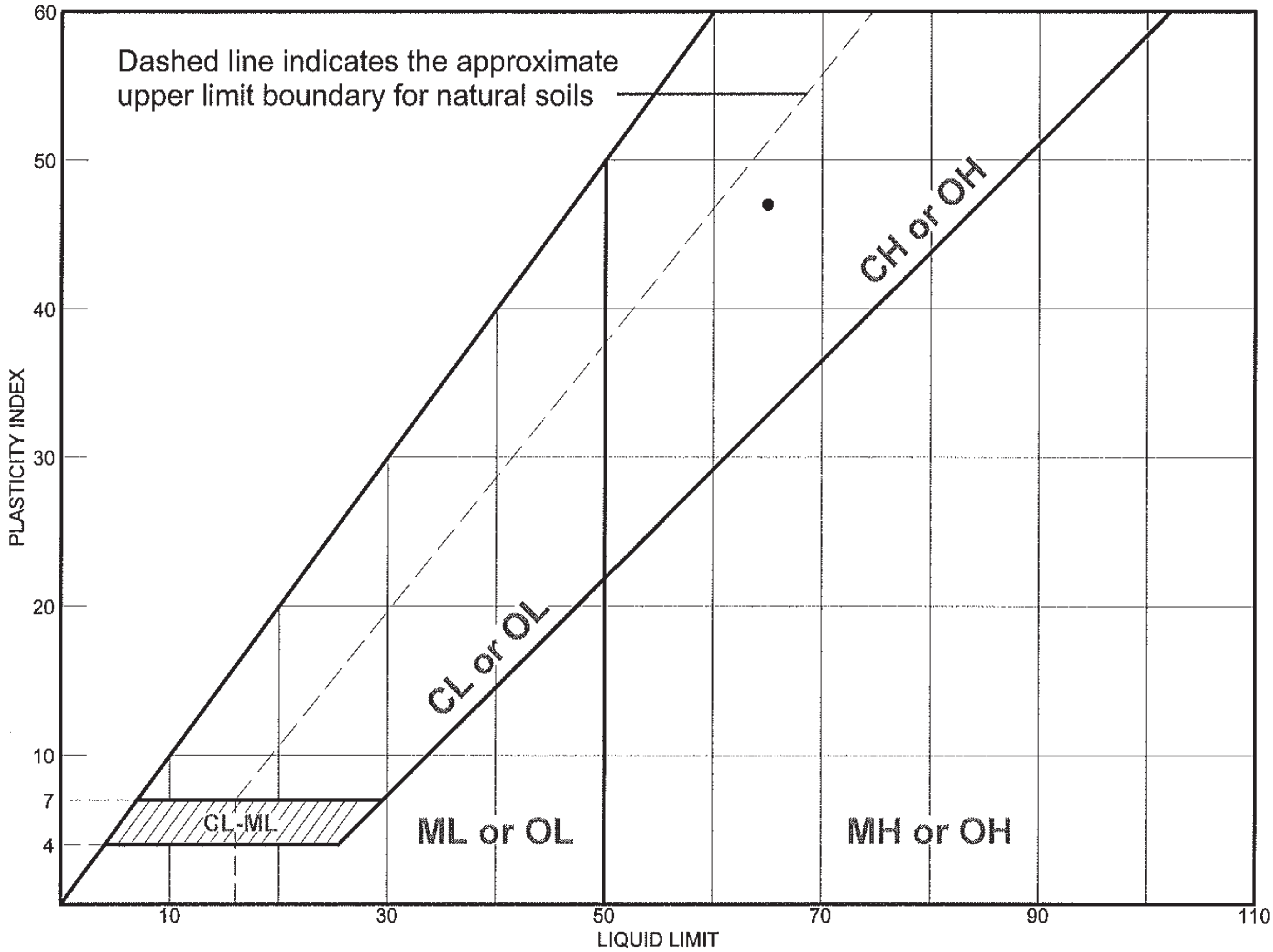
Fresno, CA

Client: Hultgren - Tillis Engineers
Project: Salton Sea

Project No: 60 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		65	18	47			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-28 (B&C) **Elev./Depth:** 0.4-5.7 Feet

Remarks:

● Material is considered Non-Organic

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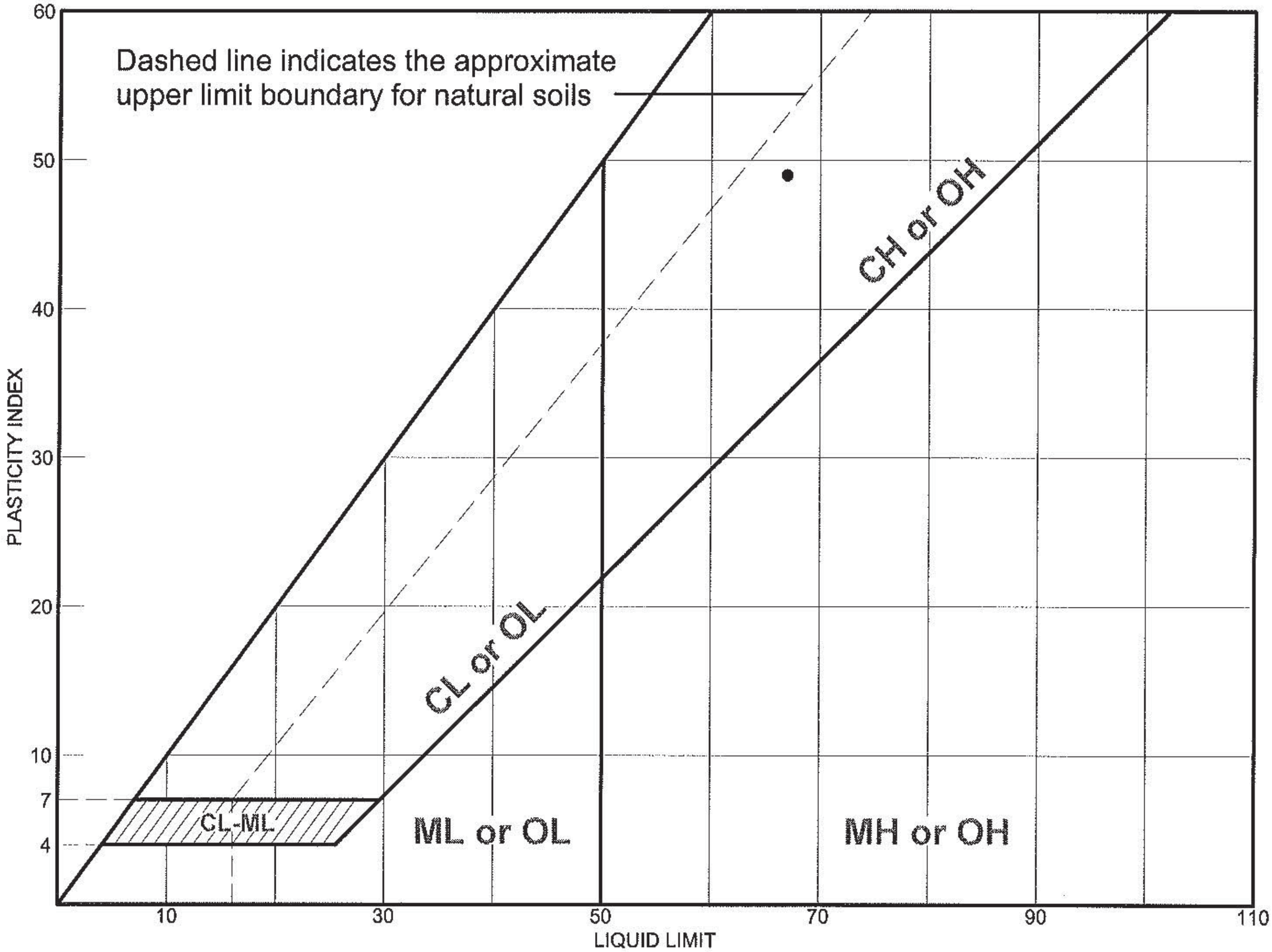
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		67	18	49			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-20 (B&C)**Elev./Depth:** 0-4.7 Feet

Remarks:

● Material is considered Non-Organic

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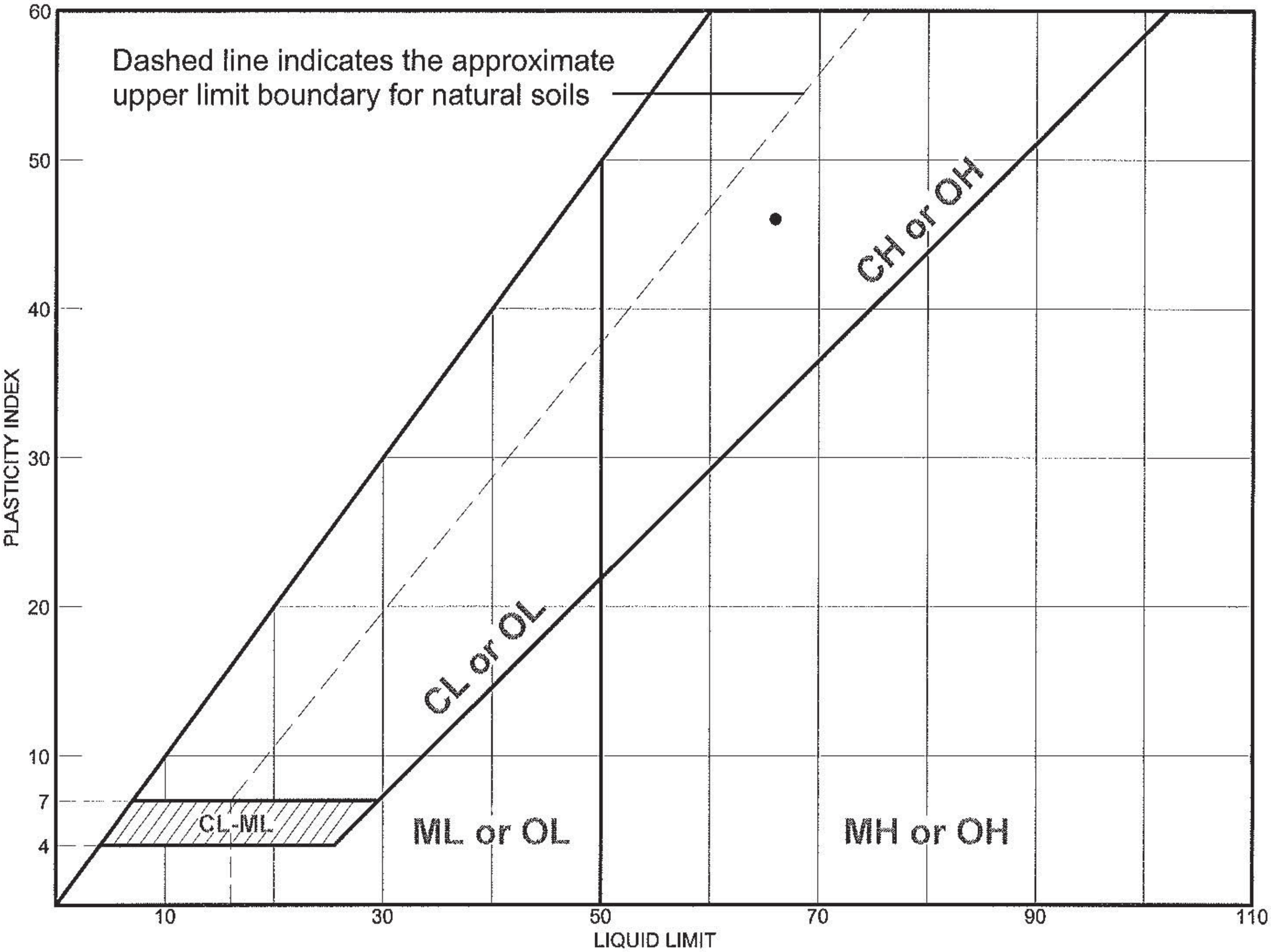
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		66	20	46			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-16 (B&C) **Elev./Depth:** 0-3.9 Feet

Remarks:

● Material is considered Non-Organic

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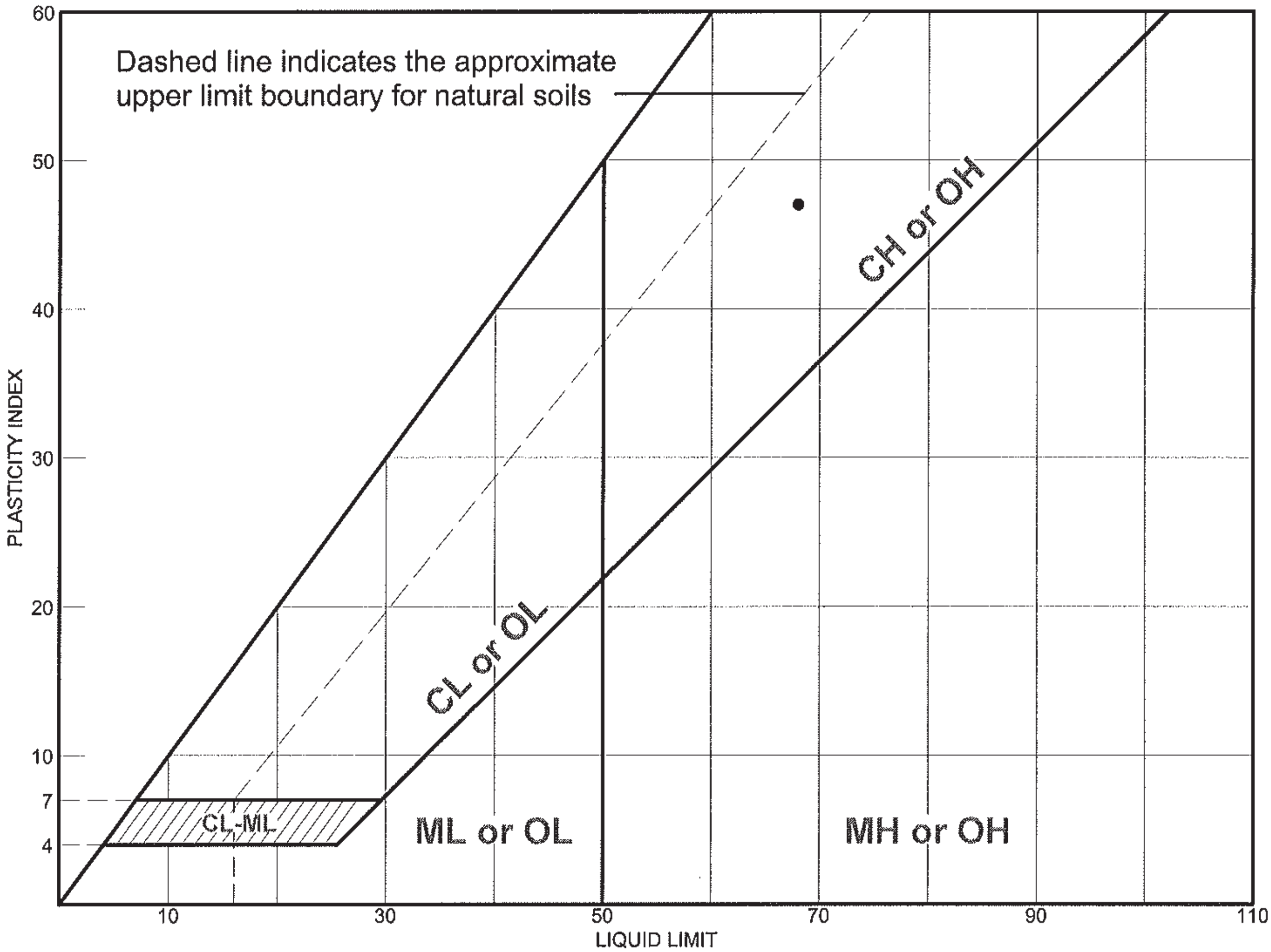
Fresno, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		68	21	47			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** VC-11 (B&C) **Elev./Depth:** 0-3.5 Feet

Remarks:

● Material is considered Non-Organic

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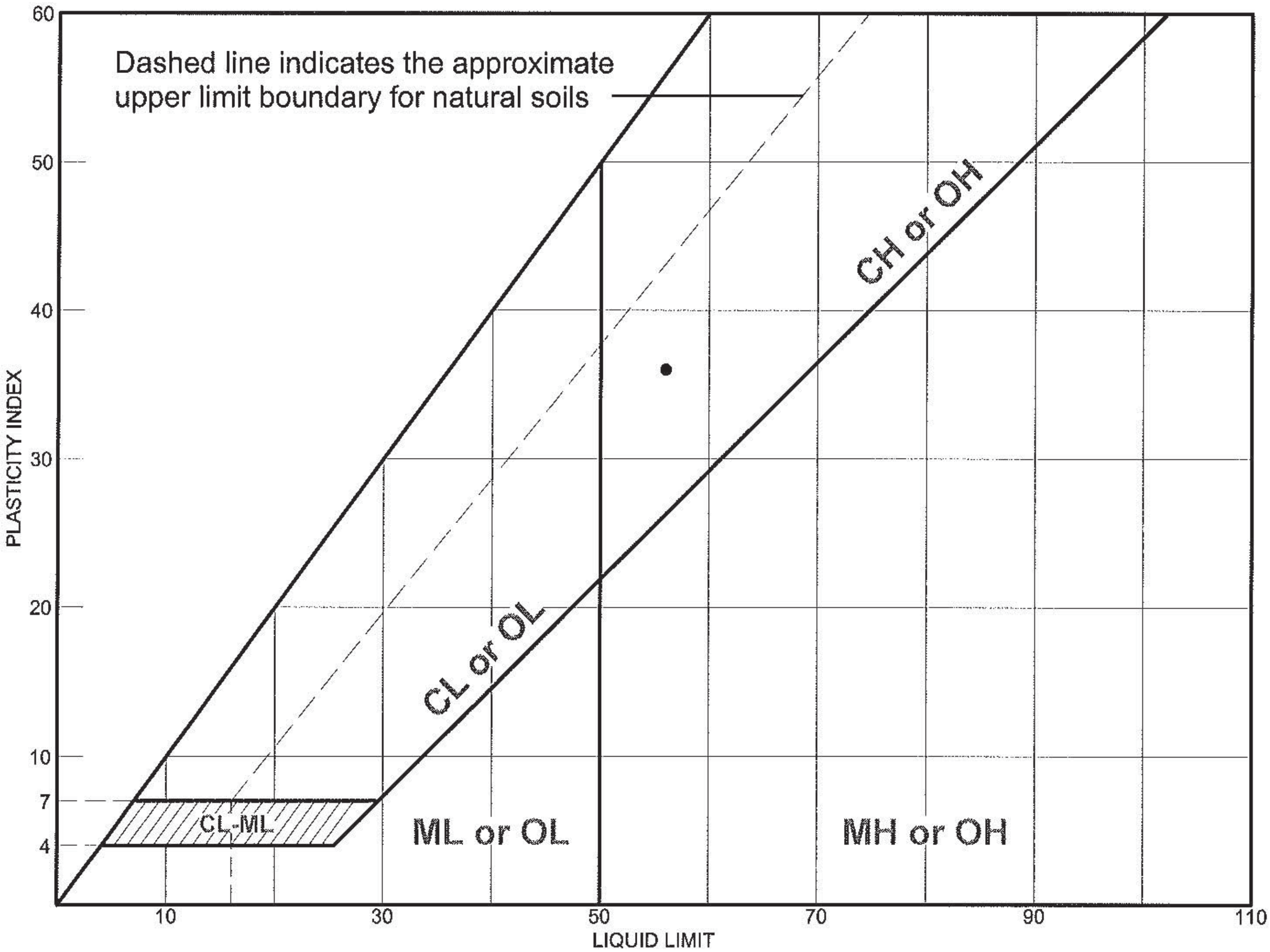
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		56	20	36			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** HA-4

Remarks:
● Material is considered Non-Organic

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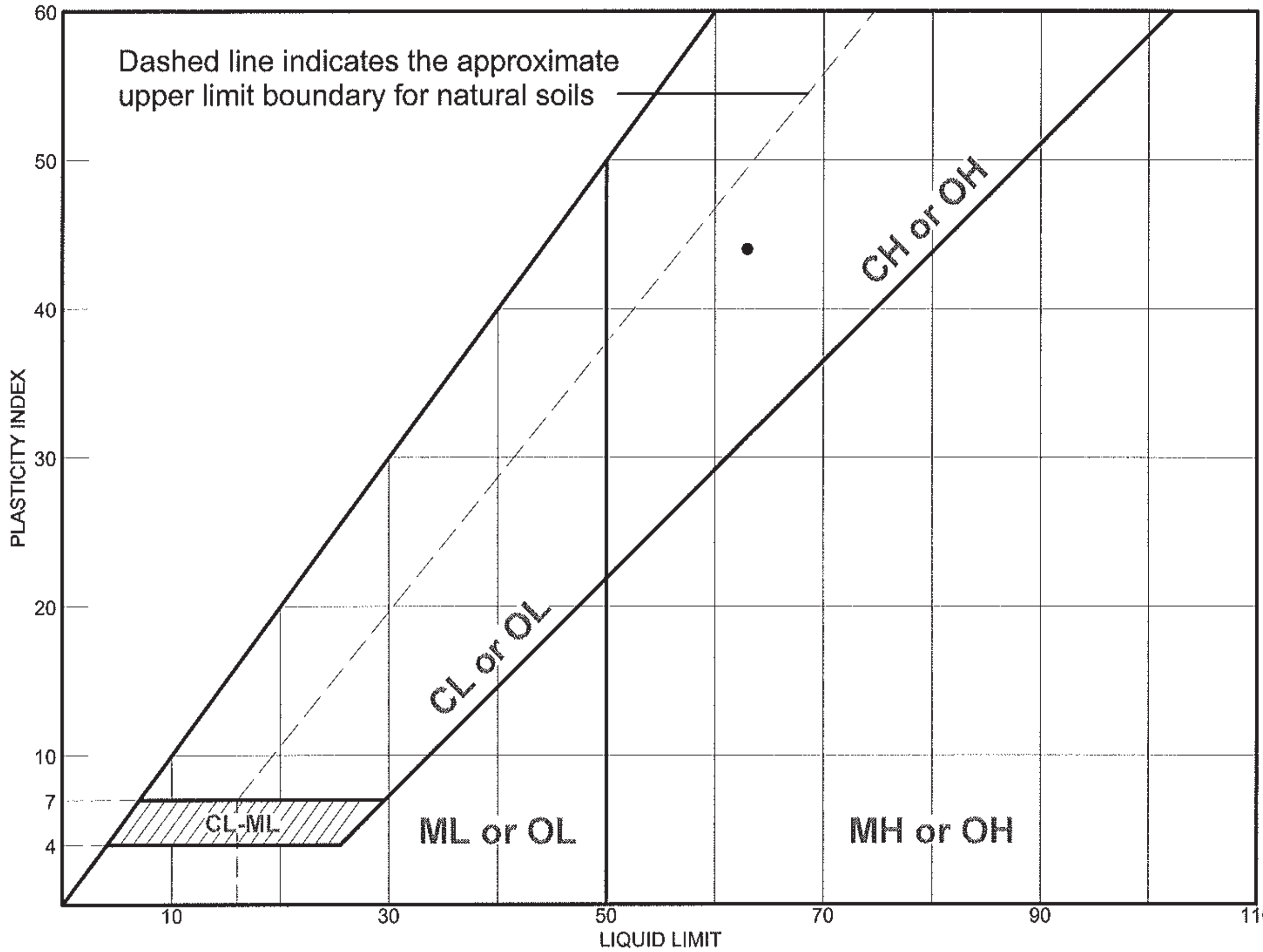
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		63	19	44			

Project No. 60 **Client:** Hultgren - Tillis Engineers

Project: Salton Sea

● **Source:** **Sample No.:** HA-1

Remarks:
● Material is considered Non-Organic

Moore Twining Associates, Inc.
Fresno, CA

Figure

MOORE TWINING
ASSOCIATES, INC.

California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

October 22, 2010

Work Order #: 0I29061

Michael Shwiyhat
MTA Materials Division
2527 Fresno St.
Fresno, CA 93721

RE: Salton Sea Project

Enclosed are the analytical results for samples received by our laboratory on 09/29/10 . For your reference, these analyses have been assigned laboratory work order number 0I29061.

All analyses have been performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, Moore Twining Associates, Inc. (MTA) is not responsible for use of less than complete reports. Results apply only to samples analyzed.

If you have any questions, please feel free to contact us at the number listed above.

Sincerely,

Moore Twining Associates, Inc.

for AG

Allen Glover
Director of Analytical Chemistry

MOORE TWINING ASSOCIATES, INC.

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(559) 268-7021 Phone
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California ELAP Certificate # 1371

MTA Materials Division 2527 Fresno St. Fresno CA, 93721	Project: Salton Sea Project Project Number: Salton Sea Project Project Manager: Michael Shwiyhat	**Reported:** 10/22/10

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
HA1 Bulk Comp.	0I29061-01	Soil	09/29/10 00:00	09/29/10 15:22
HA4 Bulk Comp.	0I29061-02	Soil	09/29/10 00:00	09/29/10 15:22
VC 11 (B+C)	0I29061-03	Soil	09/29/10 00:00	09/29/10 15:22
VC 16 (B+C)	0I29061-04	Soil	09/29/10 00:00	09/29/10 15:22
VC 20 (B+C)	0I29061-05	Soil	09/29/10 00:00	09/29/10 15:22
VC 28 (B+C)	0I29061-06	Soil	09/29/10 00:00	09/29/10 15:22

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MTA Materials Division 2527 Fresno St. Fresno CA, 93721	Project: Salton Sea Project Project Number: Salton Sea Project Project Manager: Michael Shwiyhat	**Reported:** 10/22/10

HA1 Bulk Comp.

0I29061-01 (Soil) Sampled:09/29/10 00:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Inorganics									
Bromide	ND	4000	mg/kg	2000	T0J1910	10/19/10	10/20/10	EPA 300.0	
Chloride	**29000**	4000	mg/kg	2000	T0J1910	10/19/10	10/20/10	EPA 300.0	
LOI (% Organic Matter)	**2.3**	0.10	%	1	T0J1123	10/11/10	10/13/10	ASTM D2974	
Nitrate as NO3	ND	4000	mg/kg	2000	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrite as NO2	ND	2000	mg/kg	2000	T0J1910	10/19/10	10/20/10	EPA 300.0	
Metals - Totals									
Calcium	**62000**	50	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Magnesium	**11000**	10	mg/kg	1	T0J0514	10/05/10	10/09/10	EPA 6010B	
Potassium	**5900**	500	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Sodium	**18000**	200	mg/kg	50	T0J0514	10/05/10	10/12/10	EPA 6010B	

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California ELAP Certificate # 1371

MTA Materials Division 2527 Fresno St. Fresno CA, 93721	Project: Salton Sea Project Project Number: Salton Sea Project Project Manager: Michael Shwiyhat	**Reported:** 10/22/10

HA4 Bulk Comp.

0I29061-02 (Soil) Sampled:09/29/10 00:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Inorganics									
Bromide	ND	2000	mg/kg	1000	T0J1910	10/19/10	10/20/10	EPA 300.0	
Chloride	**12000**	2000	mg/kg	1000	T0J1910	10/19/10	10/20/10	EPA 300.0	
LOI (% Organic Matter)	**0.80**	0.10	%	1	T0J1123	10/11/10	10/13/10	ASTM D2974	
Nitrate as NO3	ND	2000	mg/kg	1000	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrite as NO2	ND	1000	mg/kg	1000	T0J1910	10/19/10	10/20/10	EPA 300.0	
Metals - Totals									
Calcium	**48000**	50	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Magnesium	**9000**	10	mg/kg	1	T0J0514	10/05/10	10/09/10	EPA 6010B	
Potassium	**3700**	500	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Sodium	**8500**	80	mg/kg	20	T0J0514	10/05/10	10/12/10	EPA 6010B	

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MTA Materials Division 2527 Fresno St. Fresno CA, 93721	Project: Salton Sea Project Project Number: Salton Sea Project Project Manager: Michael Shwiyhat	**Reported:** 10/22/10

VC 11 (B+C)

0I29061-03 (Soil) Sampled:09/29/10 00:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Inorganics									
Bromide	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Chloride	**5500**	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrate as NO3	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrite as NO2	ND	500	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Metals - Totals									
Calcium	**41000**	50	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Magnesium	**8000**	10	mg/kg	1	T0J0514	10/05/10	10/09/10	EPA 6010B	
Potassium	**3700**	500	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Sodium	**6400**	80	mg/kg	20	T0J0514	10/05/10	10/12/10	EPA 6010B	

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California ELAP Certificate # 1371

MTA Materials Division 2527 Fresno St. Fresno CA, 93721	Project: Salton Sea Project Project Number: Salton Sea Project Project Manager: Michael Shwiyhat	**Reported:** 10/22/10

VC 16 (B+C)

0I29061-04 (Soil) Sampled:09/29/10 00:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Inorganics									
Bromide	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Chloride	**6900**	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrate as NO3	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrite as NO2	ND	500	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Metals - Totals									
Calcium	**36000**	50	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Magnesium	**7500**	10	mg/kg	1	T0J0514	10/05/10	10/09/10	EPA 6010B	
Potassium	**3500**	500	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Sodium	**6700**	80	mg/kg	20	T0J0514	10/05/10	10/12/10	EPA 6010B	

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MTA Materials Division 2527 Fresno St. Fresno CA, 93721	Project: Salton Sea Project Project Number: Salton Sea Project Project Manager: Michael Shwiyhat	**Reported:** 10/22/10

VC 20 (B+C)

0I29061-05 (Soil) Sampled:09/29/10 00:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Inorganics									
Bromide	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Chloride	**4600**	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrate as NO3	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrite as NO2	ND	500	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Metals - Totals									
Calcium	**40000**	100	mg/kg	10	T0J0514	10/05/10	10/12/10	EPA 6010B	
Magnesium	**7600**	10	mg/kg	1	T0J0514	10/05/10	10/09/10	EPA 6010B	
Potassium	**2000**	1000	mg/kg	10	T0J0514	10/05/10	10/12/10	EPA 6010B	
Sodium	**4600**	40	mg/kg	10	T0J0514	10/05/10	10/12/10	EPA 6010B	

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MTA Materials Division 2527 Fresno St. Fresno CA, 93721	Project: Salton Sea Project Project Number: Salton Sea Project Project Manager: Michael Shwiyhat	**Reported:** 10/22/10

VC 28 (B+C)

0I29061-06 (Soil) Sampled:09/29/10 00:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Inorganics									
Bromide	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Chloride	**8600**	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrate as NO3	ND	1000	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Nitrite as NO2	ND	500	mg/kg	500	T0J1910	10/19/10	10/20/10	EPA 300.0	
Metals - Totals									
Calcium	**48000**	50	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Magnesium	**7900**	10	mg/kg	1	T0J0514	10/05/10	10/09/10	EPA 6010B	
Potassium	**3400**	500	mg/kg	5	T0J0514	10/05/10	10/12/10	EPA 6010B	
Sodium	**8400**	80	mg/kg	20	T0J0514	10/05/10	10/12/10	EPA 6010B	

Notes and Definitions

RPD	The RPD result exceeded the QC control limits. However, both percent recoveries were acceptable.
QM	The spike recovery for this QC sample is outside of established control limits due to matrix interference.
Q4	The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration.
ug/L	micrograms per liter (parts per billion concentration units)
mg/L	milligrams per liter (parts per million concentration units)
mg/kg	milligrams per kilogram (parts per million concentration units)
ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference

Quality Control Data Available Upon Request

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Dispersive Characteristic of Clay Soil by Double Hydrometer
ASTM D4221

MTA Project Name:	Hultgren - Tillis Engineers	Report Date:	10/14/2010
	Salton Sea	Sample Date:	Sept. 20010
MTA Project Number	60	Sample I.D.:	

Sample Location: VC-28 @ 0.4-5.7 Feet
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

ASTM D422 Procedure		ASTM D4221 Procedure	
Dry Sample Wt., gm	70.1	Dry Sample Wt., gm	25
% Passing #10 Sieve	100	% Passing #10 Sieve	100
% Passing #200 Sieve	97.7	% Passing #200 Sieve	97.7
Hydrometer Reading @ 60 min	37	Hydrometer Reading @ 60 min	1
Temperature, °C	21.4	Temperature, °C	25.5
Hydrometer Correction	-4	Hydrometer Correction	0
% Passing 5-µm(a)	46	% Passing 5-µm(b)	4

% Dispersion = $\frac{\text{(\% Passing 5-µm(b))}}{\text{(\% Passing 5-µm(a))}}$ *** 100** ⟶ $\frac{4.0\ (100)}{46.0}$ = 9%

Dispersive Characteristic of Clay Soil by Crumb Test
ASTM D6572

Sample Location: VC-28 @ 0.4-5.7 Feet
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

Test Results:
Grade: 1 - Nondispersive

(a) % by ASTM D422
(b) % by ASTM D4221

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FX: 559.268.7126
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Fresno, CA 93721

MOORE TWINING ASSOCIATES, INC.

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Dispersive Characteristic of Clay Soil by Double Hydrometer
ASTM D4221

MTA Project Name:	Hultgren - Tillis Engineers	Report Date:	10/14/2010
	Salton Sea	Sample Date:	Sept. 20010
MTA Project Number	60	Sample I.D.:	

Sample Location: VC-20 @ 0-4.7 Feet
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

ASTM D422 Procedure		ASTM D4221 Procedure	
Dry Sample Wt., gm	73.4	Dry Sample Wt., gm	25
% Passing #10 Sieve	100	% Passing #10 Sieve	100
% Passing #200 Sieve	88.8	% Passing #200 Sieve	88.8
Hydrometer Reading @ 60 min	27	Hydrometer Reading @ 60 min	1
Temperature, °C	21.4	Temperature, °C	25.5
Hydrometer Correction	-4	Hydrometer Correction	0
% Passing 5-μm(a)	30	% Passing 5-μm(b)	4

$$\textbf{\% Dispersion} = \frac{\text{(\% Passing 5-μm(b))}}{\text{(\% Passing 5-μm(a))}} * 100 \longrightarrow \frac{4.0\ (100)}{30.0} = 13\%$$

Dispersive Characteristic of Clay Soil by Crumb Test
ASTM D6572

Sample Location: VC-20 @ 0-4.7 Feet
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

Test Results:
Grade: 1 - Nondispersive

(a) % by ASTM D422
(b) % by ASTM D4221

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Fresno, CA 93721

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Dispersive Characteristic of Clay Soil by Double Hydrometer
ASTM D4221

MTA Project Name:	Hultgren - Tillis Engineers	Report Date:	10/14/2010
	Salton Sea	Sample Date:	Sept. 20010
MTA Project Number	60	Sample I.D.:	

Sample Location: VC-16 @ 0-3.5 Feet
Visual Classification: Fat Clay
Sampled By: Client

Tested By: TD
Test Date: 10/9/2010

ASTM D422 Procedure		ASTM D4221 Procedure	
Dry Sample Wt., gm	69.8	Dry Sample Wt., gm	25
% Passing #10 Sieve	100	% Passing #10 Sieve	100
% Passing #200 Sieve	95.1	% Passing #200 Sieve	95.1
Hydrometer Reading @ 60 min	35	Hydrometer Reading @ 60 min	1
Temperature, °C	21.4	Temperature, °C	25.5
Hydrometer Correction	-4	Hydrometer Correction	0
% Passing 5-μm(a)	42.5	% Passing 5-μm(b)	4

% Dispersion = $\frac{\text{(\% Passing 5-μm(b))}}{\text{(\% Passing 5-μm(a))}}$ *** 100** → $\frac{4.0\ (100)}{42.5}$ = 9%

Dispersive Characteristic of Clay Soil by Crumb Test
ASTM D6572

Sample Location: VC-16 @ 0-3.5 Feet
Visual Classification: Fat Clay
Sampled By: Client

Tested By: TD
Test Date: 10/9/2010

Test Results:
Grade: 2 - Intermediate

(a) % by ASTM D422
(b) % by ASTM D4221

MOORE TWINING ASSOCIATES, INC.
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Dispersive Characteristic of Clay Soil by Double Hydrometer
ASTM D4221

MTA Project Name:	Hultgren - Tillis Engineers	Report Date:	10/14/2010
	Salton Sea	Sample Date:	Sept. 20010
MTA Project Number	60	Sample I.D.:	

Sample Location: VC-11 @ 0-3.5 Feet
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

ASTM D422 Procedure		ASTM D4221 Procedure	
Dry Sample Wt., gm	72.4	Dry Sample Wt., gm	25
% Passing #10 Sieve	100	% Passing #10 Sieve	100
% Passing #200 Sieve	89.9	% Passing #200 Sieve	89.9
Hydrometer Reading @ 60 min	30	Hydrometer Reading @ 60 min	6
Temperature, °C	21.4	Temperature, °C	25.5
Hydrometer Correction	-4	Hydrometer Correction	0
% Passing 5-µm(a)	33	% Passing 5-µm(b)	20

% Dispersion = $\frac{\text{(\% Passing 5-µm(b))}}{\text{(\% Passing 5-µm(a))}}$ *** 100** → $\frac{20.0\ (100)}{33.0}$ = 61%

Dispersive Characteristic of Clay Soil by Crumb Test
ASTM D6572

Sample Location: VC-11 @ 0-3.5 Feet
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

Test Results:
Grade: 3 - Dispersive

(a) % by ASTM D422
(b) % by ASTM D4221

MOORE TWINING ASSOCIATES, INC.
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Dispersive Characteristic of Clay Soil by Double Hydrometer
ASTM D4221

MTA Project Name:	Hultgren - Tillis Engineers	Report Date:	10/12/2010
	Salton Sea	Sample Date:	Sept. 20010
MTA Project Number	60	Sample I.D.:	

Sample Location: HA-4 (Bulk)
Visual Classification: Fat Clay W/Sand
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

ASTM D422 Procedure		ASTM D4221 Procedure	
Dry Sample Wt., gm	70.6	Dry Sample Wt., gm	25
% Passing #10 Sieve	100	% Passing #10 Sieve	100
% Passing #200 Sieve	75.2	% Passing #200 Sieve	75.2
Hydrometer Reading @ 60 min	22	Hydrometer Reading @ 60 min	1
Temperature, °C	21.4	Temperature, °C	25.5
Hydrometer Correction	-4	Hydrometer Correction	0
% Passing 5-µm(a)	23	% Passing 5-µm(b)	4

% Dispersion = $\frac{\textbf{(\% Passing 5-µm(b))}}{\textbf{(\% Passing 5-µm(a))}}$ *** 100** → $\frac{4.0\ (100)}{23.0}$ = 17%

Dispersive Characteristic of Clay Soil by Crumb Test
ASTM D6572

Sample Location: HA-4 (Bulk)
Visual Classification: Fat Clay W/Sand
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

Test Results:
Grade: 2 - Intermediate

(a) % by ASTM D422
(b) % by ASTM D4221

MOORE TWINING ASSOCIATES, INC. Since 1898

Dispersive Characteristic of Clay Soil by Double Hydrometer
ASTM D4221

MTA Project Name:	Hultgren - Tillis Engineers	Report Date:	10/12/2010
	Salton Sea	Sample Date:	Sept. 20010
MTA Project Number	60	Sample I.D.:	

Sample Location: HA-1 (Bulk)
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

ASTM D422 Procedure		ASTM D4221 Procedure	
Dry Sample Wt., gm	77.5	Dry Sample Wt., gm	25
% Passing #10 Sieve	100	% Passing #10 Sieve	100
% Passing #200 Sieve	88.9	% Passing #200 Sieve	88.9
Hydrometer Reading @ 60 min	30	Hydrometer Reading @ 60 min	1
Temperature, °C	21.3	Temperature, °C	25.5
Hydrometer Correction	-4	Hydrometer Correction	0
% Passing 5-µm(a)	36	% Passing 5-µm(b)	4

% Dispersion = $\frac{\text{(\% Passing 5-µm(b))}}{\text{(\% Passing 5-µm(a))}}$ *** 100** → $\frac{4.0\ (100)}{36.0}$ = 11%

Dispersive Characteristic of Clay Soil by Crumb Test
ASTM D6572

Sample Location: HA-1 (Bulk)
Visual Classification: Fat Clay
Sampled By: Client
Tested By: TD
Test Date: 10/9/2010

Test Results:
Grade: 1 - Nondispersive

(a) % by ASTM D422
(b) % by ASTM D4221

PH: 800.268.7021
FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

OFFICE MEMO

TO: Thang (Vic) Nguyen	**DATE:** December 29, 2010
FROM: Mike Driller	**SUBJECT:** Test Request No. 2010-29: Pin Hole Tests of Salton Sea Restoration Samples

Attached are the results of testing performed under Test Request No. 2010-29, "Pin Hole Tests of Salton Sea Restoration Soil Samples." Soil samples were received at the Bryte Laboratory on October 7, 2010 in six small plastic bags.

Pin Hole Tests were performed according to ASTM Test Designation D 4647 - 06, "Identification and Classification of Dispersive Clay Soils by the Pinhole Test." Results are listed below and on the attached Pin Hole Test Data Sheets.

The Method A procedure was used, and testing consisted of compacting the 38-mm (1.5-in.) long specimens into the pinhole test cylinder on top of the coarse sand and wire screen (see Figure 1). Samples were compacted to the density and moisture contents provided. The test method used distilled water flowing horizontally under a hydraulic head of 50 mm (2 in.) through a 1.0-mm (0.04-in.) diameter hole punched in the soil specimen. Pictures were taken before and after the Pinhole Test are attached.

<u>Pinhole Test Results</u>

The Pin Hole test is a direct, qualitative measurement of the dispersibility and erodibility of clay soils when subjected to water of low-salt concentration. The test is performed by passing water through a small hole punched in a specimen (see Figure 1). Flow from *dispersive* clays will be distinctly dark and the hole through the specimen will enlarge rapidly, with a resultant increase in the flow rate. Flow from slightly to *moderately dispersive* clays will be slightly dark with a constant hole size and flow rate. Flow from *nondispersive* clays will be completely clear with no measureable increase in the hole size. Classifications were determined using criteria from ASTM (see attached) based on the flow rate, turbidity, and hole size at the end of the test.

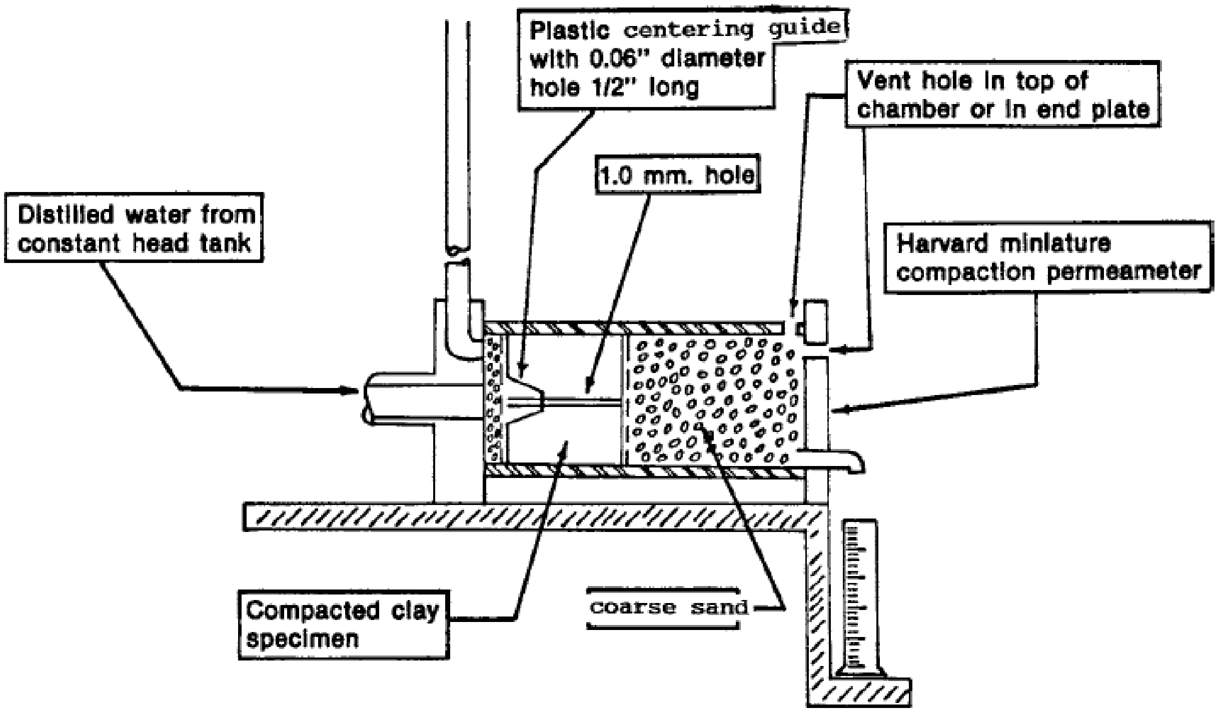


FIG. 1 Schematic Drawing of the Pinhole Test Equipment

Table 1: Results of pinhole tests

Hole No.	Bryte Lab No.	Dry Unit Weight	Moisture Content	Dispersive Classification	Remarks
HA-1	10-528	90 pcf	14.2	D1	Dispersive
HA-4	10-529	101 pcf	11.9	D1	Dispersive
VC-11	10-530	95 pcf	12.9	D2	Dispersive
VC-16	10-531	95 pcf	13.4	D1	Dispersive
VC-20	10-532	95 pcf	13.2	D2	Dispersive
VC-28	10-533	101 pcf	12.3	D2	Dispersive

Please call myself at 916-764-0277 or Doug Najima of my staff at 916-375-6012 if you have any questions.

PIN HOLE TEST DATA

Date: 12/11/2010

Page: 1

Pin Hole Test No. 1

Sample No. 10-528 (HA-1)

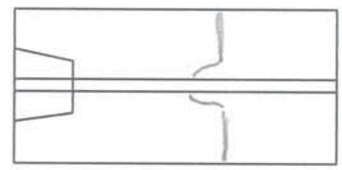
Compaction Characteristics good, firm, pliable

Water Content 14.2% @ 90pcf

Distilled water added x (yes) or ____ (no)

Curing time: 24 hrs.

Speciman after test:



Flow started on 1 trial.

Clock Time	Head	Flow Rate		Color from Side				Completely Clear From Top	Particles Falling			Flow Rate	Remarks
		ml	sec	Dark	Slight to Medium	Barely Visible	Completely Clear		None	Few	Heavy	ml / sec	
1.33p	2"	25	31.1		x					x		0.80	
	2"	25	24.4		x					x		1.02	
	2"	25	20.2		x					x		1.24	
	2"	25	17.6		x					x		1.42	
1:38p	2"	25	17.5		x					x		1.43	<---stop test.
													Classification of test results:
													Method A: D1, Dispersive clay with
													cloudy suspension of colloids in water.
													Pinhole after test was larger than the
													needle punch and expanded from 1.0mm
													to 3.58mm hole.
													Soil was air dried and moisturized to
													14.2%.

Plate A-70

PIN HOLE TEST DATA

Date: 12/13/2010

Page: 1

Pin Hole Test No. 2

Sample No. 10-529 (HA-4)

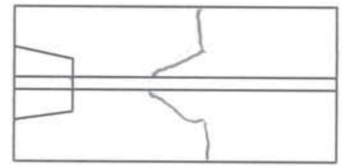
Compaction Characteristics good, firm, pliable

Water Content 11.9% @ 101pcf

Distilled water added x (yes) or ____ (no)

Curing time: 48 hrs.

Speciman after test:



Flow started on 1 trial.

Clock Time	Head	Flow Rate ml	Flow Rate sec	Color from Side: Dark	Color from Side: Slight to Medium	Color from Side: Barely Visible	Color from Side: Completely Clear	Completely Clear From Top	Particles Falling: None	Particles Falling: Few	Particles Falling: Heavy	Flow Rate ml / sec	Remarks
1:00p	2"	25	25	x						x		1.00	
	2"	25	20.1	x						x		1.24	
	2"	25	18.2	x						x		1.37	
	2"	25	17.9	x						x		1.40	
	2"	25	17.8	x						x		1.40	
1.05p	2"	25	17.6	x						x		1.42	<---stop test.
													Classification of test results:
													Method A: D1, Dispersive clay with cloudy
													suspension of colloids in water.
													Pinhole after test was larger than the needle
													punch and expanded from 1.00mm to a
													8.89mm hole.
													Soil was air dried and moisturized to
													11.9%.

PIN HOLE TEST DATA

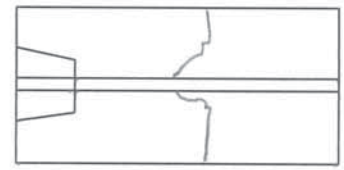
Date: 12/14/2010

Page: 1

Pin Hole Test No. 3

Sample No. 10-530 (VC-11)

Speciman after test:



Compaction Characteristics good, firm, pliable

Water Content 12.9% @ 95pcf

Distilled water added x (yes) or ___ (no)

Curing time: 24 hrs.

Flow started on 1 trial.

Clock Time	Head	Flow Rate		Color from Side				Completely Clear From Top	Particles Falling			Flow Rate	Remarks
		ml	sec	Dark	Slight to Medium	Barely Visible	Completely Clear		None	Few	Heavy	ml / sec	
1:30p	2"	25	54		x					x		0.46	
	2"	25	52.5		x					x		0.48	
	2"	25	49.9		x					x		0.50	
	2"	25	49.8		x					x		0.50	
	2"	25	47.2		x					x		0.53	
	2"	25	32.8		x					x		0.76	
	2"	25	29.8		x					x		0.76	
	2"	25	27.1		x					x		0.92	
	2"	25	26.8		x					x		0.93	
	2"	25	26.5		x					x		0.94	
	2"	25	25.1		x					x		1.00	
1:41p	2"	25	24.9		x					x		1.004	<--- stop test
													Classification of test results:
													Method A: D2, Dispersive clay with cloudy
													suspension of colloids in water.
													Pinhole after test was larger than the needle
													punch and expanded from 1.00mm to a
													9.5mm hole.
													Soil was air dried and moisturized to
													12.9%.

PIN HOLE TEST DATA

Date: 12/15/2010

Page: 1

Pin Hole Test No. 4

Sample No. 10-531 (VC-16)

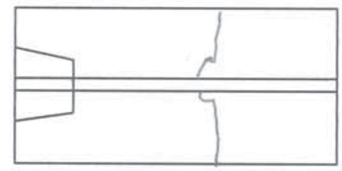
Compaction Characteristics good, firm, pliable

Water Content 13.4% @ 95pcf

Distilled water added x (yes) or ____ (no)

Curing time: 24 hrs.

Speciman after test:



Flow started on 1 trial.

Clock Time	Head	Flow Rate		Color from Side				Completely Clear From Top	Particles Falling			Flow Rate	Remarks
		ml	sec	Dark	Slight to Medium	Barely Visible	Completely Clear		None	Few	Heavy	ml / sec	
2:55p	2"	25	43.4		x					x		.058	
	2"	25	37.6		x					x		0.66	
	2"	25	31.9		x					x		0.78	
	2"	25	30.0		x					x		0.83	
	2"	25	25.6		x					x		0.98	
3:00p	2"	25	22.5		x					x		1.11	<--- stop test
													Classification of test results:
													Method A: D1, Dispersive clay with cloudy
													suspension of colloids in water.
													Pinhole after test was larger than the needle
													punch and expanded from 1.00mm to a
													7.061mm hole.
													Soil was air dried and moisturized to
													13.4%.

PIN HOLE TEST DATA

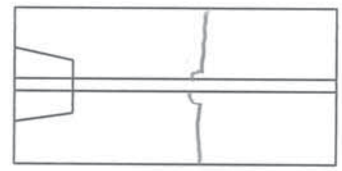
Date: 12/16/2010

Pin Hole Test No. 5

Page: 1

Sample No. 10-532 (VC-20)

Speciman after test:



Compaction Characteristics good, firm, pliable

Water Content 13.2% @ 95pcf

Distilled water added x (yes) or ____ (no)

Curing time: 24 hrs.

Flow started on 1 trial.

Clock Time	Head	Flow Rate		Color from Side				Completely Clear From Top	Particles Falling			Flow Rate	Remarks
		ml	sec	Dark	Slight to Medium	Barely Visible	Completely Clear		None	Few	Heavy	ml / sec	
2:09p	2"	25	53.8		x					x		0.46	
	2"	25	47.3		x					x		0.53	
	2"	25	40.8		x					x		0.61	
	2"	25	36.1		x					x		0.69	
	2"	25	35.8		x					x		0.70	
	2"	25	33.3		x					x		0.75	
	2"	25	32.5		x					x		0.77	
	2"	25	31.2		x					x		0.80	
	2"	25	29.7		x					x		0.84	
	2"	25	28.6		x					x		0.87	
	2"	25	27.8		x					x		0.90	
	2"	25	27.5		x					x		0.91	
	2"	25	26.3		x					x		0.95	
	2"	25	26.0		x					x		0.96	2:20p---stop test.
	2"	25	25.7		x					x		0.97	Classification of test results:
2:20p	2"	25	25.0		x					x		1.00	Method A: D2, Dispersive clay with cloudy
													suspension of colloids in water.
													Pinhole after test was larger than the needle
													punch and expanded from 1.00mm to a
													5.105mm hole.
													Soil was air dried and moisturized to 13.2%.

PIN HOLE TEST DATA

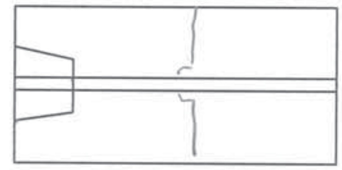
Date: 12/17/2010

Pin Hole Test No. 6

Page: 1

Sample No. 10-533 (VC-28)

Speciman after test:



Compaction Characteristics good, firm, pliable

Water Content 12.3% @ 101pcf

Distilled water added x (yes) or ____ (no)

Curing time: 24 hrs.

Flow started on 1 trial.

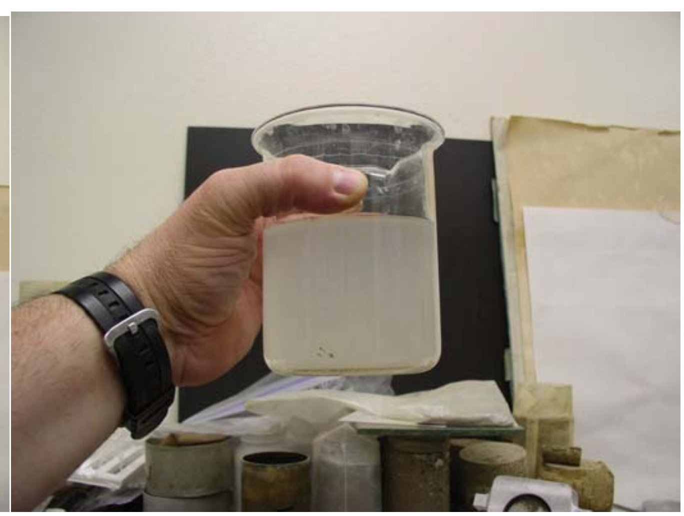
Clock Time	Head	Flow Rate ml	Flow Rate sec	Color from Side: Dark	Color from Side: Slight to Medium	Color from Side: Barely Visible	Color from Side: Completely Clear	Completely Clear From Top	Particles Falling: None	Particles Falling: Few	Particles Falling: Heavy	Flow Rate ml / sec	Remarks
2:06p	2"	25	49.5		x					x		0.51	
	2"	25	47.4		x					x		0.53	
	2"	25	41.8		x					x		0.60	
	2"	25	38.1		x					x		0.66	
	2"	25	37.9		x					x		0.66	
	2"	25	37.1		x					x		0.67	
	2"	25	36.2		x					x		0.69	
	2"	25	28.9		x					x		0.87	
	2"	25	27.1		x					x		0.92	
	2"	25	26.4		x					x		0.95	
	2"	25	24.7		x					x		1.01	
2:16p	2"	25	22.6		x					x		1.11	<--- stop test
													Classification of test results:
													Method A: D2, Dispersive clay with cloudy
													suspension of colloids in water.
													Pinhole after test was larger than the needle
													punch and expanded from 1.00mm to a
													5.029mm hole.
													Soil was air dried and moisturized to 12.3%.

Pinhole Test Pictures

Hole HA-1(Lab No. 10-528):

Hole HA-4(Lab No. 10-529):

Hole VC-11(Lab No. 10-530):



Hole VC-16(Lab No. 10-531):

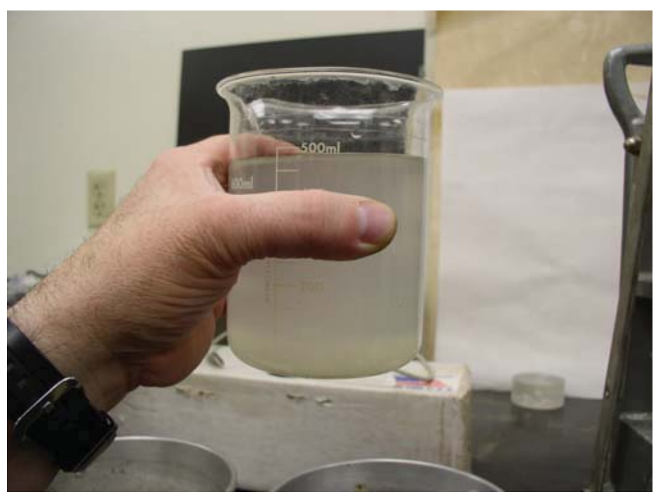




Hole VC-20(Lab No. 10-532):



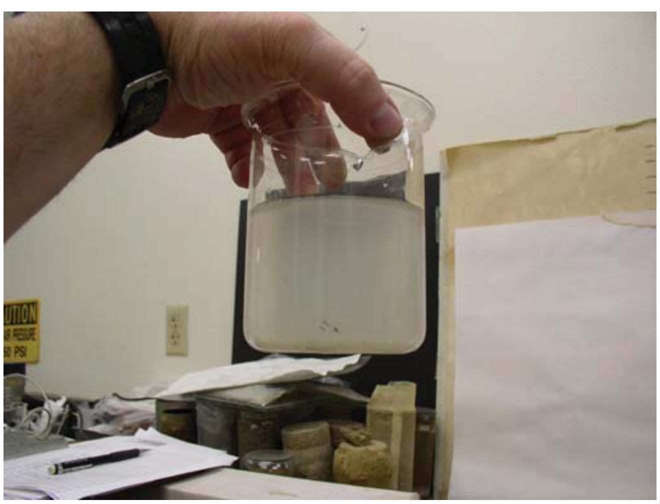
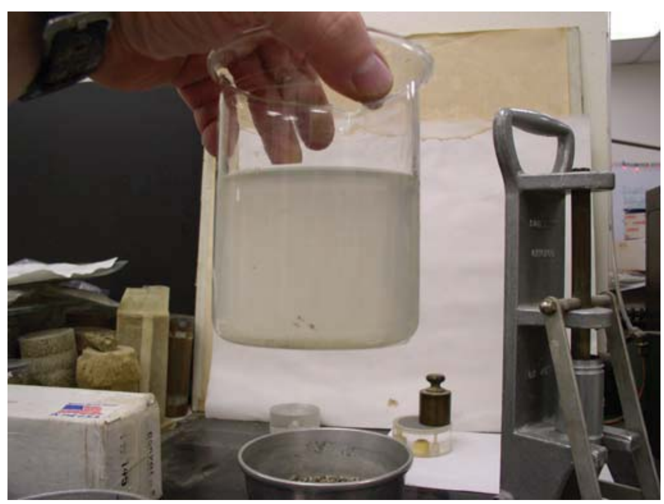


Hole VC-28(Lab No. 10-533):





ASTM Criteria for interpreting results.

7. Classification

7.1 The observations of this test method provide the basis for classifying the soil specimen into a category of dispersiveness according to the following general criteria:

7.1.1 *Method A:*

D1, D2—Dispersive clays that fail rapidly under 50-mm (2-in.) head.

ND4, ND3—Slightly to moderately dispersive clays that erode slowly under 50-mm (2-in.) or 180-mm (7-in.) head.

ND2, ND1—Nondispersive clay with very slight to no colloidal erosion under 380-mm (15-in.) or 1020-mm (40-in.) head.

TABLE 1 Criteria for Evaluating Pinhole Test Results[A]

Dispersive Classification[B]	Head, mm	Test time for given head, min.	Final flow rate through specimen, mL/s	Cloudiness of flow at end of test		Hole size after test, mm
				from side	from top	
D1	50	5	1.0–1.4	dark	very dark	≥2.0
D2	50	10	1.0–1.4	moderately dark	dark	>1.5
ND4	50	10	0.8–1.0	slightly dark	moderately dark	≤1.5
ND3	180	5	1.4–2.7	barely visible	slightly dark	≥1.5
	380	5	1.8–3.2			
ND2	1020	5	>3.0	clear	barely	<1.5
ND1	1020	5	≤3.0	perfectly clear	perfectly clear	1.0

APPENDIX D

Project Operations

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FIGURES

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Appendix D

Project Operations

D.1 Introduction

The Species Conservation Habitat (SCH) ponds are intended to be operated in a manner that would both provide a partial in-kind replacement for some of the near-term habitat losses at the Salton Sea (the Sea) and answer key questions regarding the development of shallow-water habitat as part of a long-term restoration program at the Sea. Operations of the Salton Sea SCH Project (Project) components would have to balance habitat requirements necessary to achieve desired objectives against competing constraints such as environmental limitations (physical, water quality, and climatological conditions); compatibility with existing and future adjacent land uses (agricultural fields, geothermal development, and other habitat projects at the Sonny Bono Salton Sea National Wildlife Refuge); and habitat values (at the refuge); and consistency with the applicable requirements of the Imperial Irrigation District (IID) Habitat Conservation Plan/Natural Communities Conservation Plan. Decisions necessary to strike this balance and meet the objectives would be made within an adaptive management framework.

This appendix provides a conceptual overview of the range of operations that could be used to provide suitable habitat (for species dependent on the Salton Sea) and to test different operational scenarios as part of the "proof-of-concept" aspect of the SCH Project. Key indicators of physical, chemical, and biological attributes of that habitat would be monitored to determine the effects of different operational scenarios, and any adjustments would be implemented as needed in accordance with the SCH Monitoring and Adaptive Management Framework, as described in Appendix E.

D.2 Key Project Components

The general facilities necessary for each alternative include river water diversion, sedimentation basin, saline water diversion, SCH ponds, in-pond habitat features, and an agricultural drain interception ditch.

D.2.1 River Water Diversion

River water would be diverted for the use of producing shallow-water aquatic habitat in one of two manners. For Alternatives 1 and 4, river water would be diverted via a lateral weir placed on the edge of the river channel. The diversion weir would be located upstream of the SCH ponds to provide sufficient hydraulic head to convey the water to the SCH ponds with gravity. For Alternatives 2, 3, 5, and 6, river water would be diverted via electrically driven pumps located adjacent to the SCH ponds.

D.2.2 Sedimentation Basin

Waters in the New and Alamo rivers contain suspended sediment that would need to be removed prior to conveyance and delivery to the SCH habitat ponds. The concentration of the suspended sediment in the rivers is recently reported at about 219 milligrams per liter (mg/L) for the New River and 280 mg/L for the Alamo River. The water diverted to the SCH ponds from the rivers would have to go through a sedimentation basin to remove the sediment load before the water is released to the SCH ponds. For alternatives using a gravity diversion, the sedimentation basin would be located upstream of the SCH ponds near the point of diversion. For alternatives using the pumped diversion, the sedimentation basin would be located within the SCH pond footprint.

The sedimentation basin would be operated to hold the water just long enough for the sediment to settle out. The settling time is a function of the size of the particles suspended in the water column.

Sedimentation basins elsewhere in the Imperial Valley store water for about 5 days. Routine operations would include the removal and disposal of the sediments collected in the sedimentation basin. The frequency of these actions and amount of material to be removed would be determined once an alternative were selected for design and could be modified during the life of the SCH Project as a result of sediment control measures being independently implemented as part of the Clean Water Act Section 303(d) requirements (Total Maximum Daily Loads).

D.2.3 Saline Water Diversion

Saline water would be diverted by electrically driven pumps placed on a structure in or adjacent to the Salton Sea to produce the desired salinity in the SCH ponds. The water must be pumped (lifted) because the Sea's elevation Sea is less than the desired pond elevation of -228 feet mean sea level (msl). Currently, the water would have to be lifted about 4 feet in elevation from the Sea to the SCH ponds. As the Sea's elevation declines over time, the height that the saline water would have to be lifted would increase, along with the distance that the water had to be conveyed to reach the ponds.

D.2.4 SCH Pond Berms

The SCH pond complex would be formed by constructing low height (up to approximately 8-foot-high) berms to contain water and separate the SCH ponds from the remainder of the Salton Sea and its recently exposed playa. Internal berms would segment the SCH ponds into experimental units.

The SCH ponds would be constructed primarily on recently exposed playa following the existing topography (ground-surface contours) where possible. The ground surface within the SCH ponds would be excavated (with a balance between cut and fill) to acquire material to build the berms and habitat islands. The borrow areas for the berms would generally form adjacent channels, swale channels, and shallow excavations. The maximum water surface elevation would be -228 feet msl. Pond depth would range from near zero toward the shoreline (-228 msl) to 6 feet at the exterior berm. Maximum depth in excavated areas would be up to 10 feet. Outflow structures would be constructed in the outer berms, and maximum outflow from the SCH pond complex to the Salton Sea would total approximately 130 cubic feet per second.

Berms would be maintained to repair damage due to structural failures, differential settling, surface erosion, access, and water management functions. Berms may require future strengthening by others to accommodate other compatible land uses (e.g., geothermal development).

D.2.5 In-Pond Habitat Features

Several constructed bird and fish habitat structures would be included in the SCH ponds, such as swales, holes, and habitat islands. Swales are 2-foot or deeper channels within the pond units that would be constructed with scrapers and excavators. They ultimately would serve as habitat features to increase aquatic habitat heterogeneity, connect shallow and deep areas of a pond unit, and provide deeper refugia near shallow areas. Each SCH pond would include several islands for bird habitat: one to three nesting islands (suitable for tern species) and three to six smaller roosting islands (suitable for cormorants and pelicans). The overall SCH pond complex could also include one or more large (2- to 10-acre) islands that have rocky and sandy substrate (suitable for cormorant nesting).

D.2.6 Agricultural Drain Interception Ditch

Water from adjacent agricultural drains that currently flows (or is pumped) directly into the Salton Sea would be rerouted around the SCH ponds. The interception ditch would allow for the continuation connection of these drains to the Salton Sea and not disturb the flow of agricultural drainwater from the adjacent fields. IID would maintain operational control of these drains and continue to provide all maintenance activities necessary on these drains.

D.3 Operational Variables and Range

D.3.1 Habitat Requirements and Operational Constraints

SCH ponds are intended to:

- Provide habitat suitable for production of fish dependent on the Salton Sea. Likely fish candidates are one or more varieties of tilapia, which are an important forage species for fish-eating birds. Other fishes that could become established in the SCH ponds include desert pupfish (*Cyprinodon macularius*), sailfin mollies (*Poecilia latipinna*), mosquitofish (*Gambusia affinis*), and threadfin shad (*Dorosoma petenense*).
- Provide habitat suitable to support fish-eating birds and other birds dependent on the Salton Sea. Foraging habitat would be a key attribute, but other features to meet habitat needs for nesting and resting would also be included.

SCH pond operations would attempt to meet Project goals and objectives given certain constraints of physical conditions, water quality, and climate. The general characteristics of the aquatic habitat that would likely be present for fish include:

- Highly eutrophic, shallow-water ponds that would be highly turbid in spring through fall.
- Low temperatures below 50 degrees Fahrenheit (°F) (10 degrees Celcius [°C]) during short periods of the winter and high temperatures in the low–to mid 90s °F (low 30s °C) in the late spring through early fall.
- Dissolved oxygen (DO) concentrations ranging from zero mg/L at the mudline to super-saturated during daylight hours in spring to fall.

SCH Project operations would be constrained by the physical characteristics of the ponds (e.g., depth, area, and bottom profile), but certain water quality conditions could be modified, within some range of conditions, as needed, by adjusting the limited operational controls to create more desirable habitat conditions in the ponds. The primary operational variables that could be controlled are:

- Salinity of the water within the ponds;
- Volume of water in the ponds;
- Residence time of the water in the ponds;
- Pond depth;
- Fish species stocked in the ponds; and
- Physical cover elements.

Depending on the specific alternative and pond design selected, the habitat would be composed of a few to several individual ponds. This design would allow the operators to try different combinations of storage, salinity, and residence times to investigate how these factors could be adjusted to provide the best conditions for fish and birds. Different operational scenarios would be tested during the proof-of-concept phase, the first 10 years of Project operation (to approximately 2025). After the proof-of-concept phase, pond variables would be managed to produce the best habitat for fish and wildlife dependent on the Salton Sea.

The following discussion is based on the construction and operation of approximately 2,400 acres of habitat, but the acreage could be less or more depending on the alternative selected and the funding available for Project construction.

D.3.2 Salinity of Stored Water

The SCH ponds would typically be operated within the range of 20 to 40 parts per thousand (ppt) salinity. Water from the Alamo River or New River (salinity approximately 2 ppt) would be blended with water from the Salton Sea (current[1] salinity approximately 53 ppt) to produce the desired pond salinity. Blending the river water and seawater in different amounts would allow for a range of salinities to be used in the ponds.[2]

Different ponds could be operated under different salinities to test which salinity regime results in the best combination, or balance, of invertebrate and fish productivity, bird use, seasonal fish survival, and exposure to selenium (Figure D-1). For example, cold tolerance by tilapia is better at lower salinities (20 ppt) than at higher salinities (60 ppt) (Lorenzi and Schlenk, in preparation), but selenium loading to the pond is increased (more river water equals lower salinity but higher inputs of water-borne selenium) (Appendix I, Selenium Management Strategies). Salinity in the ponds could also be increased as needed to control mosquito populations (Appendix F, Mosquito Control Plan), control emergent vegetation growth (Table D-1), and limit the development of aquatic habitat that would support freshwater fish known to be predators of desert pupfish.

During the proof-of-concept phase, salinities would be typically managed between 20 to 40 ppt. This range is generally sufficient to control many of the negative factors listed above and within the range to be tolerated by the fish species expected to be used in the SCH ponds. Pond salinity may be allowed to exceed this general range (from undiluted river water [2 ppt] up to 50 ppt) in the course of balancing evaporation and water pumping, or if deemed appropriate to test specific fish management or habitat value hypotheses. For example, it may be desirable to operate each pond at a different salinity (e.g., undiluted river water, 20 ppt, and 40 ppt) and monitor biological outcomes and long-term operational feasibility. SCH ponds would not be operated with hypersaline conditions (greater than 50 ppt) because they would result in decreased viability of the desired aquatic habitat.

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[1] The salinity in the Salton Sea is expected to increase in the future, with salinity exceeding 100,000 ppt by 2030 (DWR and DFG 2007).

[2] Evapoconcentration, increasing the salinity through the evaporation process, was simulated in the water quality modeling for this Project and found to be ineffective in achieving the desired salinity range in a short period of time.

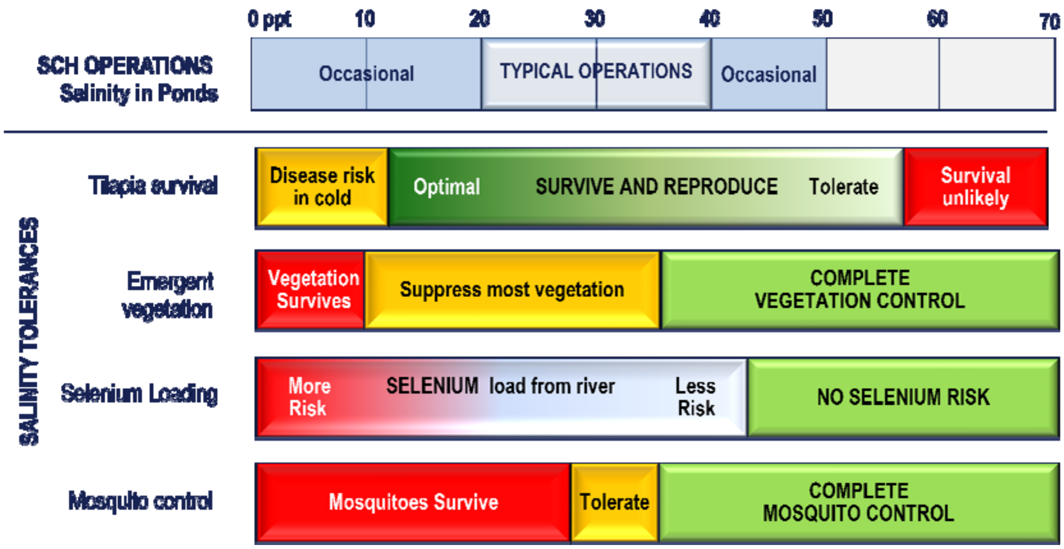

Figure D-1 Operational Range of Salinities and Biological Constraints

Table D-1 Salinity Tolerances of Local Plant Species

Species	Habitat	Typical Salinity Preference	Widest Salinity Tolerated	Comments and Sources
California Bulrush (*Schoenoplectus californicus*)	Widespread in fresh and intermediate marsh zone	0-3.5 ppt	Approximately 10 ppt or greater will control populations	Stutzenbaker 1999 Prolonged exposure to extreme conditions (15-20 ppt) exceeds the typical salinity tolerance and populations decline (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2002)
American Bulrush (*Scirpus americanus*) Olney's three-square bulrush (*Schoenoplectus americanus*)	Fresh to intermediate marshes	0-3.5 ppt	50% reduction at 4 ppt and no germination above 13 ppt	Stutzenbaker 1999; Uchytil 1992 Management and maintenance depends primarily on maintenance of water levels and secondarily on salinity levels (Uchytil 1992)
Saltmarsh Bulrush (*Scirpus maritimus* or *Scirpus robustus*)	Intermediate to brackish marshes, often on soils subject to tidal influence	3.5-10 ppt	Has been found in hypersaline lakes (~60 ppt) Germination reduced 50% at salinity = 9 ppt. No germination at salinity = 21 ppt.	Stutzenbaker 1999; International Lake Environment Committee 1998; Snyder 1991
Broad Leaf Cattail (*Typha latifolia*)	Freshwater aquatic normally, but also found in intermediate marshes	0-0.5 ppt	Found in intermediate marshes with salinity up to 3.5 ppt In marshes of southeastern Louisiana, occurred at salt levels up to 1.13%	Stutzenbaker 1999
Narrow Leaf Cattail (*Typha angustifolia*)	Freshwater aquatic normally, but also found in intermediate marshes; coastal	0-0.5 ppt	15-30 ppt	Stutzenbaker1999; Reed et al.1995
Southern Cattail (*Typha domingensis*)	Wetlands ranging from fresh to brackish	0-10 ppt	75% mortality occurred at 15 ppt	Stutzenbaker 1999; Glenn et al. 1995

D.3.3 Volume of Water in Storage

Storage is the amount of water contained in the SCH ponds at a given time. The volume that could be stored would depend upon the size of the ponds, which varies by alternative. The storage would also be controlled by changing the inflow and outflow to the SCH ponds. A pond could be operated at a constant storage or varying storage, depending on the proof-of-concept testing. Reasons for varying storage (and hence the maximum depth and inundated area) include responding to water quality conditions, desire to create different habitat conditions in the pond (e.g., shallow-water habitat), vector control, or pond maintenance.

Water quality modeling performed for the SCH Project has shown that DO or temperature conditions respond to several operational parameters, including the depth of the water in a pond and pond shape (the relationship between water depth and surface area). Therefore, changing storage in the pond can alter these conditions by changing the amount of shallow- and deepwater habitat.

The storage could be operated at any amount from empty (e.g., for emergency maintenance) to full with a maximum depth of approximately 6 feet at the terminal berm. Should the average depth of the pond be 3 feet, the storage at full depth would be approximately 7,200 acre-feet for a constructed pond complex of 2,400 acres. Operators would determine the appropriate depth and manage the total storage in the pond to meet that depth.

D.3.4 Residence Time

Residence time is a measure of the time it would take the average unit of water volume to pass through the SCH ponds (or loss to evaporation). The residence time defines the amount of water diverted from the river and the Sea and in turn controls the diversion facilities, Project energy use, and cost. Residence time may be an important parameter for the control of habitat conditions in the SCH operations.

SCH pond residence time would be altered as a result of other operations of the SCH ponds or could be an experimental variable for operational testing. Residence time may vary in response to climatic conditions (including temperature, wind frequency, direction and speed, and solar illumination) or may be modified to test various hypotheses regarding the habitat value during differing climatic conditions and to control anticipated negative conditions. These negative conditions would include the increased probability of depleted DO concentration (anoxia) in portions of the water column or pond areas.

During the Project's proof-of-concept phase, pond residence time would be managed to test the hypotheses developed through the use of the adaptive management process (see Appendix E). Based on preliminary water quality modeling results (see Appendix J, Summary of Special Studies Supporting the EIS/EIR Impact Analysis), it is anticipated that residence times could vary from a couple of weeks (2 weeks) to several months (32 weeks). This range is generally sufficient to support the proof-of-concept testing while allowing for the control of potential negative factors and the production of the desired habitat.

D.3.5 Pond Depth

The maximum and average depth of water in the SCH ponds would be varied to test various hypotheses regarding habitat value during differing climatic conditions and to control anticipated negative conditions listed above for residence time. Depth also could be controlled to manage predation on the fish in the ponds. Different ponds could be operated at different depths, and pond depth could be changed to test different scenarios. A range of depths would be created through excavation of material used for berms. The depth (and pond area) could also be changed by varying the amount of water stored in a pond during the year.

During the Project's proof-of-concept phase, pond depth would be managed to test the hypotheses developed through the use of the adaptive management process (see Appendix F). Based on preliminary water quality modeling results (see Appendix J), it is anticipated that the maximum pond depth at the edge of the berms would be 6 feet. Pond depth may be managed outside this general range to test specific fish management or habitat value hypotheses. Ponds may need to be drained or the elevation lowered for emergency maintenance or to control aquatic conditions, but this drainage would not be a routine occurrence.

D.3.6 Fish Stocking in Ponds

Fish Species Selection

The SCH ponds would be designed to support fish to serve as prey for piscivorous birds. Promising candidate species must be able to forage, grow, and reproduce in fluctuating salinities using the soft, fine-grained sediment that would naturally form the pond substrate. Fish that have evolved to deal with environmental fluctuations would be better able to thrive in SCH ponds than those whose physiology is less plastic when dealing with environmental extremes.

A number of species present in riverine or estuarine habitats of Southern California and Baja California, Mexico, could be suitable candidates for a productive SCH fish community (DFG 2011). The main attributes considered were foraging suitability for a wide range of piscivorous birds (e.g., no "bottom-hugging" flatfish that would be inaccessible to most birds), resistance to perturbation (e.g., tolerates wide fluctuations in temperature, DO, salinity), high productivity, and sustainability. These attributes were weighed against potential risk to desert pupfish, potential risk for spread to new habitats not currently occupied, and difficulty or expense in obtaining or producing sufficient numbers for stocking. For the Project's initial establishment, however, only those species currently inhabiting the Salton Sea and its connected waters would be considered for use. Desert pupfish, a federally protected species, are present around the Salton Sea and would be included in the SCH ponds. Selecting only fish species that currently reside at the Sea would avoid any new impacts beyond what the Salton Sea desert pupfish population is currently exposed.

Therefore, the fish assemblage proposed for initial deliberate introduction into the SCH ponds would include one or more forms of tilapia and possibly threadfin shad, as well as desert pupfish, sailfin molly, and mosquitofish. Stocking more than one fish species in the ponds would provide some redundancy and improve sustainability of the fish community. If these initial species do not meet the Project objectives, other candidate species evaluated by DFG (DFG 2011) would be considered.

Tilapia

Tilapia satisfy the entire suite of attributes sought in a candidate species, more than any other single species being considered for the SCH Project (DFG 2011). This family of fishes has wide tolerances for water quality conditions, flexible diet including algae and invertebrates, high fecundity, and distribution throughout the water column. Furthermore, they could also support sport fishing. This species is highly tolerant of a wide range of salinities, including high salinities, as demonstrated by their current dominance in the hypersaline Salton Sea. Juvenile Mozambique hybrids can be slowly acclimated up to 95 grams per liter and survive at least for 5 days if the temperature is kept constant at 73 to 77 °F (23 to 25 °C) (Sardella et al. 2004a). Tilapia are less capable of dealing with high salinity under extreme temperatures (Sardella et al. 2004b). The preferred temperature range for optimum tilapia growth is 82° to 86°F (28 to 30°C). Growth diminishes significantly at temperatures below 68°F (20°C) and death would occur below 50°F (10°C) (Rakocy and McGinty 1998). At temperatures below 54°F (12°C), tilapia are more vulnerable to infections by bacteria, fungi, and parasites. The temperature regime in the SCH ponds would be expected to be more extreme than that of the current lake (DWR and DFG 2007). Models of water temperatures for the SCH ponds predict temperatures below the lethal threshhold for Mozambique hybrid tilapia (Appendix J).

Tilapia are remarkably tolerant of low DO concentrations, considerably below tolerance limits for most fish. Tilapia can thrive at DO concentrations of 2 mg/L, can survive extended periods of 1 mg/L, and can tolerate routine dawn DO concentrations of less than 0.3 mg/L (Popma and Masser 1999). In low DO conditions, fish frequently are found near the surface taking in water in the thin surficial layer that remains somewhat oxygenated (personal communication, K. Fitzsimmons 2010). Such behavioral coping responses could increase the vulnerability of fish to bird predation near the surface.

Their main drawback, other than potential competition with desert pupfish, is whether they could handle the lowest water temperatures predicted for SCH ponds. Stocking different tilapia species or strains (individually or in combination) among the SCH ponds could test which species is most sustainable and resilient, and could enhance stability of the fishery resource in the ponds in the face of seasonal and annual fluctuations in water quality parameters. The three tilapia species under consideration for stocking in the SCH ponds include the following:

California Mozambique Hybrid Tilapia – California Mozambique hybrid tilapia ("Mozambique tilapia") are a hybrid of *Oreochromis mossambicus* and *O. urolepis hornorum*. This species is currently the dominant species in the Salton Sea and is widely used in aquaculture including at fish farms in the Salton Sea watershed. Advantages of this species are its demonstrated ability to survive, thrive, and achieve high productivity in hypersaline conditions, as well as its presumed importance as a suitable forage fish for all piscivorous birds at the Salton Sea. The risk from using Mozambique tilapia as the sole forage species is the potential for population crashes, as seen with the massive fish die-offs at the beginning of the decade. The proposed SCH operations would be designed to keep water quality conditions within known tolerances and, therefore, population fluctuations may be dampened.

Blue Tilapia – Blue tilapia (*Oreochromis aureus*) have a lower tolerance for salinity, but handle colder temperatures than the other two tilapia (Popma and Masser 1999). Tilapia resembling blue tilapia are currently only present in the New and Alamo rivers. The genetic makeup of this tilapia assemblage is uncertain, but likely includes *O. aureus* and possibly Mozambique tilapia genetic material given the checkered history of tilapia introductions and movements in southern California (personal communication, K. Fitzsimmons 2010).

Redbelly Tilapia – Redbelly tilapia (*Tilapia zillii*) were once the dominant tilapia species in the Salton Sea, when salinity was lower. Although they were replaced by the Mozambique tilapia, they are still thriving in some of the agricultural drains. The difference in their tolerance to salinity and temperature, as well as a different breeding strategy, may provide plasticity in response to perturbation for a fish community that contains both species.

The relative tolerances of these species to combinations of salinities (20 ppt, 45 ppt, and 60 ppt) and temperatures (cold 11-16°C [52-61 °F]), warm 23-28°C [73-82 °F], and hot 33-38°C [91-100°F]) were tested experimentally (Lorenzi and Schlenk, in preparation). The tested fish included Mozambique tilapia (two strains: wild fish from Salton Sea and an aquaculture strain from a local fish farm), fish from a blue tilapia assemblage in the New River, and redbelly tilapia from the New River. The best survival at cold temperatures was observed with the wild Mozambique tilapia, while the aquacultural strain of Mozambique tilapia was the best performer overall for all salinities at warm temperatures. The blue tilapia strain surprisingly did not have better survival than Mozambique tilapia in cold conditions. Redbelly tilapia results were equivocal, due to other sources of mortality in captivity. While most strains and species had moderately good survival in 45 ppt and 60 ppt conditions at warm temperatures, all species showed poor survival in hot high-salinity (60 ppt) conditions.

Desert Pupfish

Desert pupfish are listed as an endangered species under both Federal and California Endangered Species Acts. They currently inhabit the agricultural drains and creeks that feed into the Salton Sea, shallow areas of the Sea itself, and numerous created refuge habitats. A study of IID agricultural drains found an abundance of desert pupfish positively correlated with western mosquitofish, salfin molly, and Mozambique hybrid tilapia (Martin and Saiki 2005). Desert pupfish are observed most frequently in shallow water less than about 1 foot (30 centimeters) deep with velocities less than about 1 foot/second (Black 1980). They are capable of moving freely between the relatively fresh water in the agricultural drains and the highly saline environment in the Salton Sea (DWR and DFG 2007).

Desert pupfish are very tolerant of extreme water quality conditions, and have been held in the laboratory in water with salinity greater than 98 ppt (Barlow 1958, as cited in Moyle 2002). The ability of desert pupfish to tolerate high salinity, high pH, and low DO contributes to their ability to persist at the Salton Sea. Moyle (2002) summarized the life history of desert pupfish as follows, with additional information as noted. This species can tolerate salinities ranging from freshwater to considerably greater than seawater (up to 68 ppt in the wild), DO from saturation to as low as 0.1 to 0.4 mg/L (parts per million), and temperatures from 39.9°F (4.4°C) in winter (Schoenherr 1990) to 108.3°F (42.4°C) in summer (Carveth et al. 2006). Individuals can survive daily temperature fluctuations of up to 78.8°F (26°C) and salinity changes of 10 to 15 ppt. Larvae have a higher salinity tolerance (up to 90 ppt) than do adults (68 ppt) and can withstand sudden salinity changes of up to 35 ppt.

Under current conditions at the Salton Sea, individual desert pupfish inhabiting creeks and drains that flow into the Sea are presumed to move along the Sea's margins and among drains. This movement, which provides the opportunity for genetic exchange among desert pupfish, reduces the potential deleterious effects of isolation of individual populations. It also provides the opportunity to recolonize these same areas in the event a local population is extirpated (DWR and DFG 2007). Therefore, the SCH Project design would include features to maintain connectivity among populations.

Desert pupfish would likely thrive at the SCH ponds, as seen at the Bureau of Reclamation/U.S. Geological Survey Saline Habitat Ponds (Miles et al. 2009). The ponds that had pupfish were mostly less than 1 meter deep and had salinities ranging from 12 to 70 ppt (Miles et al. 2009). Pupfish were the most abundant fish in the Saline Habitat Ponds; over one million were captured when the ponds were drained in late 2010 (personal communication, J. Crayon 2010).

Sailfin Molly and Mosquitofish

Sailfin mollies and mosquitofish are sympatric with desert pupfish in the Salton Sink. Due to their presence in the Colorado River, they also occupy much of the agricultural water supply and drainage systems around the Salton Sea. Like desert pupfish, they demonstrate plasticity in their diet, and tolerance of high water temperature, high salinity, and low oxygen levels. They inhabit the shallow edges of water bodies, usually less than 2 feet deep. As livebearers, they require no special substrate or structure for reproduction.

Desert pupfish, sailfin mollies, and mosquitofish overlap considerably in their trophic roles where they co-exist in the Salton Sink. They would provide diversity and a degree of redundancy in the SCH fish community, which could buffer the effects of perturbation in a dynamic system. Birds that forage for small fish would prey on all three species; however, surface gleaners and skimmers would find sailfin mollies and mosquitofish more accessible, since these fishes are usually active higher in the water column than are desert pupfish.

Threadfin Shad

Threadfin shad form schools near the surface in open water. They can live in seawater but do not reproduce at that salinity. Spawning takes place in open water near floating or partially submerged objects to which the fertilized eggs stick. Threadfin shad feed heavily on larger zooplankton and can greatly reduce the abundance of these organisms (Moyle 2002).

Filling and Stocking of SCH Ponds

The SCH ponds would be stocked with fish species currently in the Salton Sea Basin and captured from local drainages. The initial SCH aquatic community would be comprised of four primary types of fish: tilapia, sailfin molly, mosquitofish, and desert pupfish. Unintentional invasion of other fish from the river waters, such as common carp (*Cyprinus carpio*), various Centrarchid species, red shiners (*Cyprinella lutrensis*), and threadfin shad, may also occur. All but the shad would be unable to survive in waters above 20 ppt salinity.

Following construction, the SCH ponds would be filled with water for the first time and allowed to "season" for a period of several weeks while undergoing various stages of chemical and biological succession. Water chemistry would fluctuate as compounds leach from the newly wetted soils and microbial communities are initiated. Once phyto- and zooplankton are established and salinity exceeds 20 ppt, fish could be introduced, starting with sailfin mollies and mosquitofish.

The first fishes introduced would likely be small species. Sailfin mollies are ubiquitous in the Salton Sea and the agricultural drains surrounding it. They could be easily trapped/and or seined for stocking into SCH ponds. The most productive collection of sailfin mollies would take place in the spring, when the young-of-the-year would still have an approximately 1:1 sex ratio and have not yet been exhausted by the energetic costs of reproduction. Mosquitofish are numerous in the agricultural drains at the Salton Sea's southern end. They also could be easily trapped and/or seined for stocking, or alternately could be obtained from aquaculture or vector control agencies. Pupfish would be trapped and/or seined from several natural localities and created refuges to insure a good representation of available genetic diversity.

Several species and strains of tilapia are present in the waters of the Salton Sea drainage, and each requires a different approach for securing sufficiently large numbers of founders. Mozambique hybrid tilapia are currently abundant in the Salton Sea and large numbers could easily be captured for stocking into SCH ponds. However, their long-term availability is tenuous with the increasing salinity in the Sea. The same fish is available from local aquacultural facilities, but may not perform as well as wild caught fish, given the selection pressure on the wild population that would likely result in greater tolerance of the Sea's salinity and temperature range (Lorenzi and Schlenk, in preparation). Redbelly tilapia are abundant in drains at the Sea's northern end, particularly those filled by tilewater. These populations should persist, due to the consistency of water quality in those drains, and fish would be available for seining/trapping for SCH ponds in the future. Finally, tilapia resembling blue tilapia are present in the rivers, agricultural drains, and Brawley Wetlands.

The release of tilapia into SCH ponds should only take place after phytoplankton and zooplankton are established. If stocks were from freshwater habitats or held in freshwater while captive, they would be first acclimated to the salinity in the ponds. This acclimation could be done under captive maintenance, or by sequestering in a small part of the ponds and allowing the salinity to gradually rise to pond levels before releasing fish into the larger habitat.

Fish Rearing

Due to ever-increasing salinity and degraded water quality in the Salton Sea, the Mozambique hybrid tilapia population in the Sea may have declined seriously by the time of construction of the SCH ponds. If so, extremely intense predation pressure on the fish initially stocked in the ponds may occur. A supply of fish would be needed for initial stocking of the SCH ponds and possible restocking if severe fish die-offs occur. It would be important to stock fish in sufficient numbers to start a sustainable population in the face of predation. Securing an adequate number of fish for stocking may require producing a generation in captivity from captured wild fish. Tilapia could be collected now from local sources while wild stocks remain and held for captive propagation at one or more of the private licensed aquaculture facilities in the area (within 15 miles of all alternative sites). Several trips (fewer than ten) by small (½ to 1 ton) trucks would be required if cultured fish are to be delivered from an aquaculture facility to SCH ponds.

Physical Cover

Heterogeneity in physical habitat structure could be manipulated in the SCH ponds to enhance cover and refugia for fish from predators and possible thermal fluctuations. Refugia from predators would be necessary to allow a sustainable population of fish to persist in the face of expected heavy predation by piscivorous birds, especially when fishery resources in the Salton Sea decline and disappear. Refugia or cover could be provided by deeper waters or physical structural complexity. Types of cover elements considered include:

Swales and Channels – Having water deeper than 3 feet in proximity to shallower areas would allow fish to disperse into areas where they would be more dispersed and/or less visible due to turbidity. These constructed regions of greater depth would provide this element.

Submerged Aquatic Vegetation – Vegetation could also provide cover from predators, especially for small fish. Widgeon grass (*Ruppia* spp.) is expected to become established in the SCH ponds. This vegetation would likely enhance food supplies by providing more microhabitat structure to support invertebrate diversity and productivity. Widgeon grass establishes from seed and needs sufficient light for photosynthesis to reach the pond bottom. Given the projected turbidity, it would be limited to shallow areas of SCH ponds.

Floating Islands – These artificial structures could be used to provide visual cover and shading for potential thermal refugia. Floating islands could be deployed in different areas, and would likely be most useful in shallower areas where other cover is limited. More information would be necessary to evaluate the applicability and feasibility of floating islands.

While many of these components would be considered part of the initial pond construction, placement and size of floating islands could be manipulated to test habitat function. Monitoring of their effectiveness would be a component of the adaptive management approach for the SCH design and operations.

D.4 Possible Operational Scenarios

Possible operational scenarios are shown in Tables D-2 to D-7. These scenarios are meant to test different concepts for creating sustainable saline habitat for fish and wildlife that minimizes risks of impacts such as fish die-offs, ecotoxicity from selenium, and diseases vectors. Upper and lower extremes of the operational range would be tested to detect any effect of that variable on Project performance. Operational values for each variable could be held constant over time or could be adjusted seasonally according to expected outcomes.

The ranges of operational variables to be tested are as follows:

Salinity – 20-40 ppt.

Storage – Approximately 80 to 100 percent of capacity (the volume would depend on the actual alternative selected and amount of ponds constructed). For example, for a constructed pond complex of 2,400 acres, storage could range from 6,000 to 7,200 acre-feet, assuming an average depth of 3 feet deep over 2,400 acres).

Residence Time – 2 to 32 weeks. This range reflects rate of inflow and outflow.

Fish Species – Fishes considered for initial introduction into SCH ponds would include one or more forms of tilapia, threadfin shad, desert pupfish, sailfin molly, and mosquitofish.

Several constraints and potential impacts were considered in the design of the operational scenarios:

Water Quality Tolerances of Target Fish – The fish species used in the ponds would have to survive and reproduce given the expected water quality conditions, both managed (salinity) and uncontrolled (air temperature, wind mixing, DO) conditions. Tilapia appear to meet many of the requirements for a productive, sustainable fishery resource for piscivorous birds. For some tilapia species or strains, cold tolerance (below 13°C [55°F]) is impaired at higher salinities (Lorenzi and Schlenck, in preparation). Hydrological modeling suggests that water temperatures could drop below 11-13°C (52-55°F) during December through February. DO concentrations could dip below tilapia minimum tolerances. Nutrient concentrations are high in the New and Alamo rivers, due to contributions from agricultural runoff. Water quality modeling suggests high levels of algal growth are possible, along with oxygen deprivation problems that accompany hot weather algal blooms (B. Barry and M. Anderson, University of California Riverside, unpublished data). Also, seasonal anoxia could be more frequent and prolonged in spring (March through May) and fall (October) due to algal blooms.

Relative Selenium Loading – Selenium in river water supplying the ponds could bioaccumulate through the food web from invertebrates and fish to birds (see Appendix I, Selenium Management Strategies). Shorter residence time and lower salinity means greater inputs of river water, which would increase overall selenium loading to the ponds.

Vector Risk – Mosquitoes that breed at the ponds could pose a potential human health risk. The likelihood for mosquito vector impacts is based on (1) breeding season (March through November) and (2) salinity tolerance of mosquito larvae (can survive up to 25 ppt, some reduction in populations between 25-28 ppt, < 28 ppt, reduced population 28-34 ppt, control 35 ppt).

Emergent Vegetation Control – The SCH ponds would be managed using elevated salinity to reduce establishment of emergent vegetation, such as cattails and bulrush. Most vegetation is inhibited by 10 ppt salinity, but some strains could tolerate salinities up to 35 ppt (Table D-2).

Table D-2 Constant Salinity (20 ppt) and Constant Storage Operational Scenario

	Scenario Name	Water Year Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1a	**Constant Salinity (low range), Constant Storage**												
Operating Variables	Salinity (ppt)	20	20	20	20	20	20	20	20	20	20	20	20
	Storage (% capacity)	100	100	100	100	100	100	100	100	100	100	100	100%
	Residence time (weeks)	4	4	4	4	4	4	4	4	4	4	4	4
Potential Constraints and Impacts	Dissolved oxygen	Anoxia					Anoxia more common						
	Fish temperature tolerance			Potentially too cold									
	Selenium loading[1]	High relative selenium loading											
	Mosquito vector relative risk[2]	High	Low mosquito risk				High mosquito risk						
1b	Residence time (weeks)	16	16	16	16	16	16	16	16	16	16	16	16
	Selenium loading[1]	Medium relative selenium loading											

1. Relative selenium loading – shorter residence time and lower salinity means greater inputs of river water, which increases selenium loading.

2. Vector risk of mosquitoes based on salinity tolerance (survive <28 ppt, reduced population 28-34 ppt, control 35 ppt) and breeding season (Mar-Nov).

Relative Selenium Loading

Residence Time	Salinity range ppt 10-19	20-29	30-39	40-50
4-8 weeks	Higher	High	Medium	Low
10-16 weeks	High	Medium	Low	Lower

Table D-3 Constant Salinity (35 ppt) and Constant Storage Operational Scenario

	Scenario Name	Water Year Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2	**Constant Salinity (high range), Constant Storage**												
Operating Variables	Salinity (ppt)	35	35	35	35	35	35	35	35	35	35	35	35
	Storage (% capacity)	100	100	100	100	100	100	100	100	100	100	100	100
	Residence time (weeks)	16	16	16	16	16	16	16	16	16	16	16	16
Potential Constraints and Impacts	Dissolved oxygen	Anoxia					Anoxia more common						
	Fish temperature tolerance			Potentially too cold									
	Selenium loading[1]	Low relative selenium loading											
	Mosquito vector relative risk[2]	Low mosquito risk											

1. Relative selenium loading – shorter residence time and lower salinity means greater inputs of river water, which increases selenium loading.

2. Vector risk of mosquitoes based on salinity tolerance (survive <28 ppt, reduced population 28-34 ppt, control 35 ppt) and breeding season (Mar-Nov).

Relative Selenium Loading

Residence Time	Salinity range ppt 10-19	20-29	30-39	40-50
4-8 weeks	Higher	High	Medium	Low
10-16 weeks	High	Medium	Low	Lower

Table D-4 Variable Salinity (20-35 ppt) and Variable Storage Operational Scenario

	Scenario Name	**Water Year**											
		Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
3	**Variable Salinity, Variable Storage**												
Operating Variables	Salinity (ppt)	20	20	20	20	20	20	25	30	35	35	30	25
	Storage (% of capacity)	100	100	100	100	100	95	90	85	80	80	90	95
	Residence time (weeks)	8	6	4	4	6	8	10	12	16	16	12	10
Potential Constraints and Impacts	Dissolved oxygen	Anoxia					Anoxia more common						
	Fish temperature tolerance			Potentially too cold									
	Selenium loading[1]	High relative selenium loading						Medium	Low relative selenium loading				Medium
	Mosquito vector relative risk[2]	High	Low mosquito risk				High	Medium		Low risk		Medium	

1. Relative selenium loading – shorter residence time and lower salinity means greater inputs of river water, which increases selenium loading.

2. Vector risk of mosquitoes based on salinity tolerance (survive <28 ppt, reduced population 28-34 ppt, control 35 ppt) and breeding season (Mar-Nov).

Relative Selenium Loading

Residence Time	Salinity range ppt 10-19	20-29	30-39	40-50
4-8 weeks	Higher	High	Medium	Low
10-16 weeks	High	Medium	Low	Lower

Table D-5 Variable Salinity (20-35 ppt) and Constant Storage Operational Scenario

	Scenario Name	Water Year Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
4	**Variable Salinity, Constant Storage**												
Operating Variables	Salinity (ppt)	20	20	20	20	20	20	25	30	35	35	30	25
	Storage (% capacity)	100	100	100	100	100	100	100	100	100	100	100	100
	Residence time (weeks)	8	6	4	4	6	8	10	12	16	16	12	10
Potential Constraints and Impacts	Dissolved oxygen	Anoxia					Anoxia more common						
	Fish temperature tolerance			Potentially too cold									
	Selenium loading[1]	High relative selenium loading						Medium		Low relative selenium		Medium	
	Mosquito vector relative risk[2]	High	Low mosquito risk				High	Medium		Low		Medium	

Relative Selenium Loading

Residence Time	Salinity range ppt 10-19	20-29	30-39	40-50
4-8 weeks	Higher	High	Medium	Low
10-16 weeks	High	Medium	Low	Lower

1. Relative selenium loading – shorter residence time and lower salinity means greater inputs of river water, which increases selenium loading.

2. Vector risk of mosquitoes based on salinity tolerance (survive <28 ppt, reduced population 28-34 ppt, control 35 ppt) and breeding season (Mar-Nov).

Table D-6 Highly Variable Salinity (20-40 ppt) and Constant Storage Operational Scenario

	Scenario Name	Water Year Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
5	**Variable Salinity, Constant Storage**												
Operating Variables	Salinity (ppt)	20	20	20	20	20	20	30	40	40	40	40	30
	Storage (% capacity)	100	100	100	100	100	100	100	100	100	100	100	100
	Residence time (weeks)	12	10	8	8	10	12	16	20	20	20	20	16
Potential Constraints and Impacts	Dissolved oxygen	Anoxia					Anoxia more common						
	Fish temperature tolerance			Potentially too cold									
	Selenium loading[1]	High relative selenium loading				Medium		Low	Lower relative loading				Low
	Mosquito vector relative risk[2]	High	Low mosquito risk				High	Med-ium	Low				Med-ium

1. Relative selenium loading – shorter residence time and lower salinity means greater inputs of river water, which increases selenium loading.

2. Vector risk of mosquitoes based on salinity tolerance (survive <28 ppt, reduced population 28-34 ppt, control 35 ppt) and breeding season (Mar-Nov).

Relative Selenium Loading

Residence Time	Salinity range ppt 10-19	20-29	30-39	40-50
4-8 weeks	Higher	High	Medium	Low
10-16 weeks	High	Medium	Low	Lower

Table D-7 Highly Variable Salinity (20-40 ppt) and Variable Storage Operational Scenario

	Scenario Name	Water Year Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
6	**Variable Salinity, Variable Storage**												
Operating Variables	Salinity (ppt)	20	20	20	20	20	20	30	40	40	40	40	30
	Storage (% capacity)	100	100	100	100	100	95	90	85	80	80	90	95
	Residence time (weeks)	12	10	8	8	10	12	16	20	16	20	20	16
Potential Constraints and Impacts	Dissolved oxygen	Anoxia					Anoxia more common						
	Fish temperature tolerance			Potentially too cold									
	Selenium loading[1]	High relative loading				Medium		Low	Very Low relative loading				Low
	Mosquito vector relative risk[2]	High	Low mosquito risk				High	Med-ium	Low				Med-ium

1. Relative selenium loading –shorter residence time and lower salinity means greater inputs of river water, which increases selenium loading.

2. Vector risk of mosquitoes based on salinity tolerance (survive <28 ppt, reduced population 28-34 ppt, control 35 ppt) and breeding season (Mar-Nov).

Relative Selenium Loading

Residence Time	Salinity range ppt 10-19	20-29	30-39	40-50
4-8 weeks	Higher	High	Medium	Low
10-16 weeks	High	Medium	Low	Lower

D.5 Testing Operational Scenarios

Different operational scenarios would be tested in the proof-of-concept period for approximately 10 years (estimated 2015–2025). Two or more operational scenarios would be implemented simultaneously in separate ponds, and outcomes monitored to test performance in meeting objectives and minimizing impacts. Key indicators of important physical, water quality, and biological attributes would be monitored.

Certain indicators of flow and water quality would be frequently monitored to guide daily or weekly pond operations. These operational triggers include pumping or inflow rates of river water and saline water, outflow rates, and salinity of water at inflow and in ponds.

Indicators of Project performance would be identified based on the SCH objectives. Thresholds or desired conditions for each indicator would be defined, and progress toward meeting those objectives measured according to the Monitoring and Adaptive Management Framework (Appendix E). For example, measuring abundance and community composition of fishes in different ponds would be an indicator of SCH Project effectiveness at providing foraging habitat for piscivorous birds (Objective 1) and creating sustainable aquatic habitat (Objective 3).

D.6 Maintenance Activities

SCH Project implementation would also include standard maintenance that would not be varied experimentally. These types of operations would include:

- Sedimentation basin operations;
- Infrastructure maintenance;
- Erosion control structure maintenance;
- Vegetation control; and
- Vector control (see Appendix F, Mosquito Control Plan).

D.6.1 Sedimentation Basin Operations

There would be two sedimentation basins. Operation and maintenance would occur throughout the year and at the end of the year. One basin would be operated at any given time, storing water and settling sediment. The other basin would be drained of water, the sediment dried, and sediment excavated down to original design elevation. Excavated sediment would be used on the Project to maintain berms, offset settling of berms, and create additional habitat islands if necessary.

D.6.2 Infrastructure Maintenance

Monitoring of physical structures would be conducted on a regular basis to check condition, and and maintenance or repairs implemented on an ongoing basis as needed. Project infrastructure for the water supply includes pumps, pump facilities and pipelines and inlet structures. Infrastructure for the water control structures includes culverts, gates, and weirs between ponds and from the ponds to the Salton Sea.

D.6.3 Erosion Control

Berm structure, riprap, and roadways on the crown would be checked periodically for seepage, cracking, erosion, and extensive burrowing by animals. Areas that would potentially receive more wave action due to extended wind fetch would receive closer scrutiny. Typical maintenance activities could include adding riprap, filling cracks or eroded areas, or spreading gravel on the roadway.

D.6.4 Vegetation Control

Unwanted vegetation at SCH infrastructure could include cattails, tules and salt cedar. Measures would be implemented to control vegetation on berms that could compromise structural integrity. Vegetation would also be removed from the sedimentation basin, interception ditch, and around the river pump station to maintain storage and flow capacity. Best management practices for vegetation control would be implemented as appropriate, including but not limited to physical removal and chemical control appropriate near waterways.

D.7 Emergency Operations

Under certain circumstances, it may be necessary to enact rapid response operations in response to a sudden threat or emergency, such as:

- Avian disease outbreak;
- Rapid drawdown of ponds for emergency actions; and
- Mosquito-borne diseases (see Appendix F, Mosquito Control Plan).

D.7.1 Avian Disease Outbreak

Birds would be monitored regularly for signs of disease outbreaks, and monitoring would be intensified if signs of disease are present. Dead and dying birds would be collected to disrupt cycles of infectious diseases. Potentially infectious carcasses would be incinerated at the Sonny Bono Refuge. For diseases that can be treated, such as the early stages of botulism, sick birds would be collected for rehabilitation and release, as is currently done on the Salton Sea.

D.7.2 Pond Drawdown

Under certain conditions it may become necessary to rapidly reduce water elevations a pond, such as emergency repair of water control structures or berms, sudden change in pond water quality, or noxious species control. The drawdown would involve raising the flashboards on the outlet control structure(s) to release water to the Sea. Draining of the ponds could occur as a result of a breach in one or more berms, but complete draining would not be utilized as a typical pond management action. Under certain emergency conditions, such as a pesticide spill in the SCH source waters, or to eradicate a noxious aquatic invader, SCH ponds could be deliberately drained. In such an event, low areas of the ponds' would retain water and act as temporary refugia for fish by design, by allowing either the salvage of the remaining fish or leaving fish in place as recruitment stocks for re-establishing fish populations.

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APPENDIX E

Monitoring and Adaptive Management Framework

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Appendix E

Monitoring and Adaptive Management Framework

E.1 Introduction

The two goals of the Salton Sea Species Conservation Habitat (SCH) Project are (1) to provide aquatic habitat to support fish and wildlife species dependent on the Salton Sea, and (2) to develop and refine information needed to successfully manage the SCH Project. The Project is intended to serve as a proof of concept for the long-term restoration envisioned for the Salton Sea. Therefore, the SCH Project is being developed consistent with the principles of adaptive management with the following objectives for its second goal:

1. Identify uncertainties in achieving the objectives of providing habitat and prey for piscivorous birds and minimizing impacts on species (e.g., selenium, disease);

2. Design science-based means to test alternatives and reduce uncertainty;

3. Develop and implement a monitoring plan that measures key indicators of SCH Project performance;

4. Develop a decision-making framework to evaluate data, adjust management, and refine operations and monitoring as needed to achieve Project goals; and

5. Provide proof of concept for future restoration to verify that the core ideas are functional and feasible prior to full scale restoration of the Salton Sea.

The purpose of this document is to present a monitoring and adaptive management framework to guide evaluation and improved management of the newly created habitat, as well as to inform future restoration. Because the SCH Project has not reached final design or construction, this document does not include the detailed protocols and site-specific sampling design necessary for actual implementation. A more detailed monitoring plan and decision-making process would be developed should the SCH Project be constructed.

E.2 Adaptive Management Process

Adaptive management is a process that promotes flexible decision-making that can be adjusted as new and improved information becomes available about outcomes of management actions and other events (Williams et. al 2007). Adaptive management provides the necessary flexibility and feedback to manage complex natural resources in the face of considerable uncertainty about the effectiveness of specific management actions. It is an iterative process with the following steps:

1. **Plan –** Define/redefine the problem, establish goals and objectives, develop restoration alternatives;

2. **Design –** Develop designs and operational scenarios for habitat ponds, develop monitoring framework;

3. **Implement –** Design, construct, and operate the SCH ponds;
4. **Monitor –** Conduct monitoring to detect change and determine status of resources;
5. **Evaluate –** Analyze, synthesize, and manage data; and
6. **Adapt and Learn –** Make any necessary adjustments to management, share information.

Because uncertainties remain about habitat function and biological responses at the ponds, the SCH Project is being designed with a range of operational scenarios (Appendix D, Project Operations) to evaluate the effectiveness of different management actions. A monitoring program would be implemented to collect data necessary to operate and evaluate the Project's success.

E.3 Monitoring Framework

E.3.1 Objective-Based Monitoring

Monitoring is a fundamental element of adaptive management because effective evaluation and management requires information about the status of target resources and their response to management activities. The information obtained would be used to measure Project effectiveness, to refine operation and management of the SCH ponds, to reduce uncertainties about key issues, and to inform subsequent stages of habitat restoration at the Salton Sea.

Monitoring can be defined as the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective (Elzinga et al. 1998). Inherent in defining monitoring as part of the adaptive management cycle are two key concepts (Elzinga et al. 1998). The first is that monitoring is driven by objectives. The objective describes the desired condition. Management is designed to meet the objective and monitoring is designed to determine if the objective is met. Objectives form the foundation of the entire monitoring project. The second concept is that monitoring is only initiated if opportunities for management change exist.

Monitoring efforts would be guided by the specific SCH Project objectives and desired outcomes. Table E-1 outlines the Project's objectives to meet its primary goal of providing aquatic habitat to support fish and wildlife species dependent on the Salton Sea. What is measured (indicator), how well it is measured, and how often it is measured are design features that would be defined by how an objective is articulated (Elzinga et al. 1998). The next step would be to define, quantitatively or qualitatively, the specific desired outcomes for each objective and to identify appropriate indicators for measurement. Monitoring should focus on the most informative, efficient, and cost-effective indicators and methods. Types of potential indicators include:

- Triggers for real-time pond operations – salinity, storage, residence time (inflow and outflow rates), depth;
- Performance measures – attributes of target species and their habitat, such as physical habitat conditions, water quality, and distribution, abundance and composition of aquatic invertebrates, fish and birds; and
- Threat indicators – contaminants of concern (selenium), mosquitoes, disease outbreaks.

Table E-1 SCH Objective-Based Monitoring Framework

Goal 1 - Provide aquatic habitat to support fish and wildlife species dependent on the Salton Sea

Objectives	Examples of Potential Indicators
1. Provide appropriate foraging habitat for piscivorous birds	• Fish species, relative abundance, and size distribution
2. Develop habitats to support piscivorous birds	• Bird utilization (species, numbers) of islands and snags • Bird roosting and nesting activity
3. Support a sustainable, productive aquatic community	• Fish species composition and abundance • Aquatic invertebrates • Phytoplankton
4. Provide suitable water quality to sustain productive fish community	• Salinity • Dissolved oxygen • Temperature • Water depth
5. Minimize adverse effects on desert pupfish	• Pupfish relative abundance and distribution in ponds • Pupfish connectivity from drains around the ponds
6. Minimize impacts from selenium	• Selenium concentrations in water and sediment • Selenium concentrations in invertebrates and fish • Egg selenium concentrations
7. Minimize impacts from disease or toxicity	• Bird die-offs - species, number, disease mechanism • Fish die-offs • Contaminant concentrations in bird eggs

E.3.2 SCH Monitoring Plan Development

A detailed monitoring plan would be developed once the final SCH Project design was approved. The actions identified in the monitoring plan would be based on the information needed to operate the Project facilities, to evaluate success and threats, and to help resolve remaining uncertainties, as well as available funding and monitoring requirements for compliance.

The SCH monitoring plan would be developed in coordination with broader efforts to plan for restoration of the Salton Sea ecosystem. The Salton Sea Ecosystem Monitoring and Assessment Plan (MAP) is being developed by the California Department of Water Resources (DWR), California Department of Fish and Game (DFG), Bureau of Reclamation, and United States Geological Survey (USGS in preparation). The MAP will provide a blueprint for quantitative evaluation of ecosystem restoration activities and will serve as a cornerstone for scientific studies that will help guide efforts to restore the Salton Sea. The SCH monitoring plan protocols would be consistent with the MAP.

Design and implementation of SCH monitoring would also be coordinated with ongoing and proposed survey and monitoring efforts at the Salton Sea to share and build on available data. This coordination would be especially valuable for evaluating SCH performance relative to other reference sites and for understanding regional patterns of physical and biological change. Examples of past and ongoing studies include biological surveys by DFG, monitoring at the Sonny Bono Salton Sea National Wildlife Refuge by the United States Fish and Wildlife Service, water quality monitoring by the Bureau of Reclamation, studies of water quality and biota in agricultural drains and rivers by USGS, bird surveys by the Natural History Museum of Los Angeles County, surveys for the Imperial Irrigation District's Habitat

Conservation Plan/Natural Community Conservation Plan, and studies of selenium and other contaminants by university researchers (University of California Riverside, San Diego State University, University of California Berkeley).

E.3.3 Elements of Monitoring Plan

The SCH monitoring plan would include several monitoring elements, modeled on the MAP framework. Each monitoring element would include a description of the purpose and justification for the monitoring activity, location(s), time period(s) and frequency of monitoring, protocol(s) for data collection, a description of the data to be collected and the anticipated use of the data, proposed quality assurance measures, reporting, and an overview of similar monitoring activities and opportunities for integration. The frequency of data collection and evaluation would be guided by the purpose of monitoring. For example, operational triggers such as water supply flow rates would be measured daily or weekly, while status of target resources would be monitored seasonally or annually. A detailed monitoring protocol would be developed prior to initiating monitoring activities in the field. This protocol would include a description of the measures that would be taken to ensure the quality of the data collected and how those measures would be implemented. The data quality assurance measures may include, but would not be limited to, procedures for calibrating or ensuring the accuracy of any instruments (e.g., GPS) employed in the field, procedures for recording and transferring electronic data, methods for ensuring proper operation of field equipment during surveys, and methods for avoiding double counting or insufficient coverage of survey areas.

Key monitoring elements would include the following:

- Physical Habitat – flow rate, depth, wetted area, islands, snags, submerged vegetation, and other habitat elements;
- Water Quality – salinity, temperature, dissolved oxygen, nutrients;
- Aquatic Biota – algae, plankton, invertebrates, fish community (species, distribution, abundance), desert pupfish;
- Birds – species, abundance and distribution, use of habitat features, breeding and nesting, sick or dead birds; and
- Contaminants **–** selenium concentrations in water, sediment, bird eggs, and other biota (invertebrates, fish).

E.4 Data Management and Assessment

Data collected, stored, or made accessible from the data management system would be available to the SCH Project team for the application of statistical and other analytical techniques. Data assessment would be used to foster the integration, consolidation, and review of data, updating of conceptual models, answering of key questions, reporting, and providing management recommendations. Consistent review and assessment of the data would be needed to assure that performance objectives are being met and that funding for data collection is effectively utilized. In addition to program-level data assessment and analysis, data assessment should take place at the individual monitoring activity level through regular evaluation and assessment of data collected over time. This individual monitoring would help ensure data quality and usefulness relative to meeting monitoring objectives.

Each year that surveys are conducted, an annual report would be generated that summarizes the data collected during that year and updates prior reports in a cumulative fashion. A synthesis report would be prepared at the end of the 10-year proof-of-concept period with final recommendations for long-term SCH management.

Data, analyses, and publications developed from this monitoring plan would be organized, stored, and made publicly accessible through a common distributed data management system, in coordination with the broader Salton Sea MAP efforts. Common protocols would be developed and applied when possible, and all geospatial data would include full metadata and would be compliant with the Federal Geographic Data Committee (FGDC) standards. DFG would establish and maintain the data management system. The data collected as part of the Salton Sea restoration program would be stored in DFG's Biogeographic Information and Observation System (BIOS) map viewer and all documentation including metadata would be accessible to the public via metadata clearinghouses and DFG's document library.

E.5 Decision-Making Process

To track progress in meeting SCH Project objectives, the scientists and managers responsible for the Project would regularly synthesize and analyze the monitoring data and evaluate the status and trends in target resources through the use of monitoring data. An overall review would be conducted annually to evaluate Project performance. A decision-making framework would be established to provide recommendations to SCH managers for maintaining or adjusting operations.

The managers of the SCH Project, DFG and DWR, must have the capacity to change practices in response to what is learned over time. Governance for adaptive management should provide a decision-making structure that fosters communication between scientists and decision makers, and has clear lines of authority where timely decisions are made and implemented. Governance for implementing adaptive management must provide for the institutional capacity to interact, learn, and adapt. The decision-making structure would be developed in further detail with the monitoring plan prior to operation of the SCH ponds.

In accordance with the adaptive management framework, the assessment and analysis of data are anticipated to lead to periodic adjustments in management of the SCH ponds and updates in the operations and monitoring plans, especially during the 10-year initial implementation phase. The monitoring plan is envisioned to be a living document and would need to remain flexible to respond effectively to unanticipated events.

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APPENDIX F

Mosquito Control Plan

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Appendix F

Mosquito Control Plan

F.1 Introduction

This plan addresses monitoring mosquito populations, the surveillance of mosquito-borne pathogens that cause diseases in human and wildlife, and the implementation of a treatment program to control mosquitoes at the Species Conservation Habitat (SCH) ponds and sedimentation basins at the outflows of the Alamo River or New River into the Salton Sea. The plan addresses human health concerns and is modeled after the Mosquito Monitoring Program for the Sonny Bono Salton Sea National Wildlife Refuge, Calipatria, California (United States Fish and Wildlife Service [USFWS] 2005). Monitoring activities would be used to locate mosquito life stages (larvae, pupae, and adults), estimate their abundance and determine species composition for the purpose of making treatment decisions. Disease surveillance would be used to detect the presence of mosquito-borne disease as part of a state-wide program. Mosquito treatments would be used to reduce the abundance of mosquito populations and associated mosquito-borne disease risk. Vector population and pathogen monitoring are fundamental components of any mosquito management program and are necessary for making informed decisions related to cost-effective mosquito management.

Mosquitoes are considered an annoyance because of their biting, and many species are known vectors of pathogens that cause serious diseases in California. Of the mosquito-borne viruses known to occur in California, western equine encephalomyelitis virus (WEE), St. Louis encephalitis virus (SLE), and West Nile virus (WN) have caused significant outbreaks of human disease (California Department of Public Health [CDPH] 2009, 2011). WEE and WN have been detected in adult mosquito samples from the Sonny Bono Salton Sea National Wildlife Refuge, which is adjacent to the SCH ponds and sedimentation basin associated with the Alamo River.

WEE tends to be most serious in very young children, whereas elderly people are most at risk from SLE and WN (CDPH 2009). Both WEE and WN can cause serious diseases in horses and emus, and WN kills a wide variety of endemic and imported birds. Birds are the primary reservoirs of the viruses and differ among species in the amplification of viruses within the bloodstream and susceptibility to the viruses. Humans and horses are dead-end hosts for the viruses; although the effects of a virus infection can be severe, titers of the virus in the bloodstream are insufficient to reinfect the mosquito vectors. With the exception of available vaccines to protect horses against WEE and WN, there are no known specific treatments or cures for diseases caused by these viruses (CDPH 2009). At the present time, mosquito control is the only practical method of protecting the people of California from mosquito-borne diseases.

The mosquito species potentially utilizing the SCH habitats as developmental sites for the immature stages of the mosquito life cycle include *Culex erythrothorax*, *Cx. tarsalis* and *Aedes vexans*. *Culex tarsalis* is the primary vector of WEE, SLE and WN in rural settings of California (CDPH 2009). *Cx. erythrothorax* and *Aedes vexans* may also contribute to disease transmission (Goddard et al. 2002). These mosquito species are targeted for monitoring and treatment.

The proposed habitats are located in Imperial Valley adjacent to the Salton Sea at the outflows of the New River and Alamo River. Within 30 miles of the SCH are the communities of Niland[1] (population 1,329), Calipatria (population 7,623), Westmorland (population 1,620), Brawley (population 22,438), Imperial (population 12,162) and El Centro (39,902); and another 10,000 people live in the unincorporated region. Surrounding land use includes farming, recreational camping and hunting, and geothermal power generation.

F.1.1 Mosquito Control Methods

Larval mosquito control has three key components: environmental management, biological control, and chemical control (Knight et al. 2003; CDPH 2008, 2011). Environmental management includes the measures that decrease habitat availability or suitability for immature mosquitoes. Environmental management includes the design and management practices applicable to the SCH Project and may also include water-level management; environmental alterations that reduce standing water through evaporation, percolation, recirculation, or drainage; and vegetation management.

Biological control uses natural predators, parasites, or pathogens to reduce immature mosquito numbers. No efficacious biological control agents are available for adult mosquitoes. Incorporation and management practices to enhance populations of mosquito-eating fish and naturally occurring insect predators can be important adjunct Integrated Vector Management (IVM) measures that significantly reduce mosquito production. While the mosquitofish, *Gambusia affinis*, is the most widely used biological control agent in California, many of the native fish species merit consideration as biological control agents for mosquitoes. The fish fauna in the agricultural drains and other aquatic habitats surrounding the Salton Sea include several small, introduced and native fish species (Saiki et al. 2010), including the desert pupfish (*Cyprinodon macularius*), that consume immature mosquitoes (Walters and Legner 1980; Walton 2007). One goal of the SCH Project is to include fish in the food web of the habitat ponds. An ancillary benefit of managing the habitat to support healthy fish populations is the planktivorous life stages and species are likely to assist mosquito control where mosquito larvae occur in the ponds or in other component habitats.

Chemical control for the aquatic stages of the mosquito life cycle includes non-persistent biological agents. The non-persistent biological agents include microbial control agents, such as *Bacillus thuringiensis* subsp. *israelensis* (*Bti*) and *Bacillus sphaericus*, and insect growth regulators (IGRs), such as methoprene. The *Bacillus* produce protein precursors during sporulation that, following ingestion by the mosquito larva, disrupt the integrity of mosquito digestive tract and interfere with the ability of the larva to osmoregulate. In California, the microbial agents are used most frequently to reduce populations of mosquito larvae. The IGR mimics an insect-specific hormone that prevents immature mosquitoes from developing into adults. Other control agents include chemicals (e.g., monomolecular surface films, light-grade oils) that alter the surface tension of the water drowning the immature stages of mosquitoes and insecticidal chemicals. These surface-tension agents are used rarely but are used against pupae which do not feed and consequently do not ingest the microbial agents. Organophosphate pesticides such as temephos are rarely used in California to control the immature stages of mosquitoes because of their potential impact on nontarget organisms and the environment.

F.2 Monitoring

It is expected that the SCH ponds would not be conducive to mosquito production because the configuration of the ponds includes a large proportion of the surface area with open water at a depth > 2 feet. Open water should reduce the survival of immature mosquitoes because of disturbance and drowning

[1] Populations are based on the 2005-2009 American Community Survey 5-Year Estimates (United States [U.S.] Census Bureau 2011).

caused by wind-driven waves and high susceptibility to predators. The SCH ponds at the high end of the range of operational salinities are predicted to be too salty for significant mosquito production and colonization by wetland plants. If mosquito production occurs in the SCH ponds, it is likely to be limited to the shallow zones of the upslope periphery of the pond and maybe the berms, if aquatic vegetation and/or inundated grasses (i.e., *Distichlis*) colonize the shallow water and berms. The width of this area may be only 3 feet to 6 feet (1 to 2 meters) which represents only 0.6-1.1 percent of the surface area of a 100-acre pond. If vegetation is found along the periphery of the sedimentation pond, then monitoring for larval mosquito populations would occur at natural openings in vegetation.

The ponds could be managed at a salinity ranging from 20 parts per thousand (ppt) to 40 ppt, which would reduce the potential for vegetation to grow in the ponds because the higher salinities exceed the tolerances of most freshwater macrophytes. Salinities at the lower end of the management range, however, may not limit macrophyte colonization. Vegetation management in the low salinity ponds may be required to reduce or eliminate conditions conducive to mosquito production.

The primary mosquito vector of encephalitis viruses in the Imperial Valley, *Culex tarsalis*, is capable of surviving and developing to adulthood successfully in salinities up to 70 percent (24.5 ppt) of full-strength sea water (Bradley 1987; Garrett and Bradley 1987). While laboratory studies using larvae collected from the Central Valley of California indicated that *Cx. tarsalis* production would be greatly reduced at salinities > 24.5 ppt, *Cx. tarsalis* larvae have been collected from the periphery of the Salton Sea (personal communications, T. J. Bradley 2011; H. Lothrop 2011; and W. K. Resien 2011). The salinity of the Salton Sea at the time these larvae were collected is estimated to have been 39 ppt. The occurrence of larvae of a brackish-water mosquito species (Bradley 1987) of public health importance in the Salton Sea raises concern that mosquito production may be possible across the entire range of salinities of the SCH ponds.

Immature (larvae, pupae) mosquito abundance is monitored using dippers. A dipper is a long-handled ladle that collects a 500 ml water sample from pools potentially serving as mosquito sources. The water sample is evaluated for the presence of larval mosquitoes and when mosquito larva are present, 'dip-counts' are used as a measure of immature mosquito abundance. Captured mosquitoes are then identified to species by skilled technicians.

Adult mosquitoes are monitored using carbon dioxide-baited traps (CO_2-baited suction traps). The traps are baited with 1-2 kilograms of dry ice that attracts adult mosquitoes as it sublimates. An electric fan forces the adult mosquitoes into a collection container. Trapped mosquitoes are enumerated, identified and processed for mosquito-borne disease detection in a laboratory. Six traps are proposed for deployment adjacent to the SCH habitats. A minimum of three traps (6 traps total) should be deployed at each group of SCH ponds at the outflows of the New River or the Alamo River, depending on the selected alternative. Traps should be placed at the western and eastern ends of each of SCH pond systems and at a site approximately equidistant between the traps on the east-west transect. Alternative placement of the traps could be carried out after operation of the SCH ponds begins if better trapping sites become evident. At least one CDC style CO_2-baited trap should be deployed at each sedimentation basin. More than one trap per each component would increase the reliability of the numbers for adult mosquito population monitoring and provide a collection if one of the traps were to fail on a particular night. Labor and time constraints, as well as funds budgeted for monitoring, would determine the extent of sampling.

Monitoring for immature and adult mosquito populations would occur from April through October. Monitoring activities may occur at any time during the day. Mosquito monitoring crews may require one half to one full day to conduct monitoring activities and the frequency would depend on mosquito activity which is in turn dependent on environmental conditions such as temperature. Monitoring frequency may range from twice per month to once every week.

F.3 Treatment

Treatment of larval mosquito populations would be focused on larvae occurring in vegetated wetland habitats that may develop along the periphery of the SCH ponds and the sedimentation basins. Only those areas where monitoring has shown that larval average dip counts for *Culex* have reached or exceeded one larva per dip would be targeted for treatment. However, specific areas treated and the extent of treatment would vary from year to year depending on mosquito populations and environmental conditions.

Larval thresholds may be reached or exceeded at any point during the monitoring season from April through October, thereby resulting in treatment. Larval treatments may occur anytime during the daylight hours. The frequency of larval treatments would depend on larvicide persistence, rate of post-treatment mosquito recovery, and species specific seasonal development. Larval treatment frequency may range from once per seven days to once per month.

The larvicides proposed to be used are Vectolex CG and Vectobac 12AS. Vectobac CG contains the active ingredient *Bacillus sphaericus*. Vectobac 12AS contains the active ingredient *Bacillus thuringiensis* subsp. *israelensis (Bti*). *B. sphaericus* and *Bti* are naturally occurring anaerobic spore forming bacteria mass produced using modern fermentation technology. Formulated *B. sphaericus* and *Bti* products contain bacterial spores and protein endotoxins. The endotoxin is activated in the alkaline midgut of susceptible insect species with subsequent binding to protein-specific receptors resulting in a lethal response (Lacey and Mulla 1990; Walton et al. 1998; Knight et al. 2003). Therefore, these products must be ingested by the target insect to be effective. Mosquito pupae and adults are not affected because they do not ingest the product.

Vectolex CG is a granular formulation consisting of 7.5 percent active ingredient. It would be applied at a rate of 5.0 to 20.0 pounds of formulated product per acre. Vectobac 12AS is a liquid formulation with 1.2 percent active ingredient. It would be applied at a rate of 0.25-1 pt/acre. Either product may be applied as a spot treatment to small areas or broadcast over larger areas by ground and/or aerial (fixed wing or helicopter) equipment. Ground-based equipment includes gas powered broadcasters affixed to a backpack, an all-terrain vehicle, or truck. The application would be done by the County Public Health Department or their contractor.

Treatment of adult mosquitoes would be initiated only if larval treatments failed to prevent adult mosquito populations from reaching and/or exceeding 25 adult *Culex* in any single trap or 5 adult *Culex* per trap in one night. Treatment may occur in riparian and upland habitats near or adjacent to the SCH Project, but not directly over the water. The specific areas treated and the extent of treatment would vary from year to year depending on mosquito populations and environmental conditions. Adulticide treatments have the potential to drift beyond the targeted treatment area.

Treatment thresholds should reflect changes in mosquito-borne disease threats. The California Mosquito-borne Virus Surveillance and Response Plan (CDPH 2009) provides a semi-quantitative measure of virus transmission risk to humans that can be used by local vector control agencies to plan and modulate control activities. This plan can be used to develop management and vector control activities at the SCH Project site. Table G-1 provides a response matrix that is a function of the mosquito-borne disease health threat.

Adult thresholds may be reached or exceeded at any point during the monitoring season from April through October, thereby resulting in treatment. Adult mosquito treatments would occur during early morning or evening hours. The frequency of adult mosquito treatments would depend on the rate of post treatment recovery and species specific seasonal development. Adult mosquito treatment frequency may range from once per five days to once per month.

The proposed adulticide is Pyrenone 25-5. Pyrenone 25-5 consists of 5 percent natural pyrethins and 25 percent piperonyl butoxide. Natural pyrethrins are extracted from chrysanthemum plants and consist of a mixture of pyrethrin-I, pyrethrin-II, cinerin I and II, and jasmolin I and II (Extension Toxicology Network 1996). The natural pyrethrins are non-systemic contact poisons which quickly penetrate the insect nervous system causing paralysis and subsequent death (Extension Toxicology Network 1996; Tomlin 1997). A few minutes after application, the insect cannot move or fly away. However, the pyrethrins are swiftly detoxified by enzymes in the insect and thus, exposed insects can recover. To delay the enzyme action so a lethal dose is assured, commercial products are formulated with the synergist piperonyl butoxide (PBO) to inhibit detoxification (Tomlin 1997).

Table F-1 Mosquito-Borne Disease Health Threat and Response Matrix

Current Conditions		Threat Level	Response
Health Threat Category[1]	SCH Mosquito Populations[2]		
No documented existing or historical health threat/emergency	No action threshold	1	Remove/manage artificial mosquito breeding sites such as tires, tanks, or similar debris/containers.
Documented historical health threat/emergency	Below action threshold	2	Response as in threat level 1, plus: allow compatible monitoring and disease surveillance. Consider compatible nonpesticide management options to reduce mosquito production.
	Above action threshold	3	Response as in threat level 2, plus: allow site-specific compatible larviciding of infested areas as determined by monitoring.
Documented existing health threat. Disease found in sentinels (chicken), equines, wildlife, mosquitoes or humans.	Below action threshold	4	Response as in threat level 2, plus: increase monitoring and disease surveillance.
	Above action threshold	5	Response as in threat levels 3 and 4, plus: allow compatible site-specific larviciding, or adulticiding of infested areas as determined by monitoring.
Officially determined existing health emergency	Below action threshold	6	Maximize monitoring and disease surveillance.
	Above action threshold	7	Response as in threat level 6, plus: allow site-specific larviciding, and adulticiding of infested areas as determined by monitoring.

1. Health threat/emergency as determined by Federal and/or State/local public health authorities with jurisdiction inclusive of SCH boundaries and/or neighboring public health authorities.

2. Action thresholds represent mosquito population levels that may require intervention measures. Thresholds would be developed in collaboration with State/local public health authorities and vector control districts.

Pyrenone 25-5 is a liquid formulation that would be applied using a rate of 0.0025 pounds active ingredient per acre. Treatments would be made using ultra-low volume (ULV) sprays that incorporate small amounts of the active ingredient as very fine droplets (10-30 micrometers in diameter). This small droplet size allows the spray to drift for a relatively longer period of time compared to larger droplets, and the small size delivers an appropriate dose of the pesticide to kill an adult mosquito. Drift is a necessary component of adulticiding because these sprays are most effective on flying insects. For this reason, adulticide applications generally occur in the evening or early morning hours when the majority of mosquito species are most active. Adulticides may be applied by truck-mounted sprayers or applied aerially by helicopter or fixed-wing aircraft. Pyrenone 25-5 will not be applied directly over water. The application would be done by the County Public Health Department or their contractor.

F.4 Availability of Resources

Significant service staff resources may be needed for environmental compliance responsibilities. The agency/agencies responsible for the mosquito-related activities has/have yet to be determined. A vector control agency/consultant/staff would be responsible for coordination and monitoring and control through the California Department of Fish and Game contact person. In order to monitor vector control activities, it is estimated that 5 percent of a full-time employee would be required. Monitoring would involve determining effects of treatments on wildlife and the presence of nesting birds and coordinating permitting, documentation, and recordkeeping with the agency/agencies responsible for vector control activities.

At present, funding has not been set aside by the State for source reduction and vector control. Physical removal of vegetation would be addressed on a case-by-case basis by the pond management agencies. Mosquito production is predicted to be low from the SCH ponds and sedimentation basins. Nevertheless, if vegetation management is needed, then this contingency should be planned for, including defining action thresholds and identifying a source of funding.

F.5 Anticipated Impacts of Use

F.5.1 Monitoring

Impacts on wildlife resources resulting from monitoring activities are expected to be negligible because of the limited scale of these activities. Some disturbance related to accessing the monitoring sites is expected to occur. Adult traps would be located adjacent to the SCH ponds and sedimentation basins. Dipping for immature mosquitoes would occur on the edges of the habitats that are expected to be generally devoid of vegetative cover.

F.5.2 Treatment

Several mosquito control products are highly specific to nematoceran dipterans (i.e., mosquitoes and related flies), have no or minimal impact on non-target organisms, and are safe for wildlife and humans (Ali 1981; Boisvert and Boisvert 2000). Because mosquitoes are more susceptible to the non-persistent biological agents than are related flies such as midges (chironomids), there is a large margin of safety against potential negative food web effects provided EPA-approved application rates are followed. The non-persistent biological agents include microbial control agents, such as *Bti* and *B. sphaericus*. The *Bacillus* produce protein precursors during sporulation that, following ingestion by the mosquito larva, disrupt the integrity of mosquito digestive tract and interfere with the ability of the larva to osmoregulate.

Bacillus sphaericus has slight to practically no acute mammalian toxicity, practically no acute avian toxicity, slight to practically no acute fish toxicity, and slight aquatic invertebrate toxicity (USFWS 1984; Florida Coordinating Council on Mosquito Control 1998). Spores and toxins become suspended in the water column and retain insecticidal activity in water with high organic matter content and suspended solids. The toxicity data available indicate a high degree of specificity of *B. sphaericus* for mosquitoes, with no demonstrated toxicity to chironomid larvae at any mosquito control application rate (Lacey and

Mulla 1990). Therefore, risks to sensitive wildlife resources resulting from direct exposure to a single *B. sphaericus* application and indirect food chain effects are expected to be negligible.

Bti has practically no acute or chronic toxicity to mammals, birds, fish, or vascular plants (U.S. Environmental Protection Agency [USEPA] 1998). Extensive acute toxicity studies indicated that *Bti* is virtually innocuous to mammals (Siegel and Shadduck 1990). These studies exposed a variety of mammalian species to *Bti* at moderate to high doses and no pathological symptoms, disease, or mortality were observed. Laboratory acute toxicity studies indicated that the active ingredient of *Bti* formulated products is not acutely toxic to fish, amphibians or crustacaceans (Garcia et al. 1980; Lee and Scott 1989; Wipfli et al. 1994; Brown et al. 2000, 2002). Other ingredients such as xylene in early formulations of *Bti* products were suspected to be potentially toxic (Fortin et al. 1986; Wipfli et al. 1994). Field studies however indicated no acute toxicity to several fish species exposed to *Bti* (Merritt et al. 1989; Jackson et al. 2002); no detectable adverse effects on breeding redwing black birds using and nesting in *Bti* treated areas (Hanowski 1997; Niemi et al. 1999); and no detectable adverse effects to tadpole shrimp 48 hours post *Bti* treatment (Dritz et al. 2001). Therefore, risks to sensitive wildlife resources resulting from direct exposure to a single *Bti* application are expected to be negligible.

Bti activity against target and susceptible nontarget invertebrates is also related to *Bti* persistence and environmental fate (Dupont and Boisvert 1986; Mulla 1990). Simulated field studies resulted in the suppression of two unicellular algae species, *Closterium* sp. and *Chlorella* sp., resulting in secondary effects on turbidity and dissolved oxygen of aquatic habitats, with potential trophic effects (Su and Mulla 1999). For these reasons, *Bti* effects on target and susceptible nontarget organisms, and potential indirect trophic impacts in the field are difficult to predict. However, single applications to limited areas are not expected to cause significant food chain effects. The ability for a population to recolonize a wetland following multiple larvicide treatments would depend on the intensity and frequency of applications at different spatial scales.

Pyrethrin has moderate to high acute mammalian toxicity, practically no acute avian toxicity, extreme fish toxicity, and high aquatic invertebrate toxicity (USFWS 1984; USEPA 2011). The USEPA uses the Risk Quotient method to estimate potential hazard to nontarget organisms. Risk quotients (RQs) are calculated by dividing acute and chronic exposure estimates by ecotoxicity values for various wildlife species. RQs are then compared to levels of concern (LOCs). Risk characterization provides information on the likelihood of an adverse effect occurring by considering the fate of the chemical in the environment, communities and species potentially at risk, their spatial and temporal distributions, and the nature of the effects observed in studies. Davis et al. (2007) found that all risk quotients for nontargets (small mammals, birds, as well as aquatic vertebrates and invertebrates in a pond subject to receiving the chemical via drift and runoff) exposed to ULV-applied adulticides were low indicating that risks to ecological receptors most likely were small. Field bioassays supported a risk assessment using actual environmental concentrations indicating that a single ULV application of synergized (with PBO) or unsynergized permethrin is unlikely to result in population impacts on medium- to large-bodied insects (Schleier and Peterson 2010). Long-term studies over two years indicated that multiple permethrin applications did not cause a reduction in terrestrial arthropods (Davis and Peterson 2008). Schleier et al. (2008) found that risk quotients for aquatic species in California wildlife refuges were 0.002 or less at 1 h after application, which did not exceed the USEPA risk quotient level of concern for endangered aquatic organisms of 0.05. These findings suggest that the amounts of pyrethrins and PBO deposited on the ground and in water after aerial ULV insecticide applications are lower than those estimated by previous exposure and risk assessments (Schleier et al. 2008).

F.5.3 Threatened and Endangered Species

Permanent vegetated wetlands in the region provide habitat for the endangered Yuma clapper rail. Desert pupfish (*Cyprinodon macularius*) occasionally are found in some of the agricultural drains connected to the Salton Sea as well as in the Salton Sea. The Sonny Bono Salton Sea National Wildlife Refuge Plan does not permit adulticide applications directly over any wetland. Some drift would probably occur; however, minimal negative impacts to rails and desert pupfish from drift are expected. A study of the impacts of pyrethrin on aquatic invertebrates in wetlands on Sutter NWR indicated no decrease in total abundance of invertebrates (Jensen et al. 1999). The predominant food item of Yuma clapper rails is crayfish (*Procambarus clarkii*). It is expected that direct effects of larvicide application in the rails habitat on crayfish would be minimal. Use of bacterial larvicides in desert pupfish habitat is expected to have minimal effects on invertebrate prey used by this species and no direct toxicity effects on the pupfish. Cumulative effects of larviciding and adulticiding on clapper rails and pupfish are difficult to estimate, but it is probable that they would have minimal impact because of the expected short duration of applications, the short life time of the treatment agents in the environment and the normal quick response of insects to reinvade habitats.

F.5.4 Wetlands and Waterfowl

Migratory birds and waterfowl (geese, ducks, and coots, sandhill cranes) may be present year-round but are most abundant in wetlands and ponds from August through March (USFWS 2005). The USFWS (2005) document provides the following information on the predicted effects of mosquito control agents on the wetland fauna of the Salton Sea region and their diets.

Ducks are known to be opportunistic feeders on both plants and invertebrates, utilizing the most readily available food sources. Invertebrates, plants, and seeds compose the majority of their diet, varying with the season and the geographic location. A study in California's Sacramento Valley has shown that plant foods are dominant in fall diets of northern pintails, while invertebrate use increases in February and March (Miller 1987). Seeds of swamp timothy comprise the most important duck food in the summer-dry habitats of the San Joaquin Valley (Miller 1987). At the Kern National Wildlife Refuge, the fall diet of northern pintails and greenwinged teal was composed of over two-thirds seeds (Euliss and Harris 1987). Thus any food chain impacts resulting from larvicide and adulticide treatment would have limited impacts to the mainly seed diet of newly arriving ducks. Summer molting waterfowl are not expected to be present in the treatment area. Studies have shown that aquatic invertebrates are a dominant food of nonbreeding waterfowl during the summer molt, and the fall and winter periods (Heitmeyer 1988).

Invertebrates are also critical for egg production during the spring (Swanson et al. 1979), and duckling growth during the summer rearing period (Krapu and Swanson 1977). Mosquitoes and chironomids make an important contribution to invertebrate food resources throughout the year. Other significant food resource contributors of the invertebrate community are Coleoptera, Odonata, and Trichoptera. However, during fall flood-up of seasonal wetlands and peak mosquito populations, ducks tend to feed on seed and other plant material. Waterfowl in general tend to feed on seeds when they reach their wintering areas, perhaps to regain energy lost during long flights (Heitmeyer 1988; Miller 1987). Thus any food chain impacts resulting from larvicide and adulticide treatment would have limited impacts to the mainly seed diet of newly arriving ducks. Their diets shift to invertebrates before treatments are expected to temporarily, but substantially reduce available invertebrate food resources. Furthermore, mosquito treatments in the spring are not expected to result in limited invertebrate food resources because of the limited frequency and area of treatment in the spring.

F.5.5 Other Migratory Birds

Shorebirds, egrets, herons, as well as some gull and tern species feed in seasonal wetlands near the SCH ponds. Shorebirds feed on a wide variety of invertebrates all year, feeding which intensifies at the onset of spring migration. Field studies indicated no acute toxicity to several fish species exposed to *Bti* (Merritt et al. 1989; Jackson et al. 2002); no detectable adverse effects to breeding redwing blackbirds using and nesting in *Bti*-treated areas (Niemi et al. 1999; Hanowski 1997); and no detectable adverse effects on tadpole shrimp 48 hours post *Bti* treatment (Dritz et al. 2001). Therefore risks to other sensitive wildlife resources resulting from direct exposure to a single larvicide application are expected to be negligible.

Risk to shorebirds, egrets, herons, gulls and terns resulting from direct exposure to pyrethrins at rates used for mosquito control is expected to be negligible. Adulticide treatments are not anticipated to result in limited invertebrate food resources because of the limited area of treatment.

F.5.6 Other Wildlife

In an extensive literature review on the effects of *Bti* on mammals, Siegel and Shadduck (1990) found the bacterium innocuous. A variety of mammals were exposed to *Bti* at moderate to high doses and observed no pathological symptoms, disease or mortality. Continued use of *Bti* and *B. sphaericus* at moderate control rates are likely to have a negligible effect on mammal species on the refuge. Pyrethrin is also likely to have a negligible effect on mammals.

The actual toxicity of *Bacillus* and/or pyrethrin to amphibians and reptiles subject to direct treatment is less clear. In general, however, actual toxicity of *Bacillus* and pyrethrin to nontarget amphibians or reptiles is expected to be minimal. The target specificity of *B. sphaericus* and *Bti* for only mosquitoes should prove harmless to amphibians and reptiles and to their food supply.

Fish are not susceptible to toxic effects of *Bti* or *B. sphaericus*. Fish can be severely affected by pyrethrins when subjected to direct application. The little amount of pyrethrin that makes contact on the aquatic substrate would be immediately diluted to insignificant amounts. Also, adsorption by abundant organic matter in the target wetland would likely occur, reducing the potential for negative impacts to mosquitofish and other fish. Jensen et al. (1999) detected no mortality to mosquitofish from pyrethrin applications to seasonal wetlands on Sacramento NWR Complex.

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APPENDIX G

Air Quality/Greenhouse Gases Documentation

APPENDIX G-1

Imperial County Air Pollution Control District, Regulation VIII, Fugitive Dust Control Measures

REGULATION VIII - FUGITIVE DUST CONTROL MEASURES (Most recently adopted) – All construction sites, regardless of size, must comply with the requirements contained within Regulation VIII. Although compliance with Regulation VIII does not constitute mitigation under the reductions attributed to environmental impacts its main purpose is to reduce the amount of PM_{10} entrained into the atmosphere as a result of anthropogenic (man-made) fugitive dust sources. Therefore, under all preliminary modeling a presumption is made that all projects are in compliance with Regulation VIII.

Standard Mitigation Measures for Fugitive PM_{10} Control

a. All disturbed areas, including Bulk Material storage which is not being actively utilized, shall be effectively stabilized and visible emissions shall be limited to no greater than 20% opacity for dust emissions by using water, chemical stabilizers, dust suppressants, tarps or other suitable material such as vegetative ground cover.

b. All on site and off site unpaved roads will be effectively stabilized and visible emissions shall be limited to no greater than 20% opacity for dust emissions by paving, chemical stabilizers, dust suppressants and/or watering.

c. All unpaved traffic areas one (1) acre or more with 75 or more average vehicle trips per day will be effectively stabilized and visible emission shall be limited to no greater than 20% opacity for dust emissions by paving, chemical stabilizers, dust suppressants and/or watering.

d. The transport of Bulk Materials shall be completely covered unless six inches of freeboard space from the top of the container is maintained with no spillage and loss of Bulk Material. In addition, the cargo compartment of all Haul Trucks is to be cleaned and/or washed at delivery site after removal of Bulk Material.

e. All Track-Out or Carry-Out will be cleaned at the end of each workday or immediately when mud or dirt extends a cumulative distance of 50 linear feet or more onto a paved road within an Urban area.

f. Movement of Bulk Material handling or transfer shall be stabilized prior to handling or at points of transfer with application of sufficient water, chemical stabilizers or by sheltering or enclosing the operation and transfer line.

g. The construction of any new Unpaved Road is prohibited within any area with a population of 500 or more unless the road meets the definition of a Temporary Unpaved Road. Any temporary unpaved road shall be effectively stabilized and visible emissions shall be limited to no greater than 20% opacity for dust emission by paving, chemical stabilizers, dust suppressants and/or watering.

In order to provide a greater degree of PM_{10} reductions, above that required by Regulation VIII, the ICAPCD recommends the following:

Discretionary Mitigation Measures for Fugitive PM_{10} Control

a. Water exposed soil with adequate frequency for continued moist soil.

b. Replace ground cover in disturbed areas as quickly as possible

c. Automatic sprinkler system installed on all soil piles

d. Vehicle speed for all construction vehicles shall not exceed 15 mph on any unpaved surface at the construction site.

e. Develop a trip reduction plan to achieve a 1.5 AVR for construction employees

f. Implement a shuttle service to and from retail services and food establishments during lunch hours

Although the preceding discussion of construction impacts and mitigation measures are primarily focused on PM_{10} emissions from fugitive dust sources, Lead Agencies should also seek to reduce emissions from construction equipment exhaust. Because of the availability of new control devices, required in the manufacturing of PM oxidation catalysts and NOx absorbers, substantial reductions in PM and NOx emissions from diesel engines is achievable. These new retrofit kits and in some cases new original equipment require the use of ultra low sulfur diesel in order to be effective.

Standard Mitigation Measures for Construction Combustion Equipment

a. Use of alternative fueled or catalyst equipped diesel construction equipment, including all off-road and portable diesel powered equipment.

b. Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to 5 minutes as a maximum.

c. Limit, to the extent feasible, the hours of operation of heavy duty equipment and/or the amount of equipment in use

d. Replace fossil fueled equipment with electrically driven equivalents (provided they are not run via a portable generator set)

To help provide a greater degree of reduction of PM emissions from construction combustion equipment the ICAPCD recommends the following enhanced measures.

<u>Enhanced Mitigation Measures for Construction Equipment</u>

a. Curtail construction during periods of high ambient pollutant concentrations; this may include ceasing of construction activity during the peak hour of vehicular traffic on adjacent roadways

b. Implement activity management (e.g. rescheduling activities to reduce short-term impacts)

7.2 Standard Mitigation Measures for Project Operations

These standard air quality mitigation measures have been separated according to land use and mitigation type.

According to Table 1, Tier I, projects generating less than 55 lbs/day of NOx or ROG; less than 150 lbs/day of PM_{10} or SOX; or less than 550 lbs/day of CO than 55 lbs/day, the Initial Study should require implementation of all the Standard Mitigation Measures in order to help mitigate or reduce the air quality impact to a level of insignificance. However, simple implementation of the mitigation measures does not guarantee that the project will be insignificant. The insignificance must be determined by the results of the Initial Study.

According to Table 1, Tier II, projects generating **55 lbs/day or greater of NOx or ROG; 150 lbs/day or greater of PM_{10} or SOX; or 550 lbs/day or greater of CO, the EIR** ***or Comprehensive Air Quality Analysis Report should select and implement all feasible and practicable measures from the discretionary list, in addition to the Standard Mitigation Measures.***

<u>RESIDENTIAL PROJECTS</u>

Standard mitigation measures for residential projects include the following site design and energy efficiency standards:

<u>Standard Site Design Measures</u>

a. Link cul-de-sacs and dead-end streets to encourage pedestrian and bicycle travel;

b. Allocate easements or land dedications for bikeways and pedestrian walkways;

c. Provide continuous sidewalks separated from the roadway by landscaping and on-street parking. Adequate lighting for sidewalks must be provided, along with crosswalks at intersections;

d. Bicycle storage at apartment complexes or condos without garages.

Standard Energy Efficiency Measures

a. Measures which meet mandatory, prescriptive and/or performance measures as required by Title 24.

COMMERCIAL PROJECTS

Standard mitigation measures for commercial projects include the following site design and energy efficiency standards:

Standard Site Design Measures

a. Provide on-site bicycle lockers and/or racks;

b. Provide on-site eating, refrigeration and food vending facilities to reduce lunchtime trips;

c. Provide shower and locker facilities to encourage employees to bike and/or walk to work;

d. Provide for paving a minimum of 100 feet from the property line for commercial driveways that access County paved roads as per County Standard Commercial Driveway Detail 410B (formerly SW-131A).

Standard Energy Efficiency Measures

a. Measures which meet mandatory, prescriptive and/or performance measures as required by Title 24.

7.3 Discretionary Mitigation Measures

The discretionary mitigation measures listed in this section have been separated according to land use and mitigation type. It is important to note that the measures identified here do not represent a comprehensive list of all mitigation measures possible. Project proponents are encouraged to propose other alternatives that are capable of providing the same level of mitigation.

RESIDENTIAL PROJECTS

Discretionary Site Design Measures

a. If the project is located on an established transit route, improve public transit accessibility by providing transit turnouts with direct pedestrian access to project.

b. For bus service within a ¼ mile of the project provide bus stop improvements such as shelters, route information, benches and lighting.

c. Increase street tree planting.

d. Outdoor electrical outlets to encourage the use of electric appliances and tools.

e. Provide bikeway lanes and/or link new comparable bikeway lanes to already existing lanes.

f. Increase the number of bicycle routes/lanes.

g. Provide pedestrian signalization and signage to improve pedestrian safety.

h. Synchronize traffic lights on streets impacted by development

Discretionary Energy Efficiency Measures

a. Use roof material with a solar reflectance value meeting the EPA/DEO Energy Star® rating to reduce summer cooling needs.

b. Use high efficiency gas or solar water heaters.

c. Use built-in energy efficient appliances.

d. Use double-paned windows.

e. Use low energy street lighting (i.e. sodium).

f. Use energy efficient interior lighting.

g. Use low energy traffic signals (i.e. light emitting diode).

h. Install door sweeps and weather stripping if more efficient doors and windows are not available.

COMMERCIAL PROJECTS

Discretionary Site Design Measures

a. Increase street tree planting

b. Shade tree planting in parking lots to reduce evaporative emissions from parked vehicles.

c. Increase number of bicycle routes/lanes.

d. If the project is located on an established transit route, improve public transit accessibility by providing transit turnouts with direct pedestrian access to protect or improve transit stop amenities.

e. For bus service within a ¼ mile of the project provide bus stop improvements such as shelters, route information, benches and lighting

f. Implement on-site circulation design elements in parking lots to reduce vehicle queuing and improve the pedestrian environment.

g. Provide pedestrian signalization and signage to improve pedestrian safety.

h. Synchronize traffic lights on streets impacted by development

Discretionary Energy Efficiency Measures

a. Use roof material with a solar reflectance value meeting the EPA/DOE Energy Star® rating to reduce summer cooling needs.

b. Use built-in energy efficient appliances, where applicable.

c. Use double-paned windows.

d. Use low energy parking lot and street lights (i.e. sodium).

e. Use energy efficient interior lighting.

f. Use low energy traffic signals (i.e. light emitting diode).

g. Install door sweeps and weather stripping if more efficient doors and windows are not available.

h. Install high efficiency gas/electric space heating.

INDUSTRIAL PROJECTS

a. Implement carpool/vanpool programs and incentives (i.e. carpool ride matching for employees, assistance with vanpool formation, provision of vanpool vehicles, etc.)

b. Provide for shuttle/mini bus service such as to establish a shuttle service from residential care areas to the worksite.

c. Provide preferential carpool and vanpool parking

d. Construct transit facilities such as bus turnouts/bus bulbs, benches, shelters, etc if the project is located on an established transit route.

e. Design and locate buildings to facilitate transit access (i.e., locate building entrances near transit stops, eliminate building setbacks, etc.)

f. Provide incentives to employees to take public transportation, walk, bike, etc.

g. Provide pedestrian signalization and signage to improve pedestrian safety.

h. Implement on-site circulation design elements in parking lots to reduce vehicle queing and improve the pedestrian environment.

i. Provide on-site bicycle and motorcycle parking. Such as providing weather-protected bicycle parking for employees.

j. Provide safe, direct access for bicyclists to adjacent bicycle routes.

k. Provide shower and locker facilities to encourage employees to bike and/or walk to work – typically, one shower and three lockers for every 25 employees.

l. Provide on-site eating, refrigeration and food vending facilities to reduce lunchtime trips.

m. Increase street tree planting

n. Measures which meet mandatory, prescriptive and/or performance measures as required by Title 24.

o. Use low emission fleet vehicles such as TLEV, ULEV, LEV, ZEV

p. Install an electrical vehicle charging station with both conductive and inductive charging capabilities.

q. Use built-in energy efficient appliances, where applicable.

r. Use double-paned windows

s. Use low energy parking lot and street lights

t. Use energy efficient interior lighting

7.4 Off-site Mitigation

Off-site mitigation for Commercial and Residential Developments:

Off-site mitigation measures are designed to offset emissions from residential and commercial projects that cannot be fully mitigated with on-site measures. Typically, off-site reductions can occur as a result from either stationary or mobile sources. For example, NOx emissions from increased vehicle trips from a residential development could be reduced by funding the expansion of existing transit services. Rule 310, Operational Development Schedule Fee has been adopted by the ICAPCD as a sound method for mitigating the emissions produced from the operations of new development projects throughout the County of Imperial. All project proponents have the option of either providing off-site mitigation or paying an Operational Development Fee. The evaluation process in providing this fee is found within the applicability and administrative requirements of Rule 310

Off-site mitigation for Industrial Projects:

Because industrial development projects are by their very nature much more complex, the evaluation of the air impacts resulting from an industrial development is addressed at two levels: that of the environmental review process and that of the ICAPCD permitting review process. The ICAPCD permitting review process addresses mitigation of air emissions from the Stationary source. Therefore, the ICAPCD has adopted the guidance policy #5 to help Lead Agencies and interested parties in the evaluation of off-site mitigation from mobile sources attracted to the stationary sources.

APPENDIX G-2

Air Quality/Greenhouse Gas Emissions Calculations

Apdx G - Emissions Summary
Tables G-1 & G-2

Table G-1 Estimated Construction Energy Consumption for Proposed Project (mitigated)

Onroad Vehicle Type	Project Alternative					
	1	2	3	4	5	6
	gallons	gallons	gallons	gallons	gallons	gallons
California Ultra-Low Sulfur Diesel Fuel	562,000	465,000	644,000	329,000	296,000	384,000

Source: USEPA 2011 (1996)

Note:

Values shown rounded to nearest 1,000 gallons

Table G-2 Estimated Construction Trip Counts for Proposed Project (mitigated)

Onroad Vehicle Type	Project Alternative					
	1	2	3	4	5	6
	trips	trips	trips	trips	trips	trips
Tractor Trailer (heavy heavy duty) - Local	6,450	5,520	7,920	2,100	2,000	2,160
Tractor Trailer (heavy heavy duty) - Import	190	130	150	160	100	130
Water Truck (medium duty)	470	470	470	470	470	470
Pickup/SUV (light duty)	6,540	5,340	7,740	4,140	3,740	4,940

Source: Applicant

Notes:

For Tractor Trailer, local is construction-related trips

For Tractor Trailer, import is bringing in equipment from other areas in state (SD, LA, SF, SAC)

Applicant real number data converted to up-rounded integer values to avoid undercounts

Trip count values shown rounded to nearest 10 to reflect approximate nature of estimates

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Table G-3 Estimated Equipment and Vehicle Schedule for Proposed Project Alternatives

Phase or Activity	Equipment and Vehicles			Two-Year Construction Schedule					Annual Maintenance Schedule				
	Type	Category	BHP	quantity	days	hrs/day	trips/day	mi/trip	quantity	days/yr	hrs/day	trips/day	mi/trip
ALTERNATIVE 1 - New River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		50	43		3	50	1	37		2	50
Import equipment from other areas	Tractor Trailer	onroad HHD		17	11		1	280					
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	3	325	8			1	28	8		
Low ground pressure haulers	Dump Truck	offroad	300	12	261	8			1	18	8		
Tracked excavator	Excavator	offroad	200	3	375	8			1	35	8		
Low ground pressure dozer	Dozer	offroad	125	2	233	8			1	5	8		
Small motor grader	Grader	offroad	140	1	25	8			1	25	8		
Barge with crane and clamshell bucket	Crane	offroad	500	3	265	8							
Hydraulic Dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	1	91	20							
Truck with crane for installed pilings	Crane Rig	offroad	350	1	20	8							
Medium backhoe loader	Backhoe	offroad	100	1	200	8			1	24	8		
Agricultural tractor with mower	Tractor	offroad	175						1	3	8		
Fugitive dust control	Water Truck	onroad HHD		1	470		1	10	1	25		1	10
Manager	Pickup/SUV	onroad LD		2	470		0.50	65	1	235		1	65
Foreman	Pickup/SUV	onroad LD		3	470		0.33	65					
Equipment Operator	Pickup/SUV	onroad LD		36	400		0.33	65	1	235		1	65
Laborers	Pickup/SUV	onroad LD		6	400		0.33	65					
ALTERNATIVE 2 - New River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		40	46		3	50	1	34	8	2	50
Import equipment from other areas	Tractor Trailer	onroad HHD		11	12		1	280					
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	3	264	8			1	27	8		
Low ground pressure haulers	Dump Truck	offroad	300	10	265	8			1	19	8		
Tracked excavator	Excavator	offroad	200	3	291	8			1	38	8		
Low ground pressure dozer	Dozer	offroad	125	2	163	8			1	6	8		
Small motor grader	Grader	offroad	140	1	28	8			1	25	8		
Barge with crane and clamshell bucket	Crane	offroad	500	2	269	8							
Hydraulic Dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	1	91	20							
Truck with crane for installed pilings	Crane Rig	offroad	350	1	21	8							
Medium backhoe loader	Backhoe	offroad	100	1	235	8			1	11	8		
Agricultural tractor with mower	Tractor	offroad	175						1	3	8		
Fugitive dust control	Water Truck	onroad HHD		1	470		1	10	1	25		1	10
Manager	Pickup/SUV	onroad LD		2	470		0.50	65	1	235		1	65
Foreman	Pickup/SUV	onroad LD		2	470		0.50	65					
Equipment Operator	Pickup/SUV	onroad LD		27	400		0.33	65	1	235		1	65
Laborers	Pickup/SUV	onroad LD		6	400		0.33	65					
ALTERNATIVE 3 - New River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		60	44		3	50	1	45	8	2	50
Import equipment from other areas	Tractor Trailer	onroad HHD		14	11		1	280					
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	4	265	8			1	28	8		
Low ground pressure haulers	Dump Truck	offroad	300	14	267	8			1	19	8		
Tracked excavator	Excavator	offroad	200	4	291	8			1	44	8		
Low ground pressure dozer	Dozer	offroad	125	3	146	8			1	6	8		
Small motor grader	Grader	offroad	140	1	34	8			1	25	8		
Barge with crane and clamshell bucket	Crane	offroad	500	4	264	8							
Hydraulic Dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	1	91	20							
Truck with crane for installed pilings	Crane Rig	offroad	350	1	21	8							
Medium backhoe loader	Backhoe	offroad	100	1	200	8			1	28	8		
Agricultural tractor with mower	Tractor	offroad	175						1	3	8		
Fugitive dust control	Water Truck	onroad HHD		1	470		1	10	1	25		1	10
Manager	Pickup/SUV	onroad LD		2	470		0.50	65	1	235		1	65
Foreman	Pickup/SUV	onroad LD		3	470		0.33	65					
Equipment Operator	Pickup/SUV	onroad LD		45	400		0.33	65	1	235		1	65
Laborers	Pickup/SUV	onroad LD		6	400		0.33	65					
ALTERNATIVE 4 - Alamo River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		20	35		3	50	1	20	8	2	50
Import equipment from other areas	Tractor Trailer	onroad HHD		18	9		1	280					
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	2	307	8			1	26	8		
Low ground pressure haulers	Dump Truck	offroad	300	7	260	8			1	18	8		
Tracked excavator	Excavator	offroad	200	2	309	8			1	26	8		
Low ground pressure dozer	Dozer	offroad	125	2	156	8			1	5	8		
Small motor grader	Grader	offroad	140	1	14	8			1	25	8		
Barge with crane and clamshell bucket	Crane	offroad	500	1	296	8							

Hydraulic Dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	1	91	20							
Truck with crane for installed pilings	Crane Rig	offroad	350	1	21	8							
Medium backhoe loader	Backhoe	offroad	100	1	200	8			1	6	8		
Agricultural tractor with mower	Tractor	offroad	175						1	3	8		
Fugitive dust control	Water Truck	onroad HHD		1	470		1	10	1	25		1	10
Manager	Pickup/SUV	onroad LD		2	470		0.50	65	1	235		1	65
Foreman	Pickup/SUV	onroad LD		2	470		0.50	65					
Equipment Operator	Pickup/SUV	onroad LD		18	400		0.33	65	1	235		1	65
Laborers	Pickup/SUV	onroad LD		6	400		0.33	65					
ALTERNATIVE 5 - Alamo River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		18	37		3	50	1	20	8	2	50
Import equipment from other areas	Tractor Trailer	onroad HHD		10	10		1	280					
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	2	258	8			1	26	8		
Low ground pressure haulers	Dump Truck	offroad	300	7	250	8			1	18	8		
Tracked excavator	Excavator	offroad	200	2	220	8			1	27	8		
Low ground pressure dozer	Dozer	offroad	125	2	102	8			1	5	8		
Small motor grader	Grader	offroad	140	1	19	8			1	25	8		
Barge with crane and clamshell bucket	Crane	offroad	500	1	253	8							
Hydraulic Dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	1	91	20							
Truck with crane for installed pilings	Crane Rig	offroad	350	1	21	8							
Medium backhoe loader	Backhoe	offroad	100	1	200	8			1	7	8		
Agricultural tractor with mower	Tractor	offroad	175						1	3	8		
Fugitive dust control	Water Truck	onroad HHD		1	470		1	10	1	25		1	10
Manager	Pickup/SUV	onroad LD		2	470		0.50	65	1	235		1	65
Foreman	Pickup/SUV	onroad LD		2	470		0.50	65					
Equipment Operator	Pickup/SUV	onroad LD		15	400		0.33	65	1	235		1	65
Laborers	Pickup/SUV	onroad LD		6	400		0.33	65					
ALTERNATIVE 6 - Alamo River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		24	30		3	50	1	26	8	2	50
Import equipment from other areas	Tractor Trailer	onroad HHD		16	8		1	280					
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	3	222	8			1	27	8		
Low ground pressure haulers	Dump Truck	offroad	300	10	239	8			1	18	8		
Tracked excavator	Excavator	offroad	200	2	284	8			1	29	8		
Low ground pressure dozer	Dozer	offroad	125	2	133	8			1	5	8		
Small motor grader	Grader	offroad	140	1	22	8			1	25	8		
Barge with crane and clamshell bucket	Crane	offroad	500	2	249	8							
Hydraulic Dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	1	91	20							
Truck with crane for installed pilings	Crane Rig	offroad	350	1	21	8							
Medium backhoe loader	Backhoe	offroad	100	1	200	8			1	13	8		
Agricultural tractor with mower	Tractor	offroad	175						1	3	8		
Fugitive dust control	Water Truck	onroad HHD		1	470		1	10	1	25		1	10
Manager	Pickup/SUV	onroad LD		2	470		0.50	65	1	235		1	65
Foreman	Pickup/SUV	onroad LD		2	470		0.50	65					
Equipment Operator	Pickup/SUV	onroad LD		24	400		0.33	65	1	235		1	65
Laborers	Pickup/SUV	onroad LD		6	400		0.33	65					

Source: Applicant

Notes:

LD = light duty, MD = medium duty, HHD = heavy heavy duty, BHP = brake horsepower

Overall project life expected to be 2 years, 47 weeks/year average to account for holidays, vacations, weather, illness, etc.

For 235 work days in a year, managers and foremen commute 2 or 3 per vehicle, all other workers commute 3 per vehicle, 65 miles per round trip average (New River or Alamo River).

Short Trip: Hauling gravel and riprap rock into the project site from nearby quarries; assume 50 miles per round trip.

Long Trip: Hauling construction equipment and facility materials to the project site from major distribution centers, such as San Diego; assume 280 miles round trip.

Daily equipment operating hours assume typical average utilization over the life of the project to allow for staging, breaks, lunch, maintenance, repairs, etc.

Table G-4 Estimated Equipment and Vehicle Activity for Proposed Project Alternatives													
Phase or Activity	Equipment and Vehicles			Const. Daily		Const. Total		Maint. Daily		Maint. Total		Total Trip Counts	
	Type	Category	BHP	hrs	VMT	hrs	VMT	hrs	VMT	hrs	VMT	Const.	Maint.
ALTERNATIVE 1 - New River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD			7,500		322,500		100		3,700	6,450	74
Import equipment from other areas	Tractor Trailer	onroad HHD			4,760		52,360		-		-	187	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	24		7,800		8		224			
Low ground pressure haulers	Dump Truck	offroad	300	96		25,056		8		144			
Tracked excavator	Excavator	offroad	200	24		9,000		8		280			
Low ground pressure dozer	Dozer	offroad	125	16		3,728		8		40			
Small motor grader	Grader	offroad	140	8		200		8		200			
Barge with crane and clamshell bucket	Crane	offroad	500	24		6,360		-		-			
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	20		1,820		-		-			
Truck with crane for installed pilings	Crane Rig	offroad	350	8		160		-		-			
Medium backhoe loader	Backhoe	offroad	100	8		1,600		8		192			
Agricultural tractor with mower	Tractor	offroad	175	-		-		8		24			
Fugitive dust control	Water Truck	onroad HHD			10		4,700		10		250	470	25
Manager	Pickup/SUV	onroad LD			65		30,550		65		15,275	470	235
Foreman	Pickup/SUV	onroad LD			65		30,550		-		-	470	-
Equipment Operator	Pickup/SUV	onroad LD			780		312,000		65		15,275	4,800	235
Laborers	Pickup/SUV	onroad LD			130		52,000		-		-	800	-
ALTERNATIVE 2 - New River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD			6,000		276,000		100		3,400	5,520	68
Import equipment from other areas	Tractor Trailer	onroad HHD			3,080		36,960		-		-	132	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	24		6,336		8		216			
Low ground pressure haulers	Dump Truck	offroad	300	80		21,200		8		152			
Tracked excavator	Excavator	offroad	200	24		6,984		8		304			
Low ground pressure dozer	Dozer	offroad	125	16		2,608		8		48			
Small motor grader	Grader	offroad	140	8		224		8		200			
Barge with crane and clamshell bucket	Crane	offroad	500	16		4,304		-		-			
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	20		1,820		-		-			
Truck with crane for installed pilings	Crane Rig	offroad	350	8		168		-		-			
Medium backhoe loader	Backhoe	offroad	100	8		1,880		8		88			
Agricultural tractor with mower	Tractor	offroad	175	-		-		8		24			
Fugitive dust control	Water Truck	onroad HHD			10		4,700		10		250	470	25
Manager	Pickup/SUV	onroad LD			65		30,550		65		15,275	470	235
Foreman	Pickup/SUV	onroad LD			65		30,550		-		-	470	-
Equipment Operator	Pickup/SUV	onroad LD			585		234,000		65		15,275	3,600	235
Laborers	Pickup/SUV	onroad LD			130		52,000		-		-	800	-
ALTERNATIVE 3 - New River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD			9,000		396,000	72	100		4,500	7,920	72
Import equipment from other areas	Tractor Trailer	onroad HHD			3,920		43,120		-		-	154	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	32		8,480		8		224			
Low ground pressure haulers	Dump Truck	offroad	300	112		29,904		8		152			

Tracked excavator	Excavator	offroad	200	32		9,312		8		352			
Low ground pressure dozer	Dozer	offroad	125	24		3,504		8		48			
Small motor grader	Grader	offroad	140	8		272		8		200			
Barge with crane and clamshell bucket	Crane	offroad	500	32		8,448		-		-			
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	20		1,820		-		-			
Truck with crane for installed pilings	Crane Rig	offroad	350	8		168		-		-			
Medium backhoe loader	Backhoe	offroad	100	8		1,600		8		224			
Agricultural tractor with mower	Tractor	offroad	175	-		-		8		24			
Fugitive dust control	Water Truck	onroad HHD			10		4,700		10		250	470	25
Manager	Pickup/SUV	onroad LD			65		30,550		65		15,275	470	235
Foreman	Pickup/SUV	onroad LD			65		30,550		-		-	470	-
Equipment Operator	Pickup/SUV	onroad LD			975		390,000		65		15,275	6,000	235
Laborers	Pickup/SUV	onroad LD			130		52,000		-		-	800	-
ALTERNATIVE 4 - Alamo River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD			3,000		105,000		100		2,000	2,100	40
Import equipment from other areas	Tractor Trailer	onroad HHD			5,040		45,360		-		-	162	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	16		4,912		8		208			
Low ground pressure haulers	Dump Truck	offroad	300	56		14,560		8		144			
Tracked excavator	Excavator	offroad	200	16		4,944		8		208			
Low ground pressure dozer	Dozer	offroad	125	16		2,496		8		40			
Small motor grader	Grader	offroad	140	8		112		8		200			
Barge with crane and clamshell bucket	Crane	offroad	500	8		2,368		-		-			
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	20		1,820		-		-			
Truck with crane for installed pilings	Crane Rig	offroad	350	8		168		-		-			
Medium backhoe loader	Backhoe	offroad	100	8		1,600		8		48			
Agricultural tractor with mower	Tractor	offroad	175	-		-		8		24			
Fugitive dust control	Water Truck	onroad HHD			10		4,700		10		250	470	25
Manager	Pickup/SUV	onroad LD			65		30,550		65		15,275	470	235
Foreman	Pickup/SUV	onroad LD			65		30,550		-		-	470	-
Equipment Operator	Pickup/SUV	onroad LD			390		156,000		65		15,275	2,400	235
Laborers	Pickup/SUV	onroad LD			130		52,000		-		-	800	-
ALTERNATIVE 5 - Alamo River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD			2,700		99,900	98	100		2,000	1,998	98
Import equipment from other areas	Tractor Trailer	onroad HHD			2,800		28,000		-		-	100	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	16		4,128		8		208			
Low ground pressure haulers	Dump Truck	offroad	300	56		14,000		8		144			
Tracked excavator	Excavator	offroad	200	16		3,520		8		216			
Low ground pressure dozer	Dozer	offroad	125	16		1,632		8		40			
Small motor grader	Grader	offroad	140	8		152		8		200			
Barge with crane and clamshell bucket	Crane	offroad	500	8		2,024		-		-			
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	20		1,820		-		-			
Truck with crane for installed pilings	Crane Rig	offroad	350	8		168		-		-			
Medium backhoe loader	Backhoe	offroad	100	8		1,600		8		56			
Agricultural tractor with mower	Tractor	offroad	175	-		-		8		24			

Fugitive dust control	Water Truck	onroad HHD			10		4,700		10		250	470	10
Manager	Pickup/SUV	onroad LD			65		30,550		65		15,275	470	64
Foreman	Pickup/SUV	onroad LD			65		30,550		-		-	470	-
Equipment Operator	Pickup/SUV	onroad LD			325		130,000		65		15,275	2,000	64
Laborers	Pickup/SUV	onroad LD			130		52,000		-		-	800	-
ALTERNATIVE 6 - Alamo River													
Haul equipment and materials to site	Tractor Trailer	onroad HHD			3,600		108,000	98	100		2,600	2,160	98
Import equipment from other areas	Tractor Trailer	onroad HHD			4,480		35,840		-		-	128	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	24		5,328		8		216			
Low ground pressure haulers	Dump Truck	offroad	300	80		19,120		8		144			
Tracked excavator	Excavator	offroad	200	16		4,544		8		232			
Low ground pressure dozer	Dozer	offroad	125	16		2,128		8		40			
Small motor grader	Grader	offroad	140	8		176		8		200			
Barge with crane and clamshell bucket	Crane	offroad	500	16		3,984		-		-			
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	20		1,820		-		-			
Truck with crane for installed pilings	Crane Rig	offroad	350	8		168		-		-			
Medium backhoe loader	Backhoe	offroad	100	8		1,600		8		104			
Agricultural tractor with mower	Tractor	offroad	175	-		-		8		24			
Fugitive dust control	Water Truck	onroad HHD			10		4,700		10		250	470	10
Manager	Pickup/SUV	onroad LD			65		30,550		65		15,275	470	64
Foreman	Pickup/SUV	onroad LD			65		30,550		-		-	470	-
Equipment Operator	Pickup/SUV	onroad LD			520		208,000		65		15,275	3,200	64
Laborers	Pickup/SUV	onroad LD			130		52,000		-		-	800	-
Trip Count Totals													
ALTERNATIVE 1	Tractor Trailer (loc)	onroad HHD										6,450	74
	Tractor Trailer (imp)	onroad HHD										187	-
	Water Truck	onroad HHD										470	25
	Pickup/SUV	onroad LD										6,540	470
ALTERNATIVE 2	Tractor Trailer (loc)	onroad HHD										5,520	68
	Tractor Trailer (imp)	onroad HHD										132	-
	Water Truck	onroad HHD										470	25
	Pickup/SUV	onroad LD										5,340	470
ALTERNATIVE 3	Tractor Trailer (loc)	onroad HHD										7,920	72
	Tractor Trailer (imp)	onroad HHD										154	-
	Water Truck	onroad HHD										470	25
	Pickup/SUV	onroad LD										7,740	470
ALTERNATIVE 4	Tractor Trailer (loc)	onroad HHD										2,100	40
	Tractor Trailer (imp)	onroad HHD										162	-
	Water Truck	onroad HHD										470	25
	Pickup/SUV	onroad LD										4,140	470
ALTERNATIVE 5	Tractor Trailer (loc)	onroad HHD										1,998	98
	Tractor Trailer (imp)	onroad HHD										100	-
	Water Truck	onroad HHD										470	10
	Pickup/SUV	onroad LD										3,740	128

ALTERNATIVE 6	Tractor Trailer (loc)	onroad HHD		2,160	98
	Tractor Trailer (imp)	onroad HHD		128	-
	Water Truck	onroad HHD		470	10
	Pickup/SUV	onroad LD		4,940	128

Source: Applicant

Notes:

LD = light duty, MD = medium duty, HHD = heavy heavy duty, BHP = brake horsepower

Overall project life expected to be 2 years, 47 weeks/year average to account for holidays, vacations, weather, illness, etc.

For 235 work days in a year, managers and foremen commute 2 or 3 per vehicle, all other workers commute 3 per vehicle, 65 miles per round trip average (New River or Alamo River).

Short Trip: Hauling gravel and riprap rock into the project site from nearby quarries; assume 50 miles per round trip.

Long Trip: Hauling construction equipment and facility materials to the project site from major distribution centers, such as San Diego; assume 280 miles round trip.

Daily equipment operating hours assume typical average utilization over the life of the project to allow for staging, breaks, lunch, maintenance, repairs, etc.

Apdx G - Factors
Table G-5

Table G-5 Emission Factors for Proposed Project Alternatives													
Phase or Activity	Equipment and Vehicles			VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_20	CO_2 eqv
	Type	Category	BHP	lbs/unit	lbs/unit	lbs/unit	lbs/unit	lbs/unit	lbs/unit	lbs/unit	lbs/unit	lbs/unit	lbs/unit
ALTERNATIVE 1													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Import equipment from other areas	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	0.28128	0.98313	2.51652	0.00284	0.09758	0.08977	276.64526	0.02538	0.01128	280.67495
Low ground pressure haulers	Dump Truck	offroad	300	0.15537	0.43417	1.34715	0.00203	0.04566	0.04201	187.70309	0.01402	0.00623	189.92895
Tracked excavator	Excavator	offroad	200	0.12195	0.56261	0.97411	0.00144	0.04656	0.04284	127.70865	0.01100	0.00489	129.45575
Low ground pressure dozer	Dozer	offroad	125	0.13278	0.50931	0.81266	0.00083	0.06805	0.06261	70.84486	0.01198	0.00532	72.74703
Small motor grader	Grader	offroad	140	0.13313	0.60498	0.89885	0.00107	0.06596	0.06068	92.76728	0.01201	0.00534	94.67452
Barge with crane and clamshell bucket	Crane	offroad	500	0.15509	0.52921	1.42304	0.00177	0.05183	0.04769	180.10128	0.01399	0.00622	182.32308
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	0.52457	1.67930	6.00668	0.00563	0.18046	0.16602	559.60311	0.04733	0.02104	567.11825
Truck with crane for installed pilings	Crane Rig	offroad	350	0.12445	0.38855	1.16607	0.00146	0.04179	0.03845	139.33583	0.01123	0.00499	141.11880
Medium backhoe loader	Backhoe	offroad	100	0.07512	0.34343	0.40872	0.00055	0.03416	0.03143	45.61918	0.00678	0.00301	46.69540
Agricultural tractor with mower	Tractor	offroad	175	0.20452	0.83349	1.53367	0.00147	0.08711	0.08014	130.41728	0.01845	0.00820	133.34733
Fugitive dust control	Water Truck	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Manager	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Foreman	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Equipment Operator	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Laborers	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
ALTERNATIVE 2													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Import equipment from other areas	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	0.28128	0.98313	2.51652	0.00284	0.09758	0.08977	276.64526	0.02538	0.01128	280.67495
Low ground pressure haulers	Dump Truck	offroad	300	0.15537	0.43417	1.34715	0.00203	0.04566	0.04201	187.70309	0.01402	0.00623	189.92895
Tracked excavator	Excavator	offroad	200	0.12195	0.56261	0.97411	0.00144	0.04656	0.04284	127.70865	0.01100	0.00489	129.45575
Low ground pressure dozer	Dozer	offroad	125	0.13278	0.50931	0.81266	0.00083	0.06805	0.06261	70.84486	0.01198	0.00532	72.74703
Small motor grader	Grader	offroad	140	0.13313	0.60498	0.89885	0.00107	0.06596	0.06068	92.76728	0.01201	0.00534	94.67452
Barge with crane and clamshell bucket	Crane	offroad	500	0.15509	0.52921	1.42304	0.00177	0.05183	0.04769	180.10128	0.01399	0.00622	182.32308
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	0.52457	1.67930	6.00668	0.00563	0.18046	0.16602	559.60311	0.04733	0.02104	567.11825
Truck with crane for installed pilings	Crane Rig	offroad	350	0.12445	0.38855	1.16607	0.00146	0.04179	0.03845	139.33583	0.01123	0.00499	141.11880
Medium backhoe loader	Backhoe	offroad	100	0.07512	0.34343	0.40872	0.00055	0.03416	0.03143	45.61918	0.00678	0.00301	46.69540
Agricultural tractor with mower	Tractor	offroad	175	0.20452	0.83349	1.53367	0.00147	0.08711	0.08014	130.41728	0.01845	0.00820	133.34733
Fugitive dust control	Water Truck	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Manager	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Foreman	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Equipment Operator	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Laborers	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
ALTERNATIVE 3													

Haul equipment and materials to site	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Import equipment from other areas	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	0.28128	0.98313	2.51652	0.00284	0.09758	0.08977	276.64526	0.02538	0.01128	280.67495
Low ground pressure haulers	Dump Truck	offroad	300	0.15537	0.43417	1.34715	0.00203	0.04566	0.04201	187.70309	0.01402	0.00623	189.92895
Tracked excavator	Excavator	offroad	200	0.12195	0.56261	0.97411	0.00144	0.04656	0.04284	127.70865	0.01100	0.00489	129.45575
Low ground pressure dozer	Dozer	offroad	125	0.13278	0.50931	0.81266	0.00083	0.06805	0.06261	70.84486	0.01198	0.00532	72.74703
Small motor grader	Grader	offroad	140	0.13313	0.60498	0.89885	0.00107	0.06596	0.06068	92.76728	0.01201	0.00534	94.67452
Barge with crane and clamshell bucket	Crane	offroad	500	0.15509	0.52921	1.42304	0.00177	0.05183	0.04769	180.10128	0.01399	0.00622	182.32308
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	0.52457	1.67930	6.00668	0.00563	0.18046	0.16602	559.60311	0.04733	0.02104	567.11825
Truck with crane for installed pilings	Crane Rig	offroad	350	0.12445	0.38855	1.16607	0.00146	0.04179	0.03845	139.33583	0.01123	0.00499	141.11880
Medium backhoe loader	Backhoe	offroad	100	0.07512	0.34343	0.40872	0.00055	0.03416	0.03143	45.61918	0.00678	0.00301	46.69540
Agricultural tractor with mower	Tractor	offroad	175	0.20452	0.83349	1.53367	0.00147	0.08711	0.08014	130.41728	0.01845	0.00820	133.34733
Fugitive dust control	Water Truck	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Manager	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Foreman	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Equipment Operator	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Laborers	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
ALTERNATIVE 4													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Import equipment from other areas	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	0.28128	0.98313	2.51652	0.00284	0.09758	0.08977	276.64526	0.02538	0.01128	280.67495
Low ground pressure haulers	Dump Truck	offroad	300	0.15537	0.43417	1.34715	0.00203	0.04566	0.04201	187.70309	0.01402	0.00623	189.92895
Tracked excavator	Excavator	offroad	200	0.12195	0.56261	0.97411	0.00144	0.04656	0.04284	127.70865	0.01100	0.00489	129.45575
Low ground pressure dozer	Dozer	offroad	125	0.13278	0.50931	0.81266	0.00083	0.06805	0.06261	70.84486	0.01198	0.00532	72.74703
Small motor grader	Grader	offroad	140	0.13313	0.60498	0.89885	0.00107	0.06596	0.06068	92.76728	0.01201	0.00534	94.67452
Barge with crane and clamshell bucket	Crane	offroad	500	0.15509	0.52921	1.42304	0.00177	0.05183	0.04769	180.10128	0.01399	0.00622	182.32308
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	0.52457	1.67930	6.00668	0.00563	0.18046	0.16602	559.60311	0.04733	0.02104	567.11825
Truck with crane for installed pilings	Crane Rig	offroad	350	0.12445	0.38855	1.16607	0.00146	0.04179	0.03845	139.33583	0.01123	0.00499	141.11880
Medium backhoe loader	Backhoe	offroad	100	0.07512	0.34343	0.40872	0.00055	0.03416	0.03143	45.61918	0.00678	0.00301	46.69540
Agricultural tractor with mower	Tractor	offroad	175	0.20452	0.83349	1.53367	0.00147	0.08711	0.08014	130.41728	0.01845	0.00820	133.34733
Fugitive dust control	Water Truck	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Manager	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Foreman	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Equipment Operator	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Laborers	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
ALTERNATIVE 5													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Import equipment from other areas	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	0.28128	0.98313	2.51652	0.00284	0.09758	0.08977	276.64526	0.02538	0.01128	280.67495
Low ground pressure haulers	Dump Truck	offroad	300	0.15537	0.43417	1.34715	0.00203	0.04566	0.04201	187.70309	0.01402	0.00623	189.92895

Apdx G - Factors
Table G-5

Tracked excavator	Excavator	offroad	200	0.12195	0.56261	0.97411	0.00144	0.04656	0.04284	127.70865	0.01100	0.00489	129.45575
Low ground pressure dozer	Dozer	offroad	125	0.13278	0.50931	0.81266	0.00083	0.06805	0.06261	70.84486	0.01198	0.00532	72.74703
Small motor grader	Grader	offroad	140	0.13313	0.60498	0.89885	0.00107	0.06596	0.06068	92.76728	0.01201	0.00534	94.67452
Barge with crane and clamshell bucket	Crane	offroad	500	0.15509	0.52921	1.42304	0.00177	0.05183	0.04769	180.10128	0.01399	0.00622	182.32308
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	0.52457	1.67930	6.00668	0.00563	0.18046	0.16602	559.60311	0.04733	0.02104	567.11825
Truck with crane for installed pilings	Crane Rig	offroad	350	0.12445	0.38855	1.16607	0.00146	0.04179	0.03845	139.33583	0.01123	0.00499	141.11880
Medium backhoe loader	Backhoe	offroad	100	0.07512	0.34343	0.40872	0.00055	0.03416	0.03143	45.61918	0.00678	0.00301	46.69540
Agricultural tractor with mower	Tractor	offroad	175	0.20452	0.83349	1.53367	0.00147	0.08711	0.08014	130.41728	0.01845	0.00820	133.34733
Fugitive dust control	Water Truck	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Manager	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Foreman	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Equipment Operator	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Laborers	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
ALTERNATIVE 6													
Haul equipment and materials to site	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Import equipment from other areas	Tractor Trailer	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	400	0.28128	0.98313	2.51652	0.00284	0.09758	0.08977	276.64526	0.02538	0.01128	280.67495
Low ground pressure haulers	Dump Truck	offroad	300	0.15537	0.43417	1.34715	0.00203	0.04566	0.04201	187.70309	0.01402	0.00623	189.92895
Tracked excavator	Excavator	offroad	200	0.12195	0.56261	0.97411	0.00144	0.04656	0.04284	127.70865	0.01100	0.00489	129.45575
Low ground pressure dozer	Dozer	offroad	125	0.13278	0.50931	0.81266	0.00083	0.06805	0.06261	70.84486	0.01198	0.00532	72.74703
Small motor grader	Grader	offroad	140	0.13313	0.60498	0.89885	0.00107	0.06596	0.06068	92.76728	0.01201	0.00534	94.67452
Barge with crane and clamshell bucket	Crane	offroad	500	0.15509	0.52921	1.42304	0.00177	0.05183	0.04769	180.10128	0.01399	0.00622	182.32308
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1000	0.52457	1.67930	6.00668	0.00563	0.18046	0.16602	559.60311	0.04733	0.02104	567.11825
Truck with crane for installed pilings	Crane Rig	offroad	350	0.12445	0.38855	1.16607	0.00146	0.04179	0.03845	139.33583	0.01123	0.00499	141.11880
Medium backhoe loader	Backhoe	offroad	100	0.07512	0.34343	0.40872	0.00055	0.03416	0.03143	45.61918	0.00678	0.00301	46.69540
Agricultural tractor with mower	Tractor	offroad	175	0.20452	0.83349	1.53367	0.00147	0.08711	0.08014	130.41728	0.01845	0.00820	133.34733
Fugitive dust control	Water Truck	onroad HHD		0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784
Manager	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Foreman	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Equipment Operator	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Laborers	Pickup/SUV	onroad LD		0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Sources: SCAQMD 2008; USEPA 2011													

Notes:

SCAQMD emission factors for 2013

Offroad diesel exhaust $PM_{2.5}$ = 92% of PM_{10} per EMFAC 2007 version 2.3

Offroad N_2O per Annex 3, Table A-101

Non-matching application-specific values interpolated or extrapolated

USEPA GWPs for CO_2 eqv (1, 21, 310)

Apdx G - Daily Emissions
Table G-6

Table G-6 Daily Emissions for Proposed Project Alternatives														
Phase or Activity	Equipment and Vehicles		Maximum Daily		VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_20	CO_2 eqv
	Type	Category	hours	VMT	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
ALTERNATIVE 1														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		7,500	16.97	69.88	205.72	0.31	10.03	8.60	31,614	0.78	0.74	31,859
Import equipment from other areas	Tractor Trailer	onroad HHD		4,760	10.77	44.35	130.56	0.19	6.36	5.46	20,064	0.50	0.47	20,220
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	24		6.75	23.60	60.40	0.07	2.34	2.15	6,639	0.61	0.27	6,736
Low ground pressure haulers	Dump Truck	offroad	96		14.92	41.68	129.33	0.20	4.38	4.03	18,019	1.35	0.60	18,233
Tracked excavator	Excavator	offroad	24		2.93	13.50	23.38	0.03	1.12	1.03	3,065	0.26	0.12	3,107
Low ground pressure dozer	Dozer	offroad	16		2.12	8.15	13.00	0.01	1.09	1.00	1,134	0.19	0.09	1,164
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	24		3.72	12.70	34.15	0.04	1.24	1.14	4,322	0.34	0.15	4,376
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	20		10.49	33.59	120.13	0.11	3.61	3.32	11,192	0.95	0.42	11,342
Truck with crane for installed pilings	Crane Rig	offroad	8		1.00	3.11	9.33	0.01	0.33	0.31	1,115	0.09	0.04	1,129
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Equipment Operator	Pickup/SUV	onroad LD		780	0.58	5.53	0.56	0.01	0.07	0.05	859	0.05	0.02	866
Laborers	Pickup/SUV	onroad LD		130	0.10	0.92	0.09	0.00	0.01	0.01	143	0.01	0.00	144
ALTERNATIVE 2														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		6,000	13.58	55.91	164.58	0.25	8.02	6.88	25,291	0.63	0.59	25,487
Import equipment from other areas	Tractor Trailer	onroad HHD		3,080	6.97	28.70	84.48	0.13	4.12	3.53	12,983	0.32	0.30	13,083
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	24		6.75	23.60	60.40	0.07	2.34	2.15	6,639	0.61	0.27	6,736
Low ground pressure haulers	Dump Truck	offroad	80		12.43	34.73	107.77	0.16	3.65	3.36	15,016	1.12	0.50	15,194
Tracked excavator	Excavator	offroad	24		2.93	13.50	23.38	0.03	1.12	1.03	3,065	0.26	0.12	3,107
Low ground pressure dozer	Dozer	offroad	16		2.12	8.15	13.00	0.01	1.09	1.00	1,134	0.19	0.09	1,164
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	16		2.48	8.47	22.77	0.03	0.83	0.76	2,882	0.22	0.10	2,917
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	20		10.49	33.59	120.13	0.11	3.61	3.32	11,192	0.95	0.42	11,342
Truck with crane for installed pilings	Crane Rig	offroad	8		1.00	3.11	9.33	0.01	0.33	0.31	1,115	0.09	0.04	1,129
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Equipment Operator	Pickup/SUV	onroad LD		585	0.44	4.15	0.42	0.01	0.05	0.03	644	0.04	0.02	650
Laborers	Pickup/SUV	onroad LD		130	0.10	0.92	0.09	0.00	0.01	0.01	143	0.01	0.00	144
ALTERNATIVE 3														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		9,000	20.37	83.86	246.86	0.37	12.03	10.32	37,937	0.94	0.88	38,231
Import equipment from other areas	Tractor Trailer	onroad HHD		3,920	8.87	36.53	107.52	0.16	5.24	4.49	16,524	0.41	0.39	16,652
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	32		9.00	31.46	80.53	0.09	3.12	2.87	8,853	0.81	0.36	8,982

Low ground pressure haulers	Dump Truck	offroad	112		17.40	48.63	150.88	0.23	5.11	4.70	21,023	1.57	0.70	21,272
Tracked excavator	Excavator	offroad	32		3.90	18.00	31.17	0.05	1.49	1.37	4,087	0.35	0.16	4,143
Low ground pressure dozer	Dozer	offroad	24		3.19	12.22	19.50	0.02	1.63	1.50	1,700	0.29	0.13	1,746
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	32		4.96	16.93	45.54	0.06	1.66	1.53	5,763	0.45	0.20	5,834
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	20		10.49	33.59	120.13	0.11	3.61	3.32	11,192	0.95	0.42	11,342
Truck with crane for installed pilings	Crane Rig	offroad	8		1.00	3.11	9.33	0.01	0.33	0.31	1,115	0.09	0.04	1,129
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Equipment Operator	Pickup/SUV	onroad LD		975	0.73	6.91	0.69	0.01	0.09	0.06	1,073	0.07	0.03	1,083
Laborers	Pickup/SUV	onroad LD		130	0.10	0.92	0.09	0.00	0.01	0.01	143	0.01	0.00	144
ALTERNATIVE 4														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		3,000	6.79	27.95	82.29	0.12	4.01	3.44	12,646	0.31	0.29	12,744
Import equipment from other areas	Tractor Trailer	onroad HHD		5,040	11.41	46.96	138.24	0.21	6.74	5.78	21,245	0.53	0.50	21,409
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	16		4.50	15.73	40.26	0.05	1.56	1.44	4,426	0.41	0.18	4,491
Low ground pressure haulers	Dump Truck	offroad	56		8.70	24.31	75.44	0.11	2.56	2.35	10,511	0.79	0.35	10,636
Tracked excavator	Excavator	offroad	16		1.95	9.00	15.59	0.02	0.74	0.69	2,043	0.18	0.08	2,071
Low ground pressure dozer	Dozer	offroad	16		2.12	8.15	13.00	0.01	1.09	1.00	1,134	0.19	0.09	1,164
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	8		1.24	4.23	11.38	0.01	0.41	0.38	1,441	0.11	0.05	1,459
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	20		10.49	33.59	120.13	0.11	3.61	3.32	11,192	0.95	0.42	11,342
Truck with crane for installed pilings	Crane Rig	offroad	8		1.00	3.11	9.33	0.01	0.33	0.31	1,115	0.09	0.04	1,129
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Equipment Operator	Pickup/SUV	onroad LD		390	0.29	2.77	0.28	0.00	0.04	0.02	429	0.03	0.01	433
Laborers	Pickup/SUV	onroad LD		130	0.10	0.92	0.09	0.00	0.01	0.01	143	0.01	0.00	144
ALTERNATIVE 5														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		2,700	6.11	25.16	74.06	0.11	3.61	3.09	11,381	0.28	0.27	11,469
Import equipment from other areas	Tractor Trailer	onroad HHD		2,800	6.34	26.09	76.80	0.11	3.74	3.21	11,803	0.29	0.28	11,894
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	16		4.50	15.73	40.26	0.05	1.56	1.44	4,426	0.41	0.18	4,491
Low ground pressure haulers	Dump Truck	offroad	56		8.70	24.31	75.44	0.11	2.56	2.35	10,511	0.79	0.35	10,636
Tracked excavator	Excavator	offroad	16		1.95	9.00	15.59	0.02	0.74	0.69	2,043	0.18	0.08	2,071
Low ground pressure dozer	Dozer	offroad	16		2.12	8.15	13.00	0.01	1.09	1.00	1,134	0.19	0.09	1,164
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	8		1.24	4.23	11.38	0.01	0.41	0.38	1,441	0.11	0.05	1,459
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	20		10.49	33.59	120.13	0.11	3.61	3.32	11,192	0.95	0.42	11,342
Truck with crane for installed pilings	Crane Rig	offroad	8		1.00	3.11	9.33	0.01	0.33	0.31	1,115	0.09	0.04	1,129

Apdx G - Daily Emissions

Table G-6

Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Equipment Operator	Pickup/SUV	onroad LD		325	0.24	2.30	0.23	0.00	0.03	0.02	358	0.02	0.01	361
Laborers	Pickup/SUV	onroad LD		130	0.10	0.92	0.09	0.00	0.01	0.01	143	0.01	0.00	144
ALTERNATIVE 6														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		3,600	8.15	33.54	98.75	0.15	4.81	4.13	15,175	0.38	0.35	15,292
Import equipment from other areas	Tractor Trailer	onroad HHD		4,480	10.14	41.74	122.88	0.18	5.99	5.14	18,884	0.47	0.44	19,030
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	24		6.75	23.60	60.40	0.07	2.34	2.15	6,639	0.61	0.27	6,736
Low ground pressure haulers	Dump Truck	offroad	80		12.43	34.73	107.77	0.16	3.65	3.36	15,016	1.12	0.50	15,194
Tracked excavator	Excavator	offroad	16		1.95	9.00	15.59	0.02	0.74	0.69	2,043	0.18	0.08	2,071
Low ground pressure dozer	Dozer	offroad	16		2.12	8.15	13.00	0.01	1.09	1.00	1,134	0.19	0.09	1,164
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	16		2.48	8.47	22.77	0.03	0.83	0.76	2,882	0.22	0.10	2,917
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	20		10.49	33.59	120.13	0.11	3.61	3.32	11,192	0.95	0.42	11,342
Truck with crane for installed pilings	Crane Rig	offroad	8		1.00	3.11	9.33	0.01	0.33	0.31	1,115	0.09	0.04	1,129
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Equipment Operator	Pickup/SUV	onroad LD		520	0.39	3.69	0.37	0.01	0.05	0.03	572	0.03	0.01	578
Laborers	Pickup/SUV	onroad LD		130	0.10	0.92	0.09	0.00	0.01	0.01	143	0.01	0.00	144
Maximum Daily Construction Emissions														
ALTERNATIVE 1, LBS					17.8	77.4	206.7	0.3	10.1	8.7	32,801	1.4	0.8	33,056
ALTERNATIVE 2, LBS					14.2	62.0	165.5	0.3	8.1	6.9	26,264	1.2	0.6	26,468
ALTERNATIVE 3, LBS					21.3	92.7	248.0	0.4	12.2	10.4	39,338	1.7	0.9	39,645
ALTERNATIVE 4, LBS					11.0	38.3	120.9	0.1	4.1	3.5	13,403	1.0	0.4	13,508
ALTERNATIVE 5, LBS					11.0	37.8	120.8	0.1	3.7	3.4	12,067	1.0	0.4	12,161
ALTERNATIVE 6, LBS					13.0	40.4	121.0	0.2	4.9	4.2	16,076	1.2	0.5	16,201
Sources: SCAQMD 2008; USEPA 2011														

Notes:

SCAQMD emission factors for 2013

Offroad diesel exhaust $PM_{2.5}$ = 92% of PM_{10} per EMFAC 2007 version 2.3

Offroad N_2O per Annex 3, Table A-101

Non-matching application-specific values interpolated or extrapolated

USEPA GWPs for CO_2 eqv (1, 21, 310)

Special Note: Daily maximums do not include importing equipment from other areas in state (local emissions only)

Table G-7 Total Emissions for Proposed Project Alternatives														
Phase or Activity	Equipment and Vehicles		Project Total		VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_20	CO_2 eqv
	Type	Category	hours	VMT	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
ALTERNATIVE 1														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		322,500	730	3,005	8,846	13	431	370	1,359,397		32	1,369,929
Import equipment from other areas	Tractor Trailer	onroad HHD		52,360	118	488	1,436	2	70	60	220,707	5	5	222,417
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	7,800		2,194	7,668	19,629	22	761	700	2,157,833		88	2,189,265
Low ground pressure haulers	Dump Truck	offroad	25,056		3,893	10,879	33,754	51	1,144	1,053	4,703,089		156	4,758,860
Tracked excavator	Excavator	offroad	9,000		1,098	5,063	8,767	13	419	386	1,149,378		44	1,165,102
Low ground pressure dozer	Dozer	offroad	3,728		495	1,899	3,030	3	254	233	264,110	45	20	271,201
Small motor grader	Grader	offroad	200		27	121	180	0	13	12	18,553	2	1	18,935
Barge with crane and clamshell bucket	Crane	offroad	6,360		986	3,366	9,051	11	330	303	1,145,444		40	1,159,575
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1,820		955	3,056	10,932	10	328	302	1,018,478		38	1,032,155
Truck with crane for installed pilings	Crane Rig	offroad	160		20	62	187	0	7	6	22,294	2	1	22,579
Medium backhoe loader	Backhoe	offroad	1,600		120	549	654	1	55	50	72,991	11	5	74,713
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		4,700	11	44	129	0	6	5	19,811	0	0	19,965
Manager	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Foreman	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Equipment Operator	Pickup/SUV	onroad LD		312,000	233	2,213	222	3	28	18	343,473	21	8	346,539
Laborers	Pickup/SUV	onroad LD		52,000	39	369	37	1	5	3	57,245	3	1	57,757
ALTERNATIVE 2														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		276,000	625	2,572	7,571	11	369	316	1,163,391		27	1,172,405
Import equipment from other areas	Tractor Trailer	onroad HHD		36,960	84	344	1,014	2	49	42	155,793	4	4	157,000
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	6,336		1,782	6,229	15,945	18	618	569	1,752,824		71	1,778,356
Low ground pressure haulers	Dump Truck	offroad	21,200		3,294	9,204	28,560	43	968	891	3,979,306		132	4,026,494
Tracked excavator	Excavator	offroad	6,984		852	3,929	6,803	10	325	299	891,917	77	34	904,119
Low ground pressure dozer	Dozer	offroad	2,608		346	1,328	2,119	2	177	163	184,763	31	14	189,724
Small motor grader	Grader	offroad	224		30	136	201	0	15	14	20,780	3	1	21,207
Barge with crane and clamshell bucket	Crane	offroad	4,304		667	2,278	6,125	8	223	205	775,156	60	27	784,719
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1,820		955	3,056	10,932	10	328	302	1,018,478		38	1,032,155
Truck with crane for installed pilings	Crane Rig	offroad	168		21	65	196	0	7	6	23,408	2	1	23,708
Medium backhoe loader	Backhoe	offroad	1,880		141	646	768	1	64	59	85,764	13	6	87,787
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		4,700	11	44	129	0	6	5	19,811	0	0	19,965
Manager	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Foreman	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Equipment Operator	Pickup/SUV	onroad LD		234,000	174	1,660	167	3	21	14	257,605	16	6	259,904
Laborers	Pickup/SUV	onroad LD		52,000	39	369	37	1	5	3	57,245	3	1	57,757
ALTERNATIVE 3														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		396,000	896	3,690	10,862	16	529	454	1,669,213		39	1,682,146
Import equipment from other areas	Tractor Trailer	onroad HHD		43,120	98	402	1,183	2	58	49	181,759	5	4	183,167
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	8,480		2,385	8,337	21,340	24	827	761	2,345,952		96	2,380,124
Low ground pressure haulers	Dump Truck	offroad	29,904		4,646	12,983	40,285	61	1,365	1,256	5,613,073		186	5,679,635
Tracked excavator	Excavator	offroad	9,312		1,136	5,239	9,071	13	434	399	1,189,223		46	1,205,492

Table G-7 Total Emissions for Proposed Project Alternatives														
Phase or Activity	Equipment and Vehicles		Project Total		VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_20	CO_2 eqv
	Type	Category	hours	VMT	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
Low ground pressure dozer	Dozer	offroad	3,504		465	1,785	2,848	3	238	219	248,240	42	19	254,906
Small motor grader	Grader	offroad	272		36	165	244	0	18	17	25,233	3	1	25,751
Barge with crane and clamshell bucket	Crane	offroad	8,448		1,310	4,471	12,022	15	438	403	1,521,496		53	1,540,265
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1,820		955	3,056	10,932	10	328	302	1,018,478		38	1,032,155
Truck with crane for installed pilings	Crane Rig	offroad	168		21	65	196	0	7	6	23,408	2	1	23,708
Medium backhoe loader	Backhoe	offroad	1,600		120	549	654	1	55	50	72,991	11	5	74,713
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		4,700	11	44	129	0	6	5	19,811	0	0	19,965
Manager	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Foreman	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Equipment Operator	Pickup/SUV	onroad LD		390,000	291	2,766	278	4	35	23	429,341	26	11	433,174
Laborers	Pickup/SUV	onroad LD		52,000	39	369	37	1	5	3	57,245	3	1	57,757
ALTERNATIVE 4														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		105,000	238	978	2,880	4	140	120	442,594	11	10	446,024
Import equipment from other areas	Tractor Trailer	onroad HHD		45,360	103	423	1,244	2	61	52	191,201	5	4	192,682
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	4,912		1,382	4,829	12,361	14	479	441	1,258,882		55	1,378,675
Low ground pressure haulers	Dump Truck	offroad	14,560		2,262	6,321	19,614	30	665	612	2,742,957		91	2,765,365
Tracked excavator	Excavator	offroad	4,944		603	2,782	4,816	7	230	212	631,392	54	24	640,029
Low ground pressure dozer	Dozer	offroad	2,496		331	1,271	2,028	2	170	156	176,829	30	13	181,577
Small motor grader	Grader	offroad	112		15	68	101	0	7	7	10,390	1	1	10,604
Barge with crane and clamshell bucket	Crane	offroad	2,368		367	1,253	3,370	4	123	113	426,480	33	15	431,741
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1,820		955	3,056	10,932	10	328	302	1,018,478		38	1,032,155
Truck with crane for installed pilings	Crane Rig	offroad	168		21	65	196	0	7	6	23,408	2	1	23,708
Medium backhoe loader	Backhoe	offroad	1,600		120	549	654	1	55	50	72,991	11	5	74,713
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		4,700	11	44	129	0	6	5	19,811	0	0	19,965
Manager	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Foreman	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Equipment Operator	Pickup/SUV	onroad LD		156,000	116	1,106	111	2	14	9	171,736	10	4	173,270
Laborers	Pickup/SUV	onroad LD		52,000	39	369	37	1	5	3	57,245	3	1	57,757
ALTERNATIVE 5														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		99,900	226	931	2,740	4	134	115	421,097	10	10	424,360
Import equipment from other areas	Tractor Trailer	onroad HHD		28,000	63	261	768	1	37	32	118,025	3	3	118,940
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	4,128		1,161	4,058	10,388	12	403	371	1,041,992		47	1,158,626
Low ground pressure haulers	Dump Truck	offroad	14,000		2,175	6,078	18,860	28	639	588	2,627,843		87	2,659,005
Tracked excavator	Excavator	offroad	3,520		429	1,980	3,429	5	164	151	449,534	39	17	455,684
Low ground pressure dozer	Dozer	offroad	1,632		217	831	1,326	1	111	102	115,619	20	9	118,723
Small motor grader	Grader	offroad	152		20	92	137	0	10	9	14,101	2	1	14,391
Barge with crane and clamshell bucket	Crane	offroad	2,024		314	1,071	2,880	4	105	97	364,525	28	13	369,022
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1,820		955	3,056	10,932	10	328	302	1,018,478		38	1,032,155
Truck with crane for installed pilings	Crane Rig	offroad	168		21	65	196	0	7	6	23,408	2	1	23,708
Medium backhoe loader	Backhoe	offroad	1,600		120	549	654	1	55	50	72,991	11	5	74,713

Table G-7 Total Emissions for Proposed Project Alternatives														
Phase or Activity	Equipment and Vehicles		Project Total		VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_20	CO_2 eqv
	Type	Category	hours	VMT	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		4,700	11	44	129	0	6	5	19,811	0	0	19,965
Manager	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Foreman	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Equipment Operator	Pickup/SUV	onroad LD		130,000	97	922	93	1	12	8	143,114	9	4	144,391
Laborers	Pickup/SUV	onroad LD		52,000	39	369	37	1	5	3	57,245	3	1	57,757
ALTERNATIVE 6														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		108,000	244	1,006	2,962	4	144	124	455,240	11	11	458,767
Import equipment from other areas	Tractor Trailer	onroad HHD		35,840	81	334	983	1	48	41	151,072	4	4	152,243
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	5,328		1,499	5,238	13,408	15	520	478	1,473,966		60	1,495,436
Low ground pressure haulers	Dump Truck	offroad	19,120		2,971	8,301	25,757	39	873	803	3,588,883		119	3,631,441
Tracked excavator	Excavator	offroad	4,544		554	2,556	4,426	7	212	195	580,308	50	22	588,247
Low ground pressure dozer	Dozer	offroad	2,128		283	1,084	1,729	2	145	133	150,758	25	11	154,806
Small motor grader	Grader	offroad	176		23	106	158	0	12	11	16,327	2	1	16,663
Barge with crane and clamshell bucket	Crane	offroad	3,984		618	2,108	5,669	7	207	190	717,524	56	25	726,375
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	1,820		955	3,056	10,932	10	328	302	1,018,478		38	1,032,155
Truck with crane for installed pilings	Crane Rig	offroad	168		21	65	196	0	7	6	23,408	2	1	23,708
Medium backhoe loader	Backhoe	offroad	1,600		120	549	654	1	55	50	72,991	11	5	74,713
Agricultural tractor with mower	Tractor	offroad	-		-	-	-	-	-	-	-	-	-	-
Fugitive dust control	Water Truck	onroad HHD		4,700	11	44	129	0	6	5	19,811	0	0	19,965
Manager	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Foreman	Pickup/SUV	onroad LD		30,550	23	217	22	0	3	2	33,632	2	1	33,932
Equipment Operator	Pickup/SUV	onroad LD		208,000	155	1,475	148	2	19	12	228,982	14	6	231,026
Laborers	Pickup/SUV	onroad LD		52,000	39	369	37	1	5	3	57,245	3	1	57,757
Total Construction Emissions														
ALTERNATIVE 1, TONS					5.5	19.6	48.4	0.07	1.9	1.8	6,310	0.5	0.2	6,388
ALTERNATIVE 2, TONS					4.5	16.1	40.3	0.05	1.6	1.4	5,227	0.4	0.2	5,292
ALTERNATIVE 3, TONS					6.2	22.2	55.1	0.08	2.2	2.0	7,241	0.5	0.3	7,330
ALTERNATIVE 4, TONS					3.3	11.8	29.3	0.04	1.1	1.0	3,701	0.3	0.1	3,748
ALTERNATIVE 5, TONS					2.9	10.4	26.3	0.03	1.0	0.9	3,328	0.3	0.1	3,370
ALTERNATIVE 6, TONS					3.8	13.4	33.6	0.05	1.3	1.2	4,311	0.3	0.2	4,366
Sources: SCAQMD 2008; USEPA 2011														

Notes:

SCAQMD emission factors for 2013

Offroad diesel exhaust $PM_{2.5}$ = 92% of PM_{10} per EMFAC 2007 version 2.3

Offroad N_2O per Annex 3, Table A-101

Non-matching application-specific values interpolated or extrapolated

USEPA GWPs for CO_2 eqv (1, 21, 310)

Table G-8 Daily Maintenance Emissions for Proposed Project Alternatives														
Phase or Activity	Equipment and Vehicles		Daily Maint,		VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_20	CO_2 eqv
	Type	Category	hours	VMT	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
ALTERNATIVE 1														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		100	0.23	0.93	2.74	0.00	0.13	0.11	422	0.01	0.01	425
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	8		2.25	7.87	20.13	0.02	0.78	0.72	2,213	0.20	0.09	2,245
Low ground pressure haulers	Dump Truck	offroad	8		1.24	3.47	10.78	0.02	0.37	0.34	1,502	0.11	0.05	1,519
Tracked excavator	Excavator	offroad	8		0.98	4.50	7.79	0.01	0.37	0.34	1,022	0.09	0.04	1,036
Low ground pressure dozer	Dozer	offroad	8		1.06	4.07	6.50	0.01	0.54	0.50	567	0.10	0.04	582
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	8		1.64	6.67	12.27	0.01	0.70	0.64	1,043	0.15	0.07	1,067
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 2														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		100	0.23	0.93	2.74	0.00	0.13	0.11	422	0.01	0.01	425
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	8		2.25	7.87	20.13	0.02	0.78	0.72	2,213	0.20	0.09	2,245
Low ground pressure haulers	Dump Truck	offroad	8		1.24	3.47	10.78	0.02	0.37	0.34	1,502	0.11	0.05	1,519
Tracked excavator	Excavator	offroad	8		0.98	4.50	7.79	0.01	0.37	0.34	1,022	0.09	0.04	1,036
Low ground pressure dozer	Dozer	offroad	8		1.06	4.07	6.50	0.01	0.54	0.50	567	0.10	0.04	582
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	8		1.64	6.67	12.27	0.01	0.70	0.64	1,043	0.15	0.07	1,067
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 3														
Haul equipment and materials to site	Tractor Trailer	onroad HHD	72	100	0.16	0.67	1.97	0.00	0.10	0.08	303	0.01	0.01	306
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	8		2.25	7.87	20.13	0.02	0.78	0.72	2,213	0.20	0.09	2,245
Low ground pressure haulers	Dump Truck	offroad	8		1.24	3.47	10.78	0.02	0.37	0.34	1,502	0.11	0.05	1,519
Tracked excavator	Excavator	offroad	8		0.98	4.50	7.79	0.01	0.37	0.34	1,022	0.09	0.04	1,036

Low ground pressure dozer	Dozer	offroad	8		1.06	4.07	6.50	0.01	0.54	0.50	567	0.10	0.04	582
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	8		1.64	6.67	12.27	0.01	0.70	0.64	1,043	0.15	0.07	1,067
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 4														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		100	0.23	0.93	2.74	0.00	0.13	0.11	422	0.01	0.01	425
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	8		2.25	7.87	20.13	0.02	0.78	0.72	2,213	0.20	0.09	2,245
Low ground pressure haulers	Dump Truck	offroad	8		1.24	3.47	10.78	0.02	0.37	0.34	1,502	0.11	0.05	1,519
Tracked excavator	Excavator	offroad	8		0.98	4.50	7.79	0.01	0.37	0.34	1,022	0.09	0.04	1,036
Low ground pressure dozer	Dozer	offroad	8		1.06	4.07	6.50	0.01	0.54	0.50	567	0.10	0.04	582
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	8		1.64	6.67	12.27	0.01	0.70	0.64	1,043	0.15	0.07	1,067
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 5														
Haul equipment and materials to site	Tractor Trailer	onroad HHD	98	100	0.22	0.91	2.69	0.00	0.13	0.11	413	0.01	0.01	416
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	8		2.25	7.87	20.13	0.02	0.78	0.72	2,213	0.20	0.09	2,245
Low ground pressure haulers	Dump Truck	offroad	8		1.24	3.47	10.78	0.02	0.37	0.34	1,502	0.11	0.05	1,519
Tracked excavator	Excavator	offroad	8		0.98	4.50	7.79	0.01	0.37	0.34	1,022	0.09	0.04	1,036
Low ground pressure dozer	Dozer	offroad	8		1.06	4.07	6.50	0.01	0.54	0.50	567	0.10	0.04	582
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	8		1.64	6.67	12.27	0.01	0.70	0.64	1,043	0.15	0.07	1,067
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72

Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 6														
Haul equipment and materials to site	Tractor Trailer	onroad HHD	98	100	0.22	0.91	2.69	0.00	0.13	0.11	413	0.01	0.01	416
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	8		2.25	7.87	20.13	0.02	0.78	0.72	2,213	0.20	0.09	2,245
Low ground pressure haulers	Dump Truck	offroad	8		1.24	3.47	10.78	0.02	0.37	0.34	1,502	0.11	0.05	1,519
Tracked excavator	Excavator	offroad	8		0.98	4.50	7.79	0.01	0.37	0.34	1,022	0.09	0.04	1,036
Low ground pressure dozer	Dozer	offroad	8		1.06	4.07	6.50	0.01	0.54	0.50	567	0.10	0.04	582
Small motor grader	Grader	offroad	8		1.07	4.84	7.19	0.01	0.53	0.49	742	0.10	0.04	757
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	8		0.60	2.75	3.27	0.00	0.27	0.25	365	0.05	0.02	374
Agricultural tractor with mower	Tractor	offroad	8		1.64	6.67	12.27	0.01	0.70	0.64	1,043	0.15	0.07	1,067
Fugitive dust control	Water Truck	onroad HHD		10	0.02	0.09	0.27	0.00	0.01	0.01	42	0.00	0.00	42
Manager	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		65	0.05	0.46	0.05	0.00	0.01	0.00	72	0.00	0.00	72
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Maximum Daily Maintenance Emissions														
ALTERNATIVE 1, LBS					2.4	8.9	20.5	0.0	0.8	0.7	2,398	0.2	0.1	2,432
ALTERNATIVE 2, LBS					2.4	8.9	20.5	0.0	0.8	0.7	2,398	0.2	0.1	2,432
ALTERNATIVE 3, LBS					2.4	8.9	20.5	0.0	0.8	0.7	2,398	0.2	0.1	2,432
ALTERNATIVE 4, LBS					2.4	8.9	20.5	0.0	0.8	0.7	2,398	0.2	0.1	2,432
ALTERNATIVE 5, LBS					2.4	8.9	20.5	0.0	0.8	0.7	2,398	0.2	0.1	2,432
ALTERNATIVE 6, LBS					2.4	8.9	20.5	0.0	0.8	0.7	2,398	0.2	0.1	2,432
Sources: SCAQMD 2008; USEPA 2011														

Notes:

SCAQMD emission factors for 2013

Offroad diesel exhaust $PM_{2.5}$ = 92% of PM_{10} per EMFAC 2007 version 2.3

Offroad N_2O per Annex 3, Table A-101

Non-matching application-specific values interpolated or extrapolated

USEPA GWPs for CO_2 eqv (1, 21, 310)

Special Note: Daily maximums do not include importing equipment from other areas in state (local emissions only)

Table G-9 Annual Maintenance Emissions for Proposed Project Alternatives															
Phase or Activity	Equipment and Vehicles		Annual Maint,		VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_20	CO_2 eqv
	Type	Category	hours	VMT	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
ALTERNATIVE 1														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		3,700	8	34	101	0	5	4	15,596	0	0	15,717
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	224		63	220	564	1	22	20	61,969	6	3	62,871
Low ground pressure haulers	Dump Truck	offroad	144		22	63	194	0	7	6	27,029	2	1	27,350
Tracked excavator	Excavator	offroad	280		34	158	273	0	13	12	35,758	3	1	36,248
Low ground pressure dozer	Dozer	offroad	40		5	20	33	0	3	3	2,834	0	0	2,910
Small motor grader	Grader	offroad	200		27	121	180	0	13	12	18,553	2	1	18,935
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	192		14	66	78	0	7	6	8,759	1	1	8,966
Agricultural tractor with mower	Tractor	offroad	24		5	20	37	0	2	2	3,130	0	0	3,200
Fugitive dust control	Water Truck	onroad HHD		250	1	2	7	0	0	0	1,054	0	0	1,062
Manager	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 2														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		3,400	8	32	93	0	5	4	14,332	0	0	14,443
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	216		61	212	544	1	21	19	59,755	5	2	60,626
Low ground pressure haulers	Dump Truck	offroad	152		24	66	205	0	7	6	28,531	2	1	28,869
Tracked excavator	Excavator	offroad	304		37	171	296	0	14	13	38,823	3	1	39,355
Low ground pressure dozer	Dozer	offroad	48		6	24	39	0	3	3	3,401	1	0	3,492
Small motor grader	Grader	offroad	200		27	121	180	0	13	12	18,553	2	1	18,935
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	88		7	30	36	0	3	3	4,014	1	0	4,109
Agricultural tractor with mower	Tractor	offroad	24		5	20	37	0	2	2	3,130	0	0	3,200
Fugitive dust control	Water Truck	onroad HHD		250	1	2	7	0	0	0	1,054	0	0	1,062
Manager	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 3														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		4,500	10	42	123	0	6	5	18,968	0	0	19,115
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	224		63	220	564	1	22	20	61,969	6	3	62,871
Low ground pressure haulers	Dump Truck	offroad	152		24	66	205	0	7	6	28,531	2	1	28,869
Tracked excavator	Excavator	offroad	352		43	198	343	1	16	15	44,953	4	2	45,568

Low ground pressure dozer	Dozer	offroad	48		6	24	39	0	3	3	3,401	1	0	3,492
Small motor grader	Grader	offroad	200		27	121	180	0	13	12	18,553	2	1	18,935
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	224		17	77	92	0	8	7	10,219	2	1	10,460
Agricultural tractor with mower	Tractor	offroad	24		5	20	37	0	2	2	3,130	0	0	3,200
Fugitive dust control	Water Truck	onroad HHD		250	1	2	7	0	0	0	1,054	0	0	1,062
Manager	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 4														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		2,000	5	19	55	0	3	2	8,430	0	0	8,496
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	208		59	204	523	1	20	19	57,542	5	2	58,380
Low ground pressure haulers	Dump Truck	offroad	144		22	63	194	0	7	6	27,029	2	1	27,350
Tracked excavator	Excavator	offroad	208		25	117	203	0	10	9	26,563	2	1	26,927
Low ground pressure dozer	Dozer	offroad	40		5	20	33	0	3	3	2,834	0	0	2,910
Small motor grader	Grader	offroad	200		27	121	180	0	13	12	18,553	2	1	18,935
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	48		4	16	20	0	2	2	2,190	0	0	2,241
Agricultural tractor with mower	Tractor	offroad	24		5	20	37	0	2	2	3,130	0	0	3,200
Fugitive dust control	Water Truck	onroad HHD		250	1	2	7	0	0	0	1,054	0	0	1,062
Manager	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 5														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		2,000	5	19	55	0	3	2	8,430	0	0	8,496
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	208		59	204	523	1	20	19	57,542	5	2	58,380
Low ground pressure haulers	Dump Truck	offroad	144		22	63	194	0	7	6	27,029	2	1	27,350
Tracked excavator	Excavator	offroad	216		26	122	210	0	10	9	27,585	2	1	27,962
Low ground pressure dozer	Dozer	offroad	40		5	20	33	0	3	3	2,834	0	0	2,910
Small motor grader	Grader	offroad	200		27	121	180	0	13	12	18,553	2	1	18,935
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	56		4	19	23	0	2	2	2,555	0	0	2,615
Agricultural tractor with mower	Tractor	offroad	24		5	20	37	0	2	2	3,130	0	0	3,200
Fugitive dust control	Water Truck	onroad HHD		250	1	2	7	0	0	0	1,054	0	0	1,062
Manager	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966

Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
ALTERNATIVE 6														
Haul equipment and materials to site	Tractor Trailer	onroad HHD		2,600	6	24	71	0	3	3	10,959	0	0	11,044
Import equipment from other areas	Tractor Trailer	onroad HHD		-	-	-	-	-	-	-	-	-	-	-
Agricultural tractor with carryall scrapers	Tractor Scraper	offroad	216		61	212	544	1	21	19	59,755	5	2	60,626
Low ground pressure haulers	Dump Truck	offroad	144		22	63	194	0	7	6	27,029	2	1	27,350
Tracked excavator	Excavator	offroad	232		28	131	226	0	11	10	29,628	3	1	30,034
Low ground pressure dozer	Dozer	offroad	40		5	20	33	0	3	3	2,834	0	0	2,910
Small motor grader	Grader	offroad	200		27	121	180	0	13	12	18,553	2	1	18,935
Barge with crane and clamshell bucket	Crane	offroad	-		-	-	-	-	-	-	-	-	-	-
Hydraulic dredge, 16-inch boat-mounted	Other Industrial	offroad	-		-	-	-	-	-	-	-	-	-	-
Truck with crane for installed pilings	Crane Rig	offroad	-		-	-	-	-	-	-	-	-	-	-
Medium backhoe loader	Backhoe	offroad	104		8	36	43	0	4	3	4,744	1	0	4,856
Agricultural tractor with mower	Tractor	offroad	24		5	20	37	0	2	2	3,130	0	0	3,200
Fugitive dust control	Water Truck	onroad HHD		250	1	2	7	0	0	0	1,054	0	0	1,062
Manager	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Foreman	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Equipment Operator	Pickup/SUV	onroad LD		15,275	11	108	11	0	1	1	16,816	1	0	16,966
Laborers	Pickup/SUV	onroad LD		-	-	-	-	-	-	-	-	-	-	-
Total Maintenance Emissions														
ALTERNATIVE 1, TONS					0.10	0.46	0.74	0.001	0.04	0.03	104	0.009	0.004	106
ALTERNATIVE 2, TONS					0.10	0.45	0.73	0.001	0.04	0.03	103	0.009	0.004	104
ALTERNATIVE 3, TONS					0.11	0.49	0.81	0.001	0.04	0.04	112	0.010	0.004	114
ALTERNATIVE 4, TONS					0.09	0.40	0.64	0.001	0.03	0.03	90	0.008	0.003	92
ALTERNATIVE 3, TONS					0.09	0.40	0.64	0.001	0.03	0.03	91	0.008	0.003	92
ALTERNATIVE 4, TONS					0.09	0.42	0.68	0.001	0.03	0.03	96	0.008	0.004	97
Sources: SCAQMD 2008; USEPA 2011														

<u>Notes:</u>

SCAQMD emission factors for 2013

Offroad diesel exhaust $PM_{2.5}$ = 92% of PM_{10} per EMFAC 2007 version 2.3

Offroad N_2O per Annex 3, Table A-101

Non-matching application-specific values interpolated or extrapolated

USEPA GWPs for CO_2 eqv (1, 21, 310)

Apdx G - Offroad Dust
Table G-10

Table G-10 Offroad Fugitive Dust Emissions for Proposed Alternatves																	
Earthmoving	Activity		Required Variables								Uncontrolled		Controlled Emissions				
	Pk. Daily	Project	EET	Moist (M)	Silt (s)	Drop (d)	Speed (S)	Wind (U)	Den (D)	Rate (V)	PM_{10}	$PM_{2.5}$	Control	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
	hours	hours	code	percent	percent	feet	mph	mph	ton/cy	cy/hr	lb/hr	lb/hr	%	lb/day	lb/day	lbs	lbs
ALTERNATIVE 1																	
Tractor Scraper	24	7,800	B+C	20		3	5			30	0.04216	0.15507	95%	0.05	0.19	16.4	60.5
Dump Truck	96	25,056	B	20		6				30	0.06849	0.00316	95%	0.33	0.02	85.8	4.0
Excavator	24	9,000	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.01	0.00	2.6	0.4
Dozer	16	3,728	A	20	9						0.30548	0.17057	95%	0.24	0.14	56.9	31.8
Grader	8	200	C	20			4				1.98400	0.15360	95%	0.79	0.06	19.8	1.5
Clamshell Derrick	24	6,360	B	20		9				30	0.09097	0.00493	95%	0.11	0.01	28.9	1.6
Crane Rig	8	160	C	20			1				0.03100	0.00120	95%	0.01	0.00	0.2	0.0
Backhoe	8	1,600	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.2	0.0
Tractor	-	-	C	20			3				0.83700	0.05612	95%	0.00	0.00	0.0	0.0
ALTERNATIVE 2																	
Tractor Scraper	24	6,336	B+C	20		3	5			30	0.04216	0.15507	95%	0.05	0.19	13.4	49.1
Dump Truck	80	21,200	B	20		6				30	0.06849	0.00316	95%	0.27	0.01	72.6	3.3
Excavator	24	6,984	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.01	0.00	2.0	0.3
Dozer	16	2,608	A	20	9						0.30548	0.17057	95%	0.24	0.14	39.8	22.2
Grader	8	224	C	20			4				1.98400	0.15360	95%	0.79	0.06	22.2	1.7
Clamshell Derrick	16	4,304	B	20		9				30	0.09097	0.00493	95%	0.07	0.00	19.6	1.1
Crane Rig	8	168	C	20			1				0.03100	0.00120	95%	0.01	0.00	0.3	0.0
Backhoe	8	1,880	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.2	0.0
Tractor	-	-	C	20			3				0.83700	0.05612	95%	0.00	0.00	0.0	0.0
ALTERNATIVE 3																	
Tractor Scraper	32	8,480	B+C	20		3	5			30	0.04216	0.15507	95%	0.07	0.25	17.9	65.8
Dump Truck	112	29,904	B	20		6				30	0.06849	0.00316	95%	0.38	0.02	102.4	4.7
Excavator	32	9,312	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.01	0.00	2.7	0.4
Dozer	24	3,504	A	20	9						0.30548	0.17057	95%	0.37	0.20	53.5	29.9
Grader	8	272	C	20			4				1.98400	0.15360	95%	0.79	0.06	27.0	2.1
Clamshell Derrick	32	8,448	B	20		9				30	0.09097	0.00493	95%	0.15	0.01	38.4	2.1
Crane Rig	8	168	C	20			1				0.03100	0.00120	95%	0.01	0.00	0.3	0.0
Backhoe	8	1,600	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.2	0.0
Tractor	-	-	C	20			3				0.83700	0.05612	95%	0.00	0.00	0.0	0.0
ALTERNATIVE 4																	
Tractor Scraper	16	4,912	B+C	20		3	5			30	0.04216	0.15507	95%	0.03	0.12	10.4	38.1
Dump Truck	56	14,560	B	20		6				30	0.06849	0.00316	95%	0.19	0.01	49.9	2.3
Excavator	16	4,944	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	1.4	0.2
Dozer	16	2,496	A	20	9						0.30548	0.17057	95%	0.24	0.14	38.1	21.3
Grader	8	112	C	20			4				1.98400	0.15360	95%	0.79	0.06	11.1	0.9

Clamshell Derrick	8	2,368	B	20		9				30	0.09097	0.00493	95%	0.04	0.00	10.8	0.6
Crane Rig	8	168	C	20			1				0.03100	0.00120	95%	0.01	0.00	0.3	0.0
Backhoe	8	1,600	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.2	0.0
Tractor	-	-	C	20			3				0.83700	0.05612	95%	0.00	0.00	0.0	0.0
ALTERNATIVE 5																	
Tractor Scraper	16	4,128	B+C	20		3	5			30	0.04216	0.15507	95%	0.03	0.12	8.7	32.0
Dump Truck	56	14,000	B	20		6				30	0.06849	0.00316	95%	0.19	0.01	47.9	2.2
Excavator	16	3,520	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	1.0	0.2
Dozer	16	1,632	A	20	9						0.30548	0.17057	95%	0.24	0.14	24.9	13.9
Grader	8	152	C	20			4				1.98400	0.15360	95%	0.79	0.06	15.1	1.2
Clamshell Derrick	8	2,024	B	20		9				30	0.09097	0.00493	95%	0.04	0.00	9.2	0.5
Crane Rig	8	168	C	20			1				0.03100	0.00120	95%	0.01	0.00	0.3	0.0
Backhoe	8	1,600	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.2	0.0
Tractor	-	-	C	20			3				0.83700	0.05612	95%	0.00	0.00	0.0	0.0
ALTERNATIVE 6																	
Tractor Scraper	24	5,328	B+C	20		3	5			30	0.04216	0.15507	95%	0.05	0.19	11.2	41.3
Dump Truck	80	19,120	B	20		6				30	0.06849	0.00316	95%	0.27	0.01	65.5	3.0
Excavator	16	4,544	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	1.3	0.2
Dozer	16	2,128	A	20	9						0.30548	0.17057	95%	0.24	0.14	32.5	18.1
Grader	8	176	C	20			4				1.98400	0.15360	95%	0.79	0.06	17.5	1.4
Clamshell Derrick	16	3,984	B	20		9				30	0.09097	0.00493	95%	0.07	0.00	18.1	1.0
Crane Rig	8	168	C	20			1				0.03100	0.00120	95%	0.01	0.00	0.3	0.0
Backhoe	8	1,600	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.2	0.0
Tractor	-	-	C	20			3				0.83700	0.05612	95%	0.00	0.00	0.0	0.0

Onsite Equipment	lbs/day	lbs/day	tons	tons
ALTERNATIVE 1	**1.5**	**0.4**	**0.11**	**0.05**
ALTERNATIVE 2	**1.5**	**0.4**	**0.09**	**0.04**
ALTERNATIVE 3	**1.8**	**0.5**	**0.12**	**0.05**
ALTERNATIVE 4	**1.3**	**0.3**	**0.06**	**0.03**
ALTERNATIVE 5	**1.3**	**0.3**	**0.05**	**0.02**
ALTERNATIVE 6	**1.5**	**0.4**	**0.07**	**0.03**

Apdx G - Onroad Dust
Table G-11

Table G-11 Onroad Fugitive Dust Emissions for Proposed Alternatves					
All Roads Travelled	Vehicle Category	Activity		Usage	
		Pk. Daily	Project	Unpaved	Paved
		VMT	VMT	%	%
ALTERNATIVE 1					
Tractor Trailer (materials/hauling)	onroad HHD	7,500	322,500	11%	89%
Tractor Trailer (equipment/supplies)	onroad HHD	4,760	52,360	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	4,700	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	30,550	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	65	30,550	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	780	312,000	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	130	52,000	6%	94%
ALTERNATIVE 2					
Tractor Trailer (materials/hauling)	onroad HHD	6,000	276,000	11%	89%
Tractor Trailer (equipment/supplies)	onroad HHD	3,080	36,960	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	4,700	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	30,550	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	65	30,550	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	585	234,000	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	130	52,000	6%	94%
ALTERNATIVE 3					
Tractor Trailer (materials/hauling)	onroad HHD	9,000	396,000	2%	98%
Tractor Trailer (equipment/supplies)	onroad HHD	3,920	43,120	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	4,700	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	30,550	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	65	30,550	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	975	390,000	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	130	52,000	6%	94%
ALTERNATIVE 4					
Tractor Trailer (materials/hauling)	onroad HHD	3,000	105,000	2%	98%
Tractor Trailer (equipment/supplies)	onroad HHD	5,040	45,360	1%	99%

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Table G-11

Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	4,700	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	30,550	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	65	30,550	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	390	156,000	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	130	52,000	6%	94%
ALTERNATIVE 5					
Tractor Trailer (materials/hauling)	onroad HHD	2,700	99,900	6%	94%
Tractor Trailer (equipment/supplies)	onroad HHD	2,800	28,000	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	4,700	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	30,550	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	65	30,550	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	325	130,000	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	130	52,000	6%	94%
ALTERNATIVE 6					
Tractor Trailer (materials/hauling)	onroad HHD	3,600	108,000	6%	94%
Tractor Trailer (equipment/supplies)	onroad HHD	4,480	35,840	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	4,700	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	30,550	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	65	30,550	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	520	208,000	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	130	52,000	6%	94%

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Table G-11

Unpaved Road Dust	Vehicle Category	Activity		Required Variables						Uncontrolled		Controlled Emissions				
		Pk. Daily	Project	EET	Moist (M)	Silt (s)	Weight (W)	Speed (S)	Precip (P)	PM_{10}	$PM_{2.5}$	Control	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
		VMT	VMT	code	percent	percent	tons	mph	days/yr	lb/VMT	lb/VMT	%	lb/day	lb/day	lbs	lbs
ALTERNATIVE 1																
Tractor Trailer (materials/hauling)	onroad HHD	825	35,475	G	20	9	30	20	20	1.89491	0.18933	95%	78.2	7.8	3,176.9	317.4
Tractor Trailer (equipment/supplies)	onroad HHD	48	524	G	20	9	30	20	20	1.89491	0.18933	95%	4.5	0.5	46.9	4.7
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	4,230	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	352.5	35.2
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (supervisors/foremen)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (operators/drivers)	onroad LD	47	18,720	G	20	9	3	20	20	0.84222	0.08407	95%	2.0	0.2	745.1	74.4
Pickup/SUV (tradesmen/laborers)	onroad LD	8	3,120	G	20	9	3	20	20	0.84222	0.08407	95%	0.3	0.0	124.2	12.4
ALTERNATIVE 2																
Tractor Trailer (materials/hauling)	onroad HHD	660	30,360	G	20	9	30	20	20	1.89491	0.18933	95%	62.5	6.2	2,718.9	271.7
Tractor Trailer (equipment/supplies)	onroad HHD	31	370	G	20	9	30	20	20	1.89491	0.18933	95%	2.9	0.3	33.1	3.3
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	4,230	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	352.5	35.2
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (supervisors/foremen)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (operators/drivers)	onroad LD	35	14,040	G	20	9	3	20	20	0.84222	0.08407	95%	1.5	0.1	558.8	55.8
Pickup/SUV (tradesmen/laborers)	onroad LD	8	3,120	G	20	9	3	20	20	0.84222	0.08407	95%	0.3	0.0	124.2	12.4
ALTERNATIVE 3																
Tractor Trailer (materials/hauling)	onroad HHD	180	7,920	G	20	9	30	20	20	1.89491	0.18933	95%	17.1	1.7	709.3	70.9
Tractor Trailer (equipment/supplies)	onroad HHD	39	431	G	20	9	30	20	20	1.89491	0.18933	95%	3.7	0.4	38.6	3.9
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	4,230	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	352.5	35.2
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (supervisors/foremen)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (operators/drivers)	onroad LD	59	23,400	G	20	9	3	20	20	0.84222	0.08407	95%	2.5	0.2	931.4	93.0
Pickup/SUV (tradesmen/laborers)	onroad LD	8	3,120	G	20	9	3	20	20	0.84222	0.08407	95%	0.3	0.0	124.2	12.4
ALTERNATIVE 4																
Tractor Trailer (materials/hauling)	onroad HHD	60	2,100	G	20	9	30	20	20	1.89491	0.18933	95%	5.7	0.6	188.1	18.8
Tractor Trailer (equipment/supplies)	onroad HHD	50	454	G	20	9	30	20	20	1.89491	0.18933	95%	4.8	0.5	40.6	4.1
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	4,230	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	352.5	35.2

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Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (supervisors/foremen)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (operators/drivers)	onroad LD	23	9,360	G	20	9	3	20	20	0.84222	0.08407	95%	1.0	0.1	372.6	37.2
Pickup/SUV (tradesmen/laborers)	onroad LD	8	3,120	G	20	9	3	20	20	0.84222	0.08407	95%	0.3	0.0	124.2	12.4
ALTERNATIVE 5																
Tractor Trailer (materials/hauling)	onroad HHD	162	5,994	G	20	9	30	20	20	1.89491	0.18933	95%	15.3	1.5	536.8	53.6
Tractor Trailer (equipment/supplies)	onroad HHD	28	280	G	20	9	30	20	20	1.89491	0.18933	95%	2.7	0.3	25.1	2.5
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	4,230	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	352.5	35.2
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (supervisors/foremen)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (operators/drivers)	onroad LD	20	7,800	G	20	9	3	20	20	0.84222	0.08407	95%	0.8	0.1	310.5	31.0
Pickup/SUV (tradesmen/laborers)	onroad LD	8	3,120	G	20	9	3	20	20	0.84222	0.08407	95%	0.3	0.0	124.2	12.4
ALTERNATIVE 6																
Tractor Trailer (materials/hauling)	onroad HHD	216	6,480	G	20	9	30	20	20	1.89491	0.18933	95%	20.5	2.0	580.3	58.0
Tractor Trailer (equipment/supplies)	onroad HHD	45	358	G	20	9	30	20	20	1.89491	0.18933	95%	4.2	0.4	32.1	3.2
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	4,230	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	352.5	35.2
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (supervisors/foremen)	onroad LD	4	1,833	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	73.0	7.3
Pickup/SUV (operators/drivers)	onroad LD	31	12,480	G	20	9	3	20	20	0.84222	0.08407	95%	1.3	0.1	496.7	49.6
Pickup/SUV (tradesmen/laborers)	onroad LD	8	3,120	G	20	9	3	20	20	0.84222	0.08407	95%	0.3	0.0	124.2	12.4

Special Note: Daily maximums do not include importing equipment from other areas in state (local emissions only)

Unpaved Roads	lbs/day	lbs/day	tons	tons
ALTERNATIVE 1	81.6	8.2	2.30	0.23
ALTERNATIVE 2	65.5	6.5	1.97	0.20
ALTERNATIVE 3	21.0	2.1	1.15	0.11
ALTERNATIVE 4	8.1	0.8	0.61	0.06
ALTERNATIVE 5	17.6	1.8	0.75	0.07
ALTERNATIVE 6	23.2	2.3	0.87	0.09

Table G-12 Offroad Fugitive Dust Emissions for Maintenance Activities

Earthmoving	Activity		Required Variables								Uncontrolled		Controlled Emissions				
	Pk. Daily	Project	EET	Moist (M)	Silt (s)	Drop (d)	Speed (S)	Wind (U)	Den (D)	Rate (V)	PM_{10}	$PM_{2.5}$	Control	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
	hours	hours	code	percent	percent	feet	mph	mph	ton/cy	cy/hr	lb/hr	lb/hr	%	lb/day	lb/day	lbs	lbs
ALTERNATIVE 1																	
Tractor Scraper	8	224	B+C	20		3	5			30	0.04216	0.15507	95%	0.02	0.06	0.5	1.7
Dump Truck	8	144	B	20		6				30	0.06849	0.00316	95%	0.03	0.00	0.5	0.0
Excavator	8	280	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	0.1	0.0
Dozer	8	40	A	20	9						0.30548	0.17057	95%	0.12	0.07	0.6	0.3
Grader	8	200	C	20			4				1.98400	0.15360	95%	0.79	0.06	19.8	1.5
Clamshell Derrick	-	-	B	20		9				30	0.09097	0.00493	95%	0.00	0.00	0.0	0.0
Crane Rig	-	-	C	20			1				0.03100	0.00120	95%	0.00	0.00	0.0	0.0
Backhoe	8	192	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.0	0.0
Tractor	8	24	C	20			3				0.83700	0.05612	95%	0.33	0.02	1.0	0.1
ALTERNATIVE 2																	
Tractor Scraper	8	216	B+C	20		3	5			30	0.04216	0.15507	95%	0.02	0.06	0.5	1.7
Dump Truck	8	152	B	20		6				30	0.06849	0.00316	95%	0.03	0.00	0.5	0.0
Excavator	8	304	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	0.1	0.0
Dozer	8	48	A	20	9						0.30548	0.17057	95%	0.12	0.07	0.7	0.4
Grader	8	200	C	20			4				1.98400	0.15360	95%	0.79	0.06	19.8	1.5
Clamshell Derrick	-	-	B	20		9				30	0.09097	0.00493	95%	0.00	0.00	0.0	0.0
Crane Rig	-	-	C	20			1				0.03100	0.00120	95%	0.00	0.00	0.0	0.0
Backhoe	8	88	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.0	0.0
Tractor	8	24	C	20			3				0.83700	0.05612	95%	0.33	0.02	1.0	0.1
ALTERNATIVE 3																	
Tractor Scraper	8	224	B+C	20		3	5			30	0.04216	0.15507	95%	0.02	0.06	0.5	1.7
Dump Truck	8	152	B	20		6				30	0.06849	0.00316	95%	0.03	0.00	0.5	0.0
Excavator	8	352	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	0.1	0.0
Dozer	8	48	A	20	9						0.30548	0.17057	95%	0.12	0.07	0.7	0.4
Grader	8	200	C	20			4				1.98400	0.15360	95%	0.79	0.06	19.8	1.5
Clamshell Derrick	-	-	B	20		9				30	0.09097	0.00493	95%	0.00	0.00	0.0	0.0
Crane Rig	-	-	C	20			1				0.03100	0.00120	95%	0.00	0.00	0.0	0.0
Backhoe	8	224	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.0	0.0
Tractor	8	24	C	20			3				0.83700	0.05612	95%	0.33	0.02	1.0	0.1
ALTERNATIVE 4																	
Tractor Scraper	8	208	B+C	20		3	5			30	0.04216	0.15507	95%	0.02	0.06	0.4	1.6
Dump Truck	8	144	B	20		6				30	0.06849	0.00316	95%	0.03	0.00	0.5	0.0
Excavator	8	208	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	0.1	0.0
Dozer	8	40	A	20	9						0.30548	0.17057	95%	0.12	0.07	0.6	0.3
Grader	8	200	C	20			4				1.98400	0.15360	95%	0.79	0.06	19.8	1.5
Clamshell Derrick	-	-	B	20		9				30	0.09097	0.00493	95%	0.00	0.00	0.0	0.0
Crane Rig	-	-	C	20			1				0.03100	0.00120	95%	0.00	0.00	0.0	0.0
Backhoe	8	48	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.0	0.0
Tractor	8	24	C	20			3				0.83700	0.05612	95%	0.33	0.02	1.0	0.1
ALTERNATIVE 5																	
Tractor Scraper	8	208	B+C	20		3	5			30	0.04216	0.15507	95%	0.02	0.06	0.4	1.6

Dump Truck	8	144	B	20		6				30	0.06849	0.00316	95%	0.03	0.00	0.5	0.0
Excavator	8	216	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	0.1	0.0
Dozer	8	40	A	20	9						0.30548	0.17057	95%	0.12	0.07	0.6	0.3
Grader	8	200	C	20			4				1.98400	0.15360	95%	0.79	0.06	19.8	1.5
Clamshell Derrick	-	-	B	20		9				30	0.09097	0.00493	95%	0.00	0.00	0.0	0.0
Crane Rig	-	-	C	20			1				0.03100	0.00120	95%	0.00	0.00	0.0	0.0
Backhoe	8	56	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.0	0.0
Tractor	8	24	C	20			3				0.83700	0.05612	95%	0.33	0.02	1.0	0.1
ALTERNATIVE 6																	
Tractor Scraper	8	216	B+C	20		3	5			30	0.04216	0.15507	95%	0.02	0.06	0.5	1.7
Dump Truck	8	144	B	20		6				30	0.06849	0.00316	95%	0.03	0.00	0.5	0.0
Excavator	8	232	D	20				6.7	1.5	60	0.00577	0.00089	95%	0.00	0.00	0.1	0.0
Dozer	8	40	A	20	9						0.30548	0.17057	95%	0.12	0.07	0.6	0.3
Grader	8	200	C	20			4				1.98400	0.15360	95%	0.79	0.06	19.8	1.5
Clamshell Derrick	-	-	B	20		9				30	0.09097	0.00493	95%	0.00	0.00	0.0	0.0
Crane Rig	-	-	C	20			1				0.03100	0.00120	95%	0.00	0.00	0.0	0.0
Backhoe	8	104	D	20				6.7	1.5	20	0.00192	0.00030	95%	0.00	0.00	0.0	0.0
Tractor	8	24	C	20			3				0.83700	0.05612	95%	0.33	0.02	1.0	0.1

Onsite Equipment	lbs/day	lbs/day	tons	tons
ALTERNATIVE 1	1.3	0.2	0.011	0.002
ALTERNATIVE 2	1.3	0.2	0.011	0.002
ALTERNATIVE 3	1.3	0.2	0.011	0.002
ALTERNATIVE 4	1.3	0.2	0.011	0.002
ALTERNATIVE 5	1.3	0.2	0.011	0.002
ALTERNATIVE 6	1.3	0.2	0.011	0.002

Construction Earthmoving	Activity		Required Variables								Uncontrolled		Controlled Emissions				
	Pk. Daily	Project	EET	Moist (M)	Silt (s)	Drop (d)	Speed (S)	Wind (U)	Den (D)	Rate (V)	PM_{10}	$PM_{2.5}$	Control	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
	hours	hours	code	percent	percent	feet	mph	mph	ton/cy	cy/hr	lb/hr	lb/hr	%	lb/day	lb/day	lbs	lbs
Bulldozer (tracked)			A	7	9						1.32827	0.66775	56%	0.00	0.00	0.0	0.0
Bulldozer (wheeled)			A	7	9						0.99621	0.50081	56%	0.00	0.00	0.0	0.0
Scraper			B+C	7		3	5			30	0.89477	0.15562	56%	0.00	0.00	0.0	0.0
Dump Truck/ADT			B	7		6				30	0.09385	0.00432	56%	0.00	0.00	0.0	0.0
Clamshell Derrick			B	7		9				30	0.12465	0.00675	56%	0.00	0.00	0.0	0.0
Dragline (small)			B	7		12				60	0.30491	0.01854	56%	0.00	0.00	0.0	0.0
Grader			C	7			4				1.98400	0.15360	56%	0.00	0.00	0.0	0.0
Tractor			C	7			3				0.83700	0.05612	56%	0.00	0.00	0.0	0.0
Compactor			C	7			2				0.24800	0.01358	56%	0.00	0.00	0.0	0.0
Crane			C	7			1				0.03100	0.00120	56%	0.00	0.00	0.0	0.0
Backhoe			D	7				6.7	1.5	20	0.00836	0.00129	56%	0.00	0.00	0.0	0.0
Bobcat			D	7				6.7	1.5	10	0.00418	0.00065	56%	0.00	0.00	0.0	0.0
Drill auger			D	7				6.7	1.5	10	0.00418	0.00065	56%	0.00	0.00	0.0	0.0
Excavator			D	7				6.7	1.5	60	0.02507	0.00387	56%	0.00	0.00	0.0	0.0
Front end loader			D	7				6.7	1.5	30	0.01254	0.00194	56%	0.00	0.00	0.0	0.0
Concrete grinder			E	10					1.9	40	0.18240	0.03040	78%	0.00	0.00	0.0	0.0

Screener (coarse)			F	18					1.9	40	0.66120	0.04560	92%	0.00	0.00	0.0	0.0

EET Code A

AP-42 Chapter 11.9 for bulldozer, tractor dozer (Tables 11.9-1):

$E = 0.75 * 1.0 * (s)^{1.5} / (M)^{1.4}$ for PM_{10}

$E = 0.105 * 5.7 * (s)^{1.2} / (M)^{1.3}$ for $PM_{2.5}$

Simplifies to $E = 0.75 * (s)^{1.5} / (M)^{1.4}$ for PM_{10}

Simplifies to $E = 0.60 * (s)^{1.2} / (M)^{1.3}$ for $PM_{2.5}$

E = lb/hr fugitive

s = silt content, percent

M = moisture content, percent

EET Code B

AP-42 Chapter 11.9 for small dragline, clamshell, dumping, scraper (Table 11.9-1):

$E = 0.75 * 0.0021 * (d)^{0.7} / (M)^{0.3}$ for PM_{10}

$E = 0.017 * 0.0021 * (d)^{1.1} / (M)^{0.3}$ for $PM_{2.5}$

Simplifies to $E = 1.6e\text{-}3 * (d)^{0.7} / (M)^{0.3}$ for PM_{10}

Simplifies to $E = 3.6e\text{-}5 * (d)^{1.1} / (M)^{0.3}$ for $PM_{2.5}$

E = lb/cy * cy/hr = lb/hr fugitive

M = moisture content, percent

d = drop distance = 12 feet (small dragline)

d = drop distance = 9 feet (clamshell)

d = drop distance = 6 feet (dump truck/ADT)

d = drop distance = 3 feet (scraper)

EET Code C

AP-42 Chapter 11.9 for scraper, grader, tractor, compactor, crane (Table 11.9-1) :

$E = S * 0.60 * 0.051 \times (S)^{2.0}$ for PM_{10}

$E = S * 0.031 * 0.040 \times (S)^{2.5}$ for $PM_{2.5}$

Simplifies to $E = 0.031 \times (S)^{3.0}$ for PM_{10}

Simplifies to $E = 0.0012 \times (S)^{3.5}$ for $PM_{2.5}$

E = lb/VMT * VMT/hr = lb/hr fugitive

S = Mean Vehicle Speed = 5 mph (scrapers)

S = Mean Vehicle Speed = 4 mph (graders)

S = Mean Vehicle Speed = 3 mph (tractors)

S = Mean Vehicle Speed = 2 mph (compactors)

S = Mean Vehicle Speed = 1 mph (cranes)

EET Code D

AP-42 Chapter 13.2.4 Loading/Handling (backhoe, Bobcat, drill auger, excavator, backhoe, front end loader):

$E = V * D * 0.35 * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ for PM_{10}

$E = V * D * 0.053 * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ for $PM_{2.5}$

Simplifies to $E = V * D * 1.1e\text{-}3 * (U/5)^{1.3} / (M/2)^{1.4}$ for PM_{10}

Simplifies to $E = V * D * 1.7e\text{-}4 * (U/5)^{1.3} / (M/2)^{1.4}$ for $PM_{2.5}$

V = cy/hr

M = moisture content, percent

E = lb/ton * tons/cy * cy/hr = lb/hr fugitive

D = 1.3 tons/cy for sand or cinder concrete

D = 1.5 tons/cy for soil (typical)

D = 1.9 tons/cy for sandstone or stone concrete

D = 2.1 tons/cy for granite rock

U = wind speed = 1 m/s or 2.2 mi/hr (light air)

U = wind speed = 2 m/s or 4.5 mi/hr (light breeze)

U = wind speed = 3 m/s or 6.7 mi/hr (light breeze)

U = wind speed = 4 m/s or 8.9 mi/hr (gentle breeze)

U = wind speed = 5 m/s or 11.2 mi/hr (gentle breeze)

U = wind speed = 6 m/s or 13.4 mi/hr (moderate breeze)

U = wind speed = 7 m/s or 15.7 mi/hr (moderate breeze)

EET Code E

AP-42 Chapter 11.19.2 Coarse Tertiary Crushing

E = 0.0024 lb/ton uncontrolled PM_{10}

E = 0.0004 lb/ton uncontrolled $PM_{2.5}$

E = D * V * 0.0024 lb/hr uncontrolled PM10

E = D * V* 0.0004 lb/hr uncontrolled PM2.5

V = cy/hr

E = lb/ton * tons/cy * cy/hr = lb/hr fugitive

D = 1.3 tons/cy for sand or cinder concrete

D = 1.9 tons/cy for sandstone or stone concrete

D = 2.1 tons/cy for granite rock

Control efficiency = 78% where applicable (water spray)

EET Code F

AP-42 Chapter 11.19.2 Coarse Screening

E = 0.0087 lb/ton uncontrolled PM_{10}

E = 0.0006 lb/ton uncontrolled $PM_{2.5}$

E = D * V * 0.0087 lb/hr uncontrolled PM10

E = D * V * 0.0006 lb/hr uncontrolled PM2.5

V = cy/hr

E = lb/ton * tons/cy * cy/hr = lb/hr fugitive

D = 1.3 tons/cy for sand or cinder concrete

D = 1.9 tons/cy for sandstone or stone concrete

D = 2.1 tons/cy for granite rock

Control efficiency = 92% where applicable (water spray)

Apdx G - Maintenance Onroad Dust
Table G-13

Table G-13 Onroad Fugitive Dust Emissions for Maintenance Activities					
All Roads Travelled	Vehicle Category	Activity		Usage	
		Pk. Daily	Project	Unpaved	Paved
		VMT	VMT	%	%
ALTERNATIVE 1					
Tractor Trailer (materials/hauling)	onroad HHD	100	3,700	11%	89%
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	250	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	6%	94%
ALTERNATIVE 2					
Tractor Trailer (materials/hauling)	onroad HHD	100	3,400	11%	89%
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	250	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	6%	94%
ALTERNATIVE 3					
Tractor Trailer (materials/hauling)	onroad HHD	100	4,500	2%	98%
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	250	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	6%	94%
ALTERNATIVE 4					
Tractor Trailer (materials/hauling)	onroad HHD	100	2,000	2%	98%
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				

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Water Truck (dust control)	onroad HHD	10	250	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	6%	94%
ALTERNATIVE 5					
Tractor Trailer (materials/hauling)	onroad HHD	100	2,000	6%	94%
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	250	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	6%	94%
ALTERNATIVE 6					
Tractor Trailer (materials/hauling)	onroad HHD	100	2,600	6%	94%
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	1%	99%
Cement Truck (concrete/pumping)	onroad HHD				
Dump Truck (soil/sand/gravel transport)	onroad HHD				
Water Truck (dust control)	onroad HHD	10	250	90%	10%
Work Truck (all trades)	onroad MD				
Pickup/SUV (managers/engineers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	6%	94%
Pickup/SUV (operators/drivers)	onroad LD	65	15,275	6%	94%
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	6%	94%

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Table G-13

Unpaved Road Dust	Vehicle Category	Activity		Required Variables						Uncontrolled		Controlled Emissions				
		Pk. Daily	Project	EET	Moist (M)	Silt (s)	Weight (W)	Speed (S)	Precip (P)	PM_{10}	$PM_{2.5}$	Control	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
		VMT	VMT	code	percent	percent	tons	mph	days/yr	lb/VMT	lb/VMT	%	lb/day	lb/day	lbs	lbs
ALTERNATIVE 1																
Tractor Trailer (materials/hauling)	onroad HHD	11	407	G	20	9	30	20	20	1.89491	0.18933	95%	1.0	0.1	36.4	3.6
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	G	20	9	30	20	20	1.89491	0.18933	95%	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	225	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	18.7	1.9
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
ALTERNATIVE 2																
Tractor Trailer (materials/hauling)	onroad HHD	11	374	G	20	9	30	20	20	1.89491	0.18933	95%	1.0	0.1	33.5	3.3
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	G	20	9	30	20	20	1.89491	0.18933	95%	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	225	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	18.7	1.9
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
ALTERNATIVE 3																
Tractor Trailer (materials/hauling)	onroad HHD	2	90	G	20	9	30	20	20	1.89491	0.18933	95%	0.2	0.0	8.1	0.8
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	G	20	9	30	20	20	1.89491	0.18933	95%	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	225	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	18.7	1.9
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
ALTERNATIVE 4																
Tractor Trailer (materials/hauling)	onroad HHD	2	40	G	20	9	30	20	20	1.89491	0.18933	95%	0.2	0.0	3.6	0.4
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	G	20	9	30	20	20	1.89491	0.18933	95%	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	225	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	18.7	1.9
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-

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ALTERNATIVE 5																
Tractor Trailer (materials/hauling)	onroad HHD	6	120	G	20	9	30	20	20	1.89491	0.18933	95%	0.6	0.1	10.7	1.1
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	G	20	9	30	20	20	1.89491	0.18933	95%	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	225	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	18.7	1.9
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
ALTERNATIVE 6																
Tractor Trailer (materials/hauling)	onroad HHD	6	156	G	20	9	30	20	20	1.89491	0.18933	95%	0.6	0.1	14.0	1.4
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	G	20	9	30	20	20	1.89491	0.18933	95%	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Dump Truck (soil/sand/gravel transport)	onroad HHD			G	20	9	30	20	20	1.89491	0.18933	95%				
Water Truck (dust control)	onroad HHD	9	225	G	20	9	30	5	20	1.76315	0.17616	95%	0.8	0.1	18.7	1.9
Work Truck (all trades)	onroad MD			G	20	9	8	20	20	1.16343	0.11619	95%				
Pickup/SUV (managers/engineers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	4	917	G	20	9	3	20	20	0.84222	0.08407	95%	0.2	0.0	36.5	3.6
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	G	20	9	3	20	20	0.84222	0.08407	95%	-	-	-	-

Special Note: Daily maximums do not include importing equipment from other areas in state (local emissions only)

Unpaved Roads	lbs/day	lbs/day	tons	tons
ALTERNATIVE 1	**2.2**	**0.2**	**0.06**	**0.01**
ALTERNATIVE 2	**2.2**	**0.2**	**0.06**	**0.01**
ALTERNATIVE 3	**1.3**	**0.1**	**0.05**	**0.00**
ALTERNATIVE 4	**1.3**	**0.1**	**0.05**	**0.00**
ALTERNATIVE 5	**1.7**	**0.2**	**0.05**	**0.01**
ALTERNATIVE 6	**1.7**	**0.2**	**0.05**	**0.01**

Paved Road Dust	Vehicle Category	Activity		Required Variables						Uncontrolled			Controlled Emissions			
		Pk. Daily	Project	EET	Moist (M)	Silt (sL)	Weight (W)	Speed (S)	Precip (P)	PM_{10}	$PM_{2.5}$	Control	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
		VMT	VMT	code	percent	g/m^2	tons	mph	days/yr	lb/VMT	lb/VMT	%	lb/day	lb/day	lbs	lbs
ALTERNATIVE 1																
Tractor Trailer (materials/hauling)	onroad HHD	89	3,293	H	--	0.2	30	--	20	0.01633	0.00401	--	1.5	0.4	53.0	13.0
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	H	--	0.015	30	--	20	0.00155	0.00038	--	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Dump Truck (soil/sand/gravel transport)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Water Truck (dust control)	onroad HHD	1	25	H	--	0.2	30	--	20	0.01633	0.00401	--	0.0	0.0	0.4	0.1
Work Truck (all trades)	onroad MD			H	--	0.2	8	--	20	0.00424	0.00104	--				
Pickup/SUV (managers/engineers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
ALTERNATIVE 2																
Tractor Trailer (materials/hauling)	onroad HHD	89	3,026	H	--	0.2	30	--	20	0.01633	0.00401	--	1.5	0.4	48.7	12.0

Tractor Trailer (equipment/supplies)	onroad HHD	0	0	H	--	0.015	30	--	20	0.00155	0.00038	--	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Dump Truck (soil/sand/gravel transport)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Water Truck (dust control)	onroad HHD	1	25	H	--	0.2	30	--	20	0.01633	0.00401	--	0.0	0.0	0.4	0.1
Work Truck (all trades)	onroad MD			H	--	0.2	8	--	20	0.00424	0.00104	--				
Pickup/SUV (managers/engineers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
ALTERNATIVE 3																
Tractor Trailer (materials/hauling)	onroad HHD	98	4,410	H	--	0.2	30	--	20	0.01633	0.00401	--	1.6	0.4	71.0	17.4
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	H	--	0.015	30	--	20	0.00155	0.00038	--	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Dump Truck (soil/sand/gravel transport)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Water Truck (dust control)	onroad HHD	1	25	H	--	0.2	30	--	20	0.01633	0.00401	--	0.0	0.0	0.4	0.1
Work Truck (all trades)	onroad MD			H	--	0.2	8	--	20	0.00424	0.00104	--				
Pickup/SUV (managers/engineers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
ALTERNATIVE 4																
Tractor Trailer (materials/hauling)	onroad HHD	98	1,960	H	--	0.2	30	--	20	0.01633	0.00401	--	1.6	0.4	31.6	7.7
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	H	--	0.015	30	--	20	0.00155	0.00038	--	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Dump Truck (soil/sand/gravel transport)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Water Truck (dust control)	onroad HHD	1	25	H	--	0.2	30	--	20	0.01633	0.00401	--	0.0	0.0	0.4	0.1
Work Truck (all trades)	onroad MD			H	--	0.2	8	--	20	0.00424	0.00104	--				
Pickup/SUV (managers/engineers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
ALTERNATIVE 5																
Tractor Trailer (materials/hauling)	onroad HHD	94	1,880	H	--	0.2	30	--	20	0.01633	0.00401	--	1.5	0.4	30.3	7.4
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	H	--	0.015	30	--	20	0.00155	0.00038	--	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Dump Truck (soil/sand/gravel transport)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Water Truck (dust control)	onroad HHD	1	25	H	--	0.2	30	--	20	0.01633	0.00401	--	0.0	0.0	0.4	0.1
Work Truck (all trades)	onroad MD			H	--	0.2	8	--	20	0.00424	0.00104	--				
Pickup/SUV (managers/engineers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
ALTERNATIVE 6																
Tractor Trailer (materials/hauling)	onroad HHD	94	2,444	H	--	0.2	30	--	20	0.01633	0.00401	--	1.5	0.4	39.4	9.7
Tractor Trailer (equipment/supplies)	onroad HHD	0	0	H	--	0.015	30	--	20	0.00155	0.00038	--	-	-	-	-
Cement Truck (concrete/pumping)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				
Dump Truck (soil/sand/gravel transport)	onroad HHD			H	--	0.2	30	--	20	0.01633	0.00401	--				

Water Truck (dust control)	onroad HHD	1	25	H	--	0.2	30	--	20	0.01633	0.00401	--	0.0	0.0	0.4	0.1
Work Truck (all trades)	onroad MD			H	--	0.2	8	--	20	0.00424	0.00104	--				
Pickup/SUV (managers/engineers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (supervisors/foremen)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-
Pickup/SUV (operators/drivers)	onroad LD	61	14,359	H	--	0.2	3	--	20	0.00156	0.00038	--	0.1	0.0	22.1	5.4
Pickup/SUV (tradesmen/laborers)	onroad LD	0	0	H	--	0.2	3	--	20	0.00156	0.00038	--	-	-	-	-

Special Note: Daily maximums do not include importing equipment from other areas in state (local emissions only)

Paved Roads	lbs/day	lbs/day	tons	tons
ALTERNATIVE 1	**1.7**	**0.4**	**0.05**	**0.01**
ALTERNATIVE 2	**1.7**	**0.4**	**0.05**	**0.01**
ALTERNATIVE 3	**1.8**	**0.4**	**0.06**	**0.01**
ALTERNATIVE 4	**1.8**	**0.4**	**0.04**	**0.01**
ALTERNATIVE 5	**1.7**	**0.4**	**0.04**	**0.01**
ALTERNATIVE 6	**1.7**	**0.4**	**0.04**	**0.01**

All Roads	lbs/day	lbs/day	tons	tons
ALTERNATIVE 1	**3.8**	**0.6**	**0.11**	**0.02**
ALTERNATIVE 2	**3.8**	**0.6**	**0.11**	**0.02**
ALTERNATIVE 3	**3.1**	**0.6**	**0.11**	**0.02**
ALTERNATIVE 4	**3.1**	**0.6**	**0.09**	**0.01**
ALTERNATIVE 5	**3.4**	**0.6**	**0.09**	**0.01**
ALTERNATIVE 6	**3.4**	**0.6**	**0.09**	**0.02**

EET Code G

Unpaved Road Dust (AP-42 Section 13.2.2):

$E = [1.5 * (s/12)^{0.9} * (W/3)^{0.45}] * P_C * (1\text{-}CE)$ for PM_{10}

$E = [1.8 * (s/12)^{1.0} * (S/30)^{0.5} / (M/0.5)^{0.2} - 0.00047] * P_C * (1\text{-}CE)$ for PM_{10}

$E = [0.15 * (s/12)^{0.9} * (W/3)^{0.45}] * P_C * (1\text{-}CE)$ for $PM_{2.5}$

$E = [0.18 * (s/12)^{1.0} * (S/30)^{0.5} / (M/0.5)^{0.2} - 0.00036] * P_C * (1\text{-}CE)$ for $PM_{2.5}$

Equation pairs calculated for average factoring of both vehicle weight and speed

s = silt content, percent

W = average vehicle weight (see below)

M = moisture content, percent

S = mean vehicle speed = 5-10 mph for watering trucks

S = mean vehicle speed = 15 mph for haul roads (general mitigation measure)

S = mean vehicle speed = 20 mph for graded dirt/gravel roads

E = lb/VMT fugitive

$P_C = (365-P)/365$

P = Number of wet days over 0.01 in precipitation for averaging period (from AP-42 Figure 13.2.1-2

Note: precipitation correction not used ($P_C = 1$) for worst case day calculations

CE = control efficiency for watering (moisture content)

Light Duty = 3 tons average

Medium Duty = 8 tons average

Heavy Heavy Duty = 30 tons average (loaded 40 tons, unloaded 20 tons)

EET Code H

Paved Road Dust (New AP-42 Section 13.2.1):

$E = 0.0022 * (sL)^{0.91} * (W)^{1.02} * P_C$ for PM_{10}

$E = 0.00054 * (sL)^{0.91} * (W)^{1.02} * P_C$ for $PM_{2.5}$

E = lb/VMT fugitive

sL = Silt Loading from Table 13.2.1-2

W = Average weight of vehicles in tons (below)

$P_C = (1-P/4N)$

P = Number of wet days over 0.01 in precipitation for averaging period (from AP-42 Figure 13.2.1-2)

N = days of period = 365 days (4N = 1460)

Note: precipitation correction not used ($P_C = 1$) for worst case day calculations

Light Duty = 3 tons average (loaded)

Medium Duty = 8 tons average (loaded)

Heavy Heavy Duty = 30 tons average (loaded 40 tons, unloaded 20 tons)

Table G-14 Operational Indirect GHG Emissions from Electric Power Consumption (water pumping)							
Parameter	**Units**	**Alternative**					
		1	**2**	**3**	**4**	**5**	**6**
Total Pumping Ouput Power	BHP	975	838	1,288	600	350	1,013
Conversion Efficiency	percent	92%	92%	92%	92%	92%	92%
Input Power	KW	791	679	1,044	487	284	821
Daily Schedule	hours	24	24	24	24	24	24
Daily Power Requirement	KW-hrs	18,974	16,298	25,055	11,676	6,811	19,704
Annual Schedule	hours	8,760	8,760	8,760	8,760	8,760	8,760
Annual Power Requirement	**MW-hrs**	**6,925**	**5,949**	**9,145**	**4,262**	**2,486**	**7,192**
Carbon Dioxide (GHG - CO_2)	lb/MW-hr	724.12	724.12	724.12	724.12	724.12	724.12
Methane (GHG - CH_4)	lb/MW-hr	0.0302	0.0302	0.0302	0.0302	0.0302	0.0302
Nitrous Oxide (GHG - N_2O)	lb/MW-hr	0.0081	0.0081	0.0081	0.0081	0.0081	0.0081
Carbon Dioxide Equivalents (CO_2 eqv)	lb/MW-hr	727.27	727.27	727.27	727.27	727.27	727.27
Carbon Dioxide (GHG - CO_2)	tonnes/yr	2,275	1,954	3,004	1,120	817	2,362
Methane (GHG - CH_4)	tonnes/yr	0.05	0.08	0.05	0.13	0.03	0.10
Nitrous Oxide (GHG - N_2O)	tonnes/yr	0.03	0.02	0.01	0.03	0.01	0.03
Carbon Dioxide Equivalents (CO_2 eqv)	**tonnes/yr**	**2,284**	**1,962**	**1,324**	**1,406**	**820**	**2,373**
Source: CCAR 2009 (CAMX - California); USEPA 2011							

Table G-15 SCAB Fleet Average Emission Factors (Diesel)

A-19 Offroad 2013

Air Basin	SC

Extrapolation (down)
Interpolation
Extrapolation (up)

Equipment	MaxHP	ROG (lb/hr)	CO (lb/hr)	NOX (lb/hr)	SOX (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)	CO2 (lb/hr)	CH4 (lb/hr)	N2O (lb/hr)	CO2 eqv (lb/hr)
	10	0.0068	0.0352	0.0424	0.0001	0.0018	0.0017	5.8	0.0006	0.0003	5.9
Aerial Lifts	15	0.0101	0.0528	0.0637	0.0001	0.0027	0.0025	8.7	0.0009	0.0004	8.8
	25	0.0166	0.0503	0.0937	0.0001	0.0051	0.0047	11.0	0.0015	0.0007	11.2
	50	0.0592	0.1757	0.1840	0.0003	0.0156	0.0143	19.6	0.0053	0.0024	20.5
	85	0.0575	0.2091	0.2799	0.0004	0.0227	0.0209	28.8	0.0052	0.0023	29.7
	120	0.0558	0.2425	0.3758	0.0004	0.0299	0.0275	38.1	0.0050	0.0022	38.9
	500	0.1191	0.4671	1.5310	0.0021	0.0448	0.0413	213	0.0107	0.0048	214.6
	750	0.2221	0.8443	2.8534	0.0039	0.0825	0.0759	385	0.0200	0.0089	387.9
	800	0.2369	0.9006	3.0436	0.0041	0.0880	0.0810	410.4	0.0214	0.0095	413.8
Aerial Lifts Composite		0.0529	0.1925	0.3059	0.0004	0.0202	0.0186	34.7	0.0048	0.0021	35.5
Air Compressors	15	0.0122	0.0484	0.0732	0.0001	0.0048	0.0044	7.2	0.0011	0.0005	7.4
	25	0.0266	0.0744	0.1306	0.0002	0.0081	0.0074	14.4	0.0024	0.0011	14.8
	50	0.0921	0.2546	0.2221	0.0003	0.0220	0.0203	22.3	0.0083	0.0037	23.6
	120	0.0825	0.3251	0.4991	0.0006	0.0456	0.0419	47.0	0.0074	0.0033	48.1
	175	0.1059	0.5054	0.8385	0.0010	0.0472	0.0434	88.5	0.0096	0.0042	90.0
	250	0.1007	0.2955	1.1320	0.0015	0.0347	0.0319	131	0.0091	0.0040	132.7
	500	0.1626	0.5399	1.7639	0.0023	0.0570	0.0525	232	0.0147	0.0065	234.1
	750	0.2547	0.8344	2.8139	0.0036	0.0898	0.0826	358	0.0230	0.0102	361.8
	1000	0.4190	1.4213	5.0841	0.0049	0.1474	0.1356	486	0.0378	0.0168	492.4
Air Compressors Composite		0.0913	0.3376	0.6065	0.0007	0.0434	0.0399	63.6	0.0082	0.0037	64.9
Bore/Drill Rigs	15	0.0120	0.0632	0.0754	0.0002	0.0029	0.0027	10.3	0.0011	0.0005	10.5
	25	0.0193	0.0658	0.1226	0.0002	0.0049	0.0045	16.0	0.0017	0.0008	16.3
	50	0.0289	0.2282	0.2568	0.0004	0.0120	0.0110	31.0	0.0026	0.0012	31.5
	120	0.0447	0.4698	0.4583	0.0009	0.0257	0.0237	77.1	0.0040	0.0018	77.8
	175	0.0704	0.7538	0.6931	0.0016	0.0302	0.0277	141	0.0063	0.0028	142.1
	250	0.0795	0.3429	0.7632	0.0021	0.0221	0.0203	188	0.0072	0.0032	189.2
	500	0.1295	0.5517	1.1717	0.0031	0.0361	0.0332	311	0.0117	0.0052	313.2
	750	0.2565	1.0899	2.3376	0.0062	0.0715	0.0658	615	0.0231	0.0103	618.8
	1000	0.4163	1.6675	5.9553	0.0093	0.1544	0.1420	928	0.0376	0.0167	934.2
Bore/Drill Rigs Composite		0.0786	0.5044	0.8125	0.0017	0.0302	0.0278	165	0.0071	0.0032	166.1
Cement and Mortar Mixers	15	0.0074	0.0386	0.0470	0.0001	0.0021	0.0020	6.3	0.0007	0.0003	6.4
	25	0.0270	0.0813	0.1510	0.0002	0.0083	0.0076	17.6	0.0024	0.0011	17.9
Cement and Mortar Mixers Composite		0.0091	0.0421	0.0556	0.0001	0.0026	0.0024	7.2	0.0008	0.0004	7.4
Concrete/Industrial Saws	25	0.0199	0.0678	0.1257	0.0002	0.0049	0.0045	16.5	0.0018	0.0008	16.8
	50	0.0955	0.2918	0.2858	0.0004	0.0247	0.0227	30.2	0.0086	0.0038	31.6
	120	0.1065	0.4836	0.7154	0.0009	0.0589	0.0542	74.1	0.0096	0.0043	75.7
	175	0.1569	0.8701	1.3612	0.0018	0.0706	0.0649	160	0.0142	0.0063	162.4
Concrete/Industrial Saws Composite		0.1002	0.4088	0.5572	0.0007	0.0452	0.0416	58.5	0.0090	0.0040	59.9
Cranes	50	0.1015	0.2892	0.2394	0.0003	0.0239	0.0220	23.2	0.0092	0.0041	24.6
	120	0.0919	0.3618	0.5508	0.0006	0.0493	0.0453	50.1	0.0083	0.0037	51.5
	175	0.1031	0.4821	0.7769	0.0009	0.0445	0.0410	80.3	0.0093	0.0041	81.8

	250	0.1040	0.2948	0.9948	0.0013	0.0351	0.0323	112	0.0094	0.0042	113.6
	350	0.1245	0.3886	1.1661	0.0015	0.0418	0.0384	139.3	0.0112	0.0050	141.1
	500	0.1551	0.5292	1.4230	0.0018	0.0518	0.0477	180	0.0140	0.0062	182.3
	750	0.2625	0.8887	2.4614	0.0030	0.0885	0.0814	303	0.0237	0.0105	306.8
	1000	0.9491	3.3249	10.3665	0.0098	0.3189	0.2934	971	0.0856	0.0381	984.2
Cranes Composite		0.1348	0.4737	1.1934	0.0014	0.0508	0.0468	129	0.0122	0.0054	130.6
Crawler Tractors	50	0.1176	0.3246	0.2627	0.0003	0.0270	0.0248	24.9	0.0106	0.0047	26.6
	120	0.1293	0.4858	0.7686	0.0008	0.0677	0.0623	65.8	0.0117	0.0052	67.7
	125	0.1328	0.5093	0.8127	0.0008	0.0681	0.0626	70.8	0.0120	0.0053	72.7
	175	0.1674	0.7448	1.2529	0.0014	0.0713	0.0656	121	0.0151	0.0067	123.6
	250	0.1764	0.5000	1.5945	0.0019	0.0613	0.0564	166	0.0159	0.0071	168.7
	500	0.2542	0.9504	2.2389	0.0025	0.0868	0.0799	259	0.0229	0.0102	262.9
	750	0.4574	1.6983	4.1042	0.0047	0.1573	0.1447	465	0.0413	0.0183	471.2
	1000	0.6901	2.6950	7.3731	0.0066	0.2361	0.2172	658	0.0623	0.0277	668.0
Crawler Tractors Composite		0.1584	0.5900	1.1593	0.0013	0.0697	0.0641	114	0.0143	0.0064	116.3
Crushing/Proc. Equipment	50	0.1741	0.5009	0.4359	0.0006	0.0422	0.0389	44.0	0.0157	0.0070	46.5
	120	0.1402	0.5764	0.8552	0.0010	0.0779	0.0717	83.1	0.0127	0.0056	85.2
	175	0.1942	0.9615	1.5237	0.0019	0.0864	0.0795	167	0.0175	0.0078	170.0
	250	0.1848	0.5425	2.0202	0.0028	0.0620	0.0571	245	0.0167	0.0074	247.2
	500	0.2608	0.8480	2.7097	0.0037	0.0884	0.0813	374	0.0235	0.0105	377.4
	750	0.4147	1.3191	4.4498	0.0059	0.1418	0.1305	589	0.0374	0.0166	594.8
	1000	1.1270	3.6752	13.3218	0.0131	0.3880	0.3569	1,308	0.1017	0.0452	1323.9
Crushing/Proc. Equipment Composite		0.1733	0.6773	1.1752	0.0015	0.0748	0.0688	132	0.0156	0.0070	134.8
Dumpers/Tenders	25	0.0097	0.0320	0.0601	0.0001	0.0029	0.0027	7.6	0.0009	0.0004	7.8
Dumpers/Tenders Composite		0.0097	0.0320	0.0601	0.0001	0.0029	0.0027	7.6	0.0009	0.0004	7.8
Excavators	25	0.0198	0.0677	0.1253	0.0002	0.0047	0.0043	16.4	0.0018	0.0008	16.7
	50	0.0816	0.2841	0.2458	0.0003	0.0212	0.0195	25.0	0.0074	0.0033	26.2
	120	0.1086	0.5177	0.6791	0.0009	0.0586	0.0539	73.6	0.0098	0.0044	75.2
	175	0.1208	0.6668	0.8932	0.0013	0.0512	0.0471	112	0.0109	0.0048	114.0
	200	0.1220	0.5626	0.9741	0.0014	0.0466	0.0428	127.7	0.0110	0.0049	129.5
	250	0.1242	0.3541	1.1360	0.0018	0.0372	0.0343	159	0.0112	0.0050	160.5
	500	0.1735	0.5271	1.4763	0.0023	0.0516	0.0475	234	0.0157	0.0070	236.2
	750	0.2895	0.8731	2.5290	0.0039	0.0871	0.0802	387	0.0261	0.0116	391.6
Excavators Composite		0.1220	0.5338	0.9071	0.0013	0.0481	0.0442	120	0.0110	0.0049	121.3
Forklifts	50	0.0445	0.1623	0.1431	0.0002	0.0121	0.0111	14.7	0.0040	0.0018	15.3
	120	0.0438	0.2176	0.2788	0.0004	0.0241	0.0222	31.2	0.0040	0.0018	31.9
	175	0.0572	0.3307	0.4261	0.0006	0.0246	0.0226	56.1	0.0052	0.0023	56.9
	250	0.0570	0.1614	0.5281	0.0009	0.0168	0.0154	77.1	0.0051	0.0023	77.9
	500	0.0781	0.2208	0.6592	0.0011	0.0228	0.0210	111	0.0070	0.0031	112.1
Forklifts Composite		0.0541	0.2235	0.3950	0.0006	0.0204	0.0188	54.4	0.0049	0.0022	55.2
Generator Sets	15	0.0149	0.0684	0.1016	0.0002	0.0058	0.0053	10.2	0.0013	0.0006	10.4
	25	0.0266	0.0908	0.1594	0.0002	0.0091	0.0083	17.6	0.0024	0.0011	18.0
	50	0.0872	0.2639	0.2847	0.0004	0.0234	0.0215	30.6	0.0079	0.0035	31.9
	120	0.1106	0.4905	0.7587	0.0009	0.0590	0.0543	77.9	0.0100	0.0044	79.5
	175	0.1347	0.7388	1.2314	0.0016	0.0592	0.0544	142	0.0122	0.0054	143.9
	250	0.1277	0.4365	1.6763	0.0024	0.0464	0.0427	213	0.0115	0.0051	214.3
	500	0.1818	0.7230	2.3955	0.0033	0.0690	0.0635	337	0.0164	0.0073	339.5
	750	0.3035	1.1671	3.9863	0.0055	0.1134	0.1044	544	0.0274	0.0122	548.1
	1000	0.7957	2.8065	10.2314	0.0105	0.2844	0.2616	1,049	0.0718	0.0319	1060.0

Generator Sets Composite		0.0767	0.3045	0.5430	0.0007	0.0324	0.0298	61.0	0.0069	0.0031	62.1
Graders	50	0.1080	0.3263	0.2772	0.0004	0.0262	0.0241	27.5	0.0097	0.0043	29.1
	120	0.1254	0.5310	0.7729	0.0009	0.0676	0.0622	75.0	0.0113	0.0050	76.8
	140	0.1331	0.6050	0.8989	0.0011	0.0660	0.0607	92.8	0.0120	0.0053	94.7
	175	0.1467	0.7345	1.1193	0.0014	0.0631	0.0581	124	0.0132	0.0059	126.0
	250	0.1492	0.4331	1.4184	0.0019	0.0494	0.0454	172	0.0135	0.0060	174.3
	500	0.1855	0.6289	1.6842	0.0023	0.0608	0.0559	229	0.0167	0.0074	232.1
	750	0.3952	1.3289	3.6674	0.0049	0.1306	0.1202	486	0.0357	0.0158	491.4
Graders Composite		0.1446	0.6053	1.1663	0.0015	0.0593	0.0546	133	0.0130	0.0058	134.8
Off-Highway Tractors	120	0.2113	0.7191	1.2368	0.0011	0.1078	0.0992	93.7	0.0191	0.0085	96.8
	175	0.2045	0.8335	1.5337	0.0015	0.0871	0.0801	130	0.0185	0.0082	133.3
	250	0.1641	0.4691	1.4453	0.0015	0.0601	0.0553	130	0.0148	0.0066	132.8
	750	0.6538	2.8815	5.8130	0.0057	0.2353	0.2165	568	0.0590	0.0262	577.5
	1000	0.9818	4.4978	10.0554	0.0082	0.3436	0.3161	814	0.0886	0.0394	828.4
Off-Highway Tractors Composite		0.2077	0.7649	1.7062	0.0017	0.0818	0.0753	151	0.0187	0.0083	154.4
Off-Highway Trucks	175	0.1441	0.7580	1.0305	0.0014	0.0602	0.0554	125	0.0130	0.0058	127.2
	250	0.1400	0.3837	1.2373	0.0019	0.0412	0.0379	167	0.0126	0.0056	168.6
	300	0.1554	0.4342	1.3471	0.0020	0.0457	0.0420	187.7	0.0140	0.0062	189.9
	500	0.2170	0.6362	1.7865	0.0027	0.0634	0.0583	272	0.0196	0.0087	275.4
	750	0.3542	1.0311	2.9938	0.0044	0.1046	0.0962	442	0.0320	0.0142	446.8
	1000	0.5484	1.6691	5.9808	0.0063	0.1796	0.1652	625	0.0495	0.0220	632.6
Off-Highway Trucks Composite		0.2141	0.6361	1.8543	0.0027	0.0644	0.0593	260	0.0193	0.0086	263.1
Other Construction Equipment	15	0.0118	0.0617	0.0737	0.0002	0.0029	0.0026	10.1	0.0011	0.0005	10.3
	25	0.0160	0.0544	0.1013	0.0002	0.0041	0.0037	13.2	0.0014	0.0006	13.4
	50	0.0753	0.2653	0.2585	0.0004	0.0205	0.0189	28.0	0.0068	0.0030	29.1
	120	0.1006	0.5277	0.7025	0.0009	0.0567	0.0522	80.9	0.0091	0.0040	82.3
	175	0.0935	0.5873	0.8011	0.0012	0.0420	0.0386	107	0.0084	0.0038	107.9
	500	0.1452	0.5234	1.5187	0.0025	0.0491	0.0452	254	0.0131	0.0058	256.3
Other Construction Equipment Composite		0.0872	0.3765	0.7938	0.0013	0.0330	0.0304	123	0.0079	0.0035	123.9
Other General Industrial Equipmen	15	0.0066	0.0391	0.0466	0.0001	0.0018	0.0017	6.4	0.0006	0.0003	6.5
	25	0.0185	0.0632	0.1170	0.0002	0.0044	0.0040	15.3	0.0017	0.0007	15.6
	50	0.0980	0.2738	0.2243	0.0003	0.0232	0.0214	21.7	0.0088	0.0039	23.1
	120	0.1177	0.4487	0.6789	0.0007	0.0644	0.0593	62.0	0.0106	0.0047	63.7
	175	0.1261	0.5728	0.9333	0.0011	0.0549	0.0505	95.9	0.0114	0.0051	97.7
	250	0.1174	0.3177	1.2013	0.0015	0.0380	0.0350	136	0.0106	0.0047	137.3
	500	0.2135	0.6384	2.0642	0.0026	0.0693	0.0638	265	0.0193	0.0086	268.5
	750	0.3546	1.0522	3.5146	0.0044	0.1165	0.1072	437	0.0320	0.0142	442.5
	1000	0.5246	1.6793	6.0067	0.0056	0.1805	0.1660	560	0.0473	0.0210	567.1
Other General Industrial Equipmen Composite		0.1542	0.5159	1.3484	0.0016	0.0580	0.0533	152	0.0139	0.0062	154.4
Other Material Handling Equipment	50	0.1361	0.3789	0.3119	0.0004	0.0323	0.0297	30.3	0.0123	0.0055	32.3
	120	0.1144	0.4370	0.6628	0.0007	0.0628	0.0578	60.7	0.0103	0.0046	62.3
	175	0.1591	0.7257	1.1860	0.0014	0.0696	0.0640	122	0.0144	0.0064	124.4
	250	0.1241	0.3385	1.2829	0.0016	0.0405	0.0372	145	0.0112	0.0050	146.8
	275	0.1269	0.3506	1.3035	0.0017	0.0414	0.0381	149.7	0.0114	0.0051	151.5
	500	0.1521	0.4596	1.4883	0.0019	0.0498	0.0458	192	0.0137	0.0061	193.8
	1000	0.7021	2.2197	7.9424	0.0073	0.2379	0.2188	741	0.0634	0.0282	751.4
Other Material Handling Equipment Composite		0.1473	0.4951	1.3132	0.0015	0.0562	0.0517	141	0.0133	0.0059	143.3
Pavers	25	0.0247	0.0799	0.1500	0.0002	0.0075	0.0069	18.7	0.0022	0.0010	19.0
	50	0.1366	0.3592	0.2948	0.0004	0.0308	0.0283	28.0	0.0123	0.0055	29.9

	120	0.1387	0.5057	0.8357	0.0008	0.0729	0.0671	69.2	0.0125	0.0056	71.2
	175	0.1777	0.7784	1.3769	0.0014	0.0769	0.0707	128	0.0160	0.0071	130.8
	250	0.2072	0.6081	1.9469	0.0022	0.0756	0.0695	194	0.0187	0.0083	197.3
	500	0.2275	0.9254	2.1080	0.0023	0.0818	0.0752	233	0.0205	0.0091	236.5
Pavers Composite		0.1511	0.5357	0.8542	0.0009	0.0603	0.0555	77.9	0.0136	0.0061	80.1
Paving Equipment	25	0.0153	0.0520	0.0968	0.0002	0.0039	0.0036	12.6	0.0014	0.0006	12.8
	50	0.1166	0.3049	0.2514	0.0003	0.0263	0.0242	23.9	0.0105	0.0047	25.6
	120	0.1087	0.3958	0.6561	0.0006	0.0574	0.0528	54.5	0.0098	0.0044	56.1
	175	0.1387	0.6079	1.0816	0.0011	0.0602	0.0554	101	0.0125	0.0056	103.0
	250	0.1277	0.3763	1.2206	0.0014	0.0467	0.0430	122	0.0115	0.0051	124.1
Paving Equipment Composite		0.1142	0.4316	0.7709	0.0008	0.0536	0.0493	68.9	0.0103	0.0046	70.6
Plate Compactors	15	0.0050	0.0263	0.0314	0.0001	0.0012	0.0011	4.3	0.0005	0.0002	4.4
Plate Compactors Composite		0.0050	0.0263	0.0314	0.0001	0.0012	0.0011	4.3	0.0005	0.0002	4.4
Pressure Washers	15	0.0071	0.0328	0.0487	0.0001	0.0028	0.0025	4.9	0.0006	0.0003	5.0
	25	0.0108	0.0368	0.0646	0.0001	0.0037	0.0034	7.1	0.0010	0.0004	7.3
	50	0.0315	0.1037	0.1284	0.0002	0.0094	0.0086	14.3	0.0028	0.0013	14.7
	120	0.0302	0.1443	0.2235	0.0003	0.0157	0.0145	24.1	0.0027	0.0012	24.5
Pressure Washers Composite		0.0159	0.0619	0.0878	0.0001	0.0058	0.0053	9.4	0.0014	0.0006	9.6
Pumps	15	0.0125	0.0497	0.0752	0.0001	0.0049	0.0046	7.4	0.0011	0.0005	7.6
	25	0.0359	0.1004	0.1761	0.0002	0.0109	0.0100	19.5	0.0032	0.0014	20.0
	50	0.1052	0.3116	0.3228	0.0004	0.0275	0.0253	34.3	0.0095	0.0042	35.8
	120	0.1149	0.4984	0.7706	0.0009	0.0617	0.0568	77.9	0.0104	0.0046	79.6
	175	0.1385	0.7405	1.2344	0.0016	0.0611	0.0562	140	0.0125	0.0056	142.1
	250	0.1266	0.4210	1.6140	0.0023	0.0457	0.0421	201	0.0114	0.0051	203.2
	500	0.1952	0.7595	2.4849	0.0034	0.0734	0.0675	345	0.0176	0.0078	348.0
	750	0.3326	1.2556	4.2353	0.0057	0.1235	0.1136	571	0.0300	0.0133	575.5
	1000	1.0536	3.7127	13.3750	0.0136	0.3744	0.3444	1,355	0.0951	0.0423	1369.9
Pumps Composite		0.0748	0.2926	0.4705	0.0006	0.0323	0.0297	49.6	0.0067	0.0030	50.7
Rollers	15	0.0074	0.0386	0.0461	0.0001	0.0018	0.0016	6.3	0.0007	0.0003	6.4
	25	0.0161	0.0549	0.1023	0.0002	0.0041	0.0038	13.3	0.0015	0.0006	13.6
	50	0.1025	0.2911	0.2583	0.0003	0.0245	0.0225	26.0	0.0092	0.0041	27.5
	120	0.0986	0.4063	0.6253	0.0007	0.0534	0.0491	59.0	0.0089	0.0040	60.4
	175	0.1247	0.6199	1.0114	0.0012	0.0550	0.0506	108	0.0113	0.0050	109.9
	250	0.1262	0.3887	1.3124	0.0017	0.0451	0.0415	153	0.0114	0.0051	154.9
	500	0.1654	0.6313	1.6820	0.0022	0.0593	0.0545	219	0.0149	0.0066	221.5
Rollers Composite		0.0973	0.4060	0.6546	0.0008	0.0453	0.0417	67.1	0.0088	0.0039	68.4
Rough Terrain Forklifts	50	0.1181	0.3778	0.3316	0.0004	0.0300	0.0276	33.9	0.0107	0.0047	35.6
	120	0.0955	0.4327	0.5995	0.0007	0.0529	0.0487	62.4	0.0086	0.0038	63.8
	175	0.1352	0.7256	1.0448	0.0014	0.0592	0.0545	125	0.0122	0.0054	126.8
	250	0.1294	0.3798	1.2955	0.0019	0.0416	0.0382	171	0.0117	0.0052	172.7
	500	0.1824	0.5717	1.7096	0.0025	0.0584	0.0537	257	0.0165	0.0073	259.2
Rough Terrain Forklifts Composite		0.1009	0.4642	0.6526	0.0008	0.0532	0.0489	70.3	0.0091	0.0040	71.7
Rubber Tired Dozers	175	0.2119	0.8457	1.5561	0.0015	0.0893	0.0821	129	0.0191	0.0085	132.5
	250	0.2435	0.6833	2.0817	0.0021	0.0881	0.0810	183	0.0220	0.0098	187.0
	500	0.3211	1.4228	2.7305	0.0026	0.1133	0.1043	265	0.0290	0.0129	269.5
	750	0.4843	2.1329	4.1797	0.0040	0.1716	0.1579	399	0.0437	0.0194	405.7
	1000	0.7496	3.4322	7.4509	0.0060	0.2591	0.2384	592	0.0676	0.0301	602.6
Rubber Tired Dozers Composite		0.2986	1.1749	2.5452	0.0025	0.1064	0.0979	239	0.0269	0.0120	243.4
Rubber Tired Loaders	25	0.0204	0.0697	0.1292	0.0002	0.0050	0.0046	16.9	0.0018	0.0008	17.2

	50	0.1200	0.3641	0.3118	0.0004	0.0292	0.0269	31.1	0.0108	0.0048	32.9
	120	0.0971	0.4152	0.6015	0.0007	0.0525	0.0483	58.9	0.0088	0.0039	60.3
	175	0.1238	0.6274	0.9501	0.0012	0.0535	0.0492	106	0.0112	0.0050	108.1
	250	0.1259	0.3685	1.2125	0.0017	0.0417	0.0384	149	0.0114	0.0050	150.8
	500	0.1867	0.6397	1.7158	0.0023	0.0613	0.0564	237	0.0168	0.0075	239.7
	750	0.3850	1.3084	3.6184	0.0049	0.1276	0.1174	486	0.0347	0.0154	491.0
	1000	0.5190	1.8389	5.9660	0.0060	0.1795	0.1651	594	0.0468	0.0208	601.3
Rubber Tired Loaders Composite		0.1195	0.4763	0.9346	0.0012	0.0508	0.0467	109	0.0108	0.0048	110.3
Scrapers	120	0.1877	0.6943	1.1141	0.0011	0.0983	0.0904	93.9	0.0169	0.0075	96.6
	175	0.2070	0.9107	1.5564	0.0017	0.0884	0.0813	148	0.0187	0.0083	151.0
	250	0.2252	0.6408	2.0481	0.0024	0.0791	0.0727	209	0.0203	0.0090	212.7
	400	0.2813	0.9831	2.5165	0.0028	0.0976	0.0898	276.6	0.0254	0.0113	280.7
	500	0.3186	1.2113	2.8288	0.0032	0.1099	0.1011	321	0.0287	0.0128	326.0
	750	0.5525	2.0861	4.9949	0.0056	0.1918	0.1764	555	0.0499	0.0222	563.2
Scrapers Composite		0.2783	1.0395	2.4118	0.0027	0.1005	0.0925	262	0.0251	0.0112	266.5
Signal Boards	15	0.0072	0.0377	0.0450	0.0001	0.0018	0.0016	6.2	0.0006	0.0003	6.3
	50	0.1151	0.3456	0.3415	0.0005	0.0296	0.0272	36.2	0.0104	0.0046	37.8
	120	0.1176	0.5214	0.7807	0.0009	0.0644	0.0593	80.2	0.0106	0.0047	81.9
	175	0.1535	0.8341	1.3333	0.0017	0.0685	0.0630	155	0.0139	0.0062	156.7
	250	0.1632	0.5350	1.9963	0.0029	0.0580	0.0534	255	0.0147	0.0065	257.6
Signal Boards Composite		0.0192	0.0934	0.1399	0.0002	0.0077	0.0071	16.7	0.0017	0.0008	17.0
Skid Steer Loaders	25	0.0202	0.0620	0.1166	0.0002	0.0063	0.0058	13.8	0.0018	0.0008	14.1
	50	0.0517	0.2263	0.2279	0.0003	0.0157	0.0144	25.5	0.0047	0.0021	26.3
	120	0.0429	0.2748	0.3267	0.0005	0.0245	0.0225	42.8	0.0039	0.0017	43.4
Skid Steer Loaders Composite		0.0468	0.2309	0.2522	0.0004	0.0179	0.0165	30.3	0.0042	0.0019	30.9
Surfacing Equipment	50	0.0477	0.1403	0.1359	0.0002	0.0119	0.0109	14.1	0.0043	0.0019	14.8
	120	0.0970	0.4215	0.6523	0.0007	0.0517	0.0475	63.8	0.0088	0.0039	65.2
	175	0.0894	0.4730	0.7742	0.0010	0.0392	0.0360	85.8	0.0081	0.0036	87.1
	250	0.1025	0.3374	1.1177	0.0015	0.0376	0.0346	135	0.0092	0.0041	136.3
	500	0.1532	0.6418	1.6597	0.0022	0.0567	0.0522	221	0.0138	0.0061	223.4
	750	0.2443	1.0046	2.6697	0.0035	0.0900	0.0828	347	0.0220	0.0098	350.5
Surfacing Equipment Composite		0.1277	0.5182	1.2760	0.0017	0.0468	0.0431	166	0.0115	0.0051	167.8
Sweepers/Scrubbers	15	0.0124	0.0729	0.0870	0.0002	0.0034	0.0031	11.9	0.0011	0.0005	12.1
	25	0.0237	0.0808	0.1496	0.0002	0.0058	0.0054	19.6	0.0021	0.0009	20.0
	50	0.1048	0.3425	0.3055	0.0004	0.0271	0.0249	31.6	0.0095	0.0042	33.1
	120	0.1107	0.5147	0.6989	0.0009	0.0622	0.0573	75.0	0.0100	0.0044	76.6
	175	0.1439	0.7997	1.1204	0.0016	0.0637	0.0586	139	0.0130	0.0058	141.1
	250	0.1146	0.3382	1.1784	0.0018	0.0362	0.0333	162	0.0103	0.0046	163.7
Sweepers/Scrubbers Composite		0.1148	0.5145	0.6862	0.0009	0.0510	0.0469	78.5	0.0104	0.0046	80.2
Tractors/Loaders/Backhoes	25	0.0195	0.0657	0.1237	0.0002	0.0056	0.0052	15.9	0.0018	0.0008	16.1
	50	0.0893	0.3199	0.2893	0.0004	0.0238	0.0219	30.3	0.0081	0.0036	31.6
	100	0.0751	0.3434	0.4087	0.0005	0.0342	0.0314	45.6	0.0068	0.0030	46.7
	120	0.0694	0.3529	0.4565	0.0006	0.0383	0.0352	51.7	0.0063	0.0028	52.7
	175	0.0988	0.5861	0.7696	0.0011	0.0428	0.0394	101	0.0089	0.0040	102.8
	250	0.1204	0.3666	1.1658	0.0019	0.0370	0.0340	172	0.0109	0.0048	173.5
	500	0.2290	0.7443	2.0659	0.0039	0.0701	0.0645	345	0.0207	0.0092	348.1
	750	0.3462	1.1159	3.2041	0.0058	0.1072	0.0986	517	0.0312	0.0139	522.2
Tractors/Loaders/Backhoes Composite		0.0792	0.3782	0.5392	0.0008	0.0387	0.0356	66.8	0.0071	0.0032	67.9
Trenchers	15	0.0099	0.0517	0.0617	0.0001	0.0024	0.0022	8.5	0.0009	0.0004	8.6

	25	0.0397	0.1355	0.2511	0.0004	0.0097	0.0090	32.9	0.0036	0.0016	33.5
	50	0.1566	0.4082	0.3432	0.0004	0.0353	0.0325	32.9	0.0141	0.0063	35.2
	120	0.1281	0.4684	0.7862	0.0008	0.0669	0.0615	64.9	0.0116	0.0051	66.7
	175	0.1955	0.8632	1.5520	0.0016	0.0849	0.0781	144	0.0176	0.0078	146.7
	250	0.2354	0.7089	2.2485	0.0025	0.0880	0.0810	223	0.0212	0.0094	226.3
	500	0.2985	1.3011	2.8470	0.0031	0.1105	0.1016	311	0.0269	0.0120	315.6
	750	0.5663	2.4440	5.4715	0.0059	0.2099	0.1931	587	0.0511	0.0227	595.0
Trenchers Composite		0.1427	0.4675	0.6684	0.0007	0.0549	0.0505	58.7	0.0129	0.0057	60.8
Welders	15	0.0104	0.0416	0.0629	0.0001	0.0041	0.0038	6.2	0.0009	0.0004	6.4
	25	0.0208	0.0581	0.1020	0.0001	0.0063	0.0058	11.3	0.0019	0.0008	11.6
	50	0.0979	0.2753	0.2535	0.0003	0.0240	0.0221	26.0	0.0088	0.0039	27.4
	120	0.0654	0.2659	0.4099	0.0005	0.0358	0.0330	39.5	0.0059	0.0026	40.4
	175	0.1101	0.5455	0.9083	0.0011	0.0490	0.0451	98.2	0.0099	0.0044	99.8
	250	0.0855	0.2618	1.0026	0.0013	0.0301	0.0277	119	0.0077	0.0034	120.3
	500	0.1092	0.3838	1.2526	0.0016	0.0394	0.0363	168	0.0098	0.0044	169.2
Welders Composite		0.0646	0.2096	0.2564	0.0003	0.0225	0.0207	25.6	0.0058	0.0026	26.5

Notes:

SCAQMD emission factors for 2014 (SCAQMD 2008)

Offroad diesel exhaust $PM_{2.5}$ = 92% of PM_{10} per EMFAC 2007 version 2.3 (SCAQMD 2008)

Offroad N_2O per Annex 3, Table A-101 (USEPA 2011)

Non-matching application-specific values interpolated or extrapolated

USEPA GWPs for CO_2 eqv (1, 21, 310)

Table G-16 SCAB Fleet Average Emission Factors

A-20 Onroad 2013

Air Basin	**SC**

	(lb/mi)	(lb/mi)	(lb/mi)	(lb/mi)	(lb/mi)	(lb/mi)	(lb/mi)	(lb/mi)	(lb/mi)	(lb/mi)
Vehicle Type	**ROG**	**CO**	**NOX**	**SOX**	**PM10**	**PM2.5**	**CO2**	**CH4**	**N2O**	**CO2 eqv**
Light Duty (pickup trucks)	0.00075	0.00709	0.00071	0.00001	0.00009	0.00006	1.10087	0.00007	0.00003	1.11070
Medium Duty (work trucks)	0.00206	0.01408	0.01577	0.00003	0.00060	0.00050	2.78163	0.00010	0.00015	2.83046
Heavy Heavy Duty (tractor/trailers)	0.00226	0.00932	0.02743	0.00004	0.00134	0.00115	4.21519	0.00010	0.00010	4.24784

Notes:
SCAQMD 2008
HHD includes tire & brake wear
Onroad N_2O per Annex 3, Table A-99

Table G-17 Highest (Most Conservative) EMFAC2007 (version 2.3) Emission Factors for On-Road Passenger Vehicles & Delivery Trucks

Projects in the SCAQMD (Scenario Years 2007 - 2026)
Derived from Peak Emissions Inventory (**Winter**, **Annual**, **Summer**)

Vehicle Class:
Passenger Vehicles (<8500 pounds) & Delivery Trucks (>8500 pounds)

The following emission factors were compiled by running the California Air Resources Board's EMFAC2007 (version 2.3) Burden Model, taking the weighted average of vehicle types and simplifying into two categories:
Passenger Vehicles & Delivery Trucks.

These emission factors can be used to calculate on-road mobile source emissions for the vehicle categories listed in the tables below, by use of the following equation:
Emissions (pounds per day) = N x TL x EF
where N = number of trips, TL = trip length (miles/day), and EF = emission factor (pounds per mile)

This methodology replaces the old EMFAC emission factors in Tables A-9-5-J-1 through A-9-5-L in Appendix A9 of the current SCAQMD CEQA Handbook. All the emission factors account for the emissions from start, running and idling exhaust. In addition, the ROG emission factors include diurnal, hot soak, running and resting emissions, and the PM10 & PM2.5 emission factors include tire and brake wear.

Scenario Year: **2007**
All model years in the range 1965 to 2007

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.01155158	CO	0.02407553
NOx	0.00121328	NOx	0.02508445
ROG	0.00118234	ROG	0.00323145
SOx	0.00001078	SOx	0.00002626
PM10	0.00008447	PM10	0.00091020
PM2.5	0.00005243	PM2.5	0.00078884
CO2	1.10672236	CO2	2.72245619
CH4	0.00010306	CH4	0.00016030
N2O	0.00004173	N2O	0.00024936
CO2 eqv	1.12182256	CO2 eqv	2.80312488

Scenario Year: **2008**
All model years in the range 1965 to 2008

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.01054844	CO	0.02194915
NOx	0.00110288	NOx	0.02371258
ROG	0.00107919	ROG	0.00299270
SOx	0.00001075	SOx	0.00002565
PM10	0.00008505	PM10	0.00085607
PM2.5	0.00005293	PM2.5	0.00073933
CO2	1.09953226	CO2	2.71943400
CH4	0.00009465	CH4	0.00014769
N2O	0.00003832	N2O	0.00022974
CO2 eqv	1.11340004	CO2 eqv	2.79375469

Scenario Year: **2009**
All model years in the range 1965 to 2009

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00968562	CO	0.02016075
NOx	0.00100518	NOx	0.02236636
ROG	0.00099245	ROG	0.00278899
SOx	0.00001066	SOx	0.00002679
PM10	0.00008601	PM10	0.00080550
PM2.5	0.00005384	PM2.5	0.00069228
CO2	1.09755398	CO2	2.72330496
CH4	0.00008767	CH4	0.00013655
N2O	0.00003550	N2O	0.00021242
CO2 eqv	1.11039937	CO2 eqv	2.79202205

Scenario Year: **2010**
All model years in the range 1966 to 2010

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00826276	CO	0.01843765
NOx	0.00091814	NOx	0.02062460
ROG	0.00091399	ROG	0.00258958
SOx	0.00001077	SOx	0.00002701
PM10	0.00008698	PM10	0.00075121
PM2.5	0.00005478	PM2.5	0.00064233
CO2	1.09568235	CO2	2.73222199
CH4	0.00008146	CH4	0.00012576
N2O	0.00003298	N2O	0.00019563
CO2 eqv	1.10761811	CO2 eqv	2.79550969

Scenario Year: **2011**
All model years in the range 1967 to 2011

Scenario Year: **2012**
All model years in the range 1968 to 2012

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00826276	CO	0.01693242
NOx	0.00084460	NOx	0.01893366
ROG	0.00085233	ROG	0.00241868
SOx	0.00001077	SOx	0.00002728
PM10	0.00008879	PM10	0.00070097
PM2.5	0.00005653	PM2.5	0.00059682
CO2	1.10235154	CO2	2.75180822
CH4	0.00007678	CH4	0.00011655
N2O	0.00003109	N2O	0.00018130
CO2 eqv	1.11360103	CO2 eqv	2.81046029

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00765475	CO	0.01545741
NOx	0.00077583	NOx	0.01732423
ROG	0.00079628	ROG	0.00223776
SOx	0.00001073	SOx	0.00002667
PM10	0.00008979	PM10	0.00064975
PM2.5	0.00005750	PM2.5	0.00054954
CO2	1.10152540	CO2	2.76628414
CH4	0.00007169	CH4	0.00010668
N2O	0.00002903	N2O	0.00016594
CO2 eqv	1.11202923	CO2 eqv	2.81996552

Scenario Year: **2013**

All model years in the range 1969 to 2013

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00709228	CO	0.01407778
NOx	0.00071158	NOx	0.01577311
ROG	0.00074567	ROG	0.00206295
SOx	0.00001072	SOx	0.00002682
PM10	0.00009067	PM10	0.00059956
PM2.5	0.00005834	PM2.5	0.00050174
CO2	1.10087435	CO2	2.78163459
CH4	0.00006707	CH4	0.00009703
N2O	0.00002716	N2O	0.00015094
CO2 eqv	1.11070222	CO2 eqv	2.83046413

Scenario Year: **2014**

All model years in the range 1970 to 2014

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00660353	CO	0.01284321
NOx	0.00065484	NOx	0.01425162
ROG	0.00070227	ROG	0.00189649
SOx	0.00001069	SOx	0.00002754
PM10	0.00009185	PM10	0.00054929
PM2.5	0.00005939	PM2.5	0.00045519
CO2	1.10257205	CO2	2.79845465
CH4	0.00006312	CH4	0.00008798
N2O	0.00002556	N2O	0.00013685
CO2 eqv	1.11181980	CO2 eqv	2.84272697

Scenario Year: **2015**

All model years in the range 1971 to 2015

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00614108	CO	0.01169445
NOx	0.00060188	NOx	0.01285026
ROG	0.00066355	ROG	0.00173890
SOx	0.00001070	SOx	0.00002741
PM10	0.00009259	PM10	0.00050307
PM2.5	0.00006015	PM2.5	0.00041268
CO2	1.10192837	CO2	2.81247685
CH4	0.00005923	CH4	0.00008076
N2O	0.00002398	N2O	0.00012562
CO2 eqv	1.11060625	CO2 eqv	2.85311641

Scenario Year: **2016**

All model years in the range 1972 to 2016

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00575800	CO	0.01080542
NOx	0.00055658	NOx	0.01172881
ROG	0.00063254	ROG	0.00161521
SOx	0.00001071	SOx	0.00002767
PM10	0.00009392	PM10	0.00046606
PM2.5	0.00006131	PM2.5	0.00037868
CO2	1.10677664	CO2	2.83134285
CH4	0.00005623	CH4	0.00007355
N2O	0.00002277	N2O	0.00011441
CO2 eqv	1.11501568	CO2 eqv	2.86835526

Scenario Year: **2017**

All model years in the range 1973 to 2017

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00537891	CO	0.00998101
NOx	0.00051297	NOx	0.01070034
ROG	0.00060109	ROG	0.00150242
SOx	0.00001079	SOx	0.00002723
PM10	0.00009446	PM10	0.00043131
PM2.5	0.00006192	PM2.5	0.00034605
CO2	1.10627489	CO2	2.84005015

Scenario Year: **2018**

All model years in the range 1974 to 2018

	Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)
CO	0.00502881	CO	0.00923234
NOx	0.00047300	NOx	0.00979416
ROG	0.00057178	ROG	0.00139856
SOx	0.00001071	SOx	0.00002749
PM10	0.00009494	PM10	0.00040110
PM2.5	0.00006234	PM2.5	0.00031792
CO2	1.10562643	CO2	2.84646835

CH4	0.00005300
N2O	0.00002146
CO2 eqv	1.11404119

CH4	0.00006663
N2O	0.00010365
CO2 eqv	2.87358027

CH4	0.00005003
N2O	0.00002026
CO2 eqv	1.11295662

CH4	0.00006203
N2O	0.00009650
CO2 eqv	2.87768473

Scenario Year: **2019**

All model years in the range 1975 to 2019

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00471820	CO	0.00857192
NOx	0.00043716	NOx	0.00900205
ROG	0.00054654	ROG	0.00130563
SOx	0.00001072	SOx	0.00002706
PM10	0.00009523	PM10	0.00037393
PM2.5	0.00006259	PM2.5	0.00029276
CO2	1.10496100	CO2	2.85060182
CH4	0.00004743	CH4	0.00005619
N2O	0.00001920	N2O	0.00008741
CO2 eqv	1.11191031	CO2 eqv	2.87887960

Scenario Year: **2020**

All model years in the range 1976 to 2020

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00444247	CO	0.00799617
NOx	0.00040506	NOx	0.00831802
ROG	0.00052463	ROG	0.00122382
SOx	0.00001073	SOx	0.00002733
PM10	0.00009550	PM10	0.00035054
PM2.5	0.00006279	PM2.5	0.00027128
CO2	1.10456157	CO2	2.85148109
CH4	0.00004495	CH4	0.00005330
N2O	0.00001820	N2O	0.00008291
CO2 eqv	1.11114749	CO2 eqv	2.87830219

Scenario Year: **2021**

All model years in the range 1977 to 2021

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00421218	CO	0.00748303
NOx	0.00037757	NOx	0.00773500
ROG	0.00050573	ROG	0.00115568
SOx	0.00001073	SOx	0.00002755
PM10	0.00009640	PM10	0.00033125
PM2.5	0.00006364	PM2.5	0.00025331
CO2	1.11009559	CO2	2.86434187
CH4	0.00004322	CH4	0.00004905
N2O	0.00001750	N2O	0.00007630
CO2 eqv	1.11642895	CO2 eqv	2.88902454

Scenario Year: **2022**

All model years in the range 1978 to 2022

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00397866	CO	0.00699290
NOx	0.00035150	NOx	0.00722470
ROG	0.00048658	ROG	0.00108569
SOx	0.00001072	SOx	0.00002774
PM10	0.00009661	PM10	0.00031501
PM2.5	0.00006389	PM2.5	0.00023906
CO2	1.11019931	CO2	2.87006769
CH4	0.00004121	CH4	0.00004557
N2O	0.00001669	N2O	0.00007088
CO2 eqv	1.11623782	CO2 eqv	2.89299807

Scenario Year: **2023**

All model years in the range 1979 to 2023

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00377527	CO	0.00658123
NOx	0.00032851	NOx	0.00679147
ROG	0.00046900	ROG	0.00102852
SOx	0.00001070	SOx	0.00002790
PM10	0.00009676	PM10	0.00030109
PM2.5	0.00006405	PM2.5	0.00022582
CO2	1.11023373	CO2	2.87466338
CH4	0.00003951	CH4	0.00004218
N2O	0.00001600	N2O	0.00006561
CO2 eqv	1.11602249	CO2 eqv	2.89588881

Scenario Year: **2024**

All model years in the range 1980 to 2024

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00358611	CO	0.00625076
NOx	0.00030721	NOx	0.00647083
ROG	0.00045136	ROG	0.00096578
SOx	0.00001080	SOx	0.00002807
PM10	0.00009676	PM10	0.00029407
PM2.5	0.00006410	PM2.5	0.00021880
CO2	1.11061572	CO2	2.88010717
CH4	0.00003781	CH4	0.00004019
N2O	0.00001531	N2O	0.00006251
CO2 eqv	1.11615549	CO2 eqv	2.90033043

Scenario Year: **2025**

All model years in the range 1981 to 2025

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00342738	CO	0.00595363

Scenario Year: **2026**

All model years in the range 1982 to 2026

Passenger Vehicles (pounds/mile)		Delivery Trucks (pounds/mile)	
CO	0.00328779	CO	0.00569435

NOx	0.00028846
ROG	0.00043545
SOx	0.00001070
PM10	0.00009679
PM2.5	0.00006418
CO2	1.11078571
CH4	0.00003641
N2O	0.00001474
CO2 eqv	1.11611985

NOx	0.00615945
ROG	0.00092178
SOx	0.00002761
PM10	0.00028425
PM2.5	0.00020958
CO2	2.88143570
CH4	0.00003765
N2O	0.00005857
CO2 eqv	2.90038172

NOx	0.00027141
ROG	0.00042052
SOx	0.00001076
PM10	0.00009687
PM2.5	0.00006415
CO2	1.11105829
CH4	0.00003518
N2O	0.00001424
CO2 eqv	1.11621250

NOx	0.00589869
ROG	0.00088403
SOx	0.00002716
PM10	0.00027657
PM2.5	0.00020187
CO2	2.88298299
CH4	0.00003581
N2O	0.00005570
CO2 eqv	2.90100126

Notes:

SCAQMD 2008

HHD-DSL composite includes tire & brake wear

Onroad N_2O per Annex 3, Table A-99

Table G-18 Highest (Most Conservative) EMFAC2007 (version 2.3) Emission Factors for On-Road Heavy-Heavy-Duty Diesel Trucks

Projects in the SCAQMD (Scenario Years 2007 - 2026)
Derived from Peak Emissions Inventory (**Winter**, **Annual**, **Summer**)

Vehicle Class:
Heavy-Heavy-Duty Diesel Trucks (33,001 to 60,000 pounds)

The following emission factors were compiled by running the California Air Resources Board's EMFAC2007 (version 2.3) Burden Model and extracting the **Heavy-Heavy-Duty Diesel Truck (HHDT)** Emission Factors.

These emission factors can be used to calculate on-road mobile source emissions for the vehicle/emission categories listed in the tables below, by use of the following equation:

Emissions (pounds per day) = N x TL x EF

where N = number of trips, TL = trip length (miles/day), and EF = emission factor (pounds per mile)

The **HHDT-DSL** vehicle/emission category accounts for all emissions from heavy-heavy-duty diesel trucks, including start, running and idling exhaust. In addition, ROG emission factors account for diurnal, hot soak, running and resting emissions, and the PM10 & PM2.5 emission factors account for tire and brake wear.

The **HHDT-DSL, Exh** vehicle/emission category includes only the exhaust portion of PM10 & PM2.5 emissions from heavy-heavy-duty diesel trucks.

Scenario Year: **2007**
All model years in the range 1965 to 2007

HHDT-DSL (pounds/mile)	
CO	0.01446237
NOx	0.04718166
ROG	0.00372949
SOx	0.00003962
PM10	0.00230900
PM2.5	0.00204018
CO2	4.22184493
CH4	0.00016312
N2O	0.00015353
CO2 eqv	4.27286406

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00216752
PM2.5	0.00199491

Scenario Year: **2008**
All model years in the range 1965 to 2008

HHDT-DSL (pounds/mile)	
CO	0.01361368
NOx	0.04458017
ROG	0.00351579
SOx	0.00004136
PM10	0.00215635
PM2.5	0.00189990
CO2	4.21067145
CH4	0.00016269
N2O	0.00015312
CO2 eqv	4.26155554

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00201296
PM2.5	0.00185303

Scenario Year: **2009**
All model years in the range 1965 to 2009

HHDT-DSL (pounds/mile)	
CO	0.01282236
NOx	0.04184591
ROG	0.00329320
SOx	0.00004013
PM10	0.00199572
PM2.5	0.00175227
CO2	4.21080792
CH4	0.00015249
N2O	0.00014352
CO2 eqv	4.25850077

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00185393
PM2.5	0.00170680

Scenario Year: **2010**
All model years in the range 1966 to 2010

HHDT-DSL (pounds/mile)	
CO	0.01195456
NOx	0.03822102
ROG	0.00304157
SOx	0.00004131
PM10	0.00183062
PM2.5	0.00160083
CO2	4.21120578
CH4	0.00014201
N2O	0.00013366
CO2 eqv	4.25562112

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00168861
PM2.5	0.00155435

Scenario Year: **2011**

All model years in the range 1967 to 2011

HHDT-DSL (pounds/mile)	
CO	**0.01112463**
NOx	**0.03455809**
ROG	**0.00279543**
SOx	**0.00003972**
PM10	**0.00166087**
PM2.5	**0.00144489**
CO2	**4.22045680**
CH4	**0.00012910**
N2O	**0.00012150**
CO2 eqv	**4.26083358**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00151936**
PM2.5	**0.00139772**

Scenario Year: **2012**

All model years in the range 1968 to 2012

HHDT-DSL (pounds/mile)	
CO	**0.01021519**
NOx	**0.03092379**
ROG	**0.00252764**
SOx	**0.00004042**
PM10	**0.00149566**
PM2.5	**0.00129354**
CO2	**4.21590774**
CH4	**0.00011651**
N2O	**0.00010966**
CO2 eqv	**4.25234923**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00135537**
PM2.5	**0.00124837**

Scenario Year: **2013**

All model years in the range 1969 to 2013

HHDT-DSL (pounds/mile)	
CO	**0.00931790**
NOx	**0.02742935**
ROG	**0.00226308**
SOx	**0.00004086**
PM10	**0.00133697**
PM2.5	**0.00114629**
CO2	**4.21518556**
CH4	**0.00010441**
N2O	**0.00009827**
CO2 eqv	**4.24784287**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00119623**
PM2.5	**0.00109863**

Scenario Year: **2014**

All model years in the range 1970 to 2014

HHDT-DSL (pounds/mile)	
CO	**0.00846435**
NOx	**0.02418049**
ROG	**0.00201594**
SOx	**0.00004092**
PM10	**0.00118458**
PM2.5	**0.00100582**
CO2	**4.21279345**
CH4	**0.00009261**
N2O	**0.00008716**
CO2 eqv	**4.24175938**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00104243**
PM2.5	**0.00096059**

Scenario Year: **2015**

All model years in the range 1971 to 2015

HHDT-DSL (pounds/mile)	
CO	**0.00766891**
NOx	**0.02122678**
ROG	**0.00178608**
SOx	**0.00004082**
PM10	**0.00104715**
PM2.5	**0.00087977**
CO2	**4.20902225**
CH4	**0.00008369**
N2O	**0.00007877**
CO2 eqv	**4.23519770**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00090631**
PM2.5	**0.00083282**

Scenario Year: **2016**

All model years in the range 1972 to 2016

HHDT-DSL (pounds/mile)	
CO	**0.00704604**
NOx	**0.01887374**
ROG	**0.00161035**
SOx	**0.00003952**
PM10	**0.00094448**
PM2.5	**0.00078443**
CO2	**4.21063031**
CH4	**0.00007508**
N2O	**0.00007067**
CO2 eqv	**4.23411393**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00080419**
PM2.5	**0.00073898**

Scenario Year: **2017**

All model years in the range 1973 to 2017

HHDT-DSL (pounds/mile)	
CO	**0.00650533**
NOx	**0.01690387**
ROG	**0.00145203**
SOx	**0.00004033**
PM10	**0.00084894**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00070873**
PM2.5	**0.00065111**

Scenario Year: **2018**

All model years in the range 1974 to 2018

HHDT-DSL (pounds/mile)	
CO	**0.00604721**
NOx	**0.01526414**
ROG	**0.00131697**
SOx	**0.00003934**
PM10	**0.00076808**

HHDT-DSL, Exh (pounds/mile)	
PM10	**0.00062758**
PM2.5	**0.00057700**

PM2.5	0.00069721
CO2	4.20820129
CH4	0.00006722
N2O	0.00006327
CO2 eqv	4.22922648

PM2.5	0.00062383
CO2	4.20756838
CH4	0.00006182
N2O	0.00005818
CO2 eqv	4.22690378

Scenario Year: **2019**

All model years in the range 1975 to 2019

HHDT-DSL (pounds/mile)	
CO	0.00565433
NOx	0.01389113
ROG	0.00120235
SOx	0.00004032
PM10	0.00070198
PM2.5	0.00056085
CO2	4.20637830
CH4	0.00005499
N2O	0.00005175
CO2 eqv	4.22357577

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00056085
PM2.5	0.00051320

Scenario Year: **2020**

All model years in the range 1976 to 2020

HHDT-DSL (pounds/mile)	
CO	0.00532242
NOx	0.01274755
ROG	0.00110621
SOx	0.00003957
PM10	0.00064574
PM2.5	0.00050904
CO2	4.20541416
CH4	0.00005216
N2O	0.00004909
CO2 eqv	4.22172889

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00050364
PM2.5	0.00046227

Scenario Year: **2021**

All model years in the range 1977 to 2021

HHDT-DSL (pounds/mile)	
CO	0.00503726
NOx	0.01179977
ROG	0.00103095
SOx	0.00004033
PM10	0.00059437
PM2.5	0.00046287
CO2	4.21495573
CH4	0.00004734
N2O	0.00004455
CO2 eqv	4.22976181

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00045411
PM2.5	0.00041729

Scenario Year: **2022**

All model years in the range 1978 to 2022

HHDT-DSL (pounds/mile)	
CO	0.00478830
NOx	0.01098794
ROG	0.00096142
SOx	0.00004106
PM10	0.00055427
PM2.5	0.00042597
CO2	4.21520828
CH4	0.00004448
N2O	0.00004186
CO2 eqv	4.22911963

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00041399
PM2.5	0.00037807

Scenario Year: **2023**

All model years in the range 1979 to 2023

HHDT-DSL (pounds/mile)	
CO	0.00457902
NOx	0.01031407
ROG	0.00090210
SOx	0.00004009
PM10	0.00052122
PM2.5	0.00039592
CO2	4.21483461
CH4	0.00004176
N2O	0.00003931
CO2 eqv	4.22789696

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00037922
PM2.5	0.00034915

Scenario Year: **2024**

All model years in the range 1980 to 2024

HHDT-DSL (pounds/mile)	
CO	0.00444444
NOx	0.00974372
ROG	0.00084009
SOx	0.00003930
PM10	0.00050766
PM2.5	0.00038320
CO2	4.19552935
CH4	0.00003930
N2O	0.00003699
CO2 eqv	4.20782175

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00036682
PM2.5	0.00033735

Scenario Year: **2025**

All model years in the range 1981 to 2025

Scenario Year: **2026**

All model years in the range 1982 to 2026

HHDT-DSL (pounds/mile)	
CO	0.00431086
NOx	0.00932573
ROG	0.00080206
SOx	0.00004018
PM10	0.00048541
PM2.5	0.00036326
CO2	4.19512979
CH4	0.00003697
N2O	0.00003479
CO2 eqv	4.20669226

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00034397
PM2.5	0.00031664

HHDT-DSL (pounds/mile)	
CO	0.00420297
NOx	0.00898990
ROG	0.00077178
SOx	0.00003946
PM10	0.00046717
PM2.5	0.00034564
CO2	4.19349747
CH4	0.00003630
N2O	0.00003417
CO2 eqv	4.20485099

HHDT-DSL, Exh (pounds/mile)	
PM10	0.00032670
PM2.5	0.00029830

Notes:

SCAQMD 2008

HHD-DSL composite includes tire & brake wear

Onroad N_2O per Annex 3, Table A-99

Table G-19 Standard Composition of Dry Air

Principal Gas	Chemical Symbol	MW g/mole	Concentration ppmv	Fraction percent	MW g/mole
Nitrogen	N_2	28.014	780,805.00	78.080500	21.873471
Oxygen	O_2	31.998	209,450.00	20.945000	6.701981
Argon	Ar	39.948	9,340.00	0.934000	0.373114
Carbon Dioxide	CO_2	44.009	377.76	0.037776	0.016625
Neon	Ne	20.183	18.21	0.001821	0.000368
Helium	He	4.003	5.24	0.000524	0.000021
Methane	CH_4	16.043	1.75	0.000175	0.000028
Krypton	Kr	83.800	1.14	0.000114	0.000096
Hydrogen	H_2	2.016	0.50	0.000050	0.000001
Nitrous Oxide	N_2O	44.013	0.31	0.000031	0.000014
Xenon	Xe	131.300	0.09	0.000009	0.000012
Totals			**1,000,000.00**	**100.000**	**28.966**

Sources: UIG 2008; USEPA 2011; du Pont 1971; Jennings 1970

Notes:

MW = molecular weight, g/mole

ppmv = parts per million by volume (10^{-6})

USEPA GHG Inventory 2011

Universal Industrial Gases, Inc., http://www.uigi.com/air.html

Condensed Laboratory Handbook, E.I. du Pont du Nemours & Co., Inc., Wilmington, DE, 1971

Environmental Engineering – Analysis and Practice, B. H. Jennings, International Textbook Company, 1970

Carbon dioxide varies with uptake by removal mechanisms, 365 (IPCC) to 380 ppmv (UIG)

APPENDIX H

Special-Status Species Evaluated but not Affected by the SCH Project

Table H-1 Special-Status Species Evaluated but not Affected by the SCH Project

Common Name	Scientific Name	Status (Fed/State/ CNPS)	Habit, Habitat, and Reason for Exclusion
Plants			
Abrams' spurge	*Chamaesyce abramsiana*	-/-/2	Prostrate annual herb in sandy sites in desert scrub. Sandy areas and scrub are not present in the Project area. Last reports were from Old Beach and Brawley in 1912 (California Natural Diversity Database 2010). Not expected to occur due to lack of suitable habitat and likely extirpation from the Project area.
Brown turbans	*Malperia tenuis*	-/-/2	Grows in sandy places in creosote bush scrub. Sandy areas and scrub are not present in the Project area. Last record from the Project area was at Fish Mountain in 1926. Not expected to occur due to lack of suitable habitat and likely extirpation from the Project area.
Chaparral sand-verbena	*Abronia villosa* var. *aurita*	-/-/1B	Annual herb known from sandy areas, such as dune areas southwest of the Salton Sea. Sandy areas are not present in the Project area. Has been indentified north, southeast, and southwest of the Sea. Last record in the Sea's vicinity is 1949. Not expected to occur due to lack of suitable habitat.
Flat-seeded spurge	*Chamaesyce platysperma*	-/-/1B	Prostrate annual herb known from sandy places and dunes in Sonoran desert scrub. Sandy areas and scrub are not present in the Project area. Known from near Superstition Mountain. Not expected to occur due to lack of suitable habitat.
Glandular ditaxis	*Ditaxis claryana*	-/-/2	Perennial herb that grows in sandy places and rocky slopes in Sonoran desert scrub. Sandy or rocky areas are not present in the Project area. Last record in Project area is a 1906 collection in Indio. Not expected to occur due to lack of suitable habitat and likely extirpation from the Project area.
Harwood's milk-vetch	*Astragalus insularis var. harwoodii*	-/-/2	Annual herb that occurs in desert dunes and stony washes. Sandy and rocky areas are not present in the Project area. Not expected to occur due to lack of suitable habitat.
Las Animas colubrina	*Colubrina californica*	-/-/2	Deciduous shrub that grows in desert scrub in narrow, steep, rocky ravines or washes. Not expected to occur due to lack of suitable habitat.
Munz's cholla	*Opuntia munzii*	-/-/1B	Grows in sandy or rocky desert flats and hills. Sandy or rocky areas are not present in the Project area. Known from the Chocolate Mountains. Not expected to occur due to lack of suitable habitat.
Orcutt's woody-aster	*Xylorhiza orcuttii*	-/-/1B	Occurs in arid canyons and washes. Although drainages are present, they are not typical desert wash but rather, are composed of agricultural fields next to marsh and mudflat. Not expected to occur due to lack of suitable habitat.
Orocopia sage	*Salvia greatae*	-/-/1B	Known from alluvial bajadas and fans adjacent to desert washes in rocky or gravely soil. Although drainages are present, they are not typical desert wash, but rather are composed of agricultural fields next to marsh and mudflat. All locations in Project vicinity

Table H-1 Special-Status Species Evaluated but not Affected by the SCH Project

Common Name	Scientific Name	Status (Fed/State/ CNPS)	Habit, Habitat, and Reason for Exclusion
			are near Salt Creek (California Natural Diversity Database 2010). Not expected to occur due to lack of suitable habitat.
Sand evening-primrose	*Camissonia arenaria*	-/-/2	Annual or perennial herb that grows in sandy or rocky sites in Sonoran desert scrub. Sandy and rocky areas are not present in the Project area. Not expected to occur due to lack of suitable habitat.
Sand food	*Pholisma sonorae*	-/-/1B	Grows in desert dunes. Parasitic on Eriogonum, Tiquilia, Ambrosia, and Pluchea spp. Dune areas are not present in the Project area. Not expected to occur due to lack of suitable habitat.
Reptiles and Amphibians			
Colorado River toad	*Ancilius alvarius*	*-/SSC/-*	Although this species occurred historically within irrigation ditches in Imperial Valley, it has been extirpated from California (California Herps 2010).
Lowland leopard frog	*Lathobates yavapaiensis*	-/SSC/-	Although this species occurred historically within streams, ponds, and irrigation ditches in Imperial Valley, it has been extirpated from California (California Herps 2010).
Coachella Valley fringe-toed lizard	*Uma inornata*	T/E/-	This species does not occur within the Project area; its range is in Coachella Valley, north of the Salton Sea (California Herps 2010).
Colorado desert fringe-toed lizard	*Uma notata*	-/SSC/-	Suitable habitat, which includes fine, loose, wind-blown sand dunes, is not present (California Herps 2010).
Flat-tailed horned lizard	*Phrynosoma mcallii*	-/SSC-	Suitable habitat, which includes sandy desert hardpan or gravel flats with fine windblown sand, is not present (California Herps 2010).
Desert tortoise	*Gopherus agassizii*	T/T/-	Range of this species is east of the Salton Sea and does not occur within the Project area. Suitable desert habitat is not present (California Herps 2010).
Sonoran mud turtle	*Kinosternon sonoriense*	-/SSC/-	Although this species historically occurred within agricultural canals in Imperial Valley, it has been extirpated from California (California Herps 2010).
Birds			
American white pelican	*Pelecanus erythrorhynchos*	-/SSC/- (breeding)*	Historically bred at the Salton Sea up until the 1950s but now uses the region for wintering and loafing (Patten et al. 2003).
Brant	*Branta bernicla*	-/SSC/- (wintering/ staging)*	Wintering and staging areas are located along the coast. The species requires eelgrass for foraging. Records of the species at Salton Sea are from migration when they stop at the Sea's northern end (Patten et al. 2003).
Fulvous whistling-duck	*Dendrocygna bicolor*	-/SSC/- (breeding)*	Has been extirpated from California as a breeding bird; however, may still be recorded as a winter visitor at locations such as Finney Lake and Sonny Bono Salton Sea National Wildlife Refuge (Patten et al. 2003).

Table H-1 Special-Status Species Evaluated but not Affected by the SCH Project

Common Name	Scientific Name	Status (Fed/State/ CNPS)	Habit, Habitat, and Reason for Exclusion
Northern harrier	*Circus cyaneus*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at Salton Sea are of wintering individuals (Patten et al. 2003).
Swainson's hawk	*Buteo swainsoni*	-/T/-	Salton Sea is not located within their current breeding range. Records of the species at Salton Sea are during migration (Patten et al. 2002).
Golden eagle	*Aquila chrysaetos*	-/FP/-	Although the Salton Sea is designated as a wintering area by DFG (2010), this species has been observed only 5 times in the past century and the species is considered a vagrant and unlikely as a wintering occurrence.
Black tern	*Chlidonias niger*	-/SSC/- (breeding)*	Although this species is regularly observed at the Salton Sea, it does not breed there. The Salton Sea is a migratory stopover for the species and no evidence exists that it has ever bred there (Patten et al. 2003).
Yellow-billed cuckoo	*Coccyzus americanus occidentalis*	C/E/-	Has been recorded 6 times within the Salton Sink but not as a breeding bird (Patten et al. 2003).
Long-eared owl	*Asio otus*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at Salton Sea are during migration or for wintering (Patten et al. 2003).
Short-eared owl	*Asio flammeus*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at Salton Sea are during migration or as a winter visitor (Patten et al. 2003).
Elf owl	*Micrathene whitneyi*	-/E/-	A few pairs occur along the Colorado River, and otherwise, this species is extirpated from California as a breeding bird (Patten et al. 2003).
Vaux's swift	*Chaetura vauxi*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at Salton Sea are during migration (Patten et al. 2003).
Gilded flicker	*Colaptes chrysoides*	-/E/-	Has been reported as a vagrant in areas south of the Salton Sea but has not been recorded at the Sea (Patten et al. 2003).
Vermilion flycatcher	*Pyrocephalus rubinus*	-/SSC/- (breeding)*	Historically present as a breeding bird in Imperial Valley but currently only known from the region of the Highline Canal near Holtville approximately 30 miles southeast of the Salton Sea (Patten et al. 2003).
Southwestern willow flycatcher	*Empidonax traillii extimus*	E/E/-	Protocol surveys conducted for this species in 2010 were negative (Dudek 2010). Observations of willow flycatcher within riparian habitat along the New and Alamo rivers are of the little willow flycatcher.
Olive-sided flycatcher	*Contopus cooperi*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at the Sea are of migrating individuals (Patten et al. 2003).
Bank swallow	*Riparia riparia*	-/T/-	Salton Sea is not located within their current breeding range.

Table H-1 Special-Status Species Evaluated but not Affected by the SCH Project

Common Name	Scientific Name	Status (Fed/State/ CNPS)	Habit, Habitat, and Reason for Exclusion
			Records of the species at the Sea are of migrating individuals (Patten et al. 2003).
Purple martin	*Progne subis*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at the Sea are of migrating individuals (Patten et al. 2003).
Bendire's thrasher	*Toxostoma bendirei*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at the Sea are of rare migrating or wintering individuals (Patten et al. 2003).
Gray vireo	*Vireo vicinor*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at Salton Sea are of wintering individuals (Patten et al. 2003).
Least Bell's vireo	*Vireo bellii pusillus*	E/E/-	Surveys conducted for this species in 2010 were negative (Dudek 2010). Seven recent records of the species are all from fall migration or wintering individuals and were recorded at Ramer Lake, Brawley, Sonny Bono Salton Sea National Wildlife Refuge, Sheldon Reservoir, and Willow Hole from 1963 to 2002.
Arizona Bell's vireo	*Vireo bellii arizonae*	-/E/-	Breeds along the Colorado River and would not occur at the Salton Sea because the subspecies is confined to the lower Colorado River in Nevada and California (Patten et al. 2003).
Lucy's warbler	*Vermivora luciae*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at the Sea are of wintering individuals (Patten et al. 2003).
Yellow warbler	*Dendroica petechia brewsteri*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at the Sea are of migrating individuals (Patten et al. 2003).
Summer tanager	*Piranga rubra*	-/SSC/- (breeding)*	Salton Sea is not located within their current breeding range. Records of the species at the Sea are of migrating individuals (Patten et al. 2003).
Mammals			
California leaf-nosed bat	*Macrotus californicus*	-/SSC/-	Although suitable foraging habitat (desert riparian, wash, scrub, succulent shrub, alkali scrub, and palm oasis) is present, suitable roosting areas are not. Requires mine tunnels or caves, occasionally buildings for roosting, and shelter from heat and aridity (DFG 2010).
Pallid bat	*Antrozous pallidus*	-/SSC/-	Although suitable foraging habitat (dry open grasslands, shrublands, and woodlands) is present, suitable roosting areas are not. Requires caves, crevices, or mines that protect them from high temperatures (DFG 2010).
Pocketed free-tailed bat	*Nyctinomops femorosaccus*	-/SSC/-	Although suitable foraging habitat (desert scrub and riparian) is present, suitable roosting areas are not. Requires rock crevices in cliffs for roosting (DFG 2010).
Spotted bat	*Euderma maculatum*	-/SSC/-	Although suitable foraging habitat (arid desert, grasslands) is present, suitable roosting areas are not present. Requires rock

Table H-1 Special-Status Species Evaluated but not Affected by the SCH Project

Common Name	Scientific Name	Status (Fed/State/ CNPS)	Habit, Habitat, and Reason for Exclusion
			crevices, caves, or buildings for roosting (DFG 2010).
Townsend's big-eared bat	*Corynorhinus townsendii*	-/SSC/-	Although suitable foraging habitat (mesic habitats, brush, and trees) is present, suitable roosting areas are not. Requires caves, mines, and other human-made structures for roosting (DFG 2010).
Western mastiff bat	*Eumops perotis californicus*	-/SSC/-	Although suitable foraging habitat (open semiarid and arid habitats) is present, suitable roosting areas are not. Requires crevices in cliff faces, high buildings, trees, and tunnels for roosting (DFG 2010).
Yuma hispid cotton rat	*Sigmodon hispidus eremicus*	-/SSC/-	Not expected to occur based on distribution. Occurs in the lower Colorado River Valley and Colorado River delta (DFG 2010).
Ringtail	*Bassariscus astulus*	-/FP/-	Although Salton Sea is within their distribution, suitable hollow trees and rocky areas are not present within the Project area (DFG 2010).
Peninsular bighorn sheep	*Ovis canadensis nelsoni DPS*	E/T,FP/-	Not expected to occur based on distribution. Occurs in areas east of the Salton Sea (DFG 2010).

Notes:

* "Season of concern" as addressed for SSC species by Shuford, W.D., and T. Gardali, eds. 2008. California bird species of special concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds No. 1. Western Field Ornithologists, Camarillo, CA, and California Department of Fish and Game, Sacramento, CA..

Federal Designations:

C Candidate for listing

E Endangered. In danger of extinction throughout all or a significant portion of its range

T Threatened. Likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range

State Designations:

E Endangered
T Threatened

FP Fully protected

SSC Species of Special Concern

California Native Plant Society (CNPS) List:

1B Plants considered rare or endangered in California and elsewhere

2 Plants considered rare, threatened, or endangered in California, but more common elsewhere

Sources:

California Department of Fish and Game (DFG). 2010. California wildlife habitat relationships system. Website (http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx) accessed December 2 through 28, 2010.

California Herps. 2010. A guide to the amphibians and reptiles of California. Available online at: http://www.californiaherps.com. California Natural Diversity Database (CNDDB). 2010. Nine quad search for USGS quadrangles Kane Spring, Westmoreland West, Obsidian Butte, Niland, and Wister. Full condensed text report.Dudek. 2010. Focused least Bell's vireo and southwestern willow flycatcher survey report for the Salton Sea Species Conservation Habitat Project, Imperial County, California. Prepared for the California Department of Fish and Game and Department of Water Resources. Submitted to the USFWS, December 3.

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APPENDIX I

Selenium Management Strategies

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Appendix I

Selenium Management Strategies

I.1 INTRODUCTION

I.1.1 Purpose and Need

The Salton Sea Species Conservation Habitat Project (SCH Project), proposed by the California Natural Resources Agency, would create up to approximately 2,080 to 3,770 acres of shallow ponds at the Salton Sea's edge (final acreage would depend on the alternative selected and funds available for construction). The ponds would be designed to provide appropriate foraging habitat for piscivorous (fish-eating) birds that depend on the Salton Sea.

Selenium is a naturally occurring element and an essential nutrient. However, when it is present at elevated concentrations in the food web, selenium can cause adverse effects, especially on reproduction of birds and fish. Selenium is already present in the water, sediments, and biota of the Salton Sea ecosystem (DWR and DFG 2007). The question is whether the SCH Project would increase the probability and magnitude of selenium impacts relative to existing and expected future conditions. Thus, it is necessary to evaluate the potential selenium exposure and risks to ecological receptors (primarily aquatic and benthic invertebrates, fish, and birds) and to develop appropriate measures to avoid, reduce, and mitigate potential impacts.

The purpose of this report is to:

- Evaluate the scope of the selenium problem for the proposed SCH Project;
- Identify a range of potential management strategies for the SCH Project's design and initial operations to minimize potential ecological impacts; and
- Outline a monitoring framework that would support adaptive management of SCH Project once operational.

I.1.2 Approach

The SCH Project is using the following approach to evaluate selenium risk and develop management strategies:

- Evaluate the scope of the selenium problem;
- Characterize sources and concentrations of selenium at the Project area under existing conditions and proposed operations;
- Identify potential ecological receptors likely to be affected (i.e., species using the SCH ponds) and target goals;
- Understand pathways to receptors, given the proposed design and operations;
- Estimate the probability, severity, and extent of potential risks from Project implementation;
- Identify a range of potential management strategies;
- Identify source control and mitigation strategies to minimize exposure of ecological receptors; and

- Identify treatment strategies if applicable and feasible (only if source control and mitigation strategies are not sufficient).

Information and insights for selenium evaluation and management were obtained from various sources. Background information and initial screening-level analysis of selenium risk came from the *Salton Sea Ecosystem Restoration Program Final Programmatic Environmental Impact Report* (DWR and DFG 2007), in particular *Appendix F – Ecological Risk Assessment*. The Bureau of Reclamation (Reclamation) measured water quality of Salton Sea and influent rivers quarterly in 2004–2009 (C. Holdren, Reclamation, unpublished data). The U.S. Geological Survey (USGS) conducted studies of selenium bioaccumulation at the experimental Saline Habitat Ponds (SHP) complex (Miles et al. 2009) and agricultural drains at the Sea's southern end (Saiki et al. 2010). University of California Riverside (UCR) conducted site-specific sampling in 2010 at alternative SCH Project sites (Amrhein et al. 2010) and ecological risk modeling of receptors, pathways, and bioaccumulation potential (Sickman et al. 2011). Potential water treatment technologies were reviewed for their effectiveness, feasibility, and applicability to the SCH Project (Cardno ENTRIX 2010). Finally, a science panel[1] reviewed the selenium ecological risk modeling data and provided input on strategies for source control, mitigation, and treatment.

I.1.3 Regulatory Standards and Toxicity Thresholds

Water quality guidelines for selenium in the Salton Sea Basin are 5 micrograms per liter[2] (µg/L) for chronic exposure and 20 µg/L for acute (1-hour average) exposure (Colorado River Basin Regional Water Quality Control Board 2006). For sediment, the United States Department of the Interior (1998) and Hamilton (2004) classified selenium concentrations between 1 and 4 micrograms per gram (µg/g) (or milligrams per kilogram [mg/kg]) as "elevated above background" or "level of concern," and concentrations >4 µg/g as the "toxicity threshold."

Selenium concentrations in biota considered to pose a potential toxicity risk vary depending on species and studies (Amrhein and Smith 2011; Ohlendorf and Heinz 2011). Lemly (2002) considered the effect of bioaccumulation within a food chain and recommended somewhat lower selenium thresholds of 2 µg/L of inorganic selenium in water, 2 µg/g in sediments, and 3 µg/g dry weight (dw) in food-chain organisms such as invertebrates. To avoid toxic effects on sensitive fish species, Lemly (2002) recommended a threshold of 4 µg/g dw in whole fish. Available evidence from the Salton Sea area indicates that tilapia, poeciliids (mosquitofish and mollies) and desert pupfish are not likely to be seriously affected at tissue concentrations of 4 µg/g dw (Saiki et al. 2010). For bird eggs, which may exhibit reduced hatching success or embryo deformities (teratogenesis) from selenium exposure, a conservative and widely reported toxicity reference value is 6 µg/g dw, although selenium sensitivity can vary widely depending on species and the chemical form of selenium in the diet (Ohlendorf and Heinz 2011).

[1] The panel convened on September 21, 2010, included scientists and resource managers with expertise in selenium environmental toxicology, geochemistry, treatment, and Salton Sea issues. Panel members included Chris Amrhein (UCR), Doug Barnum (USGS Salton Sea Science Office), Rick Gersberg (San Diego State University), Chris Holdren (Reclamation), Chen Huang (University of California Berkeley [UCB]), Keith Miles (USGS), Harry Ohlendorf (CH2M Hill), Theresa Presser (USGS), Carol Roberts (U.S. Fish and Wildlife Service [USFWS]), Mike Saiki (USGS), James Sickman (UCR), Joe Skorupa (USFWS), and Norman Terry (UCB).

[2] Concentrations of selenium can be expressed in various ways. Water concentrations are typically expressed as µg/L, or sometimes as parts per billion. Sediment concentrations can be expressed as either µg/g or mg/kg. Concentrations in biota are expressed as µg/g, or sometimes parts per million. Sediment and biota samples are typically dried before measuring, and concentrations are reported as µg/g dw.

I.2 SELENIUM SOURCES

Selenium is present in the water, sediments, and biota of the Salton Sea ecosystem (DWR and DFG 2007). Most of the selenium originally comes from the upper Colorado River in irrigation water used in the Imperial and Coachella valleys. Irrigation of seleniferous soils can also dissolve and transport selenium to drains (Ohlendorf 2003, as cited in DWR and DFG 2007). Selenium becomes concentrated by agricultural usage and is discharged from subsurface tile drains into surface drains that flow into the Sea either directly or via tributaries (Saiki et al. 2010).

I.2.1 Selenium Cycling

The biogeochemistry of selenium in aquatic systems is complex and controlled by several factors. Both the biotic and abiotic activity of selenium depends on its physiochemical form or species. Selenium chemistry resembles that of sulfur (Masscheleyn and Patrick 1993). Selenium, like sulfur, can exist in four different oxidation states: selenide (Se -II), elemental selenium (Se 0), selenite (Se IV or SeO_3^{2-}), and selenate (Se VI or SeO_4^{2-}) (Robberecht and Van Grieken 1982). Alterations in the oxidation state of selenium greatly affect solubility and play a major role in mobility, transport, fate, and effects of selenium species in wetland environments (Masscheleyn and Patrick 1993; Lemly 2002).

Inorganic forms of selenium (selenate and selenite) usually predominate in water, but inorganic as well as organic forms of selenium occur in water, sediment, and biological tissues. In an aquatic system, most selenium is associated with sediments (acting as a sink and reservoir) or plants and animals. In bottom sediments, metal and organic selenides are most common (Hamilton 2004). In water, selenate is reduced to selenite and both forms are removed from the aqueous phase into sediment. Once in sediment, selenite is reduced to elemental selenium, which may make up 99 percent of the selenium found in sediments.

Various biological, chemical, and physical processes can move selenium into or out of sediments; therefore, sediments may serve as only a temporary repository for selenium (Masscheleyn and Patrick 1993). Transport and partitioning of selenium in soils is highly influenced by pH (measure of the acidity or alkalinity of a substance) and Eh (oxidation/reduction conditions). Elemental selenium is essentially insoluble and stable in soils when anaerobic conditions occur. Heavy metal selenides and selenium sulfides are insoluble and will remain in soils with low pH or high organic matter (Kabata-Pendias 2001, as cited in DWR and DFG 2007). In contrast, selenates are very mobile and easily taken up by plants or leached through the soil due to their high solubility and low adsorption potential (onto soil particles). Selenates dominate in alkaline, well-oxidized soil environments and some (e.g., sodium selenate and potassium selenate) dominate in neutral, well-drained, mineral soils. While soluble selenates are responsible for the naturally occurring accumulation of high levels of selenium by plants, much of the total selenium measured in soils may be present in other forms. Under alkaline and oxidizing conditions, plants can accumulate the soluble forms of selenium, although selenate seems to be the preferred form for uptake (DWR and DFG 2007).

After selenium enters the sediment, further chemical and microbial reduction may occur, resulting in insoluble organic, mineral, elemental, or adsorbed selenium (Lemly 2002). Microscopic planktonic organisms, such as bacteria, protozoa, phytoplankton, and zooplankton, are a major component of the particulate matter in the water column. The particulate matter, in turn, forms the basis for detrital materials that settle onto the sediment and become the food source for sediment organisms, such as benthic macroinvertebrates. In addition, waterborne selenite can be physically adsorbed onto the sediment particles, ingested, absorbed, and transformed by the sediment organisms. Sediment-bound selenite can be reduced to insoluble elemental selenium by anaerobic microbial activities. Elemental selenium can be reduced further to inorganic and organic selenides and/or reoxidized to selenite and selenate by microorganisms in the sediment and/or in the digestive tracts of sediment macroinvertebrates. Selenides can enter the food chain via uptake into sediment organisms or be oxidized to selenite and selenate.

Selenium of different oxidation states can be further biotransformed by sediment organisms and transferred up the food chain (Fan et al. 2002; Hamilton 2004). Over time, most of the selenium associated with plant and animal tissues is deposited as detritus and eventually incorporated into the sediments. Some selenium forms may be volatilized to the atmosphere through microbial activity in the water and sediments or through direct release by aquatic plants (Lemly 2002).

Speciation affects transformation from dissolved forms to living organisms (e.g., algae, microbes) and nonliving particulate material at the base of the food webs. Selenate in the water column is taken up only slowly, especially if competition with sulfate (SO_4^{2-}) is involved. Selenite and organoselenides are much more reactive. When any form of selenium is taken up at the base of the food web by plants and microbes, it is converted to organoselenide. With extended residence times in a system the result is a buildup of proportionately more organoselenides and selenite as selenium is recycled through the base of food webs. In general, selenium concentrations in algae, microbes, sediments, or suspended particulates are 100 to 500 times higher than dissolved concentrations in selenate-dominated environments such as streams and rivers. However, when selenite or organoselenide are proportionately more abundant, the ratio can be 1,000 to10,000, such as in wetlands (Luoma and Presser 2009).

Wetting and drying cycles, as normally found in wetlands, are important factors that contribute to selenium mobilization and potential toxicity. Diffusive flux between water and sediments, in general, is highly influenced by the chemistry of both water and sediment (e.g., oxygen and selenium concentrations) (Byron and Ohlendorf 2007). Selenium is often present in chemically reduced forms when wetlands are submerged and have high organic matter. This condition favors volatilization (Masscheleyn and Patrick 1993, as cited in DWR and DFG 2007). When water levels decline and sediments are exposed, as seen with the exposed playa along the receding shoreline of the Salton Sea, selenium becomes more oxidized and bioavailable. As a result, the initial wetting as the SCH ponds are first filled has the potential to increase selenium bioavailability in sediments and organic matter (DWR and DFG 2007; Amrhein et al. 2011).

I.2.2 Selenium in Water

The Salton Sea receives flow from three rivers (Alamo, New, and Whitewater rivers), agricultural drainages, and ephemeral desert creeks. Reclamation has monitored seasonal water quality in the Salton Sea and its tributaries in 1999 and 2004–2009 (C. Holdren, Reclamation, unpublished data). Average waterborne concentrations of total selenium vary depending on water body (Table I-1). The Salton Sea has the lowest levels (mean 1.16 µg/L) because the deeper areas function as a sink for selenium (DWR and DFG 2007). For the period 2004–2009, mean annual total selenium concentrations in the rivers averaged 2.23 µg/L in the Whitewater River, 3.18 µg/L in the New River, and 5.09 µg/L in the Alamo River (C. Holdren, Reclamation, unpublished data). Summer 2010 sampling near the Project alternative sites found selenium concentrations of 1.2 µg/L in the Salton Sea, 4.1 µg/L in the Alamo River, and 1.8 µg/L in the New River (Amrhein and Smith 2011). By 2075, concentrations of selenium in New and Alamo rivers would not likely exceed 10 µg/L, as modeled in the Programmatic Environmental Impact Report (DWR and DFG 2007, Appendix H2).

Selenium concentrations in agricultural drains vary widely and are often higher. In 2005–2009, USGS measured total selenium in 29 drains or ponds operated by the Imperial Irrigation District (IID) along the Salton Sea's southern border (Saiki et al. 2010). Total selenium in unfiltered samples averaged 4.18 µg/L (range 0.79 to 79.1 µg/L). Total selenium concentrations in water were directly correlated with salinity and inversely correlated with total suspended solids concentrations. The total selenium in a subset of samples (n=7 drains, range 0.70 to 32.8 µg/L) was partitioned into the various selenium species. The mean proportions of each selenium species were 82 percent dissolved selenate, 9 percent dissolved selenite, 8 percent dissolved organic selenium, and 1 percent particulate selenium (Saiki et al. 2010).

Selenium enters the Salton Sea as highly soluble salt (primarily selenate and selenite) and accumulates in the anoxic sediments on the Sea floor (DWR and DFG 2007). Waterborne concentrations are rapidly reduced to less than 2 µg/L as selenium assimilates into biota and settles into organically rich sediments. The anoxic nature of the Sea's sediments is important in trapping selenium in insoluble, nonbioavailable forms of selenite, elemental selenium, and selenide.

Table I-1 Selenium Concentrations in Water

Location	Selenium Concentration (µg/L)		Year(s)	Notes and Source
	Mean	Range		
Salton Sea	1.16	0.98 – 2.94	2004–2009	Three surface samples near middle of the Salton Sea. Mean calculated from annual means for 6 years (2004–2009) Reclamation (unpublished data, C. Holdren)
	2.46	1.9 – 3.2	2006–2008	Near southern shore Miles et al. 2009
Whitewater River	2.23	1.27 – 2.86	2004–2009	Mean calculated from annual means for 6 years (2004–2009) Reclamation (unpublished data, C. Holdren)
Alamo River	5.09	4.22 – 6.78	2004–2009	Mean calculated from annual means for 6 years (2004–2009) Reclamation (unpublished data, C. Holdren)
	5.88	5.2 – 7.0	2006–2008	Miles et al. 2009
	4.1		2010	Amrhein and Smith 2011
New River	3.18	2.88 – 4.21	2004–2009	Mean calculated from annual means for 6 years (2004–2009) Reclamation (unpublished data, C. Holdren)
	1.8		2010	Amrhein and Smith 2011
New River (upstream) Imperial Wetlands Brawley Wetlands		2.7-5.4 2.2 – 3.9	2006–2007	River inflow to treatment wetlands Johnson et al. 2009
Agricultural drains into southern Salton Sea	4.18	0.79 – 79.1	2005–2009	29 drains and ponds Saiki et al. 2010

In 2006, Reclamation constructed a 50-hectare experimental SHP complex of four interconnected shallow saline ponds on the Sea's southern end. The USGS monitored water quality and biota at this site during 2006–2008 (Miles et al. 2009). The ponds were filled in 2006 with waters blended from the Alamo River (5.2 – to 7.0 µg/L selenium) and the Salton Sea (1.9 to 3.2 µg/L selenium). The blended waters had a selenium concentration of less than 5 µg/L flowing into the ponds. The water from the final pond (Pond 4) was sometimes recirculated to the first pond.

Salinity and selenium concentrations varied among these ponds and over time (Table I-2). The highest concentration measured was in Pond 4 (5.7 µg/L, Spring 2008). The effect of time was not consistent across all ponds. Sediment selenium concentrations increased over time in Ponds 1 and 2, relative to a slight decrease at Pond 4 (Miles et al. 2009). Selenium concentrations were typically below the Basin

Plan water standard (5 µg/L), but often exceeded Lemly's (2002) more conservative toxicity threshold (2.0 µg/L).

Table I-2 Salinity and Selenium Concentrations at Reclamation/USGS Saline Habitat Ponds

Constituent	Pond	Fall 2006	Spring 2007	Fall 2007	Spring 2008	Fall 2008
Salinity (parts per thousand [ppt])	1	6.5	24.1	4.2	13.0	21.2
	2	16.8	29.8	9.1	29.0	24.9
	3	30.9	58.9	29.9	70.7	47.6
	4	>70 *	174.0	153.3	335.0	398.0
Total Selenium in Water (µg/L)	1	3.9	1.9	2.0	3.0	2.6
	2	2.4	1.9	0.9	1.9	1.5
	3	2.7	2.7	1.2	1.6	1.7
	4	3.8	3.0	3.4	5.7	3.2
Total Selenium in Sediments (µg/g dw)	1	1.03	1.38	2.15	2.32	2.22
	2	0.94	1.25	1.37	1.31	1.61
	3	1.83	2.99	3.00	2.06	2.12
	4	1.67	2.44	2.35	1.97	1.92

Source: Miles et al. 2009

* Value exceeded measuring device capacity

I.2.3 Selenium in Sediment

The SCH ponds would be constructed on recently exposed or soon-to-be exposed playa. Selenium concentrations in sediment were measured in 2010 at proposed Project sites adjacent to the mouths of the Alamo and New rivers. Mean sediment selenium concentrations were 1.1 mg/kg (range 0.54 to 2.3 mg/kg). The majority of sediment samples (63 percent) were less than 1 mg/kg of selenium and would be considered "low risk." The remaining 37 percent of the samples were between 1 and 4 mg/kg (only two samples exceeded 2.5 mg/kg) and were considered in the "level-of-concern" category. No sample exceeded the "toxicity threshold" value of 4 mg/kg (Amrhein and Smith 2011).

Selenium could accumulate and concentrate in the SCH pond sediments over time. USGS monitored the experimental SHPs that were flooded in 2006 with water from the Alamo River and Salton Sea (Miles et al. 2009). Mean selenium concentrations in sediment were 1.03 to 2.32 mg/kg in Pond 1, 0.94 to 1.61 mg/kg in Pond 2, 1.73 to 3.00 mg/kg in Pond 3, and 1.67 to 2.35 mg/kg in Pond 4. Sediment selenium concentrations increased in Ponds 1 and 2 and decreased in Pond 4. Sediment concentrations did not exceed the 4.0 mg/kg toxicity threshold after nearly 3 years of operation. It was uncertain, however, whether the system had reached equilibrium (personal communication, R. Gersberg 2010).

Rewetting of the dried sediments when filling the newly constructed SCH ponds has the potential to solubilize and release selenium into the water (Byron and Ohlendorf 2007). Oxidized selenium is present in the exposed playa sediments that would be inundated. Experiments have measured selenium release from newly wetted sediment samples from the mouths of the New and Alamo rivers (Byron and Ohlendorf 2007, Amrhein et al 2011). Byron and Ohlendorf (2007) conducted a laboratory experiment using intact cores of Sea sediment with overlying Sea water and documented the effects of dissolved oxygen level (oxic, anoxic) and salinity (2, 20, or 35 parts per thousand [ppt]) on selenium flux. Higher positive flux from sediments into water was observed under oxic conditions and at the lowest salinity values. Selenium flux from the water to the sediment dominated at salinities of 20 and 35 ppt. Dissolved selenite (Se IV) and organic selenium compounds predominated in the overlying water. Results imply that selenium in overlying water is likely to be sequestered to the sediment under future highly saline conditions, as it is today, but may be released into the overlying water if water salinity is very low or if oxygenation is enhanced over current conditions.

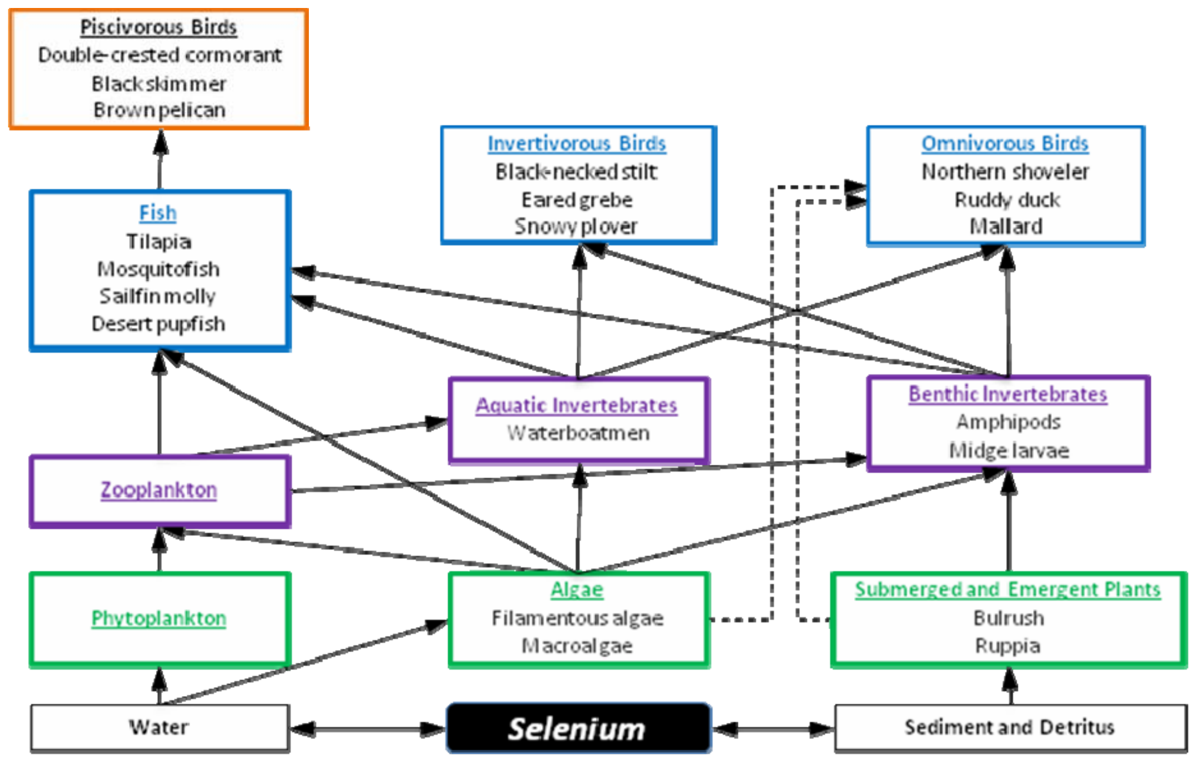
Amrhein and others (2011) incubated sediment taken near the mouth of Alamo River for up to 235 days with well-aerated water at salinities approximating 2.1 and 13.7 ppt. This experiment was designed to maximize sediment oxidation (well-mixed, well-aerated, high solution/sediment ratio). The amount of selenium in sediments was positively related to organic carbon, suggesting the primary pathway for selenium accumulation in the Salton Sea is algal uptake of soluble selenium from the water and deposition of algal detritus in sediments, as previously described in the PEIR (DWR and DFG 2007). Cumulative release of selenium from playa sediments over 194 and 235 days ranged widely (6 to 50 micrograms per kilogram, 1 to 21 percent of total sediment selenium). However, oxidation rates and amount solubilized did not appear affected by carbon content, salinity, location, or depth of sample core. Rather, the release of selenium appeared controlled by the amount of oxidizable iron present in sediments. If iron was present, the oxidized selenium adsorbed onto the iron and remained in the sediment, and less selenium would dissolve into pondwater. Therefore, water-soluble selenium (selenate) concentrations over high-iron sediments would be lower compared to low-iron sediments, and less selenium would be available for uptake into the food web via the algal pathway. This particulate-bound selenium (selenite) could still get into the food web through ingestion by benthic organisms and, subsequently, by fish and birds. Nevertheless, the volume of dissolved selenium from inflow water would likely pose a greater relative risk to wildlife bioaccumulation than selenium from sediment (Amrhein et al. 2011).

To compare selenium release from flooded and exposed sediments, Amrhein and others (2011) also measured selenium concentrations after 1 hour of wetting 3 different sediment samples (currently flooded, drained for about 1 month and 2 months due to the receding Salton Sea). Water-soluble selenium concentrations were twice as high from sites drained for 1 month (about 4 µg/L) and 3-4 times higher from sediments drained for 2 months (about 6 to 8 µg/L), compared to flooded sites (about 2 µg/L). This result is consistent with the concept of an initial "flush" following inundation. Because this experiment was well mixed and well aerated, undisturbed sediments should release selenium more slowly. SCH managers could decrease residence times (i.e., more flow-through) to flush soluble selenium out of the ponds. Selenium solubilization from sediments likely declines over time, as suggested by findings from the SHP complex, where the frequency of elevated egg selenium concentrations declined after the 1st year (Miles et al. 2009). The volume of dissolved selenium from inflow water would likely pose a greater relative risk to wildlife bioaccumulation than selenium from sediment (Amrhein et al. 2011).

I.3 ECOLOGICAL RISK ASSESSMENT

I.3.1 Ecological Receptors and Exposure Pathways

Selenium can adsorb onto organic particulate matter such as detritus, be ingested by invertebrates or fish, and bioaccumulate within aquatic food webs (Figure I-1). Selenium in the water or sediment may be transferred up the food web through attached or free-floating microorganisms or rooted submerged and emergent plants (primary producers or consumers). As selenium is transferred into the benthic or water-column invertebrates, fish or birds (secondary or tertiary consumers) may then consume it. Alternatively, the selenium pathway to higher-order aquatic and benthic invertebrates, fish, and birds may also occur directly through contact with or ingestion of water and sediment (DWR and DFG 2007).



Not all possible pathways depicted, such as detritus to invertebrates and some fish.

Figure I-1 Selenium Cycling and Transport Pathways

Selenium concentrations have been measured in various biota at the Salton Sea area, including algae, vegetation, invertebrates, fish, and bird eggs (Table I-3) (DWR and DFG 2007; Johnson et al. 2009; Miles et al. 2009; Saiki et al. 2010).

Invertebrates

Aquatic (water-column) and benthic invertebrates (including zooplankton) are found in marine, estuarine, and freshwater habitats. Aquatic and benthic invertebrates can include primary consumers that ingest sediment and surface water during feeding or burrowing. Aquatic and benthic invertebrates are a major route of food-chain transfer in the Salton Sea food chain (DWR and DFG 2007). The suggested toxicity threshold for invertebrates as prey (to avoid bioaccumulation in birds) is 3 to 4 µg/g dw (Hamilton 2004). However, selenium concentrations observed at the Salton Sea vary widely among locations and taxa (Table I-3) and frequently exceed this threshold. At the SHP complex, mean concentrations exceeded 4.0 µg/g dw in 67 to 80 percent of corixid samples and 0 to 30 percent of chironomid samples (Miles et al. 2009). In the IID agricultural drains, selenium concentrations in chironomids were an order of magnitude higher (Saiki et al. 2010).

Table I-3 Mean Selenium Concentrations in Water, Sediment and Biota

Location	Water (µg/L)	Sediment (µg/g dw)	Aquatic Plant µg/g dw	Invertebrate (µg/g dw)	Fish (µg/g dw)	Bird Eggs (µg/g dw)
Salton Sea - Open Water [1] (mean and range)	-	-	0.83 (0.2-1.1)	-	10.4 (4.37 - 25.7)	
Salton Sea - Shoreline and Shallow Water[1] (mean and range)	-	-	0.72 (0.4-1.3)	6.64 (0.82-12.1)	-	5.98 (0.54-14.2)
Salton Sea[2] (range of means)	1.9-3.2	1.42-2.42	-	2.37 - 3.64	-	5.41 (Morton Bay)
Alamo River Estuary[1] (mean and range)	-	-	-	4.25 (0.7-5.7)	11.5 (4.3 - 27.9)	
New River Estuary[1] (mean and range)	-	-	-	2.7 (2.5-2.9)	9.67 (3.5-17.0)	2.81 (1.9- 3.7)
Saline Habitat Ponds[2] (range of means)	1.2-3.9	0.94-2.44	-	2.16 - 8.50	-	4.52 - 9.09
Sonny Bono National Wildlife Refuge[2] (range of means)	0.7-1.1	0.38-0.61	-	0.92 - 2.31	-	2.18 - 4.42
Freshwater Marsh[2] (range of means)	2.0-4.2	1.73-2.67	-	2.05 - 2.83	-	5.6 - 7.05
Agricultural Drains[3] (mean and range)	5.62 (0.70-32.8)	1.43 (0.33-10.0)	2.22 (0.75-8.26)	Chironomid 6.50 (1.39-50.6)	Mosquitofish 6.81 (3.66-20.2) Salfin molly 6.89 (3.09-30.4)	-
New River Imperial Wetlands[4] (median and range)	(2.7-5.4)	0.3 (0.2-0.8)	-	Corixid, glass shrimp, Odonate, 4.1 (2.8-5.2)	Carp 4.4 Shad 4.7 (3.3-20.0)	-
New River Brawley Wetlands[4] (median and range)	(2.2-3.9)	0.4 (0.4-0.5)	-	Corixid, Odonate, glass shrimp, crayfish 2.6-3.8 (1.5-8.2)	Carp 4.0 Shad 2.8 Tilapia 4.5 (1.9-7.3)	-

1. DWR and DFG 2007, Appendix F
2. Miles et al. 2009. Saline Habitat Ponds supplied with Salton Sea and Alamo River waters, Sonny Bono National Wildlife Refuge supplied by Colorado River water, Freshwater Marsh supplied with agricultural drainwater.
3. Saiki et al. 2010. Seven IID agricultural drains in southern Salton Sea.
4. Johnson et al. 2009.

Fish

Fish may be exposed to selenium in sediment or surface water through ingestion, dermal contact, uptake through gills, and by feeding on contaminated plants, aquatic invertebrates or smaller fish. Likely fish species at the SCH ponds include tilapia, sailfin molly, western mosquitofish, and desert pupfish. Fish can be primary, secondary or tertiary consumers. Tilapia are omnivorous and forage on detritus, algae, phytoplankton and invertebrates. The food-chain pathway is the most important route of exposure for fish, which also are a major route of food-chain transfer to higher trophic levels such as birds.

Mean whole-body fish selenium concentrations were 10.4 µg/g dw in the open Salton Sea, 9.67 µg/g dw in the New River Estuary, 11.5 µg/g dw in the Alamo River Estuary (DWR and DFG 2007, Appendix F), 6.81 to 6.89 µg/g dw in IID agricultural drains (Saiki et al. 2010), and 2.8 to 4.7 µg/g dw in New River wetlands upstream (Johnson et al. 2009). Sailfin mollies and moquitofish did not appear to be adversely affected at concentrations of 3.1 to 30.4 µg/g dw, and pupfish in laboratory experiments did not exhibit negative health effects from such levels of selenium exposure (Saiki et al. 2010).

Birds

Selenium's most substantial effects occur in bird embryos, such as reduced hatching success and teratogenesis. While many bird species use the Salton Sea ecosystem for a part or all of their lives (summer breeding, wintering, or migratory stopover), the target bird species for this ecological risk analysis are those species that both breed at the Salton Sea and feed on aquatic invertebrates and fish expected to occur in the SCH ponds. The effects of selenium exposure from the SCH Project on species breeding elsewhere would be temporary and likely to be negligible, based on laboratory feeding studies that showed that selenium is depurated (lost) from the birds within about 2 weeks once selenium-treated food is removed (Ohlendorf and Heinz 2011). Breeding species that could be exposed at the SCH ponds include California brown pelican, double-crested cormorant, Caspian tern, black skimmer, gull-billed tern, black-necked stilt, and western snowy plover.

Mean egg selenium concentrations were 4.52 to 9.09 µg/g dw at the SHP complex (black-necked stilt, Miles et al. 2009), 5.98 µg/g dw at Salton Sea shoreline (DWR and DFG 2007), and 2.81 µg/g dw at New River estuary (DWR and DFG 2007).

California Brown Pelican

The California brown pelican occurs at the Salton Sea as newly fledged young and post-breeding adults as they disperse from nesting areas in Baja California. During summer, brown pelicans forage around the Sea's margin. In recent years, brown pelicans have nested in small numbers, especially at the Sea's southern end at the mouth of the Alamo River (Molina and Sturm 2004). In 2009, California brown pelicans were most abundant in August with almost 3,000 individuals recorded near and within the Project area; numbers declined in the fall but the species remained a consistent visitor throughout the year (USFWS 2010). This species was observed during Summer 2010 surveys foraging within the Sea at the mouths of the New and Alamo rivers and along the shoreline (Dudek 2010); suitable roosting and loafing habitat includes sandbars, islands, and rocky areas within the Project area.

Brown pelicans are expected to forage often at the SCH ponds for fish, as well as at the mouths of nearby rivers where fish may persist in the deltas.

Double-Crested Cormorant

The double-crested cormorant is a California Species of Special Concern. Cormorants are yearlong residents along the California coast and the Salton Sea. They feed primarily on fish, but also crustaceans and aquatic insects. Nesting habitat requirements include undisturbed areas near water and may consist of rock ledges on cliffs, rugged slopes, and live or dead trees. Breeding at the Salton Sea begins with nest building in late January (Patten et al. 2003) and may extend to July or August, though only one brood is produced (Zeiner et al. 1990, as cited in DWR and DFG 2007). Double-crested cormorants nest in colonies and usually lay three or four eggs (Udvardy 1993, as cited in DWR and DFG 2007).

Double-crested cormorants are expected to forage often at the SCH ponds, as well as at the mouths of nearby rivers where fish may persist in the deltas.

Black Skimmer

The black skimmer is a California Species of Special Concern. It is a fairly common summer resident and breeder at the Salton Sea, arriving by late April and departing by October. Nesting at the Sea's southern end begins in May and continues into the early fall, depending on the Sea's water levels (Patten et al. 2003). They typically breed on sandy islands or sandy areas in salt marshes and they can breed on isolated sections of eroded impoundment levees. They nest in colonies and produce one clutch per year with one to five eggs (four or five are most common) (Zeiner et al. 1990, as cited in DWR and DFG 2007). Black skimmers forage on small fish and crustaceans and prefer areas near river mouths and other water channels at the Salton Sea.

Black skimmers are expected to forage often at the SCH ponds for fish, as well as at the mouths of nearby rivers where fish may persist in the deltas.

Caspian Tern

The Caspian tern is a common breeding bird that occurs within the Salton Sea region from mid-April through October. It is most abundant at the Sea from late summer through fall. Most Caspian terns depart from the region by the end of October, but some remain through the winter (Patten et al. 2003). Caspian terns forage primarily or exclusively for fish but may occasionally take crayfish and insects (Cuthbert and Wires 1999). Approximately 25 percent of the North American population of the Caspian tern breeds at the Salton Sea (Cuthbert and Wires 1999; personal communication, K. Molina 2010). In 2009, the population size within the Project area was in the hundreds for the winter months and in the thousands for the breeding season (USFWS 2010). In 2010, nesting numbers of Caspian terns were up to several thousand breeding pairs, predominantly on Mullet Island and the D pond islands but also along Morton Bay's shore (personal communication, K. Molina 2010).

Caspian terns are expected to forage often at the SCH ponds for fish, as well as at the mouths of nearby rivers where fish may persist in the deltas.

Gull-Billed Tern

The gull-billed tern is a California Species of Special Concern. They arrive at the Salton Sea in mid-March and remain until October. Gull-billed terns nest on protected spits, berms, and islands composed of sand or barnacle shells; at the Salton Sea, they also nest on earthen levees and on constructed islands in shallow brackish impoundments. For Salton Sea colonies, available nesting substrates include fine, poorly drained, clay soils devoid of all vegetation with cobbles and boulders located sparsely. Nests are often located adjacent to cobbles, boulders, or other debris. Gull-billed terns forage primarily in freshwater ponds and flooded agricultural fields. Foraging habitat within the Project area would likely include agricultural fields, marshes, mudflats, drainage ditches, and fresh or saline open water. At the Salton Sea, the species forages for small fish, crayfish, lizards, butterflies, beetles, crickets, weevils, and occasionally, the young chicks of other shorebirds (DWR and DFG 2007).

Gull-billed terns are expected to forage occasionally at the SCH ponds, but their diet will be predominantly from other sources in the surrounding landscape.

Black-Necked Stilt

The black-necked stilt is a yearlong, fairly common resident at the Salton Sea (Patten et al. 2003). This shorebird prefers lakeshores, flooded alkali flats, saltponds, coastal estuaries, and flooded fields. Nesting habitat includes friable soil, mudflats, levees, or dry lakeshores near water. Nesting mainly occurs April through June (Patten et al. 2003). The clutch size averages four, with a range of three to five (Zeiner et al. 1990, as cited in DWR and DFG 2007). Black-necked stilt forages in shallow water for insects, crustaceans, mollusks, and other aquatic organisms, including some small fish.

Recent studies at the experimental SHP complex measured selenium in black-necked stilt eggs (2006, 2007, 2008) (Miles et al. 2009). Black-necked stilt are considered moderately sensitive to selenium (Skorupa 1998). Selenium concentrations in black-necked stilt eggs (2-8 µg/g dw, mean 5 µg/g dw) at the SHP complex were significantly higher than eggs from reference sites for 2 out of the 3 years, and 47 percent of the eggs exceeded the selenium toxicity threshold of 6.0 µg/g dw (Miles et al. 2009). Anderson (2008) reported that selenium concentrations in stilt eggs in SHP ponds were elevated, but concentrations were similar to those found in other stilt nesting habitats in the Salton Sea. Stilts were tracked feeding in both ponds and the Salton Sea, however, and therefore the egg selenium concentrations reflect a composite of prey from multiple sources and potentially different selenium levels. Miles and others (2009) "did not detect any relationship between selenium and embryonic malpositioning or post-hatch survival of stilt chicks, or a high frequency of embryonic deformities associated with selenium toxicity. Therefore, although a selenium risk was indicated at the SHP complex, it was not manifested by a reduction in the productivity parameters measured in [stilts]".

Black-necked stilts are expected to forage for invertebrates and some fish at the SCH ponds in the shallow margins, as well as at other shoreline habitats that persist nearby.

Western Snowy Plover

The snowy plover is a California Species of Special Concern. The western snowy plover regularly winters and breeds along the Salton Sea's shoreline. It nests during the spring and summer on open beaches with sand and barnacle substrates and in close proximity to standing water. Nesting occurs within about 1,000 feet of the Sea's edge (personal communication, K. Molina 2010). Breeding has been noted to be concentrated on the Sea's western side from Desert Shores to the mouth of San Felipe Creek and on the eastern side from Bombay Beach to Wister Unit (Patten et al. 2003). The western snowy plover also forages along the Sea's shoreline, mostly on the sand and barnacle beaches. It will also forage in shallow impoundments with exposed mud. Suitable habitat for foraging and breeding within the Project area includes the mudflats along the Sea's shoreline. Snowy plovers eat terrestrial and aquatic invertebrates, utilizing beaches, tideflats, saltflats, and salt ponds while foraging above and below the high water line (Page et al. 1995, as cited in DWR and DFG 2007).

Western snowy plovers are expected to forage for invertebrates at the SCH ponds in those areas shallow enough for this small shorebird.

I.3.2 Toxicity Reference Values

Designation of toxicity thresholds for selenium in biota has varied (Amrhein and Smith 2011; Ohlendorf and Heinz 2011). Lemly (2002) proposed no more than 3 µg/g dw in food-chain organisms, and 4 µg/g dw in whole-body fish. This fish threshold is a general standard protective of the most sensitive fish species; the fish species likely to colonize the SCH ponds are less sensitive to selenium (Saiki et al. 2010; personal communication, M. Saiki, 2011).

In bird eggs, 6 µg/g dw is a conservative and widely reported toxicity reference value (Ohlendorf and Heinz 2011). The responses to selenium vary among bird species, ranging from "sensitive" (mallard) to "average" (stilt) and "tolerant" (avocet) (Skorupa 1998, as cited in Ohlendorf and Heinz 2011). Risk of impaired reproduction can start to occur at egg concentrations of 6 to 12 µg/g dw (Table I-4). The risk of teratogenesis starts to occur above 12 µg/g dw for sensitive species and above 20 µg/g dw for moderately sensitive species (Ohlendorf and Heinz 2011). Cormorants and terns are likely to be fairly tolerant of selenium, in keeping with greater tolerance of other saltwater-adapted species such as avocets and snowy plover, compared to freshwater-adapted species such as mallards (personal communication, H. Ohlendorf, 2010).

Table I-4 Selenium Thresholds and Effects on Birds

Selenium Concentration (µg/g dw)	Probability of Effects on Birds	
	Reproductive Impairment (reduced hatching success)	Teratogenic Effects
<3.0 mean, <5.0 individual eggs	None - Background level	None - background level
<6	None	None
6 to <8	Low probability	None
8 to <12	Elevated probability for sensitive species (mallard)	None
12 to <20	Elevated for sensitive (mallard) and "average sensitivity" species (black-necked stilt)	Low probability
>20 to 35	Elevated probability	Elevated probability for sensitive species (mallard)
>35	Elevated probability	Elevated for "average sensitivity" species (black-necked stilt)

Source: Ohlendorf and Heinz 2011

I.3.3 Ecological Risk Modeling

Modeling of selenium bioaccumulation within food webs of the SCH ponds was used to predict the selenium levels in water and sediments of the SCH ponds and the range of concentrations of selenium in the tissues of fish and birds utilizing the SCH habitats. This section summarizes results of ecological risk modeling performed by UCR (Sickman et al. 2011).

Approach and Methodology

Sickman and others (2011) used the modeling approach of Presser and Luoma (2010) to simulate transformation of dissolved selenium into particulate organic matter and selenium bioaccumulation rates among trophic levels. The SCH selenium conceptual model simulates the mixing of river and Sea water to attain a specified salinity level and assumes that selenium mixing is conservative. Next, the model transforms dissolved selenium into particulate matter using a partitioning coefficient (K_d value [Presser and Luoma 2010]). Particulate selenium pools included sediments and organic detritus (including associated microbial biomass) and algae and phytoplankton. Once selenium becomes bound to organic particulate matter it is consumed by invertebrates and the bioaccumulation rate is estimated using a trophic transfer factor (TTF) derived from field measurements. Within the model, the particulate selenium pool was conceptualized to be the first level of the food web. Invertebrates (chironomids, corixids) represent the second level of the food web. Invertebrates are in turn preyed upon by fish (tilapia, mosquitofish and sailfin mollies) or invertebrate-consuming birds (black-necked stilts), which represent the third level of the food web. The fourth level of the food web represents predation of fish by piscivorous birds (terns, cormorants). Understanding of selenium transfer into particulate matter and bioaccumulation and effects in piscivorous birds are major knowledge gaps at the Salton Sea (Sickman et al. 2011).

The assessment endpoint for all birds was reproduction, since reproductive effects are the most sensitive indicator of selenium toxicosis (Ohlendorf and Heinz 2011). The metric used was the selenium concentration of bird eggs (Sickman et al. 2011). These models are progressive in structure since they simulate and track the movement of selenium as it progresses from dissolved forms into particulate matter through the food chain.

Parameters used in the General Models were computed from all available studies in and around the Salton Sea. Given significant differences in waterborne selenium concentrations, separate General Models were made for SCH ponds utilizing either Alamo River or New River water, blended with Salton Sea water to achieve operational salinity targets of 20 and 35 ppt. Separate General Models were constructed for food webs containing invertebrate-consuming birds and food webs containing fish-consuming birds (Sickman et al. 2011). Different questions were addressed with various simulations using different K_ds and TTFs, and the most applicable simulations are reported here:

Expected Water Quality. This simulation answers the question: "How much selenium would be in the biota from SCH ponds, given different sources and salinities of water supplying the ponds?" The model was run in a "forward" direction starting from initial selenium concentrations in water to produce estimates of selenium concentrations in whole-body fish and in bird eggs. This scenario utilized median values for K_d and TTFs and the median water quality parameters.

Future Scenario/River Only - 10 µg/L Rivers. This scenario simulates conditions in the future after the Salton Sea has reached excessively high salinity levels and is no longer used to supply SCH ponds with water.[3] In this hypothetical future worst case scenario, the ponds would instead be supplied only by river water, which has a total selenium concentration of up to 10 µg/L. Median K_d values were used in this future scenario.

Inverse Modeling. This simulation answers the question: "How much river water can be used in the SCH ponds before birds exhibit reduced egg viability?" Because the dissolved selenium concentrations in the Alamo and New rivers are substantially higher than in the Salton Sea, all things being equal, the selenium risk increases with decreasing SCH salinity because more river water is required to reach the target salinity. The model was run backwards to compute the maximum acceptable dissolved selenium concentration and ultimately the mixture of Sea and river water necessary to not exceed various selenium concentrations in bird eggs (6, 8, or 12 µg/g dw).

Results

Expected Water Quality Simulation

Overall, the models suggest that fish and bird eggs in SCH ponds utilizing Alamo River water will have about 50 percent higher selenium concentrations than with the same salinity in SCH ponds utilizing New River water (Table I-5). This result is due to higher dissolved selenium levels in the Alamo River water relative to the New River. Similarly, risk increases as salinity decreases, with about 25 to 30 percent higher selenium concentrations predicted at a salinity of 20 ppt relative to 35 ppt. Recall that higher risk at lower salinity is simply the outcome of greater water contributions of river water (higher total selenium concentrations) to reach lower salinity mixtures in the SCH ponds (Sickman et al. 2011).

[3] Salinity in the Salton Sea is projected to reach 250 ppt by the year 2068 (Appendix H-2, DWR and DFG 2007 If Sea and river water were then blended to achieve saline conditions, inflow for the SCH ponds would be 13 percent Sea water to achieve 35 ppt (selenium concentration 8.9 µg/L) or 7 percent Sea water to achieve 20 ppt (9.4 µg/L). Simulation 3 represents a worst-case scenario of all-river water (10 µg/L).

Table I-5 Modeled Selenium Concentrations in Biota

River Source	Salinity	Water (µg/L)	Macroinvertebrates	Fish (whole)	Bird Eggs (Invertebrate Eaters)	Bird Eggs (Fish Eaters)
New River	20 ppt	2.6	4.2	5.5	7.6	8.3
	35 ppt	2.0	3.3	4.3	6.0	6.5
Alamo River	20 ppt	4.0	6.6	8.5	11.6	12.7
	35 ppt	2.8	4.5	5.9	8.1	8.9

Selenium concentrations in biota = micrograms per gram dry weight (µg/g dw)
Source: Sickman et al. 2011 (General Model simulation)

Using expected water quality and median K_d values, the only modeling scenarios that produced egg selenium concentrations at or below the 6 µg/g effects level were SCH ponds supplied by the New River and operated at salinity of 35 ppt for those birds that eat primarily invertebrates (Table I-5). Less than 8 µg/g dw was predicted, under the expected water quality simulation, for invertebrate-consuming birds in New River SCH ponds at 20 ppt salinity, and in fish-consuming birds in New River SCH ponds at 35 ppt salinity. For Alamo River-supplied SCH ponds modeled under the expected water quality simulation, egg selenium concentrations of 8.1 to 12.7 µg/g dw were predicted depending on salinity (Sickman et al. 2011). Egg selenium concentrations would be greater in ponds operated at a lower salinity (20 ppt) than higher salinity (35 ppt) (Sickman et al. 2011). Therefore, it is anticipated that egg selenium concentrations of birds foraging at the SCH ponds would be greater than 6 µg/g dw but less than 12 µg/g dw, potentially resulting in reduced hatching success but not teratogenesis.

Future (River Water Only) Simulation

Under future, "worst-case" water quality conditions, using just river water if the Salton Sea becomes too salty to be mixed into the SCH ponds at any appreciable concentration, the models estimated egg selenium concentrations of 29.1 µg/g dw for invertebrate-eating birds and 31.8 µg/g dw for fish-eating birds. Selenium concentration estimates in the future scenario/river-only simulation suggest that serious reproductive effects would occur across a range of avian species and some species would experience teratogenic effects from selenium (comparing to effect levels in Table I-4) (Sickman et al. 2011).

Inverse Modeling Results

Results from the inverse modeling runs provide useful information for establishing salinity levels in the SCH ponds (Table I-6). Under expected water quality conditions, the Inverse Models predict that in order to keep egg selenium concentrations in invertebrate-consuming birds equal to or less than 6 µg/g dw, ponds supplied with New River water would have to be operated at salinities above 35 ppt and ponds supplied with Alamo River water would have to be operated above 44 ppt. To keep egg selenium concentrations of fish-eating birds equal to or less than 6 µg/g dw, ponds supplied with New River water would have to be operated above 39 ppt and ponds supplied with Alamo River water would have to be operated above 46 ppt (Sickman et al. 2011). A greater proportion of river water could be used if higher selenium concentrations would be tolerated in bird eggs, which would consequently result in lower salinity of water supplying the SCH ponds. For example, if egg selenium concentrations in both invertebrate-eating and fish-eating birds could be allowed reach up to 12 µg/g dw, then the SCH ponds using Alamo River water could be operated at 23 ppt, and SCH ponds using New River water could be operated with pure river water (Table I-6).

Table I-6 Predicted Salinity of SCH Ponds Necessary to Meet Target Selenium Concentrations in Bird Eggs

Target Selenium Concentration in Bird Eggs (dry weight)	Ponds Operated with New River Water				Ponds Operated with Alamo River Water			
	Invertebrate-Eating Birds		Fish-Eating Birds		Invertebrate-Eating Birds		Fish-Eating Birds	
	Selenium in Blended Water	Minimum Salinity of Blended Water	Selenium in Blended Water	Minimum Salinity of Blended Water	Selenium in Blended Water	Minimum Salinity of Blended Water	Selenium in Blended Water	Minimum Salinity of Blended Water
6 µg/g	2.06 µg/L	35 ppt	1.89 µg/L	39 ppt	2.06 µg/L	44 ppt	1.89 µg/L	46 ppt
8 µg/g	2.75 µg/L	17 ppt	2.52 µg/L	23 ppt	2.75 µg/L	36 ppt	2.52 µg/L	39 ppt
12 µg/g	4.12 µg/L	All-river source okay	3.78 µg/L	All-river source okay	4.12 µg/L	18 ppt	3.78 µg/L	23 ppt

Source: Sickman et al. 2011 (Inverse Model simulation, Appendix Tables 10a, 10b. 11a and 11b)

Reclamation/USGS SHP Pond Simulation

Data from the Reclamation/USGS SHP study (Miles et al. 2009) was also used to compute values for Kd and TTF to simulate selenium dynamics in experimental saline habitats, which are similar in design to the SCH ponds (Sickman et al. 2011). When the Reclamation/USGS SHP ponds model results are compared to the observed egg selenium concentrations of invertebrate-consuming birds in the Reclamation/USGS SHP complex (Table I-7), it can be seen that the modeled egg selenium concentrations are actually higher than those observed in the experimental ponds. Therefore, it is possible that the actual levels of selenium in the SCH ponds would be lower than those predicted by the model. Further, the observed levels of egg selenium concentrations of invertebrate-consuming birds from the reference sites were within the same range as those from the Reclamation/USGS SHP complex, suggesting that SCH ponds operated with comparable salinity levels would not significantly increase selenium ecological risk at the Salton Sea.

Table I-7 Observed and Modeled Selenium Concentrations in Invertebrate-Eating Birds at Reference Sites and SHP Complex

Site		Observed Selenium Concentrations						Modeled Selenium	
		Water (µg/L) Range			Black-Necked Stilt Eggs			Water[2] (µg/L)	Invert-Eating bird eggs
		2006	2007	2008	2006	2007	2008		
Reference Sites[1]	Freshwater Marsh	2.5	2.0-4.1	2.6-4.2	7.05	6.11	5.26	n/a	n/a
	D-Pond	0.9	0.7-0.8	0.9-1.1	3.62	2.18	4.42	n/a	n/a
SHP Ponds	Pond 1	3.9	1.9-2.0	2.6-3.0	7.85	6.18	5.45	2.7	13.1
	Pond 2	2.4	0.9-1.9	1.5-1.9	9.09	5.45	5.73	1.7	12.5
	Pond 3	2.7	1.2-2.7	1.7	--	6.06	6.99	2.0	6.2

1. Reference sites at Sonny Bono Salton Sea National Wildlife Refuge.
2. Model used mean values for selenium concentrations in water from each pond 2006–2008 (Miles et al. 2009).

Sources: Miles et al. 2009; Sickman et al. 2011

I.3.4 Conclusions

The modeling results yield several findings with relevance to SCH design and operation. First, the selenium risk in SCH ponds supplied with Alamo River water would likely be substantially higher than in ponds utilizing New River water. Risk characterization indices suggest moderate to high risk for reduced egg viability in black-necked stilts would occur in Alamo River-supplied SCH ponds and that the risks would be elevated above current risk levels (Sickman et al. 2011). Second, inverse modeling supports the premise that higher salinity levels would result in lower risk from selenium. Salinity of 35 ppt is recommended to reduce risk of reproductive effects (<6 µg/g dw). If low to moderate levels of reduced hatching success are deemed acceptable, then salinity levels closer to 20 ppt would be adequate for New River-supplied SCH ponds.

The magnitude of selenium impacts for the implemented Project could be lower than predicted by modeling. First, the ecological risk model assumed all diet comes from the SCH ponds, which could be true for species such as black-necked stilts and snowy plovers. The foraging range for many other birds (especially piscivores) would likely include other habitats beyond the SCH ponds, and those habitats (such as the freshwater ponds at the Sonny Bono Salton Sea National Wildlife Refuge, which receives Colorado River water) may have lower selenium levels. Thus, the true dietary exposure concentrations could be lower because the birds' foraging range would likely include other habitats beyond the SCH ponds. Second, when the model was run using parameters estimated from the SHP complex, the modeled egg selenium concentrations were greater than the actual measured egg concentrations (Miles et al. 2009), indicating that this model is a very conservative estimator of risk.

The model assumed that water residence time in the SCH ponds would be less than 32 weeks and that target salinity levels (20 and 35 ppt) would be reached primarily by mixing Salton Sea water with river water. Selenium concentrations in the Sea are lower than in the rivers and SCH salinity levels near the current condition in the Sea would produce the lowest dissolved selenium concentrations in the SCH ponds. Some evapoconcentration of constituents in water would occur with residence times near 32 weeks, although this is not expected to be true of selenium (personal communication, H. Ohlendorf, 2011). The data from Miles and others (2009) and the models suggest that residence times on the order of months would not appreciably increase selenium risk in the SCH ponds. While longer residence time could favor the conversion of selenate into more bioavailable forms of selenium, selenium concentrations decreased over time at other constructed habitats in the region, both in sediment of freshwater treatment wetlands (Johnson et al. 2009) and eggs from saline ponds (Miles et al. 2009), which suggests that selenium removal pathways could develop within the first 1 to 2 years after construction (Sickman et al. 2011).

I.4 MANAGEMENT STRATEGIES

The SCH ponds would be managed through a combination of source control and pond management to reduce selenium exposure and risk to biota, depending on the alternative chosen and Project operations. The levels of selenium at the SCH ponds would be monitored, at a minimum in the water, sediment, fish and bird eggs; and when feasible also particulate matter and invertebrates. If these measures do not reduce or mitigate risk to acceptable levels, then other measures including water treatment techniques would be considered; such potential actions, however, would not be part of this SCH Project.

I.4.1 Source Control and Minimization

Blend Waters to Reduce Selenium in Water Supply

Current selenium concentrations are greater in the Alamo River (5.1 to 5.8 µg/L) than the New River (3.2 to 3.5 µg/L). The modeling results suggest that selenium risk in SCH ponds would be reduced if New

River water were used instead of Alamo River water (Sickman et al. 2011). Another approach would be to “dilute” the river water with Salton Sea water (1 to 2 µg/L selenium). Therefore, the water supplied to the SCH ponds would be a blend of Salton Sea water and river water, which would be managed typically between 20 and 40 ppt and occasionally allowed up to 50 ppt with evaporation. The upper limit was selected based on expected tolerances of fish such as tilapia. Salinity of Salton Sea water is currently 53 ppt. However, low winter water temperatures can decrease the salinity tolerance of tilapia (Appendix J), so operational scenarios would likely have to balance these habitat requirements (Appendix D).

Control Vegetation to Reduce Bioaccumulation

Emergent and submerged vegetation can exacerbate selenium bioaccumulation because bioavailable forms of selenium can bioaccumulate in algae and phytoplankton or adsorb onto organic and/or particulate matter, where it is incorporated into the food web through uptake by benthic invertebrates and other detritivores. Plants such as pondweeds (e.g. *Ruppia*), cattail and bulrush can contribute appreciable amounts of organic matter that becomes detritus (Lemly 1998).

Higher salinity levels could be used in the SCH ponds to reduce or prevent the growth of emergent vegetation. For example, broad leaf cattail (*Typha latifolia*) has a typical salinity preference of 0 to 0.5 ppt, but has been found in intermediate marshes where salinities range up to 3.5 ppt (Stutzenbaker 1999). If salinity levels in the ponds were kept above 10 ppt, then many emergent vegetation species would be excluded from the ponds, reducing the risk of increased selenium bioaccumulation. Table I-8 presents salinity tolerances of several emergent plant species that could be present in the Project area.

The sedimentation basins would have very low-salinity water, which could support emergent vegetation as well as algae, phytoplankton and submerged vegetation. To discourage establishment of extensive emergent vegetation, they would be designed with steep sides and greater depths. Periodic maintenance of the sedimentation basins would include removal of accumulated sediment and organic matter that settled out from the river water and removal of any vegetation.

Flush the Ponds Following Initial Filling

It may be possible to flush some soluble selenium out of the ponds following initial filling of the ponds by decreasing the residence time (i.e., increasing flow-through rate) (Amrhein et al. 2011). Some evidence exists of selenium mobilization upon initial wetting of playa sediment (Amrhein et al. 2011). Sickman and others (2011) suggested that constructed freshwater and saline wetlands at the Salton Sea appear to develop selenium removal pathways within the first 1 to 2 years after construction. For example, at the Brawley and Imperial wetlands, appreciable amounts of selenium were sequestered or volatilized from the wetlands (Johnson et al. 2009). At the SHP complex, the percentage of stilt eggs that exceeded 6 µg/g dw declined from 77 percent during the 1st year of operation to an average of 44 percent in the 2nd and 3rd years (Miles et al. 2009).

Prevent Wildlife Access to Sedimentation Basins

The first pond where sediment would settle out is likely to have the highest concentrations of selenium (Miles et al. 2009). For the SCH Project, this location would be the sedimentation basin where river water is first diverted. Therefore, the sedimentation basin would be constructed and maintained to be deep with steep sides to discourage foraging and nesting by birds such as black-necked stilts. If necessary, other bird deterrent methods (e.g., Gorenzel and Salmon 2008) would be considered if selenium concentrations in the basins are at levels of concern and bird use is high.

Table I-8 Salinity Tolerances of Local Plant Species

Species	Habitat	Typical Salinity Preference	Widest Salinity Tolerated	Comments
American Bulrush (*Scirpus americanus*) Olney's Three-Square Bulrush *Schoenoplectus americanus*)	Fresh to intermediate marshes	0-3.5 ppt	50% reduction at 4 ppt and no germination above 13 ppt.	Stutzenbaker 1999; Uchytil 1992 Management and maintenance depends primarily on maintenance of water levels and secondarily on salinity levels (Uchytil 1992).
California Bulrush (*Schoenoplectus californicus*)	Widespread in fresh and intermediate marsh zone	0-3.5 ppt	Approximately 10 ppt or greater will control populations.	Stutzenbaker 1999 Prolonged exposure to extreme conditions (15 to 20 ppt) exceeds the typical salinity tolerance and populations decline (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2002).
Saltmarsh Bulrush (*Scirpus maritimus* or *Scirpus robustus*)	Intermediate to brackish marshes, often on soils subject to tidal influence	3.5-10 ppt	Has been found in hypersaline lakes (~60 ppt). Germination reduced 50% at salinity = 9 ppt. No germination at salinity = 21 ppt.	Stutzenbaker 1999; International Lake Environment Committee 1998; Snyder 1991
Broad Leaf Cattail (*Typha latifolia*)	Freshwater aquatic normally, but also found in intermediate marshes	0-0.5 ppt	Found in intermediate marshes with salinity up to 3.5 ppt . In marshes of southeastern Louisiana, occurred at salt levels up to 1.13%.	Stutzenbaker 1999
Narrow Leaf Cattail (*Typha angustifolia*)	Freshwater aquatic normally, but also found in intermediate marshes; coastal	0-0.5 ppt	15-30 ppt.	Stutzenbaker 1999; Reed et al. 1995
Southern Cattail (*Typha domingensis*)	Wetlands ranging from fresh to brackish	0-10 ppt	75% mortality occurred at 15 ppt.	Stutzenbaker 1999; Glenn et al. 1995

I.4.2 Water Treatment

If the various source control and mitigation measures outlined above do not sufficiently reduce ecological risk from selenium, it may be necessary to consider water treatment techniques as part of adaptive management. However, water treatment would not be implemented as part of the SCH Project.

Further evaluation would be required for any consideration of water treatment. Any process used would have to be capable of treating large water volumes with low concentrations of selenium (less than 10 µg/L) to achieve selenium concentrations less than 5 µg/L in inflow water, based on the Colorado River Basin Regional Water Quality Control Board (2006) standard, and possibly less than 2 µg/L. The amount of river water that would require treatment would depend on the Project alternative chosen, the number and size (volume) of ponds constructed, and the salinity of pond operations (typically 20 - 40 ppt). An average diversion rate of 50 cubic feet per second (approximately 32.3 million gallons per day or 22,500 gallons per minute) would accommodate some flow-through (outflow) as well as evaporation. Only river water would need to be treated, since Salton Sea water has selenium concentrations less than 2 µg/L.

The effectiveness and costs of a variety of physical, chemical, and biological technologies were evaluated in the *Selenium Treatment Technologies Report* (Cardno ENTRIX 2010). Although several treatment technologies have the potential to remove selenium, few have reliably reduced selenium concentrations to less than 5 µg/L at any scale, and still fewer have been successfully implemented at full-scale for sufficient time to demonstrate the long-term feasibility of selenium removal technology (CH2M Hill 2010). Physical treatments (reverse osmosis, nanofiltration) can be very effective, but are cost prohibitive for the SCH Project. Biological treatment (e.g., constructed treatment wetlands, controlled eutrophication using algae) appears to have the most applicability, although consensus is lacking among experts and in the literature (Cardno ENTRIX 2010).

Many questions would need to be resolved if constructed treatment wetlands were considered as a future management strategy. A primary issue is whether treatment wetlands at this scale could reliably reduce water selenium concentrations to less than 5 µg/L or even 2 µg/L. The removal of selenium by biological volatilization to the atmosphere is highly desirable because it leads to a net loss from the aquatic system, thereby preventing its entry into the food chain. One approach is to investigate ways to enhance volatilization (Lin and Terry 2003) either by selecting wetland plant species that are more effective at volatilization or by adding a carbon source (e.g., molasses) to the treatment wetland to stimulate bacterial processes and, thus, enhance volatilization. A study currently underway by UCB is evaluating the effectiveness of using a water treatment system that incorporates constructed wetlands to manage selenium (personal communication, N. Terry 2011). Preliminary laboratory mesocosm experiments suggest that different wetland designs and management techniques have the potential to reduce selenium concentrations to levels substantially lower than 5 µg/L. The next phase of the work will include a pilot wetland study to see if laboratory results could be transferred into the field. The Brawley and Imperial constructed wetlands provide another opportunity to test enhancement methodologies that could be scaled up to treat river flows before discharge to the SCH ponds (e.g., Johnson et al. 2009). Other biological treatment technologies such as algal treatment (e.g., Controlled Eutrophication Process) may further remove selenium and could be combined with constructed wetlands as a polishing step.

Another issue would be the potential ecological risk to wildlife from exposure at the treatment wetland itself, which would sequester and likely accumulate selenium within its sediments, detritus, and biota. Dense vegetation would increase the amount of particulate detritus in the system that could adsorb selenium. Design features and strategies to reduce wildlife exposure would need to be included. For example, wetlands could be designed with dense plantings to reduce the amount of open water habitat. This may deter open water species such as waterfowl and terns, but is likely to be less effective for other marsh species such as rails. Other bird deterrent methods (e.g., Gorenzel and Salmon 2008) may be necessary to dissuade birds from utilizing the treatment wetlands.

I.5 MONITORING AND STUDY

The SCH Project includes a monitoring and adaptive management framework (Appendix E) to guide evaluation and improved management of the newly created habitat, as well as to inform future restoration. Monitoring is a necessary component to obtain information on progress in meeting Project objectives, such as minimizing ecological risk from selenium. This section briefly outlines monitoring specifically for selenium, and identifies remaining uncertainties that are priorities for future study. Although monitoring is a part of the SCH Project, these potential studies, are not currently included.

I.5.1 Monitoring

Selenium in Water and Sediments

Selenium concentrations in water would be measured at various representative locations including the source waters for the ponds (both Salton Sea and river), in the sedimentation basin, blended influent water to the ponds after the sedimentation basin, habitat ponds, and outfalls. Surficial sediment samples (top 5 cm) and particulate matter from the sedimentation basin and habitat ponds would be tested for selenium. Sampling would be conducted quarterly for water and once or twice a year for sediment, and/or when water operations change, such as seasonal adjustments in salinity of inflow water. Speciation of selenium would be conducted for selected subsamples. Monitoring would be conducted for multiple years to track any seasonal or interannual variation, as well as changes as the SCH pond complex develops from first wetting of ponds to a more mature aquatic ecosystem.

Selenium in Bird Eggs

Monitoring selenium in bird eggs is the best indicator of potential selenium hazard for several reasons, as reviewed by Ohlendorf and Heinz (2011). First, birds are a principal management target for the SCH Project. As tertiary consumers of fish and invertebrates, they also integrate the selenium pathways and bioaccumulation into a high trophic level receptor. Furthermore, it is selenium in the egg, rather than the parent bird, that causes developmental abnormalities and death of embryos. Bird eggs best represent current contamination in the local environment, given the rapid accumulation (about 2 weeks) and loss (about 10 days) of selenium in eggs from adult females fed selenium-laden food days or weeks before egg-laying. Finally, eggs are easier to collect than adults and the loss of one egg from a nest probably has minimal effect on a population.

Bird eggs would be collected from representative SCH ponds and egg selenium concentration measured. Black-necked stilt is a logical choice for the monitoring, given existing comparable data from nearby and many other sites.

Selenium in Aquatic Biota

Monitoring selenium in aquatic invertebrates and fish would also be useful to better understand bioaccumulation and trophic transfer. Invertebrates and fish would be collected from representative SCH ponds and the sedimentation basin for selenium testing. Fish species would include tilapia, the largest and most important prey for many piscivorous birds, and salifin mollies, a smaller prey fish. Sailfin mollies are also good ecological surrogates for monitoring selenium concentrations in desert pupfish because of similar trophic characteristics (Saiki et al. 2011).

I.5.2 Suggestions for Future Study

Recent studies have improved understanding of selenium bioaccumulation, impacts, minimization, and treatment. At the Salton Sea, focused studies conducted as part of the SCH Project's development have reduced uncertainty about the amount of selenium in the environment at alternative SCH sites (Arnhem and Smith 2010; Amrhein et al. 2011), ecological risk potential for bioaccumulation in the food web (Sickman et al. 2011), and options for removing selenium from water using wetland vegetation (personal communication, N. Terry 2011). Nevertheless, data gaps remain (Sickman et al. 2011). This section identifies some topics for further study, both independently and in association with the SCH ponds once implemented. However, as noted above, these potential studies are not currently part of the SCH Project.

Food-Web Transfer Relationships

Several topics have been suggested by others for further investigation of selenium bioaccumulation (Miles et al. 2009; Sickman et al. 2011). For example, selenium speciation in water and particulates would be useful to establish appropriate coefficients of bioaccumulation, especially K_d factors. Study of stable isotopes (^{34}S, ^{15}N, ^{13}C) would improve understanding of food-web structure and contributions from different prey, which would improve the TTFs used to estimate selenium bioaccumulation in the ecological risk model. Isotopes could also identify spatially explicit sources of contaminant exposure. Selection of target piscivorous birds for use in the SCH ecological risk model should be revisited. Black skimmers would likely be more representative of SCH pond users than others that were considered. In contrast, gull-billed terns feed off site from drains and have a more varied diet than simply fish, while black-crowned night herons would likely be only occasional users of the SCH ponds. Finally, better understanding of local-scale movements and local foraging ecology of birds using the SCH ponds could be important to determine how much of their diet is coming from SCH ponds, and how much is coming from the surrounding areas.

Effects of Residence Time in Ponds

The potential effect of retention time in the ponds on selenium deposition or removal is not well understood (Johnson et al. 2009) and subject to varying opinions among experts (personal communications, H. Ohlendorf and R. Gersberg 2010). On the one hand, shorter retention time in the ponds (i.e., increased rate of flow) could result in increased loading of selenium to the SCH ponds from river water. On the other hand, prolonged retention time could facilitate transformation of selenium into more bioavailable forms. Monitoring of the SCH ponds under varying operational scenarios would help address this question, which has ramifications for costs of long-term operations due to water pumping rates.

Selenium Treatment Technologies

As the Salton Sea progressively becomes more saline, water treatment to remove selenium may become necessary as more river water is used to maintain suitable salinities for the fish community. As discussed above, more information about performance and feasibility of biological treatment techniques would be required to determine whether they would be an appropriate selenium control measure at a future phase of SCH Project implementation. Studies underway by UCB (N. Terry, unpublished data) would refine understanding of constructed treatment wetlands. Other treatment alternatives (reviewed by Cardno ENTRIX 2010, CH2M Hill 2010) also may receive further consideration.

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APPENDIX J

Summary of Special Studies Supporting the EIS/EIR Impact Analysis

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Appendix J

Summary of Special Studies Supporting the EIS/EIR Impact Analysis

J.1 Introduction

The environmental conditions at the Salton Sea are often extreme and can be challenging for building habitat and maintaining fish and wildlife populations. The SCH Project is being designed to support shallow-water wildlife dependent on the Salton Sea (particularly fish-eating birds) and to minimize any negative impacts on wildlife or humans (from contaminants or disease vectors). The SCH Project would consist of a series of shallow ponds, several hundred acres in size and constructed on playa exposed as the Salton Sea recedes. Depending on the slope of the playa and extent of sea level decline, the ponds would have a mean depth of about 2 to 4 feet and a maximum depth of 6 feet at the outer berm. While some deeper swales would be excavated to create habitat diversity, these would not substantially affect average depths or water volume over the total pond. A range of operational scenarios have been proposed for the initial proof-of-concept phase to test which regime would best balance ecological productivity, sustainability, and potential impacts(Appendix D). Initial operations would manage the ponds as saline habitat, with salinity between 20-40 parts per thousand (ppt).

While much has been learned about the Salton Sea over the last decade, uncertainties remained for the site-specific engineering design, effects analysis, construction, and proposed operation of a restoration project. Several studies to address key uncertainties for the SCH Project were conducted for the State by researchers at the University of California Riverside (UCR) and University of California Berkeley (UCB):

1) Contaminants in water and sediment at proposed sites for SCH Alternatives
2) Hydrological and water quality modeling of SCH alternative designs and operations
3) Salinity and temperature tolerances of fish species considered for SCH ponds
4) Ecorisk modeling of potential selenium bioaccumulation
5) Selenium treatment of water supply using wetland vegetation

This document summarizes key findings of the special studies and their application to the SCH Project. For selenium ecorisk modeling study, detailed discussions are in Appendix I Selenium Management Strategies. For the remaining studies, the study approach and results to date are summarized below from the researchers' reports. The SCH Project team then evaluated the potential implications and application to the SCH Project, which have been considered in the proposed design, operations, and impact analysis.

J.2 Contaminants in Water and Sediment

J.2.1 Purpose and Need

The SCH Project ponds would be constructed on recently exposed or soon-to-be exposed playa, and supplied with water blended from the Salton Sea and either New River or Alamo River. One issue is potential toxicity impacts from contaminants in sediments or water at the proposed SCH ponds. Water quality in the Salton Sea and its tributaries is influenced primarily by the quality of Colorado River water imported into the watershed and land use activities, principally agriculture, that contribute salts and other constituents to the Salton Sea inflows (DWR and DFG 2007). Some of those constituents, such as selenium, may contribute to toxicity risks to the ecosystem and humans through accumulation in the sediment and cycling through the food web. Sediment and water samples were collected from the alternative SCH sites and tested for contaminants.

J.2.2 Approach

Chris Amrhein and colleagues at UCR collected samples of sediment and water in summer 2010 within the footprint of the proposed alternative sites at the New and Alamo rivers. Sediment samples were collected from the surface (0-5 cm), as well as subsurface (5-15 cm deep and 15-30 cm deep) to look at historic deposition. Sediment samples were taken from exposed playa sediments and from submerged sediments, although submerged samples were not evenly collected across the potential pond sites. The samples were tested for phosphorus, trace metals and metalloids (selenium, boron, arsenic), PCBs, and organochlorine insecticides (including DDT), pyrethroid insecticides, organophosphorus insecticides, and other contaminants (Amrhein and Smith 2011; Wang et al. 2011).

An experiment was conducted to examine the release of selenium from sediments (Amrhein et al. 2011). Selenium is often present in reduced forms (less bioavailable and therefore less toxic) when wetlands are submerged and have high organic matter. When the water level is lowered, selenium can become oxidized and more bioavailable. The initial wetting period could increase selenium bioavailability by allowing solubilization of oxidized selenium into the water (DWR and DFG 2007). This experiment was designed to represent a worst-case scenario where a relatively high concentration of sediment (50:50 wet sediment to water) is mixed into the overlying, aerobic water and selenium is oxidized. These samples were incubated for up to 235 days with well-aerated water at salinities 21 ppt and 13.7 ppt. Water was periodically decanted from samples and selenium concentrations measured.

The researchers also evaluated the relationship between aeration time due to the receding Salton Sea shoreline and soluble selenium in sediment pore water. Samples were collected from three areas in Red Hill Bay at varying distances from the shoreline. The researchers estimated the "time exposed" based on the distance to the water, the slope of the land, and the elevation of the Sea over time.

J.2.3 Results

Selenium

Mean water selenium concentrations were 1.2 micrograms per liter (µg/L) in Salton Sea, 1.8 µg/L in the New River, and 4.1 µg/L in Alamo River (Amrhein and Smith 2011). Mean sediment selenium concentrations at proposed Project sites were 1.1 milligrams per kilogram dry weight (mg/kg dw) (range 0.54–2.3 mg/kg dw). The majority of sediment samples (63 percent) were less than 1 mg/kg dw and would be considered "low risk." The remaining 37 percent of the samples were between 1 and 4 mg/kg dw (only two samples exceeded 2.5 mg/kg dw) and were considered in the "level of concern" category. No sample exceeded the "toxicity threshold" value of 4 mg/kg dw.

The solubilization data indicate that oxidation due to draining and aeration of the sediments, as the Sea recedes, can increase the water-soluble selenium (Amrhein et al. 2011). Mean water selenium concentrations after 131 days incubation were 6.5 - 8.2 µg/L at Alamo River playa sites (n=15), 11.9 µg/L in Alamo River, and 12.8 at New River playa (Table J-1). Cumulative release of sediment selenium ranged from 18.9 µg/kg (8.1 percent of total sediment selenium) after 194 days in Morton Bay, up to 48.8 µg/kg (37 percent of total sediment selenium) after 235 days) in the Alamo River channel (Table J-1). The rate of release was mostly decreasing over time, suggesting the sediments will be a decreasing source of selenium.

Table J-1 Selenium Released from Oxidized Sediments

Location	Samples	Total Sediment Selenium (mg/kg)	Water Selenium (µg/L) after 131 Days	Cumulative Selenium Released from Sediments (µg/kg and Percent Oxidized)	
				194 Days Incubation	235 Days Incubation
Alamo River	2	0.18	11.9	--	48.8 (36.9%)
Alamo River - Red Hill Bay	6	1.26	6.5	--	27.9 (4.5 %)
Alamo River - Delta	4	0.36	8.2	19.6 (8.0 %)	--
Alamo River - North Morton Bay	5	0.46	6.8	18.9 (8.1%)	--
New River Bay	2	0.23	12.8	29.9 (14.9%)	--

Source: Amrhein et al. 2011 (mean values reported)

Anaerobic conditions in the sediments result in very low selenium concentrations because reduced forms of selenium have the lowest solubility. Sediment selenium concentrations were positively related to organic carbon, but the oxidation rates and amount released into water did not appear affected by carbon content, salinity, location, or depth of sample core. Rather, the release of selenium appeared controlled by the amount of oxidizable iron present in sediments. The amount of released was most strongly linked to presence of oxidizable iron (Fe [III]), which adsorbs selenium (in the form of selenite) in the sediment, resulting in less selenium dissolving into the water.

Selenium concentrations were also measured along a transect representing sediments that are currently flooded, drained for approximately 1 month, and drained approximately 2 months due to the receding Salton Sea. Water-soluble selenium concentrations were twice as high from sites drained 1 month (approximately 4 µg/L) and three to four times higher from sediments drained two months (approximately 6-8 µg/L), compared to flooded sites (approximately 2 µg/L).

Amrhein calculated the amount of selenium potentially released to the overlying water in a pond system, assuming pond sediments were aerobic to a depth of 5 cm, the overlying water averaged 1 meter deep with no water exchanges, wet bulk density of the sediments 1.8 g/cm3, and 10 µg/L selenium (85th percentile of all water samples). Based on these assumptions, the contribution from the sediments would increase the selenium in the overlying water by 0.9 µg/L (C. Amrhein, personal communication 2011). This is a conservative estimate, since water would be exchanged in the SCH ponds at a rate dependent on flow operations (likely range of residence times 4 to 32 weeks) (Appendix D).

In conclusion, aerated conditions can produce oxidized selenium, which is more soluble, although the amount dissolved into water will depend on several factors, most particularly the presence of iron (Fe [III]). This suggests an initial "flush" of selenium from the sediments could occur and is consistent with observations at the Reclamation/USGS Saline Habitat Ponds (Miles et al. 2009). However, dissolved selenium in inflow water would likely pose a greater relative risk to wildlife bioaccumulation than selenium released from sediment (Amrhein et al. 2011).

Pesticides

Levels of chlorinated insecticides and pyrethroids were measured in water of the New and Alamo rivers and in the bed sediments at potential SCH pond sites (Wang et al. 2011). In the water (four samples per river), most organochlorine pesticides were below 1.5 nanograms per liter (ng/L) or were not detected. Chlorpyrifos was the most frequently detected, but only one sample at the New River was elevated (80 ng/L). The most commonly detected pyrethroid was permethrin (3.3-7.5 ng/L) with fenpropathrin detected once at elevated levels (New River, 11.6 ng/L). The number of samples was deemed too small to allow concrete conclusions about ongoing contributions of pesticides to the SCH ponds (Wang et al. 2011).

Sediment samples were taken at three depths (0-5 centimeters [cm], 5-15 cm, and 15-30 cm below the surface) in order to discriminate potential differences in deposition of legacy (i.e., organochlorines) and current-use pesticides (i.e., pyrethroids). Total sediment pesticide concentrations detected ranged from 0.2 to 120 nanograms per gram [ng/g]. Sediment pesticide concentrations, particularly organochlorines, were greatest at the mouth of both the New and Alamo rivers. Dichlorodiphenyltrichloroethane (DDT) and its metabolites were detected in all samples, and dichlorodiphenyldichloroethylene (DDE) was the predominant pesticide residue. In general, the concentrations of organochlorine pesticides were higher in the 5–30 cm depth interval than in the 0–5 cm depth interval (more recent deposition). This pattern correlates with the banning of most organochlorine pesticides, including DDT, in the United States in the 1970s. Mean DDE concentrations in air-exposed sediments at 0-5 cm deep and 15-30 cm deep were 2.6 ng/g surface and 10.9 ng/g subsurface at New River sites, and 12.1 ng/g surface and 25.5 ng/g subsurface at Alamo River sites. Organochlorine pesticide concentrations showed a pattern of decreasing concentration with distance from the river mouths. The highest DDE concentrations were found immediately adjacent to the Alamo River mouth in Morton Bay and in New River East. Lower concentrations of DDE were found at the Alamo River-Davis Road (north of Morton Bay) and New River Middle sites. The lowest DDE concentrations were found at the New River Far West sites. This spatial pattern is consistent with the overall circulation pattern in the Salton Sea, which tends to move counterclockwise.

The submerged samples typically had lower DDE concentrations than air-exposed sediments (Wang et al. 2011). The researchers hypothesized that this could be due to more extensive degradation in the submerged areas under reduced conditions. However, this could be an artifact of uneven sampling distribution. The samples from Red Hill Bay (southwest side of Alamo River) and Morton Bay (northeast side of Alamo River) were grouped into a single “Alamo River - Red Hill” region. All the submerged samples were from Red Hill Bay, which is upcurrent of the prevailing circulation that would carry river-borne sediment toward Morton Bay and northward.

A screening criterion of 31.3 ng/g DDE was identified as a Probable Effects Concentration (PEC) for general ecotoxicity, based on sediment guidelines developed by MacDonald and others (2000) and suggested by the Colorado River Basin Regional Water Quality Control Board (CRBRWQCB 2010) to prevent direct toxicity to the macroinvertebrate population, which serves as a food base for fish and insectivorous birds. The frequency of surface sediment samples exceeding this guideline was 18 percent at Alamo River-Morton Bay (32.41 ng/g maximum); 14 percent at Alamo River-Davis Road (34.40 ng/g maximum); and none at New River sites. The frequency of subsurface samples exceeding the PEC was 37 percent at Alamo River-Morton Bay (102.60 ng/g maximum); 7 percent at Alamo River-Davis Road (38.26 ng/g maximum); and 10 percent at New River East (41.16 ng/g maximum); 3 percent at New River Middle (33.51 ng/g maximum); and none at New River West.

Chlordane (organochlorine, < 3 ng/g Alamo River, < 1.2 ng/g New River) and bifenthrin (pyrethroid, < 1.9 ng/g Alamo River, < 0.5 ng/g New River) were also detected, but at lower levels than DDE. Other pesticides were infrequently detected (Wang et al. 2011). It is worth noting that bifenthrin, a pesticide first registered for use in the late 1980s -- early 1990s, also increased concentrations with depth, which could indicate that the deepest sediments sampled in the study represent relatively young sediments (personal communication, J. Orlando 2011).

J.2.4 Application to SCH Project

Selenium

The relative pattern of water selenium concentrations showed highest concentrations in the Alamo River, then the New River, and lowest in the Salton Sea. Although concentrations measured by Amrhein and Smith

(2011) were slightly lower than those reported by the U.S. Bureau of Reclamation (C. Holdren, Reclamation, unpublished data, quarterly sampling 2004-2010), the pattern is consistent. Therefore, options to reduce selenium inputs would include operating the SCH ponds with New River water instead of Alamo River and/or operating the ponds at higher salinities (i.e., less river water and more Salton Sea water).

The solubilization experiment suggests that an initial "flush" of selenium released from the rewetted sediments could occur. Selenium solubilization from sediments would be temporary and would decline over time. Reducing water retention time and increasing flow-through of the ponds for several weeks or months following initial filling could be used to flush soluble selenium from the ponds (Amrhein et al. 2011). The volume of dissolved selenium from inflow water would likely pose a greater relative risk to wildlife bioaccumulation than selenium released from sediment.

Pesticides

To apply these data to the current SCH Project alternatives, mean DDE concentrations were recalculated from the raw data in Wang and others (2011) by combining air-exposed and submerged samples into geographic categories that matched the SCH Project alternatives (Red Hill Bay samples southwest of Alamo River were excluded because this area is no longer under consideration for Alternatives 4-6). Also, nondetects or undetected levels of DDE were defined as 0.01 ng/g for purposes of avoiding zeroes and allowing those extremely low values to be reflected in the means (Table J-2).

Table J-2 DDE Concentrations in Sediment at SCH Project Area (ng/g)

Location	Surface Mean (# samples)	Surface Maximum	Subsurface Mean (# samples)	Subsurface Maximum
New River - East	6.52 (11)	23.71	9.10 (21)	41.16
New River - Middle	2.78 (15)	7.99	5.44 (29)	33.51
New River - Far West	1.14 (6)	2.90	0.89 (13)	2.41
Alamo River - Morton Bay	13.66 (11)	32.41	25.02 (19)	102.60
Alamo River - North (Davis Road)	13.41 (7)	34.40	9.16 (14)	38.26

Source: Calculated from raw data in Wang et al. 2011. Surface (0-5 cm deep) and subsurface (5-15 cm and 15-30 cm deep). Nondetect values were defined as 0.01 ng/g for purpose of calculating means. Samples were pooled for air-exposed and submerged sites within each location.

Mean DDE concentrations in sediments at New River were 1.14 to 6.52 ng/g at the surface (0 to 5 cm deep) and 0.89 to 9.10 ng/g subsurface (5 to 15 cm and 15 to 30 cm deep). Mean DDE concentrations in sediments at Alamo River were 13.41 to 13.66 ng/g at the surface (0 to 5 cm deep) and 9.16 to 25.02 ng/g subsurface (5 to 15 cm and 15 to 30 cm deep) (Table J-2). Current DDE concentrations in surface sediments (0 to 5 cm deep) represent undisturbed existing conditions. For comparison, mean sediment DDE levels were measured at nearby sites (0-5 cm deep) by USGS in 2006-2008 (Miles et al. 2009): 4-48 ng/g at their saline habitat ponds (SHP), 41-56 ng/g in Alamo River, 15-41 ng/g in the Salton Sea near Alamo River, 60-98 ng/g at the Freshwater Marsh near Morton Bay, and 2-6 ng/g at the D-Pond on the Sonny Bono Salton Sea National Wildlife Refuge (NWR) (Miles et al. 2009). With the exception of the D-Pond, these concentrations are similar or higher than the levels measured at the SCH alternative sites.

Exposure to the more contaminated subsurface sediments would occur only in those areas disturbed by excavation for berms, swales, and islands, and would be averaged across the entire pond area including undisturbed areas. Therefore, expected DDE concentrations were calculated for each SCH alternative, based on field measurements of surface sediments (0 to 5 cms) and subsurface sediments (5 to15 and 15 to 30 cm deep) (Wang et al. 2011), and weighted according to proportion of pond area that would remain undisturbed but inundated (surface 0- to 5-cm concentrations) and area disturbed by construction [borrow ditches for berms, excavated swales and channels, borrow for habitat islands) (subsurface 5- to 30-cm concentrations)]. "Mean" is the area weighted average calculated using mean values for surface and subsurface sediment. Because DDE concentrations below 30 cm are unknown and construction could disturb deeper sediments, hypothetical "maximum" concentrations were also calculated using maximum observed values of surface and subsurface sediments, as a hypothetical upper bound of potential risk (Table J-3). The incremental increase in DDE concentration across the pond unit compared to existing levels was minor.

Table J-3 Area-Weighted Mean Sediment DDE Concentrations (ng/g) for Existing Conditions and SCH Project Alternatives

		Existing Conditions[1]		SCH Project	
		Estimated for Undisturbed Surface Sediments		Estimated for Constructed Ponds	
River	Pond units	Calculated from mean	Calculated from maximum	Calculated from mean	Calculated from maximum
New River	New East	6.5	23.7	7.1	27.6
	New Middle	2.8	8.0	3.6	15.7
	New Far West	1.1	2.9	1.0	2.7
Alamo River	Alamo Morton Bay	13.7	32.4	15.7	45.0
	Alamo - north (Davis Road)	13.4	34.4	12.9	34.8

1. DDE concentrations (mean and maximum values) in undisturbed surface sediments (0 to 5 cm deep) measured at each location (Amrhein and Smith 2011; Wang et al. 2011)

Because the concentrations of DDE and bifenthrin increased with depth sampled, it is possible that deeper sediments potentially exposed during SCH construction (excavation of playa sediments for berms and islands) could contain higher concentrations of organochlorine pesticides than reported by Wang et al. (2011). The fact that a current use pesticide like bifenthrin also increased with depth could indicate that the deepest sediments sampled could represent relatively young sediments (personal communication, J. Orlando 2011). Also, concentrations of DDE in suspended sediments collected from the Alamo River and New River in 2006-07 (Orlando et al. 2008) are comparable to concentrations seen in bed sediments in this study, suggesting that the current influx of DDE (and likely current-use pesticides) associated with suspended sediments to the Salton Sea may be of concern with respect to SCH construction and operations (personal communication, J. Orlando 2011). Targeted sampling of sites that would be actually be disturbed by construction may be warranted.

J.3 Hydrological Modeling

J.3.1 Purpose and Need

To provide suitable habitat, a shallow water system should maintain stable water balance, well-oxygenated conditions, productive food web, suitable salinity and temperature for fishery resources, limited resuspension of sediments, and flexible management practices. Salinity is an important water quality parameter that would be managed to maximize biological productivity and minimize adverse effects from water quality constituents (i.e., selenium loading, bioaccumulation through emergent vegetation) and other factors (vector control).

Options considered for establishing a salinity gradient in ponds include evapoconcentration of salts as water flows through the ponds, or blending river water with saltwater. The inflow to the SCH ponds would be a blend of nutrient-rich agricultural runoff (New or Alamo Rivers) and Salton Sea water. This has the potential for high algal production, anoxic conditions, and accumulations of ammonia and sulfide. Finally, because the shallow ponds would be located in a desert environment, water temperatures would range widely both seasonally and diurnally.

The purpose of this special study was to inform the engineering design and operational guidelines by addressing several key questions. First, what is the most effective means to achieve the desired salinity range for the ponds? Second, would the expected pond design and operations result in water quality conditions that could support a productive fish community and therefore meet project goals (support fish-eating birds)? Finally, are there particular periods or situations where conditions could exceed biological tolerances?

Hydrologic modeling by Barbara Barry and Michael Anderson (UCR) was used to explore how different potential pond configurations, source waters, and water operations could affect the expected physical, chemical, and biologic conditions in SCH ponds. This analysis involved successive iterations between UCR and the SCH Project design team to refine design alternatives and model parameters.

J.3.2 Approach and Results

The SCH Project would consist of a series of shallow ponds, several hundred acres in size and constructed on playa exposed as the Salton Sea recedes. Pond design parameters included depth, morphometry (pond shape, which affects water volume), and fetch (potential for wind mixing). Operational parameters included hydraulic residence time (4 and 16 weeks), source water (New River, Alamo River, and Salton Sea), and influent salinity.

UCR applied two models to simulate the physical, chemical, and ecological conditions in the SCH ponds. The first modeling exercise examined the water and salt balance of two pond designs: (1) interconnected ponds with flow cascading serially from one to another downslope ("sequential" ponds), and (2) independent ponds each receiving direct delivery of input water ("concurrent" ponds). Water column temperatures and salinities were predicted by DYRESM, a 1-dimensional thermodynamic-hydrodynamic model that uses meteorological data (2006-2008) combined with basin characteristics, hydrological inputs and outflows, and influent salinity and temperature. The second modeling exercise predicted vertical profiles of water temperature and dissolved oxygen (DO) for different pond designs and operations. This analysis used the Computational Aquatic Ecosystem Dynamics Model (CAEDYM), a 1-dimensional model that uses DYRESM outputs to model a wide range of water quality conditions (temperature, DO, nutrients, chlorophyll) and biological conditions (phytoplankton, zooplankton and fish).

Blending Sea and river water is the only feasible means to achieve the desired salinity range (20-40 ppt) across all ponds. Evaporation would increase salinity over time, depending on mean depth (indicative of water volume) and residence time. With an inflow salinity of 20 ppt and hydraulic residence time of 60 days, the resulting pond salinity would be 30 ppt in a 0.5 m deep pond and 23 ppt in a 1.5 m deep pond. However, relying solely on evapoconcentration of river water (2 ppt) would never achieve target salinities, and would increase selenium loading to ponds because water selenium concentrations are greater in the rivers than the Salton Sea.

The water quality modeling provided one-dimensional vertical profiles of temperature and DO, hourly over a three-year simulation period. Temperature profiles were very similar across scenarios. Water temperatures would periodically drop below tilapia tolerances (11-13°C [52-55°F]) during December through February. Thermal stratification occurred in ponds with smaller surface area (200 acres), which have less fetch and therefore less wind mixing, than larger pond areas. Deeper ponds (1.5 m mean depth) would experience stratification more frequently than shallower ponds (0.76 m mean depth).

Nutrient concentrations are high in the New and Alamo rivers due to contributions from agricultural runoff. Elevated nutrients would produce eutrophic conditions and algal blooms that could lead to anoxia. Modeling results suggested that ponds would become stratified in summer (May-October). Bottom waters would experience anoxia, particularly during periods of algal blooms in spring (March-May) and fall (October). Depending on the pond scenario, increasing residence time (ranging from 4 weeks to 32 weeks) had no effect or increased somewhat the frequency of anoxia. River source (New or Alamo) for blended water supply had little effect on stratification or anoxia. Phytoplankton was more abundant with Alamo River blended water. Zooplankton did better with New River blended water and consequently reduced phytoplankton slightly.

J.3.3 Application to SCH Project

In general, this 1-D modeling validated the conceptual understanding of how these ponds would function. While the models are not sufficiently site specific or complex to truly answer questions of pond sustainability, they did highlight some issues for consideration.

The most effective means of achieving the desired salinity range for the ponds would be blending sea and river water, not evapoconcentration. Salinity within a pond would increase over time due to high evaporative losses in this climate (7-10 ppt increase with a 60 day residence time), which would require additional input of river water to offset to maintain a target salinity. If a sequential pond design is used (water flowing through a series of ponds), then a salinity gradient increasing from first to last ponds would be expected.

The models, as limited as they are, confirmed assumptions that a productive aquatic system could be developed that would include fish for birds. This exercise proved useful to look for trends and periods of concern. Stressful conditions would occur periodically. Water temperatures would be too cold for tilapia to tolerate for periods during December to February. Anoxia would occur near the bottom and occasionally complete anoxia through the water column when phytoplankton blooms occur in spring and fall. Stratification would maintain a layer of oxygenated water near the surface. Bottom anoxia is more of a concern for benthic invertebrates than for tilapia, which can tolerate conditions of 1 μg/L DO and can move upwards to oxygenated water near the surface. Model results have guided development of the proposed operations and have focused the number of operational scenarios to be validated in the proof-of-concept phase (Appendix D).

J.4 Fish Tolerance

J.4.1 Purpose and Need

The fish species that would be stocked in the ponds would have to survive and reproduce given the expected water quality conditions, both managed (salinity) and uncontrolled (air temperature, wind mixing, dissolved oxygen). Tilapia appear to meet many of the requirements for a productive, sustainable fishery resource for piscivorous birds (DFG 2011). Tilapia are currently in the Salton Sea, are an important forage species for birds, and have impressively wide tolerances for salinity (currently persisting in the Sea at 53 ppt) and low dissolved oxygen. Their main drawback, other than potential competition with desert pupfish, is whether they could handle the lowest water temperatures predicted for SCH ponds. While the SCH ponds could be operated to adjust salinity (proposed range 20-40 ppt, Appendix D), it will be difficult if not impossible to control water temperatures that naturally fluctuate widely in this desert climate.

This laboratory experiment by Dan Schlenk and Varenka Lorenzi of UCR tested the survival tolerances of different tilapia species exposed to various combinations of salinity and temperature in order to inform design of operational scenarios and selection of fish species for stocking.

J.4.2 Approach and Results

Among the fish that currently live in the Salton Sea area, three forms of tilapia (*Cichlidae, Perciformes*) have been identified as potential candidates to stock the SCH ponds (DFG 2011): California Mozambique hybrid tilapia *Oreochromis mossambicus x O. urolepis hornorum* ("Mozambique hybrid tilapia"), an unidentified species resembling blue tilapia *Oreochromis aureus,* and redbelly tilapia *Tilapia zillii*. Blue are considered more cold tolerant than other tilapia species in general (Popma and Masser 1999). In addition, Mozambique hybrid tilapia raised in aquaculture were also considered because of its availability from local hatcheries, in anticipation of the wild stocks in the Salton Sea eventually failing with increasing salinity.

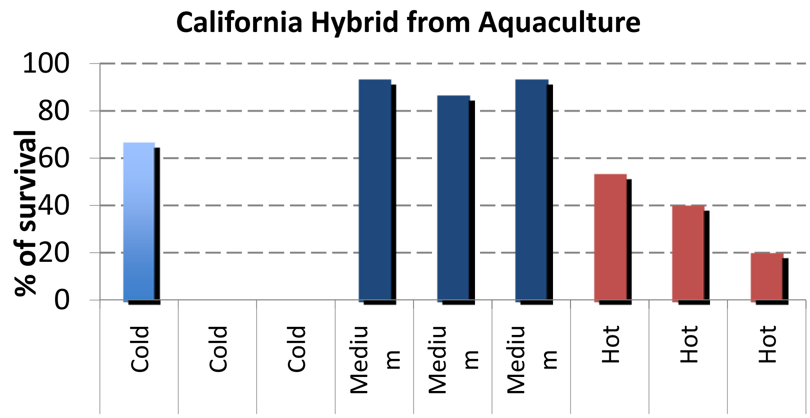
The tested fish included Mozambique hybrid tilapia (two strains: wild fish from Salton Sea and an aquaculture strain from a local fish farm), fish from a blue tilapia assemblage in the New River ("New River blue tilapia"), and redbelly tilapia collected from an agricultural drain at the northeast Salton Sea (Lorenzi and Schlenk in preparation). Juvenile fish were collected, acclimated in the lab, and then exposed to different combinations of salinity and temperature. The three salinity concentrations (20, 45, and 60 ppt) were obtained by blending water from the Salton Sea and New River, similar to the approach that would be used to operate the SCH ponds. The three temperature regimes mimicked daily fluctuation of 5 degrees Celsius (°C): cold 11-16°C (52-61 degrees Fahrenheit [°F]), warm 23-28°C (73-82 °F), and hot 33-38°C (91-100°F). After an acclimation period, survival and condition of fish was tested over a 30-day period.

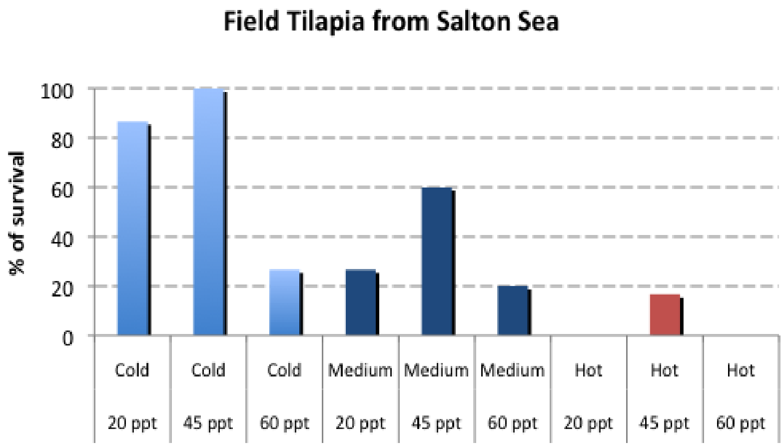
When maintained at 20 ppt salinity, the New River blue tilapia had the best overall survival across all temperature regimes (80 percent survival at cold, 40 percent at warm, and 27 percent at hot) (Lorenzi and Schlenk in preparation). Redbelly tilapia survival was very poor in the lab, but this likely was due to other stressful conditions in captivity, namely aggression. It does not appear appropriate to draw conclusions about this species' thermal and salinity tolerances from such data. While most strains and species had moderately good survival in 45 ppt and 60 ppt conditions at warm temperatures, all species showed poor survival in hot high-salinity (60 ppt) conditions.

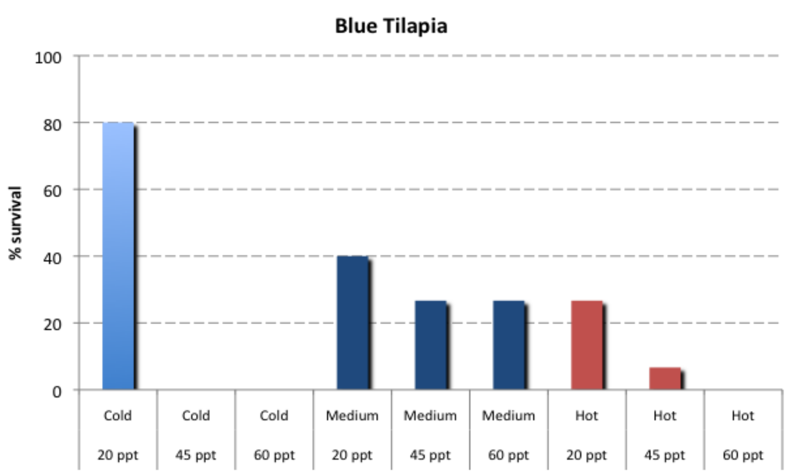
In the cold treatment (11-16°C), the fishes were less active and fed less. The Mozambique hybrid collected from the Sea had the best overall survival at cold temperatures, with excellent survival at 20 ppt (100%) and 45 ppt (85 percent), and even some survival at 60 ppt (27 percent) (Figure J-1). The California Mozambique hybrid from aquaculture (67 percent) and the blue tilapia (80 percent) were able to survive only when the salinity was low (20 ppt), indicating that the cold temperature represents a stressor for osmoregulation. Surprisingly, the New River blue tilapia did not have better survival than Mozambique tilapia in cold conditions.

In the warm treatment (23 - 28°C), some individuals in all four species and strains of tilapia managed to tolerate salinities up to 60ppt. Remarkably, some of the blue and redbelly tilapia also survived these extreme salinities, thus demonstrating the broad osmoregulatory ability typical of tilapia in general, even in these two species typically found in freshwater. At medium temperatures California Mozambique hybrid from aquaculture showed the best survival at all salinities (85-90 percent), while the wild type did well only at 45ppt. This salinity is the closest to current Sea salinity (51 ppt), so these fish were probably best adapted to osmoregulate at this salinity.

At hot temperatures (33 - 38°C), all fishes showed sign of stress and the final survival rate was quite low. The California hybrid from aquaculture did best overall and in particular at 20 ppt salinity. Only 17 percent of the California hybrid from the field survived, and only at 45 ppt salinity.







Source: Lorenzi and Schlenk (in preparation)

Figure J-1 Survival Rates of Tilapia (Aquaculture and Wild Strains of California Mozambique Hybrid Tilapia, and New River Blue Tilapia)

J.4.3 Application to SCH Project

Stocking different tilapia species or strains (individually or in combination) among the SCH ponds could be employed to increase enhance stability of the fishery resource in the ponds in the face of seasonal and annual fluctuations in water quality parameters. The Mozambique hybrid tilapia seemed to be the most resistant species across all treatments. The wild-type from the Salton Sea was most likely to survive the cold, and the aquaculture-type is the most likely to survive at high and medium temperatures. The New River blue tilapia also had good survival in cold, but only when salinities are lower (20 ppt). Redbelly tilapia are still candidates, because their poor experimental survival appeared to be due in part to lab conditions.

These results also suggest that pond operations should be adjusted to maintain lower salinities during the winter, when cold temperatures stress fish and presumably reduce osmoregulatory abilities and tolerance. Such seasonal variation in pond salinity regime has been incorporated in proposed operational scenarios (Appendix D).

J.5 Selenium Ecorisk Modeling

J.5.1 Purpose and Need

Selenium in river water supplying the SCH ponds could bioaccumulate through the food web (discussed in detail in Appendix J). The most serious toxic impacts of selenium manifest themselves in bird reproduction, namely reduced hatchability of eggs and embryo deformities (Ohlendorf and Heinz 2011). Selenium ecorisk modeling was conducted by James Sickman and colleagues at UCR to evaluate the potential risk of transfer and bioaccumulation in the foodweb under different SCH alternatives and operational scenarios (Sickman et al. 2011).

J.5.2 Approach and Results

Sickman et al. (2011) used the progressive modeling approach of Presser and Luoma (2010) to simulate transformation of dissolved selenium into particulate organic matter and selenium bioaccumulation in invertebrates, fish and birds. Since reproductive effects in birds are the most sensitive indicator of selenium toxicity (Ohlendorf and Heinz 2010), the assessment end-point was egg selenium concentration. In bird eggs, 6 µg/g dw is a conservative and widely reported toxicity reference value (Ohlendorf and Heinz 2011). The responses to selenium vary among bird species, ranging from “sensitive” (mallard) to “average” (stilt), and “tolerant” (avocet) (Skorupa 1998, as cited in Ohlendorf and Heinz 2010). Risk of impaired reproduction (reduced hatching success) can start to occur at egg concentrations of 6-12 µg/g dw. The risk of teratogenesis (deformed embryos) starts to occur above 12 µg/g dw for sensitive species, and above 20 µg/g dw for moderately sensitive species (Ohlendorf and Heinz 2010).

The model tested different operational parameters, including New or Alamo River water blended with Salton Sea water to achieve operational salinity of 20 ppt or 35 ppt, and a worst case future scenario of only river water (water selenium concentration up to 10 µg/L).

Overall, model results suggest that fish and bird eggs in SCH ponds utilizing Alamo River water would have about 50 percent higher selenium concentration compared to SCH ponds utilizing New River water (Table J-4). This is due to higher dissolved selenium levels in the Alamo River water relative to the New River. Similarly, risk increases as salinity decreases, with about 25-30 percent higher selenium concentrations predicted at a salinity of 20 ppt relative to 35 ppt. Further details on various model scenarios and results are provided in Appendix I.

Table J-4 Modeled Selenium Concentrations in Biota

River Source	Salinity	Water (µg/L)	Macro Invertebrates	Fish (Whole)	Bird Eggs (Invertebrate Eaters)	Bird Eggs (Fish Eaters)
New River	20 ppt	2.6	4.2	5.5	7.6	8.3
	35 ppt	2.0	3.3	4.3	6.0	6.5
Alamo River	20 ppt	4.0	6.6	8.5	11.6	12.7
	35 ppt	2.8	4.5	5.9	8.1	8.9

Selenium concentrations in biota = micrograms per gram dry weight (µg/g dw).
Source: Sickman et al. 2011 (General Model simulation)

J.5.3 Application to SCH Project

The modeling results yield several findings with relevance to SCH design and operation. First, the selenium risk in SCH ponds constructed with Alamo River water would likely be substantially higher than in ponds utilizing New River water. Risk characterization indices suggest there would be moderate to high risk for reduced egg viability in black-necked stilts in Alamo River SCH ponds and that the risks would be elevated above current risk levels. Second, inverse modeling supports the premise that higher salinity levels would result in lower risk from selenium. Salinity of 35 ppt is recommended to reduce risk of reproductive effects (< 6 µg/g dw). If low to moderate levels of reduced hatching success are deemed acceptable, then salinity levels closer to 20 ppt would be adequate for New River SCH ponds.

The actual magnitude of selenium impacts for the implemented Project could be lower than modeled. First, the actual concentrations could be lower because birds' foraging range would likely extend beyond the SCH ponds to include other habitats that have lower selenium levels (i.e., freshwater ponds at the Sonny Bono Refuge). Second, when the model was run using parameters estimated from the SHP complex, the modeled egg selenium concentrations were greater than the actual measured egg concentrations (Miles et al. 2009), indicating that this ecorisk model is a very conservative estimator of risk.

J.6 Selenium Treatment by Wetland Vegetation

J.6.1 Purpose and Need

One approach to reducing selenium risk to wildlife would be treating the river water supplying the SCH ponds to reduce water selenium concentrations. Only river water would need to be treated, since Salton Sea water is less than 2 µg/L. Biological treatment, such as constructed wetlands or algal treatment, appears to have the most applicability, although there is lack of consensus among experts and in the literature (Cardno ENTRIX 2010). In the New River, the constructed Imperial and Brawley Wetlands were designed to reduce nutrients as well as selenium (Johnson et al. 2009). A key uncertainty is whether constructed wetlands could reliably reduce water selenium concentrations to less than 5 µg/L (CRBRWQCB 2006) or even 2 µg/L.

A study currently underway by Norman Terry of UC Berkeley is evaluating the effectiveness of using a water treatment system that incorporates constructed wetlands to manage selenium. Phytoremediation (biological treatment by wetland plants and the microbial community they support) is a potential technique to reduce selenium. The removal of selenium by biological volatilization to the atmosphere is highly desirable because it leads to a net loss from the aquatic system, thereby preventing its entry into the food chain.

J.6.2 Approach and Interim Results

This study is investigating approaches to enhance volatilization (Lin and Terry 2003), either by selecting wetland plant species that are more effective at volatilization, or by adding a carbon source (e.g., molasses) to stimulate bacterial processes and thus enhance volatilization. Criteria for selecting plants include ability to sequester or volatilize selenium, rapid growth and spread, and suitability for the Salton Sea climate and habitat. Preliminary results from laboratory mesocosm experiments suggest that different wetland designs and management techniques have the potential to reduce selenium concentrations to levels substantially lower than 5 μg/L.

The next phase of the work will include building a pilot constructed wetland water treatment system in the south Salton Sea area to see if laboratory results could be transferred into the field. In addition, further monitoring of selenium removal is planned for the Brawley and Imperial constructed wetlands.

J.6.3 Application to SCH Project

The SCH ponds would be managed through a combination of source control and pond management to reduce selenium exposure and risk to biota, depending on the alternative chosen and project operations (Appendix I). The levels of selenium in the water, sediment, and bird eggs from the ponds would be monitored. If these measures do not reduce or mitigate risk to acceptable levels, it may be necessary to consider water treatment techniques as part of adaptive management. However, water treatment would not be implemented as part of the SCH Project.

In the future, as the Salton Sea becomes more saline, water treatment to remove selenium may become necessary as more river water is used to maintain suitable salinities for the fish community. More information about performance and feasibility of biological treatment techniques would be required to determine whether this would be an appropriate selenium control measure at a future phase of SCH Project implementation. This set of studies currently underway would refine understanding of constructed treatment wetlands.

J.7 References

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APPENDIX K

Corps Section 404 Permit Projects in the HUC 8 Watershed

GENERAL PERMITS (GP)		Permit Type	Impacts		Mitigation		
DA Number	Project Name		Waters	Wetlands	waters	wetlands	Description
SPL-1995-26500	KENNECOTT CAHUILLA PROJECT EXPANDED EXPL	NWP	0.1	-	0.1	-	drill approximately 50 to 100 exploration boreholes in a pattern within Wonderstone Wash south of Rainbow Rock
SPL-1995-31200	KENNECOTT CAHUILLA PROJECT EXPANDED EXPL	NWP	-	-	-	-	discharge fill material to construct a dike along approximately 0.25 miles of private property (Kalin parcel) and Federal Wildlife Refuge land to prevent further intrusion of the Salton Sea
SPL-1997-2004100	CALIFORNIA DESERT FISH FARM/DIVERSION DI	NWP	0.03	-	-	-	to construct an 8 foot wide earthen ditch that will be approximately 2000 feet long
SPL-1997-2007700	NORRISH ROAD BRIDGE REPLACEMENT-EAST HIG	NWP	0.02	-	-	-	to replace the existing Norrish Road timber bridge at the East Highline Canal with a new reinforced concrete bridge
SPL-1997-2010800	MESQUITE REGIONAL LANDFILL/ARID OPERATIO)	NWP	33.8	-	-	-	construct facilities ancillary to operation of the proposed Mesquite Regional Landfill
SPL-1998-2000400	MESQUITE MINE/EXPLORATORY PROGRAM	NWP	3	-	9		drill exploration holes for determining the extent of known mineralization and to locate additional mineralization on State lands. Up to 385 exploration holes are proposed during the exploration program
SPL-1998-2000900	AGGREGATE PRODUCTS, INC./ATF BERM REPAIR	UnAuth/NWP	0.24	-	0		the project is to repair and stabilize an existing berm which surrounds an existing mining pit
SPL-1998-2012800	EL CENTRO BRANCH BRIDGE REPLACEMENT/ UNI	NWP	-	-	-	-	Bridge replacement
SPL-1998-2018300	JACKSON GULCH MINE ORLOSKY INC	NWP	-	-	-	-	Project involves resumption of placer mining operation within Jackson Gulch
SPL-1999-15222	AGGREGATE PRODUCTS MINE EXPANSION	NWP	-	-	-	-	expand aggregate mining operations at the existing "Wright Pit I" and initiate operations at "Wright Pit II"
SPL-2000-00590	NEW RIVER AERATION PROJECT US BUREAU OF RECLAMATION	NWP	0.03	-	-	-	designed to enhance the water quality of the New River by creating an aeration structure consisting of a 50 x 25 foot concrete rubble wier across the River
SPL-2000-01749	YUMA TO SAN DIEGO FIBER OPTIC LINE (WD04)	NWP		-	-	-	Fiber Optic project extending from Yuma to Santee. Most channel crossings will be driectionally bored (574 of 597) the remaining 24 will be trenched and backfilled
SPL-2000-01757	AT&T FIBER OPTIC SYSTEM FROM BLYTHE TO SAN DIEGO	NWP	4.7	-	4.7	-	construct and operate a buried fiber optic telecommunications system in southern California between Blythe and Los Angeles by way of San Diego. Six (6) 1.5-inch high-density polyethylene conduits will be installed along a majority of the route
SPL-2001-00852	BRANDT ROAD BRIDGE COUNTY OF IMPERIAL	NWP	-	-	-	-	replace the Brandt Road Bridge
SPL-2001-00981	ANZA VERDE WASH (ANZA DITCH) SEWERLINE PIPELINE	UnAuth	-	-	-	-	placement of demolition debris
SPL-2002-01110	SAN FELIPE CREEK BRIDGE WIDENING	NWP	0.002	-	0.002	-	widen Bridge No. 58-124 along State Route 78 (SR-78) on both the north and south side by 8.2 feet. A total of 60 new piles will be driven into the ground on both sides of the existing deck to support the new sections of the bridge
SPL-2002-01393	SALTON SEA UNIT 6 GEOTHERMAL PROJECT	NWP	0.08*	0.1*	-	0.54*	Constrcution of a Geothermal plant and transmission line. *Now Pending Corps file No. 2010-00024-LLC
SPL-2003-01163	GEOTECHNICAL STUDIES AT THE NEW RIVER FO	NWP	-	-	-	-	conduct geotechnical drilling explorations (borings) at the New River in Imperial County, California
SPL-2003-01514	SALTON SEA UNIT 6 GEOTHERMAL POWER PLANT	NWP	*	*	*	*	*Previously issued under 2002-1392 now Pending Corps file No. 2010-00024-LLC
SPL-2004-01084	COACHELLA CANAL LINING PROJECT	NWP	-	-	-	-	create a new concrete lined channel adjacent to the existing Coachella Canal and install siphons at locations where ephemeral washes intersect the canal alignment
SPL-2005-00168	BRAWLEY BYPASS AT SR-78 & SR-111	NWP	0.414	-	-	-	construct 3.1 miles of a four-lane, divided expressway northeast of the City of Brawley in Imperial County, California. The major features of the project include nine bridge structures
SPL-2005-00444	SCG CLASS II PROJECT: PIPELINE EROSION REPAIR	RGP	0.032	-	-	-	conduct emergency repairs along the westerly shoulder of Cuff Road approximately 1.5 miles northeast of the town of Niland
SPL-2005-01042	BRIDGES 678.90 AND 679.11	NWP	0.092	-	0.092	-	the replacement of two bridges at railroad mileposts 678.90 and 679.11 near Tortuga, in Imperial County
SPL-2005-01651	HOLTVILLE TREATMENT WETLAND	NWP	0.1	-	-	-	construct treatment wetlands on a 30 acre parcel adjacent to the Alamo River
SPL-2006-00035	SR-78 SAN FELIPE CREEK BRIDGE WIDENING	NWP	0.35	-	0.29	-	to widen Bridge No. 58-124 along State Route 78 (SR-78) at San Felipe Creek
SPL-2006-00309	SHANK ROAD WETLAND PROJECT	NWP	0.37	-	-	-	A sediment cell and two wetland cells will be created on the site. The sediment cell will be approximately 8 acres and each wetland cell will be about 9 acres
SPL-2006-01186	TORRES MARTINEZ CROSSING OF DAROCA WASH	NWP	0.37	-	0.74	-	the construction of a linear transportation crossing and the widening of Highway 86 at Daroca Wash near Torres Martinez Desert Cahuilla Indians tribal land

GENERAL PERMITS (GP)		Permit Type	Impacts		Mitigation		
DA Number	Project Name		Waters	Wetlands	waters	wetlands	Description
SPL-2006-01187	TORRES MARTINEZ CROSSING OF TONALEE WASH	NWP	0.332	-	0.652	-	the construction of a linear transportation crossing
SPL-2007-00704	Sunrise Powerlink Project	NWP	9.96	-	115	-	120 mile transmission corridor from Imperial County to San Diego County
SPL-2007-01270	Picacho State Recreation Area - Taylor Lake Boat Ramp	NWP		0.06	-	0.2	Construct a concrete boat ramp. Materials used would be 105 cy of riprap, 100 cy of concrete, and 100 cy of gravel for the base layer
SPL-2007-01364	Salton City Wastewater Treatment Plant	NWP	0.928	-	1.225		the construction of a new 0.5 MGD wastewater treatment plant consisting of headworks, two aeration ponds, two clarifiers, four percolation/evaporation ponds, site piping, miscellaneous pumps, valves and electrical equipment, landscaping along the outer perimeter of the ponds, and a fence enclosing the site
SPL-2008-00979	Worthington Road Intersection Improvement	NWP	0.1	-	-		Project is to construct a turn lane at the intersection of Worthington Rd and McConnel Rd in Imperial County. For the minor road widening, the road crossing pipe needs to be replaced
SPL-2009-00445	Clean up Activities at Calexico Solid Waste Site	NWP		2.37	-	2.37	to clean up the illegally disposed waste along the west boundary along New River Floodplain
SPL-2010-00413	Seeley County Water District, Hydrogeologic Study Equipment Inst	NWP	0.0003	-	-	-	Install two, 2" diameter drive point wells (hollow steel pipes) within and adjacent to adjacent to an unnamed tributary to the New River
		Total Impact	57.4003		Total Mitigation	134.371	

STANDARD INDIVIDUAL PERMITS (SIP)		Permit Type	Impacts		Mitigation		
DA Number	Project Name		Waters	Wetlands	waters	wetlands	Description
SPL-2007-01031	Sunbeam Lake Improvement Project	SIP	1.39	0.42	1.16	1.23	proposal to renovate, rehabilitate, and improve Sunbeam Park and its associated lake
SPL-2008-01244	SES Solar Two	SIP	52.2	-	253	-	The IVSP would be a concentrating solar energy facility generating up to 709-megawatts (MW) utilizing a maximum of 28,360, 25-kilowatt (kW) SunCatchers
		Total Impact	54.01		Total Mitigaiton	255.39	

GP's and SIP's combined		
	Total Impact	111.41
	Total Mitigaiton	389.761

Nationwide Permit	NWP
Regional General Permit	RGP
Unauthorized permit	UnAuth
Standard Individual Permit	SIP
No Information Available	-

APPENDIX L

Tribal Consultation and Coordination

APPENDIX L-1

Correspondence from U.S. Army Corps of Engineers to Tribal Representatives

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Diana L. Chihuahua, Cultural Resources
Torres-Martinez Desert Cahuilla Indians
P.O. Box 1160
Thermal, California 92274

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Ms. Chihuahua,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

Maps depicting the project area are enclosed. We respectfully request any comments you may have regarding this area's role in your tribal history, and we will address any concerns that may arise in this regard. In an effort to address Native American concerns, the Corps is requesting any information that you are willing to share regarding the nature of cultural and Native American resources within the proposed project area.

The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Bridget Nash-Chrabascz, THPO
Quenchan Indian Nation
P.O. Box 1899
Yuma, Arizona 85366

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Ms. Nash-Chrabascz,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY

Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Leroy J Elliott, Chairperson
Manzanita Band of Kumeyaay Nation
P.O. Box 1302
Boulevard, California 91905

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Chairperson Elliott,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Gwendolyn Parada, Chairperson
La Posta Band of Mission Indians
P.O. Box 1120
Boulevard, California 91905

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Chairperson Parada,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Carmen Lucas
Kwaaymii Laguna Band of Mission Indians
P.O. Box 775
Pine Valley, California 91962

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Ms. Lucas,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Paul Cuero
Kumeyaay Cultural Heritage Preservation
36190 Church Road, Suite 5
Campo, California 91906

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Mr. Cuero,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Mike Jackson, Sr., President
Fort Yuma Quechan Indian Nation
P.O. Box 1899
Yuma, Arizona 85366

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Mr. Jackson,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Michael Garcia, Vice Chairperson
Ewiiaapaayp Tribal Office
4054 Willows Road
Alpine, California 91901

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Vice Chairperson Garcia,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Will Micklin, Executive Director
Ewiiaapaayp Tribal Office
4054 Willows Road
Alpine, California 91901

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Mr. Micklin,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Jill McCormick, Tribal Archaeologist
Cocopah Museum
County 15th & Avenue G
Sommerton, Arizona 85350

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Ms. McCormick,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

Maps depicting the project area are enclosed. We respectfully request any comments you may have regarding this area's role in your tribal history, and we will address any concerns that may arise in this regard. In an effort to address Native American concerns, the Corps is requesting any information that you are willing to share regarding the nature of cultural and Native American resources within the proposed project area.

The Corps is currently gathering additional information to make a determination if resources within the area are eligible for listing. In addition, the Native American Heritage Commission's record search of the Sacred Lands File did not indicate the presence of Native American cultural resources in the vicinity of the project area (see enclosure).

Please review the enclosed information and let us know if you are willing to share information or have concerns relevant to the proposed project within 30 days of receipt of this letter.

If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Monique LaChappa, Chairperson
Campo Kumeyaay Nation
36190 Church Road, Suite 1
Campo, California 91906

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Chairperson LaChappa,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, SOUTH COAST BRANCH
SAN DIEGO FIELD OFFICE
6010 Hidden Valley Road, Suite 105
Carlsbad, CALIFORNIA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Karen Kupcha
Augustine Band of Cahuilla Mission Indians
P.O. Box 846
Coachella, California 92236

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Ms. Kupcha,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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If you have any questions, please contact Lanika Cervantes at 760.602.4838 or via e-mail at Lanika.L.Cervantes@usace.army.mil. Please refer to this letter and SPL-2010-00142-LLC in your reply.

Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers
Regulatory Division, South Coast Branch
6010 Hidden Valley Road, Suite 105
Carlsbad, CA 92011

April 27, 2011

REPLY TO ATTENTION OF:
Office of the Chief
Regulatory Division

Preston J. Arrow-weed
Ah-Mut-Pipa Foundation
P.O. Box 160
Bard, California 92222

SUBJECT: Section 106 National Historic Preservation Act Consultation- Salton Sea Species Conservation Habitat Project (Corps File No. SPL-2010-00142-LLC).

Dear Mr. Arrow-weed,

The U.S. Army Corps of Engineers, Los Angeles District (Corps) is evaluating a permit application from the California Department of Fish and Game for an approximate 2,400-acre restoration project. This project would require a Department of the Army authorization to discharge fill within the Salton Sea and its adjacent wetlands in order to create a series of shallow water habitats. The proposed Project will be located in the southern portion of the Salton Sea near the mouths of the New River and Alamo River, within Imperial County, California.

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Sincerely,

Robert Smith
Senior Project Manager
South Coast Branch
San Diego Field Office

APPENDIX L-2

Correspondence from Tribes to the U.S. Army Corps of Engineers

THE COCOPAH INDIAN TRIBE
Cultural Resource Department
14515 S. Veterans Drive
Somerton, Arizona 85350
Telephone (928) 627-4849
Cell (928) 503-2291
Fax (928) 627-3173

RECEIVED
MAY 24 2011
REGULATORY BRANCH
CARLSBAD FIELD OFFICE

CCR-040-11-001

May 17, 2011

Robert Smith
Senior Project Manager
San Diego Field Office
6010 Hidden Valley Road Suite 105
Carlsbad, California 92011

RE: Section 106 Consultation – Salton Sea Species Conservation Habitat Project – SPL-2010-000142-LLC

Dear Mr. Smith:

The Cultural Resources Department of the Cocopah Indian Tribe appreciates your consultation efforts on this project. We are pleased that you contacted our department on this issue for the purpose of solicitation of our input and to address our concerns on this matter. At this time, we wish to make no comment on the development of the project at this time.

We would like to continue to be kept informed progression of the project and be a part of the consultation process in the future. Additionally, we expect to be provided with all pertinent documents for this project in both draft and final format. If you have any questions or need additional information please feel free to contact the cultural resource department. We will be happy to assist you with any future concerns or questions.

Sincerely,

H. Jill McCormick, M.A.

Cultural Resource Manager

From: Bridget Nash
To: Cervantes, Lanika L SPL
Subject: SPL-2010-00142-LLC
Date: Tuesday, May 31, 2011 10:13:35 AM

Thank you for notifying us of the proposed Salton Sea Species Conservation Habitat Project.

While the Cultural Committee supports the project as it will create additional habitat for the animals located within the area, there is some concern as to whether or not the discharged fill would impact Obsidian Butte. Looking at the maps it appears that Obsidian Butte is located just outside of the project area but there were questions about indirect impacts as a result of the proposed discharge.

If you have any questions please do not hesitate to call or email.

Bridget R. Nash-Chrabascz

Quechan Tribe Historic Preservation Officer

Quechan Indian Tribe

PO Box 1899

Yuma, AZ 85366

760-572-2423