PROJECT REPORT

TO: ENVIRONMENTAL EVALUATION COMMITTEE **AGENDA DATE: May 13, 2021**

FROM: PLANNING & DEVELOPMENT SERVICES DEPT. **AGENDA TIME 1:00pm/No. 4**

PROJECT TYPE: VEGA SES Solar Energy Project minor modifications Conditional Use Permit #20-0029 & Parcel Map 2491 SUPERVISOR DIST #2

LOCATION: Imperial County: APN: 051-360-021... et al

Imperial County, CA PARCEL SIZE: Various acreage

GENERAL PLAN (existing) AG GENERAL PLAN (proposed) N/A

ZONE (existing) County A-2- & A-3/El Centro -R-1, CG, RAP and LU/ City of Imperial- R-1, C-1 and I-2 ZONE (proposed) N/A

GENERAL PLAN FINDINGS ☒ CONSISTENT ☐ INCONSISTENT ☐ MAY BE/FINDINGS

PLANNING COMMISSION DECISION: HEARING DATE:

☐ APPROVED ☐ DENIED ☐ OTHER

PLANNING DIRECTORS DECISION: HEARING DATE:

☐ APPROVED ☐ DENIED ☐ OTHER

ENVIROMENTAL EVALUATION COMMITTEE DECISION: HEARING DATE: 05/13/21

INITIAL STUDY: #20-0039

☐ NEGATIVE DECLARATION ☒ MITIGATED NEG. DECLARATION ☐ EIR

DEPARTMENTAL REPORTS / APPROVALS:

PUBLIC WORKS	☒ NONE	☐ ATTACHED
AG / APCD	☒ NONE	☐ ATTACHED
E.H.S.	☐ NONE	☒ ATTACHED
FIRE / OES	☐ NONE	☒ ATTACHED
OTHER	(See Attached) IID, Sol Cal Gas,	

REQUESTED ACTION:

SEE ATTACHED

Initial Study

VEGA CUP 17-0001 Minor Modification & IID S-Line Upgrades Project

Imperial County, CA

April 2021

[redacted]

Reviewed by:

County of Imperial

Planning & Development Services Department

801 Main Street

El Centro, CA 92243

Prepared by:

HDR Engineering, Inc.

591 Camino de la Reina, Suite 300

San Diego, CA 92108

This page is intentionally blank.

Contents

Tables

Figures

Appendices

This page is intentionally blank.

Introduction

A. Purpose

This document is a ☐ policy-level; ☒ project-level Initial Study for evaluation of potential environmental impacts resulting with the proposed VEGA CUP 17-0001 Minor Modification & IID S-Line Upgrades Project.

B. CEQA Requirements and the Imperial County's Rules and Regulations for Implementing CEQA

As defined by Section 15063 of the State California Environmental Quality Act (CEQA) Guidelines and Section 7 of the County's Rules and Regulations for Implementing CEQA, an **Initial Study** is prepared primarily to provide the Lead Agency with information to use as the basis for determining whether an Environmental Impact Report (EIR), Negative Declaration, or Mitigated Negative Declaration would be appropriate for providing the necessary environmental documentation and clearance for any proposed project.

☐ According to Section 15065, an **EIR** is deemed appropriate for a particular proposal if the following conditions occur:

- The proposal has the potential to substantially degrade quality of the environment.
- The proposal has the potential to achieve short-term environmental goals to the disadvantage of long-term environmental goals.
- The proposal has possible environmental effects that are individually limited but cumulatively considerable.
- The proposal could cause direct or indirect adverse effects on human beings.

☐ According to Section 15070(a), a **Negative Declaration** is deemed appropriate if the proposal would not result in any significant effect on the environment.

☒ According to Section 15070(b), a **Mitigated Negative Declaration** is deemed appropriate if it is determined that though a proposal could result in a significant effect, mitigation measures are available to reduce these significant effects to insignificant levels.

This Initial Study has determined that the proposed VEGA IID S-Line upgrades and application for a minor modification to CUP 17-0001 will result in potentially significant environmental impacts; however, mitigation measures are available to reduce the potentially significant impacts and therefore, a Mitigated Negative Declaration is deemed as the appropriate document to provide necessary environmental evaluations and clearance for the proposed approvals under review in this Initial Study.

This Initial Study is prepared in conformance with the California Environmental Quality Act of 1970, as amended (Public Resources Code, Section 21000 et. seq.); the State CEQA Guidelines & County of Imperial's CEQA Regulations, Guidelines for the Implementation of CEQA; applicable

requirements of the County of Imperial; and the regulations, requirements, and procedures of any other responsible public agency or an agency with jurisdiction by law.

Pursuant to the County of Imperial's CEQA Regulations, Guidelines for the Implementation of CEQA, depending on the project scope, the County of Imperial Board of Supervisors, Planning Commission and/or Planning Director is designated the Lead Agency, in accordance with Section 15050 of the CEQA Guidelines. The Lead Agency is the public agency which has the principal responsibility for approving the necessary environmental clearances and analyses for any project in the County.

C. Intended Uses of Initial Study

This Initial Study is an informational document which is intended to inform County of Imperial decision makers, other responsible or interested agencies, and the general public of potential environmental effects of the proposed applications. The environmental review process has been established to enable public agencies to evaluate environmental consequences and to examine and implement methods of eliminating or reducing any potentially adverse impacts. While CEQA requires that consideration be given to avoiding environmental damage, the Lead Agency and other responsible public agencies must balance adverse environmental effects against other public objectives, including economic and social goals.

The Initial Study prepared for the project will be circulated for a period of no less than 35 days for public and agency review and comments.

D. Contents of Initial Study

This Initial Study is organized to facilitate a basic understanding of the existing setting and environmental implications of the proposed applications.

SECTION 1

I. INTRODUCTION presents an introduction to the entire report. This section discusses the environmental process, scope of environmental review, and incorporation by reference documents.

SECTION 2

II. ENVIRONMENTAL CHECKLIST FORM contains the County's Environmental Checklist Form. The checklist form presents results of the environmental evaluation for the proposed VEGA IID S-Line upgrades and application for a minor modification to CUP #17-0001 and those issue areas that would have either a significant impact, potentially significant impact, or no impact.

PROJECT SUMMARY, LOCATION AND ENVIRONMENTAL SETTINGS describes the proposed project, necessary entitlements and required applications. A description of discretionary approvals and permits required for project implementation is also included. It also identifies the location of the project and a general description of the surrounding environmental settings.

ENVIRONMENTAL ANALYSIS evaluates each response provided in the environmental checklist form. Each response checked in the checklist form is discussed and supported with sufficient data and analysis as necessary. As appropriate, each response discussion describes and identifies specific impacts anticipated with project implementation.

SECTION 3

III. MANDATORY FINDINGS presents Mandatory Findings of Significance in accordance with Section 15065 of the CEQA Guidelines.

E. Scope of Environmental Analysis

For evaluation of environmental impacts, each question from the Environmental Checklist Form is summarized and responses are provided according to the analysis undertaken as part of the Initial Study. Impacts and effects will be evaluated and quantified, when appropriate. To each question, there are four possible responses, including:

1. No Impact: A "No Impact" response is adequately supported if the impact simply does not apply to the proposed project.
2. Less Than Significant Impact: The proposed project will have the potential to impact the environment. These impacts, however, will be less than significant; no additional analysis is required.
3. Less Than Significant With Mitigation Incorporated: This applies where incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact."
4. Potentially Significant Impact: The proposed project could have impacts that are considered significant. Additional analyses and possibly an EIR could be required to identify mitigation measures that could reduce these impacts to less than significant levels.

F. Policy-Level or Project-Level Environmental Analysis

This Initial Study will be conducted under a ☐ policy-level, ☒project-level analysis.

Regarding mitigation measures, it is not the intent of this document to "overlap" or restate conditions of approval that are commonly established for future known projects or the proposed project and associated entitlement applications. Additionally, those other standard requirements and regulations that any development must comply with, that are outside the County's jurisdiction, are also not considered mitigation measures, and therefore, will not be identified in this document.

G. Tiered Documents and Incorporation by Reference

Information, findings, and conclusions contained in this document are based on incorporation by reference of tiered documentation, which are discussed in the following section.

1. Tiered Documents

As permitted in Section 15152(a) of the CEQA Guidelines, information and discussions from other documents can be included into this document. Tiering is defined as follows:

"Tiering refers to using the analysis of general matters contained in a broader EIR (such as the one prepared for a general plan or policy statement) with later EIRs and negative declarations on narrower projects; incorporating by reference the general discussions from the broader EIR; and concentrating the later EIR or negative declaration solely on the issues specific to the later project."

Tiering also allows this document to comply with Section 15152(b) of the CEQA Guidelines, which discourages redundant analyses, as follows:

"Agencies are encouraged to tier the environmental analyses which they prepare for separate but related projects including the general plans, zoning changes, and development projects. This approach can eliminate repetitive discussion of the same issues and focus the later EIR or negative declaration on the actual issues ripe for decision at each level of environmental review. Tiering is appropriate when the sequence of analysis is from an EIR prepared for a general plan, policy or program to an EIR or negative declaration for another plan, policy, or program of lesser scope, or to a site-specific EIR or negative declaration."

Further, Section 15152(d) of the CEQA Guidelines states:

"Where an EIR has been prepared and certified for a program, plan, policy, or ordinance consistent with the requirements of this section, any lead agency for a later project pursuant to or consistent with the program, plan, policy, or ordinance should limit the EIR or negative declaration on the later project to effects which:

(1) Were not examined as significant effects on the environment in the prior EIR; or

(2) Are susceptible to substantial reduction or avoidance by the choice of specific revisions in the project, by the imposition of conditions, or other means."

2. **Incorporation by Reference**

Incorporation by reference is a procedure for reducing the size of EIRs/MND and is most appropriate for including long, descriptive, or technical materials that provide general background information, but do not contribute directly to the specific analysis of the project itself. This procedure is particularly useful when an EIR or Negative Declaration relies on a broadly-drafted EIR for its evaluation of cumulative impacts of related projects (*Las Virgenes Homeowners Federation v. County of Los Angeles* [1986, 177 Ca.3d 300]). If an EIR or Negative Declaration relies on information from a supporting study that is available to the public, the EIR or Negative Declaration cannot be deemed unsupported by evidence or analysis (*San Francisco Ecology Center v. City and County of San Francisco* [1975, 48 Ca.3d 584, 595]).

When an EIR or Negative Declaration incorporates a document by reference, the incorporation must comply with Section 15150 of the CEQA Guidelines as follows:

- The incorporated document must be available to the public or be a matter of public record (CEQA Guidelines Section 15150[a]). The General Plan EIR is available, along with this document, at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243 Ph. (442) 265-1736.
- This document must be available for inspection by the public at an office of the lead agency (CEQA Guidelines Section 15150[b]). These documents are available at the County of Imperial Planning & Development Services Department, 801 Main Street, El Centro, CA 92243, Ph. (442) 265-1736.
- These documents must summarize the portion of the document being incorporated by reference or briefly describe information that cannot be summarized. Furthermore, these documents must describe the relationship between the incorporated information and the analysis in the tiered documents (CEQA Guidelines Section 15150[c]). As discussed above, the tiered EIRs address the entire project site and provide background and inventory information and data which apply to the project site. Incorporated information and/or data will be cited in the appropriate sections.

- These documents must include the State identification number of the incorporated documents (CEQA Guidelines Section 15150[d]). The State Clearinghouse Number for the County of Imperial General Plan EIR is SCH #93011023.

The material to be incorporated in this document will include general background information (CEQA Guidelines Section 15150[f]).

Environmental Checklist Form

1. **Project Title:** VEGA CUP 17-0001 Minor Modification & IID S-Line Upgrades Project
2. **Lead Agency Name and Address:** Imperial County Planning & Development Services Department, 801 Main Street, El Centro, CA 92243
3. **Contact Person and Phone Number:** Dave Black, Planner IV, 442-265-1749
4. **Project Location:** The VEGA CUP 17-0001 Minor Modification & IID S-Line Upgrades Project consists of three primary components: 1) Minor Revision to Conditional Use Permit (CUP) 17-0001; 2) Upgrades to the Imperial Irrigation District (IID) "S"-Line; and 3) Parcel Map (Waiver). The following describes the location of each of the project components:

   Minor Revision to CUP 17-0001. Previously approved (April 2019) CUP 17-0001 allows for the construction and operation of the VEGA SES Solar Energy Project. The project applicant is requesting a minor revision to CUP 17-0001 in order to change the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site, as described below:

   - Change the location of the previously approved on-site substation from the southwestern corner of APN #051-360-021 adjacent to Mandrapa Road/Westside Main Canal, relocating the substation site to the northwestern corner of APN #051-360-031 adjacent to W. Wixom Road and Vogel Road.
   - Change the location of the previously approved gen-tie originating from the project's substation on the southwestern corner of APN #051-360-021 to the proposed IID 230 kV Fern Substation, relocating it to the northwestern corner of APN #051-360-031 to tie-in to IID's S-Line.

   VEGA IID S-Line Upgrades. The VEGA IID S-Line Upgrades ("S-Line upgrades") component of the project consists of replacing and upgrading equipment along an approximately 18-mile segment of an existing transmission line traversing through lands in unincorporated Imperial County, City of El Centro, and City of Imperial. The S-Line upgrades would initiate at the existing Imperial Valley Substation, traveling northeast along the existing IID S-Line, and terminating at the existing El Centro Switching Station. The Imperial Valley Substation is located approximately 0.94 miles south of the Liebert Road/Mandrapa Road intersection and the Westside Main Canal. The El Centro Switching Station is located in northeast El Centro on the southwest corner of the Dogwood Road/E. Villa Avenue intersection.

   The existing S-Line and proposed upgrades would include segments of the following roadways: Liebert Road, W. Wixom Road, Drew Road, W. Kramer Road, Brockman Road, W. Hackleman Road, Forrester Road, W. Evans News, and Villa Avenue. The S-Line upgrades traverse property located in multiple Townships, Ranges, and Sections of multiple maps, as follows:

   - Sections 29, 30, 32, and 33 of Township 15 South, Range 14 East; Sections 25, 26, 27 of Township 15 South, Range 13 East, San Bernardino Base and Meridian as depicted on the 1957 El Centro, California U.S. Geological Survey (USGS) 7.5-minute topographical quadrangle map.

- Sections 28, 32, and 33 of Township 15 South, Range 13 East; Sections 4, 5, 8, 9, 17, and 18 of Township 16 South, Range 13 East; and Sections 24 and 25 of Township 16 South, Range 12 East, San Bernardino Base and Meridian as depicted on the 1957 Seeley, California USGS 7.5-minute topographical quadrangle map.
- Sections 26, 27, and 34 of Township 16 South, Range 12 East, San Bernardino Base and Meridian as depicted on the 1957 Mount Signal, California USGS 7.5-minute topographical quadrangle map.

Parcel Map (Waiver). The Parcel Map affects five existing parcels (APNs 051-360-012, 051-360-031, 051-390-005, 051-390-004, and 051-390-013).

5. **Project Sponsor's Name and Address:** Apex Energy Solutions, LLC, 604 Sutter Street, Suite 250, Folsom, CA 95630
6. **General Plan Designation:**
    - **CUP 17-0001:** Agriculture
    - **S-Line Upgrades:**
        - **Imperial County:** Recreation/Open Space and Agriculture
        - **City of El Centro:** Public, Rural Residential, General Commercial, Tourist Commercial, and Planed Industrial
        - **City of Imperial:** Residential Low Medium Density, Specific Plan, Commercial Neighborhood, and Rail Served Industrial
    - **Parcel Map:** Agriculture
7. **Zoning:**
    - **CUP 17-0001:** A-2 (General Agriculture) and A-2-R (General Agriculture Rural)
    - **S-Line Upgrades:**
        - **Imperial County:** A-2 (General Agriculture), A-2-R (General Agriculture Rural), A-3 (Heavy Agriculture)
        - **City of El Centro:** R1 (Single-Family Residential), CG (General Commercial), RAP (Residential Commercial), and LU (Limited Use)
        - **City of Imperial:** R-1 (Residential Single-Family), (SP) Specific Plan Overlay, C-1 (Commercial Neighborhood), and I-2 (Rail Served Industrial)
    - **Parcel Map**: A-2 (General Agriculture)
8. **Description of Project:**

Background

In April 2019, the Imperial County Board of Supervisors certified the Final Environmental Impact Report (EIR) (State Clearinghouse No. 2017081019) and adopted Conditional Use Permit (CUP) (CUP 17-0001) for the VEGA SES Solar Energy Project. The VEGA SES Solar Energy Project consisted of three primary components: 1) solar generation equipment and associated facilities (i.e., substation, electrical power system, and auxiliary facilities); 2) battery storage system; and, 3) above ground 230 kV generator intertie ("gentie") that will deliver the electrical energy produced by the project to the proposed IID 230 kV Fern Substation.

The Board-certified VEGA SES Solar Energy Project Final EIR (State Clearinghouse No. 2017081019) determined that all significant impacts could be reduced to a level less than significant with incorporation of mitigation measures. The potentially significant impacts that were mitigated consisted of the following: Agricultural Resources, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, and Hydrology/Water Quality.

No substantial changes to the previously-approved VEGA SES Solar Energy Project are proposed. The project applicant is requesting a minor revision to CUP 17-0001 in order to change the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site, as described below:

1. Change the location of the previously approved on-site substation from the southwestern corner of APN #051-360-021 adjacent to Mandrapa Road/Westside Main Canal, relocating the substation site to the northwestern corner of APN #051-360-031 adjacent to W. Wixom Road and Vogel Road.
2. Change the location of the previously approved gen-tie originating from the project's substation on the southwestern corner of APN #051-360-021 to the proposed IID 230 kV Fern Substation, relocating it to the northwestern corner of APN #051-360-031 to tie-in to IID's S-Line.

The project applicant is also requesting a Parcel Map for reorganization of property around Drew Road. The Parcel Map would create two parcels from an existing five parcels (APN Nos. 051-360-012, 051-360-031, 051-390-013, 051-390-005, 051-390-004) that are bisected, in part, by Drew Road.

Minor Revision to CUP 17-0001. A minor revision to CUP 17-0001 is requested in order to change the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. CUP 17-0001 allows for the construction of a new substation, on the southwestern edge of the solar energy facility site (located within APN # 051-360-021). The CUP revision would change the location of the previously-approved on-site substation from the southwestern corner of APN #051-360-021 adjacent to Mandrapa Road/Westside Main Canal, relocating the substation site to the northwestern corner of APN #051-360-031 adjacent to W. Wixom Road and Vogel Road.

The substation would take delivery of the 12.5 kV or 34.5 kV power from the project and increase the voltage of the electricity to 230 kV for metering and delivery to the IID electric grid. The substation would include a transformer, circuit breakers, meters, disconnect switches, microwave or other communication facilities and an electrical control building.

The CUP revision would also change the location of the previously approved gen-tie originating from the project's substation on the southwestern corner of APN #051-360-021 to the proposed IID 230 kV Fern Substation, relocating it to the northwestern corner of APN #051-360-031 to tie-in to IID's S-Line.

Proposed CUP Language Modification:
The Project [VEGA SES Project] will be interconnected to the regional transmission system from the on-site substation/switchyard via the Gen-Tie interconnection. CUP #17-0001 is anticipated to utilize the Gen-Tie line extending from the CUP to [an] inverter station. Alternatively, each CUP may independently construct its own 230-kV (maximum) step-up transformer and switchyard. During normal operation, each substation will "back feed" power to maintain "house" power. This would include O&M buildings, security systems, SCADA, communication systems, plant control systems,

etc. Therefore, much of the electrical equipment will be in some stage of electrical operation 24 hours-a-day. The interconnection to the IID system will be a connection to the upgraded "S" line which is contiguous to the north side of the property.

S-Line Upgrades. The S-Line upgrades component of the project consists of replacement and upgrades to the existing IID S-Line and construction of new sections or alternate route alignments connecting the Imperial Valley Substation to the El Centro Switching Station. The project would replace the existing transmission line wooden power poles with steel monopoles supported on drilled pier foundations. The proposed S-Line upgrades spans approximately 18 miles. All upgrades would be to the existing IID line and associated facilities, within IID's existing transmission corridor.

Construction activities would primarily involve demolition of old transmission lines, erecting of 157 new transmission line poles spaced approximately 200 feet apart and stringing of new transmission line onto new and existing poles. Construction is estimated to take approximately 14 months and would begin in summer of 2021. Operating from west to east, up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another). No additional work, with the exception of stringing new transmission lines, is expected to take place within the existing substations.

Parcel Map: The Parcel Map affects five existing parcels (APNs 051-360-012, 051-360-031, 051-390-005, 051-390-004, and 051-390-013). This map is being requested to separate portions of existing parcels that are located on both sides of Drew Road but only the portions on the west side are planned for use as the VEGA SES Solar Energy Project. The eastern portions will continue to be used for agriculture. The Parcel Map would create Parcel 1 comprising approximately 218 acres, located south, southwest of Drew Road and Parcel 2 comprising approximately 75.03 acres located north, northeast of Drew Road.

Surrounding Land Uses and Setting: Briefly describe the project's surroundings: The CUP and Parcel Map portions of the project are located in an area characterized by agricultural lands and solar development. The S-Line upgrades are located within an existing utility right of way, and traverse existing and planned utility-scale solar development facilities, agricultural lands, canals, the New River, roadways, and areas with development associated with the incorporated jurisdictions of Imperial and El Centro.

Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.):

- Department of Public Works – Ministerial permits (grading and encroachment)
- Imperial County Air Pollution Control District – Fugitive dust control plan, Authority to construct
- California Regional Water Quality Control Board – Notice of Intent for General Construction Permit
- Imperial Irrigation District – Encroachment permits

9. **Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?**

Yes, the Torrez Martinez Desert Cahuilla Indians and Quechan Indian Tribe. These tribes were sent an AB 52 consultation request letter.

Environmental Factors Potentially Affected

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

☐ Aesthetics	☐ Agriculture and Forestry Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☐ Energy
☐ Geology/Soils	☐ Greenhouse Gas Emissions	☐ Hazards & Hazardous Materials
☐ Hydrology / Water Quality	☐ Land Use/Planning	☐ Mineral Resources
☐ Noise	☐ Population/Housing	☐ Public Services
☐ Recreation	☐ Transportation	☐ Tribal Cultural Resources
☐ Utilities/Service Systems	☐ Wildfire	☐ Mandatory Findings of Significance

Environmental Evaluation Committee Determination

After Review of the Initial Study, the Environmental Evaluation Committee (EEC) has:

☐ Found that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ Found that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ Found that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ Found that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ Found that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

CALIFORNIA DEPARTMENT OF FISH AND GAME DE MINIMIS IMPACT FINDING:

☐Yes ☐No

EEC VOTES	YES	NO	ABSENT
PUBLIC WORKS	☐	☐	☐
ENVIRONMENTAL HEALTH	☐	☐	☐
OFFICE EMERGENCY SERVICES	☐	☐	☐
APCD	☐	☐	☐
AG	☐	☐	☐
SHERIFF DEPARTMENT	☐	☐	☐
ICPDS	☐	☐	☐

Signature

Date:

Project Summary

Background

In April 2019, the Imperial County Board of Supervisors certified the Final Environmental Impact Report (EIR) (State Clearinghouse No. 2017081019) and adopted Conditional Use Permit (CUP) (CUP 17-0001) for the VEGA SES Solar Energy Project. The VEGA SES Solar Energy Project consisted of three primary components: 1) solar generation equipment and associated facilities (i.e., substation, electrical power system, and auxiliary facilities); 2) battery storage system; and, 3) above ground 230 kV generator intertie ("gentie") that will deliver the electrical energy produced by the project to the proposed IID 230 kV Fern Substation. Figure 1 illustrates the area approved for solar development in 2019. Figure 2 shows the previously approved site plan.

The Board-certified VEGA SES Solar Energy Project Final EIR (State Clearinghouse No. 2017081019) determined that all significant impacts could be reduced to a level less than significant with incorporation of mitigation measures. The potentially significant impacts that were mitigated consisted of the following: Agricultural Resources, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, and Hydrology/Water Quality.

No substantial changes to the previously-approved VEGA SES Solar Energy Project are proposed. The project applicant is requesting a minor revision to CUP 17-0001 in order to change the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site, as described below:

1. Change the location of the previously approved on-site substation from the southwestern corner of APN #051-360-021 adjacent to Mandrapa Road/Westside Main Canal, relocating the substation site to the northwestern corner of APN #051-360-031 adjacent to W. Wixom Road and Vogel Road (Figure 3).
2. Change the location of the previously approved gen-tie originating from the project's substation on the southwestern corner of APN #051-360-021 to the proposed IID 230 kV Fern Substation, relocating it to the northwestern corner of APN #051-360-031 to tie-in to IID's S-Line (Figure 4).

The project applicant is also requesting a Parcel Map for reorganization of property around Drew Road. The Parcel Map would create two parcels from an existing five parcels (APN Nos. 051-360-012 051-360-031 051-390-013 051-390-005 051-390-004) that are bisected, in part, by Drew Road (Figure 5).

Project Location

The VEGA CUP 17-0001 Minor Modification & IID S-Line Upgrades Project and consists of three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver). Figure 6 shows the location of the project components. The following describes the location of each of the project components.

CUP 17-0001

Previously approved (April 2019) CUP 17-0001 allows for the construction and operation of the VEGA SES Solar Energy Project. The proposed Minor Revision to CUP 17-0001 is located within the VEGA SES Solar Project boundary. Specifically, the modification would change the location of the previously

approved on-site substation from the southwestern corner of APN #051-360-021 adjacent to Mandrapa Road/Westside Main Canal, relocating the substation site to the northwestern corner of APN #051-360-031 adjacent to W. Wixom Road and Vogel Road. Figure 3 depicts the previously-approved location, and the currently proposed location of the substation.

The CUP modification would also change the location of the previously approved gen-tie originating from the project's substation on the southwestern corner of APN #051-360-021 to the proposed IID 230 kV Fern Substation, relocating it to the northwestern corner of APN #051-360-031 to tie-in to IID's S-Line. Figure 4 depicts the previously-approved location, and the currently proposed location of the gen-tie.

S-Line Upgrades

The VEGA IID S-Line Upgrades ("S-Line Upgrades") component of the project consists of replacing and upgrading equipment along an approximately 18-mile segment of an existing transmission line traversing through lands in unincorporated Imperial County, City of El Centro, and City of Imperial. Figure 6 depicts the location of the S-Line upgrades. The S-Line upgrades would initiate at the existing Imperial Valley Substation, traveling northeast along the existing IID S-Line, and terminating at the existing El Centro Switching Station. The Imperial Valley Substation is located approximately 0.94 miles south of the Liebert Road/Mandrapa Road intersection and the Westside Main Canal. The El Centro Switching Station is located in northeast El Centro on the southwest corner of the Dogwood Road/E. Villa Avenue intersection.

The existing S-Line and proposed upgrades would include segments of the following roadways: Liebert Road, W. Wixom Road, Drew Road, W. Kramer Road, Brockman Road, W. Hackleman Road, Forrester Road, W. Evans News, and Villa Avenue. The S-Line upgrades traverse property located in multiple Townships, Ranges, and Sections of multiple maps, as follows:

- Sections 29, 30, 32, and 33 of Township 15 South, Range 14 East; Sections 25, 26, 27 of Township 15 South, Range 13 East, San Bernardino Base and Meridian as depicted on the 1957 El Centro, California U.S. Geological Survey (USGS) 7.5-minute topographical quadrangle map.
- Sections 28, 32, and 33 of Township 15 South, Range 13 East; Sections 4, 5, 8, 9, 17, and 18 of Township 16 South, Range 13 East; and Sections 24 and 25 of Township 16 South, Range 12 East, San Bernardino Base and Meridian as depicted on the 1957 Seeley, California USGS 7.5-minute topographical quadrangle map.
- Sections 26, 27, and 34 of Township 16 South, Range 12 East, San Bernardino Base and Meridian as depicted on the 1957 Mount Signal, California USGS 7.5-minute topographical quadrangle map.

Parcel Map (Waiver)

The Parcel Map affects five existing parcels (APNs 051-360-012, 051-360-031, 051-390-005, 051-390-004, and 051-390-013).

Project Summary

CUP 17-0001

A minor revision to CUP 17-0001 is requested in order to change the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. CUP 17-0001 allows for the construction of a new substation, on the southwestern edge of the solar energy facility site (located within APN # 051-360-021). The CUP revision would change the location of the previously approved on-site substation from the southwestern corner of APN #051-360-021 adjacent to Mandrapa Road/Westside Main Canal, relocating the substation site to the northwestern corner of APN #051-360-031 adjacent to W. Wixom Road and Vogel Road (Figure 3).

The substation would take delivery of the 12.5 kV or 34.5 kV power from the project and increase the voltage of the electricity to 230 kV for metering and delivery to the IID electric grid. The substation would include a transformer, circuit breakers, meters, disconnect switches, microwave or other communication facilities and an electrical control building.

The CUP revision would also change the location of the previously approved gen-tie originating from the project's substation on the southwestern corner of APN #051-360-021 to the proposed IID 230 kV Fern Substation, relocating it to the northwestern corner of APN #051-360-031 to tie-in to IID's S-Line (Figure 4).

Proposed CUP Language Modification

The Project [VEGA SES Project] will be interconnected to the regional transmission system from the on-site substation/switchyard via the Gen-Tie interconnection. CUP #17-0001 is anticipated to utilize the Gen-Tie line extending from the CUP to [an] inverter station. Alternatively, each CUP may independently construct its own230-kV (maximum) step-up transformer and switchyard. During normal operation, each substation will "back feed" power to maintain "house" power. This would include O&M buildings, security systems, SCADA, communication systems, plant control systems, etc. Therefore, much of the electrical equipment will be in some stage of electrical operation 24 hours-a-day. The interconnection to the IID system will be a connection to the upgraded "S" line which is contiguous to the north side of the property.

S-Line Upgrades

The S-Line upgrades component of the project consists of replacement and upgrades to the existing IID S-Line and construction of new sections or alternate route alignments connecting the Imperial Valley Substation to the El Centro Switching Station. The project would replace the existing transmission line wooden power poles with steel monopoles supported on drilled pier foundations. The proposed S-Line upgrades spans approximately 18 miles. All upgrades would be to the existing IID line and associated facilities, within IID's existing transmission corridor. Figure 6 depicts the location of the S-Line upgrades.

Construction activities would primarily involve demolition of old transmission lines, erecting of 157 new transmission line poles spaced approximately 200 feet apart and stringing of new transmission line onto new and existing poles. Construction is estimated to take approximately 14 months and would begin in summer of 2021. Operating from west to east, up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another). No additional work,

with the exception of stringing new transmission lines, is expected to take place within the existing substations.

Parcel Map (Waiver)

The Parcel Map affects five existing parcels (APNs 051-360-012, 051-360-031, 051-390-005, 051-390-004, and 051-390-013). This map is being requested to separate portions of existing parcels that are located on both sides of Drew Road but only the portions on the west side are planned for use as the VEGA SES Solar Energy Project. The eastern portions will continue to be used for agriculture.

The Parcel Map would create Parcel 1 comprising approximately 218 acres, located south, southwest of Drew Road and Parcel 2 comprising approximately 75.03 acres located north, northeast of Drew Road (Figure 5).

Environmental Setting

The S-Line upgrades component of the project consists of replacing and upgrading equipment along an approximately 18-mile segment of an existing transmission line traversing through lands in unincorporated Imperial County, City of El Centro, and City of Imperial. The S-Line upgrades would initiate at the existing Imperial Valley Substation, traveling northeast along the existing IID S-Line, and terminating at the existing El Centro Switching Station. The Imperial Valley Substation is located 0.94 mile south of the Liebert Road/Mandrapa Road intersection and the Westside Main Canal (Aqueduct), bound by flat undisturbed lands designated as "Recreation/Open Space" in unincorporated Imperial County and Bureau of Land Management (BLM) lands. The El Centro Switching Station is located in northeast El Centro on the southwestern corner of the Dogwood Road/E. Villa Avenue intersection (APN 044-430-008), bound by the IID El Centro Generating Station to the south and west, commercial/industrial land uses to the north beyond E. Villa Avenue, and agricultural lands to the east beyond Dogwood Road.

The proposed transmission line would tie into the VEGA SES Solar Energy Project, a 100-megawatt (MW) photovoltaic solar energy facility. The VEGA SES Solar Energy Project site is surrounded by the Campo Verde solar generating facility on the north and northwest, undeveloped agricultural lands on the east and south, and desert lands on the west. The project is generally located east of the Westside Main Canal. There are off-site rural residences located 500 feet of the solar energy facility site boundary: one located near the northwestern property boundary (Vogel Road/West Wixom Road intersection), and four residences along Drew Road.

Figure 1. Previously-Approved VEGA SES Solar Energy Project

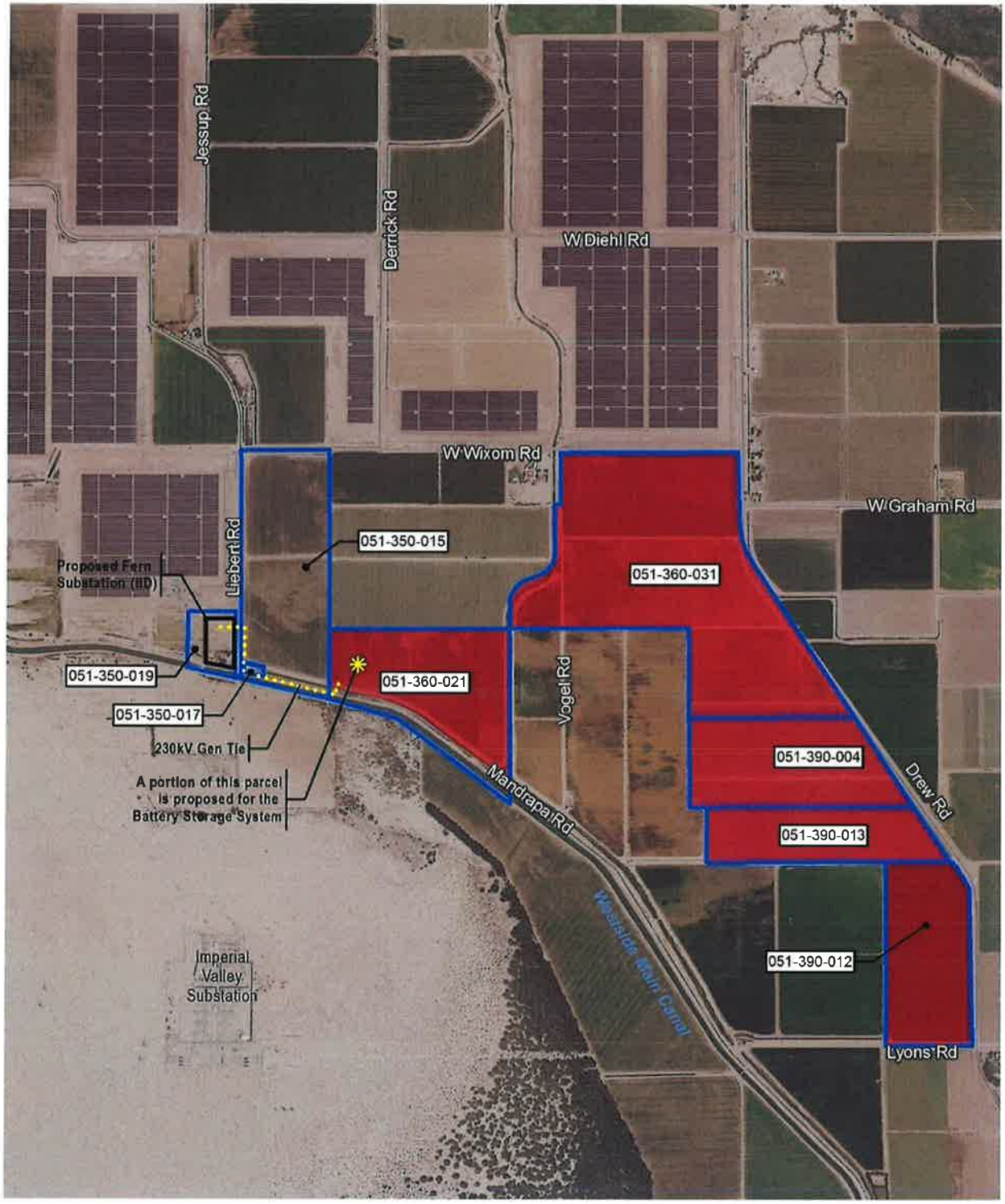


Figure 2. Previously-Approved VEGA SES Solar Energy Project – Site Plan

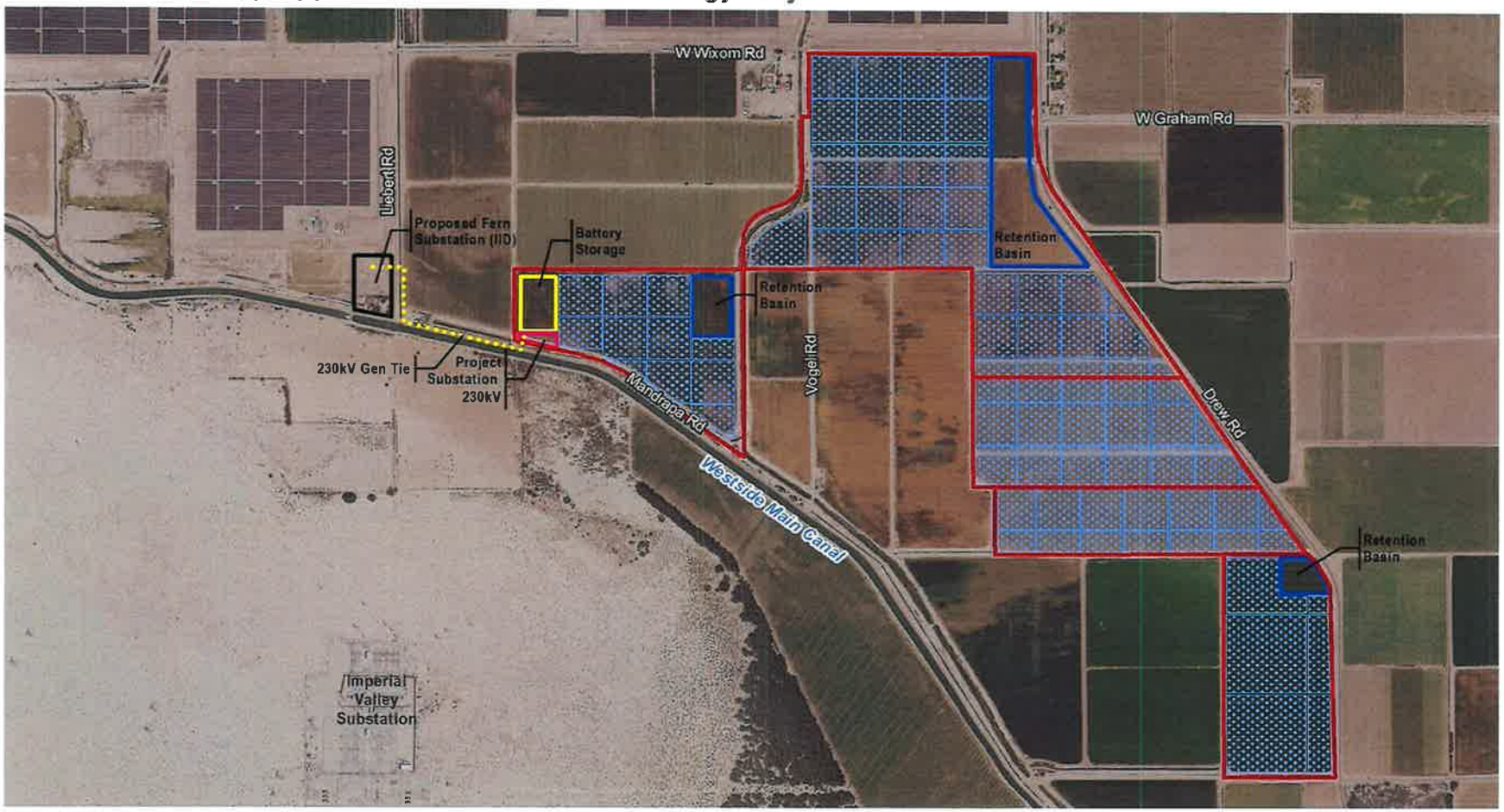
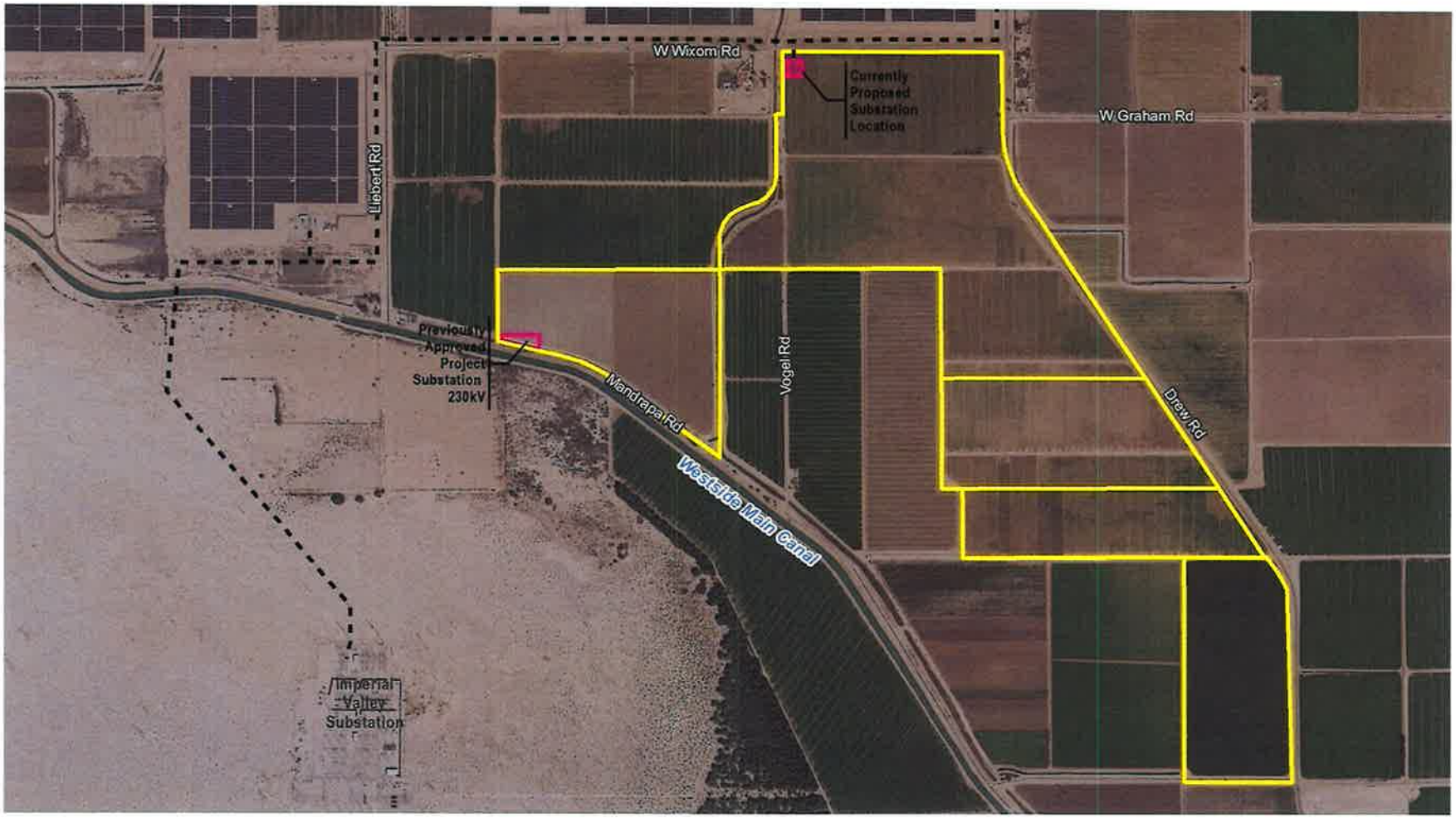


Figure 3. CUP 17-0001 Revision – Substation Location



LEGEND

- VEGA S-Line Alignment Line
- VEGA SES Solar Energy Project
- Currently Proposed Substation Location
- Previously Approved Project Substation

0 Feet 1,000

Figure 4. CUP 17-0001 Revision – Gen-Tie Location

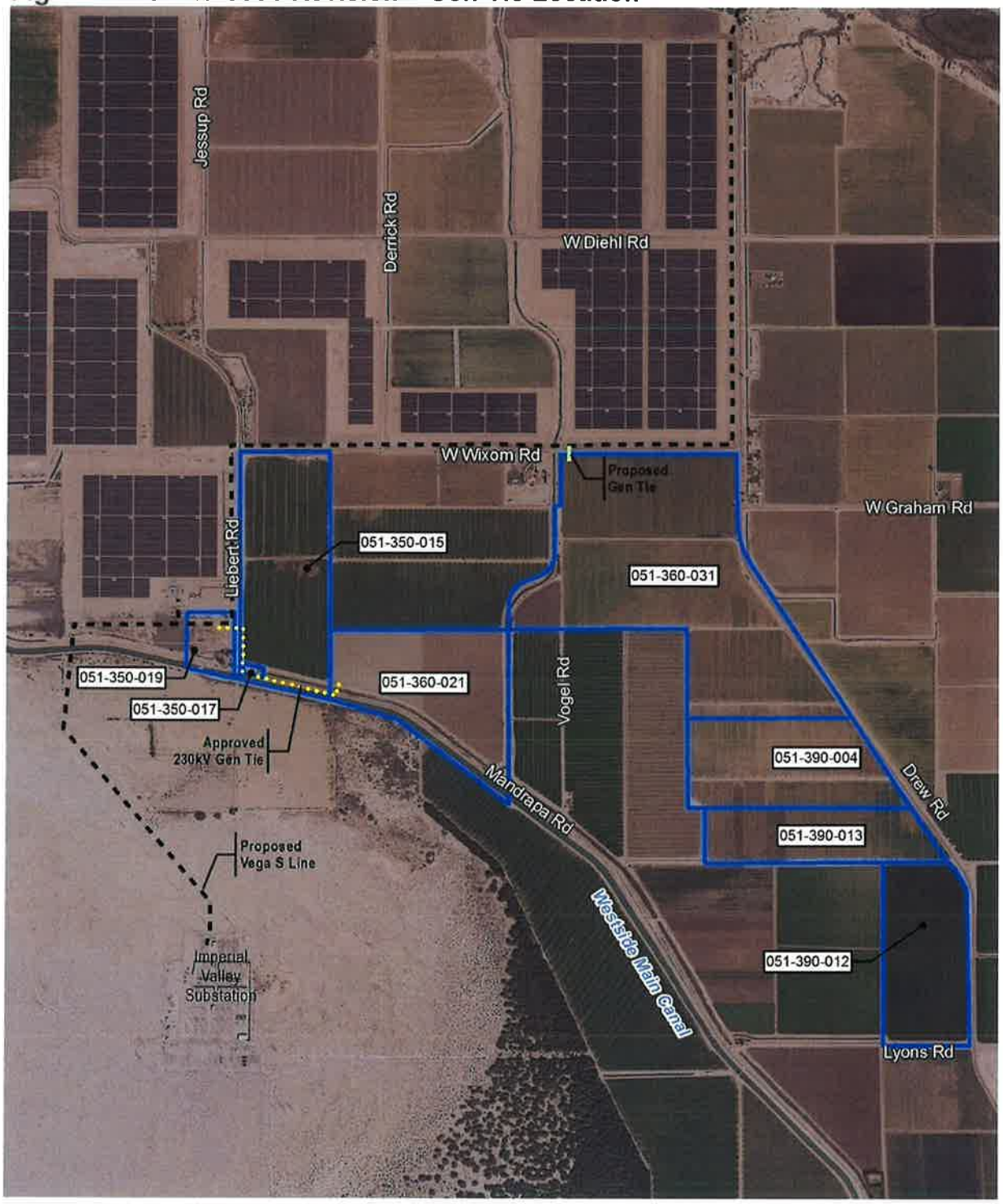


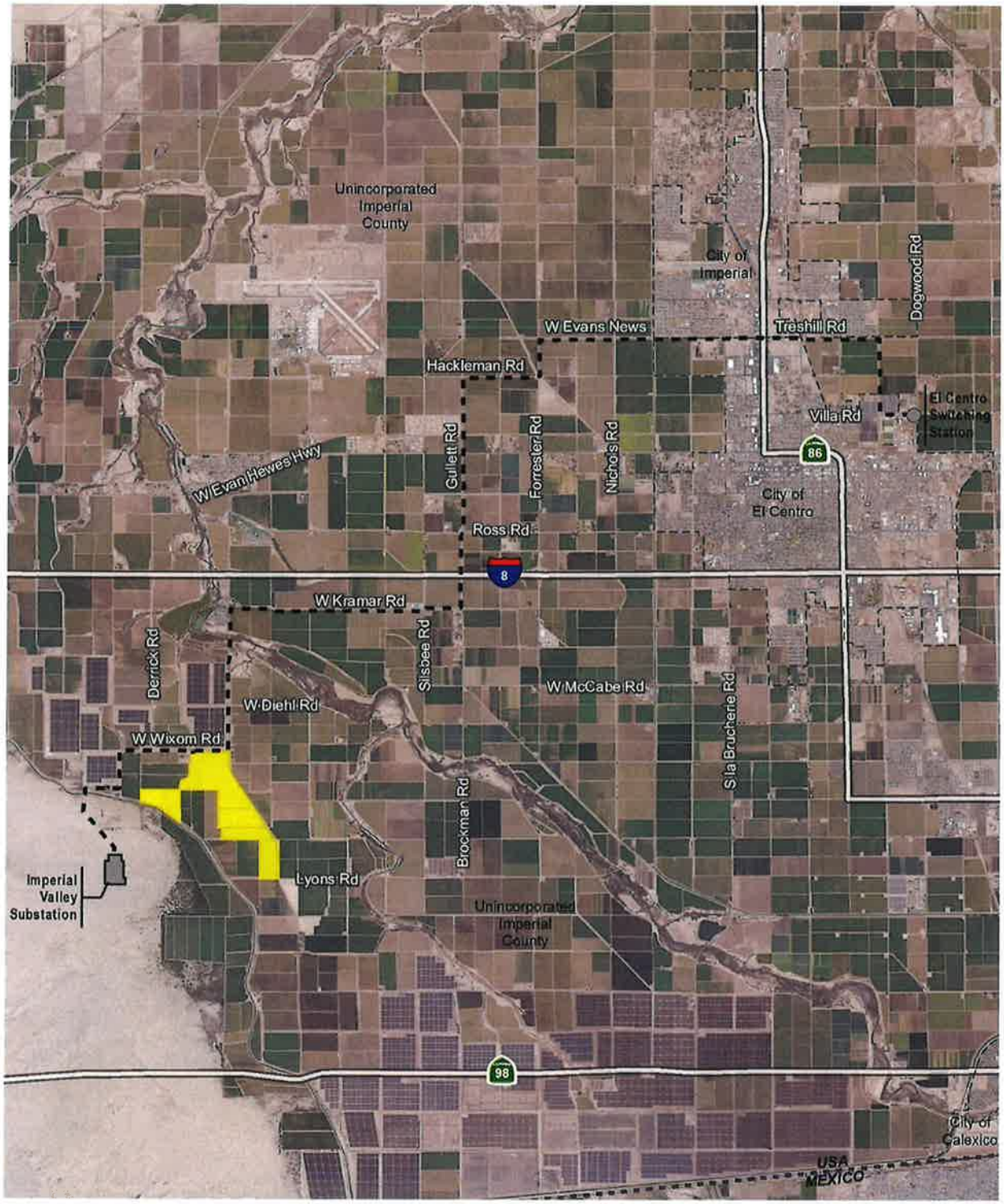
Figure 5. Parcel Map Re-organization

LEGEND

- VEGA S-Line Alignment
- Assessor Parcels
- Parcel Adjustments

0 Feet 1,000

Figure 6. Project Location



Evaluation of Environmental Impacts

1. A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors, as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).
2. All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
3. Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.
4. "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from "Earlier Analyses," as described in (5) below, may be cross-referenced).
5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
    a. Earlier Analysis Used. Identify and state where they are available for review.
    b. Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
    c. Mitigation Measures. For effects that are "Less than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6. Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.
7. Supporting Information Sources: A source list should be attached, and other sources used, or individuals contacted should be cited in the discussion.
8. This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.
9. The explanation of each issue should identify:
    a. The significance criteria or threshold, if any, used to evaluate each question; and
    b. The mitigation measure identified, if any, to reduce the impact to less than significance.

I. Aesthetics

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Except as provided in Public Resources Code Section 21099, would the project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic building within a state scenic highway?	☐	☐	☐	☒
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage points). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☒	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional aesthetic impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades. The following information is summarized from the *Visual Impact Report – VEGA IID S-Line Replacement and Reconstruction Project* prepared by ECORP Consulting, Inc. dated March 2021. This report is provided as Appendix A of this Initial Study.

a) **No Impact.** The project site is not located within an area that has been formally designated as a federal, state, or county scenic vista. No scenic vistas or areas with high visual quality would be disrupted. Thus, no impact is identified for this issue area.

b) **No Impact.** A portion of the S-Line upgrades alignment crosses over the Interstate 8 (I-8) corridor, which is considered an eligible scenic highway. However, it is not currently a designated scenic highway. Furthermore, the proposed alignment crossing over I-8 currently has existing power lines crossing over I-8 and the project would not introduce new electrical lines over I-8 where none previously existed (Appendix A of this Initial Study). Therefore, the S-Line upgrades would not substantially damage scenic resources within a state scenic highway and no impact would occur.

c) **Less than Significant Impact.** Construction of the S-Line upgrades would result in temporary visual changes due to construction activities. Potential short-term construction impacts would result from the proposed Project through the presence of construction equipment and materials. Upon completion of construction, equipment and construction materials would no longer be present. Therefore, a less than significant impact from construction activities is anticipated.

To determine the potential visual quality change as a result of the S-Line upgrades, three key views were selected that represent typical views with distinct visual characteristics along the S-Line upgrades alignment. The key views reflect views of the project alignment and were taken from locations within the public right-of-way. Visual simulations were created for the three key views to simulate project features in their context (as they would be seen from critical views and under specific viewing conditions). The photo simulations presented below are by no means representative of all views affected. They are included to provide the reader with a better overall sense of project changes to the existing environment as well as to help visualize public perception and responses to these changes.

The difference in visual quality between the existing environmental setting and with project condition is considered visual quality change. A description of the three key views and potential visual quality change as a result of implementation of the S-Line upgrades is provided below.

Key View 1: Drew Road at New River

Existing View. Key View 1 is a view from Drew Road at its crossing with the New River and faces north. As shown in Figure 7, the dominant features within this key view is Drew Road in the center and the relatively dense vegetation located on either side of Drew Road visible throughout the view. Also visible within this view are the guardrails along either side of the roadways and the utility poles and electrical lines along the entire roadway within the view. No background features are visible within this view.

Proposed Project View. From Key View 1, the overall character and experience for the viewer would not change substantially with implementation of the project. As shown in Figure 7, the main physical change that would occur within this view is the removal of the existing poles and electrical lines on the right side of the roadway and the replacement of those poles and lines with a taller and larger set of poles and higher electrical lines. There would be no visual changes on the left side of the roadway. The installation of the new poles and electrical lines would not result in the obstruction of any scenic resources in a manner that would be significant as the S-Line upgrades would result in the replacement of existing poles and electrical lines. This is considered a less than significant impact.

Key View 2: Cross Road at Central Drain

Existing View. Key View 2 is a view from Cross Road at its intersection with the Central Drain right-of-way facing east. As shown in Figure 8, the dominant features within this key view is the roadway, the residential structures on the left, and the utility poles and electrical lines on the left. Also visible within this view is the Central Drain canal, the vegetation within and adjacent to the canal and active agricultural fields on the right. Additional transmission towers and lines are visible in the background.

Proposed Project View. From Key View 2, the overall character and experience for the viewer would not change substantially with implementation of the project. As shown in Figure 8, the main physical change that would occur within this view is the removal of the existing poles and electrical lines on the north side of the Central Drain and the replacement of those poles and lines with a taller and larger set of poles and higher electrical lines. There would be no visual changes on the south side of the Central Drain. The installation of the new poles and electrical lines would not result in the obstruction of any scenic resources in a manner that would be significant as the S-Line upgrades would result in the replacement of existing poles and electrical lines and the size and location of the proposed poles would be similar to those already existing south of the Central Drain. This is considered a less than significant impact.

Key View 3: Austin Road at Central Drain

Existing View. Key View 3 is a view from Austin Road at its intersection with the Central Drain right-of-way facing east. Similar to Key View 2, the dominant features within this key view is the roadway, the residential structures on the left, and the utility poles and electrical lines on both sides (Figure 9). Also visible within this view is the Central Drain canal, the vegetation within the canal and active agricultural fields on the right. Distant structures are visible in the background associated with the more urbanized area of El Centro. While a service road and the Coachella Canal berm along the edge of the canal is visible within this key view, the overall intactness of the view is moderate as it is mostly free from encroaching man-made elements. The overall unity of this key view is moderate due to its low diversity; however, the cohesiveness of the view is maintained due to its natural setting.

Proposed Project View. From Key View 3, the overall character and experience for the viewer would not change substantially with implementation of the Project. As shown in Figure 9, the main physical change that would occur within this view is the addition of new poles and lines just south of the Central Drain that would be approximately the same size as existing poles within this corridor. There would be no visual

changes north of the Central Drain right-of-way. The installation of the new poles and electrical lines would not result in the obstruction of any scenic resources in a manner that would be significant as there are already existing poles and electrical lines similar in size and scale at this key view. This is considered a less than significant impact.

d) **Less than Significant Impact.** There would be no new sources of light or glare from the replacement of the electrical poles and lines. Shade and shadow cast from the replaced poles and lines would be larger than the previous condition, but the slim profile of these elements would not result in the introduction of large expanses of shade and shadow. This is considered a less than significant impact.

Figure 7. Key View 1 – Existing and Proposed View

Existing View

Proposed View

Imperial County Transmission Lines
View 1

Source: Appendix A of this Initial Study

Figure 8. Key View 2 -- Existing and Proposed View

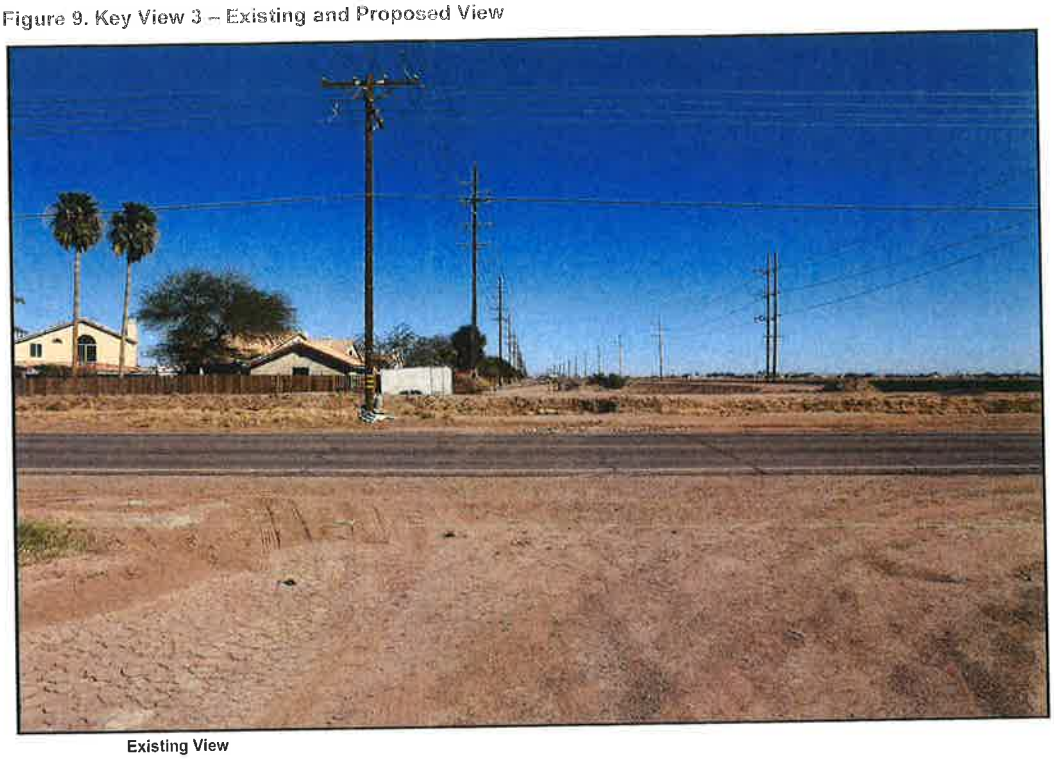
Existing View

Proposed View

Imperial County Transmission Lines
View 2

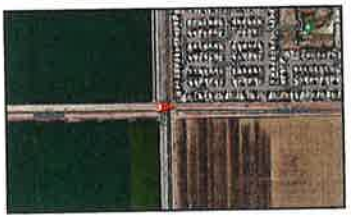
Source: Appendix A of this Initial Study

Figure 9. Key View 3 – Existing and Proposed View



Existing View

Proposed View



Imperial County Transmission Lines
View 3

Source: Appendix A of this Initial Study

II. Agriculture and Forestry Resources

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☒	☐
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☒	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional agricultural impacts would occur and the conclusions and mitigation measures (Mitigation Measures AG-1a, AG-1b, AG-2) identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **Less than Significant Impact.** According to the farmland maps prepared by the California Department of Conservation (2016a), the S-Line upgrades alignment traverses areas designated as Prime Farmland, Farmland of Statewide Importance, and Farmland of Local Importance. The project involves replacement and upgrades to the existing IID S-Line and construction of new sections or alternate route alignments connecting the Imperial Valley Substation to the El Centro Switching Station. The project would replace the existing transmission line wooden power poles with steel monopoles supported on drilled pier foundations. The new steel monopoles would be placed within IID's existing transmission corridor. Due to the limited footprint and ground disturbance of the steel monopoles, their placement would result in a less than significant impact on the conversion of Important Farmland to non-agricultural use.

b) **No Impact.** The S-Line upgrades alignment traverses areas zoned A-2 (General Agriculture) and A-3 (Heavy Agriculture). However, the transmission line alignment would be located within IID's existing transmission corridor and would not conflict with existing zoning for agricultural use. According to the 2016/2017 Imperial County Williamson Act Map produced by the California Department of Conservation's Division of Land Resource Protection (2016b), the transmission line alignment is not located on Williamson Act contracted land. The proposed project has no potential to conflict with existing zoning for agricultural use or a Williamson Act contract. Therefore, no impact is identified for this issue area.

c) **No Impact.** The S-Line upgrades alignment is not located on forest land as defined in PRC Section 1220 (g). There are no existing forest lands, timberlands, or timberland zoned Timberland Production either on-site or in the immediate vicinity; therefore, the project would not conflict with existing zoning of forest land or cause rezoning of any forest land. Additionally, the site is not zoned as forest, timberland or for Timberland Production. Therefore, no impact is identified for this issue area.

d) **No Impact.** There are no existing forest lands either on site or in the immediate vicinity of the S-Line upgrades alignment. The proposed project would not result in the loss of forest land or conversion of forest land to non-forest use. Therefore, no impact is identified for this issue area.

e) **Less than Significant Impact.** As discussed in Response II. a) above, the S-Line upgrades alignment traverses areas designated as Prime Farmland, Farmland of Statewide Importance, and Farmland of Local Importance. However, the transmission line alignment would be located within IID's existing transmission corridor. Furthermore, due to the limited footprint and ground disturbance of the steel monopoles, their placement would result in a less than significant impact on the conversion of Important Farmland to non-agricultural use.

III. Air Quality

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Where available, the significance criteria established by the applicable air quality management district or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☒	☐	☐
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?	☐	☒	☐	☐
c) Expose sensitive receptors to substantial pollutant concentrations?	☐	☒	☐	☐
d) Result in other emissions (such as those leading to odors adversely affecting a substantial number of people?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional air quality impacts would occur and the conclusions and mitigation measures (Mitigation Measures AQ-1 through AQ-5) identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades. The following information is summarized from the *Air Quality and Greenhouse Gas Emissions Assessment for the VEGA IID S-Line Upgrades Project* prepared by ECORP Consulting, Inc. dated February 2021. This report is provided as Appendix B of this Initial Study.

a) **Less than Significant with Mitigation Incorporated.** The S-Line upgrades alignment is located within the jurisdiction of the Imperial County Air Pollution Control District (ICAPCD) in the Salton Sea Air Basin. The project region is designated as a nonattainment area for the federal ozone (O_3), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) and particulate matter less than 10 microns in diameter (PM_{10}) standards and is also a nonattainment area for the state standards for O_3 and PM_{10}.

The U.S. Environmental Protection Agency, under the provisions of the Clean Air Act, requires each state with regions that have not attained the federal air quality standards to prepare a State Implementation Plan (SIP), detailing how these standards are to be met in each local area.

The region's SIP is constituted of the ICAPCD air quality plans: 2018 PM_{10} SIP, the 2018 Annual $PM_{2.5}$ SIP, the 2017 8-Hour Ozone SIP, 2013 24-Hour $PM_{2.5}$ SIP, the 2009 1997 8-hour Ozone RACT SIP, the 2009 PM_{10} SIP and the 2008 Ozone Early Progress Plans. Conformance with the AQMP for development projects is determined by demonstrating compliance with local land use plans and/or population projections, meeting the land use designation set forth in the local General Plan, and comparing assumed emissions in the AQMP to proposed emissions. The project must demonstrate compliance with all ICAPCD applicable rules and regulations, as well as local land use plans and population projections. As the project does not contain a

residential component, the project would not result in an increase in the regional population. While the project would contribute to energy supply, which is one factor of population growth, the proposed project would not significantly increase employment or growth within the region. Moreover, development of the proposed project would increase the amount of renewable energy and help California meet its Renewable Portfolio Standard (RPS). The proposed project would be required to comply with all applicable ICAPCD rules and requirements during construction and operation to reduce air emissions. Overall, the proposed project would improve air quality by reducing the amount of emissions that would be generated in association with electricity production from a fossil fuel burning facility. Furthermore, the thresholds of significance, adopted by the air district (ICAPCD), determine compliance with the goals of the attainment plans in the region. As such, emissions below the ICAPCD regional mass daily emissions thresholds presented would not conflict with or obstruct implementation of the applicable air quality plans. The following analysis is broken out by a discussion of potential impacts during construction of the project followed by a discussion of potential impacts during operation of the project.

Construction

Two basic sources of short-term emissions will be generated during construction of the proposed S-Line upgrades: operation of the construction vehicles (i.e., cranes, dump trucks, boom lifts) and the creation of fugitive dust during demolition, grading, and construction activities associated with the installation of new transmission line and poles. Activities such as line pole erecting operations, worker vehicle traffic (including on paved and unpaved roadways), and wind blowing over exposed soils would generate exhaust emissions and fugitive particulate matter emissions that affect local air quality at various times during project construction. The impact would be variable depending on the weather, soil conditions, the amount of activity taking place, and the nature of dust control efforts. The dry climate of the area during the summer months creates a high potential for dust generation. Project construction activities would be subject to ICAPCD Regulation VIII, which requires taking reasonable precautions to prevent the emissions of fugitive dust as previously described.

Predicted emissions generated during project construction were calculated using the CARB-approved CalEEMod computer program, which is designed to model emissions for land use development projects, based on typical construction requirements. See Appendix B of this Initial Study for more information regarding the construction assumptions, including construction equipment and duration, used in this analysis. Predicted maximum daily emissions associated with project construction are summarized in Table 1. As shown in Table 1, emissions of PM_{10} would exceed the ICAPCD significance threshold on the peak day(s) of construction. Exceedance of ICAPCD's significance threshold is considered a significant air quality impact.

A predominate source of PM_{10} emissions is workers commuting to the project site on unpaved roads. Commute vehicles traveling over the exposed soils of unpaved roads generates substantial amounts of fugitive PM_{10} emissions. The majority of roadways leading to the project site are paved; however, there are unpaved roadway options that could be potentially used by commuting workers. Therefore, Mitigation Measure AQ-1 is required in order to reduce PM_{10} emissions to levels below the ICAPCD threshold. Mitigation Measure AQ-1 would mandate the project contractor to restrict their workers to commuting only on paved roads during construction. As shown in Table 2, with implementation of Mitigation Measure AQ-1, emissions generated during project construction would not exceed the ICAPCD's thresholds of significance. Therefore, with implementation of Mitigation Measure AQ-1, this impact would be reduced to a less than significant level.

Table 1. Unmitigated Project Construction-Related Emissions

Construction Year	Pollutants (pounds per day)					
	ROG	NOx	CO	SO_2	PM_{10}	$PM_{2.5}$
2021	6.47	39.63	199.14	0.40	152.73	16.45
2022	6.25	36.23	198.25	0.40	152.65	16.38
ICAPCD Significance Threshold	75	100	550	N/A	150	N/A
Exceed ICAPCD Threshold?	**No**	**No**	**No**	**No**	**Yes**	**No**

Source: Appendix B of this Initial Study

Table 2. Mitigated Project Construction-Related Emissions

Construction Year	Pollutants (pounds per day)					
	ROG	NOx	CO	SO_2	PM_{10}	$PM_{2.5}$
2021	6.47	39.63	199.14	0.40	140.56	15.15
2022	6.25	36.23	198.25	0.40	140.49	15.07
ICAPCD Significance Threshold	75	100	550	N/A	150	N/A
Exceed ICAPCD Threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Source: Appendix B of this Initial Study

Operation

The proposed S-Line upgrades would not include the provision of new permanent stationary or mobile sources of criteria air pollutant emissions, and therefore, by its very nature, would not generate quantifiable criteria emissions from project operations. In addition, once the proposed project is operational, there would be no increase in automobile trips to the area. While it is anticipated that the proposed project would require intermittent maintenance, maintenance would be minimal requiring a negligible amount of traffic trips on an annual basis. Further, the S-Line would tie into solar energy facilities, thus contributing to the reduction of fossil fuel reliance by transmitting clean renewable energy to the local population and improving the air quality that would otherwise contain higher levels of criteria air pollutants from fossil fuel-sourced energy. This is considered a less than significant impact.

Conclusion

As described above, conformance with the AQMP for development projects is determined by demonstrating compliance with local land use plans and/or population projections and comparing assumed emissions in the AQMP to proposed emissions. Because the proposed project complies with local land use plans and population projections and would not exceed ICAPCD's thresholds during construction (with implementation of Mitigation Measure AQ-1) and operations, the proposed project would not conflict with or obstruct implementation of the applicable air quality plan. This is considered a less than significant impact.

Mitigation Measure:

AQ-1: In order to reduce the generation of PM_{10} emissions resulting from worker commutes during construction, a list of commute route options involving routes with 100 percent paved roadway facilities shall be prepared in pamphlet form by the project applicant, to the satisfaction of the Imperial County Planning and Development Services Department. Copies

of the paved commute route options pamphlet shall be distributed to every project worker and each pamphlet shall clearly state that commuting on unpaved roads is prohibited.

b) **Less than Significant with Mitigation Incorporated.** By its very nature, air pollution is largely a cumulative impact. No single project is sufficient in size, by itself, to result in nonattainment of ambient air quality standards. Instead, a project's individual emissions contribute to existing cumulatively significant adverse air quality impacts. If a project's individual emissions exceed its identified significance thresholds, the project would be cumulatively considerable. Projects that do not exceed significance thresholds would not be considered cumulative considerable.

The ICAPCD's application of thresholds of significance for criteria air pollutants is relevant to the determination of whether a project's individual emissions would have a cumulatively significant impact on air quality. As discussed above in Response III. a), with implementation of Mitigation Measure AQ-1, emissions generated during project construction would not exceed the ICAPCD's thresholds of significance (Table 2). Furthermore, the S-Line upgrades would not include the provision of new permanent stationary or mobile sources of criteria air pollutant emissions, and therefore, by its very nature, would not generate quantifiable criteria emissions from project operations. Therefore, the project's potential to result in a cumulatively considerable net increase of any criteria pollutant is considered less than significant.

c) **Less than Significant with Mitigation Incorporated.** The nearest sensitive receptors to the S-Line upgrades alignment are a scattering of single-family residences located along the proposed transmission line route fronting W. Wixom Road, W. Ross Road, Drew Road, W. Kramar Road, and W. Hackelman Road in unincorporated County lands. The closest residences are located 50 feet from the proposed new transmission line route on W. Hackelman Road. Additionally, there are single-family residential neighborhoods in the City of Imperial located approximately 148 feet north of the transmission corridor.

The following analysis is broken out by a discussion of potential impacts during construction of the S-Line upgrades followed by a discussion of potential impacts during operation.

Construction

Construction-related activities would result in temporary, short-term project-generated emissions of diesel particulate matter (DPM), ROG, NOx, CO, and PM_{10} from the exhaust of off-road, heavy-duty diesel equipment during project construction (e.g., grading, pole erecting, stringing of new transmission line); and other miscellaneous activities. The portion of the Salton Sea Air Basin which encompasses the project area is designated as a nonattainment area for federal O_3, $PM_{2.5}$, and PM_{10} standards and is also a nonattainment area for the state standards for O_3 and PM_{10}. Thus, existing O_3, $PM_{2.5}$, and PM_{10} levels in the Salton Sea Air Basin are at unhealthy levels during certain periods. However, as shown in Table 2, the S-Line upgrades would not exceed the ICAPCD significance thresholds for construction emissions with implementation of Mitigation Measure AQ-1. Project construction would not result in a potentially significant contribution to regional concentrations of nonattainment pollutants and would not result in a significant contribution to the adverse health impacts associated with those pollutants, provided mitigation is implemented. Therefore, with implementation of Mitigation Measure AQ-1, this impact would be reduced to a less than significant level.

Operation

Operation would not result in the development of any substantial sources of air toxics. There would be no stationary sources associated with operations; nor would the project attract additional mobile sources that spend long periods queuing and idling at the site. Onsite project emissions would not result in significant concentrations of pollutants at nearby sensitive receptors as the predominant operational emissions associated with the S-Line upgrades would be imperceivable due to very infrequent and negligible maintenance visits. Therefore, the S-Line upgrades would not be a substantial source of toxic air contaminants. The S-Line upgrades will not result in a high carcinogenic or non-carcinogenic risk during operation. This is considered a less than significant impact.

d) **No Impact**. During construction, the S-Line upgrades presents the potential for generation of objectionable odors in the form of diesel exhaust in the immediate vicinity of the site. However, these emissions are short-term in nature and will rapidly dissipate and be diluted by the atmosphere downwind of the emission sources. Additionally, odors would be localized and generally confined to the project area. Therefore, odors generated during construction would not adversely affect a substantial number of people to odor emissions.

Land uses commonly considered to be potential sources of odorous emissions include wastewater treatment plants, sanitary landfills, food processing facilities, chemical manufacturing plants, rendering plants, paint/coating operations, and concentrated agricultural feeding operations and dairies. The construction and operation of a transmission line is not an odor producer and the project site is not located near an odor producer.

IV. Biological Resources

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☒	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☒	☐	☐
c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☒	☐	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of wildlife nursery sites?	☐	☐	☒	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☒	☐
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☒	☐	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional biological resources impacts would occur and the conclusions and mitigation measures (Mitigation Measures BIO-1 through BIO-11) identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades. The following information is summarized from the *Biological Technical Report for the VEGA IID S-Line Upgrades Project* and the *Aquatic Resources Delineation for the VEGA IID S-Line Upgrades Project* prepared by ECORP Consulting, Inc. dated February 2021. These reports are provided as Appendix C and D of this Initial Study, respectively.

a) **Less than Significant with Mitigation Incorporated.**

Special-Status Plants

A literature review was performed using the California Department of Fish and Wildlife's (CDFW) California Natural Diversity Data Base and the California Native Plant Society's (CNPS) Electronic Inventory to determine the special-status plant and wildlife species that have been documented in the vicinity of the S-Line upgrades project area. The literature review identified 22 special-status plant species that have the potential to occur within the S-Line upgrades project area. Of 22 original records, one plant species is presumed absent due to the lack of suitable habitat within the project area and 14 plant species have a low potential to occur due to the limited suitable habitat within the S-Line upgrades project area. Please refer to the *Biological Technical Report for the VEGA IID S-Line Upgrades Project* for a complete list and description of special-status plant species that have the potential to occur within the S-Line upgrades project area.

There is moderate or high potential for seven rare plant species to occur due to the presence of suitable habitat within the S-Line upgrades project area. These species are brown turbans (*Malperia tenuis*), gravel milk-vetch (*Astragalus sabulonum*), California satintail (*Imperata brevifolia*), Baja California ipomopsis (*Ipomopsis effusa*), Parish's desert thorn (*Lycium parishii*), hairy stickleaf (*Mentzelia hirsutissima*), and sand food (*Pholisma sonorae*). Table 3 provides details on the special-status plant species that have a moderate to high potential to occur within the S-Line upgrades project area. Suitable habitat for these special-status plant species is present within the creosote bush scrub and freshwater wetland habitats within the S-Line upgrades project area. Impacts that may occur to these species include loss of individuals, habitat, and seedbank. These impacts are considered potentially significant and would require mitigation. Implementation of Mitigation Measures BIO-1 and BIO-2 would reduce impacts on special-status plant species to less than significant levels.

Special-Status Wildlife

The literature review identified 27 special-status wildlife species that have the potential to occur within the S-Line upgrades "Biological Resources Study Area" (S-Line upgrades project area plus 500-foot buffer of the S-Line upgrades project area). Of the 27 species, 9 of these species have a low or no potential to occur due to the lack of suitable and/or limited habitat within the Biological Resources Study Area. Please refer to the *Biological Technical Report for the VEGA IID S-Line Upgrades Project* for a complete list and description of special-status wildlife species that have the potential to occur within the Biological Resources Study Area.

Fourteen species have a moderate or high potential to occur on the S-Line upgrades project area. These species are flat-tailed horned lizard (*Phrynosoma mcallii*), ferruginous hawk (*Buteo regalis*), Yuma Ridgway's rail (*Rallus obsoletus yumanensis*), Yuma hispid cotton rat (*Sigmodon hispidus eremicus*), Colorado Desert fringe-toed lizard (*Uma notata*), California horned lark (*Eremophila alpestris* ssp. *actia*), mountain plover (*Charadrius montanus*), Crissal thrasher (*Toxostoma crissale*), LeConte's thrasher (*Toxostoma lecontei*), yellow-breasted chat (*Icteria virens*), California black rail (*Laterallus jamaicensis* ssp. *coturniculus*), vermilion flycatcher (*Pyrocephalus rubinus*), western yellow bat (*Lasiurus xanthinus*), and American badger (*Taxidea taxus*). Table 4 provides details on the special-status wildlife species that were observed and have a moderate to high potential to occur within the S-Line upgrades project area.

The following four special-status wildlife species were observed within the S-Line upgrades project area during the habitat assessment:

- **Burrowing owl (*Athene cunicularia*):** Burrowing owl is a U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern (BCC), a California Department of Fish and Wildlife (CDFW) Species of Special Concern (SSC), a BLM sensitive species, and Imperial County Species of Conservation Focus. It is typically found in dry open areas with few trees and short grasses; it is also found in

vacant lots near human habitation. It uses uninhabited mammal burrows for roosts and nests, often in close proximity to California ground squirrel (*Otospermophilus beecheyi*) colonies. Three burrowing owls were observed on the S-Line upgrades alignment. One was observed near a burrow at the top of the bank of a dirt irrigation canal adjacent to disturbed habitat, and another pair was observed in a burrow at the top of the bank of a dirt irrigation canal adjacent to agricultural lands. Both burrows are within the S-Line upgrades project area.

- **Northern harrier (*Circus hudsonius*):** Northern harrier is a CDFW SSC. This species is typically found in open habitats with dense ground cover including grasslands, agricultural fields, and marshes. Northern harriers nest on the ground, preferring wetland habitat for cover. A pair was observed during the habitat assessment near the proposed Campo Verde substation within the project area.
- **Loggerhead shrike (*Lanius ludovicianus*):** Loggerhead shrike is a USFWS BCC and CDFW SSC. This species prefers open country with scattered shrubs and trees. They frequent agricultural fields, abandoned orchards, desert scrublands, and riparian areas. One individual was observed perching on tamarisk alongside a dirt irrigation canal adjacent to agricultural fields in the Biological Resources Survey Area.
- ***Black-tailed gnatcatcher (Polioptila melanura):*** Black-tailed gnatcatcher is a CDFW Watch List species. This species remains in pairs all year, defending permanent territories. Black-tailed gnatcatchers prefer dry washes or desert brush with varied growth of mesquite, acacias, and paloverdes, but are also known to inhabit tamarisk scrub. Several black-tailed gnatcatchers were observed foraging and calling within the creosote bush scrub, arrow weed thickets, tamarisk thickets, and quailbush scrub habitats of the Biological Resources Survey Area.

Direct impacts to these species that could occur include injury, mortality, nest failures, and loss of young. Indirect impacts include loss of nesting and foraging habitat, increase in anthropogenic effects (i.e., noise levels, introduction of invasive and nonnative species, increase in human activity, increase in dust). These potential impacts are considered significant and would require mitigation. Implementation of Mitigation Measures BIO-2 through BIO-6 would reduce impacts on special-status wildlife species to less than significant levels.

Foraging habitat for a number of raptor species and breeding habitat for numerous passerine species that are protected by the Migratory Bird Treaty Act occurs throughout the S-Line upgrades alignment. The project area provides nesting habitat for ground-nesting species as well as species that nest in riparian scrub habitat. The presence of large gum trees within the Biological Resources Study Area is suitable nesting habitat for raptor species. Additionally, northern harriers are ground nesters, for which the tamarisk thickets and other dense habitats provide potential nesting habitat. Direct impacts to nesting avian species include injury, mortality, loss of young, and nest failure. Indirect impacts include loss of foraging and nesting habitat for passerine and raptors species, increase in noise and human activities, and potential introduction of invasive or nonnative species. These potential impacts are considered significant and would require mitigation. Implementation of Mitigation Measures BIO-4 through BIO-5 would reduce impacts on nesting birds to less than significant levels.

Table 3. Special-Status Plant Species with Moderate to High Potential to Occur within the S-Line Upgrades Project Area

Scientific Name Common Name	Status	Blooming Period/Elevation Range (meters)	Habitat	Potential to Occur in the S-Line Upgrades Project Area
Malperia tenuis brown turbans	**USFWS:** None **CDFW:** None **CRPR:** 2B.3 **BLM:** None	Mar-Apr (15 - 335)	Sonoran desert scrub	**High:** Habitat for this species occurs within the project area. One recent CNDDB record (2010) approximately 3.47 miles northwest of site. One historic record (1992) under a mile from the site. Known occurrence within CNPS quadrat database.
Astragalus sabulonum gravel milk-vetch	**USFWS**: None **CDFW**: None **CRPR**: 2B.2 **BLM**: None	Feb-Jun (-60 - 930)	Desert dunes Mojavean desert scrub Sonoran desert scrub	**Moderate:** Habitat for this species occurs within the project area. Historic CNDDB record (1961) approximately 1.31 miles southwest of site. Known occurrence within CNPS quadrat database.
Imperata brevifolia California satintail	**USFWS**: None **CDFW**: None **CRPR**: 2B.1 **BLM**: None	Sep-May (0 - 1215)	Chaparral Coastal scrub Mojavean desert scrub Meadows and seeps Riparian scrub	**Moderate:** Habitat for this species occurs within the project area. Historic CNDDB record (1963) approximately 4.89 miles southeast of site. Known occurrence within CNPS quadrat database.
Ipomopsis effusa Baja California ipomopsis	**USFWS**: None **CDFW**: None **CRPR**: 2B.1 **BLM**: None	Apr-Jun (0 – 100)	Chaparral Sonoran desert scrub	**Moderate:** Habitat for this species occurs within the project area. Historic CNDDB record (1987) approximately 3.92 miles southwest of site. Known occurrence within CNPS quadrat database.
Lycium parishii Parish's desert thorn	**USFWS**: None **CDFW**: None **CRPR**: 2B.3 **BLM**: None	Mar-Apr (135 – 1000)	Coastal scrub Sonoran desert scrub	**Moderate:** Habitat for this species occurs within the project area. Eight recent CNDDB records (2010) within 5 miles with the closest occurring approximately 1.8 miles southeast of the site. Known occurrence within CNPS quadrat database.
Mentzelia hirsutissima hairy stickleaf	**USFWS**: None **CDFW**: None **CRPR**: 4.3 **BLM**: None	Mar-May (0 – 700)	Sonoran desert scrub	**Moderate:** Habitat for this species occurs within the project area. Historic CNDDB record (1961) approximately 3.5 miles southeast of site. Known occurrence within CNPS quadrat database.

Pholisma sonorae sand food	**USFWS**: None **CDFW**: None **CRPR**: 1B.2 **BLM**: Sensitive	Apr-Jun (0 - 200)	Desert dunes Sonoran desert scrub	**Moderate:** Habitat for this species occurs within the project area. Historic (1915) CNDDB record approximately 4.25 miles east of site. Known occurrence within CNPS quadrat database.

Source: Appendix C of this Initial Study

Notes:

BLM = Bureau of Land Management; CDFW = California Department of Fish and Wildlife; CRPR: California Rare Plant Rankings; USFWS = U.S. Fish and Wildlife Service

California Native Plant Society (CNPS) Rare Plant Ranks:
1B: Plants rare, threatened, and endangered in California and elsewhere.
2B: Plants rare, threatened, or endangered in California, but more common elsewhere.
4: Plants of limited distribution; a watch list.
CNPS Threat Ranks:
0.1: Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
0.2: Fairly threatened in California (20-80% of occurrences threatened / moderate degree and immediacy of threat)
0.3-Not very threatened in California (less than 20% of occurrences threatened / low degree and immediacy of threat or no current threats known)

Table 4. Special-Status Wildlife Species with Moderate to High Potential to Occur within the S-Line Upgrades Project Area

Scientific Name Common Name	Status	Habitat Requirements	Potential to Occur in the S-Line Upgrades Project Area
Athene cunicularia Burrowing owl	USFWS: BCC CDFW: SSC BLM: S	Open grasslands including prairies, plains, and savannah, or vacant lots and airports. Nests in abandoned dirt burrows.	**Present.** There were two sightings of burrowing owl on the S-Line. One was at the top of the bank of a dirt irrigation canal adjacent to disturbed habitat and another pair was observed in a burrow at the top of the bank of a dirt irrigation canal adjacent to agricultural lands. Both burrows were within the Project Area. Twenty-eight recent CNDDB records of 34 total within 5 miles of the site; the closest record intersects the Project Area.
Circus hudsonius Northern harrier	CDFW: SSC	Undisturbed tracts of grasslands and wetlands with low, thick vegetation. Prefers to breed in dry upland habitats, old fields, grazed meadows, drained marshlands, and high-desert shrub steppe. Also found in pasturelands, croplands, and open floodplains.	**Present.** There was one sighting of northern harrier along the S-Line. No CNDDB records occur within 5 miles of the sites.
Lanius ludovicianus Loggerhead shrike	USFWS: BCC CDFW: SSC	Open country, with scattered shrubs and trees or other perches for hunting; includes agricultural fields, deserts, grasslands, savanna, and chaparral. Nests 2.5 to 4 feet off ground in thorny vegetation.	**Present.** There was one sighting of loggerhead shrike alongside a dirt lined irrigation canal adjacent to agricultural land in the eastern portion of the S-line. No CNDDB records within 5 miles of the site.
Polioptila melanura Black-tailed gnatcatcher	CDFW: WL	Semiarid and desert thorn scrub habitats. This species is well adapted to dry habitats and tend to be most common in areas with less than 8 inches of annual rainfall. They often live far from streams and other bodies of water.	**Present.** There were six sightings of blacktailed gnatcatcher along the S-Line. They were observed foraging in the creosote bush scrub, tamarisk thickets, and big saltbush scrub of the S-Line. No CNDDB records within 5 miles of the site.

Phrynosoma mcallii Flat-tailed horned lizard	CDFW: SSC	Desert scrub on sandy flats and valleys with little or no windblown sand, salt flats, and areas with gravelly soils.	**High.** Suitable habitat in the creosote bush scrub habitat of the gen-tie line. 19 recent CNDDB records of 30 total within 5 miles of the site with the closest overlapping the gen-tie line from 2018. Record mentions the area being a release site for this species relocated from a solar development in 2015.
Buteo regalis Ferruginous hawk	USFWS: BCC CDFW: WL	Open spaces in grasslands, prairie, plains, sagebrush steppe, scrubland, agricultural fields, and pinyon-juniper woodland edges.	**High.** Suitable habitat present. One recent CNDDB record (2003) occurs approximately 3.5 miles from the S-Line.
Rallus obsoletus ssp. *yumanensis* Yuma Ridgway's rail	USFWS: END CDFW: THR, FP	Consistently found in freshwater marshes that are composed of cattail and bulrush. This emergent vegetation averages greater than 6 feet tall. Water depth tends to be around 3.5 inches deep. Range extends from Nevada, California, and Arizona to Baja California and Sonora Mexico.	**High.** Suitable nesting and foraging habitat for this species is present near the New River and adjacent wetland. Two recent CNDDB records within 5 miles of the site with the closest being approximately one mile away in 2007 when two pairs were seen in marsh habitat adjacent to New River.
Sigmodon hispidus ssp. *eremicus* Yuma hispid cotton rat	CDFW: SSC	Inhabits a variety of habitats, but generally associated with drainage ditches, canals, and seeps vegetated with plants such as arrow weed, saltgrass, common reed, cattails, sedges, tamarisk, heliotrope, and annual grasses. They utilize runways through dense herbaceous growth and nests are built of woven grass. Noted presence in moist agricultural fields.	**High.** There is suitable habitat alongside the canals and New River. Four recent CNDDB record occurs within 5 miles of the site. Species was found in habitat that consisted of moist soils, typha, scirpus, bermuda grass and spangle grass in an agricultural drainage canal most recently as 2009 and the closest occurrence was within 1.5 miles of the project area.
Uma notata Colorado Desert fringe-toed lizard	CDFW: SSC	Dunes, washes, banks of rivers, and flats with sandy hammocks formed at the base of vegetation. Prefers arid areas, sparsely vegetated with fine windblown sand. Requires fine, loose sand for burrowing.	**Moderate.** Suitable habitat on the site and buffer in the loose sandy areas of creosote bush scrub. There is one recent CNDDB record that occurs within 2.5 miles of the site from 2004. Species was found in Pinto wash, southwest of the Imperial Valley substation.

Eremophila alpestris ssp. *actia* California horned lark	CDFW: WL	Bare open areas dominated by low vegetation or widely scattered shrubs, includes prairies, deserts, and plowed fields. Nests in a hollow on the ground.	**Moderate.** The open areas on the site and in buffer provide suitable habitat. No CNDDB records within 5 miles of the site.
Charadrius montanus Mountain plover	USFWS: BCC CDFW: SSC BLM: S	Shortgrass prairie, especially where blue grama, buffalo grass, and western wheat grass are dominant; and in grassy semidesert with scattered saltbush, sage, prickly pear, and yucca, at elevations ranging from 2,100 to 10,663 feet. Also found in fallow or recently plowed agricultural fields and in overgrazed landscapes that mimic their natural shortgrass habitat.	**Moderate**. Marginally suitable habitat within the site and buffer. Two recent CNDDB records (2008 & 2010) occur within 5 miles of the site near Fig Lagoon.
Toxostoma crissale Crissal thrasher	CDFW: SSC BLM: S	Desert and foothill scrub, and riparian brush.	**Moderate.** Suitable habitat on the site and in buffer. No CNDDB records within 5 miles of the site.
Toxostoma lecontei LeConte's thrasher	CDFW: SSC BLM: S	Small arroyos, open flats, or dunes of low, sandy, open deserts.	**Moderate.** Suitable habitat on site and in buffer in the creosote bush habitat. No CNDDB records within 5 miles of the site.
Icteria virens Yellow-breasted chat	CDFW: SSC	Riparian and upland thickets, and dry overgrown pastures. Prefers to nest in dense scrub along streams or at the edges of ponds or swamps.	**Moderate.** Suitable nesting and foraging habitat for this species is present near the New River. No CNDDB records within 5 miles of the site.
Laterallus jamaicensis ssp. *coturniculus* California black rail	USFWS: BCC CDFW: THR, FP BLM: S	Riparian marshes, coastal prairies, saltmarshes, and impounded wetlands. All of its habitats have stable shallow water, usually just 1.2 inches deep at most.	**Moderate.** Moderately suitable nesting and foraging habitat for this species is present near the New River and adjacent wetland. One recent CNDDB record occurs within 5 miles of the site where 6 individuals were observed within emergent wetland vegetation in 2001.
Pyrocephalus rubinus Vermillion flycatcher	CDFW: SSC	Arid scrublands, farmlands, deserts, parks, golf courses, and canyon mouths. They are especially reliant on stream corridors with presence of willow, cottonwood, sycamore, mesquite, and other trees.	**Moderate.** Suitable habitat present for this species. One historic record (1909) within 5 miles of the site.

Lasiurus xanthinus Western yellow bat	CDFW: SSC	Roosts in trees, particularly palms, in desert wash, desert riparian, valley foothill riparian, and palm oasis habitats.	**Moderate.** There is marginally suitable roosting habitat within the site and buffer in the palm trees. This species has a strong association with roosting under dead palm frond skirts. Four historic CNDDB records with the most recent being 1999 within 5 miles of the site.
Taxidea taxus American badger	CDFW: SSC BLM: S	Open habitats with friable soil such as grasslands, brushlands with sparse ground cover, open chaparral, and sometimes riparian zones.	**Moderate.** There is suitable habitat present for this species in the creosote bush scrub habitat of the site and buffer. One historic record (1911) within 5 miles of the site.

Source: Appendix C of this Initial Study
Notes:
BLM = Bureau of Land Management; CDFW = California Department of Fish and Wildlife; CRPR: California Rare Plant Rankings; USFWS = U.S. Fish and Wildlife Service

Federal Designations
END: Federally-listed, Endangered
THR: Federally-listed, Threatened
CAN: Federal Candidate Species
FSC: Federal Species of Concern
FPD: Federal Proposed for Delisting
BCC: Bird of Conservation Concern

State Designations
END: State-listed, Endangered
THR: State-listed, Threatened
CAN: State Candidate Species
SSC: California Species of Special Concern
FP: Fully Protected Species
WL: Watch List

Bureau of Land Management
S= Sensitive

Mitigation Measures:

BIO-1: Rare plant surveys shall be conducted within suitable habitat in the project area during the appropriate blooming period for brown turbans, gravel milk-vetch, California satintail, Baja California ipomopsis, Parish's desert thorn, hairy stickleaf, and sand food. The surveys shall be conducted by a botanist or qualified biologist in accordance with the USFWS Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed, and Candidate Plants (USFWS 1996); the CDFW Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities (CDFW 2018); and the CNPS Botanical Survey Guidelines (CNPS 2001). If any special-status species are observed during the rare plant surveys, the location of the individual plant or population will be recorded with a submeter GPS device for mapping purposes. If project-related impacts to rare plants on the project area are unavoidable, then consultation with CDFW may be required to develop a mitigation plan or additional avoidance and minimization measures. Measures that may be implemented if the species is observed include establishing a no-disturbance buffer around locations of individuals or a population, salvage or seed collection, and additional monitoring requirements.

BIO-2: A qualified biologist shall be present to monitor all ground-disturbing in vegetated areas and vegetation-clearing activities conducted for the project. During each monitoring day, the biological monitor shall perform clearance survey "sweeps" at the start of each work day that vegetation clearing takes place to minimize impacts on special-status species with potential to occur (including, but not limited to, special-status and/or nesting bird species, flat-tailed horned lizard, Yuma hispid cotton rat, Colorado Desert fringe-toed lizard, western yellow bat, American badger, Sonoran Desert toad, big free-tailed bat, pallid bat, and Townsend's big-eared bat). The monitor will be responsible for ensuring that impacts to special-status species, nesting birds, and active nests will be avoided to the greatest extent possible. Biological monitoring shall take place until the project area has been completely cleared of any vegetation. If an active nest is identified, the biological monitor shall establish an appropriate disturbance limit buffer around the nest using flagging or staking. Construction activities shall not occur within any disturbance limit buffer zones until the nest is deemed no longer active by the biologist. If special-status wildlife species are detected during biological monitoring activities, then consultation with the USFWS and/or CDFW shall be conducted and a mitigation plan shall be developed to avoid and offset impacts to these species. Measures may consist of work restrictions or additional biological monitoring activities after ground-disturbing activities are complete.

BIO-3: Pre-construction surveys for burrowing owl shall be conducted within the project area and adjacent areas prior to the start of ground-disturbing activities. The surveys shall follow the methods described in the CDFW's Staff Report on Burrowing Owl Mitigation (CDFG 2012). Two surveys shall be conducted, with the first survey being conducted between 30 and 14 days before initial ground disturbance (grading, grubbing, and construction), and the second survey being conducted no more than 24 hours prior to initial ground disturbance. If burrowing owls and/or suitable burrowing owl burrows with sign (e.g., whitewash, pellets, feathers, prey remains) are identified on the project area during the survey and impacts to those features are unavoidable, consultation with the CDFW shall be conducted and the methods described in the CDFW's Staff Report on Burrowing Owl Mitigation (CDFG 2012) for avoidance and/or passive relocation shall be followed.

BIO-4: If construction or other project activities are scheduled to occur during the bird breeding season (typically February 1 through August 31 for raptors and March 15 through August 31 for the majority of migratory bird species), a pre-construction nesting-bird survey shall be conducted by a qualified avian biologist to ensure that active bird nests, including those for the northern harrier, loggerhead shrike, black-tailed gnatcatcher, and burrowing owl, will not be disturbed or destroyed. The survey shall be completed no more than three days prior to initial ground disturbance. The nesting-bird survey shall include the project area and adjacent areas where project activities have the potential to affect active nests, either directly or indirectly, due to construction activity or noise. If an active nest is identified, the

biologist shall establish an appropriately sized disturbance limit buffer around the nest using flagging or staking. Construction activities shall not occur within any disturbance limit buffer zones until the nest is deemed inactive by the qualified biologist.

BIO-5: To the greatest extent possible, plans shall avoid impacts to common reed marsh, arrow weed thicket, and tamarisk thicket habitats to minimize potential impacts to special-status species.

BIO-6: All vehicles shall stay on designated roads within BLM land to minimize impacts to habitat. Coordination with a qualified biologist shall occur prior to the staging of equipment and placement of temporary or permanent structures within BLM land. Additionally, a biologist shall demarcate temporary and permanent work spaces in the field prior to the commencement of construction-related activities. Construction plans shall incorporate measures to minimize and avoid impacts to habitats within this area. To control for introduction of invasive plant species, tires shall be cleaned prior to entering BLM lands.

b) **Less than Significant with Mitigation Incorporated.** The S-Line upgrades project area is comprised of agriculture, arrow weed thickets, disturbed arrow weed thickets, common reed marsh, creosote bush scrub, fallow agricultural land, quailbush scrub, tamarisk thickets, and urban/developed land, which would be directly impacted by the S-Line upgrades. Disturbed quailbush scrub, mesquite thickets, and eucalyptus grove occur within the project buffer, but not within the S-Line upgrades project area.

The proposed S-Line upgrades has the potential to impact arrow weed thickets, which is considered a sensitive natural community by CDFW. In-kind mitigation, up to 3:1 ratio, may be required by CDFW to offset impacts to sensitive natural communities, which would include arrow weed thickets, in order to reduce impacts to less than significant. In-kind mitigation, up to 3:1 ratio, may also be required by CDFW to offset potential impacts to riparian habitat and would include common reed marsh and tamarisk thickets. Implementation of Mitigation Measures BIO-7 and BIO-8 would reduce impacts on sensitive natural communities and riparian habitats to less than significant levels.

Mitigation Measures:

BIO-7: If project-related impacts will occur to areas under the jurisdiction of the USACE, CDFW, or RWQCB, a regulatory permit with those agencies is needed prior to the impact occurring. Permitting includes preparation and submittal of a Pre-Construction Notification under Section 404 of the federal CWA, an Application for Water Quality Certification under Section 401 of the federal CWA, and a Notification of Lake or Streambed Alteration under Section 1600 of the California Fish and Game Code. Other items such as finalized project plans, quantities of fill material, supporting technical studies, etc., are also submitted along with the applications. As a part of this process, the project must also identify and approve mitigation through the respective agencies. Mitigation can include onsite or offsite options or could include payment of an in-lieu fee to a conservation organization. Types of mitigation can include restoration, creation, rehabilitation, enhancement, or other types of habitat improvement. Typically, the type of mitigation and acreage of mitigation is negotiated with the regulatory agencies during the permitting process.

BIO-8: New structures shall not be placed within 50 feet of wetland and/or riparian habitat boundaries. A construction buffer of 300 feet shall be established around the wetlands and riparian habitats during bird breeding season (February 1 to August 31). Prior to construction, fencing shall be installed approximately 10 feet from the wetland and riparian habitat boundaries within 50 feet of the project. Fencing shall be easily visible to construction personnel.

c) **Less than Significant with Mitigation Incorporated.** Jurisdictional areas within the S-Line upgrades alignment are associated with the New River, specifically Freshwater Forested/Shrub Wetland habitats are found immediately adjacent to the S-Line upgrades alignment (Appendix D of this Initial Study). Project construction would be confined to IID's existing transmission corridor, specifically the immediate surrounding of each transmission line pole. Construction activities could involve excavation or discharge of fill to the adjacent wetland habitats that could result in a significant impact. Mitigation BIO-7 would require coordination with USACE, CDFW, or RWQCB agencies while Mitigation BIO-8 would minimize impacts to wetlands through the use of a buffer. Adherence to Mitigation Measures BIO-7 and BIO-8 would minimize impacts to wetlands to less than significant levels.

d) **Less than Significant with Mitigation Incorporated.** The S-Line upgrades alignment is located adjacent to areas containing existing disturbances (i.e., private residences, commercial development, active agriculture, irrigation canals, and solar fields). A majority of this area does not contain suitable vegetation

and/or cover to support wildlife movement. The most biologically important area is the wetland surrounding New River. This would be considered a wildlife corridor. The riparian habitats of this area, in particular, do act as a potential corridor and nursery site for migrating wildlife species. Therefore, if the riparian vegetation associated with New River is impacted, this would be considered a significant impact. Implementation of Mitigation Measures BIO-2, BIO-4, BIO-5, and BIO-7 would reduce impacts to less than significant levels.

e) Less than **Significant Impact.** The S-Line upgrades are not located within any area where local policies or ordinances protect biological resources. Where impacts to biological resources have been identified, mitigation measures are proposed to reduce impacts to less than significant with mitigation incorporated.

f) **Less than Significant with Mitigation Incorporated.** The southwestern area of the S-Line upgrades project area is within the BLM Land Use Plan Amendment Conservation Designations of Areas of Critical Environmental Concern, California Desert National Conserved Lands, and covered under the Desert Renewable Energy Conservation Plan (DRECP) Land Use Plan Amendment. More specifically, the S-Line upgrades project area is within the Yuha Basin Areas of Critical Environmental Concern subregion of the Lake Cahuilla Ecoregion of the DRECP. Sensitive species of this subregion that have moderate to high potential to occur within the S-Line upgrades project area include: flat-tailed horned lizard, burrowing owl, American badger, and LeConte's thrasher. Management objectives for this area includes managing habitat for the flat-tailed horned lizard, rehabilitating and improving habitat quality for burrowing owl and American badger, and protecting and enhancing habitat for LeConte's thrasher. If habitat within the BLM area of the S-Line upgrades is impacted, the impact would be considered significant. Implementation of Mitigation Measure BIO-6 would reduce impacts to less than significant levels. The project will follow the guidelines in Imperial County's Conservation and Open Space Element and meet the requirements outlined in the plan. Consultation with BLM, County of Imperial Department of Planning and Development, USFWS, and CDFW will be required should listed plant and/or wildlife species be found to occur.

V. Cultural Resources

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource pursuant to §15064.5?	☐	☒	☐	☐
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☒	☐	☐
c) Disturb any human remains, including those interred outside of dedicated cemeteries?	☐	☒	☐	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional cultural resources impacts would occur and the conclusions and mitigation measures (Mitigation Measures CR-1 through CR-5) identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the proposed S-Line upgrades. The following information is summarized from the *Cultural Resources Inventory for the VEGA IID S-Line Upgrades Project* prepared by ECORP Consulting, Inc. dated February 2021. This report is provided as Appendix E of this Initial Study.

a) **Less than Significant Impact with Mitigation Incorporated.** The cultural resources inventory included a records search, literature review, and field survey.

Records Search

A records search of the California Historical Resources Information System at the South Coastal Information Center revealed that 68 cultural resources investigations were previously conducted in or within one mile of the S-Line upgrades project area. 55 of these prior investigations overlap portions of the current S-Line upgrades project area. 187 cultural resources were previously recorded in and within one mile of the S-Line upgrades project area as a result of prior investigations. Details of all 187 previously recorded resources are included in the *Cultural Resources Inventory for the VEGA IID S-Line Upgrades Project* (Appendix E of this Initial Study). Fifteen previously recorded resources, the Westside Main Canal, U.S. Highway 80, Niland-Calexico Railroad, Wormwood Canal, Villa Road, a transmission line, San Diego-Arizona Eastern Railroad, Fern Canal and Drain, Fig Canal, Diehl Drain, Fig Drain, Wixom Drain, Wixom Drain portion, El Centro Central Drain, and a bottle isolate are located within the S-Line upgrades project area.

The National Register Information System did not list any eligible or listed properties within the S-Line upgrades project area or one-mile vicinity. Additionally, no resources were identified as listed as California Historical Landmarks and by the OHP (Appendix E of this Initial Study).

Sacred Lands File Results

A search of the Sacred Lands File was completed by the California Native American Heritage Commission and resulted in a positive finding, indicating that Native American Sacred Lands have been recorded in the S-Line upgrades project area.

Field Survey Results

Fifteen previously recorded resources were relocated and updated as part of the cultural resources inventory. 23 newly identified cultural resources were documented as a result of the field survey: 18 sites and five isolates. Newly identified cultural resources consist of historic-period resources. Table 5 summarizes the updated and newly recorded resources within the S-Line upgrades project area.

Table 5. Updated and Newly Recorded Cultural Resources within the S-Line Upgrades Project Area

Temporary Number 2020-212-	Primary Number P-13-	Age/Period	Site/Isolate Description
--	8334	Historic	Westside Main Canal
--	8418	Historic	Evan Hewes Highway/Highway 80
--	8682	Historic	Niland-Calexico Railroad
--	8983	Historic	Wormwood Canal
--	9016	Historic	Transmission Towers
--	9302	Historic	San Diego & Arizona Eastern Railroad
--	12689	Historic	Fern Side Main and Fern Canal
--	12693	Historic	Fig Canal
--	13747	Historic	Diehl Drain
--	13748	Historic	Fig Drain
--	13755	Historic	Isolated Colorless Bottle
--	13761	Historic	Wixom Drain portion
--	14314	Historic	Villa Road
--	14315	Historic	Sol-22 (NW Portion of El Centro Central Drain)
--	14975	Historic	Wixom Drain
01	--	Historic	Eucalyptus Canal
02	--	Historic	Concrete-lined Canal
03	--	Historic	Rice Drain 3
04	--	Historic	Central Drain
05	--	Historic	Elder Six Drain
06	--	Historic	Date Canal
07	--	Historic	Elder Canal
08	--	Historic	Ebony Canal
09	--	Historic	Unnamed Irrigation Ditch for Elder Canal
10	--	Historic	Evergreen Lateral 3
11	--	Historic	Elder Lateral 7
12	--	Historic	Bridge 58C 0026
13	--	Historic	Unnamed Lined Irrigation Ditch

15-I	--	Historic	Shattered Amber Glass Bottle
16	--	Historic	Central Drain 10
18-I	--	Historic	Colorless Glass Bottle Base
19	--	Historic	Lotus Drain
20	--	Historic	Unnamed, Unlined Irrigation Ditch
21-I	--	Historic	Colorless Glass Bottle Base Fragment
22	--	Historic	Elder Lateral 8
24-I	--	Historic	Amber Glass Bottle Base Fragment
25	--	Historic	Date Lateral 5
26	--	Historic	Amber Glass Bottle Base

Source: Appendix E of this Initial Study

Historical Resources

Potential project construction impacts within or immediately adjacent to the existing transmission line corridor will include ground-disturbing activities associated with grading and installation of the transmission pole foundations. Subsurface or surface disturbance could result in the loss of integrity of cultural deposits, loss of information, and the alteration of a site's settings.

As described above, fifteen previously recorded resources were relocated and updated as part of the cultural resources inventory and 23 newly identified cultural resources were documented within the S-Line upgrades project area. None of these resources were formally evaluated for potential eligibility for listing in the California Register of Historical Resources (CRHR). The project applicant will avoid ground-disturbing activities within and in close proximity to these resources. However, if-ground disturbing activities must occur within and in close proximity to these resources, a significant impact would potentially occur. Mitigation Measure CUL-1 will involve conducting formal site evaluations to assess whether resources are potentially eligible for listing in the CRHR to minimize impacts to below a level of significance.

Mitigation Measure:

CUL-1: If subsurface deposits believed to be cultural or human in origin are discovered during construction, all work must halt within a 100-foot radius of the discovery. A qualified professional archaeologist, meeting the Secretary of the Interior's Professional Qualification Standards for prehistoric and historic archaeology, shall be retained to evaluate the significance of the find, and shall have the authority to modify the no work radius as appropriate, using professional judgment. The following notifications shall apply, depending on the nature of the find:

- If the professional archaeologist determines that the find does not represent a cultural resource, work may resume immediately, and no agency notifications are required.
- If the professional archaeologist determines that the find does represent a cultural resource from any time period or cultural affiliation, he or she shall immediately notify the County of Imperial. The agencies shall consult on a finding of eligibility and implement appropriate treatment measures if the find is determined to be a Historical Resource under CEQA, as defined in Section 15064.5(a) of the CEQA Guidelines, or a Historic Property, as defined in 36 CFR 60.4. Work may not resume within the no-work radius until the lead agencies, through consultation as appropriate, determine that the site either: 1) is not an Historical Resource under CEQA or an Historic Property under Section 106; or 2) that the treatment measures have been completed to their satisfaction.
- If the find includes human remains, or remains that are potentially human, he or she shall ensure reasonable protection measures are taken to protect the discovery from disturbance (AB 2641). The archaeologist shall notify the Imperial County Coroner (per § 7050.5 of the Health and Safety Code). The provisions of § 7050.5 of the California Health and Safety Code, § 5097.98 of the California PRC, and AB 2641 will be implemented. If the Coroner determines the remains are Native American and not the result of a crime scene, the Coroner will notify the NAHC, which then will designate a Native American Most Likely Descendant (MLD) for the project (§ 5097.98 of the PRC). The designated MLD will have 48 hours from the time access to the property is granted to make recommendations concerning treatment of the remains. If the landowner does not agree with the recommendations of the MLD, the NAHC may mediate (§ 5097.94 of the PRC). If no agreement is reached, the landowner must rebury the remains where they will not be further disturbed (§ 5097.98 of the PRC). This will also include either recording the site with the NAHC or the appropriate Information Center; using an open space or conservation zoning designation or easement; or recording a reinternment document with the county in which the property is located (AB 2641). Work may not resume within the no-work radius until the lead agencies, through consultation as appropriate, determine that the treatment measures have been completed to their satisfaction.

b) **Less than Significant Impact with Mitigation Incorporated.** Surface sediments in the S-Line upgrades project area consist of Holocene surficial sediments in which regional precontact archaeological deposits have been previously identified and documented, and upon which precontact resources were previously identified through previous studies within the current S-Line upgrades project area. The potential for subsurface cultural deposits still exists due to the presence of sediments contemporaneous with human occupation of the region, and the location of the S-Line upgrades project area within the dry lakebed of ancient Lake Cahuilla. The S-Line upgrades includes ground-disturbing activities that has the potential to disturb previously undocumented cultural resources that could qualify as a unique archaeological resource pursuant to CEQA. This potential impact is considered significant. Implementation of Mitigation Measure CUL-1 requires all work to stop within a 100-foot radius if potential subsurface archaeological deposits are discovered. It also requires a qualified professional archaeologist, meeting the Secretary of the Interior's Professional Qualification Standards for prehistoric and historic archaeology, to be retained to evaluate the significance of any potential find, and shall have the authority to modify the no work radius as appropriate. With implementation of Mitigation Measure CUL-1, impacts on archaeological resources would be reduced to a less than significant level.

c) **Less than Significant Impact with Mitigation Incorporated.** Potential project construction impacts within or immediately adjacent to the existing transmission line corridor will include ground-disturbing activities associated with grading and installation of the transmission pole foundations. Although the potential for encountering subsurface human remains within the S-Line upgrades project area is low, there remains a possibility that human remains are present beneath the ground surface, and that such remains could be exposed during project construction. Mitigation Measure CUL-1 would ensure that the potential impact on previously unknown human remains does not rise to the level of significance pursuant to CEQA. Implementation of Mitigation Measure CUL-1, which requires evaluation, protection, and appropriate disposition of human remains, would reduce this potential impact to a less than significant level.

VI. Energy

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☒	☐
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional energy impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **Less than Significant Impact.** The use of energy associated with the S-Line upgrades include both construction and operational activities. Construction activities consume energy through the use of heavy construction equipment and truck and worker traffic. The S-Line upgrades will use energy-conserving construction equipment, including standard mitigation measures for construction combustion equipment recommended in the ICAPCD CEQA Air Quality Handbook. The use of better engine technology, in conjunction with the ICAPCD's standard mitigation measures will reduce the amount of energy used for the S-Line upgrades.

Implementation and operation of the S-Line upgrades would promote the use of renewable energy and contribute incrementally to the reduction in demand for fossil fuel use for electricity-generating purposes and help California meet its RPS.

Based on these considerations, the S-Line upgrades would not result in potentially significant environmental impacts due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation. This is considered a less than significant impact.

b) **No Impact.** The S-Line upgrades component of the project would replace the existing transmission line wooden power poles with steel monopoles. The proposed upgrades would improve IID's ability to reliably supply renewable energy from IID's power supply mix to end-use customers. Implementation and operation of the proposed project would promote the use of renewable energy and contribute incrementally to the reduction in demand for fossil fuel use for electricity-generating purposes and help California meet its RPS. The S-Line upgrades would not conflict with or obstruct a state or local plan for renewable energy of energy efficiency. No Impact is identified for this issue area.

VII. Geology and Soils

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42?	☐	☐	☐	☒
ii. Strong seismic ground shaking?	☐	☒	☐	☐
iii. Seismic-related ground failure, including liquefaction?	☐	☒	☐	☐
iv. Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☒	☐	☐
d) Be located on expansive soil, as defined in Table 18-1B of the Uniform Building Code (1994), creating substantial direct or indirect risk to life or property?	☐	☒	☐	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☒	☐	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional geology and soils impacts would occur and the conclusions and mitigation measures (Mitigation Measure GEO-1) identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades. The following information is summarized from the *Geotechnical Report for the 230 kV "S" Transmission Line Upgrade* prepared by Landmark Consultants, Inc. dated September 2020. This report is provided as Appendix F of this Initial Study.

ai) **No Impact.** According to the *Geotechnical Report for the 230 kV "S" Transmission Line Upgrade* (Appendix F of this Initial Study), the S-Line upgrades project area is not located within an Alquist-Priolo Earthquake Fault Zone. The S-Line upgrades would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury or death involving rupture of a known earthquake fault. No impact is identified for this issue area.

aii) **Less than Significant Impact with Mitigation Incorporated.** The S-Line upgrades project area is located within a seismically-active zone in Southern California and considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. The S-Line upgrades project area could be affected by the occurrence of seismic activity to some degree but no more than the surrounding properties.

Although no known active faults pass through the S-Line upgrades project area, the S-Line upgrades is located within a seismically-active zone in Southern California. Nearby faults include the Imperial, Cerro Prieto, and Laguna Salada faults, with the closet known fault being the Superstition Hills fault located 0.5-mile northwest of the S-Line upgrades project area. Therefore, the S-Line's transmission route could be subject to strong ground motion during a seismic event, but the degree to which the project area could be affected by seismic activity would not be greater than the surrounding properties. The intensity and acceleration of ground motion during a seismic event are dependent on the magnitude of the earthquake, distance of the rupture zone, soil type, and direction of the ground motion. Therefore, the effect of ground motions may vary within the general area and the project area could experience some structural damage, thereby exposing employees to injury given the potentially hazardous nature of the project components (e.g., danger from electrocution). However, with implementation of Mitigation Measure GEO-1, impacts would be reduced to a less than significant level.

Mitigation Measure

GEO-1 Prior to approval of final engineering and grading plans for the project, the County shall verify that all recommendations contained in the Geotechnical Report for the 230 kV "S" Transmission Line Upgrade prepared by Landmark Consultants, Inc. (September 2020) have been incorporated into all final engineering and grading plans. The County's soil engineer and engineering geologist shall review grading plans prior to finalization to verify compliance with the recommendations of the report. All future grading and construction of the project site shall comply with the geotechnical recommendations contained in the geotechnical report.

aiii) **Less than Significant Impact with Mitigation Incorporated.** Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases, and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Four conditions are generally required for liquefaction to occur:
1) The soil must be saturated (relatively shallow groundwater).
2) The soil must be loosely packed (low to medium relative density).
3) The soil must be relatively cohesionless (not clayey).
4) Groundshaking of sufficient intensity must occur to function as a trigger mechanism.

The Imperial Valley has not been evaluated for seismic hazards by the California Geological Survey seismic hazard zonation program; however, liquefaction after a seismic event is well documented within Imperial Valley. As part of the geologic investigation, liquefaction analyses, in accordance with the National Center for Earthquake Engineering Research (NCEER) procedure, was performed for the S-Line upgrades project area. The soil encountered at the point of exploration included saturated silts and silty sands that could

liquefy during a Maximum Considered Earthquake. Liquefaction can occur within isolated silt and sand layers in depths between 7 to 50 feet. The triggering mechanism for liquefaction would be strong groundshaking associated with the rupture of the Superstition Hills fault or nearby faults. The potential for liquefaction is considered significant. Implementation of Mitigation Measure GEO-1 would reduce the potential liquefaction impact to a less than significant level.

aiv) **No Impact.** According to the *Geotechnical Report for the 230 kV "S" Transmission Line Upgrade* (Appendix F of this Initial Study), the hazard of landslides is unlikely due to the regional planar topography of the S-Line upgrades project area. No ancient landslides are shown on geologic maps, aerial photographs and topographic maps of the region, and no indications of landslides were observed during the geotechnical site investigation. The S-Line upgrades would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury or death involving landslides. No impact is identified for this issue area.

b) **Less than Significant Impact.** Soil erosion and loss of topsoil could result during construction as grading and construction can loosen surface soils and make soils susceptible to wind and water movement across the surface; however, excavation associated with the project changes would be minimal. Once the S-Line upgrades have been implemented, the S-Line upgrades is not expected to result in substantial soil erosion or the loss of topsoil over the long-term. Additionally, the soil encountered have low erosion potential and impacts would not be considered significant because erosion would be controlled on-site in accordance with Imperial County standards including preparation, review, and approval of a grading plan by the Imperial County Engineer. Impacts are considered less than significant.

c) **Less than Significant Impact with Mitigation Incorporated.** As discussed in Response VII. aiv) above, the S-Line upgrades project area and surrounding area is relatively flat and is not located in an area that is prone to landslide hazards.

As discussed in VII. aiii), the soil encountered at the point of exploration included saturated silts and silty sands that are moderate to highly expansive and could liquefy during a Maximum Considered Earthquake thereby resulting in the potential for liquefaction. Additionally, groundwater is expected to be encountered at depth between 5 to 20 feet bgs. Therefore, geologic hazards associated with saturated silts and silty sands have the potential to occur. However, according to the *Geotechnical Report for the 230 kV "S" Transmission Line Upgrade* (Appendix F of this Initial Study), liquefaction induced lateral spreading is not expected to occur at the pole sites because of the planar topography and the expansive soil conditions should not affect the deep foundations of the power poles. In addition to compliance with building and design standards, discussed above, implementation of Mitigation Measure GEO-1 would reduce impacts to a less than significant level.

d) **Less than Significant with Mitigation.** As previously discussed, the soils on the S-Line upgrades project aera include saturated silts and silty sands that are moderate to highly expansive. Implementation of Mitigation Measure GEO-1 would reduce impacts to a less than significant level.

e) **No Impact.** The project involves upgrading the transmission line's existing wooden power poles with steel monopoles, and an operations and maintenance building is not required or necessary. Therefore, no septic or other wastewater disposal systems would be required. Therefore, no impact is identified for this issue area.

f) **Less than Significant with Mitigation.** Many paleontological fossil sites are recorded in Imperial County and have been discovered during construction activities. Paleontological resources are typically impacted when earthwork activities, such as mass excavation cut into geological deposits (formations) with buried fossils. According to the VEGA SES Solar Energy project Final EIR (HDR 2019), within the region, paleontological resources appear to be concentrated in the shoreline of the ancient Lake Cahuilla, which covered much of Imperial Valley and created an extensive lacustrine environment. Lacustrine environments provide the appropriate conditions for fossil preservation; therefore, there is a potential for paleontological resources to be present within the S-Line upgrades project area. Project construction would not involve extensive or mass grading activity; however, although unlikely, even relatively shallow excavations may encounter vertebrate fossil remains which would be considered significant. Mitigation Measure GEO-2 will ensure that the potential impacts to paleontological resources do not rise to the level of significance pursuant to CEQA.

GEO-2 In the event that unanticipated paleontological resources or unique geologic resources are encountered during ground-disturbing activities, work must cease within 50 feet of the discovery and a paleontologist shall be hired to assess the scientific significance of the find. The consulting paleontologist shall have knowledge of local paleontology and the minimum levels of experience and expertise as defined by the Society of Vertebrate Paleontology's Standard Procedures (2010) for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources. If any paleontological resources or unique geologic features are found within the project site, the consulting paleontologist shall prepare a paleontological

Treatment and Monitoring Plan to include the methods that will be used to protect paleontological resources that may exist within the project site, as well as procedures for monitoring, fossil preparation and identification, curation of specimens into an accredited repository, and preparation of a report at the conclusion of the monitoring program.

VIII. Greenhouse Gas Emissions

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐
b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional GHG impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades. The following information is summarized from *the Air Quality and Greenhouse Gas Emissions Assessment for the VEGA IID S-Line Upgrades Project* prepared by ECORP Consulting, Inc. dated February 2021. This report is provided as Appendix B of this Initial Study.

a) **Less Than Significant Impact.** Prominent GHGs contributing to the greenhouse effect are CO_2, methane (CH_4), and N_2O. Human-caused emissions of these GHGs in excess of natural ambient concentrations are believed to be responsible for intensifying the greenhouse effect and leading to a trend of unnatural warming of the earth's climate, known as global climate change or global warming.

To date the ICAPCD has not adopted GHG significance thresholds applicable to potential development. Section 15064.7(c) of the CEQA Guidelines specifies that "[w]hen adopting or using thresholds of significance, a lead agency may consider thresholds of significance previously adopted or recommended by other public agencies, or recommended by experts, provided the decision of the lead agency to adopt such thresholds is supported by substantial evidence" (14 CCR 15064.7(c)). Thus, in the absence of any GHG emissions significance thresholds the projected emissions are compared to the SCAQMD numeric threshold of 3,000 metric tons of CO_2e annually. While significance thresholds used in the South Coast Air Basin are not binding on the ICAPCD, they are instructive for comparison purposes. This threshold is also appropriate as the SCAQMD GHG thresholds were formulated based on similar geography and climate patterns as found in Imperial County and are also employed for use in CEQA GHG analyses in the Riverside County portion of the SSAB, the same air basin that encompasses the proposed project. Therefore, the 3,000-metric ton of CO_2e threshold is appropriate for this analysis.

The following analysis is broken out by a discussion of potential impacts during construction of the S-Line upgrades followed by a discussion of potential impacts during operation of the project.

Construction

Construction-related activities that would generate GHG emissions include worker commute trips, haul trucks carrying supplies and materials to and from the S-Line upgrades project area, and off-road construction equipment (e.g., water trucks, boom trucks, cranes). Table 6 summarizes the specific construction-generated GHG emissions that would result from construction of the S-Line upgrades. Consistent with South Coast Air Quality Management (SCAQMD) recommendations, project construction GHG emissions have been amortized over the expected life of the project, which is considered to be 30 years for an electrical transmission line project. Once construction is complete, the generation of these GHG

emissions would cease. As shown in Table 6, the project would result in the generation of approximately 97 metric tons of CO_2e annualized over the lifetime of the project, which is below the SCAQMD threshold. Therefore, this is considered a less than significant impact.

Table 6. Construction-Related Greenhouse Gas Emissions

Emissions Source	CO_2e (Metric Tons/Year)
Construction in 2021	1,292
Construction in 2022	1,625
Total Emissions of Project (amortized over 30-year life of project)	97
Significance Threshold	3,000
Exceed Significance Threshold?	**No**

Source: Appendix B of this Initial Study

Operation

The S-Line upgrades would not include the provision of new permanent stationary or mobile sources of GHG emissions, and therefore, by its very nature, would not generate quantifiable GHG emissions from project operations. In addition, once the S-Line upgrades are implemented, there would be no increase in automobile trips to the area. While it is anticipated that the S-Line upgrades would require intermittent maintenance, maintenance would be minimal requiring a negligible amount of traffic trips on an annual basis. Further, the S-Line upgrades proposes installing and upgrading transmission lines for the purpose of transmitting clean renewable energy from a solar generation facility. Solar plants generate far less GHG life-cycle emissions (approximately 83 to 94 percent less) than fossil-fueled energy plants. Thus, the S-Line upgrades would potentially assist in the displacement of CO_2e over the course of 30 years, helping to offset any GHG life-cycle emissions generated by any construction activities associated with the S-Line upgrades. Operational-generated emissions would not exceed the significance threshold of 3,000 metric tons of CO_2e annually. Therefore, this is considered a less than significant impact.

b) **Less than Significant Impact.** The S-Line upgrades would not conflict with any adopted plans, policies, or regulations adopted for the purpose of reducing GHG emissions. As discussed above in Response VIII. a), the project-generated GHG emissions would not exceed the SCAQMD's GHG significance thresholds, which were prepared with the purpose of complying with statewide GHG reduction efforts. Additionally, once implementation of the S-Line upgrades is complete it would not be a source of operational GHG emissions. Implementation of the S-Line upgrades would result in a less than significant impact associated with the potential to conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emission of GHG.

IX. Hazards and Hazardous Materials

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the likely release of hazardous materials into the environment?	☐	☐	☒	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☐	☐	☒	☐
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?	☐	☐	☒	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional hazards and hazardous materials impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **Less than Significant Impact.** Construction of the S-Line upgrades will involve the limited use of hazardous materials, such as fuels and greases to fuel and service construction equipment. No extremely hazardous substances are anticipated to be produced, used, stored, transported, or disposed of as a result of construction. Regular, routine maintenance of the project may result in the potential to handle hazardous materials. However, the hazardous materials handled on-site would be limited to small amounts of everyday use cleaners and common chemicals used for maintenance. However, the project applicant would be required to comply with all applicable local, state, and federal regulations which regulate and control hazardous materials handled on-site. This is considered a less than significant impact.

b) **Less than Significant Impact.** As discussed in Response X. a), construction and operation of the S-Line upgrades would involve the handling of hazardous materials; therefore, hazardous materials may be inadvertently released through accidental spills or leaks. However, the project applicant would be required to comply with all applicable local, state, and federal regulations which regulate and control hazardous materials handled on-site. This is considered a less than significant impact.

c) **No Impact.** The S-Line upgrades component of the project is approximately 0.14 mile south from the T.L. Waggoner Elementary School located at 627 Joshua Tree Street. Project improvements to this particular segment of the S-Line, would only involve replacing the wooden power poles. Since no schools are directly adjacent to the transmission corridor, any hazardous material spill would be unlikely to affect a school located 0.14 mile from the transmission corridor. The S-Line upgrades will not use significant quantities of volatile hazardous materials, and hazardous materials that could potentially be released or encountered during excavation will be contained and managed. Due to the distance from the school and the relatively small quantity of hazardous materials to be used during construction, no impact is identified or this issue area.

d) **No Impact.** Based on a review of the Cortese List conducted in March 2021, the S-Line upgrades alignment is not located on a listed hazardous materials site (Department of Toxic Substances Control 2021). No impact is identified for this issue area.

e) **Less than Significant Impact.** The S-Line upgrades project area is located approximately 1.24 miles east from the Imperial County Airport in the City of Imperial. The Imperial County Airport Land Use Commission has established a set of land use compatibility criteria for lands surrounding the airports in Imperial County in the Imperial County Airport Land Use Compatibility Plan (1996). As identified in Figure 3-E of the Imperial County Airport Land Use Compatibility Maps, the S-Line upgrades project area traverses Airport Land Use Zones B2 (Extended Approach/Departure-Significant risk – aircraft commonly below 800 feet AGL [Above Ground Level] with significant noise [NLR {Noise Level Reduction} of 25 dBA in residential and office buildings]), Zone C (Common Traffic Pattern-Limited Risk – aircraft at or below 1,000 feet AGL with frequent noise intrusion), and Zone D (Other Airport Environs-Negligible risk – potential for annoyance from overflights). The construction phase of the project would be temporary and short-term, with no addition of residential land uses. Thus, excessive airport noise exposure to workers would be minimal and cease upon completion of the construction phase, and this is considered a less than significant impact.

f) **Less than Significant Impact.** Construction of the S-Line upgrades component of the project would cause a minor short-term increase in the local traffic in the immediate vicinity of the section of the proposed route if there would be a temporary lane closure. The S-Line upgrades would not increase traffic substantially as compared to the existing traffic volume and the capacity of the street system in the area. At least one lane of travel through each construction area would remain open throughout the construction period to accommodate roadway users, including emergency vehicles. Once operational, the project would have minimal impact on access or movement to emergency service providers. Occasional maintenance activities would be short-term in duration throughout the S-Line upgrades project area. While temporary lane closures are not anticipated, occasionally maintenance vehicles or equipment may be temporarily present alongside the roadways depending on structure locations; however, at least one lane of travel would remain open at all times. Therefore, construction or operation of the S-Line upgrades would not impair implementation of or physically interfere with an adopted emergency response plan or safety plan.

g) **Less than Significant Impact.** The majority of the S-Line upgrades project area is located in the unincorporated area of Imperial County. According to the Seismic and Public Safety Element of the General Plan, the potential for a major fire in the unincorporated areas of the County is generally low. Heat or sparks from vehicles or equipment have the potential to ignite dry vegetation and cause a fire. Vehicles and equipment will primarily use existing roads to access the transmission poles, all of which will be cleared of brush to reduce the fire potential. In addition, smoking will only be permitted in vehicles or cleared areas and appropriate fire-fighting equipment will be on site. As a result, the potential for fire from construction of the S-Line upgrades is low and considered less than significant. Operations and maintenance work, which includes regular vegetation clearing to minimize the potential for fire, will continue in the same manner as it did prior to construction of the S-Line upgrades. As a result, there will be no change in the fire potential in the area. This is considered a less than significant impact.

X. Hydrology and Water Quality

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☐	☐	☒	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:				
i. result in substantial erosion or siltation on- or off-site;	☐	☐	☒	☐
ii. substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;	☐	☐	☒	☐
iii. create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☒	☐
iv. impede or redirect flood flows?	☐	☐	☒	☐
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	☐	☐	☐	☒
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involve a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional air quality impacts would occur and the conclusions and mitigation measures (Mitigation Measures HWQ-1 through HWQ-3) identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **Less than Significant Impact.** The S-Line upgrades would require construction activities that would disturb soils. Pollutants typical of construction work, such as sediments, trash, petroleum products, concrete waste, sanitary waste, and chemicals could significantly affect water quality. Construction activities would be generally confined to IID's existing transmission corridor, generally alongside urban roadways, and limited to the area immediately surrounding transmission poles. The S-Line upgrades would be required to implement typical construction BMPs that may include sediment control practices (e.g., fiber rolls, gravel bag berms) and construction site waste management (e.g., street sweeping, concrete washout). In addition, construction areas would be returned to post-project conditions. In this context, implementation of the S-Line upgrades would result in a less than significant impact.

b) **No Impact.** The S-Line upgrades will not involve the use of groundwater. Water to be used during project-related construction activities will be limited to the amount necessary to conduct dust control activities. During construction, construction water would be brought to the site for soil conditioning and dust suppression. Water is anticipated to be provided by adjacent IID Canals. Dewatering activities are not anticipated to be performed as part of the project. As a result, the S-Line upgrades would not impede groundwater recharge and no impact would occur.

ci) **Less than Significant Impact.** The S-Line upgrades would not substantially alter the existing drainage pattern of the site. It is anticipated that the proposed drainage patterns would be similar to the existing site conditions. The project applicant would be required to implement on-site erosion control measures in accordance with County standards, which require the preparation, review, and approval of a grading plan by the County Engineer. The S-Line upgrades would not result in substantial erosion or siltation on- or off-site. This is considered a less than significant impact.

cii) **Less than Significant Impact.** The S-Line upgrades would not involve the construction of substantial impervious surfaces that would increase the rate of run-off. Construction activities would be localized to eligible transmission poles and foundations and the surrounding pervious surface would remain similar to pre-project conditions. Water will continue to percolate through the ground, as a majority of the surfaces on the project site will remain pervious. In this context, the S-Line upgrades would not result in substantial increases in run-off. This is considered a less than significant impact.

ciii) **Less than Significant Impact.** The S-Line upgrades would involve the replacement of existing wooden transmission line poles with new steel transmission line poles. Maintenance of the transmission line poles would not create substantial amounts of runoff that would exceed wastewater drainage. Water will continue to percolate through the ground, as a majority of the surfaces on the project site will remain pervious. The S-Line upgrades would not create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. This is considered a less than significant impact.

civ) **Less than Significant Impact.** According to the Federal Emergency Management Agency Flood Insurance Rate Map (Panels 06025C1700C, 06025C1725C, and 06025C2050C), the S-Line upgrades project area is mostly located in Zone X, which is an area determined to be outside of the 0.2 percent annual chance of a flood. A portion of the project does cross into a Special Flood Hazard Area, Zone A, generally associated with the New River. The transmission pole foundations would be small relative to the width of the floodplain and would not pose a substantial obstruction to flood flows, and would be located outside the floodplain to the maximum extent practical by spanning the river. The proposed project would not substantially impede or redirect flood flows and a less than significant impact is identified for this issue area.

d) **No Impact.** The S-Line upgrades project area is not located near any large bodies of water. The Salton Sea is located approximately 26 miles north of the S-Line upgrades project area. Furthermore, the project area is over 100 miles inland from the Pacific Ocean. In addition, the project area is relatively flat. Therefore, there is no potential for the project area to be inundated by seiches or tsunamis.

e) **No Impact.** The S-Line upgrades will not involve the use of groundwater. Water to be used during project-related construction activities will be limited to the amount necessary to conduct dust control activities.

During construction, construction water would be brought to the site for soil conditioning and dust suppression. Water is anticipated to be provided by adjacent IID Canals. Dewatering activities are not anticipated to be performed as part of the S-Line upgrades. As a result, the S-Line upgrades would not impede groundwater recharge and would not conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan. No impact is identified for this issue area.

XI. Land Use and Planning

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involve a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional mineral resources impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **No Impact.** The S-Line upgrades component of the project consists of replacement and upgrades to the existing IID S-Line and construction of new sections or alternate route alignments connecting the Imperial Valley Substation to the El Centro Switching Station. The transmission line alignment would be located within IID's existing transmission corridor generally following existing roadways. The S-Line upgrades component of the project would not divide an established community and no impact would occur.

   The proposed revision to CUP 17-0001 and Parcel Map would not physically divide an established community and no impact would occur.

b) **Less than Significant Impact.** Implementation of the project would require the approval of a minor revision to CUP 17-0001 and Parcel Map.

   CUP 17-0001

   CUP 17-0001 allows for the construction and operation of the VEGA SES Solar Energy Project. The project applicant is requesting a minor revision to CUP 17-0001 in order to change the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. CUP 17-0001 allows for the construction of a new substation, on the southwestern edge of the solar energy facility site (located within APN # 051-360-021). The CUP revision would change the location of the previously approved on-site substation from the southwestern corner of APN #051-360-021 adjacent to Mandrapa Road/Westside Main Canal, relocating the substation site to the northwestern corner of APN #051-360-031 adjacent to W. Wixom Rd and Vogel Road (Figure 3).

   The CUP revision would also change the location of the previously approved gen-tie originating from the project's substation on the southwestern corner of APN #051-360-021 to the proposed IID 230 kV Fern Substation, relocating it to the northwestern corner of APN #051-360-031 to tie-in to IID's S-Line (Figure 4).

   The potential land use impacts associated with the construction and operation of a utility-scale PV project (including an on-site substation and gen-tie tie in) at the project site was evaluated in the VEGA SES Solar Energy Project Final EIR (State Clearinghouse No. 2017081019). Since the certification of the Final EIR, there have been no changes to the land use environment or characteristics of the proposed project as

evaluated in the prior Final EIR. CUP 17-0001 allows for the construction and operation of the VEGA SES Solar Energy Project. The revision to CUP 17-0001 will simply be to change the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed project would not expand or increase the development footprint and the construction and operations of the project would be the same as evaluated in the prior Final EIR. No additional land use impact would occur and the conclusions that the VEGA SES Solar Energy Project would not result in a significant land use impact as identified in the previously-certified Final EIR remain accurate.

Parcel Map

The project applicant is requesting a Parcel Map for reorganization of property around Drew Road. The Parcel Map would create two parcels from an existing five parcels (APN Nos. 051-360-012, 051-360-031, 051-390-005, 051-390-004, and 051-390-013) that are bisected, in part, by Drew Road. APN Nos. 051-360-031, 051-390-004, and 051-390-013 are located within the boundaries of the previously-approved VEGA SES Solar Energy Project site.

The Parcel Map would create Parcel 1 comprising approximately 218 acres, located south, southwest of Drew Road and Parcel 2 comprising approximately 75.03 acres located north, northeast of Drew Road (Figure 5). As shown in Table 7, Parcel 1 would be utilized for the VEGA SES Solar Energy Project and Parcel 2 would remain in agricultural use.

The proposed Parcel Map will reorganize property around Drew Road and would not change the General Plan land use designation (Agriculture) or zoning (A-2) of the parcels. The proposed Parcel Map would result in no significant land use impact.

Table 7. Parcel Map Re-Organization

APNs	Proposed Use
Parcel 1	
051-360-031	Solar Facility - VEGA SES Solar Energy Project
051-390-004	
051-390-013	
Parcel 2	
051-360-012	Agriculture
051-390-005	

S-Line Upgrades

The S-Line upgrades component of the project consists of replacement and upgrades to the existing IID S-Line and construction of new sections or alternate route alignments connecting the Imperial Valley Substation to the El Centro Switching Station. The S-Line upgrades component of the project would not conflict with any land use plan, policy, or regulations adopted by agencies with jurisdiction over local land uses because the upgrades would occur within IID's existing transmission corridor. After the replacement of the existing transmission line wooden power poles with steel monopoles, IID will employ the same operations and maintenance activities of the transmission line. Therefore, no impact would occur.

XII. Mineral Resources

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional mineral resources impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **No Impact.** The S-Line upgrades project area is not used for mineral resource production. According to Figure 8: Imperial County Existing Mineral Resources of the Conservation and Open Space Element of the General Plan (County of Imperial 2016), no known mineral resources occur within the project area nor does the project area contain mapped mineral resources. Therefore, the S-Line upgrades would not result in the loss of availability of any known mineral resources that would be of value to the region and the residents of California.

b) **No Impact.** The S-Line upgrades project area is not currently used for mineral resource production and the project applicant is not proposing any form of mineral extraction. Furthermore, according to Figure 8, Imperial County Existing Mineral Resources, of the Conservation and Open Space Element of the General Plan (County of Imperial 2016), no known or mapped mineral resources occur within the project area. Therefore, the S-Line upgrades would result in no impact associated with the loss of availability of a locally-important mineral resource recovery site.

XIII. Noise

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project result in:				
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☒	☐	☐
b) Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☒	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional noise impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades. The following information is summarized from the *Noise Impact Assessment for the VEGA IID S-Line Upgrades Project* prepared by ECORP Consulting, Inc. dated February 2021. This report is provided as Appendix G of this Initial Study.

a) **Less than Significant Impact with Mitigation Incorporated.**

Construction

Construction noise associated with the S-Line upgrades would be temporary and would vary depending on the nature of the activities being performed. Noise generated would primarily be associated with the operation of off-road equipment for onsite construction activities as well as construction vehicle traffic on area roadways.

Onsite Construction Noise. Construction noise typically occurs intermittently and varies depending on the nature or phase of construction (e.g., demolition, grading, pole erecting). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. During construction, exterior noise levels could negatively affect sensitive land uses in the vicinity of the construction site.

Nearby noise-sensitive land uses consist of a scattering of single-family residential units located within 200 feet of the S-Line upgrades project site boundary. The closest sensitive receptors are located at 50 feet from the S-Line's new transmission line component running adjacent to W. Hackelman Road in the

unincorporated County. The County's General Plan Noise Element states construction equipment operation must be limited to the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturdays. No commercial construction operations are permitted on Sundays or holidays. Construction noise, from a single piece of equipment or a combination of equipment, must not exceed 75 dB Leq, when averaged over an eight (8) hour period, and measured at the nearest sensitive receptor.

Table 5-1 in the *Noise Impact Assessment for the VEGA IID S-Line Upgrades Project* (Appendix G of this Initial Study) presents the anticipated short-term construction noise levels generated for the necessary construction equipment. As shown in Table 5-1, construction has the potential to exceed the significance threshold of 75 dBA at the nearest sensitive receptors (located approximately 50 feet from the project boundary). This is considered a potentially significant impact. Implementation of Mitigation Measure NOI-1 would reduce construction-generated noise levels by installing a temporary noise barrier or enclosure between construction equipment and all residences within 50 feet of construction activities. Noise barriers or enclosures such as that recommended in Mitigation Measure NOI-1 can provide a sound reduction 35 dBA or greater (Appendix G of this Initial Study), which would reduce construction noise levels below 75 dBA. Therefore, with implementation of Mitigation Measure NOI-1, project construction activities would not expose persons to and generate noise levels in excess of County standards and this impact would be reduced to a less than significant level.

Offsite Construction Worker Traffic Noise. Construction would result in additional traffic on adjacent roadways over the time period that construction occurs. The number of on–site construction workers for the transmission line replacement and upgrades is not expected to require a substantial number of workers as they move from transmission line pole to pole. The predominant vehicular arteries expected to be used during the construction phase of the proposed project are SR-86, SR-111, and I-8. According to the California Department of Transportation (Caltrans) Technical Noise Supplement to the Traffic Noise Analysis Protocol (2013), doubling of traffic on a roadway is required to result in an increase of 3 dB (outside of the laboratory, a 3-dBA change is considered a just-perceivable difference). According to the Caltrans Traffic Census Program (2018), the roadway segment of SR-86 between El Dorado Avenue and Keystone Road currently accommodates 13,800 average daily trips, the roadway segment of SR-111 between Evan Hewes Hwy and Atens Road currently accommodates 22,900 average daily trips, and the roadway segment of I-8 between Drew Road and Forrester Road currently accommodates 15,900 average daily trips (Appendix G of this Initial Study). Project construction would not instigate construction worker commute trips at these rates. Thus, the minimal daily trips during construction would not result in a doubling of traffic on these roadways, and its contribution to existing traffic noise would not be perceptible and a less than significant impact would occur.

Operation

Operational Offsite Traffic Noise. Project operations would result in minimal additional traffic on adjacent roadways. The only visitors to the site would be that of repair or maintenance workers, whose presence at the site would be necessary infrequently and inconsistently. According to the Caltrans Technical Noise Supplement to the Traffic Noise Analysis Protocol (2013), doubling of traffic on a roadway is required to result in an increase of 3 dB (outside of the laboratory, a 3-dBA change is considered a just-perceivable difference). The S-Line upgrades would not result in a doubling of traffic, and therefore its contribution to existing traffic noise would not be perceptible and a less than significant impact would occur.

Project Operations-Onsite Noise Sources. The main stationary operational noise associated with the S-Line upgrades would be Corona Discharge. Corona is the electrical breakdown of the air into charged particles, which may result in audible noise. During Corona activity, the transmission lines sometimes generate a small amount of sound energy. Audible noise generated by Corona discharge is typically described as a crackling or humming sound. Audible Corona noise levels for a typical 230-kV line are approximately 25 dBA at locations within approximately 25 feet of the power line corridor (Appendix G of this Initial Study). This level of noise falls under the County, City of El Centro, and City of Imperial noise standards. Therefore, on-site noise sources would not exceed applicable noise standards and a less than significant impact would occur.

Mitigation Measure:

NOI-1: In order to reduce construction noise at sensitive residential receptors within 50 feet of project construction, a temporary noise barrier or enclosure shall be positioned between construction equipment and all residences within 50 feet of construction activities in a manner that breaks the line of sight between the construction equipment and these residences. The temporary noise barrier shall have a sound transmission class (STC) of 10 or greater in accordance with American Society for Testing and Materials Test Method E90, or at least 2 pounds per square foot to ensure adequate transmission loss characteristics. The temporary noise barrier can consist of a solid plywood fence at least 7/16-inch in

thickness and/or flexible sound curtains, such as an 18-ounce tarp or a 2-inch-thick fiberglass blanket, attached to chain link fencing or some other support structure. The length, height, and location of the temporary noise barrier shall be adequate to assure proper acoustical performance. Specifically, the barrier must completely break the line of sight between construction equipment and residential properties within 50 feet of construction activity, must be free of degrading holes or gaps, and must not be flanked by nearby reflective surfaces. All noise control barrier walls shall be designed to preclude structural failure due to such factors as winds, shear, shallow soil failure, earthquakes, and erosion.

b) **Less than Significant Impact.**

Construction

Construction-related ground vibration is normally associated with impact equipment such as pile drivers, jackhammers, and the operation of some heavy-duty construction equipment, such as dozers and trucks. It should be noted that pile drivers would not be necessary during construction. Vibration decreases rapidly with distance and it is acknowledged that construction activities would occur throughout the S-Line upgrades project area and would not be concentrated at the point closest to sensitive receptors.

Neither the County of Imperial, City of El Centro, or City of Imperial regulate vibrations associated with construction. However, a discussion of construction vibration is included for full disclosure purposes. For comparison purposes, the Caltrans (2020b) recommended standard of 0.2 inch per second PPV with respect to the prevention of structural damage for older residential buildings is used as a threshold. This is also the level at which vibrations may begin to annoy people in buildings. The nearest structure of concern to the construction site, with regard to groundborne vibrations, is a single-family residence located 50 feet south of the proposed new transmission line component on W. Hackelman Road. According to the *Noise Impact Assessment for the VEGA IID S-Line Upgrades Project* (Appendix G of this Initial Study), vibration as a result of construction activities would not exceed 0.2 PPV at the nearest structure. Therefore, project construction would not exceed the recommended threshold and a less than significant impact would occur.

Operation

Project operations would not include the use of any large-scale stationary equipment that would result in excessive vibration levels. Therefore, the S-Line upgrades would result in no groundborne vibration impacts during operations.

c) **Less Than Significant Impact.** The S-Line upgrades project area is located approximately 1.24 miles east from the Imperial County Airport in the City of Imperial. The Imperial County Airport Land Use Commission has established a set of land use compatibility criteria for lands surrounding the airports in Imperial County in the Imperial County Airport Land Use Compatibility Plan (1996). As identified in Figure 3-E of the Imperial County Airport Land Use Compatibility Maps, the project site traverses Airport Land Use Zones B2 (Extended Approach/Departure-Significant risk – aircraft commonly below 800 feet AGL [Above Ground Level] with significant noise [NLR {Noise Level Reduction} of 25 dBA in residential and office buildings]), Zone C (Common Traffic Pattern-Limited Risk – aircraft at or below 1,000 feet AGL with frequent noise intrusion), and Zone D (Other Airport Environs-Negligible risk – potential for annoyance from overflights). The construction phase of the S-Line upgrades would be temporary and short-term, with no addition of residential land uses. Thus, excessive airport noise exposure to workers would be minimal and cease upon completion of the construction phase, and this is considered a less than significant impact.

XIV. Population and Housing

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (e.g., by proposing new homes and businesses) or indirectly (e.g., through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional population and housing impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **No Impact.** Development of housing is not proposed as part of the S-Line upgrades. The number of on–site construction workers for the transmission line replacement and upgrades is not expected to require a substantial number of workers as they move from transmission line pole to pole. It is anticipated that up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another). No full-time employees are required to operate the transmission line. It is anticipated that maintenance of the transmission line will require minimal site presence to perform periodic visual inspections and minor repairs. Therefore, the S-Line upgrades would not result in a substantial growth in the area, as the number of employees required to operate and maintain the facility is minimal. No impact is identified for population and housing.

b) **No Impact.** No housing exists within the S-Line upgrades project area and no people reside within the project area. Therefore, the proposed project would not displace substantial numbers of people or housing, necessitating the construction of replacement housing elsewhere. No impact is identified for this issue area.

XV. Public Services

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
i. Fire Protection?	☐	☐	☒	☐
ii. Police Protection?	☐	☐	☒	☐
iii. Schools?	☐	☐	☐	☒
iv. Parks?	☐	☐	☐	☒
v. Other public facilities?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional public services impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

ai) **Less than Significant Impact.** The S-Line upgrades consists of replacing and upgrading equipment along an approximately 18-mile segment of transmission line traversing through lands in unincorporated Imperial County, City of El Centro, and City of Imperial. Fire protection and emergency medical services in the area are provided by the Imperial County Fire Department and City of El Centro Fire Department. The project would result in fire risk that would be comparable to that of the transmission line that is being replaced and upgraded. The S-Line upgrades project area would continue to be adequately supported by the existing fire protection services since the construction and operation of the project would not induce growth in the project area and the fire risk would not create the need for new or physically altered fire protection facilities. In addition, operation and maintenance would not affect the ability of fire personnel to respond to fires. Based on these considerations, the S-Line upgrades would not result in a need for fire facility expansion and a less than significant impact is identified for this issue area.

aii) **Less than Significant Impact.** Police protection services in the S-Line upgrades project area is provided by the Imperial County Sheriff's Department, City of Imperial Police Department, and City of El Centro Police Department. The S-Line upgrades would not require police services during construction or operation and maintenance beyond routine patrols and response. As with fire services discussed in Response XV. ai) above, the construction and operation of the S-Line upgrades would not induce growth in the project area, would not result in a need for additional police facilities or affect response times or other service performance. This is considered a less than significant impact.

aiii) **No Impact.** The S-Line upgrades does not include the development of residential land uses that would result in an increase in population or student generation. Construction is estimated to take approximately 14 months. The number of on–site construction workers for the transmission line upgrades is not expected to require a substantial number of workers as they move from transmission line pole to pole. It is anticipated that up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another). Construction of the S-Line upgrades would not result in an increase in student population within the Imperial County's School District since it is anticipated that construction workers would commute in during construction operations. Furthermore, no full-time employees are required to operate the project. It is anticipated that maintenance of the transmission line will be minimal to perform periodic visual inspections and minor repairs. The S-Line upgrades would not result in an increase in student population within the Imperial County's School District. Therefore, the proposed project would have no impact on Imperial County schools.

aiv) **No Impact.** Construction is estimated to take approximately 14 months. The number of on–site construction workers for the transmission line upgrades is not expected to require a substantial number of workers as they move from transmission line pole to pole. It is anticipated that up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another). Furthermore, no full-time employees are required to operate the project. It is anticipated that maintenance of the transmission line will be minimal to perform periodic visual inspections and minor repairs. Therefore, substantial permanent increases in population that would adversely affect local parks is not expected. The S-Line upgrades would have no impact on parks.

av) **No Impact.** Construction is estimated to take approximately 14 months. The number of on–site construction workers for the transmission line upgrades is not expected to require a substantial number of workers as they move from transmission line pole to pole. It is anticipated that up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another). Furthermore, no full-time employees are required to operate the project. It is anticipated that maintenance of the transmission line will be minimal to perform periodic visual inspections and minor repairs. Therefore, substantial permanent increases in population that would adversely affect libraries and other public facilities (such as post offices) are not expected. The S-Line upgrades would have no impact on other public facilities such as post offices, and libraries.

XVI. Recreation

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional recreation impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **No Impact.** The S-Line upgrades project area is not used for formal recreational purposes. Construction is estimated to take approximately 14 months. The number of on–site construction workers for the transmission line upgrades is not expected to require a substantial number of workers as they move from transmission line pole to pole. It is anticipated that up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another). Furthermore, no full-time employees are required to operate the project. It is anticipated that maintenance of the transmission line will be minimal to perform periodic visual inspections and minor repairs. As such, the S-Line upgrades would not significantly increase the use or accelerate the deterioration of regional parks or other recreational facilities. Additionally, the S-Line upgrades does not include or require the expansion of recreational facilities. No impact would occur.

b) **No Impact.** Refer to Response XVI. a) above.

XVII. Transportation

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☐	☐	☒	☐
b) Conflict with or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?	☐	☐	☒	☐
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☒	☐
d) Result in inadequate emergency access?	☐	☐	☒	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional transportation impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **Less than Significant Impact.**

Roadway Facilities

Project trip generation for both the construction and operational scenarios will be minimal. The predominant vehicular arteries expected to be used during the construction phase of the S-Line upgrades are SR-86, SR-111, and I-8. According to the Caltrans Traffic Census Program (2018), the roadway segment of SR-86 between El Dorado Avenue and Keystone Road currently accommodates 13,800 average daily trips, the roadway segment of SR-111 between Evan Hewes Hwy and Atens Road currently accommodates 22,900 average daily trips, and the roadway segment of I-8 between Drew Road and Forrester Road currently accommodates 15,900 average daily trips (Appendix G of this Initial Study). Project construction would not instigate construction worker commute trips at these rates.

Table 8 provides the estimated average daily on-road project trip generation (i.e., trips to and from the site) for the construction phase of the S-Line upgrades. As shown in Table 8, the maximum number of on-road trips would be approximately 106 worker trips. This estimated project trip generation is below the County's general criteria (County of Imperial 2007) for preparation of a traffic impact analysis as the trips would be so minimal that they would not affect roadway or intersection levels of service for any of the roadways that would be utilized for access to and from the project site.

Once the S-Line upgrades is implemented, there would be no increase in automobile trips to the area. While it is anticipated that the transmission line would require intermittent maintenance, maintenance would be minimal requiring a negligible amount of traffic trips on an annual basis. Project operations would result in minimal additional traffic on adjacent roadways. Based on these considerations, the S-Line upgrades would not result in a substantial increase in traffic and a less than significant impact would occur.

Table 8. Construction Trip Generation

Construction Phase	Worker Trip Number	Vendor Trip Number
Grading	20	0
Building Construction	106	41
Demolition	94	0

Source: Appendix B of this Initial Study

Mass Transit and Non-Motorized Travel

The S-Line upgrades project area is generally located in a rural setting. There is no regular bus service or bicycle infrastructure in the general area and project related construction and operations and maintenance phases would not impact alternative modes of transportation. The S-Line upgrades component of the project does not propose modifications to be made to existing roadways serving future designated bikeway routes. No impact would occur to alternative transportation.

b) **Less than Significant Impact.** Section 15064.3(b) of the CEQA Guidelines provides guidance on determining the significance of transportation impacts and focuses on the use of vehicle miles traveled (VMT), which is defined as the amount and distance of automobile travel associated with a project. Given the nature of the project, after construction, there would be a nominal amount of vehicle trips generated by the project. Once the S-Line upgrades are implemented, there would be no increase in automobile trips to the area. While it is anticipated that the transmission line would require intermittent maintenance, maintenance would be minimal requiring a negligible amount of traffic trips on an annual basis. The S-Line upgrades would result in less than significant VMT impacts.

c) **Less than Significant Impact.** Construction would occur within IID's existing transmission corridor. No public roadways or access roads would be constructed as a part of the project. Incompatible uses associated with the project, such as use by construction equipment and transport of new transmission towers would be short-term and minor and impacts would be less than significant.

d) **Less than Significant Impact.** Construction of the S-Line upgrades would cause a minor short-term increase in the local traffic in the immediate vicinity of the section of the proposed route if there would be a temporary lane closure. The S-Line upgrades would not increase traffic substantially as compared to the existing traffic volume and the capacity of the street system in the area. At least one lane of travel through each construction area would remain open throughout the construction period to accommodate roadway users, including emergency vehicles.

Once operational, the S-Line upgrades would have minimal impact on access or movement to emergency service providers. Occasional maintenance activities would be short-term in duration throughout the S-Line upgrades project area. While temporary lane closures are not anticipated, occasionally maintenance vehicles or equipment may be temporarily present alongside the roadways depending on structure locations; however, at least one lane of travel would remain open at all times. Therefore, maintenance would have a less than significant impact on emergency vehicle access and movements.

XVIII. Tribal Cultural Resources

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project cause a substantial adverse change in the significance of a tribal cultural resource defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)?	☐	☒	☐	☐
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe?	☐	☒	☐	☐

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional tribal cultural resources impacts would occur and the conclusions and mitigation measures (Mitigation Measure CR-5) identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a-b) **Less than Significant Impact with Mitigation Incorporated.** The California Native American Heritage Commission (NAHC) maintains the confidential Sacred Lands File which contains sites of traditional, cultural, or religious value to the Native American community. A search of the Sacred Lands File was completed by the NAHC and resulted in a positive finding, indicating that Native American Sacred Lands have been recorded in the S-Line upgrades project area.

Assembly Bill 52 was passed in 2014 and took effect July 1, 2015. It established a new category of environmental resources that must be considered under CEQA called tribal cultural resources (Public Resources Code 21074) and established a process for consulting with Native American tribes and groups regarding those resources. Assembly Bill 52 requires a lead agency to begin consultation with a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. Imperial County will consult with appropriate tribes with the potential for interest in the region.

The County has requested for tribes to provide any information regarding any Traditional Cultural Properties, Sacred Sites, resource collecting areas, or any other areas of concern known to occur in the S-Line upgrades project area. Mitigation Measure TCR-1 would ensure that the potential impacts on unidentified tribal cultural resources do not rise to the level of significance.

Mitigation Measure

TCR-1: If previously unidentified tribal cultural resources are identified during construction activities, construction work within 100 feet of the find shall be halted and directed away from the discovery until a Secretary of the Interior qualified archaeologist and tribal representative assesses the significance of the resource. The archaeologist, in consultation with Imperial County and any interested Tribes, shall make the necessary plans for treatment of the find(s) and for the evaluation and mitigation of impacts if the finds are determined to be a tribal cultural resource as defined in PRC Section 21074.

XIX. Utilities and Service Systems

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☐	☐	☒	☐
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?	☐	☐	☒	☐
c) Result in a determination by the wastewater treatment provider, which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☒	☐
d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☒	☐
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional utilities and service systems impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **Less than Significant Impact.** Construction activities would be confined to IID's existing transmission corridor, generally alongside existing roadways. Construction would generate a minimal volume of wastewater during construction. During construction activities, wastewater would be contained within portable toilet facilities and disposed of at an approved site. No habitable structures are proposed; therefore, there would be no wastewater generation from the S-Line upgrades. The S-Line upgrades would not require

or result in the relocation or construction of new or expanded wastewater facilities. No stormwater flows would result with implementation of the S-Line upgrades, therefore, no expanded or new storm drainage facilities would be required.

The S-Line upgrades may require the use of a water truck to support dust suppression during ground disturbing work. Water used for dust control and other water used for the project would continue to percolate into the ground. In addition, sufficient water would be used from IID owned canals surrounding the project area. Relocation or construction of new or expanded water facilities is not required.

The S-Line upgrades component of the project consists of replacement and upgrades to the existing IID S-Line and construction of new sections or alternate route alignments connecting the Imperial Valley Substation to the El Centro Switching Station. The S-Line upgrades would replace the existing transmission line wooden power poles with steel monopoles supported on drilled pier foundations. All transmission line improvements would occur within IID's existing transmission corridor. In addition, the S-Line upgrades would not require or result in the relocation or construction of new or expanded electric power, natural gas, or telecommunications facilities.

Based on these considerations, a less than significant impact is identified for this issue area.

b) **Less than Significant Impact.** Water demands for the S-Line upgrades would be minimal and mostly used during construction for dust control. Water use for construction would also be periodic and temporary during the construction period. Operations and maintenance activities for the project will be conducted in the same manner as previously conducted. Therefore, the S-Line upgrades will have a less than significant impact on water supplies or entitlements.

c) **Less than Significant Impact.** As discussed in XIX. a) above, the S-Line upgrades would generate minimal wastewater during construction and upon completion of the project. Wastewater generation during construction would be contained to portable toilets for construction workers and the waste would be disposed of at appropriately licensed facilities with adequate capacity. In addition, no habitable structures would be constructed that would increase wastewater generation. This is a less than significant impact.

d) **Less than Significant Impact.** Solid waste generation would be minor for the construction and operation of the S-Line upgrades. Existing wooden poles would be the largest source of solid waste during construction. There are several solid waste facilities within Imperial County and solid waste will be disposed of using a locally-licensed waste hauling service, most likely Allied Waste. Trash would likely be hauled to the Calexico Solid Waste Site (13-AA-0004) located in Calexico or CR&R Material Recovery and Transfer Station (13-AA-0109) located in El Centro. The Calexico Solid Waste Site has approximately 1,561,235 cubic yards of remaining capacity and is estimated to remain in operation through 2179. (CalRecycle 2021). Therefore, there is ample landfill capacity in the County to receive the minor amount of solid waste generated by construction and operation of the S-Line upgrades. A less than significant impact is identified for this issue area.

e) **No Impact.** The S-Line upgrades will be required to comply with state and local requirements for waste reduction and recycling; including the 1989 California Integrated Waste Management Act and the 1991 California Solid Waste and Recycling Access Act of 1991. As identified in Response XIX. d) above, the landfills serving the site would have sufficient capacity to accommodate project construction solid waste disposal needs, and project solid waste disposal would not require the need for new or expanded landfill facilities. The S-Line upgrades would adhere to federal, state, and local management, reduction statutes, and regulations related to solid waste disposal limits. No impact would occur.

XX. Wildfire

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:				
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☐	☐	☐	☒
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☐	☐	☒	☐
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☐	☐	☐	☒

Impact Analysis

The following evaluates the three primary components: 1) Minor Revision to CUP 17-0001; 2) Upgrades to the IID "S"-Line; and 3) Parcel Map (Waiver) as described in detail in the Project Summary section.

The revision to CUP 17-0001 involves a change to the location of the previously-approved on-site substation and gen-tie tie-in, within the boundaries of the VEGA SES Solar Energy Project site. The proposed Parcel Map will reorganize property around Drew Road. The proposed project would not expand or increase the development footprint and the construction and operations of the previously-approved VEGA SES Solar Energy Project would be the same as evaluated in the prior Final EIR. No additional wildfire impacts would occur and the conclusions identified in the previously-certified Final EIR remain accurate and applicable to the VEGA SES Solar Energy Project.

The following impact analysis is focused on the S-Line upgrades.

a) **No Impact.** According to the Draft Fire Hazard Severity Zone Map for Imperial County prepared by the California Department of Forestry and Fire Protection, the S-Line upgrades project area is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2007). Therefore, the S-Line upgrades would not substantially impair an adopted emergency response plan or emergency evacuation plan. No impact is identified for this issue area.

b) **No Impact.** The S-Line upgrades project area is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2007). Therefore, the S-Line upgrades would not exacerbate wildfire risks. No impact is identified for this issue area.

c) **Less than Significant Impact.** The S-Line upgrades project area is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2007). The S-Line upgrades consists of replacing and upgrading equipment along an

approximately 18-mile segment of transmission line traversing through lands in unincorporated Imperial County, City of El Centro, and City of Imperial. Fire protection and emergency medical services in the area are provided by the Imperial County Fire Department and City of El Centro Fire Department. The S-Line upgrades would result in fire risk that would be comparable to that of the transmission line that is being replaced and upgraded. The S-Line upgrades project area would continue to be adequately supported by the existing fire protection services. In addition, operation and maintenance would not affect the ability of fire personnel to respond to fires. The S-Line upgrades would not exacerbate fire risk. This is considered a less than significant impact.

d) **No Impact.** The S-Line upgrades project aera is not located in or near state responsibility areas or lands classified as very high hazard severity zones (California Department of Forestry and Fire Protection 2007). The S-Line upgrades would not expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes. No impact is identified for this issue area.

XXI. Mandatory Findings of Significance

Environmental Issue Area:	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☒	☐	☐
b) Does the project have impacts that are individually limited, but cumulatively considerable ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☒	☐	☐
c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☒	☐	☐

Impact Analysis

a) **Less than Significant Impact with Mitigation Incorporated.**

Special-Status Plants

As described in Response IV. a) above, there is moderate or high potential for the following seven rare plant species to occur due to the presence of suitable habitat within the project area: brown turbans, gravel milk-vetch, California satintail, Baja California ipomopsis, Parish's desert thorn, hairy stickleaf, and sand food. Impacts that may occur to these species include loss of individuals, habitat, and seedbank. These impacts are considered potentially significant and would require mitigation. However, implementation of Mitigation Measures BIO-1 and BIO-2 would reduce impacts on special-status plant species to less than significant levels.

Special-Status Wildlife

As described in Response IV. a) above, 14 special-status species have a moderate or high potential to occur on the project area, These species are flat-tailed horned lizard, ferruginous hawk, Yuma Ridgway's rail, Yuma hispid cotton rat, Colorado Desert fringe-toed lizard, California horned lark, mountain plover, Crissal thrasher, LeConte's thrasher, yellow-breasted chat, California black rail, vermilion flycatcher, western yellow bat, and American badger. In addition, burrowing owl, northern harrier, loggerhead shrike, and black-tailed gnatcatcher were observed within the project area. Direct impacts to these species that

could occur include injury, mortality, nest failures, and loss of young. Indirect impacts include loss of nesting and foraging habitat, increase in anthropogenic effects (i.e., noise levels, introduction of invasive and nonnative species, increase in human activity, increase in dust). Implementation of Mitigation Measures BIO-2 through BIO-6 would reduce impacts on special-status wildlife species to less than significant levels.

The project area provides nesting habitat for ground-nesting species as well as species that nest in riparian scrub habitat. Direct impacts to nesting avian species include injury, mortality, loss of young, and nest failure. Indirect impacts include loss of foraging and nesting habitat for passerine and raptors species, increase in noise and human activities, and potential introduction of invasive or nonnative species. These impacts are considered potentially significant and would require mitigation. Implementation of Mitigation Measures BIO-4 through BIO-5 would reduce impacts on nesting birds to less than significant levels.

Cultural Resources

Potential project construction impacts within or immediately adjacent to the existing transmission line corridor will include ground-disturbing activities associated with grading and installation of the transmission pole foundations. Subsurface or surface disturbance could result in the loss of integrity of cultural deposits, loss of information, and the alteration of a site's settings. As described above, fifteen previously recorded resources were relocated and updated as part of the cultural resources inventory and 23 newly identified cultural resources were documented within the project area. None of these resources were formally evaluated for potential eligibility for listing in the CRHR. The project applicant will avoid ground-disturbing activities within and in close proximity to these resources. However, if-ground disturbing activities must occur within and in close proximity to these resources, a potentially significant impact would occur. The project also has the potential to disturb previously undocumented cultural resources that could qualify as a unique archaeological resource pursuant to CEQA. Mitigation Measure CUL-1 would reduce impacts to below a level of significance.

b) **Less than Significant Impact with Mitigation Incorporated.** Based on the analysis contained in this Initial Study, the proposed project would not result in significant impacts to aesthetics, agricultural and forestry resources, energy, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, population and housing, public services, recreation, transportation and traffic, and utilities and service systems.

The proposed project would have potential impacts that are significant on the following resources areas: air quality, biological resources, cultural resources, geology and soils, and noise. However, implementation of mitigation measures would ensure potential impacts are reduced to less than significant levels. The proposed project would incrementally contribute to cumulative impacts for projects occurring within the vicinity of the project. However, compliance with the mitigation measures would ensure that no residually significant impacts would result with implementation of the project either directly or indirectly. In the absence of residually significant impacts, the incremental accumulation of effects would not be cumulatively considerable. Therefore, a finding of less than significant is identified for this issue area.

c) **Less than Significant Impact with Mitigation Incorporated.** Based on the analysis contained in this Initial Study, all impacts related to the proposed project would remain less than significant through implementation of mitigation measures. There would not be any long-term environmental effects, which would cause substantial adverse effects on human beings, either directly or indirectly. Any effects related to construction of the project would be temporary and short-term (14 months) and would not result in any long-term or permanent effects on human beings. Any environmental effects would be less than significant, as noted in the prior sections of this Initial Study.

References

California Department of Conservation (DOC). 2016a. *Imperial County Important Farmland 2016.*

——— 2016b. *Imperial County Williamson Act FY 2016/2017).*

California Department of Forestry and Fire Protection. 2007. Draft Fire Hazard Severity Zones in LRA – Imperial County. https://osfm.fire.ca.gov/media/6682/fhszl06_1_map13.pdf

California Department of Resources Recycling and Recovery (CalRecycle). 2021. Facility/Site Summary Details: Calexico Solid Waste Site (13-AA-0004). Retrieved from https://www2.calrecycle.ca.gov/SolidWaste/Site/Summary/591

County of Imperial. 2016. County of Imperial General Plan. Conservation and Open Space Element.

——— 1993. County of Imperial General Plan. Seismic and Public Safety Element.

County of Imperial. 1996. Airport Land Use Compatibility Plan. Amended June 19, 1996.

County of Imperial Department of Public Works. 2007. Traffic Study and Report Policy. Available at: https://publicworks.imperialcounty.org/wp-content/uploads/2019/12/TrafficStudyReportPolicy.pdf

Department of Toxic Substances Control. 2021. EnviroStor – Hazardous Waste and Substances Site List (Cortese). Available at: https://www.envirostor.dtsc.ca.gov/public/search?cmd=search&reporttype=CORTESE&site_type=CSITES,FUDS&status=ACT,BKLG,COM&reporttitle=HAZARDOUS+WASTE+AND+SUBSTANCES+SITE+LIST+%28CORTESE%29

HDR. 2019. VEGA SES Solar Energy Project Final Environmental Impact Report (SCH No. 2017081019).

List of Preparers

This Initial Study was prepared for the Imperial County Planning and Development Services Department by HDR at 591 Camino de la Reina, Suite 300, San Diego, CA 92108. The following professionals participated in its preparation:

Imperial County Planning and Development Services Department

Jim Minnick, Planning and Development Services Director

Michael Abraham, AICP, Assistant Planning and Development Services Director

David Black, Planner IV

HDR

Tim Gnibus, Principal

Sharyn Del Rosario, Project Manager

Elaine Lee, Environmental Planner

Ronell Santos, Biologist

Anders Burvall, Senior Geographic Information Systems Analyst

Renee Stueber, Document Production Administrator

Technical Report Preparers

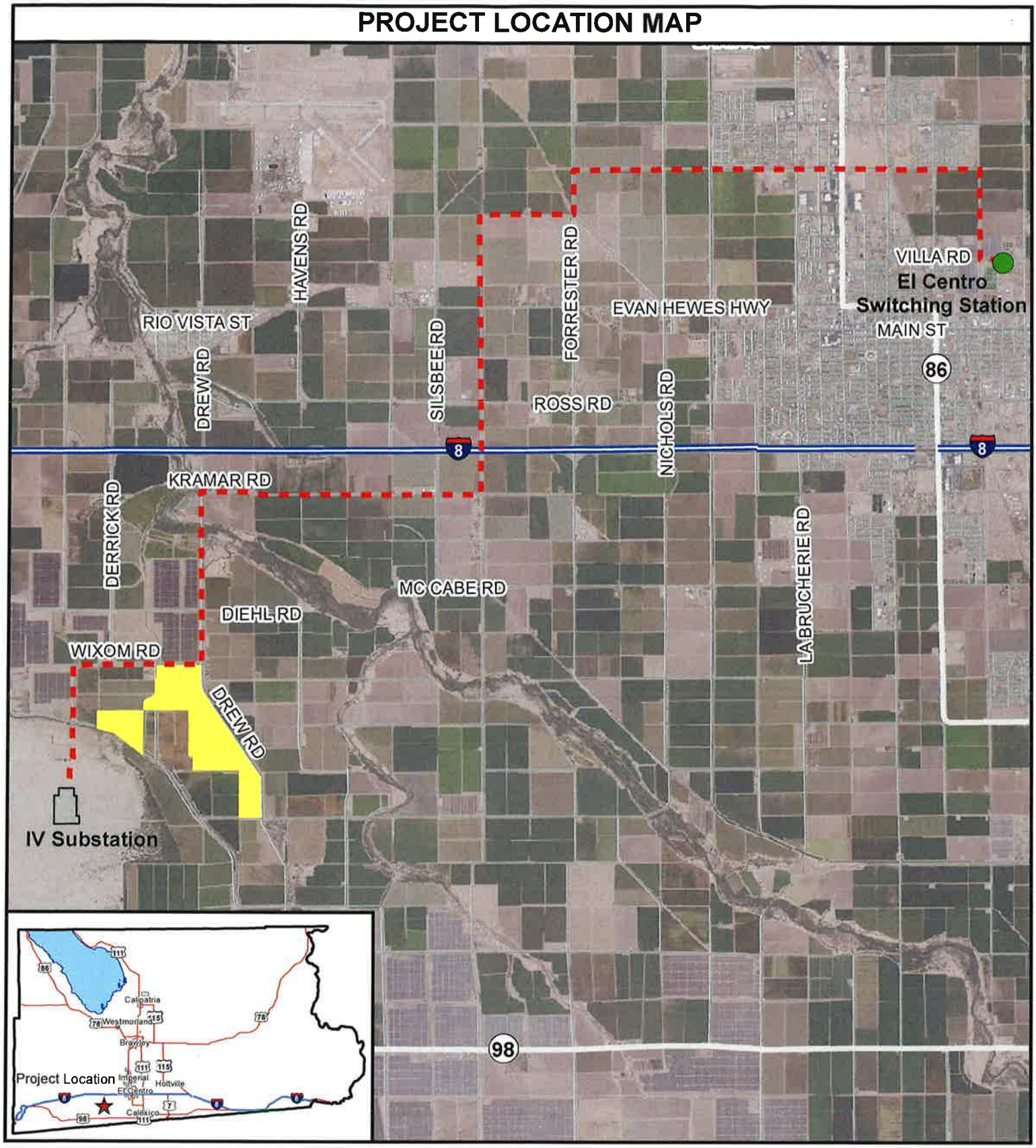
ECORP Consulting, Inc.

- Air Quality and Greenhouse Gas Emissions Assessment for the VEGA IID S-Line Upgrades Project
- Biological Technical Report for the VEGA IID S-Line Upgrades Project
- Aquatic Resources Delineation for the VEGA IID S-Line Upgrades
- Cultural Resources Inventory for the VEGA IID S-Line Upgrades Project (Confidential Appendix)
- Noise Impact Assessment for the VEGA IID S-Line Upgrades Project
- Visual Impact Report – VEGA IID S-Line Replacement and Reconstruction Project

Landmark Consultants, Inc.

- Geotechnical Report for the 230 kV "S" Transmission Line Upgrade

PROJECT LOCATION MAP



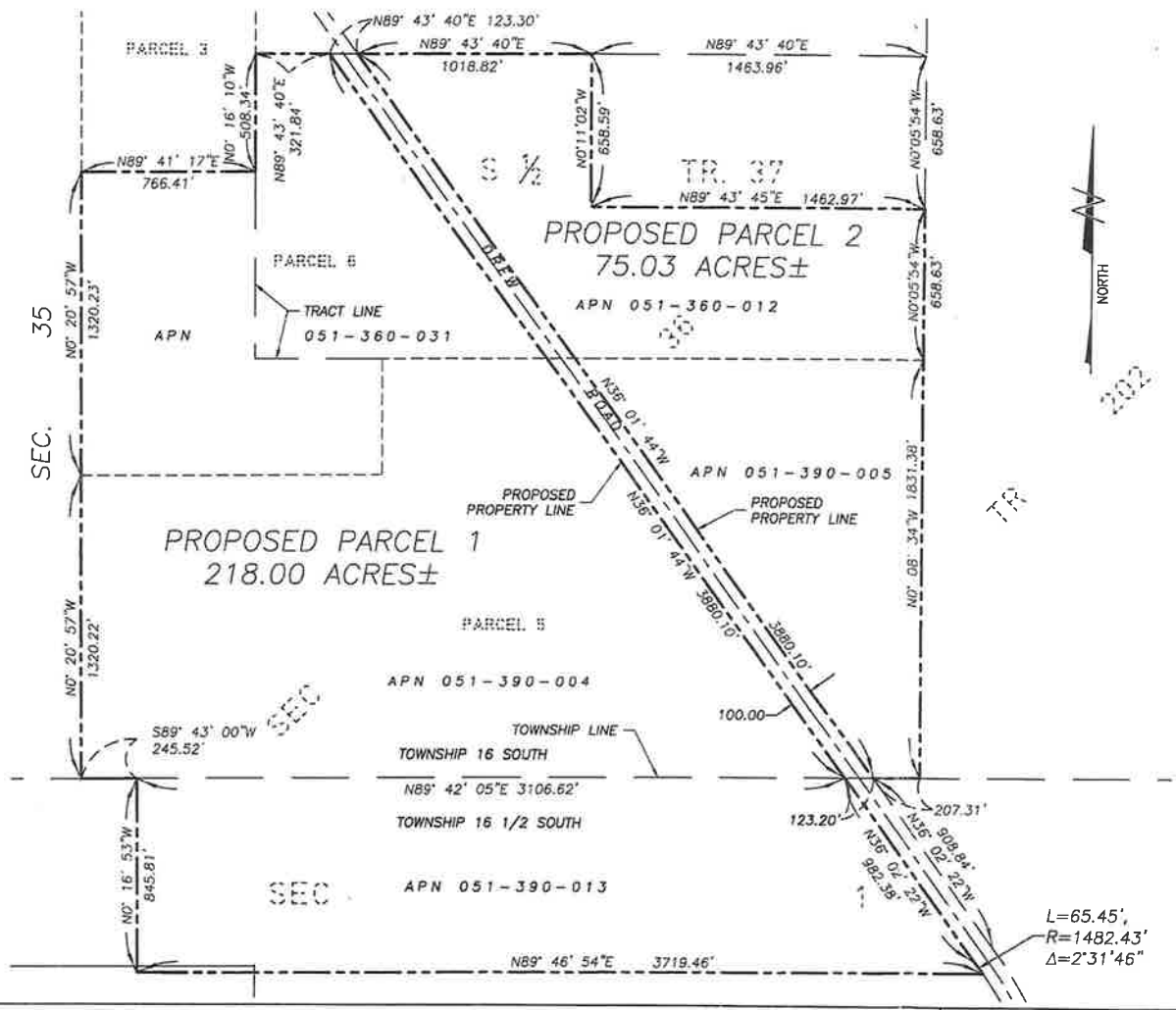
VEGA IID S-LINE UPGRADES PROJECT
CUP #20-0029 MINOR MODIFICATION
& PARCEL MAP 2491
APN #051-360-031, 021, 051-390-012, 013, 004,
& 051-350-015, 017, 019

- Vega SES Solar
- IV Substation
- El Centro Switching Sation
- IID S Line
- US Highways
- Interstate
- Centerline

N

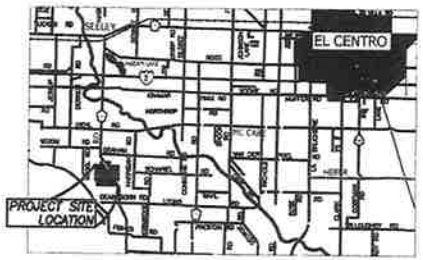
TENTATIVE MAP No.____
IN THE COUNTY OF IMPERIAL

PORTIONS SECTION 36, TOWNSHIP 16 SOUTH–RANGE 12 EAST, AND SECTION 1, TOWNSHIP 16½ SOUTH–RANGE 12 EAST, S.B.M.



LEGEND

- PROPOSED PARCEL LINE
- EXISTING PROPERTY LINE
- TRACT LINE
- EXISTING CENTERLINE AS DESCRIBED



OWNER

MICHEAL A. ABATTI AND KERRI A. ABATTI
P.O. BOX 287 EL CENTRO, CA 92244

ASSESSOR PARCEL NUMBERS AND ZONING

APN: 051–360–031 LIES IN ZONE A–2–R
APN: 051–360–012 LIES IN ZONE A–2
APN: 051–390–004 LIES IN ZONE A–2–R
APN: 051–390–005 LIES IN ZONE A–2
APN: 051–390–013 LIES IN ZONE A–2–R

FLOOD ZONE

THE SUBJECT LAND ACCORDING TO THE LEGAL DESCRIPTION OF SUCH MATTERS (WITH INSTRUMENT, BOOK AND PAGE NUMBER INDICATED); NO PART OF THE SUBJECT LAND IS LOCATED IN A 100–YEAR FLOOD PLAIN OR IN AN IDENTIFIED "FLOOD PRONE AREA", AS DEFINED PURSUANT TO THE FLOOD DISASTER PROTECTION ACT OF 1973, AS AMENDED, AS REFLECTED BY FLOOD INSURANCE RATE MAP PANEL #06025C2050C DATED SEPTEMBER 26, 2008,

500' 0' 500' 1000'
SCALE: 1"=500'

Precision Engineering & Surveying, Inc.
P.O .Box 2216 El Centro, CA 92244
Telephone: (760) 353-2684
799 E. Heil Avenue El Centro, Ca 92243
Fax: (760) 353-2686

TENTATIVE PARCEL MAP ____ VEGA / DREW SOLAR		SHEET 1 OF 2
DRAWN BY: C.D.	CHECKED BY: T.B.J.	
CLIENT: Z-GLOBAL	JOB No. 19151	
	Date: SEPT 22, 2020	

9/24/20

Attachment A
(MMR&P)

MITIGATION, MONTORING AND REPORTING PROGRAM

MITIGATION MEASURES
PURSUANT TO THE ENVIRONMENTAL EVALUATION COMMITTEE
May 13, 2021
[IS# 20-0039]
VEGA SES PROJECT UPGRADE, PM 2491, CUP 20-0029

(APN 051-360-021 et al..)

(CEQA – Mitigated Negative Declaration)

Pursuant to the review and recommendations of the Imperial County Environmental Evaluation Committee (EEC) on May 13, 2021 the following Mitigation Measures are hereby proposed for the project:

AIR QUALITY

AQ-1: In order to reduce the generation of PM_{10} emissions resulting from worker commutes during construction, a list of commute route options involving routes with 100 percent paved roadway facilities shall be prepared in pamphlet form by the project applicant, to the satisfaction of the Imperial County Planning and Development Services Department. Copies of the paved commute route options pamphlet shall be distributed to every project worker and each pamphlet shall clearly state that commuting on unpaved roads is prohibited.

BIOLOGICAL RESOURCES:

Mitigation Measures:

BIO-1: Rare plant surveys shall be conducted within suitable habitat in the project area during the appropriate blooming period for brown turbans, gravel milk-vetch, California satintail, Baja California ipomopsis, Parish's desert thorn, hairy stickleaf, and sand food. The surveys shall be conducted by a botanist or qualified biologist in accordance with the USFWS Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed, and Candidate Plants (USFWS 1996); the CDFW Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities (CDFW 2018); and the CNPS Botanical Survey Guidelines (CNPS 2001). If any special-status species are observed during the rare plant surveys, the location of the individual plant or population will be recorded with a submeter GPS device for mapping purposes. If project-related impacts to rare plants on the project area are unavoidable, then consultation with CDFW may be required to develop a mitigation plan or additional avoidance and minimization measures. Measures that may be implemented if the species is observed include establishing a no-disturbance buffer around locations of individuals or a population, salvage or seed collection, and additional monitoring requirements.

BIO-2: A qualified biologist shall be present to monitor all ground-disturbing in vegetated areas and vegetation-clearing activities conducted for the project. During each monitoring day, the biological monitor shall perform clearance survey "sweeps" at the start of each work day that vegetation clearing takes place to minimize impacts on special-status species with

potential to occur (including, but not limited to, special-status and/or nesting bird species, flat-tailed horned lizard, Yuma hispid cotton rat, Colorado Desert fringe-toed lizard, western yellow bat, American badger, Sonoran Desert toad, big free-tailed bat, pallid bat, and Townsend's big-eared bat). The monitor will be responsible for ensuring that impacts to special-status species, nesting birds, and active nests will be avoided to the greatest extent possible. Biological monitoring shall take place until the project area has been completely cleared of any vegetation. If an active nest is identified, the biological monitor shall establish an appropriate disturbance limit buffer around the nest using flagging or staking. Construction activities shall not occur within any disturbance limit buffer zones until the nest is deemed no longer active by the biologist. If special-status wildlife species are detected during biological monitoring activities, then consultation with the USFWS and/or CDFW shall be conducted and a mitigation plan shall be developed to avoid and offset impacts to these species. Measures may consist of work restrictions or additional biological monitoring activities after ground-disturbing activities are complete.

BIO-3: Pre-construction surveys for burrowing owl shall be conducted within the project area and adjacent areas prior to the start of ground-disturbing activities. The surveys shall follow the methods described in the CDFW's Staff Report on Burrowing Owl Mitigation (CDFG 2012). Two surveys shall be conducted, with the first survey being conducted between 30 and 14 days before initial ground disturbance (grading, grubbing, and construction), and the second survey being conducted no more than 24 hours prior to initial ground disturbance. If burrowing owls and/or suitable burrowing owl burrows with sign (e.g., whitewash, pellets, feathers, prey remains) are identified on the project area during the survey and impacts to those features are unavoidable, consultation with the CDFW shall be conducted and the methods described in the CDFW's Staff Report on Burrowing Owl Mitigation (CDFG 2012) for avoidance and/or passive relocation shall be followed.

BIO-4: If construction or other project activities are scheduled to occur during the bird breeding season (typically February 1 through August 31 for raptors and March 15 through August 31 for the majority of migratory bird species), a pre-construction nesting-bird survey shall be conducted by a qualified avian biologist to ensure that active bird nests, including those for the northern harrier, loggerhead shrike, black-tailed gnatcatcher, and burrowing owl, will not be disturbed or destroyed. The survey shall be completed no more than three days prior to initial ground disturbance. The nesting-bird survey shall include the project area and adjacent areas where project activities have the potential to affect active nests, either directly or indirectly, due to construction activity or noise. If an active nest is identified, the biologist shall establish an appropriately sized disturbance limit buffer around the nest using flagging or staking. Construction activities shall not occur within any disturbance limit buffer zones until the nest is deemed inactive by the qualified biologist.

BIO-5: To the greatest extent possible, plans shall avoid impacts to common reed marsh, arrow weed thicket, and tamarisk thicket habitats to minimize potential impacts to special-status species.

BIO-6: All vehicles shall stay on designated roads within BLM land to minimize impacts to habitat. Coordination with a qualified biologist shall occur prior to the staging of equipment and placement of temporary or permanent structures within BLM land. Additionally, a biologist shall demarcate temporary and permanent work spaces in the field prior to the commencement of construction-related activities. Construction plans shall incorporate measures to minimize and avoid impacts to habitats within this area. To control for introduction of invasive plant species, tires shall be cleaned prior to entering BLM lands.

BIO-7: If project-related impacts will occur to areas under the jurisdiction of the USACE, CDFW, or RWQCB, a regulatory permit with those agencies is needed prior to the impact occurring. Permitting includes preparation and submittal of a Pre-Construction Notification under Section 404 of the federal CWA, an Application for Water Quality Certification under Section 401 of the federal CWA, and a Notification of Lake or Streambed Alteration under Section 1600 of the California Fish and Game Code. Other items such as finalized project plans,

quantities of fill material, supporting technical studies, etc., are also submitted along with the applications. As a part of this process, the project must also identify and approve mitigation through the respective agencies. Mitigation can include onsite or offsite options or could include payment of an in-lieu fee to a conservation organization. Types of mitigation can include restoration, creation, rehabilitation, enhancement, or other types of habitat improvement. Typically, the type of mitigation and acreage of mitigation is negotiated with the regulatory agencies during the permitting process.

BIO-8: New structures shall not be placed within 50 feet of wetland and/or riparian habitat boundaries. A construction buffer of 300 feet shall be established around the wetlands and riparian habitats during bird breeding season (February 1 to August 31). Prior to construction, fencing shall be installed approximately 10 feet from the wetland and riparian habitat boundaries within 50 feet of the project. Fencing shall be easily visible to construction personnel.

CULTURAL

Mitigation Measure:

CUL-1: If subsurface deposits believed to be cultural or human in origin are discovered during construction, all work must halt within a 100-foot radius of the discovery. A qualified professional archaeologist, meeting the Secretary of the Interior's Professional Qualification Standards for prehistoric and historic archaeology, shall be retained to evaluate the significance of the find, and shall have the authority to modify the no work radius as appropriate, using professional judgment. The following notifications shall apply, depending on the nature of the find:

If the professional archaeologist determines that the find does not represent a cultural resource, work may resume immediately, and no agency notifications are required.

If the professional archaeologist determines that the find does represent a cultural resource from any time period or cultural affiliation, he or she shall immediately notify the County of Imperial. The agencies shall consult on a finding of eligibility and implement appropriate treatment measures if the find is determined to be a Historical Resource under CEQA, as defined in Section 15064.5(a) of the CEQA Guidelines, or a Historic Property, as defined in 36 CFR 60.4. Work may not resume within the no-work radius until the lead agencies, through consultation as appropriate, determine that the site either: 1) is not an Historical Resource under CEQA or an Historic Property under Section 106; or 2) that the treatment measures have been completed to their satisfaction.

If the find includes human remains, or remains that are potentially human, he or she shall ensure reasonable protection measures are taken to protect the discovery from disturbance (AB 2641). The archaeologist shall notify the Imperial County Coroner (per § 7050.5 of the Health and Safety Code). The provisions of § 7050.5 of the California Health and Safety Code, § 5097.98 of the California PRC, and AB 2641 will be implemented. If the Coroner determines the remains are Native American and not the result of a crime scene, the Coroner will notify the NAHC, which then will designate a Native American Most Likely Descendant (MLD) for the project (§ 5097.98 of the PRC). The designated MLD will have 48 hours from the time access to the property is granted to make recommendations concerning treatment of the remains. If the landowner does not agree with the recommendations of the MLD, the NAHC may mediate (§ 5097.94 of the PRC).

If no agreement is reached, the landowner must rebury the remains where they will not be further disturbed (§ 5097.98 of the PRC). This will also include either recording the site with the NAHC or the appropriate Information Center; using an open space or conservation zoning designation or easement; or recording a reinternment document with the county in which the property is located (AB 2641). Work may not resume within the no-work radius until the lead agencies, through consultation as appropriate, determine that the treatment measures have been completed to their satisfaction.

GEOLOGY & SOILS

Mitigation Measure

GEO-1 Prior to approval of final engineering and grading plans for the project, the County shall verify that all recommendations contained in the Geotechnical Report for the 230 kV "S" Transmission Line Upgrade prepared by Landmark Consultants, Inc. (September 2020) have been incorporated into all final engineering and grading plans. The County's soil engineer and engineering geologist shall review grading plans prior to finalization to verify compliance with the recommendations of the report. All future grading and construction of the project site shall comply with the geotechnical recommendations contained in the geotechnical report.

GEO-2 In the event that unanticipated paleontological resources or unique geologic resources are encountered during ground-disturbing activities, work must cease within 50 feet of the discovery and a paleontologist shall be hired to assess the scientific significance of the find. The consulting paleontologist shall have knowledge of local paleontology and the minimum levels of experience and expertise as defined by the Society of Vertebrate Paleontology's Standard Procedures (2010) for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources. If any paleontological resources or unique geologic features are found within the project site, the consulting paleontologist shall prepare a paleontological Treatment and Monitoring Plan to include the methods that will be used to protect paleontological resources that may exist within the project site, as well as procedures for monitoring, fossil preparation and identification, curation of specimens into an accredited repository, and preparation of a report at the conclusion of the monitoring program.

NOISE

Mitigation Measure:

NOI-1: In order to reduce construction noise at sensitive residential receptors within 50 feet of project construction, a temporary noise barrier or enclosure shall be positioned between construction equipment and all residences within 50 feet of construction activities in a manner that breaks the line of sight between the construction equipment and these residences. The temporary noise barrier shall have a sound transmission class (STC) of 10 or greater in accordance with American Society for Testing and Materials Test Method E90, or at least 2 pounds per square foot to ensure adequate transmission loss characteristics. The temporary noise barrier can consist of a solid plywood fence at least 7/16-inch in thickness and/or flexible sound curtains, such as an 18-ounce tarp or a 2-inch-thick fiberglass blanket, attached to chain link fencing or some other support structure. The length, height, and location of the temporary noise barrier shall be adequate to assure proper acoustical performance. Specifically, the barrier must completely break the line of sight between construction equipment and residential properties within 50 feet of construction activity, must be free of degrading holes or gaps, and must not be flanked by nearby reflective surfaces. All noise control barrier walls shall be designed to preclude structural failure due to such factors as winds, shear, shallow soil failure, earthquakes, and erosion.

TRIBAL CULTURAL

Mitigation Measure

TCR-1: ***If previously unidentified tribal cultural resources are identified during construction activities, construction work within 100 feet of the find shall be halted and directed away from the discovery until a Secretary of the Interior qualified archaeologist and tribal representative assesses the significance of the resource. The archaeologist, in consultation with Imperial County and any interested Tribes, shall make the necessary plans for treatment of the find(s) and for the evaluation and mitigation of impacts if the finds are determined to be a tribal cultural resource as defined in PRC Section 21074***

Attachment B
(Comment Letters)

Kimberly Noriega

From: Krug, Robert@DTSC <Robert.Krug@dtsc.ca.gov>
Sent: Friday, March 26, 2021 10:02 AM
To: Kimberly Noriega
Subject: RE: Request for Comments - CUP20-0029

CAUTION: This email originated outside our organization; please use caution.

Hi Kimberly,
If the project creates hazardous waste then they need to dispose of it properly.
Bob

Robert Krug
Supervisor / Senior Environmental Scientist
DTSC Imperial CUPA
627 Wake Avenue
El Centro, CA 92243
Robert.Krug@dtsc.ca.gov
(760) 336-8919 Work
(760) 457-7376 Cell

RECEIVED
MAR 26 2021
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

From: Kimberly Noriega <KimberlyNoriega@co.imperial.ca.us>
Sent: Friday, March 26, 2021 9:17 AM
To: County Ag Commissioner, Imperial@CDPR <carlosortiz@co.imperial.ca.us>; Sandra Mendivil <SandraMendivil@co.imperial.ca.us>; Sanchez, Margo <margosanchez@co.imperial.ca.us>; Matt Dessert <MattDessert@co.imperial.ca.us>; Belen Leon <BelenLeon@co.imperial.ca.us>; Soucier, Monica@Imperial <monicasoucier@co.imperial.ca.us>; Esperanza Colio <EsperanzaColio@co.imperial.ca.us>; Alphonso Andrade <AlphonsoAndrade@co.imperial.ca.us>; Jorge Perez <JorgePerez@co.imperial.ca.us>; Jeff Lamoure <JeffLamoure@co.imperial.ca.us>; Alfredo Estrada Jr <AlfredoEstradaJr@co.imperial.ca.us>; Robert Malek <RobertMalek@co.imperial.ca.us>; Andrew Loper <AndrewLoper@co.imperial.ca.us>; John Gay <JohnGay@co.imperial.ca.us>; Carlos Yee <CarlosYee@co.imperial.ca.us>; Guillermo Mendoza <GuillermoMendoza@co.imperial.ca.us>; Robert Benavidez <rbenavides@icso.org>; Donald Vargas - IID <DVargas@IID.com>; Stefan T. Chatwin - City of Imperial Manager <schatwin@cityofimperial.org>; ltylenda@cityofimperial.org; thagen@cityofelcentro.org; Moorhouse, Scott@CHP <SMoorhouse@chp.ca.gov>; Krug, Robert@DTSC <Robert.Krug@dtsc.ca.gov>; sha-lcr-webcomments@usbr.gov
Cc: Michael Abraham <MichaelAbraham@co.imperial.ca.us>; David Black <DavidBlack@co.imperial.ca.us>; Carina Gomez <CarinaGomez@co.imperial.ca.us>; Gabriela Robb <GabrielaRobb@co.imperial.ca.us>; John Robb <JohnRobb@co.imperial.ca.us>; Maria Scoville <mariascoville@co.imperial.ca.us>; Rosa Soto <RosaSoto@co.imperial.ca.us>; Valerie Grijalva <ValerieGrijalva@co.imperial.ca.us>
Subject: Request for Comments - CUP20-0029

EXTERNAL:

Good afternoon,

Please see attached Request for Comments Packet for Conditional Use Permit #20-0029. Comments are due by **April 6, 2021 at 5:00 PM.**

In an effort to increase the efficiency at which information is distributed and reduce paper usage, the Request for Comments Packet is being sent to you via this email.

Should you have any questions regarding this project, please feel free to contact Planner David Black (442)265-1736 ext. 1746 or submit your comment letters to icpdscommentletters@co.imperial.ca.us

Thank you,

Kimberly Noriega

Office Assistant III

Imperial County
Planning and Development Services
801 Main St.
El Centro, CA 92243
☎**Phone**: (442) 265-1736
☎**Fax**: (442) 265-1735

The preceding e-mail message (including any attachments) contains information that may be confidential, be protected by the attorney-client or other applicable privileges, or constitute non-public information. It is intended to be conveyed only to the designated recipient(s). If you are not an intended recipient of this message, please notify the sender by replying to this message and then delete it from your system. Use, dissemination, distribution, or reproduction of this message by unintended recipients is not authorized and may be unlawful.

ADMINISTRATION / TRAINING
1078 Dogwood Road
Heber, CA 92249

Administration
Phone: (442) 265-6000
Fax: (760) 482-2427

Training
Phone: (442) 265-6011

OPERATIONS/PREVENTION
2514 La Brucherie Road
Imperial, CA 92251

Operations
Phone: (442) 265-3000
Fax: (760) 355-1482

Prevention
Phone: (442) 265-3020

March 29, 2021

RE: Vega IID S-Line Upgrade CUP #20-0029
1179 Drew Rd, El Centro, CA.
APN 051-360-012, 051-360-031, 051-390-005, 051-390-004, and 051-390-013

Imperial County Fire Department Fire Prevention Bureau would like to thank you for the opportunity to review and comment on Vega IID S-Line Upgrade CUP #20-0029. The project description is S-Line Upgrade for the use by the solar photovoltaic (PV) energy generation and battery storage project. All business's (i.e., contractors, sub-contractors, and any other companies) that are used for this project will need to have a County of Imperial business licenses. Please contact County of Imperial Tax Collectors Office for application process (442) 265-1270.

Again, thank you for the opportunity to comment. Imperial County Fire Department reserves the right to comment and request additional requirements pertaining to this project regarding fire and life safety measures, California building and fire code, and National Fire Protection Association standards at a later time as we see necessary.

If you have any questions, please contact the Imperial County Fire Prevention Bureau at 442-265-3020 or 442-265-3021.

Sincerely

Robert Malek
Deputy Chief
Imperial County Fire Department
Fire Prevention Bureau

Andrew Loper
Lieutenant/Fire Prevention Specialist
Imperial County Fire Department
Fire Prevention Bureau

CC: Alfredo Estrada Jr. Fire Chief
Imperial County Fire Department

RECEIVED
APR 05 2021
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Kimberly Noriega

From: Margo Sanchez
Sent: Tuesday, April 6, 2021 4:18 PM
To: Kimberly Noriega; ICPDSCommentLetters; David Black
Subject: RE: Request for Comments - CUP20-0029

Good afternoon Mr. Black,

The Agricultural Commissioner's office has No Comment for CUP20-0029 VEGA IID 5 Line Upgrade Project at this time.

RECEIVED
APR 06 2021
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Best regards,
Margo

Margo E. Sanchez
Deputy Agricultural Commissioner/Sealer
Imperial County
agcom.imperialcounty.org
442.265.1500

From: Kimberly Noriega <KimberlyNoriega@co.imperial.ca.us>
Sent: Friday, March 26, 2021 10:15 AM
To: Carlos Ortiz <CarlosOrtiz@co.imperial.ca.us>; Sandra Mendivil <SandraMendivil@co.imperial.ca.us>; Margo Sanchez <MargoSanchez@co.imperial.ca.us>; Matt Dessert <MattDessert@co.imperial.ca.us>; Belen Leon <BelenLeon@co.imperial.ca.us>; Monica Soucier <MonicaSoucier@co.imperial.ca.us>; Esperanza Colio <EsperanzaColio@co.imperial.ca.us>; Alphonso Andrade <AlphonsoAndrade@co.imperial.ca.us>; Jorge Perez <JorgePerez@co.imperial.ca.us>; Jeff Lamoure <JeffLamoure@co.imperial.ca.us>; Alfredo Estrada Jr <AlfredoEstradaJr@co.imperial.ca.us>; Robert Malek <RobertMalek@co.imperial.ca.us>; Andrew Loper <AndrewLoper@co.imperial.ca.us>; John Gay <JohnGay@co.imperial.ca.us>; Carlos Yee <CarlosYee@co.imperial.ca.us>; Guillermo Mendoza <GuillermoMendoza@co.imperial.ca.us>; Robert Benavidez <rbenavides@icso.org>; Donald Vargas - IID <DVargas@IID.com>; katy.sanchez@nahc.ca.gov; Stefan T. Chatwin - City of Imperial Manager <schatwin@cityofimperial.org>; ltylenda@cityofimperial.org; thagen@cityofelcentro.org; Scott Moorhouse - CHP Captain <smoorhouse@chp.ca.gov>; Robert Krug <Robert.Krug@dtsc.ca.gov>; sha-lcr-webcomments@usbr.gov; jfreeman@semprautilities.com; byronfrontier@yahoo.com; Roger Sanchez <roger.sanchez-rangel@dot.ca.gov>
Cc: Michael Abraham <MichaelAbraham@co.imperial.ca.us>; David Black <DavidBlack@co.imperial.ca.us>; Carina Gomez <CarinaGomez@co.imperial.ca.us>; Gabriela Robb <GabrielaRobb@co.imperial.ca.us>; John Robb <JohnRobb@co.imperial.ca.us>; Maria Scoville <mariascoville@co.imperial.ca.us>; Rosa Soto <RosaSoto@co.imperial.ca.us>; Valerie Grijalva <ValerieGrijalva@co.imperial.ca.us>
Subject: RE: Request for Comments - CUP20-0029

Good afternoon,

Please see attached Revised Request for Comments Packet for Conditional Use Permit #20-0029. Comments are due by **April 6, 2021 at 5:00 PM.**
NOTE: Revision was made to first page, to include additional distribution.

In an effort to increase the efficiency at which information is distributed and reduce paper usage, the Request for Comments Packet is being sent to you via this email.

Should you have any questions regarding this project, please feel free to contact Planner David Black (442)265-1736 ext. 1746 or submit your comment letters to icpdscommentletters@co.imperial.ca.us

Thank you,

Kimberly Noriega
Office Assistant III

Imperial County
Planning and Development Services
801 Main St.
El Centro, CA 92243
☎ **Phone**: (442) 265-1736
☎ **Fax**: (442) 265-1735

The preceding e-mail message (including any attachments) contains information that may be confidential, be protected by the attorney-client or other applicable privileges, or constitute non-public information. It is intended to be conveyed only to the designated recipient(s). If you are not an intended recipient of this message, please notify the sender by replying to this message and then delete it from your system. Use, dissemination, distribution, or reproduction of this message by unintended recipients is not authorized and may be unlawful.

From: Kimberly Noriega
Sent: Friday, March 26, 2021 9:17 AM
To: Carlos Ortiz <CarlosOrtiz@co.imperial.ca.us>; Sandra Mendivil <SandraMendivil@co.imperial.ca.us>; Margo Sanchez <MargoSanchez@co.imperial.ca.us>; Matt Dessert <MattDessert@co.imperial.ca.us>; Belen Leon <BelenLeon@co.imperial.ca.us>; Monica Soucier <MonicaSoucier@co.imperial.ca.us>; Esperanza Colio <EsperanzaColio@co.imperial.ca.us>; Alphonso Andrade <AlphonsoAndrade@co.imperial.ca.us>; Jorge Perez <JorgePerez@co.imperial.ca.us>; Jett Lamoure <JettLamoure@co.imperial.ca.us>; Alredo Estrada <AlfredoEstradaJr@co.imperial.ca.us>; Robert Malek <RobertMalek@co.imperial.ca.us>; Andrew Loper <AndrewLoper@co.imperial.ca.us>; John Gay <JohnGay@co.imperial.ca.us>; Carlos Yee <CarlosYee@co.imperial.ca.us>; Guillermo Mendoza <GuillermoMendoza@co.imperial.ca.us>; Robert Benavidez <rbenavides@icso.org>; Donald Vargas - IID <DVargas@IID.com>; Stefan T. Chatwin - City of Imperial Manager <schatwin@cityofimperial.org>; ltylenda@cityofimperial.org; thagen@cityofelcentro.org; Scott Moorhouse - CHP Captain <smoorhouse@chp.ca.gov>; Robert Krug <Robert.Krug@dtsc.ca.gov>; sha-lcr-webcomments@usbr.gov
Cc: Michael Abraham <MichaelAbraham@co.imperial.ca.us>; David Black <DavidBlack@co.imperial.ca.us>; Carina Gomez <CarinaGomez@co.imperial.ca.us>; Gabriela Robb <GabrielaRobb@co.imperial.ca.us>; John Robb <JohnRobb@co.imperial.ca.us>; Maria Scoville <mariascoville@co.imperial.ca.us>; Rosa Soto <RosaSoto@co.imperial.ca.us>; Valerie Grijalva <ValerieGrijalva@co.imperial.ca.us>
Subject: Request for Comments - CUP20-0029

Good afternoon,

Please see attached Request for Comments Packet for Conditional Use Permit #20-0029. Comments are due by **April 6, 2021 at 5:00 PM.**

In an effort to increase the efficiency at which information is distributed and reduce paper usage, the Request for Comments Packet is being sent to you via this email.

Should you have any questions regarding this project, please feel free to contact Planner David Black (442)265-1736 ext. 1746 or submit your comment letters to icpdscommentletters@co.imperial.ca.us

Thank you,

Kimberly Noriega
Office Assistant III

Imperial County
Planning and Development Services
801 Main St.
El Centro, CA 92243
☎ **Phone:** (442) 265-1736
☎ **Fax:** (442) 265-1735

The preceding e-mail message (including any attachments) contains information that may be confidential, be protected by the attorney-client or other applicable privileges, or constitute non-public information. It is intended to be conveyed only to the designated recipient(s). If you are not an intended recipient of this message, please notify the sender by replying to this message and then delete it from your system. Use, dissemination, distribution, or reproduction of this message by unintended recipients is not authorized and may be unlawful.

150 SOUTH NINTH STREET
EL CENTRO, CA 92243-2850

TELEPHONE: (442) 265-1800
FAX: (442) 265-1799

AIR POLLUTION CONTROL DISTRICT

April 12, 2021

RECEIVED
APR 12 2021
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Jim Minnick
Planning & Development Services Director
801 Main Street
El Centro, CA 92243

SUBJECT: Condition Use Permit (CUP) 21-0029—VEGA IID S-Line Upgrade

Dear Mr. Minnick:

The Imperial County Air Pollution Control District ("Air District") appreciates the opportunity to review and comment on Condition Use Permit (CUP) 21-0029 for the replacement and upgrade of equipment along an approximately 18-mile long segment of transmission line running through the cities of El Centro and Imperial and unincorporated areas of the County.

Following electronic communication with the applicant it is the understanding of the Air District that construction involves only the installation of power poles and that all earthmoving will be above ground and no trenching will be required. However, fugitive dust (PM_{10}) is expected to be generated by construction activities such as demolition of current lines, grading and the installation of new transmission lines and poles. As such, the Project must adhere to **Regulation VIII** which is a collection of rules designed to limit emissions of fugitive dust (PM_{10}) to 20% opacity. If any construction activities include the use of a generator or air compressor above 50 brake horsepower, the applicant will need to contact the Permitting & Engineering Division of the Air District to determine if a permit is required.

Air District rules and regulations can be accessed online at https://apcd.imperialcounty.org/rules-and-regulations. Should you have questions please feel free to contact the Air District for assistance at (442) 265-1800.

Respectfully,

Curtis Blondell
APC Environmental Coordinator

Monica N. Soucier
APC Division Manager

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER

Kimberly Noriega

From:	Kennedy, William <WKennedy@socalgas.com>
Sent:	Monday, April 5, 2021 9:02 AM
To:	ICPDSCommentLetters
Cc:	David Black
Subject:	VEGA IID S-Line Project - (SCG PF 41-21-100)
Follow Up Flag:	Follow up
Flag Status:	Flagged

RECEIVED
APR 05 2021
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

CAUTION: This email originated outside our organization; please use caution.

SoCalGas
A Sempra Energy utility

Southern California
Gas Company
1981 W. Lugonia Ave
Redlands, CA 92374
Attn: Planning Dept. - M.L.8031
1-800-427-2200

Date: 04/05/2021

ATTN: David Black, Planner
Imperial County

The purpose of this letter is to inform you that SoCalGas has received the notice pertaining to the VEGA IID S-Line Project in the city of El Centro. Thank you for the advanced notice of the project.

So far, based on the plans that we received, we understand there are several **High Priority** SoCalGas facilities in your proposed work area. If conflicts are assumed, SCG would like to have the requestor propose a meet, and/or call, for all utility company reps to discuss the full scope of the project and any possible construction that might affect the existing utilities and to determine what should be done to avoid any delays or conflicts. Any cost of relocating existing facilities due to conflict with proposed construction will be at the requestors cost unless determined otherwise by land and right of way rulings. Protect in place is best practice preferred.

Public safety is our highest priority and it is still extremely important that you utilize the Underground Service Alert (Dig Alert) One-Call System, 811, before beginning any construction or excavation project. A physical excavation of the utility in question by the requestor would be the most accurate way of obtaining location and depth information. Please inform SoCalGas as soon as possible if there are any changes to plans or work areas, thank you.

If, for any reason, there are SoCalGas facilities in conflict and a request to be relocated is needed, it is important to send the request in writing. Please include all required information below:

- A Signed "Notice to Owner" request on Official Letterhead from the City, County, Agency and/or Development company.
- Name, Title and Project Number.
- Address, Location, Parameters & Scope of Entire Job/Project, Including Start Date.
- Copy of Thomas Guide Page and/or Google Map Screenshot Highlighting Project Area.
- Requestor Company's Contact Name, Title, Phone Number, Email, and other pertinent information.

Please furnish us with "signed" final plans and subsequent plan revisions as soon as they are available. A minimum of twelve weeks is needed to analyze plans (at least 90% plans acceptable) and to design required alterations to any conflicting Medium Pressure SoCalGas facilities. Minimum **Six Months** for **High Priority** facilities. Please keep us informed of any and all pre-construction meetings, construction schedules, etc., so that our work can be scheduled accordingly.

Contact information below If you have any questions or require additional information.

SCG SE Region Redlands Utility Request SCGSERegionRedlandsUtilityRequest@semprautilities.com

Bill Kennedy
Planning Associate
SoCalGas
Redlands, CA
wkennedy@socalgas.com
(909) 335-3949

IID

www.iid.com

A century of service. *Since 1911*

April 6, 2021

Mr. David Black
Planner IV
Planning & Development Services Department
County of Imperial
801 Main Street
El Centro, CA 92243

SUBJECT: Vega SES Solar Energy/IID S Line Project; CUP Application No. 21-0029 (to modify CUP No. 17-0001)

Dear Mr. Black:

On March 26, 2021, the Imperial Irrigation District received from the Imperial County Planning & Development Services Department, a request for agency comments on Conditional Use Permit application no. 21-0029 (to modify CUP No. 17-0001) for the Vega SES Solar Energy/IID S Line project. The Vega SES project consists of a 100MW solar PV energy generation plant with a battery storage facility on 494 acres of land located east of the Westside Main Canal, south of Wixom Road, west of Drew Road and north of Lyons Road in the Imperial County, California. The Vega SES project proposes to interconnect to the IID electrical grid via the district's 230kV S line. Since the transmission line is being considered an integral part of Vega SES project, the applicant, Apex Energy Solutions, LLC; through the County of Imperial, the lead agency for the Vega SES project, will undertake the land use permitting and environmental compliance for upgrading the transmission line.

The IID has reviewed the document and, in addition to previous comments provided in letter dated August 13, 2018 (see attached), requests that applicant be advised that the project will need to comply with the California Safe Drinking Water Act and have potable water delivered to the solar facility.

Should you have any questions, please do not hesitate to contact me at 760-482-3609 or at dvargas@iid.com. Thank you for the opportunity to comment on this matter.

Respectfully,

Donald Vargas
Compliance Administrator II

Enrique B. Martinez – General Manager
Mike Pacheco – Manager, Water Dept.
Marilyn Del Bosque Gilbert – Manager, Energy Dept.
Constance Bergmark – Mgr. of Planning & Eng./Chief Elect. Engineer, Energy Dept.
Enrique De Leon – Asst. Mgr., Energy Dept., Distr., Planning, Eng. & Customer Service
Jamie Asbury – Assoc. General Counsel
Vance Taylor – Asst. General Counsel
Michael P. Kemp – Superintendent, Regulatory & Environmental Compliance
Laura Cervantes – Supervisor, Real Estate

IID

A century of service.

www.iid.com

Since 1911

August 13, 2018

Mr. David Black
Planner IV
Planning & Development Services Department
County of Imperial
801 Main Street
El Centro, CA 92243

SUBJECT: First Administrative Draft EIR for VEGA SES Solar Energy Project

Dear Mr. Black:

On August 1, 2018, the Imperial irrigation District received from the Imperial County Planning & Development Services Department, the first administrative draft of the Environmental Impact Report for VEGA SES Solar Energy Project. The project consists of three components: (1) a solar energy generation facility, (2) a battery storage system and (3) a 230 kV gen-tie line to interconnect with the "proposed" 230 kV IID Fern Substation. The project is located east of the Westside Main Canal, south of Wixom Road, west of Drew Road and north of Lyons Road, 9 miles southwest of El Centro.

The IID has reviewed the document and, in addition to the comments provided in the letter dated August 28, 2017, issued by the district on the Notice of Preparation of the Draft EIR (see attached letter), has the following observations:

1. The project plans to interconnect with the "proposed" 230 kV IID Fern Substation. Be advised that this substation is currently not being considered for construction by the district.

2. Dividing a project into two or more pieces and evaluating each piece in a separate environmental document (Piecemealing or Segmenting), rather than evaluating the whole of the project in one environmental document, is explicitly forbidden by CEQA, because dividing a project into a number of pieces would allow a Lead Agency to minimize the apparent environmental impacts of a project by evaluating individual pieces separately, each of which may have a less-than-significant impact on the environment, but which together may result in a significant impact. Segmenting a project may also hinder developing comprehensive mitigation strategies. In general, if an activity or facility is necessary for the operation of a project, or necessary to achieve the project objectives, or a reasonably foreseeable consequence of approving the project, then it should be considered an integral project component that should be analyzed within the environmental analysis. The

project description should include all project components, including those that will have to be approved by responsible agencies. The State CEQA Guidelines define a project under CEQA as "the whole of the action" that may result either directly or indirectly in physical changes to the environment. This broad definition is intended to provide the maximum protection of the environment. CEQA case law has established general principles on project segmentation for different project types. For a project requiring construction of offsite infrastructure, the offsite infrastructure must be included in the project description. *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App. 4th 713.

Should you have any questions, please do not hesitate to contact me at 760-482-3609 or at dvargas@iid.com. Thank you for the opportunity to comment on this matter.

Respectfully,

Donald Vargas
Compliance Administrator II

Kevin Kelley – General Manager
Mike Pacheco – Manager, Water Dept.
Enrique B. Martinez – Manager, Energy Dept.
Jamie Asbury – Deputy Manager, Energy Dept., Operations
Enrique De Leon – Asst. Mgr., Energy Dept., Distr., Planning, Eng. & Customer Service
Vance Taylor – Asst. General Counsel
Robert Laurie – Asst. General Counsel
Michael P. Kemp – Superintendent, Regulatory & Environmental Compliance
Harold Walk Jr. – Supervisor, Real Estate
Randy Gray – ROW Agent, Real Estate
Jessica Lovecchio – Environmental Project Mgr. Sr., Water Dept.

IID

A century of service.

www.iid.com

Since 1911

August 28, 2017

Mr. David Black
Planner IV
Planning & Development Services Department
County of Imperial
801 Main Street
El Centro, CA 92243

SUBJECT: NOP of a Draft EIR for VEGA SES Solar Energy Project

Dear Mr. Black:

On August 10, 2017, the Imperial Irrigation District received from the Imperial County Planning & Development Services Department, a Notice of Preparation of a Draft Environmental Impact Report for the VEGA SES Solar Energy Project. The project consists of three components: (1) a solar energy generation facility, (2) a battery storage system and (3) a 230 kV gen-tie line to interconnect with the proposed 230 kV IID Fern Substation. The site is located east of the Westside Main Canal, south of Wixom Road, west of Drew Road and north of Lyons Road, 9 miles southwest of El Centro, CA

The IID has reviewed the initial Study and has the following comment:

1. For temporary construction electrical service and permanent electrical service to the on-site substation and the battery storage facility, the applicant should contact the IID Customer Project Development Office at (760) 482-3300 and speak with the area's project manager. In addition to submitting a formal application for electrical service (available at the IID website http://www.iid.com/home/showdocument?id=12923), the applicant will be required to submit electrical loads, plan & profile drawings (hard copy and CAD files), project schedule, estimated in-service date and project's Conditional Use Permit. All associated fees, rights of way and environmental documentation is the responsibility of the applicant.

2. Please note that a circuit study may be required prior to IID committing to serve the project.

3. The IID water facilities that may be impacted include the Westside Main Canal, Wormwood Lateral 5, Wormwood Lateral 7, Wormwood 7 Drain, Fig Drain, and the Fig Drain No. 1.

4. Taking into account that the project may impact IID drains with site runoff flows and discharge from proposed storm water detention facilities, a comprehensive IID hydraulic drain system analysis will be required to determine impacts and mitigation if the project discharges into IID's drain system. IID's hydraulic drainage system analysis includes an associated drain impact fee.

5. To ensure there are no impacts to IID water facilities, County of Imperial approved grading, drainage and fencing plans should be submitted to the IID Water Engineering Section prior to final project design as well as the projects' Storm Water Pollution Prevention Plan. IID Water Engineering can be contacted at (760) 339-9265 for further information.

6. To obtain water for the construction phase of the projects, the applicant should be advised to contact IID South End Division at (760) 482-9800.

7. The IID Water Department will require that the applicant secure with the district the necessary Water Supply Agreements for industrial use.

8. All new non-agricultural water supply requests are processed in accordance with the IID's Interim Water Supply Policy and Temporary Land Conversion Fallowing Policy. Policy documents are posted at http://www.iid.com/water/municipal-industrial-and-commercial-customers. For additional information regarding these water supply policies, applicant should contact the IID Water Supply Planning section at (760) 339-9755.

9. IID's canal or drain banks may not be used to access the project sites. Any abandonment of easements or facilities shall be approved by IID based on systems (Irrigation, Drainage, Power, etc.) needs.

10. Any construction or operation on IID property or within its existing and proposed right of way or easements including but not limited to: surface improvements such as proposed new streets, driveways, parking lots, landscape; and all water, sewer, storm water, or any other above ground or underground utilities; requires an encroachment permit, or encroachment agreement (depending on the circumstances). The permit application and its instructions are available at http://www.iid.com/home/showdocument?id=271. Additional information regarding encroachment permits or agreements can be provided by the IID Real Estate Section, which can be contacted at (760) 339-9239.

11. In addition to IID's recorded easements, IID claims, at a minimum, a prescriptive right of way to the toe of slope of all existing canals and drains. Where space is limited and depending upon the specifics of adjacent modifications, the IID may claim additional secondary easements/prescriptive rights of ways to ensure operation and maintenance of IID's facilities can be maintained and are not impacted and if impacted mitigated. Thus, IID should be consulted prior to the installation of any facilities adjacent to IID's facilities. Certain conditions may be placed on adjacent facilities to mitigate or avoid impacts to IID's facilities.

12. Any new, relocated, modified or reconstructed IID facilities required for and by the project (which can include but is not limited to electrical utility substations, electrical transmission and distribution lines, etc.) need to be included as part of the project's CEQA and/or NEPA documentation, environmental impact analysis and mitigation. Failure to do so will result in postponement of any construction and/or modification of IID facilities until such time as the environmental documentation is amended and environmental impacts are fully mitigated. **Any and all mitigation necessary as a result of the construction, relocation and/or upgrade of IID facilities is the responsibility of the project proponent.**

13. Electrical service is a public utility of utmost importance in the implementation and success of a project and not assessing a project's potential impact on this environmental factor could adversely affect the project as well as the capability of the Imperial Irrigation District to provide electrical service in an efficient and timely manner. Hence, the IID suggests that electrical service be included under the Environmental Factor titled "Utilities/Service Systems" of the checklist. It is important to note that per CEQA Statute and Guidelines the Environmental Checklist under Appendix G is a sample form and may be tailored to satisfy individual agencies' needs and project circumstances and substantial evidence of potential impacts that are not listed on this form must also be considered. The sample questions in the checklist are intended to encourage thoughtful assessment of impacts, and do not necessarily represent thresholds of significance, thus the inclusion of the items we suggest would lead to a more thorough evaluation of a project.

Should you have any questions, please do not hesitate to contact me at 760-482-3609 or at dvargas@iid.com. Thank you for the opportunity to comment on this matter.

Respectfully,

Donald Vargas
Compliance Administrator II

Kevin Kelley – General Manager
Mike Pacheco – Manager, Water Dept.
Vicken Kasarjian – Manager, Energy Dept.
Charles Allegranza – Manager, Energy Dept., Operations
Jamie Asbury – Deputy Manager, Energy Dept., Operations
Vance Taylor – Asst. General Counsel
Robert Laurie – Asst. General Counsel
Carlos Vasquez - Planning and Engineering Manager, Energy Dept
Jesse Montaño – Transmission, Planning and Engineering Oversight
Enrique De Leon – Asst. Mgr., Energy Dept., Distr., Planning, Eng. & Customer Service
Michael P. Kemp – Superintendent, Real Estate & Environmental Compliance
Harold Walk Jr. – Supervisor, Real Estate
Randy Gray – ROW Agent, Real Estate
Jessica Lovecchio – Environmental Project Mgr Sr., Water Dept.

Attachment C

(Application Material)

MINOR SUBDIVISION

I.C. PLANNING & DEVELOPMENT SERVICES DEPT
801 Main Street, El Centro, CA 92243 (760) 482-4236

- APPLICANT MUST COMPLETE ALL NUMBERED (black) SPACES – Please type or print -

1. PROPERTY OWNER'S NAME Michael & Karri Abatti, Trustees of Family Trust	EMAIL ADDRESS angela@mikeabattifarms.com	
2. MAILING ADDRESS P.O. Box 287 El Centro, CA	ZIP CODE 92244	PHONE NUMBER 760-352-0755
3. ENGINEER'S NAME CAL. LICENSE NO. Precision Engineering & Surveying, Inc. PLS 9436	EMAIL ADDRESS taylor@presurvinc.com	
4. MAILING ADDRESS P.O. Box 2216 El Centro, CA	ZIP CODE 92244	PHONE NUMBER 760-353-2684

5. PROPERTY (site) ADDRESS Parcels 5 & 6 of PTR	LOCATION Drew Road 1/2 mile South of Graham Road
6. ASSESSOR'S PARCEL NO. 051-360-012,051-360-031,051-390-013,051-390-005, & 051-390-004	SIZE OF PROPERTY (in acres or square foot) 293.03 Acres
7. LEGAL DESCRIPTION (attach separate sheet if necessary) See attached list of legal descriptions 1179 Drew Rd, Seeley, CA 92273	
8. EXPLAIN PURPOSE/REASON FOR MINOR SUBDIVISION To separate the parcels on the East side of Drew Road from the parcels on the West side of Drew Road for a Solar Farm.	

9. Proposed DIVISION of the above specified land is as follows:

PARCEL	SIZE in acres or sq. feet	EXISTING USE	PROPOSED USE	ZONE
1 or A	218.00 AC	Agriculture	Solar Farm	A2
2 or B	75.03 AC	Agriculture	Agriculture	A2
3 or C				
4 or D				

PLEASE PROVIDE CLEAR & CONCISE INFORMATION (ATTACH SEPARATE SHEET IF NEEDED)

RECEIVED
OCT 20 2020
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

10. DESCRIBE PROPOSED SEWER SYSTEM(s) NA

11. DESCRIBE PROPOSED WATER SYSTEM NA

12. DESCRIBE PROPOSED ACCESS TO SUBDIVIDED LOTS Drew Road

13. IS THIS PARCEL PLANNED TO BE ANNEXED? ☐ Yes ☑ No IF YES, TO WHAT CITY or DISTRICT?

I HEREBY APPLY FOR PERMISSION TO DIVIDE THE ABOVE SPECIFIED PROPERTY THAT I ☐ OWN ☐ CONTROL, AS PER ATTACHED INFORMATION, AND PER THE MAP ACT AND PER THE SUBDIVISION ORDINANCE.

I, CERTIFY THAT THE ABOVE INFORMATION, TO THE BEST OF MY KNOWLEDGE, IS TRUE AND CORRECT.

Michael Abatti — Print Name (owner)
Karri Abatti — Date
Signature (owner)
Taylor Preece — Print Name (Agent)
10/13/20 — Date
Signature (Agent)

REQUIRED SUPPORT DOCUMENTS

A. TENTATIVE MAP
B. PRELIMINARY TITLE REPORT (6 months or newer)
C. FEE
D. OTHER

Special Note:
An notarized owners affidavit is required if application is signed by Agent.

APPLICATION RECEIVED BY:	JDR	DATE	10/20/2020
APPLICATION DEEMED COMPLETE BY:		DATE	
APPLICATION REJECTED BY:		DATE	
TENTATIVE HEARING BY:		DATE	
FINAL ACTION: ☐ APPROVED ☐ DENIED		DATE	

REVIEW / APPROVAL BY OTHER DEPT'S required.
☐ P. W.
☐ E. H. S.
☐ A. P. C. D.
☐ O. E. S.
☐
☐

PM# 02491

IS20-0031

Precision Engineering & Surveying, Inc.
P.O. Box 2216 El Centro, CA 92244 799 E. Heil Ave., El Centro, CA 92243.
Tel. (760) 353-2684 •Fax (760) 353-2686

October 15, 2020

Jim Minnick, Director
Planning & Development Services
County of Imperial
801 Main Street
El Centro, CA 92243

Re: Lot Line Adjustment #00310 application withdrawal & Parcel Map Waiver

Dear Mr. Minnick,

Due to Drew Road splitting the parcels, my client has requested to withdraw the application for Lot Line Adjustment #00310 and submit a Parcel Map Waiver application in its place.
Tim Reilly, Imperial County Surveyor, had a meeting with Jim Minnick and Joe Hernandez discussing the Record of Survey being prepared for the Z-Global Vega Solar Site. Since the Record of Survey will show the final configuration of parcels after the legal descriptions are recorded, we are requesting a Parcel Map Waiver.

If you have any further questions or need additional information please reach out to me at 760-587-6572.

RECEIVED
OCT 20 2020
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Sincerely,

Taylor Preece, PLS, Survey Manager
Precision Engineering & Surveying, Inc.

Z-Global Vega Legal Descriptions

PARCEL 5:

LOTS 2, 3 AND 4, SECTION 1, TOWNSHIP 16 1/2 SOUTH, RANGE 12 EAST, S.B.M., AND LOTS 3, 4 AND 6, AND THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 36, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

EXCEPT THAT PORTION OF SAID LOT 2 LYING EAST OF THE STATE HIGHWAY AS SAID HIGHWAY WAS LOCATED ON MARCH 5, 1947 TOWNSHIP 16 SOUTH, RANGES 12 AND 13 EAST, S.B.M.

ALSO EXCEPT THAT PORTION OF SAID LAND CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED NOVEMBER 23, 1949 IN BOOK 763, PAGE 550 OF OFFICIAL RECORDS.

ALSO EXCEPTING THAT PORTION OF SAID LOT 6 LYING EAST OF THE SOUTHERLY PROLONGATION OF THE WEST LINE OF TRACT 202, TOWNSHIP 16 SOUTH, RANGES 12 AND 13 EAST, S.B.M.

PARCEL 6:

LOT 5, SECTION 36, AND THE SOUTHWEST QUARTER OF TRACT 37 AND THE SOUTH HALF OF THE SOUTHEAST QUARTER OF TRACT 37, ALL IN TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

RECEIVED
OCT 20 2020
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

EXHIBIT "A"

LEGAL DESCRIPTION

PARCEL 1

THOSE PORTIONS OF TRACT 37, LOT 4, LOT 5, AND LOT 6 ALONG WITH THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 36, TOWNSHIP 16 SOUTH, RANGE 12 EAST, SAN BERNARDINO MERIDIAN, ALSO THOSE PORTIONS OF LOT 2, LOT 3, AND LOT 4, SECTION 1, TOWNSHIP 16 1/2 SOUTH, RANGE 12 EAST, SAN BERNARDINO MERIDIAN ALL LYING IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE SOUTH TOWNSHIP LINE OF SAID TOWNSHIP 16 SOUTH, AND THE WEST RIGHT OF WAY LINE OF DREW ROAD; THENCE SOUTH 36°02'22" WEST A DISTANCE OF 982.38 FEET TO THE BEGINNING OF A NON-TANGENT CURVE, CONCAVE TO THE SOUTHWEST, HAS A BEGINNING RADIAL BEARING OF NORTH 52°07'25" EAST AND A RADIUS OF 1482.43 FEET; THENCE ALONG SAID CURVE A DISTANCE OF 65.45 FEET TO THE SOUTH LINE OF SAID LOT 2; THENCE SOUTH 89°46'54" WEST A DISTANCE OF 3719.46 FEET TO THE WEST LINE OF SAID SECTION 1; THENCE NORTH 00°16'53" WEST, ALONG THE WEST LINE OF SAID SECTION 1 A DISTANCE OF 845.81 FEET TO THE NORTH TOWNSHIP LINE OF SAID TOWNSHIP 16 ½ SOUTH; THENCE SOUTH 89°43'00" WEST A DISTANCE OF 245.52 FEET; THENCE NORTH 00°21'20" WEST A DISTANCE OF 1320.22 FEET TO THE SOUTHWEST CORNER OF SAID LOT 5; THENCE NORTH 00°20'57" WEST A DISTANCE OF 1320.23 FEET TO THE NORTHWEST CORNER OF SAID LOT 5; THENCE NORTH 89°41'17" EAST A DISTANCE OF 766.41 FEET TO THE WEST LINE OF TRACT 37; THENCE NORTH 00°16'10" WEST, ALONG THE WEST LINE OF TRACT 37, A DISTANCE OF 508.34 FEET; THENCE NORTH 89°43'10" EAST A DISTANCE OF 321.84 FEET TO THE WEST RIGHT OF WAY LINE OF DREW ROAD; THENCE SOUTH 36°04'45" EAST A DISTANCE OF 1069.82 FEET; THENCE SOUTH 36°00'39" EAST A DISTANCE OF 2810.39 FEET TO THE POINT OF BEGINNING.

THE ABOVE DESCRIBED PROPERTY SHALL BE HELD AS ONE PARCEL AND NO PORTION THEREOF SHALL BE SOLD SEPARATELY.

CONTAINING 218.00 ACRES, MORE OR LESS.

RECEIVED
OCT 20 2020
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

October 19, 2020
JOB#19151

EXHIBIT "A"

LEGAL DESCRIPTION

PARCEL 2

THOSE PORTIONS OF TRACT 37, LOT 3, LOT 4, AND LOT 6 ALONG WITH THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 36, TOWNSHIP 16 SOUTH, RANGE 12 EAST, SAN BERNARDINO MERIDIAN, IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE EAST-WEST HALF TRACT LINE OF SAID TRACT 37 AND THE EAST RIGHT OF WAY LINE OF DREW ROAD; THENCE NORTH 89°41'41" EAST A DISTANCE OF 1018.82 FEET, ALONG THE EAST-WEST HALF TRACT LINE OF SAID TRACT 37; THENCE SOUTH 00°11'02" EAST A DISTANCE OF 658.59 FEET; THENCE NORTH 89°43'45" EAST A DISTANCE OF 1462.97 FEET TO THE EAST LINE OF SAID TRACT 37; THENCE SOUTH 00°05'54" EAST A DISTANCE OF 658.63 FEET TO THE SOUTHEAST CORNER OF SAID TRACT 37; THENCE SOUTH 00°08'34" EAST A DISTANCE OF 1831.38 FEET TO THE SOUTH LINE OF SAID SECTION 36, ALSO BEING THE SOUTH TOWNSHIP LINE; THENCE SOUTH 89°42'05" WEST A DISTANCE OF 207.31 FEET TO THE EAST RIGHT OF WAY LINE OF DREW ROAD; THENCE NORTH 36°01'44" WEST, ALONG THE EAST RIGHT OF WAY LINE OF DREW ROAD, A DISTANCE OF 3880.10 FEET TO THE POINT OF BEGINNING.

THE ABOVE DESCRIBED PROPERTY SHALL BE HELD AS ONE PARCEL AND NO PORTION THEREOF SHALL BE SOLD SEPARATELY.

CONTAINING 75.03 ACRES, MORE OR LESS.

RECEIVED
OCT 20 2020
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

October 19, 2020
JOB#19151

CHICAGO TITLE COMPANY

PRELIMINARY REPORT

Order No.: 7102001211-SB
Property: APN# 051-360-012, 021 & 031; and 051-390-004, 005 & 013 Calexico, CA 92231

In response to the application for a policy of title insurance referenced herein, ***Chicago Title Company*** *hereby reports that it is prepared to issue, or cause to be issued, as of the date hereof, a policy or policies of title insurance describing the land and the estate or interest therein hereinafter set forth, insuring against loss which may be sustained by reason of any defect, lien or encumbrance not shown or referred to as an exception herein or not excluded from coverage pursuant to the printed Schedules, Conditions and Stipulations or Conditions of said policy forms.*

The printed Exceptions and Exclusions from the coverage and Limitations on Covered Risks of said policy or policies are set forth in Attachment One. The policy to be issued may contain an arbitration clause. When the Amount of Insurance is less than that set forth in the arbitration clause, all arbitrable matters shall be arbitrated at the option of either the Company or the Insured as the exclusive remedy of the parties. Limitations on Covered Risks applicable to the CLTA and ALTA Homeowner's Policies of Title Insurance which establish a Deductible Amount and a Maximum Dollar Limit of Liability for certain coverages are also set forth in Attachment One. Copies of the policy forms should be read. They are available from the office which issued this report.

This report (and any supplements or amendments hereto) is issued solely for the purpose of facilitating the issuance of a policy of title insurance and no liability is assumed hereby. If it is desired that liability be assumed prior to the issuance of a policy of title insurance, a Binder or Commitment should be requested.

The policy(ies) of title insurance to be issued hereunder will be policy(ies) of Chicago Title Insurance Company, a Florida corporation.

Please read the exceptions shown or referred to herein and the exceptions and exclusions set forth in Attachment One of this report carefully. The exceptions and exclusions are meant to provide you with notice of matters which are not covered under the terms of the title insurance policy and should be carefully considered.

It is important to note that this preliminary report is not a written representation as to the condition of title and may not list all liens, defects and encumbrances affecting title to the land.

Chicago Title Insurance Company

By:

President

Countersigned By:

Authorized Officer or Agent

CHICAGO TITLE INSURANCE COMPANY CORPORATE SEAL

Attest:

Secretary

Visit Us on our Website: www.ctic.com

CHICAGO TITLE COMPANY

ISSUING OFFICE: 1425 Main Street, El Centro, CA 92244

FOR SETTLEMENT INQUIRIES, CONTACT:
Chicago Title Company
1425 W. Main Street • El Centro, CA 92243
(760)335-3130 • FAX (760)352-8099

PRELIMINARY REPORT

Update: 1

Title Officer: Stacey Benner
Email: stacey.benner@ctt.com
Phone No.: (760)335-3125
Fax No.: (760)353-1307
Title No.: 7102001211-SB

Escrow Officer: Heather Skains
Email: heather.skains@ctt.com
Phone No.: (760)335-3130
Fax No.: (760)352-9410
Escrow No.: 7102001211-HS

PROPERTY ADDRESS(ES): APN# 051-360-012, 021 & 031; and 051-390-004, 005 & 013, Calexico, CA

EFFECTIVE DATE: March 20, 2020 at 12:00 AM

The form of policy or policies of title insurance contemplated by this report is:

CLTA Standard Coverage Policy 1990 (04-08-14)

1. The estate or interest in the Land hereinafter described or referred to covered by this Report is:

   Fee

2. Title to said estate or interest at the date hereof is vested in:

   Michael A. Abatti and Kerri A. Abatti, Trustees of the Michael and Kerri Abatti Family Trust dated July 25, 2007

3. The Land referred to in this Report is described as follows:

   For APN/Parcel ID(s): 051-360-012-000, 051-360-021-000, 051-360-031-000, 051-390-004-000, 051-390-005-000, 051-390-013-000 and 051-390-012-000

   PARCEL 1:

   THE SOUTHEAST QUARTER OF THE NORTHEAST QUARTER, AND THAT PORTION OF THE SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SECTION 35, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING EAST OF THE CENTER LINE OF COUNTY ROAD AS CONSTRUCTED THROUGH SAID SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SAID LAND ON NOVEMBER 3, 1959.

   PARCEL 2:

   THAT PORTION OF THE SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SECTION

PRELIMINARY REPORT
(continued)

35, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING SOUTH AND EAST OF THE CENTER LINE OF FIG DRAIN AND WEST OF THE CENTER LINE OF COUNTY ROAD AS NOW CONSTRUCTED OVER SAID LAND.

PARCEL 3:

LOT 2, SECTION 36, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

PARCEL 4:

THAT PORTION OF THE NORTH HALF OF TRACT 37, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING SOUTH AND WEST OF STATE HIGHWAY AS LOCATED ON MAY 6, 1954.

PARCEL 5:

LOTS 2, 3 AND 4, SECTION 1, TOWNSHIP 16 1/2 SOUTH, RANGE 12 EAST, S.B.M., AND LOTS 3, 4 AND 6, AND THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 36, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

EXCEPT THAT PORTION OF SAID LOT 2 LYING EAST OF THE STATE HIGHWAY AS SAID HIGHWAY WAS LOCATED ON MARCH 5, 1947 TOWNSHIP 16 SOUTH, RANGES 12 AND 13 EAST, S.B.M.

ALSO EXCEPT THAT PORTION OF SAID LAND CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED NOVEMBER 23, 1949 IN BOOK 763, PAGE 550 OF OFFICIAL RECORDS.

ALSO EXCEPTING THAT PORTION OF SAID LOT 6 LYING EAST OF THE SOUTHERLY PROLONGATION OF THE WEST LINE OF TRACT 202, TOWNSHIP 16 SOUTH, RANGES 12 AND 13 EAST, S.B.M.

PARCEL 6:

LOT 5, SECTION 36, AND THE SOUTHWEST QUARTER OF TRACT 37 AND THE SOUTH HALF OF THE SOUTHEAST QUARTER OF TRACT 37, ALL IN TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

PARCEL 7:

LOT 1, SECTION 36, THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SECTION 35, AND THAT PART OF LOT 1, SECTION 35, TOWNSHIP 16 SOUTH, RANGE 12 3AST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING EAST OF THE EAST LINE OF TRACT 293, SAID TOWNSHIP AND RANGE, PRODUCED SOUTHERLY TO THE SOUTH LINE OF SAID LOT 1.

PRELIMINARY REPORT
(continued)

EXCEPTING FROM SAID LAND THE NORTH 22 FEET THEREOF.

PARCEL 8:

THE NORTH HALF OF THE SOUTHWEST QUARTER, EXCEPTING ANY PORTION LYING SOUTH AND WEST OF THE WEST SIDE MAIN CANAL, AND THAT PORTION OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 35, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTHEAST CORNER OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 35; THENCE SOUTH ALONG THE EASTERLY LINE OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SAID SECTION, TO THE POINT WHERE THE NORTHERLY LINE OF THE RIGHT OF WAY OF WEST SIDE MAIN CANAL AS IT IS NOW SITUATED, INTERSECTS SAID LINE; THENCE NORTHWESTERLY ALONG THE NORTHERLY LINE OF THE RIGHT OF WAY OF SAID WEST SIDE MAIN CANAL TO THE POINT WHERE IT INTERSECTS THE NORTHERLY LINE OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SAID SECTION; THENCE EASTERLY ALONG SAID NORTH LINE OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SAID SECTION, TO THE POINT OF BEGINNING.

EXCEPT THAT PORTION, IF ANY, LYING SOUTH AND WEST OF IMPERIAL IRRIGATION DISTRICT DRAIN DITCH.

PARCEL 9:

LOTS 7 AND 10, SECTION 1, TOWNSHIP 16-1/2 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

EXCEPTING THEREFROM THAT PART OF LOT 7 HERETOFORE CONVEYED TO THE COUNTY OF IMPERIAL FOR HIGHWAY PURPOSES, BEING 30 FEET ON EACH SIDE OF A LINE DESCRIBED AS:

BEGINNING ON THE NORTH LINE OF LOT 7, AT A POINT 225 FEET WESTERLY OF THE NORTHEAST CORNER OF SAID LOT 7; THENCE ON THE ARC OF A CIRCLE THE RADIUS OF WHICH IS 1100 FEET TO A POINT ON THE EAST LINE OF SAID LOT 7, WHERE SAID CENTER LINE OF SAID ROAD INTERSECTS THE EAST LINE OF SAID LOT 7.

AT THE DATE HEREOF, EXCEPTIONS TO COVERAGE IN ADDITION TO THE PRINTED EXCEPTIONS AND EXCLUSIONS IN SAID POLICY FORM WOULD BE AS FOLLOWS:

1. Property taxes, which are a lien not yet due and payable, including any assessments collected with taxes to be levied for the fiscal year 2020-2021.

2. Property taxes, including any personal property taxes and any assessments collected with taxes are as follows:

Code Area:	085-001
Tax Identification No.:	051-360-012-000
Fiscal Year:	2019-2020
1st Installment:	$861.65 Paid
2nd Installment:	$861.65 Not Paid
Land:	$133,184.00
Improvements:	$6,367.00

3. Property taxes, including any personal property taxes and any assessments collected with taxes are as follows:

Code Area:	085-001
Tax Identification No.:	051-360-021-000
Fiscal Year:	2019-2020
1st Installment:	$1,722.75 Paid
2nd Installment:	$1,722.75 Not Paid
Land:	$259,365.00
Improvements:	$20,385.00

4. Property taxes, including any personal property taxes and any assessments collected with taxes are as follows:

Code Area:	085-001
Tax Identification No.:	051-360-031-000
Fiscal Year:	2019-2020
1st Installment:	$5,233.79 Paid
2nd Installment:	$5,233.79 Not Paid
Land:	$796,596.00
Improvements:	$54,798.00

5. Property taxes, including any personal property taxes and any assessments collected with taxes are as follows:

Code Area:	085-001
Tax Identification No.:	051-390-004-000
Fiscal Year:	2019-2020
1st Installment:	$2,337.29 Paid
2nd Installment:	$2,337.29 Not Paid
Land:	$356,870.00
Improvements:	$22,935.00

6. Property taxes, including any personal property taxes and any assessments collected with taxes are as follows:

Code Area:	085-001
Tax Identification No.:	051-390-005-000
Fiscal Year:	2019-2020
1st Installment:	$474.16 Paid
2nd Installment:	$474.16 Not Paid
Land:	$70,096.00
Improvements:	$6,367.00

EXCEPTIONS
(continued)

7. Property taxes, including any personal property taxes and any assessments collected with taxes are as follows:

Code Area:	074-004
Tax Identification No.:	051-390-013-000
Fiscal Year:	2019-2020
1st Installment:	$1,691.39 Paid
2nd Installment:	$1,691.39 Not Paid
Land:	$272,111.00
Improvements:	$31,857.00

8. The lien of supplemental or escaped assessments of property taxes, if any, made pursuant to the provisions of Chapter 3.5 (commencing with Section 75) or Part 2, Chapter 3, Articles 3 and 4, respectively, of the Revenue and Taxation Code of the State of California as a result of the transfer of title to the vestee named in Schedule A or as a result of changes in ownership or new construction occurring prior to Date of Policy.

9. Taxes and assessments levied by the Imperial Irrigation District, if any.

10. Rights or claims of easements for canals, drains, laterals, irrigation pipelines and gates not recorded in the public record.

11. Title to, and easements in, any portion of the land lying within any highways, roads, streets, or other ways.

12. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial County
Purpose:	Road
Recording Date:	March 9, 1925
Recording No.:	in book 67, page 445 of Official Records
Affects:	Reference is made to said document for full particulars. Affects Parcels 1 and 2

13. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	Drain ditch and appurtenances
Recording Date:	November 5, 1948
Recording No.:	in book 215, page 67 of Official Records
Affects:	Over a strips 150 feet wide and 75 feet wide over the South half of the Northeast quarter of Section 35. Affects Parcels 1 and 2

14. A non-exclusive easement 20 feet wide for roadway along the South line of Parcel 2 lying South and East of the center line of Fig Drain and West of the center line of the County Road as now constructed, in favor of Jack V. Williams, et ux., and Stanley M. Mitosinka, et ux., recorded March 19, 1962 in book 1105, page 635 of Official Records.

15. A non-exclusive 20 foot easement for roadway lying Northerly of and contiguous to the South line of Parcel 2, South and East of the center line of Fig Drain and West of the center line of the County Road as now constructed over said land, in favor of Carroll O. Childers, et ux. and Jimmy C. Hampton, et ux., recorded July 27, 1962 in book 1113, page 64 of Official Records.

EXCEPTIONS
(continued)

16. Conditions and Restrictions contained in the Deed in favor of the State of California, recorded June 16, 1949 in book 749, page 335 of Official Records and November 23, 1949 in book 763, page 550 of Official Records. Reference is made to said document for full particulars.

Affects Parcels 4, 5 and 6

17. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial County
Purpose:	Public Road
Recording Date:	July 18, 1911
Recording No.:	in book 59, page 63 of Deeds
Affects:	A 60 foot wide strip over the South half of Parcel 5.

18. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	Canal and Pole Lines
Recording Date:	March 20, 1931
Recording No.:	in book 254, page 487 of Official Records
Affects:	A 50 foot wide strip over Parcel 5.

19. Easement(s) for the purpose(s) shown below and rights incidental thereto as reserved in a document;

Reserved by:	Imperial Irrigation District
Purpose:	For irrigation, waste and drainage canals.
Recording Date:	July 23, 1945
Recording No.:	in book 642, page 294 of Offiicial Records
Affects:	The exact location and extent of said easement is not disclosed of record. Affects Parcel 5

20. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	Canal and Pole Lines
Recording Date:	September 3, 1937
Recording No.:	in book 681, page 285 of Official Records
Affects:	Over a 90 foot wide strip, the Easterly line parallel with and 140 feet Easterly of the center line of State Highway as now constructed over said land. Affects Parcel 5

21. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	Canal and Pole Lines
Recording Date:	March 2, 1949
Recording No.:	in book 739, page 323 and 326 of Offiicial Records
Affects:	The North Line of Parcel 6 and the East line of Parcel 5.

EXCEPTIONS
(continued)

22. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial County
Purpose:	Road
Recording Date:	March 12, 1918
Recording No.:	in book 96, page 190 of Deeds
Affects:	The East 20 feet of Lot 5 of Parcel 6.

23. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	Canal and Pole Lines
Recording Date:	March 13, 1931
Recording No.:	in book 254, page 409 of Official Records
Affects:	25 foot wide strip parallel with and adjacent to the East line of Parcel 6. Also, over the South half of Parcel 6.

24. Easement(s) for the purpose(s) shown below and rights incidental thereto as reserved in a document;

Reserved by:	Imperial Irrigation District
Purpose:	For irrigation, waste or drainage canals.
Recording Date:	December 9, 1946
Recording No.:	in book 667, page 599 of Official Records
Affects:	The exact location and extent of said easement is not disclosed of record. Affects Parcel 6

25. The terms, covenants and conditions of an agreement between the Imperial Irrigation District and D. B. Roberts to supply domestic water to Parcel 7, herein described, recorded August 31, 1955 in book 918, page 41 of Official Records.

Reference is made to said document for full particulars.

26. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	Canal and Pole Lines
Recording Date:	March 9, 1961
Recording No.:	in book 1073, page 29 of Official Records
Affects:	East of a line parallel with and 35 feet West of the center line of Wormwood Lateral 7 Canal as now constructed along a portion of the East line of Parcel 7.

27. An Anchor Permit in favor of the Imperial Irrigation District:

Purpose:	Anchors, guys or guy stubs
Recorded:	March 27, 1973 in book 1344, page 294 of Official Records
Affects:	Parcel 7, at a point 50 feet West of the centerline of Wormwood Canal and 30 feet South of the centerline of Wixom Road; and at a point 50 feet West of the centerline of Wormwood Canal and 770 feet South of the centerline of Wixom Road over Parcel 7.

EXCEPTIONS
(continued)

28. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial County
Purpose:	A right of way over a strip of land 60 feet wide, extending North and over said land.
Recording No.:	in book 67, page 445 of Official Records
Affects:	Reference is made to said document for full particulars. Affects Parcel 8

29. A right of way 100 feet wide for Westside Drain as per Map, also, 75 feet along the East line, as set out in the Deed from the Imperial Irrigation District to G. W. McCune, et ux., recorded in book 215, page 73 of Official Records. Reference is made to said document for full particulars. Affects Parcel 8

30. A right of way for roads, ditches and canals as shown on License Survey Map on file in book 5, page 42 of License Surveys. Affects Parcel 8

31. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Carroll O. Childers, et al.
Purpose:	Roadway Purposes
Recording Date:	February 28, 1962
Recording No.:	in book 1104, page 193 of Official Records
Affects:	Parcel 8, over a 30 foot wide strip over the North 30 feet of the East 150 feet of the Northeast quarter of the Southwest quarter of Section 35, except any portion lying South and East of Fig Drain.

32. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Carroll O. Childers, et al.
Purpose:	Irrigation Ditch
Recording Date:	December 9, 1963
Recording No.:	in book 1171, page 7 of Official Records
Affects:	The West 20 feet of the Northwest quarter of the Southwest quarter of Section 35, lying North of the Westside Main Canal. Affects Parcel 8

33. A deed of trust to secure an indebtedness in the amount shown below,

Amount:	$1,250,000.00
Dated:	December 3, 2003
Trustor/Grantor	Michael A. Abatti and Kerri A. Abatti, husband and wife
Trustee:	Farm Credit Services Southwest, FLCA
Beneficiary:	Farm Credit Services Southwest, FLCA
Recording Date:	December 23, 2003
Recording No.:	2003-040213 in book 2266, page 1147 of Official Records

Affects: The herein described Land and other land.

EXCEPTIONS
(continued)

34. Any invalidity or defect in the title of the vestees in the event that the trust referred to herein is invalid or fails to grant sufficient powers to the trustee(s) or in the event there is a lack of compliance with the terms and provisions of the trust instrument.

If title is to be insured in the trustee(s) of a trust, (or if their act is to be insured), this Company will require a Trust Certification pursuant to California Probate Code Section 18100.5.

The Company reserves the right to add additional items or make further requirements after review of the requested documentation. Affects Parcels 1-9

35. The herein described Land is located in an area frequently subject to Land Conservation Contracts executed pursuant to the Williamson Act (Cal. Govt. Code §§ 51200 et seq.). Land Conservation Contracts restrict the land use to agricultural, recreational, open-space and other compatible uses. If the herein described Land is subject to a Land Conservation Contract, please notify the Title Department.

The Company reserves the right to add additional items and/or make further requirements

Affects Parcels 1-9

36. Any right, interest or claim that may exist, arise or be asserted under or pursuant to the Perishable Agricultural Commodities Act of 1930, as amended, 7 USC 499a et seq., the Packers and Stockyard Act of 1921, as amended, 7 USC 181 et seq., or any similar state laws. Affects Parcels 1-9

37. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	County of Imperial
Purpose:	County Road
Recording No.:	in book 96, page 179 of Deeds
Affects:	The South 30 feet of Parcel 9.

38. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	For canal, telephone and/or electric power lines.
Recording Date:	September 22, 1933
Recording No.:	in book 368, page 44 of Official Records
Affects:	Said right of way to be 6 feet in width, lying parallel with and adjacent to the Wormwood No. 5 Canal along the South side of Lot 10 of Parcel 9.

39. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation District
Purpose:	For canal, telephone and/or electric power line.
Recording Date:	September 22, 1933
Recording No.:	in book 365, page 593 of Official Records
Affects:	Said right of way to be 6 feet in width lying adjacent to the Wormwood Canal along the East side of Lots 7 and 10 of Parcel 9.

EXCEPTIONS
(continued)

40. Easement(s) for the purpose(s) shown below and rights incidental thereto, as granted in a document:

Granted to:	Imperial Irrigation Distinct
Purpose:	For a power line.
Recording Date:	October 13, 1938
Recording No.:	in book 502, page 79 of Official Records
Affects:	Said right of way to be along those portions of said land now being used as public travelled ways. Affects Parcel 9

41. An agreement between B.A. Harrigan, et ux., and the Imperial Irrigation District, recorded December 3, 1956 in book 957, page 258 of Official Records, wherein Harrigan's agree to accept Fig Drain No. 1-B at the Southwest corner of said Parcel 9, as the sole drain for said parcel.

Reference is made to said document for full particulars.

END OF EXCEPTIONS

NOTES

Note 1. Notice: Please be aware that due to the conflict between federal and state laws concerning the cultivation, distribution, manufacture or sale of marijuana, the Company is not able to close or insure any transaction involving Land that is associated with these activities.

Note 2. If a county recorder, title insurance company, escrow company, real estate broker, real estate agent or association provides a copy of a declaration, governing document or deed to any person, California law requires that the document provided shall include a statement regarding any unlawful restrictions. Said statement is to be in at least 14-point bold face type and may be stamped on the first page of any document provided or included as a cover page attached to the requested document. Should a party to this transaction request a copy of any document reported herein that fits this category, the statement is to be included in the manner described.

Note 3. If this company is requested to disburse funds in connection with this transaction, Chapter 598, Statutes of 1989 mandates hold periods for checks deposited to escrow or sub-escrow accounts. The mandatory hold period for cashier's checks, certified checks and teller's checks is one business day after the day deposited. Other checks require a hold period of from two to five business days after the day deposited. In the event that the parties to the contemplated transaction wish to record prior to the time that the funds are available for disbursement (and subject to Company approval), the Company will require the prior written consent of the parties. Upon request, a form acceptable to the company authorizing said early recording may be provided to Escrow for execution.

Note 4. Any documents being executed in conjunction with this transaction must be signed in the presence of an authorized Company employee, an authorized employee of an agent, an authorized employee of the insured lender, or by using Bancserv or other approved third-party service. If the above requirements cannot be met, please call the company at the number provided in this report.

Note 5. The application for title insurance was placed by reference to only a street address or tax identification number. The proposed Insured must confirm that the legal description in this report covers the parcel(s) of Land requested to be insured. If the legal description is incorrect, the proposed Insured must notify the Company and/or the settlement company in order to prevent errors and to be certain that the legal description for the intended parcel(s) of Land will appear on any documents to be recorded in connection with this transaction and on the policy of title insurance.

Note 6. Note: Pursuant to Government Code Section 27388.1, as amended and effective as of 1-1-2018, a Documentary Transfer Tax (DTT) Affidavit may be required to be completed and submitted with each document when DTT is being paid or when an exemption is being claimed from paying the tax. If a governmental agency is a party to the document, the form will not be required. DTT Affidavits may be available at a Tax Assessor-County Clerk-Recorder.

Note 7. Due to the special requirements of SB 50 (California Public Resources Code Section 8560 et seq.), any transaction that includes the conveyance of title by an agency of the United States must be approved in advance by the Company's State Counsel, Regional Counsel, or one of their designees.

Note 8. This Company will require a full copy of the trust agreement and any amendments thereto.

NOTES
(continued)

Note 9. The Company will require the following documents for review prior to the issuance of any title insurance predicated upon a conveyance or encumbrance from the entity named below.

Limited Liability Company: Apex Energy Solutions, LLC

a. A copy of its operating agreement, if any, and any and all amendments, supplements and/or modifications thereto, certified by the appropriate manager or member.

b. If a domestic Limited Liability Company, a copy of its Articles of Organization and all amendment thereto with the appropriate filing stamps.

c. If the Limited Liability Company is member-managed a full and complete current list of members certified by the appropriate manager or member.

d. A current dated certificate of good standing from the proper governmental authority of the state in which the entity was created

e. If less than all members, or managers, as appropriate, will be executing the closing documents, furnish evidence of the authority of those signing.

f) If Limited Liability Company is a Single Member Entity, a Statement of Information for the Single Member will be required.

g) Each member and manager of the LLC without an Operating Agreement must execute in the presence of a notary public the Certificate of California LLC (Without an Operating Agreement) Status and Authority form

END OF NOTES

EXHIBIT "A"

Legal Description

For APN/Parcel ID(s): 051-360-012-000, 051-360-021-000, 051-360-031-000, 051-390-004-000, 051-390-005-000, 051-390-013-000 and 051-390-012-000

PARCEL 1:

THE SOUTHEAST QUARTER OF THE NORTHEAST QUARTER, AND THAT PORTION OF THE SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SECTION 35, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING EAST OF THE CENTER LINE OF COUNTY ROAD AS CONSTRUCTED THROUGH SAID SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SAID LAND ON NOVEMBER 3, 1959.

PARCEL 2:

THAT PORTION OF THE SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SECTION 35, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING SOUTH AND EAST OF THE CENTER LINE OF FIG DRAIN AND WEST OF THE CENTER LINE OF COUNTY ROAD AS NOW CONSTRUCTED OVER SAID LAND.

PARCEL 3:

LOT 2, SECTION 36, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

PARCEL 4:

THAT PORTION OF THE NORTH HALF OF TRACT 37, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING SOUTH AND WEST OF STATE HIGHWAY AS LOCATED ON MAY 6, 1954.

PARCEL 5:

LOTS 2, 3 AND 4, SECTION 1, TOWNSHIP 16 1/2 SOUTH, RANGE 12 EAST, S.B.M., AND LOTS 3, 4 AND 6, AND THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 36, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

EXCEPT THAT PORTION OF SAID LOT 2 LYING EAST OF THE STATE HIGHWAY AS SAID HIGHWAY WAS LOCATED ON MARCH 5, 1947 TOWNSHIP 16 SOUTH, RANGES 12 AND 13 EAST, S.B.M.

ALSO EXCEPT THAT PORTION OF SAID LAND CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED NOVEMBER 23, 1949 IN BOOK 763, PAGE 550 OF OFFICIAL RECORDS.

ALSO EXCEPTING THAT PORTION OF SAID LOT 6 LYING EAST OF THE SOUTHERLY PROLONGATION OF THE WEST LINE OF TRACT 202, TOWNSHIP 16 SOUTH, RANGES 12 AND 13 EAST, S.B.M.

EXHIBIT "A"
Legal Description

PARCEL 6:

LOT 5, SECTION 36, AND THE SOUTHWEST QUARTER OF TRACT 37 AND THE SOUTH HALF OF THE SOUTHEAST QUARTER OF TRACT 37, ALL IN TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

PARCEL 7:

LOT 1, SECTION 36, THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SECTION 35, AND THAT PART OF LOT 1, SECTION 35, TOWNSHIP 16 SOUTH, RANGE 12 3AST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, LYING EAST OF THE EAST LINE OF TRACT 293, SAID TOWNSHIP AND RANGE, PRODUCED SOUTHERLY TO THE SOUTH LINE OF SAID LOT 1.

EXCEPTING FROM SAID LAND THE NORTH 22 FEET THEREOF.

PARCEL 8:

THE NORTH HALF OF THE SOUTHWEST QUARTER, EXCEPTING ANY PORTION LYING SOUTH AND WEST OF THE WEST SIDE MAIN CANAL, AND THAT PORTION OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 35, TOWNSHIP 16 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTHEAST CORNER OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 35; THENCE SOUTH ALONG THE EASTERLY LINE OF THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SAID SECTION, TO THE POINT WHERE THE NORTHERLY LINE OF THE RIGHT OF WAY OF WEST SIDE MAIN CANAL AS IT IS NOW SITUATED, INTERSECTS SAID LINE; THENCE NORTHWESTERLY ALONG THE NORTHERLY LINE OF THE RIGHT OF WAY OF SAID WEST SIDE MAIN CANAL TO THE POINT WHERE IT INTERSECTS THE NORTHERLY LINE OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SAID SECTION; THENCE EASTERLY ALONG SAID NORTH LINE OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SAID SECTION, TO THE POINT OF BEGINNING.

EXCEPT THAT PORTION, IF ANY, LYING SOUTH AND WEST OF IMPERIAL IRRIGATION DISTRICT DRAIN DITCH.

PARCEL 9:

LOTS 7 AND 10, SECTION 1, TOWNSHIP 16-1/2 SOUTH, RANGE 12 EAST, S.B.M., IN AN UNINCORPORATED AREA OF THE COUNTY OF IMPERIAL, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

EXCEPTING THEREFROM THAT PART OF LOT 7 HERETOFORE CONVEYED TO THE COUNTY OF IMPERIAL FOR HIGHWAY PURPOSES, BEING 30 FEET ON EACH SIDE OF A LINE DESCRIBED AS:

BEGINNING ON THE NORTH LINE OF LOT 7, AT A POINT 225 FEET WESTERLY OF THE NORTHEAST CORNER OF SAID LOT 7; THENCE ON THE ARC OF A CIRCLE THE RADIUS OF

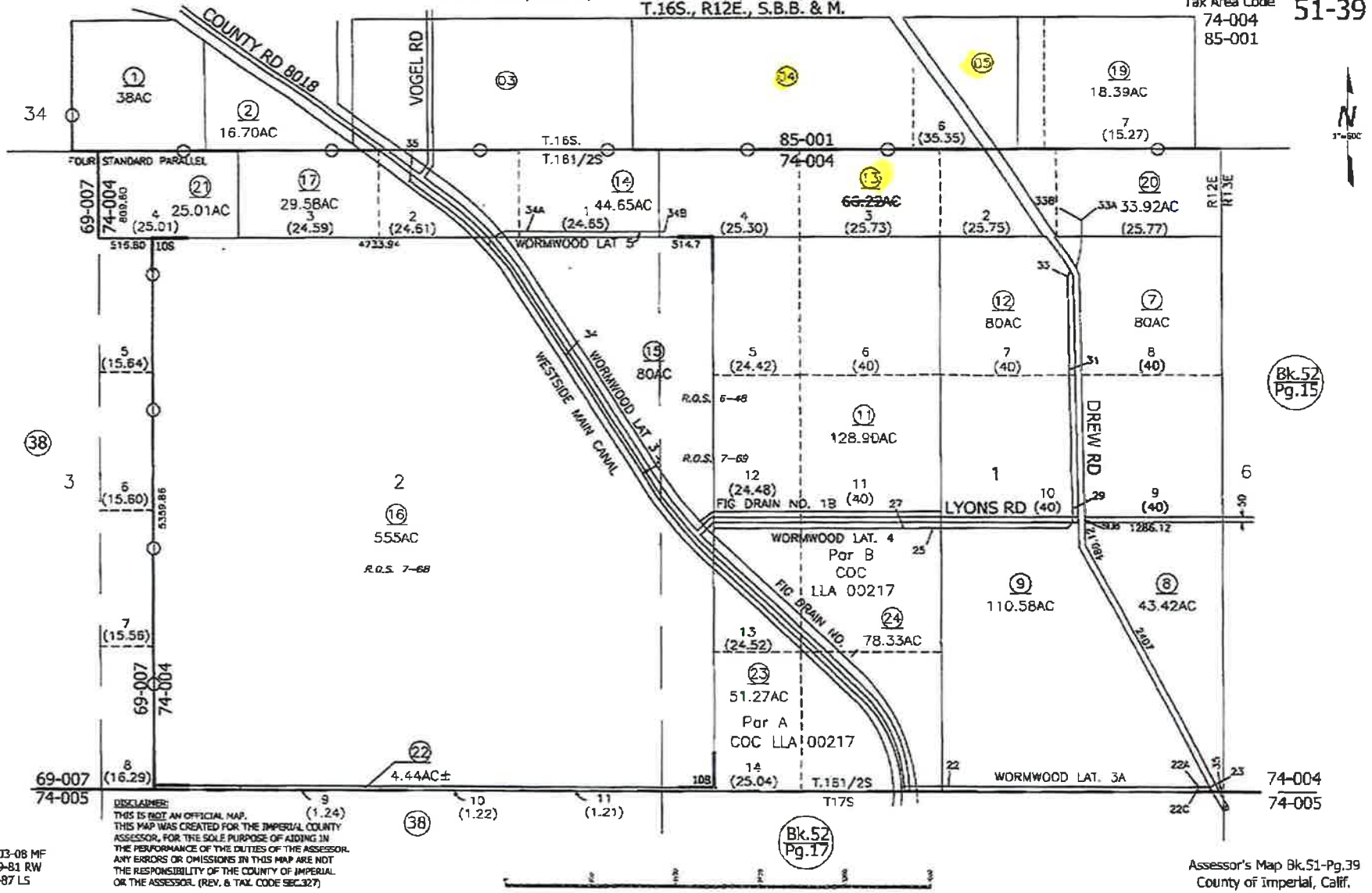
EXHIBIT "A"
Legal Description

WHICH IS 1100 FEET TO A POINT ON THE EAST LINE OF SAID LOT 7, WHERE SAID CENTER LINE OF SAID ROAD INTERSECTS THE EAST LINE OF SAID LOT 7.

TRACT 108, SEC. 1, 2 & POR. SEC. 1,2, T.16 1/2S., R12E. & POR. SEC. 35, 36, T.16S., R12E., S.B.B. & M.

Tax Area Code 74-004 85-001

51-39



DISCLAIMER:
THIS IS NOT AN OFFICIAL MAP.
THIS MAP WAS CREATED FOR THE IMPERIAL COUNTY ASSESSOR, FOR THE SOLE PURPOSE OF AIDING IN THE PERFORMANCE OF THE DUTIES OF THE ASSESSOR. ANY ERRORS OR OMISSIONS IN THIS MAP ARE NOT THE RESPONSIBILITY OF THE COUNTY OF IMPERIAL OR THE ASSESSOR. (REV. & TAX. CODE SEC.327)

11-03-08 MF
8-19-81 RW
5-3-87 LS

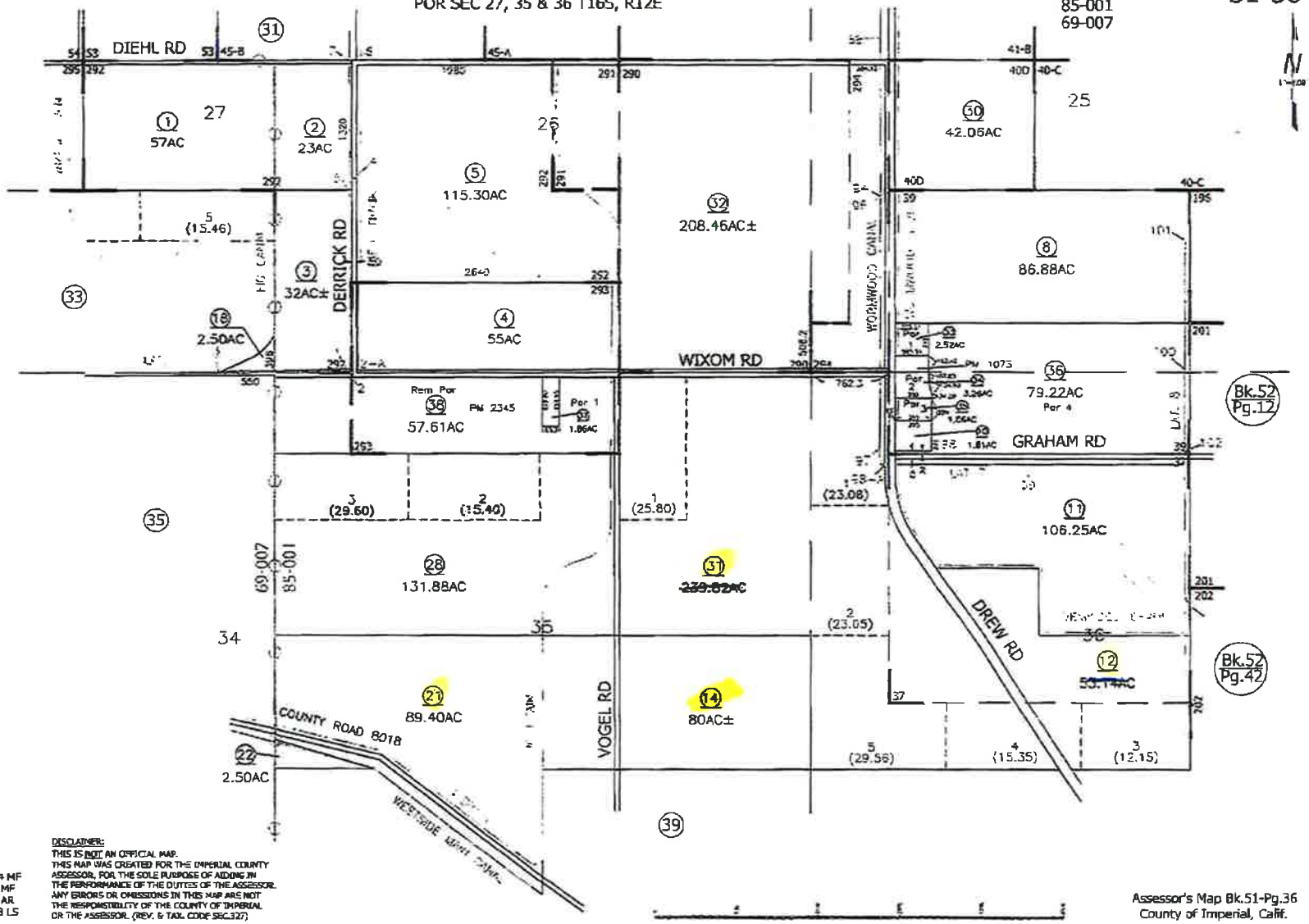
Assessor's Map Bk.51-Pg.39
County of Imperial, Calif.

This map/plat is being furnished as an aid in locating the herein described Land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the Company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

TRACT 37, 39 & 40-D & 290 TO 294 INCL &
POR SEC 27, 35 & 36 T16S, R12E

Tax Area Code
85-001
69-007

51-36



DISCLAIMER:
THIS IS NOT AN OFFICIAL MAP.
THIS MAP WAS CREATED FOR THE IMPERIAL COUNTY ASSESSOR, FOR THE SOLE PURPOSE OF AIDING IN THE PERFORMANCE OF THE DUTIES OF THE ASSESSOR. ANY ERRORS OR OMISSIONS IN THIS MAP ARE NOT THE RESPONSIBILITY OF THE COUNTY OF IMPERIAL OR THE ASSESSOR. (REV. & TAX. CODE SEC.327)

1-14-14 MF
8-4-11 MF
6-2-03 AR
5-30-78 LS

This map/plat is being furnished as an aid in locating the herein described Land in relation to adjoining streets, natural boundaries and other land, and is not a survey of the land depicted. Except to the extent a policy of title insurance is expressly modified by endorsement, if any, the Company does not insure dimensions, distances, location of easements, acreage or other matters shown thereon.

Assessor's Map Bk.51-Pg.36
County of Imperial, Calif.

Letter of Transmittal:

Dec. 1, 2020

TO: David Black, Planner IV and Director Minnick

FROM: Jurg Heuberger, Consultant for VEGA SES 1/S line

RE: Revision (minor) to CUP 17-0001 and inclusion of "S" line upgrade

David and Jim:

Please consider this letter of transmittal as our formal application to:

- Modify the currently approved/recorded CUP 17-0001 as shown on the attached red lined CUP
- Include in the CEQA documentation the upgrade required for the "S" line owned by IID
- Also attached is a copy of the recorded CUP
- Also attached is a detailed drawing of the "S" line from end to end

Note attached to this is the fee in the amount of $ 11,000.00.

Note also the Precision Engineering has already submitted to your office an application for a parcel map to address some land issues around Drew Rd.

Due to the fact that these applications are all tied to the same Solar project and same property we understand that you will address them under one CEQA document. It is understood that the original project included a full EIR. In this case it appears that an Initial Study and Mitigated Negative Declaration would be an appropriate direction however we understand that is your decision.

To assist in that option, we have ECORP prepare a number of technical studies including but not limited to Biological, Cultural, Visual, Noise and Traffic. A full list will be provided under separate cover shortly. These studies should be available mid-January.

From a time – schedule perspective please understand that there are very defined target dates that this project must meet. The IID's "S" line is in part funded through the ISO and construction on this line for funding as well as the ability to connect the VEGA ProJet with its current PPA requires that it start no later than Aug. 1, 2020. That means all approvals through the County as well as the IID need to be completed no later than July 1, 2020. Given the IID cannot take action until the County has certified a CEQA document we need to see about having the final County approvals no later than early June.

Please note that Sunpin as a result of their now owned VEGA 1 project is responsible for a significant portion of the "S" Line upgrade since this will be their transmission tie in and which is why this application includes the "S" line. Permitting and construction of the "S" line upgrade is all being handled through Sunpin Solar. Once the upgrade is done this will them become or remain an IID owned/operated line. This is being done in cooperation with IID and we are working closely with IID staff.

With respect to the CUP modification, since it only includes the on-site relocation of the substation/tie in we do not believe that this modification requires changes to any agreements nor to fees such as the Public Benefit Fee, Fire Fees etc.

In conclusion, I will be the main and should be the only point of contact on this project so please address all correspondence to me. Insofar as the Parcel Map application that correspondence should continue to be addressed to Taylor Preece at Precision Engineering with a CC to me. Taylor will handle the map engineering, but I will be the project coordinator. Also email invoices to me so I can pass them on with review.

CC: Sunpin (XJ CHEN)
John Gay, Public Works Director
Tony Rouhotas, County CO
Don Vargas, IID

OWNER'S AFFIDAVIT

In the event the applicant is not owner, the following shall be signed and acknowledge by the owner.

Permission is hereby granted to "Jurg Heuberger" Consultant for Sunpin to apply for this
(Lessee, Tenant, Contractor-Specify)

CUP's Variances, Building Permits etc. on the described property located at address
(State permit type clearly i.e. building, land used)

SWC Drew Road and Wixom Road, Imperial County, CA Further identified by Assessor's Parcel Number
(APN) APN's 051-360-021, 051-360-031, 051-370-004, 051-370-012, 051-370-013 (CUP#17-0001) is hereby granted.

OWNER (SIGNATURE)

Tian Li
OWNER (TYPED OR PRINT)

2020 Main Street, Ste 300, Irvine, CA 92614
OWNER'S ADDRESS

12/04/2020
DATE

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA
COUNTY OF Imperial } S.S.

On December 4, 2020 before me, Rachel Ulrike Cummings, personally appeared Tian Li, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature Rachel U. Cummings (Seal)

RACHEL U. CUMMINGS
Notary Public - California
Orange County
Commission # 2207621
My Comm. Expires Aug 25, 2021

ATTENTION NOTARY: Although the information requested below is OPTIONAL, it could prevent fraudulent attachment of this certificate to unauthorized document.

Title or Type of Document Owner's Affidavit
Number of Pages _____ Date of Document _____
Signer(s) Other Than Named Above _____

CONDITIONAL USE PERMIT

I.C. PLANNING & DEVELOPMENT SERVICES DEPT.
801 Main Street, El Centro, CA 92243 (760) 482-4236

- APPLICANT MUST COMPLETE ALL NUMBERED (black) SPACES – Please type or print -

1. PROPERTY OWNER'S NAME Vega SES LLC	EMAIL ADDRESS c/o jurgheuberger@gmail.com and xchen@sunpinsolar.us	
2. MAILING ADDRESS (Street / P O Box, City, State) 62020 Main St., Suite 300, Irvine , Ca	ZIP CODE 92614	PHONE NUMBER 760-996-0313 c.o jurg
3. APPLICANT'S NAME Tom LI and X J Chen	EMAIL ADDRESS c/o jurgheuberger@gmail.com	
4. MAILING ADDRESS (Street / P O Box, City, State) same as above	ZIP CODE	PHONE NUMBER 714-949-2207
4. ENGINEER'S NAME N A — CA. LICENSE NO.	EMAIL ADDRESS	
5. MAILING ADDRESS (Street / P O Box, City, State) N A	ZIP CODE	PHONE NUMBER

6. ASSESSOR'S PARCEL NO. (051360021000; 051360031000;051390004000; 051390013000)	SIZE OF PROPERTY (In acres or square foot) (See Attached)	ZONING (existing) A - 2
7. PROPERTY (site) ADDRESS (pending)		
8. GENERAL LOCATION (i.e. city, town, cross street) West of Drew Rd., south of I-8 see site plan and vicinity map		
9. LEGAL DESCRIPTION (See Attached)		

PLEASE PROVIDE CLEAR & CONCISE INFORMATION (ATTACH SEPARATE SHEET IF NEEDED)

10. DESCRIBE PROPOSED USE OF PROPERTY (list and describe in detail) modify the previously approved CUP for the solar project to re-locate the on site substation and tie in to the "S" line along with an upgrade to the IID owned "S" line (See attached)	
11. DESCRIBE CURRENT USE OF PROPERTY	Farming
12. DESCRIBE PROPOSED SEWER SYSTEM	N A
13. DESCRIBE PROPOSED WATER SYSTEM	N A
14. DESCRIBE PROPOSED FIRE PROTECTION SYSTEM	N A
15. IS PROPOSED USE A BUSINESS? ☒ Yes ☐ No	IF YES, HOW MANY EMPLOYEES WILL BE AT THIS SITE? during operations none

I / WE THE LEGAL OWNER (S) OF THE ABOVE PROPERTY CERTIFY THAT THE INFORMATION SHOWN OR STATED HEREIN IS TRUE AND CORRECT.

Jurg Heuberger for applicant (see owners Affidavit) — 12.1.2020
Print Name — Date

Signature

Print Name — Date

Signature

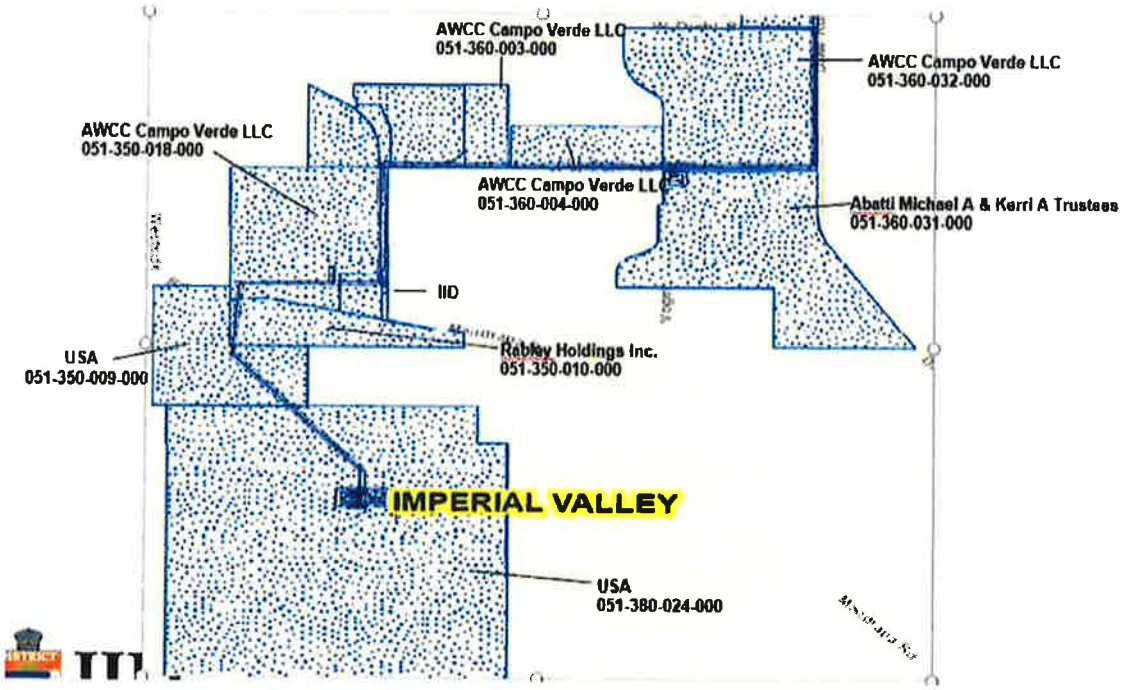
REQUIRED SUPPORT DOCUMENTS

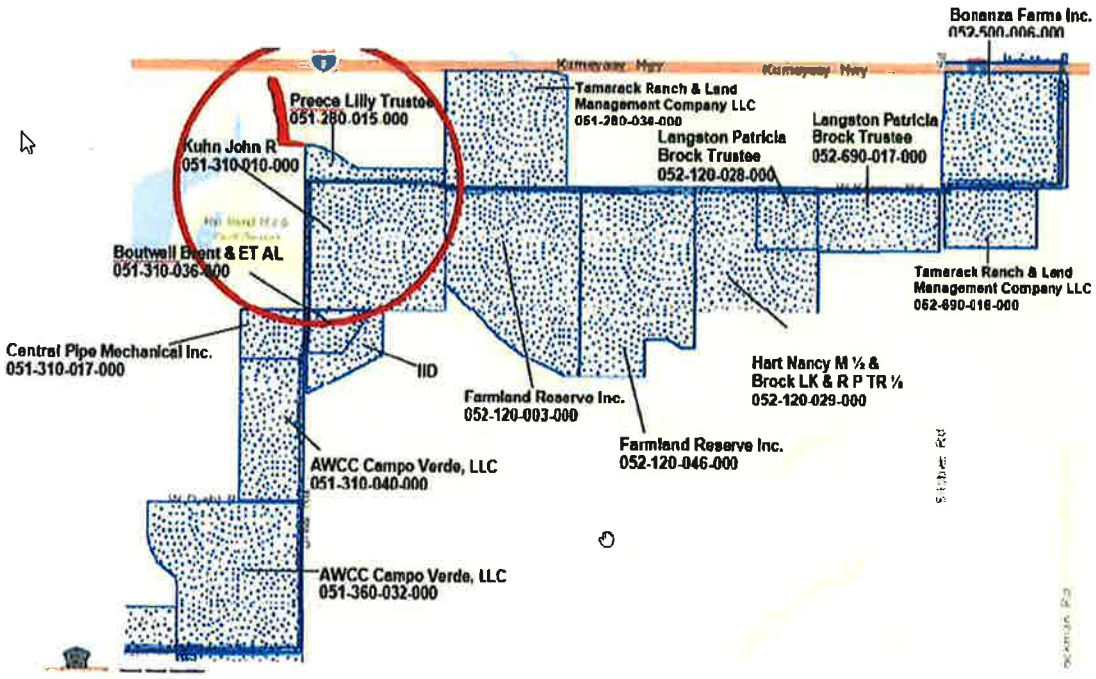
A. SITE PLAN
B. FEE
C. OTHER
D. OTHER

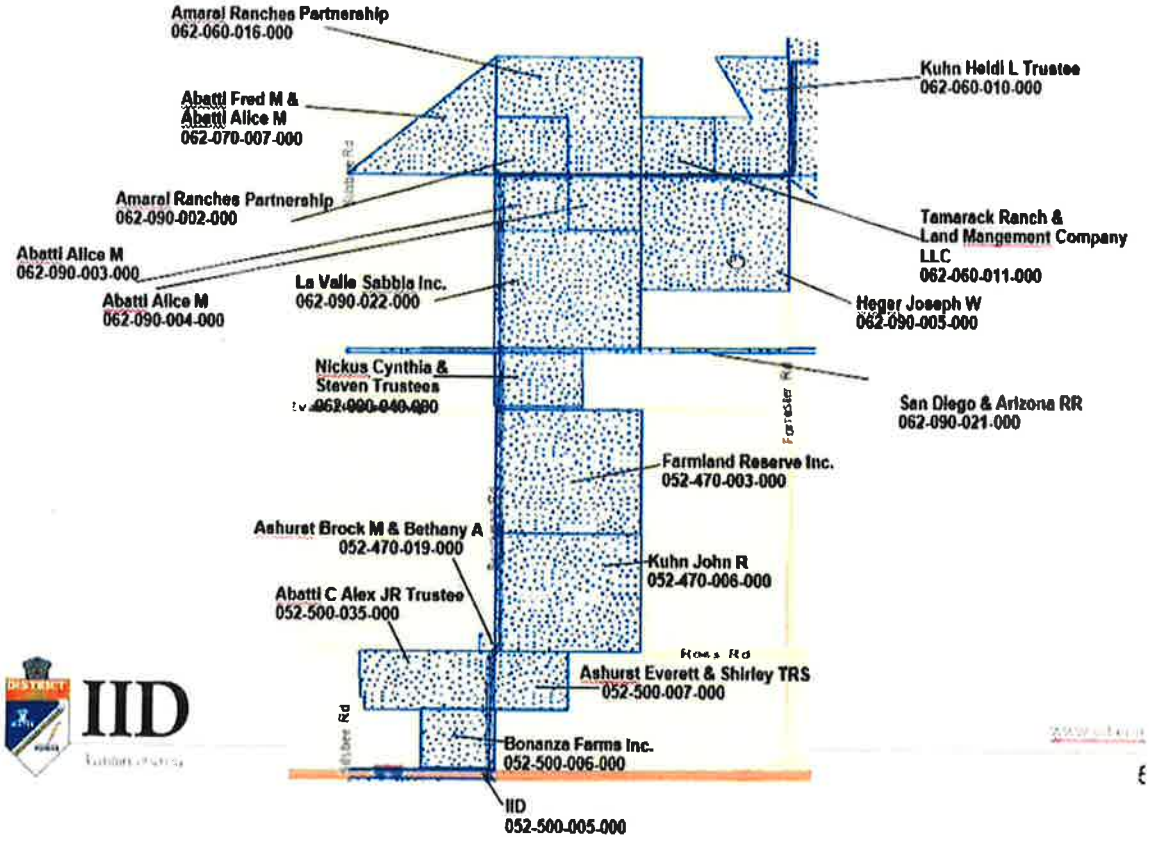
APPLICATION RECEIVED BY:	DB	DATE	12-10-20
APPLICATION DEEMED COMPLETE BY:		DATE	
APPLICATION REJECTED BY:		DATE	
TENTATIVE HEARING BY:		DATE	
FINAL ACTION: ☐ APPROVED ☐ DENIED		DATE	

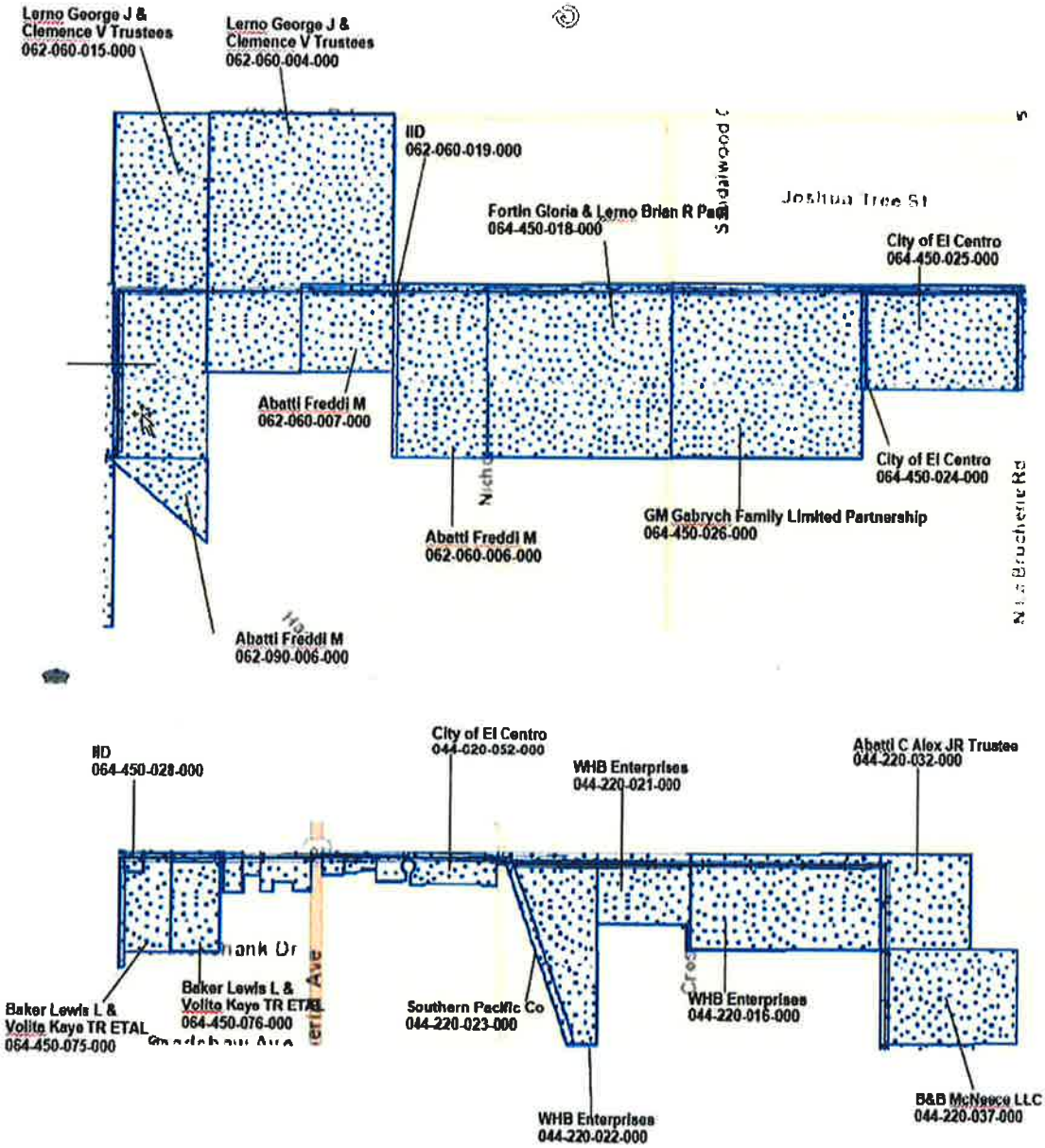
REVIEW / APPROVAL BY OTHER DEPT'S required.
☐ P. W.
☐ E. H. S.
☐ A. P. C. D.
☐ O. E. S.
☐
☐

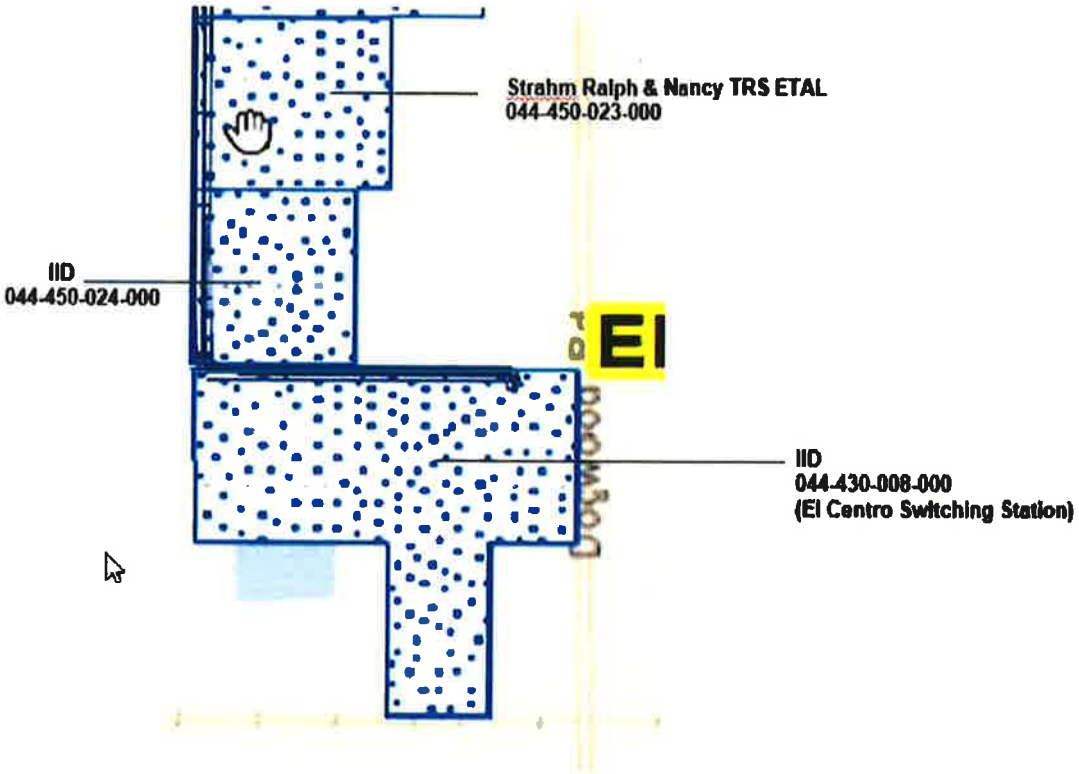
CUP # 20-0029


AWCC Campo Verde LLC
051-360-003-000
AWCC Campo Verde LLC
051-360-032-000
AWCC Campo Verde LLC
051-350-018-000
AWCC Campo Verde LLC
051-360-004-000
Abatti Michael A & Kerri A Trustees
051-360-031-000
IID
USA
051-350-009-000
Rabley Holdings Inc.
051-350-010-000
IMPERIAL VALLEY
USA
051-380-024-000


Bonanza Farms Inc.
052-500-006-000
Preece Lilly Trustee
051-280-015-000
Tamarack Ranch & Land
Management Company LLC
051-280-038-000
Langston Patricia
Brock Trustee
052-120-028-000
Langston Patricia
Brock Trustee
052-690-017-000
Kuhn John R
051-310-010-000
Boutwell Brent & ET AL
051-310-036-000
Tamarack Ranch & Land
Management Company LLC
052-690-016-000
Central Pipe Mechanical Inc.
051-310-017-000
IID
Farmland Reserve Inc.
052-120-003-000
Hart Nancy M ½ &
Brock LK & R P TR ½
052-120-029-000
Farmland Reserve Inc.
052-120-046-000
AWCC Campo Verde, LLC
051-310-040-000
AWCC Campo Verde, LLC
051-360-032-000


Amaral Ranches Partnership
062-060-016-000
Abatti Fred M &
Abatti Alice M
062-070-007-000
Amaral Ranches Partnership
062-090-002-000
Abatti Alice M
062-090-003-000
Abatti Alice M
062-090-004-000
La Valle Sabbia Inc.
062-090-022-000
Nickus Cynthia &
Steven Trustees
062-090-040-000
Kuhn Heidi L Trustee
062-060-010-000
Tamarack Ranch &
Land Mangement Company
LLC
062-060-011-000
Heger Joseph W
062-090-005-000
San Diego & Arizona RR
062-090-021-000
Farmland Reserve Inc.
052-470-003-000
Ashurst Brock M & Bethany A
052-470-019-000
Kuhn John R
052-470-006-000
Abatti C Alex JR Trustee
052-500-035-000
Ross Rd
Ashurst Everett & Shirley TRS
052-500-007-000
Gilbert Rd
Bonanza Farms Inc.
052-500-006-000
IID
052-500-005-000


Lerno George J &
Clemence V Trustees
062-060-015-000
Lerno George J &
Clemence V Trustees
062-060-004-000
IID
062-060-019-000
Joshua Tree St
Fortin Gloria & Lerno Brian R Pa
064-450-018-000
City of El Centro
064-450-025-000
Abatti Freddi M
062-060-007-000
City of El Centro
064-450-024-000
Abatti Freddi M
062-060-006-000
GM Gabrych Family Limited Partnership
064-450-026-000
Abatti Freddi M
062-090-006-000
IID
064-450-028-000
City of El Centro
044-020-052-000
WHB Enterprises
044-220-021-000
Abatti C Alex JR Trustee
044-220-032-000
Baker Lewis L &
Volita Kaye TR ETAL
064-450-075-000
Baker Lewis L &
Volita Kaye TR ETAL
064-450-076-000
Southern Pacific Co
044-220-023-000
WHB Enterprises
044-220-016-000
WHB Enterprises
044-220-022-000
B&B McNeece LLC
044-220-037-000


Strahm Ralph & Nancy TRS ETAL
044-450-023-000
IID
044-450-024-000
IID
044-430-008-000
(El Centro Switching Station)

When Recorded Return To:

Imperial County
Planning & Development Services
801 Main Street
El Centro, California 92243

CONDITIONAL USE PERMIT #17-0001
VEGA SES SOLAR ENERGY PROJECT
APN 051-360-021, 051-360-031, 051-390-004, 051-390-012, 051-390-013
(Approved at the Board of Supervisors on April 16, 2019)

This Agreement is made and entered into on this ___day of _____,~~2019~~2021, by and between VEGA SES LLC hereinafter referred to as the Permittee (Permittee), and the COUNTY OF IMPERIAL, a political subdivision of the State of California, (hereinafter referred to as "COUNTY") related to the VEGA SES SOLAR ENERGY Project.

RECITALS

WHEREAS, Permittee is the lessee or successor-in-interest of certain land in Imperial County to be improved with the proposed photovoltaic solar energy facility, electrical switch station, substation, and internal solar development transmission lines, on approximately 574 acres within Imperial County. The proposed facility is located in the south western portion of Imperial County, California, approximately eight miles west & southwest of the City of El Centro and approximately 13 miles west & northwest of Calexico.

WHEREAS, Permittee has applied to the County of Imperial for a Conditional Use Permit #17-0001 for constructing and operating a new solar energy facility with ancillary support facilities, including electrical interconnections to be transmitted to ~~a proposed IID Substation (Fern)~~ IID "S" line at the north side of the project (the "Project").

WHEREAS, the overall Project includes one (1) CUP's on different properties within the County,

WHERAS, The Permittee for the Vega SES Solar Energy project shall fully comply with all of the terms and conditions of the Project as specified hereinafter within this Conditional Use Permit.

The rest of this page is intentionally left blank.

GENERAL CONDITIONS:

The "GENERAL CONDITIONS" are shown by the letter "G". These conditions are conditions that are either routinely and commonly included in all Conditional Use Permits as "standardized conditions" and/or are conditions that the Imperial County Planning Commission has established as a requirement on all CUP's for consistent application and enforcement. The Permittee is hereby advised that the General Conditions are as applicable as the SITE SPECIFIC conditions. The General Conditions are in addition to the MMRP and any and all other requirements for the project.

G-1 GENERAL LAW and other Requirements:

The Permittee shall comply with all local, state and/or federal laws, rules, regulations, ordinances, and/or standards (LORS) as they may pertain to the Project, whether specified herein or not. The Project shall be constructed and operated as described in the General Plan Amendment, Zone Change, Conditional Use Permit application and the Final Environmental Impact Report, (FEIR) and Mitigation and Monitoring Reporting Program (MMRP). A violation of any such LORS or conditions, applications, the FEIR or the MMRP shall be a violation of this CUP.

G-2 PERMITS/LICENSES:

The Permittee shall obtain any and all local, state and/or federal permits, licenses, and/or other approvals for the construction and/or operation of the Project. This shall include, but shall not be limited to, local requirements by the Imperial County EHS/Health Department, Imperial County Planning and Development Services Department, Imperial County Air Pollution Control District (ICAPCD), Imperial Irrigation District (IID), Imperial County Public Works Department, Imperial County Sheriff/Coroner's office, and the Imperial County Fire Protection/Office of Emergency Services, among others. Permittee shall likewise comply with all such permit requirements. Additionally, Permittee shall submit a copy of such additional permits and/or licenses to the Imperial County Planning and Development Services Department within thirty (30) days of receipt, including amendments or alternatives thereto, when requested.

G-3 RECORDATION:

This permit shall not be effective until it is recorded at the Imperial County Recorder's Office and payment of the recordation fee shall be the responsibility of the Permittee. If the Permittee fails to pay the recordation fee within six (6) months from the date of approval, this permit shall be deemed null and void. Recording is an action of notice and does not convey any rights to Permittee

G-4 DURATION OF AGREEMENT

Unless otherwise specified within the specific conditions, this permit shall be limited to a maximum of thirty (30) years from the recordation of the CUP. The CUP may be extended for an additional ten (10) year period by the appropriate County entity (either the Planning Director, the Planning Commission or the Board of Supervisors as set forth in the applicable Imperial County Ordinances) upon a finding that the Project is in compliance with all conditions of the CUP as stated herein and any applicable Land Use regulation of the County of Imperial. If an extension is necessary, the Permittee shall file a written extension request with the Planning Director at least sixty (60) days prior to the expiration date of the permit. Such an extension request shall include the appropriate extension fee. Nothing stated or implied within this permit shall constitute a guarantee that an extension will be granted. An extension may not be granted if the Project is in violation of any one or all of the conditions or if there is a history of non-compliance with the permit conditions.

G-5 INDEMNIFICATION:

In addition to any other indemnifications provided for the Project, and as a condition of this permit, Permittee shall defend, indemnify, hold harmless, and release the County, its agents, officers, attorneys, and employees from any claim, action, or proceeding brought against any of them, the purpose of which is to attack, set aside, void, or annul the entitlements, any permits, approvals or adoption of the environmental document which accompanies it. This indemnification obligation shall include, but not be limited to, damages, costs, expenses, attorneys' fees for counsel chosen by County, or expert witness fees that may be asserted by any person or entity, including the Permittee, arising out of or in connection with the approval of this permit, whether there is concurrent, passive or active negligence on the part of the County, its agents, officers, attorneys, or employees. This indemnification shall include Permittee's actions or failure to act involved in drilling, grading, construction, operation or abandonment of the permitted activities. Permittee further agrees to comply with the terms of the indemnification agreement incorporated by this reference. Failure to provide payment of any fees or other costs for this indemnification shall cause Permittee to be in non-compliance with this permit. Upon notification of non-compliance, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with this project.

G-6 INSURANCE:

For the term of the CUP and any period thereafter for decommissioning and reclamation, the Permittee and/or Permittee's prime contractor assigned site control during construction, shall secure and maintain liability in tort and property damage, commercial liability and all risk builders' insurance at a minimum of **$1,000,000 each, combined single limit property damage**

and personal injury, to protect persons or property from injury or damage caused in any way by construction and/or operation of permitted facilities. Such insurance shall be endorsed to name the County, its officers, agents, and employees as additional insureds and shall be in a form and from a company acceptable to County. The Permittee shall require that proper Workers' Compensation insurance cover all laborers working on such facilities as required by the State of California. The Permittee and/or Permittee's prime contractor assigned site control during construction, shall also secure liability insurance and such other insurance as may be required by the State and/or Federal Law. Evidence of such insurance shall be provided to the County prior to commencement of any activities authorized by this permit, e.g. an endorsed Certificate of Insurance is to be provided to the Imperial County Planning and Development Services Department by the insurance carrier and said insurance and certificate shall be kept current for the life of the permitted Project. Certificate(s) of Insurance shall be sent directly to the Imperial County Planning and Development Services Department by the insurance carrier and shall be endorsed to name the Department as a recipient of both renewal and cancellation notices.

G-7 INSPECTION AND RIGHT OF ENTRY:

The County reserves the right to enter the premises to make appropriate inspection(s) and to determine if the condition(s) of this permit are complied with. The owner or operator shall allow an authorized County representative access into the site upon the presentation of credentials and other documents as may be required by law to:

(A) Enter at reasonable times upon the owner's or operator's premises where a permitted facility or activity is located or conducted, or where records must be kept under the conditions of the permit.

(B) Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit.

(C) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under the permit.

(D) Sample or monitor, at reasonable times, for the purpose of assuring permit compliance or, otherwise authorized by law, any substances or parameters at any location.

G-8 SEVERABILITY:

Should any condition(s) of this permit be determined by a Court or other agency with proper jurisdiction to be invalid for any reason, such determination shall not invalidate the remaining provision(s) of this permit.

G-9 PROVISION TO RUN WITH THE LAND/PROJECT:

The provisions of this Permit are to run with the land/project and shall bind the current and future owner(s), successor(s)-in-interest, assignee(s) and/or transferee(s) of said Project pursuant to the recordation required by Condition G-3. Permittee shall not without prior notification to the Imperial County Planning and Development Services Department assign, sell or transfer, or grant control of Project or any right or privilege therein granted by this permit. The Permittee shall provide a minimum of thirty (30) days written notice prior to any proposed transfer becoming effective. The permitted use identified herein is limited for use upon the permitted properties described herein and may not be transferred to any another other parcel(s) without prior approval.

The Permittee shall pay any and all amounts determined by the County to defray any and all cost(s) for the review of reports, field investigations, monitoring, and other activities directly related to the enforcement/monitoring for compliance of this Conditional Use Permit, County Ordinance, MMRP or any other applicable law. All County Departments, directly involved in the monitoring/enforcement of this permit may bill Permittee under this provision; however said billing shall only be through and with the approval of the Imperial County Planning and Development Services Department. All County staff time will be billed on a time and materials basis. Failure by Permittee to provide any payment required of Permittee to the County in the CUP shall cause Permittee to be in non-compliance of the CUP. Upon Permittee being in such noncompliance, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with the Project.

G-10 REPORTS/INFORMATION:

If requested by the Imperial County Planning Director, Permittee at its sole expense shall provide any such documentation/report as necessary to ascertain compliance with the Conditional Use Permit. The format, content and supporting documentation shall be as required by the Imperial County Planning Director.

G-11 DEFINITIONS:

In the event of a dispute the meaning(s) or the intent of any word(s), phrase(s) and/or conditions or sections herein shall be determined by the Imperial County Planning Commission. Their determination shall be final unless an appeal is made to the Imperial County Board of Supervisors within the required time.

G-12 MINOR AMENDMENTS:

Unless as otherwise required by law (including but not limited to County ordinance interpretations and minor modifications or changes can be made

to the Project with the mutual agreement of Developer and County and only in one of the following circumstances:

(A) Where the change is ministerial, mutually agreeable to Director of Planning & Development Services Department and Developer and constitutes an administrative interpretation, less than significant amendment or change or technical modification to the design, construction and/or operation of the Project under the existing applicable rules, regulations, and laws of the County and does not

(1) Alter the permitted uses of the Property as a whole or within any CUP; or

(2) Increase the density or intensity of use of the Property as a whole or within any CUP; or,

(3) Increase the maximum height and size of permitted buildings or structures; or,

(4) Delete a requirement for the reservation or dedication of land for public purposes within the Property as a whole; or

(5) Conflict with a condition of approval or MMRP; or

(6) Constitute a discretionary approval by the County for which a subsequent or supplemental environmental impact report would be required pursuant to Section 21166 of the Public Resources Code.

(B) Where the change is ministerial, mutually agreeable to Developer and constitutes an administrative interpretation, less than significant amendment or change or technical modification to the design, construction and/or operation of the Project under the existing applicable rules, regulations, and laws of non-County agencies as to Project matters within their sole jurisdiction.

G-13 SPECIFICITY:

The issuance of this permit provides a temporary use right on the project property within the requirements set out here and does not authorize the Permittee to construct or operate the Project in violation of any LORS or beyond the duration, term or specified boundaries of the Project as shown the application/project description/permit, nor shall this permit allow any accessory or ancillary use not specified herein. This permit does not provide any prescriptive right or use to the Permittee for future addition and or modifications to the Project.

G-14 NON-COMPLIANCE (ENFORCEMENT & TERMINATION):

Should the Permittee violate any condition herein, the County shall give written notice of such violation and actions required of Permittee to correct such violation. If Permittee does not act to correct the identified violation within forty-five (45) days after written notice, County may revoke the CUP. If Permittee pursues correction of such violation with reasonable diligence, the County may extend the cure period. Upon such revocation, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with the Project. County may include in such notice of violation and subsequent process default and/or termination of the Development Agreement along with violation or revocation of the CUP, and the procedures set out here shall govern.

G-15 GENERAL WELFARE:

All construction and operations of the solar energy facility shall be conducted with consistency with all laws, conditions, adopted County policies, plans, mitigation measures and the permit application so that the Project will be in harmony with the area and not conflict with the public health, safety, comfort, convenience, and general welfare of those residing in the area.

G-16 PERMITS OF OTHER AGENCIES INCORPORATED:

Permits granted by other governmental agencies in connection with the Project are incorporated herein by reference. The County reserves the right to apply conditions of those permits, as the County deems appropriate and subject to its having jurisdiction; provided, however, that enforcement of a permit granted by another governmental agency shall require written concurrence by the respective agency. Permittee shall provide to the County, upon request, copies and amendments of all such permits.

G-17 HEALTH HAZARD:

If the County Health Officer reasonably determines that a significant health or safety hazard exists to the public, the County Health Officer may require appropriate measures and the Permittee shall implement such measures to mitigate the health hazard. If the hazard to the public is determined to be imminent, such measures may be imposed immediately and may include temporary suspension of permitted activities. The measures imposed by the County Health Officer shall not prohibit the Permittee from requesting a special Imperial County Planning Commission meeting, provided the Permittee bears all related costs.

G-18 APPROVALS AND CONDITIONS SUBSEQUENT TO GRANTING PERMIT:

Permittee's acceptance of this permit shall be deemed to constitute agreement with the terms and conditions contained herein. Where a

requirement is imposed in this permit that Permittee conduct a monitoring program, and where the County has reserved the right to impose or modify conditions with which the Permittee must comply based on data obtained there from, or where the Permittee is required to obtain additional conditional use permits for County approval for subsequent activities, and disagreement arises, the Permittee, operator and/or agent, the Imperial County Planning and Development Services Director or other affected party, as determined by the Imperial County Planning and Development Services Director, may request that a hearing before the Imperial County Planning Commission. Upon receipt of a request, the Imperial County Planning Commission shall conduct a hearing and make a written determination. The Imperial County Planning Commission may request support and advice from a technical advisory committee. Failure of the Imperial County Planning Commission to act shall constitute endorsement of staff's determination with respect to implementation.

SITE SPECIFIC CONDITIONS:

S-1 AUTHORIZED SCOPE OF ACTIVITIES:

(A) Permittee shall be the master Developer for this Project and shall be responsible as for all improvements, septic, sewer, approved potable water system(s) if required, pipelines, roads and other improvements discussed in the Conditional Use Permit Application and Conditions Application and FEIR, and MMRP. If Permittee sells all or part of this Project, an approved agreement shall be in place for new Project owner to build and maintain as agreed to by the conditions set forth in this CUP. The Imperial County Planning and Development Services Director shall approve of such agreement between Permittee and a new master Developer for this Project. The County Assessor's Office shall be notified of any ownership change.

(B) Permittee shall develop this CUP property as a separate solar energy facility. Any development with a combination of parcels will require the owner(s) to have a recorded deed restriction to "hold the parcel as one parcel" that runs with the land. This deed restriction shall be for a minimum of thirty (30) years and shall only be released upon the expiration of the thirty (30) years, the expiration or termination of the Conditional Use Permit, or upon approval of the Imperial County Planning and Development director that the restriction is no longer needed based on a change in the development or regulation.

(C) The Permittee shall construct and operate the following facilities in compliance with the Conditional Use Permit, the County's General Plan's Land Use Element, Land Use Ordinance and all other applicable local, state, and federal laws, ordinances, regulations and standards

(LORS), to include any other permits which are incorporated herein by reference.

(D) Construction, operation, maintenance, replacement and removal of a solar energy facility & battery energy storage system as described in Permittee's CUP Application & FEIR & DEIR. The solar energy facility would include photovoltaic modules, mounting structures, electrical wiring, inverters, transformers and AC electric collector system, project electric substation and ancillary facilities. Ancillary facilities would include safety and security equipment, retention basins, perimeter fencing, access gates, lighting systems, access roads, and could include temporary construction trailers, an operations and maintenance (O&M) building, equipment enclosures, water treatment system and building, septic system, parking, and fire protection including a minimum 10,000 gallon fire water tank, and monitoring and control systems. The project proposes to use either thin film or crystalline solar photovoltaic (PV) technology modules mounted on fixed or horizontal single-axis tracker (HSAT) systems; concentrating photovoltaic (CPV) systems mounted on a dual-axis tracking system; or a mix of the technologies.

(E) PV module arrays would be mounted on racks supported by driven piles. The depth of the piles would be dependent on the geotechnical recommendations for the Project. The fixed-frame racks would be secured at a fixed tilt of 20° to 25° from horizontal facing a southerly direction. If HSAT technology is used, the PV modules would rotate around the north-south HSAT axis so that the PV modules would face the sun as it moves across the sky throughout the day. The PV modules would reach their maximum height (up to nine feet above the ground, depending on the final design) when the HSAT is rotated to point the modules at the rising or setting sun at both sunrise and sunset. When the HSAT system is rotated so that the PV modules are horizontal (at noon, or when stowed during high winds), the nominal height would be approximately six feet above the ground, depending on the final design. The individual PV systems would be configured in large arrays by placing them in columns spaced approximately ten feet apart to maximize operational performance and to allow access for panel cleaning and maintenance. These arrays would be separated from each other and the perimeter security fence by nominal 20-foot wide roads, consistent with emergency access requirements.

(F) CPV technology uses optics such as lenses to concentrate a large amount of sunlight onto a small area of PV cells to generate electricity. The CPV technology focuses the sunlight onto highly efficient solar cells using Fresnel lenses. The CPV technology would likely use a dual-axis tracking system to position the tracker to ensure that concentrated sunlight remains precisely focused on the solar cells throughout the day. The dual-axis tracking structures use single pole/mast-mounted panels that would be approximately 30-feet high at both sunrise and

sunset when the panel is rotated to point at the rising or setting sun. The dual-axis modules would be spaced approximately 80 feet apart on-site substation will step-up the voltage from the collection level voltage to 230-kV. Breakers, buswork, protective relaying, Supervisory Control and Data Acquisition (SCADA), and associated substation equipment will be constructed on the CUPs. The communication system may include an above or below-ground fiber optic cable network or microwave tower.

(G) The Project will be interconnected to the regional transmission system from the on-site substation/switchyard via the Gen-Tie interconnection. CUP #17-0001 is anticipated to utilize the Gen-Tie line extending from the CUP to and inverter stations. Alternatively, each CUP may independently construct its own 230-kV (maximum) step-up transformer and switchyard. During normal operation, each substation will "back feed" power to maintain "house" power. This would include O&M buildings, security systems, SCADA, communication systems, plant control systems, etc. Therefore, much of the electrical equipment will be in some stage of electrical operation 24 hours-a-day. The interconnection to the IID system will be a connection to the upgraded "S" line which is contiguous to the north side of the property.

Formatted: Highlight

(H) The field of energy storage is rapidly advancing, and a wide variety of technology is available to choose from. To date, a single technology or provider has not been selected for this component of the Project. The analysis contained in this EIR reflects the worst-case scenario for impacts from these technologies in order to mitigate any impacts from these technologies. Thus the analysis covers the full-range of technologies for when the final decision is made on which technology to construct. The storage component will utilize technologies that operate based upon the principles of potential energy (e.g. pumped storage), chemical energy (e.g. batteries), mechanical/kinetic energy (e.g. flywheel), or any combination thereof. The storage component may be centralized and located adjacent to the substation or switchgear or, alternatively, the energy storage component may be distributed throughout the facility adjacent to individual power conversion centers. The storage component would be housed in a warehouse type building or in smaller modular structures such as cargo shipping containers.

S-2 AESTHETICS:

The Permittee shall design and maintain all buildings and equipment enclosures to have exterior surfaces with neutral, non-reflective colors. The construction and maintenance of County-approved landscaping along the access into the Operation/Maintenance Facility shall be in compliance with the Land Use Ordinance, Division 3, Chapters 1 and 2, Sections 90302.00 through 90302.19. As applied to other solar projects

and as indicated in the FEIR and as indicated in the FEIR and Mitigation Monitoring and Reporting Program.

(A) The Permittee shall design and install lighting at construction storage yards and staging areas, such that light bulbs and reflectors are not visible from public viewing areas; lighting does not create reflected glare; and illumination of the Project facilities, vicinity, and nighttime sky is minimized.

(B) Lighting shall be designed so exterior light fixtures are hooded, with lights directed downward or toward the area to be illuminated and so that backscatter to the nighttime sky is minimized. The design of the lighting shall be such that the luminescence or light source is shielded to minimize light trespass outside the Project boundary.

(C) All lighting shall be of minimum necessary brightness consistent with worker safety and OSHA-Requirements.

(D) High illumination areas not occupied on a continuous basis shall have switches or motion detectors to light the area only when occupied.

S-3 AGRICULTURE:

(A) Prior to the issuance of the initial grading permit or building permit, Permittee shall submit to County of Imperial a Reclamation Plan to return the property to conditions comparable to its current condition for agricultural production. The Reclamation Plan shall include a description of the farming infrastructure to include but not limited to a crop history, water delivery system, drainage system, field access, field roads, grading aspects, reclamation cost estimate prepared by a California-licensed general contractor or civil engineer. The developer shall provide financial assurance/bonding in the amount equal to the reclamation cost estimate to restore all agricultural land/farmland to its pre-construction condition including removal of all structures and equipment, soil testing for and clean-up of contaminants in the soil, disking, leveling, and any other clean up and repair necessary to return the land to an agriculturally productive farmable condition prior to the issuance of the initial grading permit or building permit. The Reclamation Plan with appropriate bonding will need approval from the Imperial County Planning and Development Services Director, and County Counsel before any grading or building permit is issued.

(B) Permittee shall minimize paving and ground disturbing activities to the maximum extent practical within agricultural fields to retain soil characteristics.

(C) The Project Developer shall:

(1) Develop and implement an approved Pest Management Plan for the duration of the project that will reduce negative impacts to surrounding farmland. Plan shall be reviewed and approved by the Imperial County Agricultural Commissioner's Office.

(2) Monitor for all pests including insects, vertebrates, weeds, and pathogens. Promptly control or eradicate pests when found, or when notified by the County Agricultural Commissioner's office that a pest problem is present on the project site. The assistance of a licensed pest control advisor (PCA) is recommended. All treatments must be performed by a qualified applicator or a licensed pest control operator (PCO).

(3) "Control" means to reduce the population of common pests below economically damaging levels, and includes attempts to exclude pests before infestation, and effective control methods after infestation. Effective control methods may include physical/mechanical removal, bio-control, cultural control, or chemical treatments.

(4) Notify the County Agricultural Commissioner's office immediately regarding any suspected exotic/invasive pest species such as A- and Q-rated pest species as defined by the California Department of Food Agriculture (CDFA). Eradication of exotic pests will be done under the direction of the Agricultural Commissioner's Office and/or CDFA.

(5) Obey all pesticide use laws, regulations, and permit conditions.

(6) Allow access for County Agricultural Commissioner staff for routine visual and trap pest surveys, compliance inspections, eradication of exotic pests, and other official duties.

(7) Ensure that all project employees that handle pest control issues are appropriately trained and certified, that all required records are maintained and available for inspection, and that all permits and other required legal documents are current.

(8) Maintain records of pests found and controlled and either have them available for review, or submit them to the County Agricultural Commissioner's office on a quarterly basis.

(9) The Permittee shall reimburse the County Agricultural Commissioner's office for the actual cost of investigations, inspections, or other required non-routine responses to the site that are not funded by other sources.

(10) Reclamation/Decommissioning Plan and Security. The DOC has clarified the goal of a reclamation and decommissioning plan: the land must be restored to land which can be farmed. In addition to MM AG-1b, for Prime Farmland and Non-Prime Farmland, the Applicant shall submit to Imperial County a Reclamation Plan prior to issuance of a grading permit. The Reclamation Plan shall document the procedures by which each CUP will be returned to its current agricultural condition/LESA score. Permittee also shall provide financial assurance/bonding in an amount equal to a cost estimate prepared by a California-licensed general contractor or civil engineer for implementation of the Reclamation Plan in the event Permittee fails to perform the Reclamation Plan. MM AG-1b, prior to the issuance of a grading permit or building permit (whichever is issued first).

(D) Prior to the issuance of a grading permit or building permit (whichever permit comes first) for the Project, the mitigation of impact to agricultural lands shall be accomplished as follows:

Mitigation for the temporary loss of Non-Prime Farmland: Permittee may choose one of the following three methods for mitigation:

a) Agricultural Conservation Easements on a "1 to 1" basis on land of equal size, of equal quality farmland, outside of the path of development. The Conservation Easement shall meet the State Department of Conservation's regulations and shall be recorded prior to issuance of any grading or building permits. OR

b) The Permittee shall pay an "Agricultural In-Lieu Mitigation Fee" in the amount of 20% of the fair market value per acre for the acres of non-prime farmland impacted by the Project based on five comparable sales of land used for agricultural purposes as of the effective date of the permit, including program costs on a cost recovery/time and material basis. The Agricultural In-Lieu Mitigation Fee, will be placed in a trust account administered by the Imperial County Agricultural Commissioner's office and will be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County. OR

c) If Permittee and the County voluntarily enter into a public benefit agreement or Development Agreement that includes Agricultural Benefit Fee payment that is equal to or greater than the amount that would be due under Option 2 of these mitigation measures and the public benefit agreement requires that the Agricultural Benefit Fee be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County, then this

mitigation measure may be satisfied by payment of a voluntarily agreed to Agricultural Benefit Fee.

Mitigation for the temporary loss of Prime Farmland: Permittee may choose one of the following three methods for mitigation:

d) Agricultural Conservation Easements on a "2 to 1" basis on land of equal size, of equal quality farmland, outside of the path of development. The Conservation Easement shall meet the State Department of Conservation's regulations and shall be recorded prior to issuance of any grading or building permits. OR

e) The Permittee shall pay an "Agricultural In-Lieu Mitigation Fee" in the amount of 30% of the fair market value per acre for the acres of prime farmland impacted by the Project based on five comparable sales of land used for agricultural purposes as of the effective date of the permit, including program costs on a cost recovery/time and material basis. The Agricultural In-Lieu Mitigation Fee, will be placed in a trust account administered by the Imperial County Agricultural Commissioner's office and will be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County. OR

f) If Permittee and the County voluntarily enter into a public benefit agreement and or Development Agreement that includes Agricultural Benefit Fee payment that is equal to or greater than the amount that would be due under option number 2 of this mitigation measure and the public benefit agreement requires that the Agricultural Benefit Fee be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County, then this mitigation measure may be satisfied by payment of voluntarily agreed to Agricultural Benefit Fee.

S-4 AIR QUALITY:

(A) The Permittee shall comply at all times with the Imperial County Air Pollution Control District's (ICAPCD) Regulation VIII, Fugitive Dust Control. The primary pollutant controlled by this regulation is PM10, "fugitive dust." All identified PM10 sources associated with the construction and operation of the facility, such as open areas, roads, stock piles, material transport and grading activities, shall be controlled such that surface areas are stabilized and visible dust emissions are below 20%. Any control measure not listed within the appropriate sections of Regulation VIII, such as but not limited to watering, graveling, chemical stabilizers and wind barriers shall not be utilized without prior approval from the ICAPCD.

(B) Prior to commencing construction, each CUP owner shall submit a Dust Control Plan to the ICAPCD for approval identifying all sources of PM_{10} emissions and associated mitigation measures during the construction and operational phases of the Project. The Project Proponent shall submit a "Construction Notification Form" to the ICAPCD ten (10) days prior to the commencement of any earthmoving activity. The Dust Control Plan submitted to the ICAPCD shall meet all applicable requirements for control of fugitive dust emissions, including the following measures designed to achieve the no greater than 20% opacity performance standard for dust control:

(1) All on-site and off-site unpaved roads shall 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.

(2) All unpaved traffic areas one acre or more in size with seventy-five (75) or more average vehicle trips per day, shall 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.

(3) 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 shall be cleaned and/or washed at the delivery site after removal of bulk material.

(4) All track-out or carry-out, which includes bulk materials that adhere to the exterior surfaces of motor vehicles and/or equipment (including tires) that may then fall onto the pavement, shall be cleaned at the end of each workday, or immediately when mud or dirt extends a cumulative distance of fifty (50) linear feet or more onto a paved road within an urban area.

(5) 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.

(6) The construction of new unpaved roads is prohibited within any area with a population of five hundred (500) or more, unless the road meets ICAPCD's 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.

(7) Shall comply with the Mitigation and Monitoring Program and applicable mitigations.

(C) Each CUP owner shall implement all applicable standard mitigation measures for construction combustion equipment for the reduction of excess NOx emissions as contained in the Imperial County CEQA Air Quality Handbook and associated regulations. These measures include:

(1) Use of alternative fueled or catalyst equipped diesel construction equipment, including all off-road and portable diesel powered equipment.

(2) Minimize idling time, either by shutting equipment off when not in use or reducing the time of idling to five minutes at a maximum.

(3) Limit the hours of operation of heavy-duty equipment and/or the amount of equipment in use.

(4) Replace fossil-fueled equipment with electrically driven equivalents (assuming powered by a portable generator set and are available, cost effective, and capable of performing the task in an effective, timely manner).

(5) Curtail construction during periods of high ambient pollutant concentrations; this may include ceasing construction activity during the peak hour of vehicular traffic on adjacent roadways.

(6) Implement activity management (e.g. rescheduling activities to avoid overlap of construction phases, which would reduce short-term impacts).

(D) Each CUP owner shall use all available EPA TEIR 2 or better (TIER 2+) construction equipment. **AQ-1**

(E) Consistent with the requirements of ICAPCD Policy 5, each CUP owner shall pay an emission mitigation fee sufficient to off-set the amount by which the Project's NOx emissions exceed the 100 lbs/day threshold. ICAPCD allows a project to pay in-lieu impact fees using the most current Carl Moyer Cost Effective methodology to reduce excess NOx emissions. Under the ICAPCD program, the exact amount of the fee cannot be calculated until the time of construction when more precise data regarding the construction equipment types and hours of operation are known and ICAPCD can calculate the fee. Prior to any earthmoving activity, each CUP owner shall submit to the ICAPCD a complete list of all construction equipment to be utilized during the construction phase identifying make, model, year, horsepower, and estimated hours of usage.

(F) Each CUP shall comply with all mitigations in the Mitigation Monitoring and Reporting Program listed **AQ-1 THRU AQ-5.**

S-5 GEOLOGY/SOILS and MINERAL RESOURCES

(A) Prior to approval of final engineering and grading plans for the project, the County shall verify that all recommendations contained in the *Geotechnical Report for the Vega SES Solar Facility* prepared by Landmark Consultants, Inc. (August 2018) have been incorporated into all final engineering and grading plans. The County's soil engineer and engineering geologist shall review grading plans prior to finalization, to verify compliance with the recommendations of the report. All future grading and construction of the project site shall comply with the geotechnical recommendations contained in the geotechnical report.

S-6 CULTURAL RESOURCES:

(A) Pursuant to CEQA Guidelines §15064.5(f), in the event that previously unidentified unique archaeological resources are encountered during construction or operational repairs, archaeological monitors will be authorized to temporarily divert construction work within 100 feet of the area of discovery until significance and the appropriate mitigation measures are determined by a qualified archaeologist familiar with the resources of the region. Applicant shall notify the County within 24 hours. Applicant shall provide contingency funding sufficient to allow for implementation of avoidance measures or appropriate mitigation.

(B) In the event of the discovery of previously unidentified archaeological materials, the contractor shall immediately cease all work activities within approximately 100 feet of the discovery. Prehistoric archaeological materials might include obsidian and chert flaked-stone tools (e.g., projectile points, knives, and scrapers) or tool making debris; culturally darkened soil ("midden") containing heat-affected rocks, artifacts, or shellfish remains; and stone milling equipment (e.g., mortars, pestles, handstones, or milling slabs); and battered stone tools, such as hammerstones and pitted stones. Historic-period materials might include stone, concrete, or adobe footings and walls; filled wells or privies; and deposits of metal, glass, and/or ceramic refuse. After cessation of excavation, the contractor shall immediately contact the Imperial County Department of Planning and Development Services. Except in the case of cultural items that fall within the scope of the Native American Grave Protection and Repatriation Act, the discovery of any cultural resource within the project area shall not be grounds for a "stop work" notice or otherwise interfere with the project's continuation except as set forth in this paragraph.

In the event of an unanticipated discovery of archaeological materials during construction, the applicant shall retain the services of a qualified professional archaeologist, meeting the Secretary of the Interior's Standards for a Qualified Archaeologist, to evaluate the significance of the materials prior to resuming any construction-related activities in the vicinity of the find. If the qualified archaeologist determines that the discovery constitutes a significant resource under CEQA and it cannot be avoided, the applicant shall implement an archaeological data recovery program.

(C)

In the event that unanticipated paleontological resources or unique geologic resources are encountered during ground-disturbing activities, work must cease within 50 feet of the discovery and a paleontologist shall be hired to assess the scientific significance of the find. The consulting paleontologist shall have knowledge of local paleontology and the minimum levels of experience and expertise as defined by the Society of Vertebrate Paleontology's Standard Procedures (2010) for the Assessment and Mitigation of Adverse Impacts on Paleontological Resources. If any paleontological resources or unique geologic features are found within the project site, the consulting paleontologist shall prepare a paleontological Treatment and Monitoring Plan to include the methods that will be used to protect paleontological resources that may exist within the project site, as well as procedures for monitoring, fossil preparation and identification, curation of specimens into an accredited repository, and preparation of a report at the conclusion of the monitoring program

(D) In the event that evidence of human remains is discovered, construction activities within 200 feet of the discovery will be halted or diverted and the Imperial County Coroner will be notified (Section 7050.5 of the Health and Safety Code). If the Coroner determines that the remains are Native American, the Coroner will notify the NAHC, which will designate an MLD for the project (Section 5097.98 of the PRC). The designated MLD then has 48 hours from the time access to the property is granted to make recommendations concerning treatment of the remains (AB 2641). If the landowner does not agree with the recommendations of the MLD, the NAHC can mediate (Section 5097.94 of the PRC). If no agreement is reached, the landowner must rebury the remains where they will not be further disturbed (Section 5097.98 of the PRC). This will also include either recording the site with the NAHC or the appropriate Information Center; using an open space or conservation zoning designation or easement; or recording a document with the county in which the property

S-7 HEALTH, SAFETY AND HAZARDOUS MATERIAL/FIRE AND FUELS MANAGEMENT

(A) All trash and debris within the Project site shall be disposed of off-site, in accordance with current, local, state, and federal disposal regulations. Compliance with this measure shall be verified by the Planning and Development Services Department.

(B) If it is determined that hazardous wastes are, or will be generated by the proposed operations, the wastes 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).

(C) If it Is determined that hazardous wastes will be generated, the Permittee should also obtain a United States Environmental Protection Agency, Identification Number by contacting (800) 618-6942. Certain hazardous waste treatment processes or hazardous material, handling, storage or uses may require authorization from the local Certified Unified Program Agency (CUPA). Information about the requirement for authorization can be obtained by contacting the local CUPA.

(D) Firearms shall be prohibited in all Project areas except for those used by licensed security personnel.

(E) The Permittee shall ensure that the AST, farm equipment area, and any other debris have been cleared from the site.

Prior to the demolition of any building, structure, or transite pipe, the Applicant shall hire a California Certified Lead Inspector/Assessor and Certified asbestos Consultant to evaluate these features for the presence of lead based paint (LBP) and/or asbestos containing materials (ACM). Confirmed LBP and/or ACM shall be handled by a licensed LBP contractor and/or Licensed Asbestos Contractor. All contaminants shall be remediated in compliance with California environmental regulations and policies. LBP and/or ACM shall be disposed of according to appropriate regulations.

(F) **Hazardous Materials Discovery:** All construction contractor(s) shall be instructed to immediately stop all subsurface construction activities in the event that petroleum is discovered, an odor is identified, or significantly stained soil is visible during construction. Contractors shall be instructed to follow all applicable regulations regarding discovery and response for hazardous materials encountered during the construction process. During construction, discovery of hazardous materials shall result in the immediate stop of all subsurface construction activities.

S-8 HYDROLOGY AND WATER QUALITY

A. Prior to construction and site restoration for each CUP site, the Applicant shall acquire appropriate Clean Water Act regulatory permits; prepare SWPPP with incorporated control measures outlined in Mitigation Measure 4.9-1a; and implement BMPs. **Prepare SWPPP and Implement Best Management Practices (BMP) Prior to Construction and Site Restoration.** The project applicant or its contractor shall prepare a SWPPP specific to the project and be responsible for securing coverage under SWRCB's National Pollution Discharge Elimination System (NPDES) stormwater permit for general construction activity (Order 2009-0009-DWQ). The SWPPP shall identify specific actions and BMPs relating to the prevention of stormwater pollution from project-related construction sources by identifying a practical sequence for site restoration, BMP implementation, contingency measures, responsible parties, and agency contacts. The SWPPP shall reflect localized surface hydrological conditions and shall be reviewed and approved by the project applicant prior to commencement of work and shall be made conditions of the contract with the contractor selected to build and decommission the project. The SWPPP(s) shall incorporate control measures in the following categories:

- Soil stabilization and erosion control practices (e.g., hydroseeding, erosion control blankets, mulching) Dewatering and/or flow diversion practices, if required.)
- Sediment control practices (temporary sediment basins, fiber rolls).
- Temporary and post-construction on- and off-site runoff controls.
- Special considerations and BMPs for water crossings, wetlands, and drainages
- Monitoring protocols for discharge(s) and receiving waters, with emphasis place on the water quality.
- Waste management, handling, and disposal control practices
- Corrective action and spill contingency measures
- Agency and responsible party contact information
- Training procedures that shall be used to ensure that workers are aware of permit requirements and proper installation methods for BMPs specified in the SWPPP

B. The SWPPP shall be prepared by a qualified SWPPP practitioner with BMPs selected to achieve maximum pollutant removal and that represent the best available technology that is economically achievable. Emphasis for BMPs shall be placed on controlling discharges of oxygen-depleting substances, floating material, oil and grease, acidic or caustic substances or compounds, and turbidity. BMPs for soil stabilization and erosion control practices and sediment control practices will also be required. Performance and effectiveness of these BMPs shall be determined either by visual means where applicable (i.e., observation of above-normal sediment release), or by actual water sampling in actives: dissolved oxygen, floating material, oil and grease, pH, and turbidity cases where verification of contaminant reduction or elimination, (inadvertent petroleum release) is required to determine adequacy of the measure.

C. Prior to issuance of a grading permit for each CUP site, the Applicant shall provide Colorado River Basin Regional Water Quality Control Board with the location, type of discharge, and methods treatment and monitoring for all groundwater dewatering discharges if the project requires construction dewatering. **Properly Dispose of Construction Dewatering in Accordance with the Colorado River Basin Regional Water Quality Control Board.** If required, all construction dewatering shall be discharged to an approved land disposal area or drainage facility in accordance with Colorado River Basin RWQCB requirements. The project applicant or its construction contractor shall provide the Colorado River Basin RWQCB with the location, type of discharge, and methods of treatment and monitoring for all groundwater dewatering discharges. Emphasis shall be placed on those discharges that would occur directly or in proximity to surface water bodies and drainage facilities.

D. Post construction for each CUP site, the Applicant shall implement a Drainage Plan in accordance with the County and Imperial Irrigation District guidelines as outlined. **Incorporate Post-Construction Runoff BMPs Into Project Drainage Plan and Maximize Opportunities for Low Impact Development.** The project Drainage Plan shall adhere to County and IID guidelines to treat, control, and manage the on- and off-site discharge of stormwater to existing drainage systems. Low Impact Development opportunities, including, but not limited to infiltration trenches or bioswales, will be investigated and integrated into the Drainage Plan to the maximum extent practical. The Drainage Plan shall provide both short- and long-term drainage solutions to ensure the proper sequencing of drainage facilities and treatment of runoff generated from project impervious surfaces prior to off-site discharge. The project applicant shall ensure the provision of sufficient outlet protection through the use of energy dissipaters, vegetated rip-rap, soil protection, and/or other appropriate BMPs to slow runoff velocities and prevent erosion at discharge locations, access roads, electrical distribution, and solar array locations. A long-term maintenance plan shall be developed and implemented to support the functionality of drainage control devices. The facility layout(s) shall also include sufficient container storage and on-site containment and pollution-control devices for drainage facilities to avoid the off-site release of water quality pollutants, including, but not limited to oil and grease, fertilizers, treatment chemicals, and sediment.

S-9 BIOLOGICAL RESOURCES:

(A) GENERAL CONSTRUCTION

a) Each CUP owner shall identify and retain a qualified biologist(s) approved by CDFW.

b) The name, documented experience, any permit numbers, and resumes for the qualified biologist(s) shall be submitted to the CDFW for approval at least seven (7) days prior to initiation of

construction. It is assumed CDFW will approve qualified biologist(s) within fifteen (15) days of the submittal.

c) The qualified biologist(s) shall be present on-site during all ground-disturbing phases of construction to regularly monitor construction activities and ensure construction is proceeding in compliance with the avoidance, minimization, and mitigation measures committed to by the Applicant, as well as measures required (project manager, resident engineer) to ensure that issues relating to biological resources are appropriately and lawfully managed.

d) The qualified biologist shall be responsible for reporting any noncompliance issues to CDFW within forty-eight (48) hours. The resident engineer shall be immediately notified to halt work, if necessary.

e) The qualified biologist(s) shall provide a report to CDFW at least monthly identifying construction activities and the results of compliance monitoring related to implementation of avoidance and minimization measures.

The qualified biologist(s) shall meet the following minimum qualifications:

(1) Have a bachelor's degree in biological sciences, zoology, botany, ecology, or a closely related field or at least four (4) years of experience in field biology or current certification of a nationally recognized biological society, such as The Ecological Society of America or The Wildlife Society;

(2) Have at least one (1) year of field experience with biological resources found in the geographic region of the Project; and

(3) Have extensive knowledge of the biology and ecology of sensitive species occurring and potential occurring within the Project site.

(4) Have specialized avian experience necessary to conduct nesting surveys and monitor buffers.

(1) Each CUP owner shall develop and implement a Worker
(2) Environmental Awareness Program (WEAP) prior to the start of construction. The WEAP shall be submitted to the Imperial County Planning and Development Services Department for review and approval prior to the issuance of building permits. The WEAP training shall be led by the qualified biologist(s) and shall cover the following:

(a) The potential presence and ecology of sensitive biological resources found on-site, such as potential jurisdictional waters and nesting avian species;

(b) Flagging/fencing of exclusion areas;

(c) Proper implementation of protective measures to avoid impacts to special-status species; The reasons, need, and method by which employees should report on wildlife mortality, follow nest management protocols, dispose of carcasses, comply with applicable regulations (including the consequences of noncompliance), and the appropriate agencies and personnel that should be contacted after incidents; and

(d) Other permit requirements and environmental issues.

(3) All construction site personnel shall be required to attend the WEAP training in conjunction with hazard and safety training prior to working on-site.

(4) Parking of vehicles shall occur within the fenced Project area or within previously disturbed areas prior to construction of the fencing, and away from sensitive habitats.

(5) Grading shall only occur where necessary and as specified by the Project's final engineering plans, and shall be avoided wherever possible to minimize the amount of ground disturbance.

(6) To the extent possible, Project layout and design shall generally follow existing contours of the Project site to minimize the amount of grading required. To the extent possible, nighttime construction shall be avoided. When activities must occur at night, all Project lighting (e.g., staging areas, equipment storage sites, roadway) shall be directed downward and away from natural vegetation communities. Light glare shields shall be used to reduce the extent of illumination into adjoining areas.

(7) Nighttime and daytime on-site construction vehicle speeds shall be restricted to ten (10) miles per hour and twenty (20) miles per hour, respectively. Speed limit signs shall be posted throughout the site to remind construction workers of travel speed restrictions.

(8) Spoils, trash, and any construction-generated debris shall be removed to an approved off-site disposal facility. A trash abatement program shall be established. Trash and food items shall be contained in closed containers and removed daily to reduce the attraction of opportunistic predators such as common ravens, coyotes, and feral cats and dogs that may prey on sensitive species.

(9) When handling toxic substances, construction vehicles shall carry a Hazardous Material Spill Kit for use in the event of a spill. All construction personnel working on-site shall be trained in using

these kits. Spill containment materials must be on-site or readily available for any equipment maintenance or refueling.

(10) Construction workers shall be prohibited from bringing domestic pets and firearms to the site.

(11) A SWPPP or equivalent shall be prepared prior to the start of construction to comply with applicable RWQCB storm water management provisions. The SWPPP or SWPPP equivalent document shall identify the design features and BMPs that shall be used to effectively manage drainage-related issues (e.g., erosion and sedimentation) during construction. Erosion control measures shall be regularly checked by inspectors, the qualified biologists, and/or resident engineer. Fencing and erosion control measures of all construction areas shall be inspected a minimum of once per week (refer to mitigation measure MM 4.11.1b in Section 4.11, Hydrology and Water Quality).

(12) All construction activities shall cease during heavy rains to prevent unnecessary erosion, runoff, and sedimentation, and shall not resume until conditions are suitable for the movement of equipment and materials.

(13) No planting or seeding of invasive plant species on the most recent version of the California Invasive Plant Council (Cal-IPC) California Invasive Plant Inventory for the Project region shall be permitted.

(14) To prevent indirect effects to sensitive natural resources from fugitive dust associated with construction of the Project, all active construction areas shall be watered down as necessary. All trucks hauling soil, sand, and other loose materials shall be covered or shall maintain at least 2 feet of free-board. All unpaved access roads, parking areas, and staging areas at construction sites shall have non-potable water or nontoxic soil stabilizers applied as needed.

(15) At the completion of construction, all construction-related materials shall be removed from the site.

(16) Each CUP owner shall develop a Weed Management Plan prior to the commencement of construction activities.
   1) The Weed Management Plan shall include a variety of measures that shall be undertaken during construction and operation activities to prevent the introduction and spread of new weed species.
   2) The Weed Management Plan shall also address monitoring, plus educating personnel on weed identification and

methods for avoiding and treating infestations. Weed control methods may include both physical and chemical control.

3) All chemical applications require oversight by a holder of a valid Qualified Applicator's License (QAL) issued by the California Department of Pesticide Regulation (CADPR) Recommendations for use of chemical products will be made in writing by a Pest Control Advisor (PCA) with a valid CADPR license. Chemical products will be registered, non-restricted, general-use herbicides. Treatment applications will follow use and safety guidelines available on product labels. Typical active ingredients expected for chemical treatments are glyphosate and triclopyr. Glyphosate and triclopyr are found in broad-spectrum, systemic herbicides, and available in numerous products intended for control of post-emergent vegetation. Chemical treatment of vegetation in and around aquatic or wetland features requires products approved for use within such habitats, as described on product labels.

4) The Weed Management plan shall be submitted to the Imperial County Planning and Development Services Department & the Agriculture Commission Office for review and approval prior to issuance of building permits.

(B)

(1) Each CUP owner shall develop and implement an Operation and Maintenance Worker Education Plan to advise personnel on general operations measures. The Worker Education Plan shall be submitted to the County of Imperial Planning and Development Services Department for review and approval prior to issuance of building permits. The following provisions shall be included in the Worker Education Plan and implemented throughout the operational lifespan of each CUP:

(a) Operation and maintenance personnel shall be prohibited from:

(1) Harming, harassing, or feeding wildlife and/or collecting special-status plant or wildlife species.

(2) Traveling (either on foot or in a vehicle) outside of Project footprint except on public roads.

(3) Littering on the Project area.

(4) Allowing persons not employed at the facility to remain on site after daylight hours

(5) Exceeding normal nighttime operational noise or lighting levels.

(2) All operation and maintenance equipment, including cranes and personnel, shall stay within the permanent impact footprint of CUP boundaries, the Electrical Collector Line Corridor, or the Gen-Tie line corridor, except when not physically feasible or when necessary to protect human life or property. Operation and maintenance vehicles shall be parked in designated areas and away from sensitive habitats.

(3) Nighttime and daytime vehicle speeds within each CUP, the Electrical Collector Line Corridor, and the Gen-Tie line corridor shall be restricted to ten (10) miles per hour and twenty-five (25) miles per hour, respectively. Speed limit signs shall be posted throughout the Project site to remind workers of travel speed restrictions.

(4) Each CUP, the Electrical Collector Line Corridor, and the Gen-Tie line corridor shall be kept clear of trash and other litter to reduce the attraction of opportunistic predators such as common ravens, coyotes, and feral dogs that may prey on sensitive species.

(5) Operation and maintenance employees shall be prohibited from bringing domestic pets and firearms to the site.

(6) The General Construction Permit shall specify post-construction storm water control standards, and preparation and implementation of a Long-Term Maintenance Plan for the retention/detention basins

(7) Operation and maintenance activities at each CUP, the Electric Collector Line Corridor, and the Gen-Tie corridor shall be carried out in accordance with the Weed Management Plan

(C) **JURISDICTIONAL WATERS AND WETLANDS MEASURES - ALL CUPs**

(1)

(a) Each CUP owner shall implement the following measures during decommissioning activities occurring within each CUP.

(1) All mitigation measures required during construction of the Project to avoid or minimize impacts to biological resources shall also be implemented during decommissioning activities.

(2) Decommissioning of the Project shall minimize new site disturbance and removal of native vegetation to the maximum extent possible.

(3) Topsoil removed during decommissioning shall be stockpiled and used as topsoil during restoration efforts associated with decommissioning disturbance.

(4) Soil shall be stabilized and vegetated with plant species characteristic of native species within adjacent habitats, except where immediately reclaimed as agriculture. Local seed sources shall be used where feasible.

(5) Surface water flows shall be restored to pre-disturbance conditions. Unnecessary stream crossings, roads, and pads shall be removed and revegetated. Erosion control measures shall be installed in all disturbance areas.

(6) Petroleum and chemical spills shall be remediated prior to the completion of decommissioning. **Corridor, and the Gen-Tie corridor**

(b) Each CUP owner shall implement the following measures prior to and during construction activities at each CUP, the Electric Collector line Corridor and Gen-Tie line corridor to avoid construction-related impacts to jurisdictional waters and wetlands.

(c) Each CUP and Project design shall avoid direct and indirect impacts to jurisdictional waters to the greatest extent feasible. Construction within jurisdictional waters and/or wetlands shall be subject to prior authorization by USACE, RWQCB, and CDFW.

(d) All equipment operating in and near jurisdictional waters or wetlands shall be in good working condition and free of leaks. All vehicles shall have drip pans during storage to contain minor spills and drips. No refueling or storage shall take place within 100 feet of a drainage channel or structure. In addition, all maintenance crews working with heavy equipment shall be trained in spill containment and response.

(e) Discharges shall not permanently restrict or impede the passage of normal or expected high flows, or cause the permanent relocation or diversion of the flows.

(f) Where turbidity or erosion occurs or is expected to occur from drainage structures, biofilters, detention basins or other

appropriate drainage catchment structures shall be installed where flow conveyance occurs from the Project directly into a jurisdictional area.

(g) Temporary impacts to jurisdictional waters and wetlands will be recontoured to pre-construction conditions. Temporary impacts to vegetated jurisdictional waters and wetlands will also be revegetated with appropriate native vegetation or non-native compatible with the landscape palette.

(h) Permanent impacts to jurisdictional waters and wetlands shall be mitigated either through on-site and/or off-site re-establishment and/or enhancement of jurisdictional waters and wetlands or through an approved-mitigation bank or in-lieu fee program, if one is available. The type of mitigation, mitigation location, and the final mitigation ratios will be established during the permit process for the Project's USACE Section 404 permit, the RWQCB Section 401 Water Quality Certification, and a CDFW Streambed Alteration Agreement. The federal agencies have published guidance on mitigation, i.e., the final rule for Compensatory Mitigation for Losses to Aquatic Resources that was issued by USACE and USEPA. Issuance of required permits/authorizations and preparation of a detailed Wetland/Waters Mitigation Plan to be submitted for review and approval by the USACE, RWQCB, and CDFW before impacts to jurisdictional waters.

(i) Each CUP owner shall comply with additional measures identified during permitting through the USACE, RWQCB, and CDFW. In addition, the determination of whether the Project may be permitted under USACE's NWP program, or whether an individual permit shall be required, shall be determined formally as part of the CWA Section 404 permit process. To qualify for an NWP, the proposed action and the associated unavoidable impacts to jurisdictional waters based on final project designs must satisfy all terms and conditions of the applicable NWP, as well as all general conditions and any relevant regional conditions of the NWP program.

(j) The Wetland/Waters Mitigation Plan shall describe proposed on-site and off-site mitigation. For all habitat restoration proposed, this plan shall include details regarding site preparation (e.g., grading), planting specifications, and irrigation design, as well as maintenance and monitoring procedures. The plan shall also outline yearly success criteria and remedial measures should the mitigation effort fall short of the success criteria, and a strategy for long-term mitigation site management. Alternatively, mitigation obligations may be

satisfied by participating in a fee-based mitigation program (e.g., a wetland mitigation bank) in which case, long-term management for such mitigation shall be covered under the terms of the formal banking agreement or by purchasing appropriate mitigation credits from a regulatory approved bank.

(k) The following measures shall apply to construction activities at the Full Build-out Scenario.

(1) A qualified biologist shall be on-site during all ground-disturbing construction activities in potential BUOW habitat. The qualified biologist shall be responsible for implementing and overseeing BUOW avoidance and minimization measures.

(2) The qualified biologist shall have the authority to stop construction if activities are in violation of avoidance and minimization measures. A qualified biologist possesses a bachelor's degree in wildlife biology or a related field and has demonstrated field experience in the identification and life history of BUOW.

(3) Per CDFW guidance, a take avoidance survey (i.e., pre-construction clearance survey) will be conducted by a qualified biologist to determine presence or absence of BUOW no less than fourteen (14) days and no more than thirty (30) days prior to initiating construction activities. Surveys shall include areas within the Project footprint and a surrounding 500-foot (150-meter) buffer. The survey shall consist of walking parallel transects and noting any fresh BUOW sign or presence. The results of the take avoidance survey shall be provided to CDFW. If more than thirty (30) days pass between the take avoidance survey and initiation of Project construction, additional take avoidance surveys may be required, depending on what actions have been implemented to deter BUOW from moving into the Project footprint and buffer area. A final take avoidance survey shall be conducted within the Project footprint within twenty-four (24) hours prior to initiation of construction activities. Given the total duration of construction and the size of the Project, it is expected that take avoidance surveys will be conducted in phases, in order to stay within the required survey windows associated with construction activities.

(4) If occupied burrows are found during take avoidance surveys, appropriate construction buffers or setback

distances shall be determined by the qualified biologist on a case-by-case basis, depending on the season in which disturbance will occur, the type of disturbance, and other factors that could influence susceptibility to disturbance (e.g., topography, vegetation, existing disturbance levels, etc.). To the extent feasible, buffers of 246 feet (75 meters) will be used during the breeding season (February 1 through August 31) and 164 feet (50 meters) will be used during nonbreeding season (September 1 through January 31). "Shelter in place" techniques shall be used if necessary to create a visual and auditory barrier between construction activities and the occupied burrow. Techniques shall include placing hay bales, fencing, or another physical barrier between the occupied burrow and construction activities. The qualified biologist shall determine if and/or when shelter in place is necessary and feasible for implementation. When construction activities commence adjacent to the buffer area, a qualified biologist shall be present on-site full time to monitor the behavior of BUOW for at least 3 days. The qualified biologist shall have the authority to increase the setback distance if there are signs of disturbance, such as changes in behavior as a result of construction or other indications of distress by BUOW.

(a) If BUOW activity is detected at a burrow within the Project footprint during the non-breeding season (September 1 through January 31), BUOW shall be excluded from active burrows and encouraged to passively relocate to suitable, unoccupied habitat outside of the exclusion area. BUOW shall be excluded by installing one-way doors in burrow entrances. Although passive relocation does not result in control of the recipient area for BUOW, the qualified biologists shall verify that there is an acceptable "recipient" area within a reasonable distance that provides the necessary subsidies to support BUOW with the goal to minimize the stress of relocation. Subsidies to be considered include suitable burrows (primary and satellite) and habitat quality (e.g., vegetation cover, diversity) that is equal to or greater than that from which they were relocated. If, during pre-construction surveys, BUOW activity is detected at a burrow within the Project footprint during the breeding season (February 1 through August 31), then an appropriate construction buffer or setback distance shall be determined by the qualified biologist on a

case-by-case basis. This buffer shall be flagged and all Project-related activity shall remain outside of the flagged area until a qualified biologist determines the burrow is no longer occupied (e.g., juveniles are foraging independently and are capable of independent survival).

(b) In the event that BUOW will be excluded from the Project footprint and occupied burrows will be impacted, a mitigation site with suitable burrows and habitat shall be secured and a Burrowing Owl Exclusion Plan shall be developed and approved by CDFW prior to excluding BUOW from burrows. Specific objectives for BUOW protection addressed by this Burrowing Owl Exclusion Plan shall describe exclusion methodology, burrow excavation procedures, on-site and post-relocation monitoring of occupied burrows, and reporting.

(c) Occupied BUOW burrows directly impacted shall be replaced by installing artificial burrows on mitigation sites (i.e., conservation easements, in-lieu fee lands, Farm Contract land), or other land as agreed to by CDFW, at a ratio of 1:1. If the mitigation sites identified for the Project have at least two suitable BUOW burrows for each occupied burrow directly impacted, then artificial burrows shall not be installed. Suitable burrows are defined as burrows greater than approximately 4 inches (10 centimeters) in diameter (height and width) and greater than approximately 60 inches (150 centimeters) in depth. Burrows shall be scoped to ensure they are of proper depth for BUOW.

(d) A security in an amount equal to the fair market value of the cost of a perpetual conservation easement and long-term endowment for the number of acres of burrowing owl habitat mitigation obligation for each CUP Phase (one or more CUPs for which a security is posted) prior to commencement of construction shall be posted to fulfill the mitigation obligations for lost burrowing owl habitat.

(e) A CUP owner shall proffer compensatory mitigation when a total of four CUP Phases have posted security and proffered compensatory

mitigation or eighteen (18) months from the date of posting security on the first CUP Phase, whichever is longer. Security shall be returned to the CUP owner upon proffer of compensatory mitigation. CDFW may extend the 18-month period if the CUP owner is making a good-faith effort to proffer mitigation and demonstrating progress in securing mitigation. If the 18-month period elapses and the CUP owner cannot proffer mitigation or demonstrate a good faith effort to secure mitigation, CDFW may cash in the security to secure mitigation itself.

(l) The CUP owner shall proffer mitigation for lost burrowing owl core foraging habitat, as identified in the BUOW occupancy analysis and model by (1) securing a CUP owner purchased conservation easement or similar instrument that protects the agricultural use of the land in perpetuity at a ratio of 1:1; (2) participating in the Burrowing Owl Habitat Mitigation Plan administered by the Imperial Community Foundation-Burrowing Owl Stewardship and Education Fund (IVCF-BOSEF) (or similar qualified non-profit organization and approved by CDFW), if available; and/or (3) using a CDFW-approved in-lieu fee program, if one is available at the time the compensatory mitigation is proffered. To be available as compensatory mitigation for this Project, the Burrowing Owl Habitat Mitigation Plan shall be developed for approval by CDFW and the IVCF-BOSEF Board of Directors (or the Board of Directors of similar qualified non-profit organization) before the time compensatory mitigation is proffered.

(m) The Burrowing Owl Habitat Mitigation Plan would be developed to compensate for impacts to core foraging habitat, and include the following components:

(1) Avoiding higher quality habitat to the extent practicable. [Note: The Project Applicant has already implemented this measure by removing portions of the Project based on the occupancy model.]

(2) A strategy and methods to enroll farmers in a program to grow and retain Burrowing Owl Friendly Crops (BOFC) identified by the occupancy model (i.e., wheat and alfalfa). Core BUOW foraging habitat shall be mitigated at a 1:1 ratio by entering farm land into short-term (minimum 3 years) farm agreements to predominantly grow BOFC.

(3) A strategy and method for integrating owl-friendly farm practices to reduce mortality of owls. For farm land enrolled in BOFC agreements that include requirements to implement BUOW safe farm practices, impacts to core BUOW foraging habitat shall be mitigated at a reduced ratio of 0.7:1, which reflects the combined benefit of farming BOFC using BOSFP through short-term (minimum of 3 years) farm

(n) A long-term financing plan and a defined program-sufficient to fund the BOFC/BOSFP agreement program through the end of the Project's operational life (anticipated to be approximately 30 years) (e.g. endowment account).

(o) A Bird and Bat Conservation Strategy (BBCS) will be developed by the Project Applicant in coordination with the County of Imperial, USFWS, and CDFW. The BBCS will include the following components:

(1) A description and assessment of the existing habitat and avian and bat species;

(2) An avian and bat risk assessment and specific measures to avoid, minimize, reduce, or eliminate avian and bat injury or mortality during all phases of the Project.

(3) A post-construction monitoring plan that will be implemented to assess impacts on avian and bat species resulting from the Project. The post-construction monitoring plan will include a description of standardized carcass searches, scavenger rate (i.e., carcass removal) trials, searcher efficiency trials, and reporting.

(4) Statistical methods will be used to estimate Project avian and bat species, including special status species, annual mortality by taxa and season. Analysis will also determine collision rates during diurnal and nocturnal periods; species mortality composition; and assess the spatial distribution mortalities. Sufficient data (i.e., sample sizes) will dictate the extent that fatality models can be used to generate fatality estimates within the various categories. Fatality estimates will be generated using the most appropriate fatality estimator given the data set.

(5) An injured bird response plan that delineates care and curation of any and all injured birds.

(6) A nesting bird management strategy to outline actions to be taken for avian nests detected within the impact footprint during operation of the Project.

(7) A conceptual adaptive management and decision-making framework for reviewing, characterizing, and responding to monitoring results.

(8) Monitoring studies following commencement of commercial operation of each CUP area. Monitoring results will be reviewed annually by the Applicant and the County of Imperial, in consultation with CDFW and USFWS, to inform adaptive management responses.

(9) During Project construction, incidental avian carcasses or injured birds found during construction shall be documented. Should a carcass be found by Project personnel, the carcass shall be photographed, the location shall be marked, the carcass shall not be moved, and a qualified biologist shall be contacted to examine the carcass. When a carcass is detected, the following data shall be recorded (to the extent possible): observer, date/time, species or most precise species group possible, sex, age, estimated time since death, potential cause of death or other pertinent information, distance and bearing to nearest structure (if any) that may have been associated with the mortality, location (recorded with a Global Positioning System [GPS]), and condition of carcass.

(10) If any federal listed, state listed or fully protected avian carcasses or injured birds are found during construction or post-construction monitoring, the Project Applicant shall notify USFWS and CDFW within 24 hours via email or phone and work with the resource agencies to determine the appropriate course of action for these species. For such listed species, the CUP owner shall obtain or retain a biologist with the appropriate USFWS Special Purpose Utility Permit(s) and CDFW Scientific Collecting Permit(s) to collect and salvage all dead and injured birds, and store/curate them in freezers for later disposition and analysis.

(11) Although take is not anticipated, it is possible. Should mortality of a federally listed species be documented, the take will be addressed by applying for an incidental take permit through the development of a Habitat Conservation Plan (HCP) that satisfies the permit

issuance criteria stipulated under Section 10(a)(l)(B) of the Endangered Species Act or through consultation under Section 7 of the federal Endangered Species Act. If mortality of a State-listed species is documented, the CUP owner shall apply for a 2081(b) incidental take permit from CDFW. Alternatively, if available, the CUP owner may elect to obtain incidental take authorization through participation in the Desert Renewable Energy Conservation Plan.

(12) Utility lines constructed above-ground shall conform to Avian Power Line Interaction Committee (APLIC) standards.

(13) Post-construction monitoring studies shall be conducted by a third-party independent contractor for at least two (2) years following commencement of commercial operation of each CUP area. Monitoring results shall be reviewed annually by the Applicant and the County of Imperial, in consultation with CDFW and USFWS, to determine if and to what extent post-construction monitoring studies shall be continued in future years.

(2) To the extent possible, construction shall occur outside the typical avian breeding season (February 15 through September 15). If construction must occur during the general avian breeding season, a pre-construction nest survey shall be conducted within the impact area and a 500-foot (150-meter) buffer by qualified biologist no more than seven (7) days prior to the start of vegetation clearing and/or ground disturbing construction activities in any given area of the Project footprint. Construction crews shall coordinate with the qualified biologist at least seven (7) days prior to the start of construction in a given area to ensure that the construction area has been adequately surveyed. A nest is defined as active once birds begin constructing or repairing the nest in readiness for egg-laying. A nest is no longer an "active nest" if abandoned by the adult birds or once nestlings or fledglings are no longer dependent on the nest. If no active nests are discovered, construction may proceed. If active nests are observed that could be disturbed by construction activities, these nests and an appropriately sized buffer (typically a 200-foot (61-meter) buffer for non-raptor species nests and at least a 500-foot (150-meter) buffer for raptor or federally listed species nests) would be avoided until the young have fledged. Final construction buffers or setback distances shall be determined by the qualified biologist in coordination with USFWS and CDFW on a case-by-case basis, depending on the species, season in which disturbance shall occur, the type of disturbance, and other factors that could

influence susceptibility to disturbance (e.g., topography, vegetation, existing disturbance levels, etc.). Active nests shall be avoided until the young have fledged and/or the monitor determines that no impacts are anticipated to the nesting birds or their young. If vegetation clearing and/or ground disturbing activities cease for fourteen (14) or more consecutive days during the nesting season in areas where suitable nesting habitat remains, repeat nesting bird surveys shall be required to ensure new nesting locations have not been established within the impact area and the defined buffers.

(3) Construction-generated noise may result in disturbance to nesting migratory birds. The following measures shall be incorporated to minimize noise generated from construction activities:

(a) The qualified biologist shall coordinate with contractors to ensure that heavy equipment will be repaired as far as practical from habitats where nesting birds may be present.

(b) Construction equipment, including generators and compressors, shall be equipped with manufacturers' standard noise-control devices or better (e.g., mufflers, acoustical lagging, and/or engine enclosures).

(c) The construction contractor shall maintain all construction vehicles and equipment in proper operating condition and provide mufflers on all gas- and diesel-powered equipment.

(d) The Project's BBCS shall be implemented during the construction. Incidental avian carcasses or injured birds found during construction shall be documented. If a carcass be found by Project personnel, the carcass shall be photographed, the location shall be marked, the carcass shall not be moved, and a qualified biologist shall be contacted to examine the carcass. When a carcass is detected, the following data shall be recorded (to the extent possible): observer, date/time, species or most precise species group possible, sex, age, estimated time since death, potential cause of death or other pertinent information, distance and bearing to nearest structure (if any) that may have been associated with the mortality, location (recorded with a Global Positioning System [GPS]), and condition of carcass.

(4) During decommissioning, Project improvements associated with the Electric Collector Corridor Line and the Mount Signal Solar Farm Project Gen-Tie line shall be removed. In addition, all unnecessary overhead power lines and poles shall be removed by each CUP owner.

(5) Adhere to all mitigations outlined in the Mitigation Monitoring and Reporting Program (MM&RP) for the Lindsey Solar Farm project.

S-10 PUBLIC SERVICES:

(A) If Permittee receives an exclusion of applicable sales and use tax payable to the County of Imperial under Senate Bill 71 under the State Public Resource Code (Section 26003, et al.) and the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA), Permittee shall pay to the County and Local Transportation Authority an amount equal to the sales tax (currently at 1.5%) which would have been received if Permittee had not obtained such exclusion.

(B) Permittee shall require that its general construction contractor exercise its option to obtain a California Department of Tax and Fee Administration (CDTFA) sub-permit for the jobsite and allocate all eligible use tax payments to Imperial County and LTA. Permittee will require that the general contractor provide County of Imperial with either a copy of their CDTFA account number and sub-permit. To accomplish this, Permittee shall either cause its general construction contractor and/or sub-contractor to treat the project in accordance with the relevant CDTFA for sales and use tax purposes or form a "Buying Company" as defined by CDTFA. Permittee can adopt an alternate methodology to accomplish this goal if the County Executive Office approves such methodology prior to issuance of building permits. Permittee shall require its general construction contractor to use commercially reasonable best efforts to cause its subcontractors and vendors to obtain similar sub-permits for the jobsite and to allocate all eligible sales and use tax payment to Imperial County and LTA.

(C) Permittee shall direct use taxes on out-of-County taxable purchased construction related items to Imperial County, to the extent permitted and consistent with State use tax law.

(D) Permittee shall use its best efforts, consistent with state law, to source taxable purchases from construction retail vendors within the County of Imperial.

(E) The Permittee shall exclude from assessment and taxation under California Revenue and Taxation Code Section 73 (AB 1451) only that property qualifying as an Active Solar Energy System, pursuant to the applicable guidelines issued by the Board of Equalization.

(1) The Permittee shall widely publicize to County residents the availability of job opportunities associated with the project (whether or not those job opportunities are within Imperial County or are regional). Since the majority of the population residents in the incorporated Cities of the County, dissemination of the information

should be relatively easy. Postings at City Halls, newspaper and television advertisements, local job centers, and dedicated website shall offer sufficient avenues of communication. The Imperial County Office of Employment and Training in addition to the Imperial Valley College presents viable sources for community awareness. The information shall provide available positions, details of positions including qualifications, number of openings, indicated the anticipated start date for each, and application process. In order to maintain oversight of the process, the application process can be completed both on a dedicated website and at dedicated computers at the County which would afford those without Internet connection the ability to apply. The Permittee's information shall be forwarded to the Permittee or their contractor and copies of applications files are maintained at the County.

(2) During the development phase of the project, the Permittee shall provide a roster of employees to include their position and place of residence. Permittee shall also attempt to coordinate a ride-share program with Caltrans and other regional employers to facilitate the employment of Imperial County residents in jobs related to this project.

(3) Unless prohibited by local, state or federal law or regulation, Permittee shall make good faith efforts to hire qualified residents of the Imperial County with the objective that a majority of the total work force is comprised of the Imperial County residents.

(4) The Permittee shall install and implement security measures which may include, but not limited to, secured perimeter fencing with barbed wire, sensors, with controlled access points, security alarms, security camera systems, security guard vehicle patrols to deter trespass or unauthorized activities that would interfere with operation of the proposed project.

(5) Permittee shall compensate the County pursuant to the Department of Environmental Health Fee Schedule for any costs of calls related to bees and mosquitoes.

(6) The Permittee shall reimburse the Sheriff's Department for any investigations regarding theft on the Project site and related law enforcement.

(7) All construction supervisors and foremen shall be provided with communication devices, cell phones or walkie-talkies, in the event of an emergency situation on-site.

(8) All construction-related activities shall take place within the development footprint of the Project as defined by the final engineering plans. The anticipated impact areas, including staging areas, equipment access, and disposal or temporary placement of spoils, shall be delineated with staking and/or orange construction fencing prior to construction to avoid natural resources where possible. No construction-related activities shall occur outside of the designated impact area. All construction materials, staging, storage, dispensing, fueling, and maintenance activities shall be designated on construction maps and shall be situated a minimum of fifty (50) feet from all drainages. Staging and temporary access shall occur on existing roadways whenever possible.

(9) For operation and maintenance fees associated with Fire Department/OES: Compare to DA

(a) Permittee shall pay a fee of $50 per acre per year prior to commencement of the construction period to address the Imperial County Fire/OES expenses for service calls within the Project's Utility/Transmission area. Said amount shall be prorated on a monthly basis for periods of time less than a full year. Permittee shall provide advance, written notice to County Executive Office of the construction schedule and all revisions thereto.

Permittee shall pay an annual fee of $20 per acre per year during the post-construction, operational phase of the Project to address the Imperial County Fire/OES expenses for service calls within the Project's Utility/Transmission area. Said fee will be paid to the Fire Department to cover on-going maintenance and operations costs created by the project.

(b) Costs associated with items two above items shall be annually adjusted on January 1st to add a CPI (Los Angeles) increase. Such costs associated with these items can be readjusted in the County's sole discretion if a new service analysis is prepared and that service analysis is approved by both the County and the Permittee.

(10) **FIRE** – In lieu of providing all-weather access roads for fire protection vehicles, the Permittee shall be permitted to provide compacted dirt roads (in compliance with ICAPCD's rules and regulations) for fire protection vehicles if prior to the issuance of any grading permit for the Project shall purchase an All-Terrain Vehicle (ATV) for the Fire Department. The ATV is estimated to cost between $320,000.00 and $365,000.00. Final cost, conditions and equipment of the ATV shall be determined prior to the

issuance of the initial grading permit. The County agrees to require, as a condition of approval, other developers in the area to reimburse the Applicant for the expenses associated with the purchase of the ATV. The Permittee shall be reimbursed only for those expenses in excess of their proportionate share for the purchase of the ATV that the Permittee would have been required to pay. Furthermore, if an ATV was already purchased by another developer in the area, then the Permittee shall only be required to pay a fire mitigation in the amount of up to $100 per acre that would represent their proportionate share to reimburse the purchaser of the ATV. The County shall be responsible for managing the reimbursement component of this condition of approval.

(11) Permittee shall participate in the Imperial County Public Benefit Program for the life of the CUP and shall at all times be a party to a public benefit agreement in a form acceptable to County Counsel in order to pay for all costs, benefits, and fees associated with the approved project, Approval of this public benefit agreement will be by the Board of Supervisors prior to the issuance of the first building permit.

S-11 COMMENCEMENT OF WORK:

If the project for which a Conditional Use Permit has been approved has not commenced, or permits for said project have not been issued, within one (1) year from approval date the Conditional Use Permit shall be null and void. If a Conditional Use Permit has been unused, abandoned, discontinued, or ceased for one (1) year, the Conditional Use Permit shall be null and void, and be of no effect. Notice to applicant/permittee under this division will not be required or provided by Department.

If an applicant cannot initiate or obtain permits for the approved use during the one (1) year, applicant may request a one (1) year extension from the Department. The request for an extension shall be in writing and be submitted with explanation to the Planning & Development Services Department at least sixty (60) days prior to the end of the one (1) year period. The Director shall have the authority to extend the initial startup period of a Conditional Use Permit two times for a maximum of one (1) year each. No extension under this section shall be extended for more than two (2) years.

S-12 CONSTRUCTION STANDARDS:

The solar energy facility structures shall be built in accordance with the California Building Code requirements applicable to "Seismic Category D". All structures and facilities shall be designed in accordance with the

publication entitled "Recommended Lateral Force Requirements and Commentary by the Structural Engineers Association of California". The structural components of the permitted facilities shall be reviewed by the Building Official/Planning and Development Services Director. Applicable building permits shall be procured from the County for facilities prior to commencement of construction of such facilities.

S-13 EMERGENCY RESPONSE/ACTION PLAN:

(A) The Permittee shall prepare an Emergency Response/Action Plan that has been approved by the Imperial County Fire/OES Department, and the Local Enforcement Agency. Any hazardous materials storage areas shall be designed with curbs or other containment measures, e.g. double-walled storage tanks, to contain spills and leaks and if on-site hazardous materials exceed fifty-five (55) gallons, a "Hazardous Material Management Plan" shall be prepared and approved by the County LEA and CUPA.

(B) The Emergency Response/Action Plan shall cover all possible emergencies, e.g. major fluid spills, earthquakes, fires, floods or other emergencies. At all times, there shall be at least one employee either on the facility premises or on-call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility of coordinating all emergency response measures. This Emergency Coordinator shall be thoroughly familiar with all aspects of the solar facility's Emergency Response/Action Plan, all operations and activities at the facility, location of all records within the facility and the facilities layout. This person shall have the authority to commit the resources needed to carry out the contingency plan. Adequate personnel and equipment shall be available to respond to emergencies and to insure compliance with the conditions of the permit.

(C) The Emergency Response/Action Plan shall be prepared in consultation with, but not be limited to, the Imperial County Fire Protection/Office of Emergency Services, County Environmental Health Services/Health Department, County Sheriff/Coroner's office, County Public Works Department, Imperial County Planning and Development Services Department, and other appropriate state and county agencies. The plan shall include a notification list of response agencies which shall be notified immediately upon the discovery of a reportable unauthorized discharge and the list shall include: Imperial Fire Protection/Office of Emergency Services, Imperial County Planning and Development Services Department, County Environmental Health Services/Health Department, County Department of Public Works (DPW), California Highway Patrol, as applicable.

(D) All employees shall be trained by classroom and hands-on training on safety procedures, maintenance programs and emergency response

protocols to ensure safety and reliability in the event of an unforeseen emergency situation.

(E) The Permittee shall provide adequate safety devices against the hazard of fire and explosion for activities that involve the use and storage of flammable, explosive or highly corrosive or reactive materials as well as provide adequate fire-fighting and fire suppression equipment and using devices standard within the industry in compliance with all applicable state and local laws as determined by the Fire Chief, Office of Emergency Services.

(F) The Permittee shall implement all State and County-approved worker safety and fire protection plans and programs.

(G) Any gates on-site shall have a "knox" lock and be rapidly accessible by the Imperial Fire Protection/Office of Emergency Services.

(H) Appropriate first aid provisions for facility operations shall be made for emergency response during Project construction, operation, and maintenance activities with appropriate first aid training for Project employees.

(I) During construction, a member of each working crew shall be trained in basic first aid and supplied with necessary medical equipment to respond to emergencies as provided for in the Emergency Response/Action Plan required above.

(J) Permittee shall identify a responsible agent for emergency purposes, whose name, title, e-mail address and telephone number, which shall be provided to the County Department of Public Works, County Fire Protection/OES Department, County Environmental Health Services/Health Department, County Sheriff/Coroner's office, Imperial Irrigation District (IID), and Imperial County Planning and Development Services Department.

S-14 LAND USE IMPROVEMENTS

(A) The Permittee shall prepare an appropriate parking plan for review and approval by the County Planning and Development Services and County Public Works Department for all proposed Operation & Maintenance buildings.

(B) The Permittee shall surface with a minimum of three (3) inches of asphaltic concrete paving or material of higher quality all access drives, parking areas, and vehicular maneuvering areas from primary access to any constructed operation and maintenance buildings.

S-15 NOISE STANDARDS:

(A) During the construction period, heavy truck traffic to/from the solar facilities shall be limited to the hours between 7:00 AM and 7:00 PM.

(B) During construction, in accordance with Imperial County Noise Element of the General Plan, the noise level shall not exceed 75 dBA_{Leq} at the property boundary when averaged over an 8-hour period.

(C) During operation of the facility, the maximum permitted continuous sound level shall be not more than 45 dBA_{Leq}, as measured at the nearest residence using the "A" scale and measured with a sound level meter and associated octave band analyzer. The level may be exceeded by ten percent (10%) if the noise is intermittent and during daylight hours.

(D) Haul trucks and other engine-powered equipment shall be muffled and operated with engine exhaust brake use limited to emergencies.

S-16 ODOR CONTROL:

The Permittee shall control all odor-causing, harmful, noxious emissions to insure that quantities or air contaminants released as a result of the permitted facilities do not exceed County, State or Federal standards, nor constitute a public nuisance, per the Imperial County Land Use Ordinance, Division 13, Enforcement, Chapter 2, Abatement of Nuisances, Sections 91302.00 through 91301.02.

S-17 PLAN APPROVALS:

Permittee shall submit to the Imperial County Planning and Development Services Department, architectural, landscaping and lighting plans prior to construction of those facilities, to include painting of structures, planting of trees and/or vegetation, and shall receive all approvals prior to commencing construction of the applicable permitted facilities. Approval shall not be unreasonably withheld so long as the plans are consistent with applicable Imperial Count Land Use Ordinance requirements.

S-18 PROJECT DESIGN:

(A) All facility access and parking areas shall be constructed to the standards of the Imperial County Land Use Ordinance.

(B) All permitted activities shall provide for the minimum feasible surface land disturbance for compatibility with the existing uses wherever possible.

(C) All equipment and electrical interconnection facilities used at the solar plant facilities shall be maintained in a manner that prevents breaking, cracking, and leaking, e.g. operator staffing and training, including appropriate quality assurance procedures, with the operation of back-up or auxiliary facilities when necessary.

(D) A Storm-water Pollution Prevention Plan (SWPPP) shall be prepared for construction of the project in accordance with the requirements of the County of Imperial and the RWQCB (See S-8, Hydrology and Water Quality, Item #1).

(E) All on-site basins shall be designed and constructed under the supervision of a California-licensed Civil Engineer meeting sound engineering standards, with all applicable regulations and all requirements of the County Environmental Health Services/Health Department and Public Works Departments are complied with.

(F) Obtain encroachment permits for any construction or operation on IID existing right of way or easements.

S-19 REPORTING AND MONITORING:

(A) The Permittee shall furnish to the County, at its sole cost within a reasonable time, any relevant reports/information which the County requires for monitoring purposes to determine whether cause exists for revoking this permit, or to determine compliance with this permit. The Permittee shall submit all required reports to the Planning Director, County Planning and Development Services Department, 801 Main Street, El Centro, CA 92243.

(B) Permittee and Imperial County Planning and Development Services Department Director shall agree upon an environmental consultant for overseeing all the required mitigation, conditional use permit conditions and public benefit agreement requirements during the construction of project.

(C) Permittee shall pay for a third party environmental consultant monitoring and compliance.

(D) The Planning and Development Services Department, in consultation with the third party Environmental Consultant and the County Executive Office, will require that all mitigation measures be satisfied, all mitigation monitoring and Reporting Program requirements have been satisfied, all Conditions of Approval in the Conditional Use Permit are in full compliance and all conditions of the Development Agreement have been satisfied before the Final Certificate of Occupancy Certificate is issued.

(E) During the operation of solar facility, an Annual Compliance Report shall be submitted to the Imperial County Planning and Development Services Department, documenting the implementation of the conditions and general measures as well as any resource-specific measures.

(F) The Permittee shall reimburse the Imperial County Planning and Development Services Department for County as well as monitoring and investigations related to the construction and operation of the Project. Permittee shall compensate the County pursuant to the Imperial County Planning & Development Services Department Fee Schedule for any costs incurred.

(G) Permittee shall pay for all costs as required to comply with the Conditions of Approval and MMRP, and shall implement all required mitigation measures as indicated in the Final Environmental Impact Report (FEIR) and Mitigation Monitoring, Reporting Program (MMRP). If mitigation measures for FEIR and MM&RP are more stringent than the conditions in this permit, the FEIR & MM&RP mitigations will be required.

(H) All County staff time will be billed on a time and materials basis. Failure by Permittee to provide any payment required of Permittee to the County in the CUP shall cause Permittee to be in non-compliance of the CUP. Upon Permittee being in such noncompliance, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with the Project.

S-20 SPILLS AND RUNOFF:

The Permittee shall design and construct the permitted facilities to prevent spills from endangering adjacent properties and to prevent runoff from any source being channeled or directed in an unnatural way so as to cause erosion, siltation, or other detriments pursuant to the construction Storm Water Pollution Prevention Plan approved by the Regional Water Quality Control Board.

S-21 SOLAR FACILITIES CLOSURE AND SITE RESTORATION:

(A) Permittee shall implement the site restoration plan as outlined within the plan at the earlier of when the operation of the permitted facilities herein authorized has ceased or the term of the CUP has expired. At such time, all facilities shall be dismantled, and the lands involved restored to their pre-construction condition and available for agricultural production uses as agreed to by the Imperial County Planning and Development Services Director.

(B) Within thirty (30) days prior to ground disturbance, a decommissioning and restoration plan shall be submitted and approved by the Imperial County Planning and Development Services Director.

(C) Within thirty (30) days prior to ground disturbance, a Bond, or other acceptable surety, in the amount of the estimated site restoration financial calculations/bond, for the developed project area as specified in the [or grading plan(s) area], or other forms of security acceptable to County Counsel's office, shall be filed with the County that guarantees restoration of the land to its condition prior to the permitted solar plant development.

(D) Upon completion of such site restoration, and demonstration that the land has been restored to the agriculturally productive/farmable condition prior to the permitted solar plant development the Bond or other surety shall be released by the County.

(E) The above financial calculations/bond shall be reviewed every five (5) years in December and adjusted on January 1st to add a CPI (Los Angeles) increase by the Planning and Development Services Director. This readjustment can be made in the County's sole discretion and must be funded by the Permittee within ninety (90) calendars after notice of the additional amount of such adjustment.

S-22 PUBLIC WORKS

(A) The Permittee shall furnish a Drainage and Grading Plan/Study to provide for property grading and drainage control, which shall also include prevention of sedimentation of damage to off-site properties. The Study/Plan shall be submitted to the Department of Public Works for review and approval. The Permittee must also provide an engineering estimate for the offsite improvements to be reviewed and approved by this department. A security bond shall be required for the offsite improvements prior to the issuance of the encroachment permit. The Permittee shall implement the approved plan. Employment of the appropriate Best Management Practices (BMP's) shall be included.

(B) A Transportation Permit shall be required from road agency(s) having jurisdiction over the haul route(s) for any hauls of heavy equipment and large vehicles which impose greater then legal loads on riding surfaces, including bridges.

(C) All proposed utility poles must be installed outside the clear recovery area.

(D) All work performed with Caltrans Right of Way will require an encroachment permit.

(E) All work performed for other agencies (such as IID) shall comply with the requirements of such agencies.

(F) CUP owner shall be responsible for repairing any damage caused to the roads it utilizes per Public Works acceptance.

(G) CUP owner shall limit the Project's construction traffic on unpaved County roadways to the extent possible and utilize improved paved roadways. In the event the CUP owner's construction traffic requires the use of unpaved County roadways, the CUP owner shall mitigate those County unpaved roadways in accordance with ICAPCD 805 requirements.

(H) In addition to complying with Rule 805, if 50 vehicle trips per day (VPD) are triggered by the projects on any single County unpaved roadway, the CUP owner shall provide for the future maintenance cost of the affected roadway for the full term of the CUP which trigged the increase beyond the 50 VPD threshold.

(I) Prior to the issuance of grading permit. As each CUP may be constructed individually and independently, the CUP owner shall improve the roads as per acceptance with ICPWD. If a CUP owner has already improved the roads that will be utilized by the next CUP to start construction, then no new road improvements are required.

S-23 WASTE DISPOSAL

(A) The Permittee shall insure that all solar plant facilities waste, liquid, gas or solid, which are generated on-site shall be disposed of in compliance with appropriate local, state, and federal regulations, in effect or as subsequently duly-enacted. All solid waste debris and/or any hazardous wastes located on the Project site must be satisfactorily removed to a permitted facility prior to the commencement of grading earthen material at the site.

(B) Littering shall not be allowed. Project personnel shall not deposit or leave any food or waste in the Project area, and no biodegradable or non-biodegradable debris shall remain in the right-of-way or on the Project site following completion of construction.

(C) The Permittee shall notify the Imperial County Planning and Development Services Director thirty (30) days in advance of any directional drilling required for the construction of facility.

S-24 CALTRANS

(A) An encroachment permit shall be required for any work performed within Caltrans right-of-way. If required, any traffic control will need to

be addressed as part of Caltrans permit approval. Stoppage of traffic for placement of aerial lines, installation or removal of overhead conductors crossing a highway requires traffic control will be addressed in accordance with the Caltrans Standard Plans and the California Manual on Uniform Traffic Control Devices (MUTCD).

(B) Any work performed within Caltrans right-of-way must provide an approved final environmental document including the California Environmental Quality Act (CEQA) determination addressing any environmental impacts within the Caltrans right-of-way and any corresponding technical studies, if required. If these materials are not included with the encroachment permit application, the Permittee will be required to acquire and provide these to Caltrans before the permit application will be accepted. Identification of avoidance and/or mitigation measures will be a condition of encroachment permit approval as well as procurement of any necessary regulatory and resource agency permits.

The rest of this page is intentionally left blank.

NOW THEREFORE, County hereby issues the Conditional Use Permit #17-0001, and Permittee hereby accepts such permit upon the terms and conditions set forth herein.

IN WITNESS THEREOF, the parties hereto have executed this Agreement the day and year first written.

PERMITTEE:

_____ _____

VEGA SES, LLC Date
Jurg Heuberger
604 Sutter Street
Folsom, CA 95630

COUNTY OF IMPERIAL, a political subdivision of the STATE OF CALIFORNIA

_____ _____

Jim Minnick, Date
Director, Planning & Development Services Department

PERMITTEE NOTARIZATION

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA

COUNTY OF _____ } S.S.

On_____ before me, _____ a Notary Public in and for said County and State, personally appeared _____, who proved to on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal

Signature_____

_____

ATTENTION NOTARY: Although the information requested below is OPTIONAL, it could prevent fraudulent attachment of this certificate to unauthorized document_____

—

Title or Type of Document_____

Number of Pages_____ Date of Document_____

Signer(s) Other Than Named Above_____

Dated_____

COUNTY NOTARIZATION

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA

COUNTY OF IMPERIAL} S.S.

On_____ before me, _____ a Notary Public in and for said County and State, personally appeared _____, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal

Signature_____

ATTENTION NOTARY: Although the information requested below is OPTIONAL, it could prevent fraudulent attachment of this certificate to unauthorized document.

Title or Type of Document_____

Number of Pages_____ Date of Document_____

Signer(s) Other Than Named Above_____

S:\APN\051\360\021\BS Folder 3-26-2019\CUP\CUP 17-0001 updated per CEO PC hearing - Copy.doc

When Recorded Return To:

Imperial County
Planning & Development Services
801 Main Street
El Centro, California 92243

RECORDED

APR 29 2019

CHUCK STOREY
Imperial County Clerk Recorder

Recorded in Official Records,
IMPERIAL COUNTY
Doc#: 2019007502
04/29/2019 04:19 PM

CONDITIONAL USE PERMIT #17-0001
VEGA SES SOLAR ENERGY PROJECT
APN 051-360-021, 051-360-031, 051-390-004, 051-390-012, 051-390-013
(Approved at the Board of Supervisors on April 16, 2019)

This Agreement is made and entered into on this 29th day of April, 2019, by and between VEGA SES LLC hereinafter referred to as the Permittee (Permittee), and the COUNTY OF IMPERIAL, a political subdivision of the State of California, (hereinafter referred to as "COUNTY") related to the VEGA SES SOLAR ENERGY Project.

RECITALS

WHEREAS, Permittee is the lessee or successor-in-interest of certain land in Imperial County to be improved with the proposed photovoltaic solar energy facility, electrical switch station, substation, and internal solar development transmission lines, on approximately 574 acres within Imperial County. The proposed facility is located in the south western portion of Imperial County, California, approximately eight miles west & southwest of the City of El Centro and approximately 13 miles west & northwest of Calexico.

WHEREAS, Permittee has applied to the County of Imperial for a Conditional Use Permit #17-0001 for constructing and operating a new solar energy facility with ancillary

support facilities, including electrical interconnections to be transmitted to a proposed IID Substation (Fern) (the "Project").

WHEREAS, the overall Project includes one (1) CUP's on different properties within the County,

WHERAS, The Permittee for the Vega SES Solar Energy project shall fully comply with all of the terms and conditions of the Project as specified hereinafter within this Conditional Use Permit.

The rest of this page is intentionally left blank.

GENERAL CONDITIONS:

The "GENERAL CONDITIONS" are shown by the letter "G". These conditions are conditions that are either routinely and commonly included in all Conditional Use Permits as "standardized conditions" and/or are conditions that the Imperial County Planning Commission has established as a requirement on all CUP's for consistent application and enforcement. The Permittee is hereby advised that the General Conditions are as applicable as the SITE SPECIFIC conditions. The General Conditions are in addition to the MMRP and any and all other requirements for the project.

G-1 GENERAL LAW and other Requirements:

The Permittee shall comply with all local, state and/or federal laws, rules, regulations, ordinances, and/or standards (LORS) as they may pertain to the Project, whether specified herein or not. The Project shall be constructed and operated as described in the General Plan Amendment, Zone Change, Conditional Use Permit application and the Final Environmental Impact Report, (FEIR) and Mitigation and Monitoring Reporting Program (MMRP). A violation of any such LORS or conditions, applications, the FEIR or the MMRP shall be a violation of this CUP.

G-2 PERMITS/LICENSES:

The Permittee shall obtain any and all local, state and/or federal permits, licenses, and/or other approvals for the construction and/or operation of the Project. This shall include, but shall not be limited to, local requirements by the Imperial County EHS/Health Department, Imperial County Planning and Development Services Department, Imperial County Air Pollution Control District (ICAPCD), Imperial Irrigation District (IID), Imperial County Public Works Department, Imperial County Sheriff/Coroner's office, and the Imperial County Fire Protection/Office of Emergency Services, among others. Permittee shall likewise comply with all such permit requirements. Additionally, Permittee shall submit a copy of such additional permits and/or licenses to the Imperial County Planning and Development Services Department within thirty (30) days of receipt, including amendments or alternatives thereto, when requested.

G-3 RECORDATION:

This permit shall not be effective until it is recorded at the Imperial County Recorder's Office and payment of the recordation fee shall be the responsibility of the Permittee. If the Permittee fails to pay the recordation fee within six (6) months from the date of approval, this permit shall be deemed null and void. Recording is an action of notice and does not convey any rights to Permittee

G-4 DURATION OF AGREEMENT

Unless otherwise specified within the specific conditions, this permit shall be limited to a maximum of thirty (30) years from the recordation of the CUP. The CUP may be extended for an additional ten (10) year period by the appropriate County entity (either the Planning Director, the Planning Commission or the Board of Supervisors as set forth in the applicable Imperial County Ordinances) upon a finding that the Project is in compliance with all conditions of the CUP as stated herein and any applicable Land Use regulation of the County of Imperial. If an extension is necessary, the Permittee shall file a written extension request with the Planning Director at least sixty (60) days prior to the expiration date of the permit. Such an extension request shall include the appropriate extension fee. Nothing stated or implied within this permit shall constitute a guarantee that an extension will be granted. An extension may not be granted if the Project is in violation of any one or all of the conditions or if there is a history of non-compliance with the permit conditions.

G-5 INDEMNIFICATION:

In addition to any other indemnifications provided for the Project, and as a condition of this permit, Permittee shall defend, indemnify, hold harmless, and release the County, its agents, officers, attorneys, and employees from any claim, action, or proceeding brought against any of them, the purpose of which is to attack, set aside, void, or annul the entitlements, any permits, approvals or adoption of the environmental document which accompanies it. This indemnification obligation shall include, but not be limited to, damages, costs, expenses, attorneys' fees for counsel chosen by County, or expert witness fees that may be asserted by any person or entity, including the Permittee, arising out of or in connection with the approval of this permit, whether there is concurrent, passive or active negligence on the part of the County, its agents, officers, attorneys, or employees. This indemnification shall include Permittee's actions or failure to act involved in drilling, grading, construction, operation or abandonment of the permitted activities. Permittee further agrees to comply with the terms of the indemnification agreement incorporated by this reference. Failure to provide payment of any fees or other costs for this indemnification shall cause Permittee to be in non-compliance with this permit. Upon notification of non-compliance, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with this project.

G-6 INSURANCE:

For the term of the CUP and any period thereafter for decommissioning and reclamation, the Permittee and/or Permittee's prime contractor assigned site control during construction, shall secure and maintain liability in tort and property damage, commercial liability and all risk builders' insurance at a minimum of **$1,000,000 each, combined single limit property damage**

and personal injury, to protect persons or property from injury or damage caused in any way by construction and/or operation of permitted facilities. Such insurance shall be endorsed to name the County, its officers, agents, and employees as additional insureds and shall be in a form and from a company acceptable to County. The Permittee shall require that proper Workers' Compensation insurance cover all laborers working on such facilities as required by the State of California. The Permittee and/or Permittee's prime contractor assigned site control during construction, shall also secure liability insurance and such other insurance as may be required by the State and/or Federal Law. Evidence of such insurance shall be provided to the County prior to commencement of any activities authorized by this permit, e.g. an endorsed Certificate of Insurance is to be provided to the Imperial County Planning and Development Services Department by the insurance carrier and said insurance and certificate shall be kept current for the life of the permitted Project. Certificate(s) of Insurance shall be sent directly to the Imperial County Planning and Development Services Department by the insurance carrier and shall be endorsed to name the Department as a recipient of both renewal and cancellation notices.

G-7 INSPECTION AND RIGHT OF ENTRY:

The County reserves the right to enter the premises to make appropriate inspection(s) and to determine if the condition(s) of this permit are complied with. The owner or operator shall allow an authorized County representative access into the site upon the presentation of credentials and other documents as may be required by law to:

(A) Enter at reasonable times upon the owner's or operator's premises where a permitted facility or activity is located or conducted, or where records must be kept under the conditions of the permit.

(B) Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit.

(C) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under the permit.

(D) Sample or monitor, at reasonable times, for the purpose of assuring permit compliance or, otherwise authorized by law, any substances or parameters at any location.

G-8 SEVERABILITY:

Should any condition(s) of this permit be determined by a Court or other agency with proper jurisdiction to be invalid for any reason, such determination shall not invalidate the remaining provision(s) of this permit.

G-9 PROVISION TO RUN WITH THE LAND/PROJECT:

The provisions of this Permit are to run with the land/project and shall bind the current and future owner(s), successor(s)-in-interest, assignee(s) and/or transferee(s) of said Project pursuant to the recordation required by Condition G-3. Permittee shall not without prior notification to the Imperial County Planning and Development Services Department assign, sell or transfer, or grant control of Project or any right or privilege therein granted by this permit. The Permittee shall provide a minimum of thirty (30) days written notice prior to any proposed transfer becoming effective. The permitted use identified herein is limited for use upon the permitted properties described herein and may not be transferred to any another other parcel(s) without prior approval.

The Permittee shall pay any and all amounts determined by the County to defray any and all cost(s) for the review of reports, field investigations, monitoring, and other activities directly related to the enforcement/monitoring for compliance of this Conditional Use Permit, County Ordinance, MMRP or any other applicable law. All County Departments, directly involved in the monitoring/enforcement of this permit may bill Permittee under this provision; however said billing shall only be through and with the approval of the Imperial County Planning and Development Services Department. All County staff time will be billed on a time and materials basis. Failure by Permittee to provide any payment required of Permittee to the County in the CUP shall cause Permittee to be in non-compliance of the CUP. Upon Permittee being in such noncompliance, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with the Project.

G-10 REPORTS/INFORMATION:

If requested by the Imperial County Planning Director, Permittee at its sole expense shall provide any such documentation/report as necessary to ascertain compliance with the Conditional Use Permit. The format, content and supporting documentation shall be as required by the Imperial County Planning Director.

G-11 DEFINITIONS:

In the event of a dispute the meaning(s) or the intent of any word(s), phrase(s) and/or conditions or sections herein shall be determined by the Imperial County Planning Commission. Their determination shall be final unless an appeal is made to the Imperial County Board of Supervisors within the required time.

G-12 MINOR AMENDMENTS:

Unless as otherwise required by law (including but not limited to County ordinance interpretations and minor modifications or changes can be made

to the Project with the mutual agreement of Developer and County and only in one of the following circumstances:

(A) Where the change is ministerial, mutually agreeable to Director of Planning & Development Services Department and Developer and constitutes an administrative interpretation, less than significant amendment or change or technical modification to the design, construction and/or operation of the Project under the existing applicable rules, regulations, and laws of the County and does not

(1) Alter the permitted uses of the Property as a whole or within any CUP; or

(2) Increase the density or intensity of use of the Property as a whole or within any CUP; or,

(3) Increase the maximum height and size of permitted buildings or structures; or,

(4) Delete a requirement for the reservation or dedication of land for public purposes within the Property as a whole; or

(5) Conflict with a condition of approval or MMRP; or

(6) Constitute a discretionary approval by the County for which a subsequent or supplemental environmental impact report would be required pursuant to Section 21166 of the Public Resources Code.

(B) Where the change is ministerial, mutually agreeable to Developer and constitutes an administrative interpretation, less than significant amendment or change or technical modification to the design, construction and/or operation of the Project under the existing applicable rules, regulations, and laws of non-County agencies as to Project matters within their sole jurisdiction.

G-13 SPECIFICITY:

The issuance of this permit provides a temporary use right on the project property within the requirements set out here and does not authorize the Permittee to construct or operate the Project in violation of any LORS or beyond the duration, term or specified boundaries of the Project as shown the application/project description/permit, nor shall this permit allow any accessory or ancillary use not specified herein. This permit does not provide any prescriptive right or use to the Permittee for future addition and or modifications to the Project.

G-14 NON-COMPLIANCE (ENFORCEMENT & TERMINATION):

Should the Permittee violate any condition herein, the County shall give written notice of such violation and actions required of Permittee to correct such violation. If Permittee does not act to correct the identified violation within forty-five (45) days after written notice, County may revoke the CUP. If Permittee pursues correction of such violation with reasonable diligence, the County may extend the cure period. Upon such revocation, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with the Project. County may include in such notice of violation and subsequent process default and/or termination of the Development Agreement along with violation or revocation of the CUP, and the procedures set out here shall govern.

G-15 GENERAL WELFARE:

All construction and operations of the solar energy facility shall be conducted with consistency with all laws, conditions, adopted County policies, plans, mitigation measures and the permit application so that the Project will be in harmony with the area and not conflict with the public health, safety, comfort, convenience, and general welfare of those residing in the area.

G-16 PERMITS OF OTHER AGENCIES INCORPORATED:

Permits granted by other governmental agencies in connection with the Project are incorporated herein by reference. The County reserves the right to apply conditions of those permits, as the County deems appropriate and subject to its having jurisdiction; provided, however, that enforcement of a permit granted by another governmental agency shall require written concurrence by the respective agency. Permittee shall provide to the County, upon request, copies and amendments of all such permits.

G-17 HEALTH HAZARD:

If the County Health Officer reasonably determines that a significant health or safety hazard exists to the public, the County Health Officer may require appropriate measures and the Permittee shall implement such measures to mitigate the health hazard. If the hazard to the public is determined to be imminent, such measures may be imposed immediately and may include temporary suspension of permitted activities. The measures imposed by the County Health Officer shall not prohibit the Permittee from requesting a special Imperial County Planning Commission meeting, provided the Permittee bears all related costs.

G-18 APPROVALS AND CONDITIONS SUBSEQUENT TO GRANTING PERMIT:

Permittee's acceptance of this permit shall be deemed to constitute agreement with the terms and conditions contained herein. Where a

requirement is imposed in this permit that Permittee conduct a monitoring program, and where the County has reserved the right to impose or modify conditions with which the Permittee must comply based on data obtained there from, or where the Permittee is required to obtain additional conditional use permits for County approval for subsequent activities, and disagreement arises, the Permittee, operator and/or agent, the Imperial County Planning and Development Services Director or other affected party, as determined by the Imperial County Planning and Development Services Director, may request that a hearing before the Imperial County Planning Commission. Upon receipt of a request, the Imperial County Planning Commission shall conduct a hearing and make a written determination. The Imperial County Planning Commission may request support and advice from a technical advisory committee. Failure of the Imperial County Planning Commission to act shall constitute endorsement of staff's determination with respect to implementation.

SITE SPECIFIC CONDITIONS:

S-1 AUTHORIZED SCOPE OF ACTIVITIES:

(A) Permittee shall be the master Developer for this Project and shall be responsible as for all improvements, septic, sewer, approved potable water system(s), pipelines, roads and other improvements discussed in the Conditional Use Permit Application and Conditions Application and FEIR, and MMRP. If Permittee sells all or part of this Project, an approved agreement shall be in place for new Project owner to build and maintain as agreed to by the conditions set forth in this CUP. The Imperial County Planning and Development Services Director shall approve of such agreement between Permittee and a new master Developer for this Project. The County Assessor's Office shall be notified of any ownership change.

(B) Permittee shall develop this CUP property as a separate solar energy facility. Any development with a combination of parcels will require the owner(s) to have a recorded deed restriction to "hold the parcel as one parcel" that runs with the land. This deed restriction shall be for a minimum of thirty (30) years and shall only be released upon the expiration of the thirty (30) years, the expiration or termination of the Conditional Use Permit, or upon approval of the Imperial County Planning and Development director that the restriction is no longer needed based on a change in the development or regulation.

(C) The Permittee shall construct and operate the following facilities in compliance with the Conditional Use Permit, the County's General Plan's Land Use Element, Land Use Ordinance and all other applicable local, state, and federal laws, ordinances, regulations and standards

(LORS), to include any other permits which are incorporated herein by reference.

(D) Construction, operation, maintenance, replacement and removal of a solar energy facility & battery energy storage system as described in Permittee's CUP Application & FEIR & DEIR. The solar energy facility would include photovoltaic modules, mounting structures, electrical wiring, inverters, transformers and AC electric collector system, project electric substation and ancillary facilities. Ancillary facilities would include safety and security equipment, retention basins, perimeter fencing, access gates, lighting systems, access roads, and could include temporary construction trailers, an operations and maintenance (O&M) building, equipment enclosures, water treatment system and building, septic system, parking, and fire protection including a minimum 10,000 gallon fire water tank, and monitoring and control systems. The project proposes to use either thin film or crystalline solar photovoltaic (PV) technology modules mounted on fixed or horizontal single-axis tracker (HSAT) systems; concentrating photovoltaic (CPV) systems mounted on a dual-axis tracking system; or a mix of the technologies.

(E) PV module arrays would be mounted on racks supported by driven piles. The depth of the piles would be dependent on the geotechnical recommendations for the Project. The fixed-frame racks would be secured at a fixed tilt of 20° to 25° from horizontal facing a southerly direction. If HSAT technology is used, the PV modules would rotate around the north-south HSAT axis so that the PV modules would face the sun as it moves across the sky throughout the day. The PV modules would reach their maximum height (up to nine feet above the ground, depending on the final design) when the HSAT is rotated to point the modules at the rising or setting sun at both sunrise and sunset. When the HSAT system is rotated so that the PV modules are horizontal (at noon, or when stowed during high winds), the nominal height would be approximately six feet above the ground, depending on the final design. The individual PV systems would be configured in large arrays by placing them in columns spaced approximately ten feet apart to maximize operational performance and to allow access for panel cleaning and maintenance. These arrays would be separated from each other and the perimeter security fence by nominal 20-foot wide roads, consistent with emergency access requirements.

(F) CPV technology uses optics such as lenses to concentrate a large amount of sunlight onto a small area of PV cells to generate electricity. The CPV technology focuses the sunlight onto highly efficient solar cells using Fresnel lenses. The CPV technology would likely use a dual-axis tracking system to position the tracker to ensure that concentrated sunlight remains precisely focused on the solar cells throughout the day. The dual-axis tracking structures use single pole/mast-mounted panels that would be approximately 30-feet high at both sunrise and

sunset when the panel is rotated to point at the rising or setting sun. The dual-axis modules would be spaced approximately 80 feet apart on-site substation will step-up the voltage from the collection level voltage to 230-kV. Breakers, buswork, protective relaying, Supervisory Control and Data Acquisition (SCADA), and associated substation equipment will be constructed on the CUPs. The communication system may include an above or below-ground fiber optic cable network or microwave tower.

(G) The Project will be interconnected to the regional transmission system from the on-site substation/switchyard via the Gen-Tie interconnection. CUP #17-0001 is anticipated to utilize the Gen-Tie line extending from the CUP to and inverter stations. Alternatively, each CUP may independently construct its own 230-kV (maximum) step-up transformer and switchyard. During normal operation, each substation will "back feed" power to maintain "house" power. This would include O&M buildings, security systems, SCADA, communication systems, plant control systems, etc. Therefore, much of the electrical equipment will be in some stage of electrical operation 24 hours-a-day.

(H) The field of energy storage is rapidly advancing, and a wide variety of technology is available to choose from. To date, a single technology or provider has not been selected for this component of the Project. The analysis contained in this EIR reflects the worst-case scenario for impacts from these technologies in order to mitigate any impacts from these technologies. Thus the analysis covers the full-range of technologies for when the final decision is made on which technology to construct. The storage component will utilize technologies that operate based upon the principles of potential energy (e.g. pumped storage), chemical energy (e.g. batteries), mechanical/kinetic energy (e.g. flywheel), or any combination thereof. The storage component may be centralized and located adjacent to the substation or switchgear or, alternatively, the energy storage component may be distributed throughout the facility adjacent to individual power conversion centers. The storage component would be housed in a warehouse type building or in smaller modular structures such as cargo shipping containers.

S-2 AESTHETICS:

The Permittee shall design and maintain all buildings and equipment enclosures to have exterior surfaces with neutral, non-reflective colors. The construction and maintenance of County-approved landscaping along the access into the Operation/Maintenance Facility shall be in compliance with the Land Use Ordinance, Division 3, Chapters 1 and 2, Sections 90302.00 through 90302.19. As applied to other solar projects and as indicated in the FEIR and as indicated in the FEIR and Mitigation Monitoring and Reporting Program.

(A) The Permittee shall design and install lighting at construction storage yards and staging areas, such that light bulbs and reflectors are not visible from public viewing areas; lighting does not create reflected glare; and illumination of the Project facilities, vicinity, and nighttime sky is minimized.

(B) Lighting shall be designed so exterior light fixtures are hooded, with lights directed downward or toward the area to be illuminated and so that backscatter to the nighttime sky is minimized. The design of the lighting shall be such that the luminescence or light source is shielded to minimize light trespass outside the Project boundary.

(C) All lighting shall be of minimum necessary brightness consistent with worker safety and OSHA-Requirements.

(D) High illumination areas not occupied on a continuous basis shall have switches or motion detectors to light the area only when occupied.

S-3 AGRICULTURE:

(A) Prior to the issuance of the initial grading permit or building permit, Permittee shall submit to County of Imperial a Reclamation Plan to return the property to conditions comparable to its current condition for agricultural production. The Reclamation Plan shall include a description of the farming infrastructure to include but not limited to a crop history, water delivery system, drainage system, field access, field roads, grading aspects, reclamation cost estimate prepared by a California-licensed general contractor or civil engineer. The developer shall provide financial assurance/bonding in the amount equal to the reclamation cost estimate to restore all agricultural land/farmland to its pre-construction condition including removal of all structures and equipment, soil testing for and clean-up of contaminants in the soil, disking, leveling, and any other clean up and repair necessary to return the land to an agriculturally productive farmable condition prior to the issuance of the initial grading permit or building permit. The Reclamation Plan with appropriate bonding will need approval from the Imperial County Planning and Development Services Director, and County Counsel before any grading or building permit is issued.

(B) Permittee shall minimize paving and ground disturbing activities to the maximum extent practical within agricultural fields to retain soil characteristics.

(C) The Project Developer shall:

(1) Develop and implement an approved Pest Management Plan for the duration of the project that will reduce negative impacts to

surrounding farmland. Plan shall be reviewed and approved by the Imperial County Agricultural Commissioner's Office.

(2) Monitor for all pests including insects, vertebrates, weeds, and pathogens. Promptly control or eradicate pests when found, or when notified by the County Agricultural Commissioner's office that a pest problem is present on the project site. The assistance of a licensed pest control advisor (PCA) is recommended. All treatments must be performed by a qualified applicator or a licensed pest control operator (PCO).

(3) "Control" means to reduce the population of common pests below economically damaging levels, and includes attempts to exclude pests before infestation, and effective control methods after infestation. Effective control methods may include physical/mechanical removal, bio-control, cultural control, or chemical treatments.

(4) Notify the County Agricultural Commissioner's office immediately regarding any suspected exotic/invasive pest species such as A- and Q-rated pest species as defined by the California Department of Food Agriculture (CDFA). Eradication of exotic pests will be done under the direction of the Agricultural Commissioner's Office and/or CDFA.

(5) Obey all pesticide use laws, regulations, and permit conditions.

(6) Allow access for County Agricultural Commissioner staff for routine visual and trap pest surveys, compliance inspections, eradication of exotic pests, and other official duties.

(7) Ensure that all project employees that handle pest control issues are appropriately trained and certified, that all required records are maintained and available for inspection, and that all permits and other required legal documents are current.

(8) Maintain records of pests found and controlled and either have them available for review, or submit them to the County Agricultural Commissioner's office on a quarterly basis.

(9) The Permittee shall reimburse the County Agricultural Commissioner's office for the actual cost of investigations, inspections, or other required non-routine responses to the site that are not funded by other sources.

(10) Reclamation/Decommissioning Plan and Security. The DOC has clarified the goal of a reclamation and decommissioning plan: the land must be restored to land which can be farmed. In addition to

MM AG-1b, for Prime Farmland and Non-Prime Farmland, the Applicant shall submit to Imperial County a Reclamation Plan prior to issuance of a grading permit. The Reclamation Plan shall document the procedures by which each CUP will be returned to its current agricultural condition/LESA score. Permittee also shall provide financial assurance/bonding in an amount equal to a cost estimate prepared by a California-licensed general contractor or civil engineer for implementation of the Reclamation Plan in the event Permittee fails to perform the Reclamation Plan. MM AG-1b, prior to the issuance of a grading permit or building permit (whichever is issued first).

(D) Prior to the issuance of a grading permit or building permit (whichever permit comes first) for the Project, the mitigation of impact to agricultural lands shall be accomplished as follows:

Mitigation for the temporary loss of Non-Prime Farmland: Permittee may choose one of the following three methods for mitigation:

a) Agricultural Conservation Easements on a "1 to 1" basis on land of equal size, of equal quality farmland, outside of the path of development. The Conservation Easement shall meet the State Department of Conservation's regulations and shall be recorded prior to issuance of any grading or building permits. OR

b) The Permittee shall pay an "Agricultural In-Lieu Mitigation Fee" in the amount of 20% of the fair market value per acre for the acres of non-prime farmland impacted by the Project based on five comparable sales of land used for agricultural purposes as of the effective date of the permit, including program costs on a cost recovery/time and material basis. The Agricultural In-Lieu Mitigation Fee, will be placed in a trust account administered by the Imperial County Agricultural Commissioner's office and will be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County. OR

c) If Permittee and the County voluntarily enter into a public benefit agreement or Development Agreement that includes Agricultural Benefit Fee payment that is equal to or greater than the amount that would be due under Option 2 of these mitigation measures and the public benefit agreement requires that the Agricultural Benefit Fee be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County, then this mitigation measure may be satisfied by payment of a voluntarily agreed to Agricultural Benefit Fee.

Mitigation for the temporary loss of Prime Farmland: Permittee may choose one of the following three methods for mitigation:

d) Agricultural Conservation Easements on a "2 to 1" basis on land of equal size, of equal quality farmland, outside of the path of development. The Conservation Easement shall meet the State Department of Conservation's regulations and shall be recorded prior to issuance of any grading or building permits. OR

e) The Permittee shall pay an "Agricultural In-Lieu Mitigation Fee" in the amount of 30% of the fair market value per acre for the acres of prime farmland impacted by the Project based on five comparable sales of land used for agricultural purposes as of the effective date of the permit, including program costs on a cost recovery/time and material basis. The Agricultural In-Lieu Mitigation Fee, will be placed in a trust account administered by the Imperial County Agricultural Commissioner's office and will be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County. OR

f) If Permittee and the County voluntarily enter into a public benefit agreement and or Development Agreement that includes Agricultural Benefit Fee payment that is equal to or greater than the amount that would be due under option number 2 of this mitigation measure and the public benefit agreement requires that the Agricultural Benefit Fee be used for such purposes as the acquisition, stewardship, preservation and enhancement of agricultural lands within Imperial County, then this mitigation measure may be satisfied by payment of voluntarily agreed to Agricultural Benefit Fee.

S-4 AIR QUALITY:

(A) The Permittee shall comply at all times with the Imperial County Air Pollution Control District's (ICAPCD) Regulation VIII, Fugitive Dust Control. The primary pollutant controlled by this regulation is PM10, "fugitive dust." All identified PM10 sources associated with the construction and operation of the facility, such as open areas, roads, stock piles, material transport and grading activities, shall be controlled such that surface areas are stabilized and visible dust emissions are below 20%. Any control measure not listed within the appropriate sections of Regulation VIII, such as but not limited to watering, graveling, chemical stabilizers and wind barriers shall not be utilized without prior approval from the ICAPCD.

(B) Prior to commencing construction, each CUP owner shall submit a Dust Control Plan to the ICAPCD for approval identifying all sources of PM_{10} emissions and associated mitigation measures during the construction and operational phases of the Project. The Project Proponent shall

submit a "Construction Notification Form" to the ICAPCD ten (10) days prior to the commencement of any earthmoving activity. The Dust Control Plan submitted to the ICAPCD shall meet all applicable requirements for control of fugitive dust emissions, including the following measures designed to achieve the no greater than 20% opacity performance standard for dust control:

(1) All on-site and off-site unpaved roads shall 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.

(2) All unpaved traffic areas one acre or more in size with seventy-five (75) or more average vehicle trips per day, shall 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.

(3) 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 shall be cleaned and/or washed at the delivery site after removal of bulk material.

(4) All track-out or carry-out, which includes bulk materials that adhere to the exterior surfaces of motor vehicles and/or equipment (including tires) that may then fall onto the pavement, shall be cleaned at the end of each workday, or immediately when mud or dirt extends a cumulative distance of fifty (50) linear feet or more onto a paved road within an urban area.

(5) 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.

(6) The construction of new unpaved roads is prohibited within any area with a population of five hundred (500) or more, unless the road meets ICAPCD's 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.

(7) Shall comply with the Mitigation and Monitoring Program and applicable mitigations.

(C) Each CUP owner shall implement all applicable standard mitigation measures for construction combustion equipment for the reduction of excess NOx emissions as contained in the Imperial County CEQA Air Quality Handbook and associated regulations. These measures include:

(1) Use of alternative fueled or catalyst equipped diesel construction equipment, including all off-road and portable diesel powered equipment.

(2) Minimize idling time, either by shutting equipment off when not in use or reducing the time of idling to five minutes at a maximum.

(3) Limit the hours of operation of heavy-duty equipment and/or the amount of equipment in use.

(4) Replace fossil-fueled equipment with electrically driven equivalents (assuming powered by a portable generator set and are available, cost effective, and capable of performing the task in an effective, timely manner).

(5) Curtail construction during periods of high ambient pollutant concentrations; this may include ceasing construction activity during the peak hour of vehicular traffic on adjacent roadways.

(6) Implement activity management (e.g. rescheduling activities to avoid overlap of construction phases, which would reduce short-term impacts).

(D) Each CUP owner shall use all available EPA TEIR 2 or better (TIER 2+) construction equipment. **AQ-1**

(E) Consistent with the requirements of ICAPCD Policy 5, each CUP owner shall pay an emission mitigation fee sufficient to off-set the amount by which the Project's NOx emissions exceed the 100 lbs/day threshold. ICAPCD allows a project to pay in-lieu impact fees using the most current Carl Moyer Cost Effective methodology to reduce excess NOx emissions. Under the ICAPCD program, the exact amount of the fee cannot be calculated until the time of construction when more precise data regarding the construction equipment types and hours of operation are known and ICAPCD can calculate the fee. Prior to any earthmoving activity, each CUP owner shall submit to the ICAPCD a complete list of all construction equipment to be utilized during the construction phase identifying make, model, year, horsepower, and estimated hours of usage.

(F) Each CUP shall comply with all mitigations in the Mitigation Monitoring and Reporting Program listed **AQ-1 THRU AQ-5.**

S-5 GEOLOGY/SOILS and MINERAL RESOURCES

(A) Prior to approval of final engineering and grading plans for the project, the County shall verify that all recommendations contained in the *Geotechnical Report for the Vega SES Solar Facility* prepared by Landmark Consultants, Inc. (August 2018) have been incorporated into all final engineering and grading plans. The County's soil engineer and engineering geologist shall review grading plans prior to finalization, to verify compliance with the recommendations of the report. All future grading and construction of the project site shall comply with the geotechnical recommendations contained in the geotechnical report.

S-6 CULTURAL RESOURCES:

(A) Pursuant to CEQA Guidelines §15064.5(f), in the event that previously unidentified unique archaeological resources are encountered during construction or operational repairs, archaeological monitors will be authorized to temporarily divert construction work within 100 feet of the area of discovery until significance and the appropriate mitigation measures are determined by a qualified archaeologist familiar with the resources of the region. Applicant shall notify the County within 24 hours. Applicant shall provide contingency funding sufficient to allow for implementation of avoidance measures or appropriate mitigation.

(B) In the event of the discovery of previously unidentified archaeological materials, the contractor shall immediately cease all work activities within approximately 100 feet of the discovery. Prehistoric archaeological materials might include obsidian and chert flaked-stone tools (e.g., projectile points, knives, and scrapers) or tool making debris; culturally darkened soil ("midden") containing heat-affected rocks, artifacts, or shellfish remains; and stone milling equipment (e.g., mortars, pestles, handstones, or milling slabs); and battered stone tools, such as hammerstones and pitted stones. Historic-period materials might include stone, concrete, or adobe footings and walls; filled wells or privies; and deposits of metal, glass, and/or ceramic refuse. After cessation of excavation, the contractor shall immediately contact the Imperial County Department of Planning and Development Services. Except in the case of cultural items that fall within the scope of the Native American Grave Protection and Repatriation Act, the discovery of any cultural resource within the project area shall not be grounds for a "stop work" notice or otherwise interfere with the project's continuation except as set forth in this paragraph.

In the event of an unanticipated discovery of archaeological materials during construction, the applicant shall retain the services of a qualified professional archaeologist, meeting the Secretary of the Interior's Standards for a Qualified Archaeologist, to evaluate the significance of the materials prior to resuming any construction-related activities in the

vicinity of the find. If the qualified archaeologist determines that the discovery constitutes a significant resource under CEQA and it cannot be avoided, the applicant shall implement an archaeological data recovery program.

(C)

In the event that unanticipated paleontological resources or unique geologic resources are encountered during ground-disturbing activities, work must cease within 50 feet of the discovery and a paleontologist shall be hired to assess the scientific significance of the find. The consulting paleontologist shall have knowledge of local paleontology and the minimum levels of experience and expertise as defined by the Society of Vertebrate Paleontology's Standard Procedures (2010) for the Assessment and Mitigation of Adverse Impacts on Paleontological Resources. If any paleontological resources or unique geologic features are found within the project site, the consulting paleontologist shall prepare a paleontological Treatment and Monitoring Plan to include the methods that will be used to protect paleontological resources that may exist within the project site, as well as procedures for monitoring, fossil preparation and identification, curation of specimens into an accredited repository, and preparation of a report at the conclusion of the monitoring program

(D) In the event that evidence of human remains is discovered, construction activities within 200 feet of the discovery will be halted or diverted and the Imperial County Coroner will be notified (Section 7050.5 of the Health and Safety Code). If the Coroner determines that the remains are Native American, the Coroner will notify the NAHC, which will designate an MLD for the project (Section 5097.98 of the PRC). The designated MLD then has 48 hours from the time access to the property is granted to make recommendations concerning treatment of the remains (AB 2641). If the landowner does not agree with the recommendations of the MLD, the NAHC can mediate (Section 5097.94 of the PRC). If no agreement is reached, the landowner must rebury the remains where they will not be further disturbed (Section 5097.98 of the PRC). This will also include either recording the site with the NAHC or the appropriate Information Center; using an open space or conservation zoning designation or easement; or recording a document with the county in which the property

S-7 HEALTH, SAFETY AND HAZARDOUS MATERIAL/FIRE AND FUELS MANAGEMENT

(A) All trash and debris within the Project site shall be disposed of off-site, in accordance with current, local, state, and federal disposal regulations. Compliance with this measure shall be verified by the Planning and Development Services Department.

(B) If it is determined that hazardous wastes are, or will be generated by the proposed operations, the wastes 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).

(C) If it is determined that hazardous wastes will be generated, the Permittee should also obtain a United States Environmental Protection Agency, Identification Number by contacting (800) 618-6942. Certain hazardous waste treatment processes or hazardous material, handling, storage or uses may require authorization from the local Certified Unified Program Agency (CUPA). Information about the requirement for authorization can be obtained by contacting the local CUPA.

(D) Firearms shall be prohibited in all Project areas except for those used by licensed security personnel.

(E) The Permittee shall ensure that the AST, farm equipment area, and any other debris have been cleared from the site.

Prior to the demolition of any building, structure, or transite pipe, the Applicant shall hire a California Certified Lead Inspector/Assessor and Certified asbestos Consultant to evaluate these features for the presence of lead based paint (LBP) and/or asbestos containing materials (ACM). Confirmed LBP and/or ACM shall be handled by a licensed LBP contractor and/or Licensed Asbestos Contractor. All contaminants shall be remediated in compliance with California environmental regulations and policies. LBP and/or ACM shall be disposed of according to appropriate regulations.

(F) **Hazardous Materials Discovery:** All construction contractor(s) shall be instructed to immediately stop all subsurface construction activities in the event that petroleum is discovered, an odor is identified, or significantly stained soil is visible during construction. Contractors shall be instructed to follow all applicable regulations regarding discovery and response for hazardous materials encountered during the construction process. During construction, discovery of hazardous materials shall result in the immediate stop of all subsurface construction activities.

S-8 HYDROLOGY AND WATER QUALITY

A. Prior to construction and site restoration for each CUP site, the Applicant shall acquire appropriate Clean Water Act regulatory permits; prepare SWPPP with incorporated control measures outlined in Mitigation Measure 4.9-1a; and implement BMPs. **Prepare SWPPP and Implement Best Management Practices (BMP) Prior to Construction and Site**

Restoration. The project applicant or its contractor shall prepare a SWPPP specific to the project and be responsible for securing coverage under SWRCB's National Pollution Discharge Elimination System (NPDES) stormwater permit for general construction activity (Order 2009-0009-DWQ). The SWPPP shall identify specific actions and BMPs relating to the prevention of stormwater pollution from project-related construction sources by identifying a practical sequence for site restoration, BMP implementation, contingency measures, responsible parties, and agency contacts. The SWPPP shall reflect localized surface hydrological conditions and shall be reviewed and approved by the project applicant prior to commencement of work and shall be made conditions of the contract with the contractor selected to build and decommission the project. The SWPPP(s) shall incorporate control measures in the following categories:

- Soil stabilization and erosion control practices (e.g., hydroseeding, erosion control blankets, mulching) Dewatering and/or flow diversion practices, if required.)
- Sediment control practices (temporary sediment basins, fiber rolls).
- Temporary and post-construction on- and off-site runoff controls.
- Special considerations and BMPs for water crossings, wetlands, and drainages
- Monitoring protocols for discharge(s) and receiving waters, with emphasis place on the water quality.
- Waste management, handling, and disposal control practices
- Corrective action and spill contingency measures
- Agency and responsible party contact information
- Training procedures that shall be used to ensure that workers are aware of permit requirements and proper installation methods for BMPs specified in the SWPPP

B. The SWPPP shall be prepared by a qualified SWPPP practitioner with BMPs selected to achieve maximum pollutant removal and that represent the best available technology that is economically achievable. Emphasis for BMPs shall be placed on controlling discharges of oxygen-depleting substances, floating material, oil and grease, acidic or caustic substances or compounds, and turbidity. BMPs for soil stabilization and erosion control practices and sediment control practices will also be required. Performance and effectiveness of these BMPs shall be determined either by visual means where applicable (i.e., observation of above-normal sediment release), or by actual water sampling in actives: dissolved oxygen, floating material, oil and grease, pH, and turbidity cases where verification of contaminant reduction or elimination, (inadvertent petroleum release) is required to determine adequacy of the measure.

C. Prior to issuance of a grading permit for each CUP site, the Applicant shall provide Colorado River Basin Regional Water Quality Control Board with the location, type of discharge, and methods treatment and monitoring for all groundwater dewatering discharges if the project requires construction dewatering. **Properly Dispose of Construction Dewatering In**

Accordance with the Colorado River Basin Regional Water Quality Control Board. If required, all construction dewatering shall be discharged to an approved land disposal area or drainage facility in accordance with Colorado River Basin RWQCB requirements. The project applicant or its construction contractor shall provide the Colorado River Basin RWQCB with the location, type of discharge, and methods of treatment and monitoring for all groundwater dewatering discharges. Emphasis shall be placed on those discharges that would occur directly or in proximity to surface water bodies and drainage facilities.

D. Post construction for each CUP site, the Applicant shall implement a Drainage Plan in accordance with the County and Imperial Irrigation District guidelines as outlined. **Incorporate Post-Construction Runoff BMPs into Project Drainage Plan and Maximize Opportunities for Low Impact Development.** The project Drainage Plan shall adhere to County and IID guidelines to treat, control, and manage the on- and off-site discharge of stormwater to existing drainage systems. Low Impact Development opportunities, including, but not limited to infiltration trenches or bioswales, will be investigated and integrated into the Drainage Plan to the maximum extent practical. The Drainage Plan shall provide both short- and long-term drainage solutions to ensure the proper sequencing of drainage facilities and treatment of runoff generated from project impervious surfaces prior to off-site discharge. The project applicant shall ensure the provision of sufficient outlet protection through the use of energy dissipaters, vegetated rip-rap, soil protection, and/or other appropriate BMPs to slow runoff velocities and prevent erosion at discharge locations, access roads, electrical distribution, and solar array locations. A long-term maintenance plan shall be developed and implemented to support the functionality of drainage control devices. The facility layout(s) shall also include sufficient container storage and on-site containment and pollution-control devices for drainage facilities to avoid the off-site release of water quality pollutants, including, but not limited to oil and grease, fertilizers, treatment chemicals, and sediment.

S-9 BIOLOGICAL RESOURCES:

(A) GENERAL CONSTRUCTION

a) Each CUP owner shall identify and retain a qualified biologist(s) approved by CDFW.

b) The name, documented experience, any permit numbers, and resumes for the qualified biologist(s) shall be submitted to the CDFW for approval at least seven (7) days prior to initiation of construction. It is assumed CDFW will approve qualified biologist(s) within fifteen (15) days of the submittal.

c) The qualified biologist(s) shall be present on-site during all ground-disturbing phases of construction to regularly monitor construction activities and ensure construction is proceeding in compliance with the avoidance, minimization, and mitigation

measures committed to by the Applicant, as well as measures required (project manager, resident engineer) to ensure that issues relating to biological resources are appropriately and lawfully managed.

d) The qualified biologist shall be responsible for reporting any noncompliance issues to CDFW within forty-eight (48) hours. The resident engineer shall be immediately notified to halt work, if necessary.

e) The qualified biologist(s) shall provide a report to CDFW at least monthly identifying construction activities and the results of compliance monitoring related to implementation of avoidance and minimization measures.

The qualified biologist(s) shall meet the following minimum qualifications:

(1) Have a bachelor's degree in biological sciences, zoology, botany, ecology, or a closely related field or at least four (4) years of experience in field biology or current certification of a nationally recognized biological society, such as The Ecological Society of America or The Wildlife Society;

(2) Have at least one (1) year of field experience with biological resources found in the geographic region of the Project; and

(3) Have extensive knowledge of the biology and ecology of sensitive species occurring and potential occurring within the Project site.

(4) Have specialized avian experience necessary to conduct nesting surveys and monitor buffers.

(1) Each CUP owner shall develop and implement a Worker
(2) Environmental Awareness Program (WEAP) prior to the start of construction. The WEAP shall be submitted to the Imperial County Planning and Development Services Department for review and approval prior to the issuance of building permits. The WEAP training shall be led by the qualified biologist(s) and shall cover the following:

(a) The potential presence and ecology of sensitive biological resources found on-site, such as potential jurisdictional waters and nesting avian species;

(b) Flagging/fencing of exclusion areas;

(c) Proper implementation of protective measures to avoid impacts to special-status species; The reasons, need, and method by which employees should report on wildlife mortality, follow nest management protocols, dispose of carcasses, comply with applicable regulations (including the consequences of

noncompliance), and the appropriate agencies and personnel that should be contacted after incidents; and

(d) Other permit requirements and environmental issues.

(3) All construction site personnel shall be required to attend the WEAP training in conjunction with hazard and safety training prior to working on-site.

(4) Parking of vehicles shall occur within the fenced Project area or within previously disturbed areas prior to construction of the fencing, and away from sensitive habitats.

(5) Grading shall only occur where necessary and as specified by the Project's final engineering plans, and shall be avoided wherever possible to minimize the amount of ground disturbance.

(6) To the extent possible, Project layout and design shall generally follow existing contours of the Project site to minimize the amount of grading required. To the extent possible, nighttime construction shall be avoided. When activities must occur at night, all Project lighting (e.g., staging areas, equipment storage sites, roadway) shall be directed downward and away from natural vegetation communities. Light glare shields shall be used to reduce the extent of illumination into adjoining areas.

(7) Nighttime and daytime on-site construction vehicle speeds shall be restricted to ten (10) miles per hour and twenty (20) miles per hour, respectively. Speed limit signs shall be posted throughout the site to remind construction workers of travel speed restrictions.

(8) Spoils, trash, and any construction-generated debris shall be removed to an approved off-site disposal facility. A trash abatement program shall be established. Trash and food items shall be contained in closed containers and removed daily to reduce the attraction of opportunistic predators such as common ravens, coyotes, and feral cats and dogs that may prey on sensitive species.

(9) When handling toxic substances, construction vehicles shall carry a Hazardous Material Spill Kit for use in the event of a spill. All construction personnel working on-site shall be trained in using these kits. Spill containment materials must be on-site or readily available for any equipment maintenance or refueling.

(10) Construction workers shall be prohibited from bringing domestic pets and firearms to the site.

(11) A SWPPP or equivalent shall be prepared prior to the start of construction to comply with applicable RWQCB storm water management provisions. The SWPPP or SWPPP equivalent document shall identify the design features and BMPs that shall be used to effectively manage drainage-related issues (e.g., erosion and sedimentation) during construction. Erosion control measures shall be regularly checked by inspectors, the qualified biologists, and/or resident engineer. Fencing and erosion control measures of all construction areas shall be inspected a minimum of once per week (refer to mitigation measure MM 4.11.1b in Section 4.11, Hydrology and Water Quality).

(12) All construction activities shall cease during heavy rains to prevent unnecessary erosion, runoff, and sedimentation, and shall not resume until conditions are suitable for the movement of equipment and materials.

(13) No planting or seeding of invasive plant species on the most recent version of the California Invasive Plant Council (Cal-IPC) California Invasive Plant Inventory for the Project region shall be permitted.

(14) To prevent indirect effects to sensitive natural resources from fugitive dust associated with construction of the Project, all active construction areas shall be watered down as necessary. All trucks hauling soil, sand, and other loose materials shall be covered or shall maintain at least 2 feet of free-board. All unpaved access roads, parking areas, and staging areas at construction sites shall have non-potable water or nontoxic soil stabilizers applied as needed.

(15) At the completion of construction, all construction-related materials shall be removed from the site.

(16) Each CUP owner shall develop a Weed Management Plan prior to the commencement of construction activities.

1) The Weed Management Plan shall include a variety of measures that shall be undertaken during construction and operation activities to prevent the introduction and spread of new weed species.
2) The Weed Management Plan shall also address monitoring, plus educating personnel on weed identification and methods for avoiding and treating infestations. Weed control methods may include both physical and chemical control.
3) All chemical applications require oversight by a holder of a valid Qualified Applicator's License (QAL) issued by the California Department of Pesticide Regulation (CADPR) Recommendations for use of chemical products will be made in writing by a Pest Control Advisor (PCA) with a valid

CADPR license. Chemical products will be registered, non-restricted, general-use herbicides. Treatment applications will follow use and safety guidelines available on product labels. Typical active ingredients expected for chemical treatments are glyphosate and triclopyr. Glyphosate and triclopyr are found in broad-spectrum, systemic herbicides, and available in numerous products intended for control of post-emergent vegetation. Chemical treatment of vegetation in and around aquatic or wetland features requires products approved for use within such habitats, as described on product labels.

4) The Weed Management plan shall be submitted to the Imperial County Planning and Development Services Department & the Agriculture Commission Office for review and approval prior to issuance of building permits.

(B)

(1) Each CUP owner shall develop and implement an Operation and Maintenance Worker Education Plan to advise personnel on general operations measures. The Worker Education Plan shall be submitted to the County of Imperial Planning and Development Services Department for review and approval prior to issuance of building permits. The following provisions shall be included in the Worker Education Plan and implemented throughout the operational lifespan of each CUP:

(a) Operation and maintenance personnel shall be prohibited from:

(1) Harming, harassing, or feeding wildlife and/or collecting special-status plant or wildlife species.

(2) Traveling (either on foot or in a vehicle) outside of Project footprint except on public roads.

(3) Littering on the Project area.

(4) Allowing persons not employed at the facility to remain on site after daylight hours

(5) Exceeding normal nighttime operational noise or lighting levels.

(2) All operation and maintenance equipment, including cranes and personnel, shall stay within the permanent impact footprint of CUP boundaries, the Electrical Collector Line Corridor, or the Gen-Tie line corridor, except when not physically feasible or when necessary to protect human life or property. Operation and

maintenance vehicles shall be parked in designated areas and away from sensitive habitats.

(3) Nighttime and daytime vehicle speeds within each CUP, the Electrical Collector Line Corridor, and the Gen-Tie line corridor shall be restricted to ten (10) miles per hour and twenty-five (25) miles per hour, respectively. Speed limit signs shall be posted throughout the Project site to remind workers of travel speed restrictions.

(4) Each CUP, the Electrical Collector Line Corridor, and the Gen-Tie line corridor shall be kept clear of trash and other litter to reduce the attraction of opportunistic predators such as common ravens, coyotes, and feral dogs that may prey on sensitive species.

(5) Operation and maintenance employees shall be prohibited from bringing domestic pets and firearms to the site.

(6) The General Construction Permit shall specify post-construction storm water control standards, and preparation and implementation of a Long-Term Maintenance Plan for the retention/detention basins

(7) Operation and maintenance activities at each CUP, the Electric Collector Line Corridor, and the Gen-Tie corridor shall be carried out in accordance with the Weed Management Plan

(C) **JURISDICTIONAL WATERS AND WETLANDS MEASURES - ALL CUPs**

(1)

(a) Each CUP owner shall implement the following measures during decommissioning activities occurring within each CUP.

(1) All mitigation measures required during construction of the Project to avoid or minimize impacts to biological resources shall also be implemented during decommissioning activities.

(2) Decommissioning of the Project shall minimize new site disturbance and removal of native vegetation to the maximum extent possible.

(3) Topsoil removed during decommissioning shall be stockpiled and used as topsoil during restoration efforts associated with decommissioning disturbance.

(4) Soil shall be stabilized and vegetated with plant species characteristic of native species within adjacent habitats, except where immediately reclaimed as agriculture. Local seed sources shall be used where feasible.

(5) Surface water flows shall be restored to pre-disturbance conditions. Unnecessary stream crossings, roads, and pads shall be removed and revegetated. Erosion control measures shall be installed in all disturbance areas.

(6) Petroleum and chemical spills shall be remediated prior to the completion of decommissioning. **Corridor, and the Gen-Tie corridor**

(b) Each CUP owner shall implement the following measures prior to and during construction activities at each CUP, the Electric Collector line Corridor and Gen-Tie line corridor to avoid construction-related impacts to jurisdictional waters and wetlands.

(c) Each CUP and Project design shall avoid direct and indirect impacts to jurisdictional waters to the greatest extent feasible. Construction within jurisdictional waters and/or wetlands shall be subject to prior authorization by USACE, RWQCB, and CDFW.

(d) All equipment operating in and near jurisdictional waters or wetlands shall be in good working condition and free of leaks. All vehicles shall have drip pans during storage to contain minor spills and drips. No refueling or storage shall take place within 100 feet of a drainage channel or structure. In addition, all maintenance crews working with heavy equipment shall be trained in spill containment and response.

(e) Discharges shall not permanently restrict or impede the passage of normal or expected high flows, or cause the permanent relocation or diversion of the flows.

(f) Where turbidity or erosion occurs or is expected to occur from drainage structures, biofilters, detention basins or other appropriate drainage catchment structures shall be installed where flow conveyance occurs from the Project directly into a jurisdictional area.

(g) Temporary impacts to jurisdictional waters and wetlands will be recontoured to pre-construction conditions. Temporary impacts to vegetated jurisdictional waters and wetlands will

also be revegetated with appropriate native vegetation or non-native compatible with the landscape palette.

(h) Permanent impacts to jurisdictional waters and wetlands shall be mitigated either through on-site and/or off-site re-establishment and/or enhancement of jurisdictional waters and wetlands or through an approved-mitigation bank or in-lieu fee program, if one is available. The type of mitigation, mitigation location, and the final mitigation ratios will be established during the permit process for the Project's USACE Section 404 permit, the RWQCB Section 401 Water Quality Certification, and a CDFW Streambed Alteration Agreement. The federal agencies have published guidance on mitigation, i.e., the final rule for Compensatory Mitigation for Losses to Aquatic Resources that was issued by USACE and USEPA. Issuance of required permits/authorizations and preparation of a detailed Wetland/Waters Mitigation Plan to be submitted for review and approval by the USACE, RWQCB, and CDFW before impacts to jurisdictional waters.

(i) Each CUP owner shall comply with additional measures identified during permitting through the USACE, RWQCB, and CDFW. In addition, the determination of whether the Project may be permitted under USACE's NWP program, or whether an individual permit shall be required, shall be determined formally as part of the CWA Section 404 permit process. To qualify for an NWP, the proposed action and the associated unavoidable impacts to jurisdictional waters based on final project designs must satisfy all terms and conditions of the applicable NWP, as well as all general conditions and any relevant regional conditions of the NWP program.

(j) The Wetland/Waters Mitigation Plan shall describe proposed on-site and off-site mitigation. For all habitat restoration proposed, this plan shall include details regarding site preparation (e.g., grading), planting specifications, and irrigation design, as well as maintenance and monitoring procedures. The plan shall also outline yearly success criteria and remedial measures should the mitigation effort fall short of the success criteria, and a strategy for long-term mitigation site management. Alternatively, mitigation obligations may be satisfied by participating in a fee-based mitigation program (e.g., a wetland mitigation bank) in which case, long-term management for such mitigation shall be covered under the terms of the formal banking agreement or by purchasing appropriate mitigation credits from a regulatory approved bank.

(k) The following measures shall apply to construction activities at the Full Build-out Scenario.

(1) A qualified biologist shall be on-site during all ground-disturbing construction activities in potential BUOW habitat. The qualified biologist shall be responsible for implementing and overseeing BUOW avoidance and minimization measures.

(2) The qualified biologist shall have the authority to stop construction if activities are in violation of avoidance and minimization measures. A qualified biologist possesses a bachelor's degree in wildlife biology or a related field and has demonstrated field experience in the identification and life history of BUOW.

(3) Per CDFW guidance, a take avoidance survey (i.e., pre-construction clearance survey) will be conducted by a qualified biologist to determine presence or absence of BUOW no less than fourteen (14) days and no more than thirty (30) days prior to initiating construction activities. Surveys shall include areas within the Project footprint and a surrounding 500-foot (150-meter) buffer. The survey shall consist of walking parallel transects and noting any fresh BUOW sign or presence. The results of the take avoidance survey shall be provided to CDFW. If more than thirty (30) days pass between the take avoidance survey and initiation of Project construction, additional take avoidance surveys may be required, depending on what actions have been implemented to deter BUOW from moving into the Project footprint and buffer area. A final take avoidance survey shall be conducted within the Project footprint within twenty-four (24) hours prior to initiation of construction activities. Given the total duration of construction and the size of the Project, it is expected that take avoidance surveys will be conducted in phases, in order to stay within the required survey windows associated with construction activities.

(4) If occupied burrows are found during take avoidance surveys, appropriate construction buffers or setback distances shall be determined by the qualified biologist on a case-by-case basis, depending on the season in which disturbance will occur, the type of disturbance, and other factors that could influence susceptibility to disturbance (e.g., topography, vegetation, existing disturbance levels, etc.). To the extent feasible, buffers of 246 feet (75 meters) will be used during the breeding

season (February 1 through August 31) and 164 feet (50 meters) will be used during nonbreeding season (September 1 through January 31). "Shelter in place" techniques shall be used if necessary to create a visual and auditory barrier between construction activities and the occupied burrow. Techniques shall include placing hay bales, fencing, or another physical barrier between the occupied burrow and construction activities. The qualified biologist shall determine if and/or when shelter in place is necessary and feasible for implementation. When construction activities commence adjacent to the buffer area, a qualified biologist shall be present on-site full time to monitor the behavior of BUOW for at least 3 days. The qualified biologist shall have the authority to increase the setback distance if there are signs of disturbance, such as changes in behavior as a result of construction or other indications of distress by BUOW.

(a) If BUOW activity is detected at a burrow within the Project footprint during the non-breeding season (September 1 through January 31), BUOW shall be excluded from active burrows and encouraged to passively relocate to suitable, unoccupied habitat outside of the exclusion area. BUOW shall be excluded by installing one-way doors in burrow entrances. Although passive relocation does not result in control of the recipient area for BUOW, the qualified biologists shall verify that there is an acceptable "recipient" area within a reasonable distance that provides the necessary subsidies to support BUOW with the goal to minimize the stress of relocation. Subsidies to be considered include suitable burrows (primary and satellite) and habitat quality (e.g., vegetation cover, diversity) that is equal to or greater than that from which they were relocated. If, during pre-construction surveys, BUOW activity is detected at a burrow within the Project footprint during the breeding season (February 1 through August 31), then an appropriate construction buffer or setback distance shall be determined by the qualified biologist on a case-by-case basis. This buffer shall be flagged and all Project-related activity shall remain outside of the flagged area until a qualified biologist determines the burrow is no longer occupied (e.g., juveniles are foraging independently and are capable of independent survival).

(b) In the event that BUOW will be excluded from the Project footprint and occupied burrows will be impacted, a mitigation site with suitable burrows and habitat shall be secured and a Burrowing Owl Exclusion Plan shall be developed and approved by CDFW prior to excluding BUOW from burrows. Specific objectives for BUOW protection addressed by this Burrowing Owl Exclusion Plan shall describe exclusion methodology, burrow excavation procedures, on-site and post-relocation monitoring of occupied burrows, and reporting.

(c) Occupied BUOW burrows directly impacted shall be replaced by installing artificial burrows on mitigation sites (i.e., conservation easements, in-lieu fee lands, Farm Contract land), or other land as agreed to by CDFW, at a ratio of 1:1. If the mitigation sites identified for the Project have at least two suitable BUOW burrows for each occupied burrow directly impacted, then artificial burrows shall not be installed. Suitable burrows are defined as burrows greater than approximately 4 inches (10 centimeters) in diameter (height and width) and greater than approximately 60 inches (150 centimeters) in depth. Burrows shall be scoped to ensure they are of proper depth for BUOW.

(d) A security in an amount equal to the fair market value of the cost of a perpetual conservation easement and long-term endowment for the number of acres of burrowing owl habitat mitigation obligation for each CUP Phase (one or more CUPs for which a security is posted) prior to commencement of construction shall be posted to fulfill the mitigation obligations for lost burrowing owl habitat.

(e) A CUP owner shall proffer compensatory mitigation when a total of four CUP Phases have posted security and proffered compensatory mitigation or eighteen (18) months from the date of posting security on the first CUP Phase, whichever is longer. Security shall be returned to the CUP owner upon proffer of compensatory mitigation. CDFW may extend the 18-month period if the CUP owner is making a good-faith effort to proffer mitigation and demonstrating progress in securing

mitigation. If the 18-month period elapses and the CUP owner cannot proffer mitigation or demonstrate a good faith effort to secure mitigation, CDFW may cash in the security to secure mitigation itself.

(l) The CUP owner shall proffer mitigation for lost burrowing owl core foraging habitat, as identified in the BUOW occupancy analysis and model by (1) securing a CUP owner purchased conservation easement or similar instrument that protects the agricultural use of the land in perpetuity at a ratio of 1:1; (2) participating in the Burrowing Owl Habitat Mitigation Plan administered by the Imperial Community Foundation-Burrowing Owl Stewardship and Education Fund (IVCF-BOSEF) (or similar qualified non-profit organization and approved by CDFW), if available; and/or (3) using a CDFW-approved in-lieu fee program, if one is available at the time the compensatory mitigation is proffered. To be available as compensatory mitigation for this Project, the Burrowing Owl Habitat Mitigation Plan shall be developed for approval by CDFW and the IVCF-BOSEF Board of Directors (or the Board of Directors of similar qualified non-profit organization) before the time compensatory mitigation is proffered.

(m) The Burrowing Owl Habitat Mitigation Plan would be developed to compensate for impacts to core foraging habitat, and include the following components:

(1) Avoiding higher quality habitat to the extent practicable. [Note: The Project Applicant has already implemented this measure by removing portions of the Project based on the occupancy model.]

(2) A strategy and methods to enroll farmers in a program to grow and retain Burrowing Owl Friendly Crops (BOFC) identified by the occupancy model (i.e., wheat and alfalfa). Core BUOW foraging habitat shall be mitigated at a 1:1 ratio by entering farm land into short-term (minimum 3 years) farm agreements to predominantly grow BOFC.

(3) A strategy and method for integrating owl-friendly farm practices to reduce mortality of owls. For farm land enrolled in BOFC agreements that include requirements to implement BUOW safe farm practices, impacts to core BUOW foraging habitat shall be mitigated at a reduced ratio of 0.7:1, which reflects the combined

benefit of farming BOFC using BOSFP through short-term (minimum of 3 years) farm

(n) A long-term financing plan and a defined program-sufficient to fund the BOFC/BOSFP agreement program through the end of the Project's operational life (anticipated to be approximately 30 years) (e.g. endowment account).

(o) A Bird and Bat Conservation Strategy (BBCS) will be developed by the Project Applicant in coordination with the County of Imperial, USFWS, and CDFW. The BBCS will include the following components:

(1) A description and assessment of the existing habitat and avian and bat species;

(2) An avian and bat risk assessment and specific measures to avoid, minimize, reduce, or eliminate avian and bat injury or mortality during all phases of the Project.

(3) A post-construction monitoring plan that will be implemented to assess impacts on avian and bat species resulting from the Project. The post-construction monitoring plan will include a description of standardized carcass searches, scavenger rate (i.e., carcass removal) trials, searcher efficiency trials, and reporting.

(4) Statistical methods will be used to estimate Project avian and bat species, including special status species, annual mortality by taxa and season. Analysis will also determine collision rates during diurnal and nocturnal periods; species mortality composition; and assess the spatial distribution mortalities. Sufficient data (i.e., sample sizes) will dictate the extent that fatality models can be used to generate fatality estimates within the various categories. Fatality estimates will be generated using the most appropriate fatality estimator given the data set.

(5) An injured bird response plan that delineates care and curation of any and all injured birds.

(6) A nesting bird management strategy to outline actions to be taken for avian nests detected within the impact footprint during operation of the Project.

(7) A conceptual adaptive management and decision-making framework for reviewing, characterizing, and responding to monitoring results.

(8) Monitoring studies following commencement of commercial operation of each CUP area. Monitoring results will be reviewed annually by the Applicant and the County of Imperial, in consultation with CDFW and USFWS, to inform adaptive management responses.

(9) During Project construction, incidental avian carcasses or injured birds found during construction shall be documented. Should a carcass be found by Project personnel, the carcass shall be photographed, the location shall be marked, the carcass shall not be moved, and a qualified biologist shall be contacted to examine the carcass. When a carcass is detected, the following data shall be recorded (to the extent possible): observer, date/time, species or most precise species group possible, sex, age, estimated time since death, potential cause of death or other pertinent information, distance and bearing to nearest structure (if any) that may have been associated with the mortality, location (recorded with a Global Positioning System [GPS]), and condition of carcass.

(10) If any federal listed, state listed or fully protected avian carcasses or injured birds are found during construction or post-construction monitoring, the Project Applicant shall notify USFWS and CDFW within 24 hours via email or phone and work with the resource agencies to determine the appropriate course of action for these species. For such listed species, the CUP owner shall obtain or retain a biologist with the appropriate USFWS Special Purpose Utility Permit(s) and CDFW Scientific Collecting Permit(s) to collect and salvage all dead and injured birds, and store/curate them in freezers for later disposition and analysis.

(11) Although take is not anticipated, it is possible. Should mortality of a federally listed species be documented, the take will be addressed by applying for an incidental take permit through the development of a Habitat Conservation Plan (HCP) that satisfies the permit issuance criteria stipulated under Section 10(a)(l)(B) of the Endangered Species Act or through consultation under Section 7 of the federal Endangered Species Act. If mortality of a State-listed species is documented, the CUP owner shall apply for a 2081(b) incidental take permit from CDFW. Alternatively, if available, the CUP owner may elect to obtain incidental take authorization

through participation in the Desert Renewable Energy Conservation Plan.

(12) Utility lines constructed above-ground shall conform to Avian Power Line Interaction Committee (APLIC) standards.

(13) Post-construction monitoring studies shall be conducted by a third-party independent contractor for at least two (2) years following commencement of commercial operation of each CUP area. Monitoring results shall be reviewed annually by the Applicant and the County of Imperial, in consultation with CDFW and USFWS, to determine if and to what extent post-construction monitoring studies shall be continued in future years.

(2) To the extent possible, construction shall occur outside the typical avian breeding season (February 15 through September 15). If construction must occur during the general avian breeding season, a pre-construction nest survey shall be conducted within the impact area and a 500-foot (150-meter) buffer by qualified biologist no more than seven (7) days prior to the start of vegetation clearing and/or ground disturbing construction activities in any given area of the Project footprint. Construction crews shall coordinate with the qualified biologist at least seven (7) days prior to the start of construction in a given area to ensure that the construction area has been adequately surveyed. A nest is defined as active once birds begin constructing or repairing the nest in readiness for egg-laying. A nest is no longer an "active nest" if abandoned by the adult birds or once nestlings or fledglings are no longer dependent on the nest. If no active nests are discovered, construction may proceed. If active nests are observed that could be disturbed by construction activities, these nests and an appropriately sized buffer (typically a 200-foot (61-meter) buffer for non-raptor species nests and at least a 500-foot (150-meter) buffer for raptor or federally listed species nests) would be avoided until the young have fledged. Final construction buffers or setback distances shall be determined by the qualified biologist in coordination with USFWS and CDFW on a case-by-case basis, depending on the species, season in which disturbance shall occur, the type of disturbance, and other factors that could influence susceptibility to disturbance (e.g., topography, vegetation, existing disturbance levels, etc.). Active nests shall be avoided until the young have fledged and/or the monitor determines that no impacts are anticipated to the nesting birds or their young. If vegetation clearing and/or ground disturbing activities cease for fourteen (14) or more consecutive days during the nesting season in areas where suitable nesting habitat

remains, repeat nesting bird surveys shall be required to ensure new nesting locations have not been established within the impact area and the defined buffers.

(3) Construction-generated noise may result in disturbance to nesting migratory birds. The following measures shall be incorporated to minimize noise generated from construction activities:

(a) The qualified biologist shall coordinate with contractors to ensure that heavy equipment will be repaired as far as practical from habitats where nesting birds may be present.

(b) Construction equipment, including generators and compressors, shall be equipped with manufacturers' standard noise-control devices or better (e.g., mufflers, acoustical lagging, and/or engine enclosures).

(c) The construction contractor shall maintain all construction vehicles and equipment in proper operating condition and provide mufflers on all gas- and diesel-powered equipment.

(d) The Project's BBCS shall be implemented during the construction. Incidental avian carcasses or injured birds found during construction shall be documented. If a carcass be found by Project personnel, the carcass shall be photographed, the location shall be marked, the carcass shall not be moved, and a qualified biologist shall be contacted to examine the carcass. When a carcass is detected, the following data shall be recorded (to the extent possible): observer, date/time, species or most precise species group possible, sex, age, estimated time since death, potential cause of death or other pertinent information, distance and bearing to nearest structure (if any) that may have been associated with the mortality, location (recorded with a Global Positioning System [GPS]), and condition of carcass.

(4) During decommissioning, Project improvements associated with the Electric Collector Corridor Line and the Mount Signal Solar Farm Project Gen-Tie line shall be removed. In addition, all unnecessary overhead power lines and poles shall be removed by each CUP owner.

(5) Adhere to all mitigations outlined in the Mitigation Monitoring and Reporting Program (MM&RP) for the Lindsey Solar Farm project.

S-10 PUBLIC SERVICES:

(A) If Permittee receives an exclusion of applicable sales and use tax payable to the County of Imperial under Senate Bill 71 under the State Public Resource Code (Section 26003, et al.) and the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA), Permittee shall pay to the County and Local Transportation Authority an amount equal to the sales tax (currently at 1.5%) which would have been received if Permittee had not obtained such exclusion.

(B) Permittee shall require that its general construction contractor exercise its option to obtain a California Department of Tax and Fee Administration (CDTFA) sub-permit for the jobsite and allocate all eligible use tax payments to Imperial County and LTA. Permittee will require that the general contractor provide County of Imperial with either a copy of their CDTFA account number and sub-permit. To accomplish this, Permittee shall either cause its general construction contractor and/or sub-contractor to treat the project in accordance with the relevant CDTFA for sales and use tax purposes or form a "Buying Company" as defined by CDTFA. Permittee can adopt an alternate methodology to accomplish this goal if the County Executive Office approves such methodology prior to issuance of building permits. Permittee shall require its general construction contractor to use commercially reasonable best efforts to cause its subcontractors and vendors to obtain similar sub-permits for the jobsite and to allocate all eligible sales and use tax payment to Imperial County and LTA.

(C) Permittee shall direct use taxes on out-of-County taxable purchased construction related items to Imperial County, to the extent permitted and consistent with State use tax law.

(D) Permittee shall use its best efforts, consistent with state law, to source taxable purchases from construction retail vendors within the County of Imperial.

(E) The Permittee shall exclude from assessment and taxation under California Revenue and Taxation Code Section 73 (AB 1451) only that property qualifying as an Active Solar Energy System, pursuant to the applicable guidelines issued by the Board of Equalization.

(1) The Permittee shall widely publicize to County residents the availability of job opportunities associated with the project (whether or not those job opportunities are within Imperial County or are regional). Since the majority of the population residents in the incorporated Cities of the County, dissemination of the information should be relatively easy. Postings at City Halls, newspaper and television advertisements, local job centers, and dedicated website shall offer sufficient avenues of communication. The Imperial

County Office of Employment and Training in addition to the Imperial Valley College presents viable sources for community awareness. The information shall provide available positions, details of positions including qualifications, number of openings, indicated the anticipated start date for each, and application process. In, order to maintain oversight of the process, the application process can be completed both on a dedicated website and at dedicated computers at the County which would afford those without Internet connection the ability to apply. The Permittee's information shall be forwarded to the Permittee or their contractor and copies of applications files are maintained at the County.

(2) During the development phase of the project, the Permittee shall provide a roster of employees to include their position and place of residence. Permittee shall also attempt to coordinate a ride-share program with Caltrans and other regional employers to facilitate the employment of Imperial County residents in jobs related to this project.

(3) Unless prohibited by local, state or federal law or regulation, Permittee shall make good faith efforts to hire qualified residents of the Imperial County with the objective that a majority of the total work force is comprised of the Imperial County residents.

(4) The Permittee shall install and implement security measures which may include, but not limited to, secured perimeter fencing with barbed wire, sensors, with controlled access points, security alarms, security camera systems, security guard vehicle patrols to deter trespass or unauthorized activities that would interfere with operation of the proposed project.

(5) Permittee shall compensate the County pursuant to the Department of Environmental Health Fee Schedule for any costs of calls related to bees and mosquitoes.

(6) The Permittee shall reimburse the Sheriff's Department for any investigations regarding theft on the Project site and related law enforcement.

(7) All construction supervisors and foremen shall be provided with communication devices, cell phones or walkie-talkies, in the event of an emergency situation on-site.

(8) All construction-related activities shall take place within the development footprint of the Project as defined by the final engineering plans. The anticipated impact areas, including staging areas, equipment access, and disposal or temporary placement of

spoils, shall be delineated with staking and/or orange construction fencing prior to construction to avoid natural resources where possible. No construction-related activities shall occur outside of the designated impact area. All construction materials, staging, storage, dispensing, fueling, and maintenance activities shall be designated on construction maps and shall be situated a minimum of fifty (50) feet from all drainages. Staging and temporary access shall occur on existing roadways whenever possible.

(9) For operation and maintenance fees associated with Fire Department/OES: Compare to DA

(a) Permittee shall pay a fee of $50 per acre per year prior to commencement of the construction period to address the Imperial County Fire/OES expenses for service calls within the Project's Utility/Transmission area. Said amount shall be prorated on a monthly basis for periods of time less than a full year. Permittee shall provide advance, written notice to County Executive Office of the construction schedule and all revisions thereto.

Permittee shall pay an annual fee of $20 per acre per year during the post-construction, operational phase of the Project to address the Imperial County Fire/OES expenses for service calls within the Project's Utility/Transmission area. Said fee will be paid to the Fire Department to cover on-going maintenance and operations costs created by the project.

(b) Costs associated with items two above items shall be annually adjusted on January 1st to add a CPI (Los Angeles) increase. Such costs associated with these items can be readjusted in the County's sole discretion if a new service analysis is prepared and that service analysis is approved by both the County and the Permittee.

(10) **FIRE** – In lieu of providing all-weather access roads for fire protection vehicles, the Permittee shall be permitted to provide compacted dirt roads (in compliance with ICAPCD's rules and regulations) for fire protection vehicles if prior to the issuance of any grading permit for the Project shall purchase an All-Terrain Vehicle (ATV) for the Fire Department. The ATV is estimated to cost between $320,000.00 and $365,000.00. Final cost, conditions and equipment of the ATV shall be determined prior to the issuance of the initial grading permit. The County agrees to require, as a condition of approval, other developers in the area to reimburse the Applicant for the expenses associated with the purchase of the ATV. The Permittee shall be reimbursed only for

those expenses in excess of their proportionate share for the purchase of the ATV that the Permittee would have been required to pay. Furthermore, if an ATV was already purchased by another developer in the area, then the Permittee shall only be required to pay a fire mitigation in the amount of up to $100 per acre that would represent their proportionate share to reimburse the purchaser of the ATV. The County shall be responsible for managing the reimbursement component of this condition of approval.

(11) Permittee shall participate in the Imperial County Public Benefit Program for the life of the CUP and shall at all times be a party to a public benefit agreement in a form acceptable to County Counsel in order to pay for all costs, benefits, and fees associated with the approved project, Approval of this public benefit agreement will be by the Board of Supervisors prior to the issuance of the first building permit.

S-11 COMMENCEMENT OF WORK:

If the project for which a Conditional Use Permit has been approved has not commenced, or permits for said project have not been issued, within one (1) year from approval date the Conditional Use Permit shall be null and void. If a Conditional Use Permit has been unused, abandoned, discontinued, or ceased for one (1) year, the Conditional Use Permit shall be null and void, and be of no effect. Notice to applicant/permittee under this division will not be required or provided by Department.

If an applicant cannot initiate or obtain permits for the approved use during the one (1) year, applicant may request a one (1) year extension from the Department. The request for an extension shall be in writing and be submitted with explanation to the Planning & Development Services Department at least sixty (60) days prior to the end of the one (1) year period. The Director shall have the authority to extend the initial startup period of a Conditional Use Permit two times for a maximum of one (1) year each. No extension under this section shall be extended for more than two (2) years.

S-12 CONSTRUCTION STANDARDS:

The solar energy facility structures shall be built in accordance with the California Building Code requirements applicable to "Seismic Category D". All structures and facilities shall be designed in accordance with the publication entitled "Recommended Lateral Force Requirements and Commentary by the Structural Engineers Association of California". The structural components of the permitted facilities shall be reviewed by the Building Official/Planning and Development Services Director. Applicable

building permits shall be procured from the County for facilities prior to commencement of construction of such facilities.

S-13 EMERGENCY RESPONSE/ACTION PLAN:

(A) The Permittee shall prepare an Emergency Response/Action Plan that has been approved by the Imperial County Fire/OES Department, and the Local Enforcement Agency. Any hazardous materials storage areas shall be designed with curbs or other containment measures, e.g. double-walled storage tanks, to contain spills and leaks and if on-site hazardous materials exceed fifty-five (55) gallons, a "Hazardous Material Management Plan" shall be prepared and approved by the County LEA and CUPA.

(B) The Emergency Response/Action Plan shall cover all possible emergencies, e.g. major fluid spills, earthquakes, fires, floods or other emergencies. At all times, there shall be at least one employee either on the facility premises or on-call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility of coordinating all emergency response measures. This Emergency Coordinator shall be thoroughly familiar with all aspects of the solar facility's Emergency Response/Action Plan, all operations and activities at the facility, location of all records within the facility and the facilities layout. This person shall have the authority to commit the resources needed to carry out the contingency plan. Adequate personnel and equipment shall be available to respond to emergencies and to insure compliance with the conditions of the permit.

(C) The Emergency Response/Action Plan shall be prepared in consultation with, but not be limited to, the Imperial County Fire Protection/Office of Emergency Services, County Environmental Health Services/Health Department, County Sheriff/Coroner's office, County Public Works Department, Imperial County Planning and Development Services Department, and other appropriate state and county agencies. The plan shall include a notification list of response agencies which shall be notified immediately upon the discovery of a reportable unauthorized discharge and the list shall include: Imperial Fire Protection/Office of Emergency Services, Imperial County Planning and Development Services Department, County Environmental Health Services/Health Department, County Department of Public Works (DPW), California Highway Patrol, as applicable.

(D) All employees shall be trained by classroom and hands-on training on safety procedures, maintenance programs and emergency response protocols to ensure safety and reliability in the event of an unforeseen emergency situation.

(E) The Permittee shall provide adequate safety devices against the hazard of fire and explosion for activities that involve the use and storage of flammable, explosive or highly corrosive or reactive materials as well as provide adequate fire-fighting and fire suppression equipment and using devices standard within the industry in compliance with all applicable state and local laws as determined by the Fire Chief, Office of Emergency Services.

(F) The Permittee shall implement all State and County-approved worker safety and fire protection plans and programs.

(G) Any gates on-site shall have a "knox" lock and be rapidly accessible by the Imperial Fire Protection/Office of Emergency Services.

(H) Appropriate first aid provisions for facility operations shall be made for emergency response during Project construction, operation, and maintenance activities with appropriate first aid training for Project employees.

(I) During construction, a member of each working crew shall be trained in basic first aid and supplied with necessary medical equipment to respond to emergencies as provided for in the Emergency Response/Action Plan required above.

(J) Permittee shall identify a responsible agent for emergency purposes, whose name, title, e-mail address and telephone number, which shall be provided to the County Department of Public Works, County Fire Protection/OES Department, County Environmental Health Services/Health Department, County Sheriff/Coroner's office, Imperial Irrigation District (IID), and Imperial County Planning and Development Services Department.

S-14 LAND USE IMPROVEMENTS

(A) The Permittee shall prepare an appropriate parking plan for review and approval by the County Planning and Development Services and County Public Works Department for all proposed Operation & Maintenance buildings.

(B) The Permittee shall surface with a minimum of three (3) inches of asphaltic concrete paving or material of higher quality all access drives, parking areas, and vehicular maneuvering areas from primary access to any constructed operation and maintenance buildings.

S-15 NOISE STANDARDS:

(A) During the construction period, heavy truck traffic to/from the solar facilities shall be limited to the hours between 7:00 AM and 7:00 PM.

(B) During construction, in accordance with Imperial County Noise Element of the General Plan, the noise level shall not exceed 75 dBA_{Leq} at the property boundary when averaged over an 8-hour period.

(C) During operation of the facility, the maximum permitted continuous sound level shall be not more than 45 dBA_{Leq}, as measured at the nearest residence using the "A" scale and measured with a sound level meter and associated octave band analyzer. The level may be exceeded by ten percent (10%) if the noise is intermittent and during daylight hours.

(D) Haul trucks and other engine-powered equipment shall be muffled and operated with engine exhaust brake use limited to emergencies.

S-16 ODOR CONTROL:

The Permittee shall control all odor-causing, harmful, noxious emissions to insure that quantities or air contaminants released as a result of the permitted facilities do not exceed County, State or Federal standards, nor constitute a public nuisance, per the Imperial County Land Use Ordinance, Division 13, Enforcement, Chapter 2, Abatement of Nuisances, Sections 91302.00 through 91301.02.

S-17 PLAN APPROVALS:

Permittee shall submit to the Imperial County Planning and Development Services Department, architectural, landscaping and lighting plans prior to construction of those facilities, to include painting of structures, planting of trees and/or vegetation, and shall receive all approvals prior to commencing construction of the applicable permitted facilities. Approval shall not be unreasonably withheld so long as the plans are consistent with applicable Imperial Count Land Use Ordinance requirements.

S-18 PROJECT DESIGN:

(A) All facility access and parking areas shall be constructed to the standards of the Imperial County Land Use Ordinance.

(B) All permitted activities shall provide for the minimum feasible surface land disturbance for compatibility with the existing uses wherever possible.

(C) All equipment and electrical interconnection facilities used at the solar plant facilities shall be maintained in a manner that prevents breaking, cracking, and leaking, e.g. operator staffing and training, including appropriate quality assurance procedures, with the operation of back-up or auxiliary facilities when necessary.

(D) A Storm-water Pollution Prevention Plan (SWPPP) shall be prepared for construction of the project in accordance with the requirements of the County of Imperial and the RWQCB (See S-8, Hydrology and Water Quality, Item #1).

(E) All on-site basins shall be designed and constructed under the supervision of a California-licensed Civil Engineer meeting sound engineering standards, with all applicable regulations and all requirements of the County Environmental Health Services/Health Department and Public Works Departments are compiled with.

(F) Obtain encroachment permits for any construction or operation on IID existing right of way or easements.

S-19 REPORTING AND MONITORING:

(A) The Permittee shall furnish to the County, at its sole cost within a reasonable time, any relevant reports/information which the County requires for monitoring purposes to determine whether cause exists for revoking this permit, or to determine compliance with this permit. The Permittee shall submit all required reports to the Planning Director, County Planning and Development Services Department, 801 Main Street, El Centro, CA 92243.

(B) Permittee and Imperial County Planning and Development Services Department Director shall agree upon an environmental consultant for overseeing all the required mitigation, conditional use permit conditions and public benefit agreement requirements during the construction of project.

(C) Permittee shall pay for a third party environmental consultant monitoring and compliance.

(D) The Planning and Development Services Department, in consultation with the third party Environmental Consultant and the County Executive Office, will require that all mitigation measures be satisfied, all mitigation monitoring and Reporting Program requirements have been satisfied, all Conditions of Approval in the Conditional Use Permit are in full compliance and all conditions of the Development Agreement have been satisfied before the Final Certificate of Occupancy Certificate is issued.

(E) During the operation of solar facility, an Annual Compliance Report shall be submitted to the Imperial County Planning and Development Services Department, documenting the implementation of the conditions and general measures as well as any resource-specific measures.

(F) The Permittee shall reimburse the Imperial County Planning and Development Services Department for County as well as monitoring and investigations related to the construction and operation of the Project. Permittee shall compensate the County pursuant to the Imperial County Planning & Development Services Department Fee Schedule for any costs incurred.

(G) Permittee shall pay for all costs as required to comply with the Conditions of Approval and MMRP, and shall implement all required mitigation measures as indicated in the Final Environmental Impact Report (FEIR) and Mitigation Monitoring, Reporting Program (MMRP). If mitigation measures for FEIR and MM&RP are more stringent than the conditions in this permit, the FEIR & MM&RP mitigations will be required.

(H) All County staff time will be billed on a time and materials basis. Failure by Permittee to provide any payment required of Permittee to the County in the CUP shall cause Permittee to be in non-compliance of the CUP. Upon Permittee being in such noncompliance, County may, at its sole discretion, cease processing, defending any lawsuit or paying for costs associated with the Project.

S-20 SPILLS AND RUNOFF:

The Permittee shall design and construct the permitted facilities to prevent spills from endangering adjacent properties and to prevent runoff from any source being channeled or directed in an unnatural way so as to cause erosion, siltation, or other detriments pursuant to the construction Storm Water Pollution Prevention Plan approved by the Regional Water Quality Control Board.

S-21 SOLAR FACILITIES CLOSURE AND SITE RESTORATION:

(A) Permittee shall implement the site restoration plan as outlined within the plan at the earlier of when the operation of the permitted facilities herein authorized has ceased or the term of the CUP has expired. At such time, all facilities shall be dismantled, and the lands involved restored to their pre-construction condition and available for agricultural production uses as agreed to by the Imperial County Planning and Development Services Director.

(B) Within thirty (30) days prior to ground disturbance, a decommissioning and restoration plan shall be submitted and approved by the Imperial County Planning and Development Services Director.

(C) Within thirty (30) days prior to ground disturbance, a Bond, or other acceptable surety, in the amount of the estimated site restoration financial calculations/bond, for the developed project area as specified in the [or grading plan(s) area], or other forms of security acceptable to County Counsel's office, shall be filed with the County that guarantees restoration of the land to its condition prior to the permitted solar plant development.

(D) Upon completion of such site restoration, and demonstration that the land has been restored to the agriculturally productive/farmable condition prior to the permitted solar plant development the Bond or other surety shall be released by the County.

(E) The above financial calculations/bond shall be reviewed every five (5) years in December and adjusted on January 1st to add a CPI (Los Angeles) increase by the Planning and Development Services Director. This readjustment can be made in the County's sole discretion and must be funded by the Permittee within ninety (90) calendars after notice of the additional amount of such adjustment.

S-22 PUBLIC WORKS

(A) The Permittee shall furnish a Drainage and Grading Plan/Study to provide for property grading and drainage control, which shall also include prevention of sedimentation of damage to off-site properties. The Study/Plan shall be submitted to the Department of Public Works for review and approval. The Permittee must also provide an engineering estimate for the offsite improvements to be reviewed and approved by this department. A security bond shall be required for the offsite improvements prior to the issuance of the encroachment permit. The Permittee shall implement the approved plan. Employment of the appropriate Best Management Practices (BMP's) shall be included.

(B) A Transportation Permit shall be required from road agency(s) having jurisdiction over the haul route(s) for any hauls of heavy equipment and large vehicles which impose greater then legal loads on riding surfaces, including bridges.

(C) All proposed utility poles must be installed outside the clear recovery area.

(D) All work performed with Caltrans Right of Way will require an encroachment permit.

(E) All work performed for other agencies (such as IID) shall comply with the requirements of such agencies.

(F) CUP owner shall be responsible for repairing any damage caused to the roads it utilizes per Public Works acceptance.

(G) CUP owner shall limit the Project's construction traffic on unpaved County roadways to the extent possible and utilize improved paved roadways. In the event the CUP owner's construction traffic requires the use of unpaved County roadways, the CUP owner shall mitigate those County unpaved roadways in accordance with ICAPCD 805 requirements.

(H) In addition to complying with Rule 805, if 50 vehicle trips per day (VPD) are triggered by the projects on any single County unpaved roadway, the CUP owner shall provide for the future maintenance cost of the affected roadway for the full term of the CUP which trigged the increase beyond the 50 VPD threshold.

(I) Prior to the issuance of grading permit. As each CUP may be constructed individually and independently, the CUP owner shall improve the roads as per acceptance with ICPWD. If a CUP owner has already improved the roads that will be utilized by the next CUP to start construction, then no new road improvements are required.

S-23 WASTE DISPOSAL

(A) The Permittee shall insure that all solar plant facilities waste, liquid, gas or solid, which are generated on-site shall be disposed of in compliance with appropriate local, state, and federal regulations, in effect or as subsequently duly-enacted. All solid waste debris and/or any hazardous wastes located on the Project site must be satisfactorily removed to a permitted facility prior to the commencement of grading earthen material at the site.

(B) Littering shall not be allowed. Project personnel shall not deposit or leave any food or waste in the Project area, and no biodegradable or non-biodegradable debris shall remain in the right-of-way or on the Project site following completion of construction.

(C) The Permittee shall notify the Imperial County Planning and Development Services Director thirty (30) days in advance of any directional drilling required for the construction of facility.

S-24 CALTRANS

(A) An encroachment permit shall be required for any work performed within Caltrans right-of-way. If required, any traffic control will need to

be addressed as part of Caltrans permit approval. Stoppage of traffic for placement of aerial lines, installation or removal of overhead conductors crossing a highway requires traffic control will be addressed in accordance with the Caltrans Standard Plans and the California Manual on Uniform Traffic Control Devices (MUTCD).

(B) Any work performed within Caltrans right-of-way must provide an approved final environmental document including the California Environmental Quality Act (CEQA) determination addressing any environmental impacts within the Caltrans right-of-way and any corresponding technical studies, if required. If these materials are not included with the encroachment permit application, the Permittee will be required to acquire and provide these to Caltrans before the permit application will be accepted. Identification of avoidance and/or mitigation measures will be a condition of encroachment permit approval as well as procurement of any necessary regulatory and resource agency permits.

The rest of this page is intentionally left blank.

NOW THEREFORE, County hereby issues the Conditional Use Permit #17-0001, and Permittee hereby accepts such permit upon the terms and conditions set forth herein.

IN WITNESS THEREOF, the parties hereto have executed this Agreement the day and year first written.

PERMITTEE:

4-25-19

VEGA SES, LLC
Ziad Alaywan
604 Sutter Street
Folsom, CA 95630

Date

COUNTY OF IMPERIAL, a political subdivision of the STATE OF CALIFORNIA

4/29/19

Jim Minnick, James Minnick
Director, Planning & Development Services Department

Date

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of IMPERIAL)

On April 25, 2019 before me, ESTHER GOMEZ ALEMAN, Notary Public,
Date *Here Insert Name and Title of the Officer*

personally appeared ZIAD ALATWAN
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____
Signature of Notary Public

ESTHER GOMEZ ALEMAN
Notary Public - California
Imperial County
Commission # 2181093
My Comm. Expires Feb 17, 2021

Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document
Title or Type of Document: Notarization Document Date: 4-25-19
Number of Pages: 1 Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____	Signer's Name: _____
☐ Corporate Officer — Title(s): _____	☐ Corporate Officer — Title(s): _____
☐ Partner — ☐ Limited ☐ General	☐ Partner — ☐ Limited ☐ General
☐ Individual ☐ Attorney In Fact	☐ Individual ☐ Attorney In Fact
☐ Trustee ☐ Guardian or Conservator	☐ Trustee ☐ Guardian or Conservator
☐ Other: _____	☐ Other: _____
Signer is Representing: _____	Signer is Representing: _____

©2014 National Notary Association • www.NationalNotary.org • 1-800-US NOTARY (1-800-876-6827) Item #5907

COUNTY NOTARIZATION

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA

COUNTY OF IMPERIAL} S.S.

On 04/29/2019 before me, JOSE M. HERNANDEZ a Notary Public in and for said County and State, personally appeared JAMES ALVIN MINNICK, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal

Signature Jose M. Hernandez

JOSE M. HERNANDEZ
Notary Public - California
Imperial County
Commission # 2258722
My Comm. Expires Oct 16, 2022

ATTENTION NOTARY: Although the information requested below is OPTIONAL, it could prevent fraudulent attachment of this certificate to unauthorized document.

Title or Type of Document Cup#17-0001

Number of Pages 52 Date of Document 04/29/2019

Signer(s) Other Than Named Above ZIAD ALAYWAN

S:\APN\051\360\021\BS Folder 3-26-2019\CUP\CUP 17-0001 updated per CEO PC hearing - Copy.doc

Noise Impact Assessment

Vega IID S-Line Upgrades Project

Imperial County, California

Prepared For:

Apex Energy Solutions, LLC
604 Sutter Street
Suite 250
Folsom, California 95630

February 2021

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

A-3-RE	Heavy Agriculture with a Renewable Energy Overlay
ABL	Above Ground Level
Aqueduct	Westside Main Canal

BLM	Bureau of Land Management
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
CVSS	Campo Verde Substation
dB	Decibel
dBA	Decibel is A-weighted
ECSS	El Centro Switching Station
FHWA	Federal Highway Administration
FTA	Federal Highway Administration
I-8	Interstate Highway 8
IID	Imperial Irrigation District
IVSS	Imperial Valley Substation
L_{eq}	Measure of ambient noise
OPR	Office of Planning and Research
OSHA	Federal Occupational Safety and Health Administration
OSHPD	Office of State Health Planning and Development
PPV	Peak particle velocity
Project	Vega SES 4 Solar Energy Storage Project
RMS	Root mean square
SR	State Route
WEAL	Western Electro-Acoustic Laboratory, Inc.
VSS	Vega Substation

1.0 INTRODUCTION

The Vega IID S-Line Upgrades Project (Project) proposes the replacement and upgrade of equipment associated with an approximately 18-mile span of transmission line traversing though lands in unincorporated Imperial County, the City of El Centro, and City of Imperial. This report was prepared as a comparison of predicted Project noise levels to noise standards promulgated by the County of Imperial and City of El Centro General Plan Noise Elements. The purpose of this report is to estimate Project-generated noise and to determine the level of impact the Project would have on the environment.

1.1 Project Overview

The Project proposes both the replacement and upgrade to the existing IID S-Line system, as appropriate, as well as construction of new sections or alternate route alignments connecting the Imperial Valley Substation (IVSS) to the El Centro Switching Station (ECSS). The IVSS is located 0.94 mile south of the Liebert Road/Mandrapa Road intersection and the Westside Main Canal (Aqueduct), bound by flat undisturbed lands designated as "Recreation/Open Space" in unincorporated Imperial County and Bureau of Land Management (BLM) lands. The ECSS is located in northeast El Centro on the southwestern corner of the Dogwood Road/E. Villa Avenue intersection (APN 044-430-008), bound by the IID El Centro Generating Station to the south and west, commercial/industrial land uses to the north beyond E. Villa Ave, and agricultural lands to the east beyond Dogwood Road. The Project site spans for approximately 18 miles and could potentially affect 411 acres of land during implementation. The Project is located approximately twenty miles south of the Salton Sea and 3 miles north of the United States (U.S.)/Mexico border in southcentral Imperial County (see Figure 1. Project Vicinity).

The path of the proposed Project site extends north from the IVSS in unincorporated Imperial County through open lands and over the Westside Main Canal Aqueduct and Mandrapa Road, approximately one mile northwest of the existing IVSS, before extending east 0.5 mile to Liebert Road. Traversing parallel with the west side of Liebert Road, the Project site tracks north, adjacent to solar energy generation facilities, for approximately one mile to the Liebert Road/W. Wixom Road intersection before spanning east along the north side of W. Wixom Road to Drew Road. Along the west side of Drew Road, the site extends north past more lands dedicated to solar energy generation for approximately 1.8 miles. At the Drew Road/W. Kramar Road intersection, just east of the Rio Bend RV and Golf Resort, the site jogs along the south side of W. Kramar Road approximately 1.6 miles to Brockman Road, an unpaved road that connects W. Kramar Road and Interstate 8. The Project site extends north from the W. Kramar Road/Brockman Road intersection over Interstate 8 and then over the W. Evan Hewes Highway, through approximately 2.5 miles of agricultural land, to W. Hackleman Road. The Project site then traverses east along the south side of W. Hackleman Road for approximately one mile to the W. Hackleman Road/Patrol Road/Forrester Road intersection, then spans north for 0.5 mile along the east side of Forrester Road. Next the Project site extends eastward approximately 1.5 miles to the El Centro and Imperial city limits. The site continues along a drainage channel that serves as the city limit boundaries of both the City of El Centro and City of Imperial for another 3 miles approximately. The linear Project site then jogs south for approximately one mile, along a corridor parallel and directly in between Cross Road and Dogwood Road, to E. Villa Avenue. At E. Villa Avenue the Project site spans east for approximately 0.4 mile to the ECSS on

the southwest corner of the E. Villa Avenue/Dogwood Road intersection in El Centro. (See Figure 2. Project Location.)

The Project site encompasses areas of existing S-Line alignment as well as new route areas and includes a ten-foot buffer on either side of the right-of-way (ROW). Where existing ROW is adjacent to a roadway, the Project encompasses an identical width on the opposite side of the roadway to provide flexibility in siting the proposed upgrades to the alignment. There is an existing switching station (the ECSS) with three existing substations along the alignment: Campo Verde Substation (CVSS), Vega Substation (VSS), and IVSS. The CVSS is located 0.28 miles northwest of the Liebert Road/Mandrapa Road intersection (APN 051-350-019), bound by vacant undeveloped land to the south and east designated "Agricultural" and a PV solar energy facility to the north and west in unincorporated Imperial County. The VSS is located on the southeast corner of the Vogel Road/W. Wixom Road in unincorporated Imperial County (APN 051-360-031-000), bound by agricultural lands to the south and east, a solar PV facility to the north beyond W. Wixom Road, and a single-family residential unit to the west beyond Vogel Road. The proposed transmission lines would tie into a 100-megawatt (MW) photovoltaic solar energy facility with an integrated 100 MW battery storage system, thus contributing to the reduction of fossil fuel reliance by transmitting clean renewable energy to the local population and improving the air quality that would otherwise contain higher levels of criteria air pollutants and greenhouse gas emissions from fossil fuel-sourced energy production.

1.2 Applicable Land Use Regulations

As previously described, the Project proposes the replacement and upgrade of equipment associated with an approximately 18-mile span of transmission line traversing though lands in unincorporated Imperial County and the cities of El Centro and Imperial. The unincorporated County lands traversed by the proposed Project transmission lines are made up of lands designated as "Recreation/Open Space" and "Agricultural" by the Imperial County General Plan. The area parcel for the CVSS is designated "Agricultural" and the area parcel for the VSS is also designated "Agricultural".

The portions of the proposed Project transmission lines along the northern boundary of El Centro traverse lands designated "Public", "Rural Residential", "General Commercial", "Tourist Commercial", and "Planned Industrial" in the City of El Centro General Plan. The northern boundary of El Centro is also the southern boundary of the City of Imperial, and the portions of the proposed Project transmission lines along this boundary also traverse lands designated in the City of Imperial General Plan designated as "Residential Low Medium Density", "Specific Plan", "Commercial Neighborhood", and "Rail Served Industrial". The Project area parcel for the ECSS is located within El Centro City limits and designated "Public"

1.3 Project Construction

Construction activities would primarily involve demolition of old transmission lines, erecting of 157 new transmission line poles spaced approximately 200 feet apart and stringing of new transmission line onto new and existing poles. The construction of the site is estimated to take 14 months and would begin in summer of 2021. Operating from west to east, up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another) on different phases of the proposed

Project. No additional work, with the exception of stringing new transmission lines, is expected to take place within the existing substations.

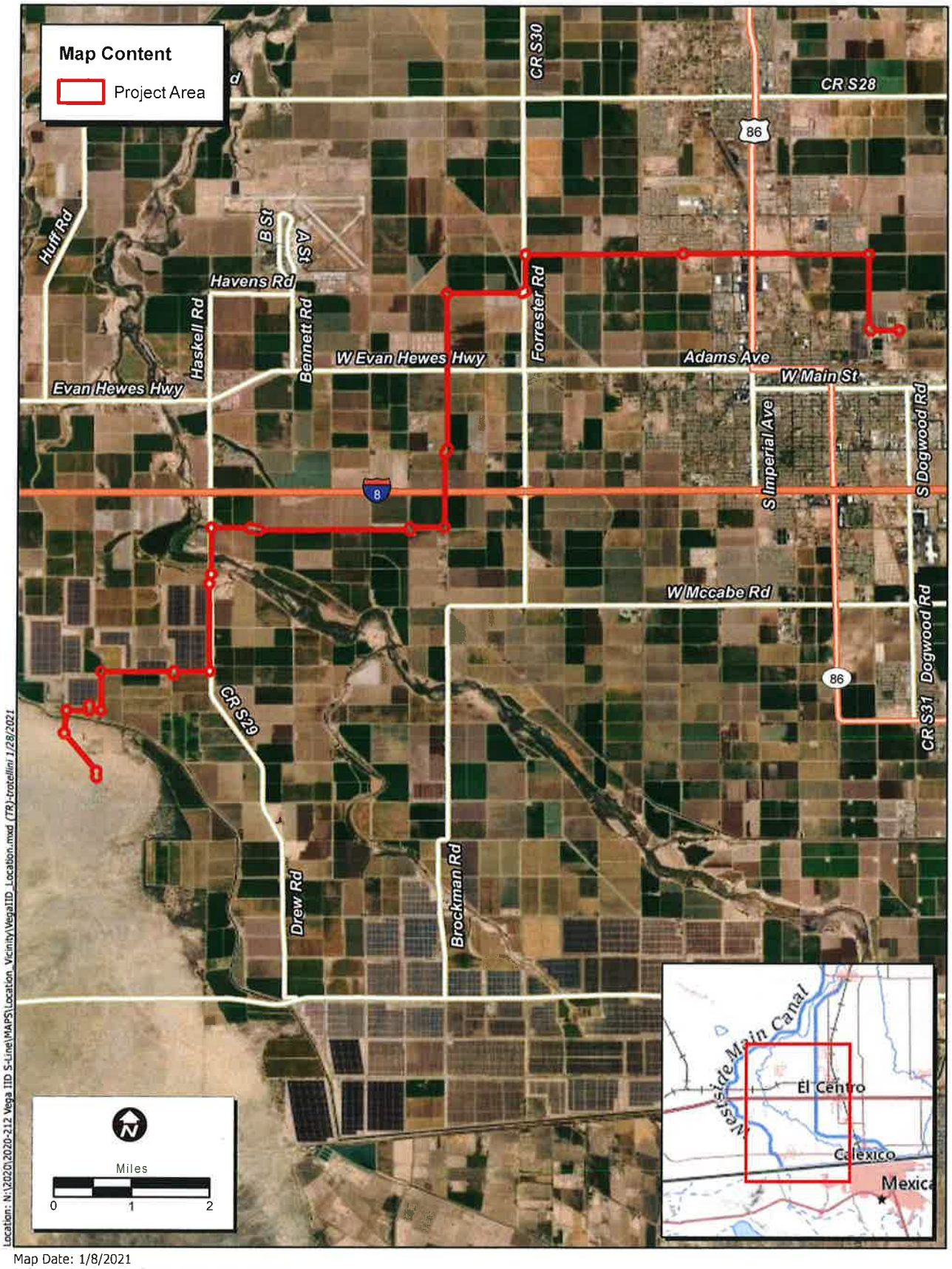
Map Date: 1/8/2021

Sources:

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Figure 1. Project Vicinity

2020-212 Vega IID S-Line



Map Date: 1/8/2021

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Figure 2. Project Location

2020-212 Vega IID S-Line

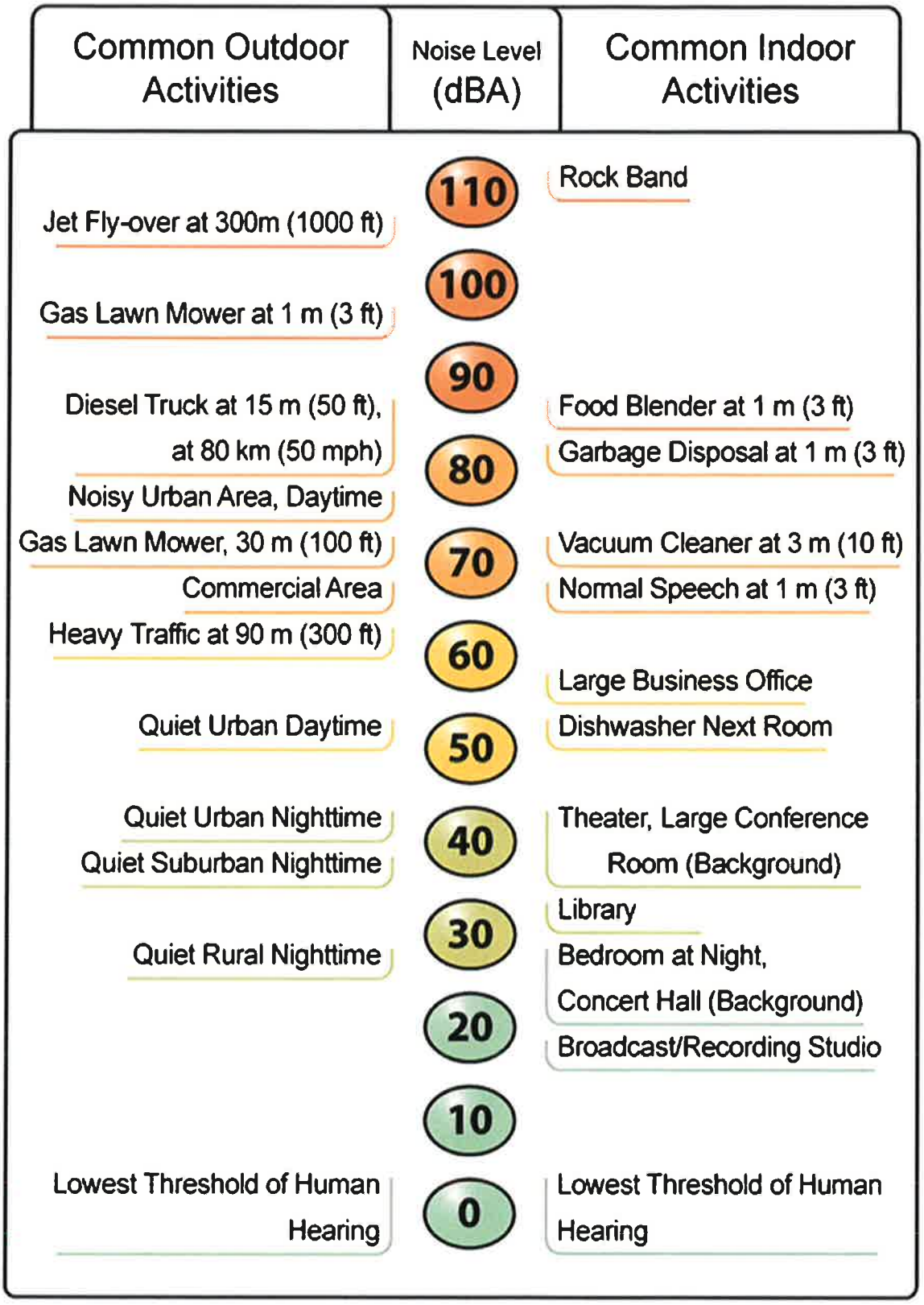
2.0 ENVIRONMENTAL NOISE AND GROUNDBORNE VIBRATION ANALYSIS

2.1 Fundamentals of Noise and Environmental Sound

2.1.1 Addition of Decibels

The decibel (dB) scale is logarithmic, not linear, and therefore sound levels cannot be added or subtracted through ordinary arithmetic. Two sound levels 10 dB apart differ in acoustic energy by a factor of 10. When the standard logarithmic decibel is A-weighted (dBA), an increase of 10 dBA is generally perceived as a doubling in loudness. For example, a 70-dBA sound is half as loud as an 80-dBA sound and twice as loud as a 60-dBA sound. When two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be three dB higher than one source under the same conditions (Federal Transit Administration [FTA] 2018). For example, a 65-dB source of sound, such as a truck, when joined by another 65 dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by three dB). Under the decibel scale, three sources of equal loudness together would produce an increase of five dB.

Typical noise levels associated with common noise sources are depicted in Figure 2. *Common Noise Levels*



Source: California Department of Transportation (Caltrans) 2020a

Figure 3. Common Noise Levels

2.1.2 *Sound Propagation and Attenuation*

Noise can be generated by a number of sources, including mobile sources such as automobiles, trucks and airplanes, and stationary sources such as construction sites, machinery, and industrial operations. Sound spreads (propagates) uniformly outward in a spherical pattern, and the sound level decreases (attenuates) at a rate of approximately six dB for each doubling of distance from a stationary or point source. Sound from a line source, such as a highway, propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of approximately three dB for each doubling of distance from a line source, such as a roadway, depending on ground surface characteristics (Federal Highway Administration [FHWA] 2011). No excess attenuation is assumed for hard surfaces like a parking lot or a body of water. Soft surfaces, such as soft dirt or grass, can absorb sound, so an excess ground-attenuation value of 1.5 dB per doubling of distance is normally assumed. For line sources, an overall attenuation rate of three dB per doubling of distance is assumed (FHWA 2011).

Noise levels may also be reduced by intervening structures; generally, a single row of detached buildings between the receptor and the noise source reduces the noise level by about five dBA (FHWA 2006), while a solid wall or berm generally reduces noise levels by 10 to 20 dBA (FHWA 2011). However, noise barriers or enclosures specifically designed to reduce site-specific construction noise can provide a sound reduction 35 dBA or greater (Western Electro-Acoustic Laboratory, Inc. [WEAL] 2000). To achieve the most potent noise-reducing effect, a noise enclosure/barrier must physically fit in the available space, must completely break the "line of sight" between the noise source and the receptors, must be free of degrading holes or gaps, and must not be flanked by nearby reflective surfaces. Noise barriers must be sizable enough to cover the entire noise source and extend lengthwise and vertically as far as feasibly possible to be most effective. The limiting factor for a noise barrier is not the component of noise transmitted through the material, but rather the amount of noise flanking around and over the barrier. In general, barriers contribute to decreasing noise levels only when the structure breaks the "line of sight" between the source and the receiver.

The manner in which older homes in California were constructed generally provides a reduction of exterior-to-interior noise levels of about 20 to 25 dBA with closed windows (Caltrans 2002). The exterior-to-interior reduction of newer residential units is generally 30 dBA or more (Harris Miller, Miller & Hanson Inc. [HMMH] 2006). Generally, in exterior noise environments ranging from 60 dBA Community Noise Equivalent Level (CNEL) to 65 dBA CNEL, interior noise levels can typically be maintained below 45 dBA, a typically residential interior noise standard, with the incorporation of an adequate forced air mechanical ventilation system in each residential building, and standard thermal-pane residential windows/doors with a minimum rating of Sound Transmission Class (STC) 28. (STC is an integer rating of how well a building partition attenuates airborne sound. In the U.S., it is widely used to rate interior partitions, ceilings, floors, doors, windows, and exterior wall configurations.) In exterior noise environments of 65 dBA CNEL or greater, a combination of forced-air mechanical ventilation and sound-rated construction methods is often required to meet the interior noise level limit. Attaining the necessary noise reduction from exterior to interior spaces is readily achievable in noise environments less than 75 dBA CNEL with proper wall construction techniques following California Building Code methods, the selections of proper windows and doors, and the incorporation of forced-air mechanical ventilation systems.

2.1.3 Noise Descriptors

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Several rating scales have been developed to analyze the adverse effect of community noise on people. Because environmental noise fluctuates over time, these scales consider that the effect of noise on people is largely dependent on the total acoustical energy content of the noise, as well as the time of day when the noise occurs. The L_{eq} is a measure of ambient noise, while the L_{dn} and CNEL (Community Noise Equivalent Level) are measures of community noise. Each is applicable to this analysis and defined in Table 2-1.

Table 2-1. Common Acoustical Descriptors

Descriptor	Definition
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micropascals (or 20 micronewtons per square meter), where 1 pascal is the pressure resulting from a force of 1 newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micropascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hertz (Hz)	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average acoustic energy content of noise for a stated period of time. Thus, the Leq of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure. For evaluating community impacts, this rating scale does not vary, regardless of whether the noise occurs during the day or the night.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	A 24-hour average Leq with a 10 dBA "weighting" added to noise during the hours of 10:00 p.m. to 7:00 a.m. to account for noise sensitivity in the nighttime. The logarithmic effect of these additions is that a 60 dBA 24-hour Leq would result in a measurement of 66.4 dBA Ldn.
Community Noise Equivalent Level, CNEL	A 24-hour average Leq with a 5 dBA "weighting" during the hours of 7:00 p.m. to 10:00 p.m. and a 10 dBA "weighting" added to noise during the hours of 10:00 p.m. to 7:00 a.m. to account for noise sensitivity in the evening and nighttime, respectively. The logarithmic effect of these additions is that a 60 dBA 24-hour Leq would result in a measurement of 66.7 dBA CNEL.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends on its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.
Decibel, dB	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.

The A weighted decibel sound level scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about ±1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends on the distance between the receptor and the noise source. Close to the noise source, the models are accurate to within about ±1 to 2 dBA.

2.1.4 Human Response to Noise

The human response to environmental noise is subjective and varies considerably from individual to individual. Noise in the community has often been cited as a health problem, not in terms of actual physiological damage, such as hearing impairment, but in terms of inhibiting general well-being and contributing to undue stress and annoyance. The health effects of noise in the community arise from interference with human activities, including sleep, speech, recreation, and tasks that demand concentration or coordination. Hearing loss can occur at the highest noise intensity levels.

Noise environments and consequences of human activities are usually well represented by median noise levels during the day or night or over a 24-hour period. Environmental noise levels are generally considered low when the CNEL is below 60 dBA, moderate in the 60 to 70 dBA range, and high above 70 dBA. Examples of low daytime levels are isolated, natural settings with noise levels as low as 20 dBA and quiet, suburban, residential streets with noise levels around 40 dBA. Noise levels above 45 dBA at night can disrupt sleep. Examples of moderate-level noise environments are urban residential or semi-commercial areas (typically 55 to 60 dBA) and commercial locations (typically 60 dBA). People may consider louder environments adverse, but most will accept the higher levels associated with noisier urban residential or residential-commercial areas (60 to 75 dBA) or dense urban or industrial areas (65 to 80 dBA). Regarding increases in A-weighted noise levels (dBA), the following relationships should be noted in understanding this analysis:

- Except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived by humans.
- Outside of the laboratory, a 3-dBA change is considered a just-perceivable difference.
- A change in level of at least 5 dBA is required before any noticeable change in community response would be expected. An increase of 5 dBA is typically considered substantial.
- A 10-dBA change is subjectively heard as an approximate doubling in loudness and would almost certainly cause an adverse change in community response.

2.1.5 Effects of Noise on People

Hearing Loss

While physical damage to the ear from an intense noise impulse is rare, a degradation of auditory acuity can occur even within a community noise environment. Hearing loss occurs mainly due to chronic exposure to excessive noise but may be due to a single event such as an explosion. Natural hearing loss associated with aging may also be accelerated from chronic exposure to loud noise.

The Occupational Safety and Health Administration (OSHA) has a noise exposure standard that is set at the noise threshold where hearing loss may occur from long-term exposures. The maximum allowable level is 90 dBA averaged over eight hours. If the noise is above 90 dBA, the allowable exposure time is correspondingly shorter.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. For ground vehicles, a noise level of about 55 dBA L_{dn} is the threshold at which a substantial percentage of people begin to report annoyance.

2.2 Fundamentals of Environmental Groundborne Vibration

2.2.1 Vibration Sources and Characteristics

Sources of earthborne vibrations include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) or manmade causes (explosions, machinery, traffic, trains, construction equipment, etc.). Vibration sources may be continuous (e.g., factory machinery) or transient (e.g., explosions).

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One is the peak particle velocity (PPV); another is the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. The RMS velocity is defined as the average of the squared amplitude of the signal. The PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration.

PPV is generally accepted as the most appropriate descriptor for evaluating the potential for building damage. For human response, however, an average vibration amplitude is more appropriate because it takes time for the human body to respond to the excitation (the human body responds to an average vibration amplitude, not a peak amplitude). Because the average particle velocity over time is zero, the RMS amplitude is typically used to assess human response. The RMS value is the average of the amplitude squared over time, typically a 1- sec. period (FTA 2018).

Table 2-2 displays the reactions of people and the effects on buildings produced by continuous vibration levels. The annoyance levels shown in the table should be interpreted with care since vibration may be found to be annoying at much lower levels than those listed, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage. In high-noise environments,

which are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

Ground vibration can be a concern in instances where buildings shake, and substantial rumblings occur. However, it is unusual for vibration from typical urban sources such as buses and heavy trucks to be perceptible. For instance, heavy-duty trucks generally generate groundborne vibration velocity levels of 0.006 PPV at 50 feet under typical circumstances, which as identified in Table 2-2 is considered very unlikely to cause damage to buildings of any type. Common sources for groundborne vibration are planes, trains, and construction activities such as earth-moving which requires the use of heavy-duty earth moving equipment.

Table 2-2. Human Reaction and Damage to Buildings for Continuous or Frequent Intermittent Vibration Levels

Peak Particle Velocity (inches/second)	Approximate Vibration Velocity Level (VdB)	Human Reaction	Effect on Buildings
0.006–0.019	64–74	Range of threshold of perception	Vibrations unlikely to cause damage of any type
0.08	87	Vibrations readily perceptible	Recommended upper level to which ruins and ancient monuments should be subjected
0.1	92	Level at which continuous vibrations may begin to annoy people, particularly those involved in vibration sensitive activities	Virtually no risk of architectural damage to normal buildings
0.2	94	Vibrations may begin to annoy people in buildings	Threshold at which there is a risk of architectural damage to normal dwellings
0.4–0.6	98–104	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Architectural damage and possibly minor structural damage

Source: Caltrans 2020b

3.0 EXISTING ENVIRONMENTAL NOISE SETTING

3.1 Noise-Sensitive Land Uses

Noise-sensitive land uses are generally considered to include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels. Additional land uses such as hospitals, historic sites, cemeteries, and certain recreation areas are considered sensitive to increases in exterior noise levels. Schools, churches, hotels, libraries, and other places where low interior noise levels are essential are also considered noise-sensitive land uses.

The nearest sensitive receptors to the Project site include a scattering of single-family residential units along the transmission line route through the unincorporated County and single-family residential neighborhoods at the southwestern corner of the City of Imperial, CA. The nearest sensitive receptors to the proposed Project are two single-family residential units in the unincorporated County approximately 50 feet from the proposed new transmission line segment on W. Hackleman Road. The nearest sensitive receptor to the component of the Project located on the boundary between El Centro and Imperial City limits is approximately 148 feet from the northernmost component of the proposed Project transmission line segment adjacent to the Central Canal.

3.2 Existing Ambient Noise Environment

The Project site consists of a mix of developed and undeveloped Agricultural, Recreation/Open Space, Public, Residential and Commercial use lands. The most common noise in the Project vicinity is produced by automotive (e.g., cars, trucks, buses, motorcycles) and agricultural vehicles (e.g., tractors, haulers, etc.) traversing the various County Roads, State Routes (SR) and Interstate Highways (I-8) along the path of the transmission lines. The main vehicular arteries within the proposed Project vicinity are SR-86, SR-111, and I-8. Traffic moving along streets produces a sound level that remains relatively constant and is part of the minimum ambient noise level in the Project vicinity. Vehicular noise varies with the volume, speed, and type of traffic. Slower traffic produces less noise than fast-moving traffic. Trucks typically generate more noise than cars. Infrequent or intermittent noise also is associated with vehicles, including sirens, vehicle alarms, slamming of doors, trains, garbage, and construction vehicle activity and honking of horns. These noises add to urban noise and are regulated by a variety of agencies.

One of the phenomena associated with high-voltage transmission lines, is Corona discharge. Corona is the electrical breakdown of the air into charged particles, which may result in audible noise. During Corona activity, the existing transmission lines within the Project site sometimes generate a small amount of sound energy. Audible noise generated by Corona discharge is typically described as a crackling or humming sound. Audible Corona noise levels for a typical 230-kV line are approximately 25 dBA at locations within approximately 25 feet of the power line corridor (Imperial County 2014).

4.0 REGULATORY FRAMEWORK

4.1 Federal

4.1.1 Occupational Safety and Health Act of 1970

OSHA regulates onsite noise levels and protects workers from occupational noise exposure. To protect hearing, worker noise exposure is limited to 90 decibels with A-weighting (dBA) over an eight-hour work shift (29 Code of Regulations 1910.95). Employers are required to develop a hearing conservation program when employees are exposed to noise levels exceeding 85 dBA. These programs include provision of hearing protection devices and testing employees for hearing loss on a periodic basis.

4.2 State

4.2.1 State of California General Plan Guidelines

The State of California regulates vehicular and freeway noise affecting classrooms, sets standards for sound transmission and occupational noise control, and identifies noise insulation standards and airport noise/land-use compatibility criteria. The State of California General Plan Guidelines (State of California 2003), published by the Governor's Office of Planning and Research (OPR), also provides guidance for the acceptability of projects within specific CNEL/L_{dn} contours. The guidelines also present adjustment factors that may be used in order to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

4.2.2 State Office of Planning and Research Noise Element Guidelines

The State OPR *Noise Element Guidelines* include recommended exterior and interior noise level standards for local jurisdictions to identify and prevent the creation of incompatible land uses due to noise. The Noise Element Guidelines contain a Land Use Compatibility table that describes the compatibility of various land uses with a range of environmental noise levels in terms of the CNEL.

4.3 Local

4.3.1 Imperial County General Plan Noise Element

The County of Imperial General Plan Noise Element establishes maximum allowable average-hourly noise limits for various land use designations (refer to Table 4-1). These noise standards are to be applied at the property line of the noise-generating land use. In instances where the adjoining land use designations differ from that of the noise-generating land use, the more restrictive noise standard shall apply. Where the ambient noise level is equal to or exceeds the property line noise standard, the increase of the existing or proposed noise shall not exceed 3 dBA L_{eq}, which is a just-perceivable increase in noise. L_{eq} is defined as the average acoustic energy content of noise for a stated period of time. Thus, the L_{eq} of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure.

Table 4-1 County of Imperial Property Line Noise Standards		
Land Use Zone	**Time Period**	**Average-Hourly Noise Level (dBA L_{eq})**
Residential	7 a.m. - 10 p.m. 10 p.m. - 7 a.m.	50 45
Multi-residential	7 a.m. - 10 p.m. 10 p.m. - 7 a.m.	55 50
Commercial	7 a.m. -10 p.m. 10 p.m. - 7 a.m.	60 55
Light Industrial/Industrial Park	Any time	70
General Industrial	Any time	75

Source: Imperial County 2015.

Notes: When the noise-generating property and the receiving property have different uses, the more restrictive standard shall apply. When the ambient noise level is equal to or exceeds the Property Line noise standard, the increase of the existing or proposed noise shall not exceed 3 dBA L_{eq}.

Significant Increase of Ambient Noise Levels

The increase of noise levels generally results in an adverse impact to the noise environment. The County Noise/Land Use Compatibility Guidelines are not intended to allow the increase of ambient noise levels up to the maximum without consideration of feasible noise reduction measures. The following guidelines are established by the County of Imperial for the evaluation of significant noise impact.

- If the future noise level after a project is completed will be within the "normally acceptable" noise levels shown in the Noise/Land Use Compatibility Guidelines, but will result in an increase of 5 dB CNEL or greater, the project will have a potentially significant noise impact and mitigation measures must be considered.
- If the future noise level after a project is completed will be greater than the "normally acceptable" noise levels shown in the Noise/Land Use Compatibility Guidelines, a noise increase of 3 dB CNEL or greater shall be considered a potentially significant noise impact and mitigation measures must be considered.

Noise-Related Land Use Compatibility

Land use compatibility defines the acceptability of a land use in a specified noise environment. When an acoustical analysis is performed, conformance of the proposed project with the Noise/Land Use Compatibility Guidelines (Table 7 in the Imperial County General Plan Noise Element) will be used to evaluate potential noise impact and will provide criteria for environmental impact findings and conditions for project approval.

Construction Noise Standards

Construction noise, from a single piece of equipment or a combination of equipment, shall not exceed 75 dB L_{eq} in unincorporated Imperial County, when averaged over an eight (8) hour period, and measured at the nearest sensitive receptor. This standard assumes a construction period, relative to an individual sensitive receptor of days or weeks. In cases of extended length construction times, the standard may be tightened so as not to exceed 75 dB L_{eq} when averaged over a one (1) hour period.

Construction equipment operation are required to be limited to the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. Saturday. No commercial construction operations are permitted on Sunday or holidays. In cases of a person constructing or modifying a residence for himself/herself, and if the work is not being performed as a business, construction equipment operations may be performed on Sundays and holidays between the hours of 9:00 a.m. and 5:00 p.m. Such non-commercial construction activities may be further restricted where disturbing, excessive, or offensive noise causes discomfort or annoyance to reasonable persons of normal sensitivity residing in an area.

4.3.2 City of El Centro General Plan Noise Element

Portions of the linear Project site span through the City of El Centro and therefore would potentially affect receptors within the City from onsite and offsite sources. The City Noise Element of the General Plan is a comprehensive program for including noise management in the planning process, providing a tool for planners to use in achieving and maintaining land uses that are compatible with existing and future environmental noise levels. The Noise Policy identifies noise-sensitive land uses and noise sources and defines areas of noise impact for the purpose of developing programs to ensure that residents in El Centro, and other noise-sensitive land uses, will be protected from excessive noise intrusion. As development proposals are submitted to the City, each is evaluated with respect to the provisions in the Noise Element to ensure that noise impacts are reduced through planning and project design. Through implementation of the policies of the Noise Element, El Centro seeks to reduce or avoid adverse noise impacts for the purposes of protecting the general health, safety, and welfare of the community.

The most basic planning strategy to minimize adverse impacts on new land uses due to noise is to avoid designating certain land uses at locations within the City that would negatively affect noise sensitive land users. Users such as schools, hospitals, child care, senior care, congregate care, churches, and all types of residential use should be located outside of any area anticipated to exceed acceptable noise levels as defined by the Land Use Compatibility Matrix, or should be protected from noise through sound attenuation measures such as site and architectural design and sound walls. The City of El Centro has adopted guidelines as a basis for planning decisions based on noise considerations. In the case that the noise levels identified at a proposed project site fall within levels considered normally acceptable, the project is considered compatible with the existing noise environment.

Additionally, the Noise Element contains goals and policies that must be used to guide decisions concerning land uses that are common sources of excessive noise levels. The following relevant and applicable goals from the City's Noise Element have been identified for the Project:

- **Noise Goal 1**: Minimize the effect of noise through proper land use planning.

Policy 1.1: Use noise/land use compatibility standards as a guide for the future planning and development decisions.

Policy 1.2: Provide noise control measures and sound attenuating construction in areas of new construction or rehabilitation.

- **Noise Goal 3**: Minimize non-transportation related noise impacts to preserve the City's overall environment.

  Policy 3.1: Reduce the impact of noise producing land uses and activities on noise sensitive land uses.

  Policy 3.3: Require mitigation measures to ensure that noise resulting from public and private construction projects is reduced to an acceptable level.

4.3.3 City of El Centro Code of Ordinances

The City's regulations with respect to noise are included in Chapter 17.1, *Noise Abatement and Control,* of the City's Code of Ordinances. This section provides exterior noise limits for the various land uses within the City. There standards are presented in Table 4-2.

Table 4-2. Exterior Noise Level Limits

Zone*	Time of Day	One-Hour Average
Single-Family Residential Zones	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	55 45
Multi-Family Residential Zones	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	55 50
Commercial, Civic and Limited Use Zones	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	60 55
Manufacturing Zones	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	75 70

Source: City of El Centro 2020

*Notes: *Zones which exists on the abutting or nearby property at whose boundary the measurement is taken. The sound level limit at a location on a boundary between two zoning districts is the arithmetic mean of the respective limits for the two districts. If the measured ambient sound level exceeds the applicable limit shown in the Table, the allowable sound level shall be the ambient noise level minus 5 dB but not less than the sound level limit specified in the Table.*

Section 17.1-8, *Construction Equipment*, states that it shall be unlawful for any person to operate construction equipment at any construction site on Sundays, and days appointed by the president, governor, or the City council for a public holiday. In addition, it shall be unlawful for any person to operate construction equipment at any construction site on Mondays through Saturdays except between the hours of 6:00 a.m. and 7:00 p.m. Additionally, no such equipment, or combination of equipment

regardless of age or date of acquisition, shall be operated so as to cause noise at a level in excess of 75 decibels for more than eight hours during any twenty-four hour period when measured at or within the property lines of any property which is developed and used either in part or in whole for residential purposes.

4.3.4 *City of Imperial General Plan Noise Element*

Portions of the linear Project site would potentially affect receptors within the City Imperial. The City's Noise Element of the General Plan provides policy direction for minimizing noise impacts on the community and for coordinating with surrounding jurisdictions and other entities regarding noise control. The City has adopted guidelines as a basis for planning decisions and in the case where the noise levels identified at a proposed project site fall within levels considered normally acceptable, the project is considered compatible with the existing noise environment. The Noise Element also includes goals, objectives, policies and implementations that are intended to achieve the vision of the Noise Element and guide the City's efforts to minimize noise-land use incompatibilities and support the health and serenity of its citizens. The goals, objectives, policies and implementations applicable to the proposed Project are listed below.

Goal N-1: Maintain the quiet rural residential nature of the community through the use of sensitive land use planning practices and appropriate noise mitigation measures.

Objective 1: The City should establish maximum noise levels for various noise-sensitive uses.

- ***Policy 1-A***: 60 dBA CNEL is established as the acceptable outdoor noise exposure level for rural single-family residential areas.

Objective 4: Noise attenuation measures should be required to reduce noise to an acceptable level.

- ***Policy 4-E:*** Noise barrier walls and berms shall be required where other noise attenuation measures fail to reduce the adverse noise levels.
- ***Policy 5-A:*** The City shall maintain a community noise ordinance to resolve noise complaints; the ordinance should address the following as a minimum:

    1. Prohibition of construction activities between the hours of 8:00 p.m. and 7:00 a.m.; however, the following zones will have the opportunity to obtain exemption:

        - General Industrial
        - Rail-Served Industrial
        - Public
        - Agriculture

5.0 IMPACT ASSESSMENT

5.1 Thresholds of Significance

The impact analysis provided below is based on the following California Environmental Quality Act Guidelines Appendix G thresholds of significance. The project would result in a significant noise-related impact if it would produce:

1) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.

2) Generation of excessive groundborne vibration or groundborne noise levels.

3) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels.

For purposes of this analysis, Project construction noise affecting receptors in the unincorporated County is compared to the County's construction noise standard of 75 dBA, when averaged over an eight (8) hour period and measured at the nearest sensitive receptor. Similarly, Project construction noise affecting receptors in the City of El Centro is compared to the City's construction noise standard of 75 dBA. The City of Imperial does not promulgate a numeric construction noise threshold, therefore, for the purposes of this analysis, Project construction noise affecting sensitive receptors in the City of Imperial is compared to a standard of 75 dBA.

5.2 Methodology

This analysis of the existing and future noise environments is based on empirical observations. Predicted construction noise levels were calculated utilizing the FHWA's Roadway Construction Model (2006). Groundborne vibration levels associated with construction-related activities for the Project have been evaluated utilizing typical groundborne vibration levels associated with construction equipment. Potential groundborne vibration impacts related to structural damage and human annoyance were evaluated, taking into account the distance from construction activities to nearby structures and typically applied criteria for structural damage and human annoyance. Project operational noise is addressed qualitatively.

5.3 Impact Analysis

5.3.1 Project Construction Noise

Would the Project Result in Short-Term Construction-Generated Noise in Excess of Standards?

Onsite Construction Noise

Construction noise associated with the proposed Project would be temporary and would vary depending on the nature of the activities being performed. Noise generated would primarily be associated with the operation of off-road equipment for onsite construction activities as well as construction vehicle traffic on area roadways. Construction noise typically occurs intermittently and varies depending on the nature or phase of construction (e.g., demolition, grading, pole erecting). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. Typical operating cycles for these types of construction equipment may involve one or two minutes of full power operation followed by three to four minutes at lower power settings. Other primary sources of acoustical disturbance would be random incidents, which would last less than one minute (such as dropping large pieces of equipment or the hydraulic movement of machinery lifts). During construction, exterior noise levels could negatively affect sensitive land uses in the vicinity of the construction site.

Nearby noise-sensitive land uses consist of a scattering of single-family residential units located within 200 feet of the proposed Project site boundary. The closest sensitive receptors are located at 50 feet from the proposed Project's new transmission line component running adjacent to W. Hackelman Road. As previously described, the County's General Plan Noise Element states construction equipment operation must be limited to the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, and 9:00 a.m. to 5:00 p.m. on Saturdays. No commercial construction operations are permitted on Sundays or holidays. Construction noise, from a single piece of equipment or a combination of equipment, must not exceed 75 dB L_{eq}, when averaged over an eight (8) hour period, and measured at the nearest sensitive receptor.

Moreover, Section 17.1-8 of the City's Code of Ordinances for the City of El Centro states that it is unlawful for any person to operate construction equipment at any construction site on Sundays, and days appointed by the president, governor, or the City council for a public holiday. In addition, it is unlawful for any person to operate construction equipment at any construction site on Mondays through Saturdays except between the hours of 6:00 a.m. and 7:00 p.m. No such equipment, or combination of equipment regardless of age or date of acquisition, is permitted to be operated so as to cause noise at a level in excess of 75 decibels for more than eight hours during any twenty-four hour period when measured at or within the property lines of any property which is developed and used either in part or in whole for residential purposes.

The City of Imperial does not promulgate a numeric construction noise threshold, therefore, for the purposes of this analysis, Project construction noise affecting sensitive receptors in the City of Imperial is compared to a standard of 75 dBA.

The anticipated short-term construction noise levels generated for the necessary construction equipment are presented in Table 5-1.

Table 5-1. Construction Average (dBA) Noise Levels at Nearest Receptors (50 Feet Distant)			
Equipment	**Estimated Exterior Construction Noise Level at Existing Residences**	**Construction Noise Standards (dBA L_{eq})**	**Exceeds Standards?**
Demolition			
Bore/Drill Rigs (2)	71.8 (each)	*75*	**No**
Cranes (3)	72.3 (each)	*75*	**No**
Bucket Trucks (6)	67.7 (each)	*75*	**No**
Air Compressors (3)	73.7 (each)	*75*	**No**
Boom Lifts (6)	67.7 (each)	*75*	**No**
Rough Terrain Forklifts (2)	79.4 (each)	*75*	**Yes**
Skid Steer Loaders (2)	75.1 (each)	*75*	**Yes**
Tractors/Loaders/Backhoes (2)	80.0 (each)	*75*	**Yes**
Water Trucks (3)	74.4 (each)	*75*	**No**
Dump Trucks (2)	72.5 (each)	*75*	**No**
Semi Tractors (4)	70.3 (each)	*75*	**No**
Off-Highway Trucks x2 dBA (4)	74.0 (each)	*75*	**No**
Off-Highway Trucks x4 dBA	77.0	*75*	**Yes**
Combined Demolition Equipment	**89.8**	*75*	**Yes**
Grading			
Bore/Drill Rigs (2)	77.4 (each)	*75*	**Yes**
Cranes (2)	72.6 (each)	*75*	**No**
Rough Terrain Forklifts (2)	79.4 (each)	*75*	**Yes**
Rubber Tired Loaders (2)	75.1 (each)	*75*	**Yes**
Skid Steer Loaders (2)	75.1 (each)	*75*	**Yes**
Combined Grading Equipment	**86.5**	*75*	**Yes**
Construction			
Bore/Drill Rigs (2)	77.4 (each)	*75*	**Yes**
Cranes (3)	72.6 (each)	*75*	**No**
Bucket Trucks (6)	67.7 (each)	*75*	**No**
Boom Lifts (6)	67.7 (each)	*75*	**No**
Air Compressors	73.7 (each)	*75*	**No**
Other Construction Equipment (6)	82.0 (each)	*75*	**No**

Table 5-1. Construction Average (dBA) Noise Levels at Nearest Receptors (50 Feet Distant)			
Equipment	**Estimated Exterior Construction Noise Level at Existing Residences**	**Construction Noise Standards (dBA L_{eq})**	**Exceeds Standards?**
Rough Terrain Forklifts (2)	79.4 (each)	*75*	**No**
Skid Steer Loaders (2)	75.1 (each)	*75*	**Yes**
Tractors/Loaders/Backhoes (2)	80.0 (each)	*75*	**Yes**
Water Trucks (3)	74.4 (each)	*75*	**No**
Dump Trucks (2)	72.5 (each)	*75*	**No**
Semi Tractors (4)	70.3 (each)	*75*	**No**
Pick-up Trucks (12)	71.0 (each)	*75*	**No**
Combined Construction	**92.9**	*75*	**Yes**

Source: Construction noise levels were calculated by ECORP Consulting using the FHWA Roadway Noise Construction Model (FHWA 2006). Refer to Attachment A for Model Data Outputs.

Notes: The nearest residences are located approximately 50 feet from the Project boundary.
Project construction-generated noise was calculated to account for equipment identified by the Project proponent (see Attachment A). Where identified Project equipment did not match the equipment list options contained in the RCNM, alternative equipment was selected.

L_{eq} = The equivalent energy noise level, is the average acoustic energy content of noise for a stated period of time. Thus, the L_{eq} of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure. For evaluating community impacts, this rating scale does not vary, regardless of whether the noise occurs during the day or the night.

As shown in Table 5-1, Project construction has the potential to exceed the significance threshold of 75 dBA at the nearest sensitive receptors. It is noted that the noise levels shown in Table 5-1 are based on a worst-case scenario in which all pieces of construction equipment are operating at the same time, at the highest level of intensity, and at 50 feet from a sensitive receptor. It is very unlikely that noise levels would reach those predicted in Table 5-1.

Mitigation is required to reduce construction noise to levels below this threshold. Noise barriers or enclosures can provide a sound reduction of 35 dBA or greater (WEAL 2000). To be effective, a noise enclosure/barrier must physically fit in the available space, must completely break the line of sight between the noise source and the receptors, must be free of degrading holes or gaps, and must not be flanked by nearby reflective surfaces. Noise barriers must be sizable enough to cover the entire noise source and extend lengthwise and vertically as far as feasibly possible to be most effective. The limiting factor for a noise barrier is not the component of noise transmitted through the material, but rather the amount of noise flanking around and over the barrier. In the case of Project construction, an enclosure/barrier would only be necessary at the area of the construction site where noise producing activities are being performed.

As such, the following mitigation is recommended.

NOI-1: In order to reduce construction noise at sensitive residential receptors within 50 feet of Project construction, a temporary noise barrier or enclosure shall be positioned between construction equipment and all residences within 50 feet of construction activities in a manner that breaks the line of sight between the construction equipment and these residences. The temporary noise barrier shall have a sound transmission class (STC) of 10 or greater in accordance with American Society for Testing and Materials Test Method E90, or at least 2 pounds per square foot to ensure adequate transmission loss characteristics. The temporary noise barrier can consist of a solid plywood fence at least 7/16-inch in thickness and/or flexible sound curtains, such as an 18-ounce tarp or a 2-inch-thick fiberglass blanket, attached to chain link fencing or some other support structure. The length, height, and location of the temporary noise barrier shall be adequate to assure proper acoustical performance. Specifically, the barrier must completely break the line of sight between construction equipment and residential properties within 50 feet of construction activity, must be free of degrading holes or gaps, and must not be flanked by nearby reflective surfaces. All noise control barrier walls shall be designed to preclude structural failure due to such factors as winds, shear, shallow soil failure, earthquakes, and erosion.

Implementation of mitigation measures NOI-1 would substantially reduce construction-generated noise levels. As previously described, noise barriers or enclosures such as that recommended in mitigation measure NOI-1 can provide a sound reduction 35 dBA or greater (WEAL 2000), which would be a reduction robust enough to maintain construction noise levels less than 75 dBA. Temporary noise barriers can consist of a solid plywood fence and/or flexible sound curtains, such as an 18-ounce tarp or a 2-inch-thick fiberglass blanket. Therefore, Project construction activities would not expose persons to and generate noise levels in excess of County standards with implementation of NOI-1.

Offsite Construction Worker Traffic Noise

Project construction would result in additional traffic on adjacent roadways over the time period that construction occurs. The number of on–site construction workers for the transmission line replacement and upgrades is not expected to require a substantial number of workers as they move from transmission line pole to pole. As previously described, the predominant vehicular arteries expected to be used during the construction phase of the proposed Project are SR-86, SR-111, and I-8. According to the California Department of Transportation (Caltrans) *Technical Noise Supplement to the Traffic Noise Analysis Protocol* (2013), doubling of traffic on a roadway is required to result in an increase of 3 dB (outside of the laboratory, a 3-dBA change is considered a just-perceivable difference). According to the Caltrans Traffic Census Program (2018), the roadway segment of SR-86 between El Dorado Avenue and Keystone Road currently accommodates 13,800 average daily trips, the roadway segment of SR-111 between Evan Hewes Hwy and Atens Road currently accommodates 22,900 average daily trips, and the roadway segment of I-8 between Drew Road and Forrester Road currently accommodates 15,900 average daily trips. Project construction would not instigate construction worker commute trips at these rates. Thus, the minimal daily trips during Project construction would not result in a doubling of traffic on these roadways, and its contribution to existing traffic noise would not be perceptible.

5.3.2 *Project Operational Noise*

Would the Project Result in a Substantial Permanent Increase in Ambient Noise Levels in Excess of County or City Standards During Operations?

As previously described, noise-sensitive land uses are locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Residences, schools, hospitals, guest lodging, libraries, and some passive recreation areas would each be considered noise-sensitive and may warrant unique measures for protection from intruding noise. The nearest sensitive receptors to the proposed Project are two single-family residential units in the unincorporated County approximately 50 feet from the proposed new transmission line segment on W. Hackleman Road. The nearest sensitive receptor to the component of the Project located on the boundary between El Centro and Imperial City limits is approximately 148 feet from the northernmost component of the proposed Project transmission line segment adjacent to the Central Canal.

Operational Offsite Traffic Noise

Project operations would result in minimal additional traffic on adjacent roadways. The only visitors to the site would be that of repair or maintenance workers, whose presence at the site would be necessary infrequently and inconsistently. According to the California Department of Transportation (Caltrans) *Technical Noise Supplement to the Traffic Noise Analysis Protocol* (2013), doubling of traffic on a roadway is required to result in an increase of 3 dB (outside of the laboratory, a 3-dBA change is considered a just-perceivable difference). The proposed Project would not result in a doubling of traffic, and therefore its contribution to existing traffic noise would not be perceptible.

Project Land Use Compatibility

Both the County, City of El Centro, and City of Imperial utilize the land use compatibility standards presented in their General Plan Noise Elements that provide a tool to gauge the compatibility of new land uses relative to existing noise levels. The compatibility standards identify acceptable noise levels for various land uses. In the case that the noise levels identified at the proposed Project site fall within the "acceptable" levels presented in the General Plans, the Project is considered compatible with the existing noise environment.

As previously stated, the Project proposes either the replacement or upgrades to the existing IID S-Line and construction of new sections or alternate route alignments connecting the IVSS to the ECSS. The operational noise impact of the proposed transmission line installation would be insubstantial and imperceivable compared to existing ambient noise levels. Thus, the proposed Project would not result in a substantial permanent increase in ambient noise levels in excess of County or City standards during operations and would not be incompatible with adjacent land uses.

Project Operations-Onsite Noise Sources

The main stationary operational noise associated with the Project would be Corona Discharge. Corona is the electrical breakdown of the air into charged particles, which may result in audible noise. During Corona activity, the transmission lines sometimes generate a small amount of sound energy. Audible noise generated by Corona discharge is typically described as a crackling or humming sound. Audible

Corona noise levels for a typical 230-kV line are approximately 25 dBA at locations within approximately 25 feet of the power line corridor (Imperial County 2014). This level of noise falls under the County, City of El Centro, and City of Imperial noise standards.

5.3.3 Project Construction Groundborne Vibration

Would the Project Expose Structures to Substantial Groundborne Vibration During Construction?

Excessive groundborne vibration impacts result from continuously occurring vibration levels. Increases in groundborne vibration levels attributable to the Project would be primarily associated with short-term construction-related activities. Construction on the Project site would have the potential to result in varying degrees of temporary groundborne vibration, depending on the specific construction equipment used and the operations involved. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance.

Construction-related ground vibration is normally associated with impact equipment such as pile drivers, jackhammers, and the operation of some heavy-duty construction equipment, such as dozers and trucks. It is noted that pile drivers would not be necessary during Project construction. Vibration decreases rapidly with distance and it is acknowledged that construction activities would occur throughout the Project site and would not be concentrated at the point closest to sensitive receptors. Groundborne vibration levels associated with typical construction equipment at 25 feet distant are summarized in Table 5-2.

Table 5-2. Representative Vibration Source Levels for Construction Equipment

Equipment Type	Peak Particle Velocity at 25 Feet (inches per second)
Large Bulldozer	0.089
Caisson Drilling	0.089
Loaded Trucks	0.076
Hoe Ram	0.089
Jackhammer	0.035
Small Bulldozer/Tractor	0.003
Vibratory Roller	0.210

Source: FTA 2018; Caltrans 2020b

Neither the County of Imperial, City of El Centro, or City of Imperial regulate vibrations associated with construction. However, a discussion of construction vibration is included for full disclosure purposes. For comparison purposes, the Caltrans (2020b) recommended standard of 0.2 inch per second PPV with respect to the prevention of structural damage for older residential buildings is used as a threshold. This is also the level at which vibrations may begin to annoy people in buildings. The nearest structure of concern to the construction site, with regard to groundborne vibrations, is a single-family residence located 50 feet south of the proposed Project new transmission line component on W. Hackelman Road.

Based on the representative vibration levels presented for various construction equipment types in Table 5-2 and the construction vibration assessment methodology published by the FTA (2018), it is possible to estimate the potential project construction vibration levels. The FTA provides the following equation:

$$[PPVequip = PPVref \times (25/D)^{1.5}]$$

Table 5-3 presents the expected Project related vibration levels at a distance of 50 feet.

Table 5-3. Construction Vibration Levels at 50 Feet

Receiver PPV Levels (in/sec)[1]					Peak Vibration	Threshold	Exceed Threshold
Large Bulldozer, Caisson Drilling & Hoe Ram	Loaded Trucks	Jackhammer	Small Bulldozer	Vibratory Roller			
0.030	0.025	0.012	0.001	0.070	**0.070**	*0.2*	**No**

Notes [1]Based on the Vibration Source Levels of Construction Equipment included on Table 5-4 (FTA 2018). Distance to the nearest structure of concern is approximately 30 feet measured from project site boundary.

As shown in Table 5-3, vibration as a result of construction activities would not exceed 0.2 PPV at the nearest structure. Thus, project construction would not exceed the recommended threshold.

5.3.4 Project Operational Groundborne Vibration

Would the Project Expose Structures to Substantial Groundborne Vibration During Operations?

Project operations would not include the use of any large-scale stationary equipment that would result in excessive vibration levels. Therefore, the project would not result groundborne vibration impacts during operations.

5.3.5 Excess Airport Noise

Would the Project Expose People Residing or Working in the Project Area to Excessive Airport Noise?

The Project site is located approximately 1.24 miles east from the Imperial County Airport in the City of Imperial. The Imperial County Airport Land Use Commission has established a set of land use compatibility criteria for lands surrounding the airports in Imperial County in the Imperial County Airport Land Use Compatibility Plan (1996). As identified in Figure 3-E of the Imperial County Airport Land Use Compatibility Maps, the proposed Project site traverses Airport Land Use Zones B2 (Extended Approach/Departure-Significant risk – aircraft commonly below 800 feet AGL [Above Ground Level] with significant noise [NLR {Noise Level Reduction} of 25 dBA in residential and office buildings]), Zone C (Common Traffic Pattern-Limited Risk – aircraft at or below 1,000 feet AGL with frequent noise intrusion), and Zone D (Other Airport Environs-Negligible risk – potential for annoyance from overflights). As previously discussed, the construction and operational phases of the proposed Project would be

temporary and short-termed, with no addition of residential land uses. Thus, excessive airport noise exposure to workers would be minimal and cease upon completion of the construction phase.

5.3.6 Cumulative Noise

Would the Project Contribute to Cumulatively Considerable Noise During Construction?

Construction activities associated with the proposed Project and other construction projects in the area may overlap, resulting in construction noise in the area. However, construction noise impacts primarily affect the areas adjacent to the construction site. Construction noise for the proposed Project was determined to be under the significance threshold following compliance with recommended mitigation. Cumulative development in the vicinity of the Project site could result in elevated construction noise levels at sensitive receptors in the Project area. However, each project would be required to comply with the applicable noise limitations on construction. Therefore, the Project would not contribute to cumulative impacts during construction.

Would the Project Contribute to Cumulatively Considerable Noise from Offsite Traffic?

As described previously, Project operations would result in extremely minimal additional traffic on adjacent roadways. The only visitors to the site would be that of repair or maintenance work that would be done very infrequently. Thus, any cumulative noise impacts from project-related traffic would be minimal.

Would the Project Contribute to Cumulatively Considerable Noise from Stationary Sources?

Cumulative noise impacts would primarily be associated with the transformers, inverters, substations, and transmission lines from the proposed Project. Long-term noise sources associated with development at the Project site, combined with other cumulative projects, could cause local noise-level increases. Noise levels associated with the proposed Project and related cumulative projects together could result in higher noise levels than considered separately. However, noise increase as a result of the Project would not exceed County or City standards.

6.0 REFERENCES

Caltrans. 2020a. IS/EA Annotated Outline. http://www.dot.ca.gov/ser/vol1/sec4/ch31ea/chap31ea.htm.

____. 2020b. Transportation and Construction Vibration Guidance Manual.

____. 2018. Traffic Census Program: 2017 Traffic Volumes. https://dot.ca.gov/programs/traffic-operations/census

____. 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol.

El Centro, City of. 2004. City of El Centro General Plan.

____. 2020. City of El Centro Code of Ordinances.

FHWA. 2011. Effective Noise Control During Nighttime Construction. Available online at: http://ops.fhwa.dot.gov/wz/workshops/accessible/schexnayder_paper.htm.

____. 2006. Roadway Construction Noise Model.

FTA. 2018. Transit Noise and Vibration Impact Assessment.

HMMH. 2006. Transit Noise and Vibration Impact Assessment, Final Report.

Imperial, County of. 2014. *Seville Solar Farm Complex Draft Environmental Impact Report.*

Imperial, County of. 2015. General Plan Noise Element.

____. 2008. General Plan Circulation and Scenic Highways Element.

____. 1996. Imperial County Airport Land Use Compatibility Plan.

OPR. 2003. State of California General Plan Guidelines.

WEAL. 2000. Sound Transmission Sound Test Laboratory Report No. TL 96-186.

LIST OF ATTACHMENTS

Attachment A - Federal Highway Administration Highway Roadway Construction Noise Outputs – Project Construction Noise

ATTACHMENT A

Federal Highway Administration Highway Roadway Construction Noise Outputs – Project Construction Noise

DATA, EQUIPMENT AND TIME ESTIMATE – General Information

Please provide all applicable data. Note that all listed equipment will be assumed to operate 8 hours daily unless otherwise indic

Provided data can be estimates. Any data not known will be supplied with modeling software defaults

Project: _Vega S-Line Transmission Line Upgrade and New Pole Installation

Land Use Type	Units/ SF
Lay Down Yard	30,000

Building Demolition

Tons of Demolished Material	
OR	
Building Square Footage	

Earthwork

Total Cut (cubic yards)	3420
Total Fill (cubic yards)	3420

Start Dates (For One Phase Projects)

Construction Activity	(Month/ Year)	Duration (Months)
Demolition (if applicable)	3/22/2022	5/31/2022
Site Preparation		
Grading	8/31/2021	1/20/2022
Construction	9/27/2021	3/21/2022
Paving		
Painting		

Start Dates (For Multi- Phase Projects)

Construction Activity	(Month/ Year)	Duration (Months)
PHASE 1		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		
PHASE 2		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		
PHASE 3		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		

Construction Equipment- Demolition

Equipment	# of Units	Model Year	
Bore/Drill Rigs	2	TBD	
Concrete/Industrial Saws			
Crane	3	2018	
Crawler Tractors			
Crushing/Processing Equip.			
Excavators			
Graders			
Off-Highway Tractors			
Off-Highway Trucks			
Other Equipment	15	2018 (newer) / Tier 4	Bucket Trucks (6), Air Compressors (3), Boom Lifts (6),
Pavers			
Paving Equipment			
Pile Drivers			
Rollers			
Rough Terrain Forklifts	2	2018 - Tier 4	
Rubber Tired Dozers			
Rubber Tired Loaders			
Scrapers			
Signal Boards			
Skid Steer Loaders	2	2018 - Tier 4	
Surfacing Equipment			
Tractors/Loaders/Backhoes	2	2018 - Tier 4	
Trenchers			
Water Trucks	3	2018	
Dump Trucks	2	2018	
Semi Tractor	4	2018	
Light Duty P/U's	12	2019 (or newer)	

Construction Equipment- Grading

Equipment	# of Units	Model Year
Bore/Drill Rigs	2	2018 - Tier 4
Concrete/Industrial Saws		
Crane	2	2018 - Tier 4
Crawler Tractors		
Crushing/Processing Equip.		
Excavators		
Graders		
Off-Highway Tractors		
Off-Highway Trucks		
Other Equipment		
Pavers		
Paving Equipment		
Pile Drivers		
Rollers		
Rough Terrain Forklifts	2	2018 - Tier 4
Rubber Tired Dozers		
Rubber Tired Loaders	2	2018 - Tier 4
Scrapers		
Signal Boards		
Skid Steer Loaders	2	2018 - Tier 4
Surfacing Equipment		
Tractors/Loaders/Backhoes		
Trenchers		

*Other Equipment: Bucket Trucks (6), Air Compressors (3), Boom Lifts (6), Drum Puller (1), Wire Puller (1), Wire Tensioner (1), & Wire Reeler (3)

Construction Equipment- Construction

Equipment	# of Units	Model Year
Bore/Drill Rigs	2	TBD
Concrete/Industrial Saws		
Crane	3	2018
Crawler Tractors		
Crushing/Processing Equip.		
Excavators		
Graders		
Off-Highway Tractors		
Off-Highway Trucks		
*Other Equipment	21	2018 (newer) / Tier 4
Pavers		
Paving Equipment		
Pile Drivers		
Rollers		
Rough Terrain Forklifts	2	2018 - Tier 4
Rubber Tired Dozers		
Rubber Tired Loaders		
Scrapers		
Signal Boards		
Skid Steer Loaders	2	2018 - Tier 4
Surfacing Equipment		
Tractors/Loaders/Backhoes	2	2018 - Tier 4
Trenchers		
Water Trucks	3	2018
Dump Trucks	2	2018
Semi Tractor	4	2018
Light Duty P/U's	12	2019 (or newer)

RCNM Equipment Equivelents
*Bucket Truck = Man Lift
*Boom Lift = Man Lift
*Skid Steer Loader = Front End Loader
*Water Trucks = Concrete pump truck
*Semi Tractor = Flat Bed Trucks
*Wire Puller, Drum Puller, Wire Tensioner, Wire Reeler = All other Equipment >5HP
*Combined 2x pickup trucks (added 3 dBA) in order to run 2 models
*Combined 4x pickup trucks (added 6 dBA) in order to run 2 models

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 2/19/2021
Case Description: Demolition Part 1

Description	**Affected Land Use**
Demolition Part 1	Residential

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Drill Rig Truck	No	20		79.1	50	0
Drill Rig Truck	No	20		79.1	50	0
Crane	No	16		80.6	50	0
Crane	No	16		80.6	50	0
Crane	No	16		80.6	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lif (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Compressor (air)	No	40		77.7	50	0
Compressor (air)	No	40		77.7	50	0
Compressor (air)	No	40		77.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0

		Calculated (dBA)	
Equipment		***Lmax**	**Leq**
Drill Rig Truck		78.8	71.8
Drill Rig Truck		78.8	71.8
Crane		80.2	72.3
Crane		80.2	72.3
Crane		80.2	72.3
Man Lift (Bucket Truck)		74.4	67.4
Man Lif (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Compressor (air)		77.7	73.7
Compressor (air)		77.7	73.7
Compressor (air)		77.7	73.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
	Total	80.2	**83.4**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 2/19/2021
Case Description: Demolition 2

Description	**Affected Land Use**
Demolition 2	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Gradall (Rough Terrain Forklifts)	No	40		83.4	50	0
Gradall (Rough Terrain Forklifts)	No	40		83.4	50	0
Front End Loader (Skid Steer Loader)	No	40		79.1	50	0
Front End Loader (Skid Steer Loader)	No	40		79.1	50	0
Tractor	No	40	84		50	0
Tractor	No	40	84		50	0
Concrete Pump Truck (Water Truck)	No	20		81.4	50	0
Concrete Pump Truck (Water Truck)	No	20		81.4	50	0
Concrete Pump Truck (Water Truck)	No	20		81.4	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0
Pick Up Truck x2	No	40		78	50	0
Pick Up Truck x2	No	40		78	50	0
Pick Up Truck x2	No	40		78	50	0
Pick Up Truck x2	No	40		78	50	0
Pick Up Truck x4	No	40		81	50	0

Calculated (dBA)

Equipment	*Lmax	Leq
Gradall (Rough Terrain Forklift)	83.4	79.4
Gradall (Rough Terrain Forklift)	83.4	79.4
Front End Loader (Skid Steer Loader)	79.1	75.1
Front End Loader (Skid Steer Loader)	79.1	75.1
Tractor	84	80
Tractor	84	80
Concrete Pump Truck (Water Truck)	81.4	74.4
Concrete Pump Truck (Water Truck)	81.4	74.4
Concrete Pump Truck (Water Truck)	81.4	74.4
Dump Truck	76.5	72.5
Dump Truck	76.5	72.5
Flat Bed Truck (Semi Tractor)	74.3	70.3
Flat Bed Truck (Semi Tractor)	74.3	70.3
Flat Bed Truck (Semi Tractor)	74.3	70.3
Flat Bed Truck (Semi Tractor)	74.3	70.3
Pick Up Truck x2	78	74
Pick Up Truck x2	78	74
Pick Up Truck x2	78	74
Pick Up Truck x2	78	74
Pick Up Truck x4	81	77
Total	84	**88.8**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 2/19/2021
Case Description: Grading

Description	**Affected Land Use**
Grading	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Auger Drill Rig	No	20		84.4	50	0
Auger Drill Rig	No	20		84.4	50	0
Crane	No	16		80.6	50	0
Crane	No	16		80.6	50	0
Gradall (Rough Terrain Forklift)	No	40		83.4	50	0
Gradall (Rough Terrain Forklift)	No	40		83.4	50	0
Front End (Rubber Tired) Loader	No	40		79.1	50	0
Front End (Rubber Tired) Loader	No	40		79.1	50	0
Front End (Rubber Tired) Loader	No	40		79.1	50	0
Front End (Rubber Tired) Loader	No	40		79.1	50	0

Calculated (dBA)

Equipment	***Lmax**	**Leq**
Auger Drill Rig	84.4	77.4
Auger Drill Rig	84.4	77.4
Crane	80.6	72.6
Crane	80.6	72.6
Gradall (Rough Terrain Forklift)	83.4	79.4
Gradall (Rough Terrain Forklift)	83.4	79.4

Front End (Rubber Tired) Loader	79.1	75.1
Front End (Rubber Tired) Loader	79.1	75.1
Front End (Rubber Tired) Loader	79.1	75.1
Front End (Rubber Tired) Loader	79.1	75.1
Total	84.4	**86.5**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 2/19/2021
Case Description: Construction Part 1

Description	**Affected Land Use**
Construction Part 1	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Auger Drill Rig	No	20		84.4	50	0
Auger Drill Rig	No	20		84.4	50	0
Crane	No	16		80.6	50	0
Crane	No	16		80.6	50	0
Crane	No	16		80.6	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Bucket Truck)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Man Lift (Boom Lift)	No	20		74.7	50	0
Compressor (air)	No	40		77.7	50	0
Compressor (air)	No	40		77.7	50	0
Compressor (air)	No	40		77.7	50	0

Calculated (dBA)

Equipment		*Lmax	Leq
Auger Drill Rig		84.4	77.4
Auger Drill Rig		84.4	77.4
Crane		80.6	72.6
Crane		80.6	72.6
Crane		80.6	72.6
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Bucket Truck)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Man Lift (Boom Lift)		74.7	67.7
Compressor (air)		77.7	73.7
Compressor (air)		77.7	73.7
Compressor (air)		77.7	73.7
	Total	84.4	**84.8**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 2/19/2021
Case Description: Construction Part 2

Description	**Affected Land Use**
Construction Part 2	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
All Other Equipment > 5 HP (Drum Puller)	No	50	85		50	0
All Other Equipment > 5 HP (Wire Puller)	No	50	85		50	0
All Other Equipment > 5 HP (Wire Tensioner)	No	50	85		50	0
All Other Equipment > 5 HP (Wire Reeler)	No	50	85		50	0
All Other Equipment > 5 HP (Wire Reeler)	No	50	85		50	0
All Other Equipment > 5 HP (Wire Reeler)	No	50	85		50	0
Gradall (Rough Terrain Forklift)	No	40		83.4	50	0
Gradall (Rough Terrain Forklift)	No	40		83.4	50	0
Front End Loader (Steer Skid Loader)	No	40		79.1	50	0
Front End Loader (Steer Skid Loader)	No	40		79.1	50	0
Tractor	No	40	84		50	0
Tractor	No	40	84		50	0
Concrete Pump Truck (Water Truck)	No	20		81.4	50	0
Concrete Pump Truck (Water Truck)	No	20		81.4	50	0
Concrete Pump Truck (Water Truck)	No	20		81.4	50	0
Dump Truck	No	40		76.5	50	0
Dump Truck	No	40		76.5	50	0
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0

Calculated (dBA)

Equipment	*Lmax	Leq
All Other Equipment > 5 HP (Drum Puller)	85	82
All Other Equipment > 5 HP (Wire Puller)	85	82
All Other Equipment > 5 HP (Wire Tensioner)	85	82
All Other Equipment > 5 HP (Wire Reeler)	85	82
All Other Equipment > 5 HP (Wire Reeler)	85	82
All Other Equipment > 5 HP (Wire Reeler)	85	82
Gradall (Rough Terrain Forklift)	83.4	79.4
Gradall (Rough Terrain Forklift)	83.4	79.4
Front End Loader (Steer Skid Loader)	79.1	75.1
Front End Loader (Steer Skid Loader)	79.1	75.1
Tractor	84	80
Tractor	84	80
Concrete Pump Truck (Water Truck)	81.4	74.4
Concrete Pump Truck (Water Truck)	81.4	74.4
Concrete Pump Truck (Water Truck)	81.4	74.4
Dump Truck	76.5	72.5
Dump Truck	76.5	72.5
Flat Bed Truck (Semi Tractor)	74.3	70.3
Flat Bed Truck (Semi Tractor)	74.3	70.3
Flat Bed Truck (Semi Tractor)	74.3	70.3
Total	85	**91.9**

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 2/19/2021
Case Description: Construction Part 3

Description	**Affected Land Use**
Construction Part 3	Residential

Description	**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Flat Bed Truck (Semi Tractor)	No	40		74.3	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0
Pickup Truck	No	40		75	50	0

Calculated (dBA)

Equipment	***Lmax**	**Leq**
Flat Bed Truck (Semi Tractor)	74.3	70.3
Pickup Truck	75	71
Pickup Truck	75	71

Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
Pickup Truck		75	71
	Total	75	**82.1**

*Calculated Lmax is the Loudest value.

Air Quality and Greenhouse Gas Emissions Assessment

Vega IID S-Line Upgrades Project

Imperial County, California

Prepared For:

Apex Energy Solutions, LLC
604 Sutter Street
Suite 250
Folsom, California 95630

February 2021

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
µg/m3	Micrograms per cubic meter; ppm = parts per million
1992 CO Plan	1992 Federal Attainment Plan for Carbon Monoxide
AB	Assembly Bill
AQMD	Air Quality Management District
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CalEEMod	California Emissions Estimator Model
Caltrans	California Department of Transportation
CAP	Climate Action Plan
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CCAA	California Clean Air Act
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
BLM	Bureau of Land Management
CVSS	Campo Verde Substation
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
County	Imperial County
DPM	Diesel particulate matter
ECSS	El Centro Switching Station

LIST OF ACRONYMS AND ABBREVIATIONS

EO	Executive Order
GHG	Greenhouse gas
GWP	Global warming potential
ICAPCD	Imperial County Air Pollution Control District
IID	Imperial Irrigation District
IVSS	Imperial Valley Substation
IPCC	Intergovernmental Panel on Climate Change
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NO_2	Nitrogen dioxide
NO_x	Nitric oxides
O_3	Ozone
PM	Particulate matter
PM_{10}	Coarse particulate matter
$PM_{2.5}$	Fine particulate matter
ppb	Parts per billion
Project	Vega IID S-Line Project
ROGs	Reactive organic gases
SB	Senate Bill
SIP	State Implementation Plan
SO_2	Sulfur dioxide
SO_x	Sulfur oxides
SR	State Route
SRA	Source receptor area
SSAB	Salton Sea Air Basin
TACs	Toxic air contaminants
USEPA	U.S. Environmental Protection Agency
VOCs	Volatile organic compounds
VMT	Vehicle Miles Traveled
VSS	Vega Substation

1.0 INTRODUCTION

This report documents the results of an assessment of both air quality and greenhouse gas (GHG) emissions completed for the Vega Imperial Irrigation District (IID) S-Line Upgrades Project (Project), which proposes the replacement and upgrade of equipment associated with an approximately 18-mile span of transmission line traversing though lands in unincorporated Imperial County, the City of El Centro, and City of Imperial. The purpose of this assessment is to estimate Project-generated criteria air pollutants and GHG emissions attributable to the Project and to determine the level of impact the Project would have on the environment. This assessment was prepared using methodologies and assumptions recommended in the rules and regulations promulgated by the Imperial County Air Pollution Control District (ICAPCD). Regional and local existing conditions are presented, along with pertinent emissions standards and regulations.

1.1 Project Overview

The Project proposes both the replacement and upgrade to the existing IID S-Line system, as appropriate, as well as construction of new sections or alternate route alignments connecting the Imperial Valley Substation (IVSS) to the El Centro Switching Station (ECSS). The IVSS is located 0.94 mile south of the Liebert Road/Mandrapa Road intersection and the Westside Main Canal (Aqueduct), bound by flat undisturbed lands designated as "Recreation/Open Space" in unincorporated Imperial County and Bureau of Land Management (BLM) lands. The ECSS is located in northeast El Centro on the southwestern corner of the Dogwood Road/E. Villa Avenue intersection (APN 044-430-008), bound by the IID El Centro Generating Station to the south and west, commercial/industrial land uses to the north beyond E. Villa Ave, and agricultural lands to the east beyond Dogwood Road. The Project site spans for approximately 18 miles and could potentially affect 411 acres of land during implementation. The Project is located approximately twenty miles south of the Salton Sea and 3 miles north of the United States (U.S.)/Mexico border in southcentral Imperial County (see Figure 1. *Project Vicinity*).

The path of the proposed Project site extends north from the IVSS in unincorporated Imperial County through open lands and over the Westside Main Canal Aqueduct and Mandrapa Road, approximately one mile northwest of the existing IVSS, before extending east 0.5 mile to Liebert Road. Traversing parallel with the west side of Liebert Road, the Project site tracks north, adjacent to solar energy generation facilities, for approximately one mile to the Liebert Road/W. Wixom Road intersection before spanning east along the north side of W. Wixom Road to Drew Road. Along the west side of Drew Road, the site extends north past more lands dedicated to solar energy generation for approximately 1.8 miles. At the Drew Road/W. Kramar Road intersection, just east of the Rio Bend RV and Golf Resort, the site jogs along the south side of W. Kramar Road approximately 1.6 miles to Brockman Road, an unpaved road that connects W. Kramar Road and Interstate 8. The Project site extends north from the W. Kramar Road/Brockman Road intersection over Interstate 8 and then over the W. Evan Hewes Highway, through approximately 2.5 miles of agricultural land, to W. Hackleman Road. The Project site then traverses east along the south side of W. Hackleman Road for approximately one mile to the W. Hackleman Road/Patrol Road/Forrester Road intersection, then spans north for 0.5 mile along the east side of Forrester Road. Next the Project site extends eastward approximately 1.5 miles to the El Centro and Imperial city limits.

The site continues along a drainage channel that serves as the city limit boundaries of both the City of El Centro and City of Imperial for another 3 miles approximately. The linear Project site then jogs south for approximately one mile, along a corridor parallel and directly in between Cross Road and Dogwood Road, to E. Villa Avenue. At E. Villa Avenue the Project site spans east for approximately 0.4 mile to the ECSS on the southwest corner of the E. Villa Avenue/Dogwood Road intersection in El Centro. (See Figure 2. *Project Location.*)

The Project site encompasses areas of existing S-Line alignment as well as new route areas and includes a ten-foot buffer on either side of the right-of-way (ROW). Where existing ROW is adjacent to a roadway, the Project encompasses an identical width on the opposite side of the roadway to provide flexibility in siting the proposed upgrades to the alignment. There is an existing switching station (the ECSS) with three existing substations along the alignment: Campo Verde Substation (CVSS), Vega Substation (VSS), and IVSS. The CVSS is located 0.28 miles northwest of the Liebert Road/Mandrapa Road intersection (APN 051-350-019), bound by vacant undeveloped land to the south and east designated "Agricultural" and a PV solar energy facility to the north and west in unincorporated Imperial County. The VSS is located on the southeast corner of the Vogel Road/W. Wixom Road in unincorporated Imperial County (APN 051-360-031-000), bound by agricultural lands to the south and east, a solar PV facility to the north beyond W. Wixom Road, and a single-family residential unit to the west beyond Vogel Road. The proposed transmission lines would tie into a 100-megawatt (MW) photovoltaic solar energy facility with an integrated 100 MW battery storage system, thus contributing to the reduction of fossil fuel reliance by transmitting clean renewable energy to the local population and improving the air quality that would otherwise contain higher levels of criteria air pollutants and greenhouse gas emissions from fossil fuel-sourced energy production.

1.2 Applicable Land Use Regulations

As previously described, the Project proposes the replacement and upgrade of equipment associated with an approximately 18-mile span of transmission line traversing though lands in unincorporated Imperial County and the cities of El Centro and Imperial. The unincorporated County lands traversed by the proposed Project transmission lines are made up of lands designated as "Recreation/Open Space" and "Agricultural" by the Imperial County General Plan. The area parcel for the CVSS is designated "Agricultural" and the area parcel for the VSS is also designated "Agricultural".

The portions of the proposed Project transmission lines along the northern boundary of El Centro traverse lands designated "Public", "Rural Residential", "General Commercial", "Tourist Commercial", and "Planned Industrial" in the City of El Centro General Plan. The northern boundary of El Centro is also the southern boundary of the City of Imperial, and the portions of the proposed Project transmission lines along this boundary also traverse lands designated in the City of Imperial General Plan designated as "Residential Low Medium Density", "Specific Plan", "Commercial Neighborhood", and "Rail Served Industrial". The Project area parcel for the ECSS is located within El Centro City limits and designated "Public"

1.3 Project Construction

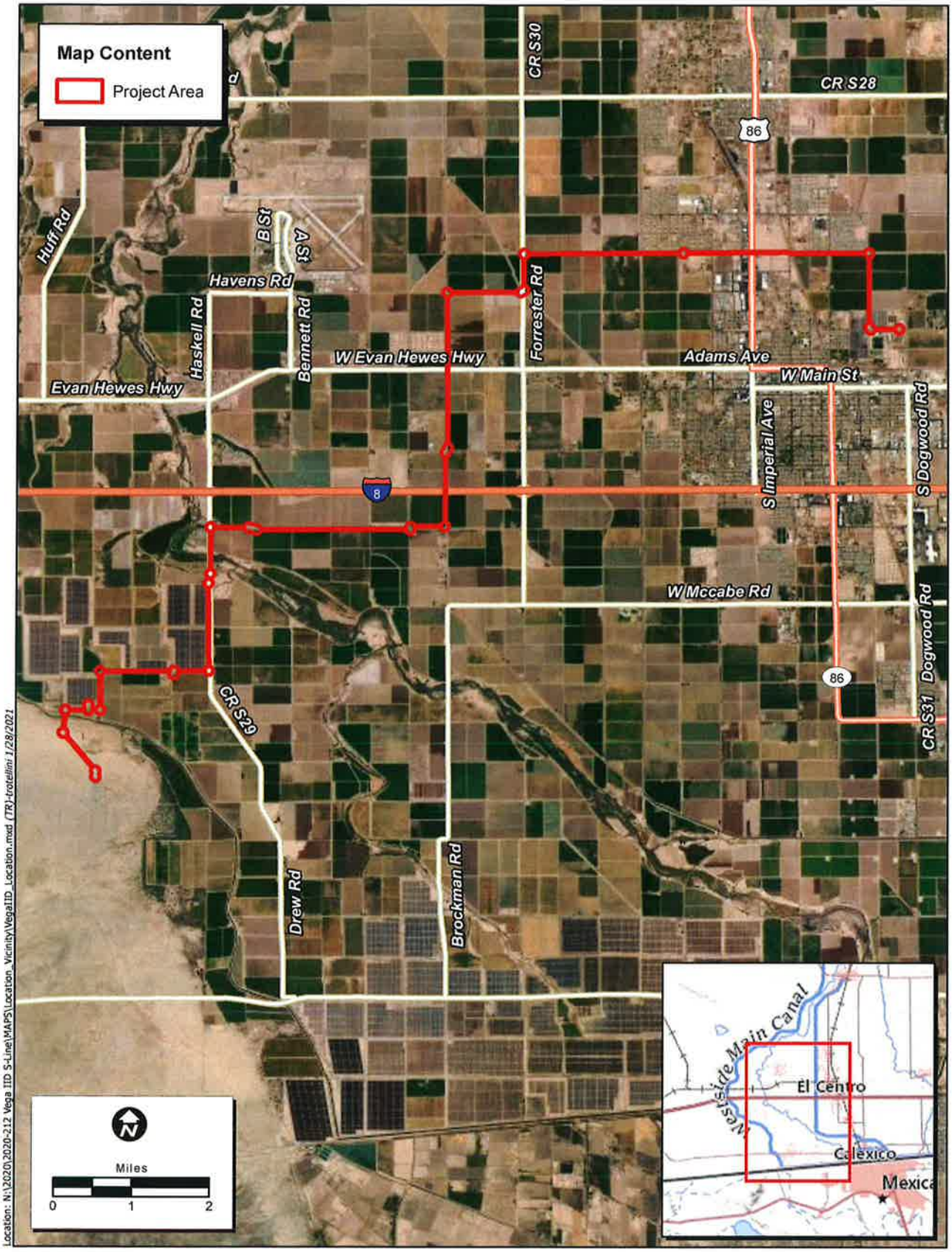
Construction activities would primarily involve demolition of old transmission lines, erecting of 157 new transmission line poles spaced approximately 200 feet apart and stringing of new transmission line onto new and existing poles. The construction of the site is estimated to take 14 months and would begin in summer of 2021. Operating from west to east, up to 8 crews would be working in pairs (2 crews working simultaneously on two separate poles adjacent to one another) on different phases of the proposed Project. No additional work, with the exception of stringing new transmission lines, is expected to take place within the existing substations.

Map Date: 1/8/2021
Sources:

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Figure 1. Project Vicinity

2020-212 Vega IID S-Line



Map Date: 1/8/2021

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Figure 2. Project Location

2020-212 Vega IID S-Line

2.0 AIR QUALITY

2.1 Air Quality Setting

Air quality in a region is determined by its topography, meteorology, and existing air pollutant sources. These factors are discussed below, along with the current regulatory structure that applies to the Salton Sea Air Basin (SSAB), which encompasses the Project site, pursuant to the regulatory authority of the ICAPCD.

Ambient air quality is commonly characterized by climate conditions, the meteorological influences on air quality, and the quantity and type of pollutants released. The air basin is subject to a combination of topographical and climatic factors that reduce the potential for high levels of regional and local air pollutants. The following section describes the pertinent characteristics of the air basin and provides an overview of the physical conditions affecting pollutant dispersion in the Project area.

2.1.1 Salton Sea Air Basin

The California Air Resources Board (CARB) divides the State into air basins that share similar meteorological and topographical features. Imperial County, which extends over 4,482 square miles in the southeastern corner of California, lies in the SSAB, which also encompasses the Imperial Valley and the central part of Riverside County, including the Coachella Valley. The province is characterized by the large-scale sinking and warming of air within the semi-permanent subtropical high-pressure center over the Pacific Ocean. The elevation in Imperial County ranges from about 230 feet below sea level in the Salton Sea to more than 2,800 feet on the mountain summits to the east.

Temperature and Precipitation

The flat terrain near the Salton Sea, intense heat from the sun during the day, and strong radiational cooling at night create deep convective thermals during the daytime and equally strong surface-based temperature inversions at night. The temperature inversions and light nighttime winds trap any local air pollution emissions near the ground. The area is subject to frequent hazy conditions at sunrise, followed by rapid daytime dissipation as winds pick up and the temperature warms. The lack of clouds and atmospheric moisture creates strong diurnal and seasonal temperature variations ranging from an average summer maximum of 108 degrees Fahrenheit (° F) down to a winter morning minimum of 38° F. The most pleasant weather occurs from about mid-October to early May when daily highs are in the 70s and 80s with very infrequent cloudiness or rainfall. Imperial County experiences rainfall on an average of only four times per year (>0.10 inches in 24 hours). The local area usually has three days of rain in winter and one thunderstorm day in August. The annual rainfall in this region is less than three inches per year (ICAPCD 2010).

Wind

Winds in the area are driven by a complex pattern of local, regional and global forces, but primarily reflect the temperature difference between the cool ocean to the west and the heated interior of the entire desert southwest. For much of the year, winds flow predominantly from the west to the east. In summer,

intense solar heating in the Imperial Valley creates a more localized wind pattern, as air comes up from the southeast via the Gulf of California. During periods of strong solar heating and intense convection, turbulent motion creates good mixing and low levels of air pollution. However, even strong turbulent mixing is insufficient to overcome the limited air pollution controls on sources in the Mexicali, Mexico area. Imperial County is predominately agricultural land. This is a factor in the cumulative air quality of the SSAB. The agricultural production generates dust and small particulate matter through the use of agricultural equipment on unpaved roads, land preparation, and harvest practices. The Imperial County experiences unhealthful air quality from photochemical smog and from dust due to extensive surface disturbance and the very arid climate (ICAPCD 2010).

Inversion

The entire county is affected by inversion layers, where warm air overlays cooler air. Inversion layers trap pollutants close to the ground. In the winter, these pollutant-trapping, ground-based inversions are formed during windless, clear-sky conditions, as cold air collects in low-lying areas such as valleys and canyons. Imperial County experiences surface inversions almost every day of the year. Due to strong surface heating, these inversions are usually broken allowing pollutants to be more easily dispersed (ICAPCD 2010).

2.1.2 Criteria Air Pollutants

Criteria air pollutants are defined as those pollutants for which the federal and state governments have established air quality standards for outdoor or ambient concentrations to protect public health with a determined margin of safety. Ozone (O_3), coarse particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$) are generally considered to be regional pollutants because they or their precursors affect air quality on a regional scale. Pollutants such as carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) are considered to be local pollutants because they tend to accumulate in the air locally. PM is also considered a local pollutant. Health effects commonly associated with criteria pollutants are summarized in Table 2-1.

Table 2-1. Criteria Air Pollutants- Summary of Common Sources and Effects

Pollutant	Major Manmade Sources	Human Health & Welfare Effects
CO	An odorless, colorless gas formed when carbon in fuel is not burned completely; a component of motor vehicle exhaust.	Reduces the ability of blood to deliver oxygen to vital tissues, effecting the cardiovascular and nervous system. Impairs vision, causes dizziness, and can lead to unconsciousness or death.
NO_2	A reddish-brown gas formed during fuel combustion for motor vehicles, energy utilities and industrial sources.	Respiratory irritant; aggravates lung and heart problems. Precursor to ozone and acid rain. Causes brown discoloration of the atmosphere.
O_3	Formed by a chemical reaction between reactive organic gases (ROGs) and nitrous oxides (N_2O) in the presence of sunlight. Common sources of these precursor pollutants include motor vehicle exhaust, industrial emissions, solvents, paints and landfills.	Irritates and causes inflammation of the mucous membranes and lung airways; causes wheezing, coughing and pain when inhaling deeply; decreases lung capacity; aggravates lung and heart problems. Damages plants; reduces crop yield.
PM_{10} & $PM_{2.5}$	Power plants, steel mills, chemical plants, unpaved roads and parking lots, wood-burning stoves and fireplaces, automobiles and others.	Increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. Impairs visibility (haze).
SO_2	A colorless, nonflammable gas formed when fuel containing sulfur is burned. Examples are refineries, cement manufacturing, and locomotives.	Respiratory irritant. Aggravates lung and heart problems. Can damage crops and natural vegetation. Impairs visibility.

Source: California Air Pollution Control Officers Association (CAPCOA 2013)

Carbon Monoxide

CO in the urban environment is associated primarily with the incomplete combustion of fossil fuels in motor vehicles. CO combines with hemoglobin in the bloodstream and reduces the amount of oxygen that can be circulated through the body. High CO concentrations can cause headaches, aggravate cardiovascular disease and impair central nervous system functions. CO concentrations can vary greatly over comparatively short distances. Relatively high concentrations of CO are typically found near crowded intersections and along heavy roadways with slow moving traffic. Even under the most severe meteorological and traffic conditions, high concentrations of CO are limited to locations within relatively short distances of the source. Overall CO emissions are decreasing as a result of the Federal Motor Vehicle Control Program, which has mandated increasingly lower emission levels for vehicles manufactured since 1973. CO levels in the SSAB are in compliance with the state and federal one- and eight-hour standards.

Nitrogen Oxides

Nitrogen gas comprises about 80 percent of the air and is naturally occurring. At high temperatures and under certain conditions, nitrogen can combine with oxygen to form several different gaseous compounds collectively called nitric oxides (NO_x). Motor vehicle emissions are the main source of NO_x in urban areas. NO_x is very toxic to animals and humans because of its ability to form nitric acid with water in the eyes, lungs, mucus membrane, and skin. In animals, long-term exposure to NO_x increases susceptibility to respiratory infections, and lowering resistance to such diseases as pneumonia and

influenza. Laboratory studies show that susceptible humans, such as asthmatics, who are exposed to high concentrations can suffer from lung irritation or possible lung damage. Precursors of NO_x, such as NO and NO_2, attribute to the formation of O_3 and $PM_{2.5}$. Epidemiological studies have also shown associations between NO_2 concentrations and daily mortality from respiratory and cardiovascular causes and with hospital admissions for respiratory conditions.

Ozone

O_3 is a secondary pollutant, meaning it is not directly emitted. It is formed when volatile organic compounds (VOCs) or ROGs and NO_x undergo photochemical reactions that occur only in the presence of sunlight. The primary source of ROG emissions is unburned hydrocarbons in motor vehicle and other internal combustion engine exhaust. NO_x forms as a result of the combustion process, most notably due to the operation of motor vehicles. Sunlight and hot weather cause ground-level O_3 to form. Ground-level O_3 is the primary constituent of smog. Because O_3 formation occurs over extended periods of time, both O_3 and its precursors are transported by wind and high O_3 concentrations can occur in areas well away from sources of its constituent pollutants.

People with lung disease, children, older adults, and people who are active can be affected when O_3 levels exceed ambient air quality standards. Numerous scientific studies have linked ground-level O_3 exposure to a variety of problems including lung irritation, difficult breathing, permanent lung damage to those with repeated exposure, and respiratory illnesses.

Particulate Matter

PM includes both aerosols and solid particulates of a wide range of sizes and composition. Of concern are those particles smaller than or equal to 10 microns in diameter size (PM_{10}) and small than or equal to 2.5 microns in diameter ($PM_{2.5}$). Smaller particulates are of greater concern because they can penetrate deeper into the lungs than larger particles. PM_{10} is generally emitted directly as a result of mechanical processes that crush or grind larger particles or form the resuspension of dust, typically through construction activities and vehicular travel. PM_{10} generally settles out of the atmosphere rapidly and is not readily transported over large distances. $PM_{2.5}$ is directly emitted in combustion exhaust and is formed in atmospheric reactions between various gaseous pollutants, including NO_x, sulfur oxides (SO_x) and VOCs. $PM_{2.5}$ can remain suspended in the atmosphere for days and/or weeks and can be transported long distances.

The principal health effects of airborne PM are on the respiratory system. Short-term exposure of high $PM_{2.5}$ and PM_{10} levels are associated with premature mortality and increased hospital admissions and emergency room visits. Long-term exposure is associated with premature mortality and chronic respiratory disease. According to the U.S. Environmental Protection Agency (USEPA), some people are much more sensitive than others to breathing PM_{10} and $PM_{2.5}$. People with influenza, chronic respiratory and cardiovascular diseases, and the elderly may suffer worse illnesses; people with bronchitis can expect aggravated symptoms; and children may experience decline in lung function due to breathing in PM_{10} and $PM_{2.5}$. Other groups considered sensitive include smokers and people who cannot breathe well through their noses. Exercising athletes are also considered sensitive because many breathe through their mouths.

2.1.3 Toxic Air Contaminants

In addition to the criteria pollutants discussed above, toxic air contaminants (TACs) are another group of pollutants of concern. TACs are considered either carcinogenic or noncarcinogenic based on the nature of the health effects associated with exposure to the pollutant. For regulatory purposes, carcinogenic TACs are assumed to have no safe threshold below which health impacts would not occur, and cancer risk is expressed as excess cancer cases per one million exposed individuals. Noncarcinogenic TACs differ in that there is generally assumed to be a safe level of exposure below which no negative health impact is believed to occur. These levels are determined on a pollutant-by-pollutant basis.

There are many different types of TACs, with varying degrees of toxicity. Sources of TACs include industrial processes such as petroleum refining and chrome plating operations, commercial operations such as gasoline stations and dry cleaners, and motor vehicle exhaust. Additionally, diesel engines emit a complex mixture of air pollutants composed of gaseous and solid material. The solid emissions in diesel exhaust are known as diesel particulate matter (DPM). In 1998, California identified DPM as a TAC based on its potential to cause cancer, premature death, and other health problems (e.g., asthma attacks and other respiratory symptoms). Those most vulnerable are children (whose lungs are still developing) and the elderly (who may have other serious health problems). Overall, diesel engine emissions are responsible for the majority of California's known cancer risk from outdoor air pollutants. Public exposure to TACs can result from emissions from normal operations, as well as from accidental releases of hazardous materials during upset conditions. The health effects of TACs include cancer, birth defects, neurological damage, and death.

Diesel Exhaust

Most recently, CARB identified DPM as a TAC. DPM differs from other TACs in that it is not a single substance but rather a complex mixture of hundreds of substances. Diesel exhaust is a complex mixture of particles and gases produced when an engine burns diesel fuel. DPM is a concern because it causes lung cancer; many compounds found in diesel exhaust are carcinogenic. DPM includes the particle-phase constituents in diesel exhaust. The chemical composition and particle sizes of DPM vary between different engine types (heavy-duty, light-duty), engine operating conditions (idle, accelerate, decelerate), fuel formulations (high/low sulfur fuel), and the year of the engine (USEPA 2002). Some short-term (acute) effects of diesel exhaust include eye, nose, throat, and lung irritation, and diesel exhaust can cause coughs, headaches, light-headedness, and nausea. DPM poses the greatest health risk among the TACs; due to their extremely small size, these particles can be inhaled and eventually trapped in the bronchial and alveolar regions of the lung.

Total Organic Gases

Total organic gases (TOG) emissions are compounds of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate. Specifically, TOG emissions include all organic gas compounds emitted to the atmosphere, including the low reactivity compounds (methane, ethane, various chlorinated fluorocarbons, acetone, perchloroethylene, volatile methyl siloxanes, etc.). TOG emissions also include low volatility or "low vapor pressure" organic

compounds (e.g., some petroleum distillate mixtures). TOG includes all organic compounds that can become airborne (through evaporation, sublimation, as aerosols, etc.), excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate.

Various subsets of TOG cause headaches, dizziness, upper respiratory tract irritation, nausea, and cancer. Vehicular traffic traveling on area roadways, such as North Marina Drive, are sources of TOG.

2.1.4 Asbestos

The term "asbestos" describes naturally occurring fibrous minerals found in certain types of rock formations. It is a mineral compound of silicon, oxygen, hydrogen, and various metal cations. When mined and processed, asbestos is typically separated into very thin fibers. When these fibers are present in the air, they are normally invisible to the naked eye. Once airborne, asbestos fibers can cause serious health problems. If inhaled, asbestos fibers can impair normal lung functions, and increase the risk of developing lung cancer, mesothelioma, or asbestosis.

Naturally-occurring asbestos, which was identified as a TAC in 1986 by CARB, is located in many parts of California and is commonly associated with ultramafic rock. The Project site is not located in an area of known or suspected naturally-occurring asbestos (DOC 2000).

2.1.5 Ambient Air Quality

Ambient air quality at the project site can be inferred from ambient air quality measurements conducted at nearby air quality monitoring stations. CARB maintains more than 60 monitoring stations throughout California. O_3, PM_{10} and $PM_{2.5}$ are the pollutant species most potently affecting the Project region. As described in detail below, the region is designated as a nonattainment area for the federal O_3, PM_{10} and $PM_{2.5}$ standards and is also a nonattainment area for the state standards for O_3 and PM_{10} (CARB 2019). The El Centro air quality monitoring station, located at 150 9th Street approximately 10.26 miles northeast of the IVSS and 1.65 miles southwest of the ECSS, monitors ambient concentrations of O_3, $PM_{2.5}$ and PM_{10}. Ambient emission concentrations will vary due to localized variations in emission sources and climate and should be considered "generally" representative of ambient concentrations in the project area.

Table 2-2 summarizes the published data concerning O_3, $PM_{2.5}$ and PM_{10} since 2017 for each year that the monitoring data is provided.

Table 2-2. Summary of Ambient Air Quality Data

Pollutant Standards	2017	2018	2019
O_3			
Max 1-hour concentration (ppm)	0.110	0.102	0.080
Max 8-hour concentration (ppm) (federal/state)	0.092 / 0.092	0.090 / 0.090	0.071 / 0.071
Number of days above 1-hour standard (federal/state)	0 / 4	0 / 2	0 / 0
Number of days above 8-hour standard (federal/state)	17 / 17	14 / 15	1 / 1
PM_{10}			
Max 24-hour concentration (µg/m3) (federal/state)	23.2 / 23.2	22.4 / 22.4	21.4 / 21.4
Number of days above federal 24-hour standard	0.0	0.0	0.0
$PM_{2.5}$			
Max 24-hour concentration (µg/m3) (federal/state)	268.5 / 186.4	256.3 / 253.0	123.9 / 130.0
Number of days above 24-hour standard (federal/state)	5.0 / *	5.1 / 113.0	0.0 / 53.7

Source: CARB 2020a
$\mu g/m^3$ = micrograms per cubic meter; ppm = parts per million
* = Insufficient data available

The USEPA and CARB designate air basins or portions of air basins and counties as being in "attainment" or "nonattainment" for each of the criteria pollutants. Areas that do not meet the standards are classified as nonattainment areas. The National Ambient Air Quality Standards (NAAQS) (other than O_3, PM_{10} and $PM_{2.5}$ and those based on annual averages or arithmetic mean) are not to be exceeded more than once per year. The NAAQS for O_3, PM_{10}, and $PM_{2.5}$ are based on statistical calculations over one- to three-year periods, depending on the pollutant. The California Ambient Air Quality Standards (CAAQS) are not to be exceeded during a three-year period. The attainment status for the portion of the SSAB encompassing the Project site is included in Table 2-3.

Table 2-3. Attainment Status of Criteria Pollutants in the Imperial County Portion of the SSAB

Pollutant	State Designation	Federal Designation
O_3	Nonattainment	Nonattainment
PM_{10}	Nonattainment	Nonattainment
$PM_{2.5}$	Attainment	Nonattainment
CO	Attainment	Unclassified/Attainment
NO_2	Attainment	Unclassified/Attainment
SO_2	Attainment	Unclassified/Attainment

Source: CARB 2019

The determination of whether an area meets the state and federal standards is based on air quality monitoring data. Some areas are unclassified, which means there is insufficient monitoring data for determining attainment or nonattainment. Unclassified areas are typically treated as being in attainment. Because the attainment/nonattainment designation is pollutant-specific, an area may be classified as nonattainment for one pollutant and attainment for another. Similarly, because the state and federal standards differ, an area could be classified as attainment for the federal standards of a pollutant and as nonattainment for the state standards of the same pollutant. The region incorporating the Project site is designated as a nonattainment area for the federal O_3, $PM_{2.5}$ and PM_{10} standards and is also a nonattainment area for the state standards for O_3 and PM_{10} (CARB 2019).

2.1.6 Sensitive Receptors

Sensitive receptors are defined as facilities or land uses that include members of the population who are particularly sensitive to the effects of air pollutants, such as children, the elderly, and people with illnesses. Examples of these sensitive receptors are residences, schools, hospitals, and daycare centers. CARB has identified the following groups of individuals as the most likely to be affected by air pollution: the elderly over 65, children under 14, athletes, and persons with cardiovascular and chronic respiratory diseases such as asthma, emphysema, and bronchitis.

The nearest sensitive receptors to the Project site include a scattering of single-family residential units along the transmission line route through the unincorporated County and single-family residential neighborhoods at the southwestern corner of the City of Imperial, CA. The nearest sensitive receptors to the proposed Project are two single-family residential units in the unincorporated County approximately 50 feet from the proposed new transmission line segment on W. Hackleman Road. The nearest sensitive receptor to the component of the Project located on the boundary between El Centro and Imperial City limits is approximately 148 feet from the northernmost component of the proposed Project transmission line segment adjacent to the Central Canal.

2.2 Regulatory Framework

2.2.1 Federal

Clean Air Act

The Clean Air Act (CAA) of 1970 and the CAA Amendments of 1971 required the USEPA to establish the NAAQS, with states retaining the option to adopt more stringent standards or to include other specific pollutants. On April 2, 2007, the Supreme Court found that carbon dioxide (CO_2) is an air pollutant covered by the CAA; however, no NAAQS have been established for CO_2.

These standards are the levels of air quality considered safe, with an adequate margin of safety, to protect the public health and welfare. They are designed to protect those "sensitive receptors" most susceptible to further respiratory distress such as asthmatics, the elderly, very young children, people already weakened by other disease or illness, and persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollutant concentrations considerably above these minimum standards before adverse effects are observed.

The USEPA has classified air basins (or portions thereof) as being in attainment, nonattainment, or unclassified for each criteria air pollutant, based on whether or not the NAAQS have been achieved. If an area is designated unclassified, it is because inadequate air quality data were available as a basis for a nonattainment or attainment designation. Table 2-3 lists the federal attainment status of the SSAB for the criteria pollutants.

2.2.2 State

California Clean Air Act

The California Clean Air Act (CCAA) allows the state to adopt ambient air quality standards and other regulations provided that they are at least as stringent as federal standards. CARB, a part of the California Environmental Protection Agency, is responsible for the coordination and administration of both federal and state air pollution control programs within California, including setting the CAAQS. CARB also conducts research, compiles emission inventories, develops suggested control measures, and provides oversight of local programs. CARB establishes emissions standards for motor vehicles sold in California, consumer products (such as hairspray, aerosol paints, and barbecue lighter fluid), and various types of commercial equipment. It also sets fuel specifications to further reduce vehicular emissions. CARB also has primary responsibility for the development of California's State Implementation Plan (SIP), for which it works closely with the federal government and the local air districts.

California State Implementation Plan

The CCAA (and its subsequent amendments) requires the state to prepare an air quality control plan referred to as the SIP. The SIP is a living document that is periodically modified to reflect the latest emissions inventories, plans, and rules and regulations of air basins as reported by the agencies with jurisdiction over them. The CAA Amendments dictate that states containing areas violating the NAAQS revise their SIPs to include extra control measures to reduce air pollution. The SIP includes strategies and control measures to attain the NAAQS by deadlines established by the CAA. The USEPA has the responsibility to review all SIPs to determine if they conform to the requirements of the CAA. State law makes CARB the lead agency for all purposes related to the SIP. Local air districts and other agencies prepare SIP elements and submit them to CARB for review and approval. CARB then forwards SIP revisions to the USEPA for approval and publication in the Federal Register.

Local air districts, such as the ICAPCD, prepare air quality attainment plans or air quality management plans and submit them to CARB for review, approval, and incorporation into the applicable SIP. The air districts develop the strategies stated in the SIPs for achieving air quality standards on a regional basis.

For 8-Hour O_3, the ICAPCD adopted the 2017 8-hour Ozone State Implementation Plan in October 2018. The plan includes control measures which are an integral part of how the ICAPCD currently controls the ROG and NO_X emissions within the O_3 nonattainment areas. The overall strategy includes programs and control measures which represent the implementation of Reasonable Available Control Technology (40 CFR 51.912) and the assurance that stationary sources maintain a net decrease in emissions.

For PM_{10}, the ICAPCD adopted the PM_{10} State Implementation Plan in 2018, which maintained previously adopted fugitive dust control measures (Regulation VIII). The USEPA had previously approved Regulation VIII fugitive dust rules into the Imperial County portion of the California SIP in 2013.

For $PM_{2.5}$, the ICAPCD adopted the $PM_{2.5}$ SIP in April 2018. This SIP concluded that the majority of the $PM_{2.5}$ emissions resulted from transport in nearby Mexico. Specifically, the SIP demonstrates attainment of the 2006 $PM_{2.5}$ NAAQS "but for" transport of international emissions from Mexicali, Mexico. In accordance with the CCAA, the $PM_{2.5}$ SIP satisfies the attainment demonstration requirement satisfying the provisions of the CCAA.

The ICAPCD is working cooperatively with counterparts from Mexico to implement emissions reductions strategies and projects for air quality improvements at the border. The two countries strive to achieve these goals through local input from states, County governments, and citizens. Within the Mexicali and Imperial Valley area, the Air Quality Task Force (AQTF) has been organized to address those issues unique to the border region known as the Mexicali/Imperial air shed. The AQTF membership includes representatives from Federal, State, and local governments from both sides of the border, as well as representatives from academia, environmental organizations, and the general public. This group was created to promote regional efforts to improve the air quality monitoring network, emissions inventories, and air pollution transport modeling development, as well as the creation of programs and strategies to improve air quality.

Tanner Air Toxics Act & Air Toxics "Hot Spots" Information and Assessment Act

CARB's Statewide comprehensive air toxics program was established in 1983 with Assembly Bill (AB) 1807, the Toxic Air Contaminant Identification and Control Act (Tanner Air Toxics Act of 1983). AB 1807 created California's program to reduce exposure to air toxics and sets forth a formal procedure for CARB to designate substances as TACs. Once a TAC is identified, CARB adopts an airborne toxics control measure (ATCM) for sources that emit designated TACs. If there is a safe threshold for a substance at which there is no toxic effect, the control measure must reduce exposure to below that threshold. If there is no safe threshold, the measure must incorporate toxics best available control technology to minimize emissions.

CARB also administers the state's mobile source emissions control program and oversees air quality programs established by state statute, such as AB 2588, the Air Toxics "Hot Spots" Information and Assessment Act of 1987. Under AB 2588, TAC emissions from individual facilities are quantified and prioritized by the air quality management district or air pollution control district. High priority facilities are required to perform a health risk assessment (HRA) and, if specific thresholds are exceeded, required to communicate the results to the public in the form of notices and public meetings. In September 1992, the "Hot Spots" Act was amended by Senate Bill (SB) 1731, which required facilities that pose a significant health risk to the community to reduce their risk through a risk management plan.

2.2.3 *Local*

Imperial County Air Pollution Control District

The ICAPCD is the local air quality agency and shares responsibility with CARB for ensuring that state and federal ambient air quality standards are achieved and maintained in the SSAB. Furthermore, ICAPCD adopts and enforces controls on stationary sources of air pollutants through its permit and inspection programs and regulates agricultural burning. Other ICAPCD responsibilities include monitoring ambient air quality, preparing clean air plans, planning activities such as modeling and maintenance of the emission inventory, and responding to citizen air quality complaints.

To achieve and maintain ambient air quality standards, the ICAPCD has adopted various rules and regulations for the control of airborne pollutants. The ICAPCD Rules and Regulations that are applicable to the proposed project include, but are not limited to, ICAPCD Rule 801 requirements for construction activities. The purpose of this rule is to reduce the amount of PM_{10} entrained in the ambient air as a result of emissions generated from construction and other earthmoving activities by requiring actions to prevent, reduce, or mitigate PM_{10} emissions. In addition, the project is required to adopt best available control measures to minimize emissions from surface-disturbing activities to comply with ICAPCD Regulation VIII (Fugitive Dust Rules). These measures include the following (ICAPCD 2017):

- 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 percent opacity for dust emissions by using water, chemical stabilizers, dust suppressants, tarps, or other suitable material such as vegetative ground cover.
- All on-site and off-site unpaved roads will be effectively stabilized and visible emissions shall be limited to no greater than 20 percent opacity for dust emissions by paving, chemical stabilizers, dust suppressants, and/or watering.
- All unpaved traffic areas of 1 acre or more with 75 or more average vehicle trips per day will be effectively stabilized and visible emissions shall be limited to no greater than 20 percent opacity for dust emissions by paving, chemical stabilizers, dust suppressants, and/or watering.
- The transport of bulk materials shall be completely covered unless 6 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 the delivery site after removal of bulk material.
- 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.
- 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.

- 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 percent opacity for dust emission by paving, chemical stabilizers, dust suppressants and/or watering.

In addition, there are other ICAPCD rules and regulations, not detailed here, which may apply to the proposed Project but are administrative or descriptive in nature. These include rules associated with fees, enforcement and penalty actions, and variance procedures.

Salton Sea Air Quality Mitigation Program

As part of the 2003 QSA Water Transfer, the SSAQMP was developed to address air quality mitigation requirements that are associated with transferring up to 300,000 acre-feet of conserved water per year. The transfer of water reduces the volume of agricultural return flow to the Salton Sea, exposing playa and increasing the potential for dust emissions around the Salton Sea. Mitigation measures to address potential dust emissions include: 1) restricting access to exposed playa, 2) researching and monitoring the exposed playa, 3) creating or purchasing offsetting emission reduction credits and 4) implementation of direct emission reduction measures on the exposed playa. The SSAQMP's objective is to detect, locate, assess and identify options to mitigate dust from the exposed playa. In July 2016, The SSAQMP document was accepted by IID's Board of Directors to provide a comprehensive, science-based, adaptive approach to the air quality mitigation requirements. The Program includes steps to characterize emissions potential of the exposed playa as the Salton Sea recedes and provide options to proactively prevent significant dust emissions.

2.3 Air Quality Emissions Impact Assessment

2.3.1 Thresholds of Significance

The impact analysis provided below is based on the following California Environmental Quality Act (CEQA) Guidelines Appendix G thresholds of significance. The Project would result in a significant impact to air quality if it would do any of the following:

1) Conflict with or obstruct implementation of any applicable air quality plan.

2) Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors).

3) Expose sensitive receptors to substantial pollutant concentrations.

4) Result in other emissions (such as those leading to odors adversely affecting a substantial number of people).

ICAPCD Thresholds

The significance criteria established by the applicable air quality management or air pollution control district (ICAPCD) may be relied upon to make the above determinations. The ICAPCD has identified significance thresholds for use in evaluating project impacts under CEQA. Accordingly, the ICAPCD-recommended thresholds of significance are used to determine whether implementation of the proposed Project would result in a significant air quality impact. Significance thresholds for evaluation construction and operational air quality impacts are listed in Table 2-4.

Table 2-4. ICAPCD Significance Thresholds – Pounds per Day

Criteria Pollutant and Precursors	Construction Activities	Operations	
	Average Daily Emissions (lbs/day)	Average Daily Emissions (lbs/day)	
		Tier I Threshold	Tier II Threshold
ROG	75	<137	>137
NO_x	100	<137	>137
PM_{10}	150	<150	>150
$PM_{2.5}$	N/A	<550	>550
CO	550	<550	>550
SO_2	N/A	<150	>150

Source: ICAPCD 2017

Projects that are predicted to exceed Tier I thresholds require implementation of applicable ICAPCD standard mitigation measures to be considered less than significant. Projects exceeding Tier II thresholds are required to implement applicable ICAPCD standard mitigation measures, as well as applicable discretionary mitigation measures. Projects that exceed the Tier II thresholds after implementation of standard and discretionary mitigation measures would be considered to have a potentially significant impact to human health and welfare.

By its very nature, air pollution is largely a cumulative impact. No single project is sufficient in size, by itself, to result in nonattainment of ambient air quality standards. Instead, a project's individual emissions contribute to existing cumulatively significant adverse air quality impacts. If a project's individual emissions exceed its identified significance thresholds, the project would be cumulatively considerable. Projects that do not exceed significance thresholds would not be considered cumulative considerable.

2.3.2 *Methodology*

Air quality impacts were assessed in accordance with methodologies recommended by the ICAPCD. Where criteria air pollutant quantification was required, emissions were modeled using the California Emissions Estimator Model (CalEEMod), version 2016.3.2. CalEEMod is a statewide land use emissions computer model designed to quantify potential criteria pollutant emissions associated with both construction and operations from a variety of land use projects. Project construction-generated air

pollutant emissions were calculated using CalEEMod model defaults for Imperial County as well as timing and equipment identified by the Project proponent (see Attachment A).

For instance, the majority of equipment to be used during Project implementation is proposed to be Tier 4 engine equipment. The first federal standards (Tier 1) for new off-road diesel engines were adopted in 1994 for engines over 50 horsepower and were phased in from 1996 to 2000. In 1996, a Statement of Principles pertaining to off-road diesel engines was signed between the USEPA, CARB, and engine makers (including Caterpillar, Cummins, Deere, Detroit Diesel, Deutz, Isuzu, Komatsu, Kubota, Mitsubishi, Navistar, New Holland, Wis-Con, and Yanmar). On August 27, 1998, the USEPA signed the final rule reflecting the provisions of the Statement of Principles. The 1998 regulation introduced Tier 1 standards for equipment under 50 horsepower and increasingly more stringent Tier 2, Tier 3, and Tier 4 standards for all equipment with phase-in schedules from 2000 to 2015. As a result, all off-road, diesel-fueled construction equipment manufactured from 2006 to 2015 has been manufactured to Tier 3 standards. The Tier 3 standards can reduce NOx emissions by as much as 64 percent and PM emissions by as much as 39 percent. On May 11, 2004, the USEPA signed the final rule introducing Tier 4 emission standards, which are currently phased-in over the period of 2008-2015. The Tier 4 standards require that NOx emissions be further reduced by about 90 percent. All off-road, diesel-fueled construction equipment manufactured in 2015 or later have been manufactured to Tier 4 standards. **The appropriate equipment has been adjusted in CalEEMod to reflect the equipment identified by the Project proponent, including equipment identified as Tier 4.** Since CalEEMod does not differentiate between the use of Tier 4 equipment as a Project feature and actual mitigation measures, these applied Tier 4 equipment are incorporated into the CalEEMod mitigation module.

Post construction air pollutant emissions were based on the Project site plans and the estimated traffic trip generation rates provided by the CalEEMod model defaults for Imperial County.

2.3.3 Impact Analysis

Construction-Related Criteria Air Quality Emissions

Emissions generated during Project construction would be temporary and short-term but have the potential to represent a significant air quality impact. Two basic sources of short-term emissions will be generated through implementation of the proposed Project: operation of the construction vehicles (i.e., cranes, dump trucks, boom lifts) and the creation of fugitive dust during demolition, grading, and construction activities associated with the installation of new transmission line and poles. Activities such as line pole erecting operations, worker vehicle traffic (including on paved and unpaved roadways), and wind blowing over exposed soils would generate exhaust emissions and fugitive PM emissions that affect local air quality at various times during Project construction. Effects would be variable depending on the weather, soil conditions, the amount of activity taking place, and the nature of dust control efforts. The dry climate of the area during the summer months creates a high potential for dust generation. Project construction activities would be subject to ICAPCD Regulation VIII, which requires taking reasonable precautions to prevent the emissions of fugitive dust as previously described.

Predicted emissions generated during Project construction were calculated using the CARB-approved CalEEMod computer program, which is designed to model emissions for land use development projects, based on typical construction requirements. See Attachment A for more information regarding the construction assumptions, including construction equipment and duration, used in this analysis.

Predicted maximum daily emissions associated with Project construction are summarized in Table 2-6. Project-generated emissions would be short-term and of temporary duration, lasting only as long as construction activities occur, but would be considered a significant air quality impact if the volume of pollutants generated exceeds the ICAPCD's thresholds of significance.

Table 2-6. Unmitigated Project Construction-Related Emissions

Construction Year	Pollutant (pounds per day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
Construction 2021	6.47	39.63	199.14	0.40	152.73	16.45
Construction 2022	6.25	36.23	198.25	0.40	152.65	16.38
ICAPCD Significance Threshold	*75*	*100*	*550*	*N/A*	*150*	*N/A*
Exceed ICAPCD Threshold?	**No**	**No**	**No**	**No**	**Yes**	**No**

Source: CalEEMod version 2016.3.2. Refer to Attachment A for Model Data Outputs.
Notes: Pounds per day taken from the season with the highest output. Emission reduction/credits for construction were applied based on the required implementation of Best Management Practices that must be implemented during Project construction, such as limiting vehicle speeds to 10 miles per hour on unpaved roads.

As shown in Table 2-6, emissions of PM_{10} would exceed the ICAPCD significance threshold on the peak day(s) of construction. A predominate source of Project PM_{10} emissions is workers commuting to the Project site on unpaved roads. Commute vehicles traveling over the exposed soils of unpaved roads generates substantial amounts of fugitive PM_{10} emissions. The majority of roadways leading to the Project site are paved; however, there are unpaved roadway options that could be potentially used by commuting workers. Therefore, Mitigation Measure AQ-1 is required in order to reduce PM_{10} emissions to levels below the significance threshold. Mitigation Measure AQ-1 would mandate the Project contractor to restrict their workers to commuting only on paved roads during Project implementation.

The following mitigation is recommended.

AQ-1: In order to reduce the generation of PM_{10} emissions resulting from worker commutes during construction, a list of commute route options involving routes with 100 percent paved roadway facilities shall be prepared in pamphlet form by the Project applicant, to the satisfaction of the County of Imperial Planning Department. Copies of the paved commute route options pamphlet

shall be distributed to every Project worker and each pamphlet shall clearly state that commuting on unpaved roads is prohibited.

Predicted maximum daily emissions associated with Project construction with implementation of mitigation measure AQ-1 are summarized in Table 2-7.

Table 2-7. Mitigated Project Construction-Related Emissions

Construction Year	Pollutant (pounds per day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
Construction 2021	6.47	39.63	199.14	0.40	140.56	15.15
Construction 2022	6.25	36.23	198.25	0.40	140.49	15.07
ICAPCD Significance Threshold	*75*	*100*	*550*	*N/A*	*150*	*N/A*
Exceed ICAPCD Threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Source: CalEEMod version 2016.3.2. Refer to Attachment A for Model Data Outputs.
Notes: Pounds per day taken from the season with the highest output. Emission reduction/credits for construction were applied based on the required implementation of Best Management Practices that must be implemented during Project construction, such as limiting vehicle speeds to 10 miles per hour on unpaved roads.

As shown in Table 2-7, emissions generated during Project construction would not exceed the ICAPCD's thresholds of significance with implementation of mitigation measure AQ-1. Therefore, criteria pollutant emissions generated during Project construction would not result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is nonattainment under an applicable federal or state ambient air quality standard, and no health effects from Project criteria pollutants would occur.

Operational Criteria Air Quality Emissions

The proposed Project would not include the provision of new permanent stationary or mobile sources of criteria air pollutant emissions, and therefore, by its very nature, would not generate quantifiable criteria emissions from Project operations. In addition, once the proposed Project is implemented, there would be no increase in automobile trips to the area. While it is anticipated that the proposed Project would require intermittent maintenance, maintenance would be minimal requiring a negligible amount of traffic trips on an annual basis. Further, as previously described the proposed transmission lines would tie into solar energy facilities, thus contributing to the reduction of fossil fuel reliance by transmitting clean renewable energy to the local population and improving the air quality that would otherwise contain higher levels of criteria air pollutants from fossil fuel-sourced energy.

Conflict with an Applicable Air Quality Management Plan

As previously described, the Project region is classified as nonattainment for federal O_3, $PM_{2.5}$ and PM_{10} standards (CARB 2019). The USEPA, under the provisions of the CAA, requires each state with regions that have not attained the federal air quality standards to prepare a SIP, detailing how these standards are to be met in each local area. The SIP is a legal agreement between each state and the federal government to commit resources to improving air quality. It serves as the template for conducting regional and project-level air quality analysis. CARB is the lead agency for developing the SIP in California. Local air districts, such as the ICAPCD, prepare air quality attainment plans or air quality management plans and submit them to CARB for review, approval, and incorporation into the applicable SIP. The air districts develop the strategies stated in the SIPs for achieving air quality standards on a regional basis.

The region's SIP is constituted of the ICAPCD air quality plans: 2018 PM_{10} SIP, the 2018 Annual $PM_{2.5}$ SIP, the 2017 8-Hour Ozone SIP, 2013 24-Hour $PM_{2.5}$ SIP, the 2009 1997 8-hour Ozone RACT SIP, the 2009 PM_{10} SIP and the 2008 Ozone Early Progress Plans. Project compliance with all of the ICAPCD rules and regulations results in conformance with the ICAPCD air quality plans. These air quality attainment plans are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, permitting, etc.), district rules, state regulations, and federal controls describing how the state will attain ambient air quality standards. These SIP plans and associated control measures are based on information derived from projected growth in Imperial County in order to project future emissions and then determine strategies and regulatory controls for the reduction of emissions. Growth projections are based on the general plans developed by the County of Imperial and the incorporated cities in the county.

As previously described, the Project proposes both the replacement and upgrades to the existing IID S-Line, as appropriate, as well as construction of new sections or alternate route alignments for an approximate 18-mile span of 230 kilovolt (kV) transmission line. The Project would not result in population growth and would not cause an increase in currently established population projections. The Project does not include residential development or large local or regional employment centers, and thus would not result in significant population or employment growth. Furthermore, the Project would contribute to the reduction of fossil fuel reliance by transmitting clean renewable energy to the local population, thus improving the air quality that would otherwise contain higher levels of criteria air pollutants from fossil fuel-sourced energy production. Therefore, the Project would not conflict with any applicable air quality management plans and would result in a beneficial impact to the region's air quality.

Exposure of Sensitive Receptors to Toxic Air Contaminants

As previously described, sensitive receptors are defined as facilities or land uses that include members of the population that are particularly sensitive to the effects of air pollutants, such as children, the elderly, and people with illnesses. Examples of these sensitive receptors are residences, schools, hospitals, and daycare centers. CARB has identified the following groups of individuals as the most likely to be affected by air pollution: the elderly over age 65, children under age 14, athletes, and persons with cardiovascular and chronic respiratory diseases such as asthma, emphysema, and bronchitis. The nearest sensitive receptors to the Project site are a scattering of single-family residences located along the proposed transmission line route fronting W. Wixom Road, W. Ross Road, Drew Road, W. Kramar Road, and W.

Hackelman Road in unincorporated County lands. The closest residences are located 50 feet from the proposed new transmission line route on W. Hackelman Road. Additionally, there are sensitive single-family residential neighborhoods in the City of Imperial located approximately 148 feet north of the Project corridor.

Construction-Generated Air Contaminants

Construction-related activities would result in temporary, short-term proposed Project-generated emissions of diesel particulate matter (DPM), ROG, NOx, CO, and PM_{10} from the exhaust of off-road, heavy-duty diesel equipment during Project construction (e.g., grading, pole erecting, stringing of new transmission line); and other miscellaneous activities. The portion of the SSAB which encompasses the Project area is designated as a nonattainment area for federal O_3, $PM_{2.5}$, and PM_{10} standards and is also a nonattainment area for the state standards for O_3 and PM_{10} (CARB 2019). Thus, existing O_3, $PM_{2.5}$, and PM_{10} levels in the SSAB are at unhealthy levels during certain periods. However, as shown in Table 2-7, the Project would not exceed the ICAPCD significance thresholds for construction emissions with the imposition of mitigation.

The health effects associated with O_3 are generally associated with reduced lung function. Because the Project would not involve construction activities that would result in O_3 precursor emissions (ROG or NO_x) in excess of the ICAPCD thresholds, the Project is not anticipated to substantially contribute to regional O_3 concentrations and the associated health impacts.

CO tends to be a localized impact associated with congested intersections. In terms of adverse health effects, CO competes with oxygen, often replacing it in the blood, reducing the blood's ability to transport oxygen to vital organs. The results of excess CO exposure can include dizziness, fatigue, and impairment of central nervous system functions. The Project would not involve activities that would result in CO emissions in excess of the ICAPCD thresholds. Thus, the Project's CO emissions would not contribute to the health effects associated with this pollutant.

Particulate matter (PM_{10} and $PM_{2.5}$) contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Particulate matter exposure has been linked to a variety of problems, including premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms such as irritation of the airways, coughing, or difficulty breathing. For construction-type activity, DPM is the primary TAC of concern. Based on the emission modeling conducted, the maximum onsite Project construction-related daily emissions of exhaust $PM_{2.5}$, considered a surrogate for DPM, would be 0.91 pounds/day in the year 2021 (see Attachment A). $PM_{2.5}$ exhaust is considered a surrogate for DPM because more than 90 percent of DPM is less than 1 microgram in diameter and therefore is a subset of particulate matter under 2.5 microns in diameter (i.e., $PM_{2.5}$). Most $PM_{2.5}$ derives from combustion, such as use of gasoline and diesel fuels by motor vehicles. As with O_3 and NOx, the Project would not generate emissions of PM_{10} or $PM_{2.5}$ that would exceed the ICAPCD's thresholds. Accordingly, the Project's PM_{10} and $PM_{2.5}$ emissions are not expected to cause any increase in related regional health effects for these pollutants.

In summary, Project construction would not result in a potentially significant contribution to regional concentrations of nonattainment pollutants and would not result in a significant contribution to the adverse health impacts associated with those pollutants, provided mitigation recommendations are implemented.

Operational Air Contaminants

Operation of the proposed Project would not result in the development of any substantial sources of air toxics. There would be no stationary sources associated with Project operations; nor would the Project attract additional mobile sources that spend long periods queuing and idling at the site. Onsite Project emissions would not result in significant concentrations of pollutants at nearby sensitive receptors as the predominant operational emissions associated with the proposed Project would be imperceivable due to very infrequent and negligible maintenance visits. Therefore, the Project would not be a substantial source of TACs. The Project will not result in a high carcinogenic or non-carcinogenic risk during operation.

Naturally Occurring Asbestos

Another potential air quality issue associated with construction-related activities is the airborne entrainment of asbestos due to the disturbance of naturally-occurring asbestos-containing soils. The proposed Project is not located within an area designated by the State of California as likely to contain naturally-occurring asbestos (Department of Conservation [DOC] 2000). As a result, construction-related activities would not be anticipated to result in increased exposure of sensitive land uses to asbestos.

Carbon Monoxide Hot Spots

It has long been recognized that CO exceedances are caused by vehicular emissions, primarily when idling at intersections. Concentrations of CO are a direct function of the number of vehicles, length of delay, and traffic flow conditions. Under certain meteorological conditions, CO concentrations close to congested intersections that experience high levels of traffic and elevated background concentrations may reach unhealthy levels, affecting nearby sensitive receptors. Given the high traffic volume potential, areas of high CO concentrations, or "hot spots," are typically associated with intersections that are projected to operate at unacceptable levels of service during the peak commute hours. It has long been recognized that CO hotspots are caused by vehicular emissions, primarily when idling at congested intersections. However, transport of this criteria pollutant is extremely limited, and CO disperses rapidly with distance from the source under normal meteorological conditions. Furthermore, vehicle emissions standards have become increasingly more stringent in the last 20 years. Currently, the allowable CO emissions standard in California is a maximum of 3.4 grams/mile for passenger cars (there are requirements for certain vehicles that are more stringent). With the turnover of older vehicles, introduction of cleaner fuels, and implementation of increasingly sophisticated and efficient emissions control technologies, CO concentration in the SSAB is designated as in attainment. Detailed modeling of Project-specific CO "hot spots" is not necessary and thus this potential impact is addressed qualitatively.

A CO "hot spot" would occur if an exceedance of the state one-hour standard of 20 parts per million (ppm) or the eight-hour standard of 9 ppm were to occur. The analysis prepared for CO attainment in the South Coast Air Quality Management District's (SCAQMD's) *1992 Federal Attainment Plan for Carbon*

Monoxide in Los Angeles County and a Modeling and Attainment Demonstration prepared by the SCAQMD as part of the 2003 Air Quality Management Plan can be used to demonstrate the potential for CO exceedances of these standards. The SCAQMD is the air pollution control officer for much of southern California. The SCAQMD conducted a CO hot spot analysis as part of the 1992 CO Federal Attainment Plan at four busy intersections in Los Angeles County during the peak morning and afternoon time periods. The intersections evaluated included Long Beach Boulevard and Imperial Highway (Lynwood), Wilshire Boulevard and Veteran Avenue (Westwood), Sunset Boulevard and Highland Avenue (Hollywood), and La Cienega Boulevard and Century Boulevard (Inglewood). The busiest intersection evaluated was at Wilshire Boulevard and Veteran Avenue, which has a traffic volume of approximately 100,000 vehicles per day. Despite this level of traffic, the CO analysis concluded that there was no violation of CO standards (SCAQMD 1992). In order to establish a more accurate record of baseline CO concentrations affecting the Los Angeles, a CO "hot spot" analysis was conducted in 2003 at the same four busy intersections in Los Angeles at the peak morning and afternoon time periods. This "hot spot" analysis did not predict any violation of CO standards. The highest one-hour concentration was measured at 4.6 ppm at Wilshire Boulevard and Veteran Avenue and the highest eight-hour concentration was measured at 8.4 ppm at Long Beach Boulevard and Imperial Highway. Thus, there was no violation of CO standards.

Similar considerations are also employed by other Air Districts when evaluating potential CO concentration impacts. More specifically, the Bay Area Air Quality Management District (BAAQMD), the air pollution control officer for the San Francisco Bay Area, concludes that under existing and future vehicle emission rates, a given project would have to increase traffic volumes at a single intersection by more than 44,000 vehicles per hour or 24,000 vehicles per hour where vertical and/or horizontal air does not mix—in order to generate a significant CO impact.

As previously stated, the proposed Project is anticipated to result in negligible traffic trips from infrequent maintenance visits. Thus, the proposed Project would not generate traffic volumes at any intersection of more than 100,000 vehicles per day (or 44,000 vehicles per day) and there is no likelihood of the Project traffic exceeding CO values.

Odors

Typically, odors are regarded as an annoyance rather than a health hazard. However, manifestations of a person's reaction to foul odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache).

With respect to odors, the human nose is the sole sensing device. The ability to detect odors varies considerably among the population and overall is quite subjective. Some individuals have the ability to smell minute quantities of specific substances; others may not have the same sensitivity but may have sensitivities to odors of other substances. In addition, people may have different reactions to the same odor; in fact, an odor that is offensive to one person (e.g., from a fast-food restaurant) may be perfectly acceptable to another. It is also important to note that an unfamiliar odor is more easily detected and is more likely to cause complaints than a familiar one. This is because of the phenomenon known as odor fatigue, in which a person can become desensitized to almost any odor and recognition only occurs with an alteration in the intensity.

Quality and intensity are two properties present in any odor. The quality of an odor indicates the nature of the smell experience. For instance, if a person describes an odor as flowery or sweet, then the person is describing the quality of the odor. Intensity refers to the strength of the odor. For example, a person may use the word "strong" to describe the intensity of an odor. Odor intensity depends on the odorant concentration in the air. When an odorous sample is progressively diluted, the odorant concentration decreases. As this occurs, the odor intensity weakens and eventually becomes so low that the detection or recognition of the odor is quite difficult. At some point during dilution, the concentration of the odorant reaches a detection threshold. An odorant concentration below the detection threshold means that the concentration in the air is not detectable by the average human.

During construction, the proposed Project presents the potential for generation of objectionable odors in the form of diesel exhaust in the immediate vicinity of the site. However, these emissions are short-term in nature and will rapidly dissipate and be diluted by the atmosphere downwind of the emission sources. Additionally, odors would be localized and generally confined to the Project area. Therefore, odors generated during Project construction would not adversely affect a substantial number of people to odor emissions.

Land uses commonly considered to be potential sources of obnoxious odorous emissions include agriculture (farming and livestock), wastewater treatment plants, food processing plants, chemical plants, composting facilities, refineries, landfills, dairies, and fiberglass molding. The proposed Project does not include any uses identified as being associated with odors.

3.0 GREENHOUSE GAS EMISSIONS

3.1 Greenhouse Gas Setting

Certain gases in the earth's atmosphere, classified as GHGs, play a critical role in determining the earth's surface temperature. Solar radiation enters the earth's atmosphere from space. A portion of the radiation is absorbed by the earth's surface and a smaller portion of this radiation is reflected back toward space. This absorbed radiation is then emitted from the earth as low-frequency infrared radiation. The frequencies at which bodies emit radiation are proportional to temperature. Because the earth has a much lower temperature than the sun, it emits lower-frequency radiation. Most solar radiation passes through GHGs; however, infrared radiation is absorbed by these gases. As a result, radiation that otherwise would have escaped back into space is instead trapped, resulting in a warming of the atmosphere. This phenomenon, known as the greenhouse effect, is responsible for maintaining a habitable climate on earth. Without the greenhouse effect, the earth would not be able to support life as we know it.

Prominent GHGs contributing to the greenhouse effect are CO_2, methane (CH_4), and N_2O. Fluorinated gases also make up a small fraction of the GHGs that contribute to climate change. Fluorinated gases include chlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride; however, it is noted that these gases are not associated with typical land use development. Human-caused emissions of these GHGs in excess of natural ambient concentrations are believed to be responsible for intensifying the greenhouse effect and leading to a trend of unnatural warming of the earth's climate, known as global climate change or global warming. It is "extremely likely" that more than

half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic factors together (Intergovernmental Panel on Climate Change [IPCC] 2014).

Table 3-1 describes the primary GHGs attributed to global climate change, including their physical properties, primary sources, and contributions to the greenhouse effect.

Each GHG differs in its ability to absorb heat in the atmosphere based on the lifetime, or persistence, of the gas molecule in the atmosphere. CH_4 traps over 25 times more heat per molecule than CO_2, and N_2O absorbs 298 times more heat per molecule than CO_2 (IPCC 2014). Often, estimates of GHG emissions are presented in carbon dioxide equivalents (CO_2e), which weight each gas by its global warming potential. Expressing GHG emissions in CO_2e takes the contribution of all GHG emissions to the greenhouse effect and converts them to a single unit equivalent to the effect that would occur if only CO_2 were being emitted.

Climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and TACs, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short atmospheric lifetimes (about one day), GHGs have long atmospheric lifetimes (one to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. Although the exact lifetime of any particular GHG molecule is dependent on multiple variables and cannot be pinpointed, it is understood that more CO_2 is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, or other forms. Of the total annual human-caused CO_2 emissions, approximately 55 percent is sequestered through ocean and land uptakes every year, averaged over the last 50 years, whereas the remaining 45 percent of human-caused CO_2 emissions remains stored in the atmosphere (IPCC 2013).

Table 3-1. Greenhouse Gases	
Greenhouse Gas	**Description**
CO_2	Carbon dioxide is a colorless, odorless gas. CO_2 is emitted in a number of ways, both naturally and through human activities. The largest source of CO_2 emissions globally is the combustion of fossil fuels such as coal, oil, and gas in power plants, automobiles, industrial facilities, and other sources. A number of specialized industrial production processes and product uses such as mineral production, metal production, and the use of petroleum-based products can also lead to CO_2 emissions. The atmospheric lifetime of CO_2 is variable because it is so readily exchanged in the atmosphere.[1]
CH_4	Methane is a colorless, odorless gas and is the major component of natural gas, about 87 percent by volume. It is also formed and released to the atmosphere by biological processes occurring in anaerobic environments. Methane is emitted from a variety of both human-related and natural sources. Human-related sources include fossil fuel production, animal husbandry (intestinal fermentation in livestock and manure management), rice cultivation, biomass burning, and waste management. These activities release significant quantities of CH_4 to the atmosphere. Natural sources of CH_4 include wetlands, gas hydrates, permafrost, termites, oceans, freshwater bodies, non-wetland soils, and other sources such as wildfires. The atmospheric lifetime of CH_4 is about12 years.[2]
N_2O	Nitrous oxide is a clear, colorless gas with a slightly sweet odor. Nitrous oxide is produced by both natural and human-related sources. Primary human-related sources of N_2O are agricultural soil management, animal manure management, sewage treatment, mobile and stationary combustion of fossil fuels, adipic acid production, and nitric acid production. N_2O is also produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests. The atmospheric lifetime of N_2O is approximately 120 years.[3]

Sources: [1]USEPA 2016a, [2] USEPA 2016b, [3] USEPA 2016c

The quantity of GHGs that it takes to ultimately result in climate change is not precisely known; it is sufficient to say the quantity is enormous, and no single project alone would measurably contribute to a noticeable incremental change in the global average temperature or to global, local, or microclimates. From the standpoint of CEQA, GHG impacts to global climate change are inherently cumulative.

3.1.1 Sources of Greenhouse Gas Emissions

In 2020, CARB released the 2020 edition of the California GHG inventory covering calendar year 2018 emissions. In 2018, California emitted 425.3 million gross metric tons of CO_2e including from imported electricity. Combustion of fossil fuel in the transportation sector was the single largest source of California's GHG emissions in 2018, accounting for approximately 30 percent of total GHG emissions in the state. This sector was followed by the industrial sector (21 percent) and the electric power sector including both in-state and out-of-state sources (15 percent) (CARB 2020b). Emissions of CO_2 are byproducts of fossil fuel combustion. CH_4, a highly potent GHG, primarily results from off-gassing (the release of chemicals from nonmetallic substances under ambient or greater pressure conditions) and is largely associated with agricultural practices and landfills. N_2O is also largely attributable to agricultural practices and soil management. Carbon dioxide sinks, or reservoirs, include vegetation and the ocean, which absorb CO_2 through sequestration and dissolution (CO_2 dissolving into the water), respectively, two of the most common processes for removing CO_2 from the atmosphere.

3.2 Regulatory Framework

3.2.1 State

Executive Order S-3-05

Executive Order (EO) S-3-05, signed by Governor Arnold Schwarzenegger in 2005, proclaims that California is vulnerable to the impacts of climate change. It declares that increased temperatures could reduce the Sierra Nevada snowpack, further exacerbate California's air quality problems, and potentially cause a rise in sea levels. To combat those concerns, the EO established total GHG emission targets for the state. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent below the 1990 level by 2050.

Assembly Bill 32 Climate Change Scoping Plan and Updates

In 2006, the California legislature passed Assembly Bill (AB) 32 (Health and Safety Code § 38500 et seq., or AB 32), also known as the Global Warming Solutions Act. AB 32 requires CARB to design and implement feasible and cost-effective emission limits, regulations, and other measures, such that statewide GHG emissions are reduced to 1990 levels by 2020 (representing a 25 percent reduction in emissions). Pursuant to AB 32, CARB adopted a Scoping Plan in December 2008, which outlines measures to meet the 2020 GHG reduction goals. California is on track to meet or exceed the target of reducing GHG emissions to 1990 levels by the end of 2020.

The Scoping Plan is required by AB 32 to be updated at least every five years. The latest update, the 2017 Scoping Plan Update, addresses the 2030 target established by Senate Bill (SB) 32 as discussed below and establishes a proposed framework of action for California to meet a 40 percent reduction in GHG emissions by 2030 compared to 1990 levels. The key programs that the Scoping Plan Update builds on include increasing the use of renewable energy in the state, the Cap-and-Trade Regulation, the Low Carbon Fuel Standard, and reduction of methane emissions from agricultural and other wastes.

Senate Bill 32 and Assembly Bill 197 of 2016

In August 2016, Governor Brown signed SB 32 and AB 197, which serve to extend California's GHG reduction programs beyond 2020. SB 32 amended the Health and Safety Code to include § 38566, which contains language to authorize CARB to achieve a statewide GHG emission reduction of at least 40 percent below 1990 levels by no later than December 31, 2030. SB 32 codified the targets established by Executive Order (EO) B-30-15 for 2030, which set the next interim step in the State's continuing efforts to pursue the long-term target expressed in EOs S-3-05 and B-30-15 of 80 percent below 1990 emissions levels by 2050.

Senate Bill 100 of 2018

In 2018, SB 100 was signed by Governor Brown, codifying a goal of 60 percent renewable procurement by 2030 and 100 percent by 2045 Renewables Portfolio Standard.

3.3 Greenhouse Gas Emissions Impact Assessment

3.3.1 Thresholds of Significance

The impact analysis provided below is based on the following CEQA Guidelines Appendix G thresholds of significance. The Project would result in a significant impact to greenhouse gas emissions if it would:

1) Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment.

2) Conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases or

The Appendix G thresholds for GHG's do not prescribe specific methodologies for performing an assessment, do not establish specific thresholds of significance, and do not mandate specific mitigation measures. Rather, the CEQA Guidelines emphasize the lead agency's discretion to determine the appropriate methodologies and thresholds of significance consistent with the manner in which other impact areas are handled in CEQA. With respect to GHG emissions, the CEQA Guidelines § 15064.4(a) states that lead agencies "shall make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate" GHG emissions resulting from a project. The CEQA Guidelines note that an agency has the discretion to either quantify a project's GHG emissions or rely on a "qualitative analysis or other performance-based standards." (14 California Code of Regulations [CCR] 15064.4(b)). A lead agency may use a "model or methodology" to estimate GHG emissions and has the discretion to select the model or methodology it considers "most appropriate to enable decision makers to intelligently take into account the project's incremental contribution to climate change." (14 CCR 15064.4(c)). Section 15064.4(b) provides that the lead agency should consider the following when determining the significance of impacts from GHG emissions on the environment:

1. The extent a project may increase or reduce GHG emissions as compared to the existing environmental setting.

2. Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project.

3. The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions (14 CCR 15064.4(b)).

In addition, Section 15064.7(c) of the CEQA Guidelines specifies that "[w]hen adopting or using thresholds of significance, a lead agency may consider thresholds of significance previously adopted or recommended by other public agencies, or recommended by experts, provided the decision of the lead agency to adopt such thresholds is supported by substantial evidence" (14 CCR 15064.7(c)). The CEQA Guidelines also clarify that the effects of GHG emissions are cumulative and should be analyzed in the context of CEQA's requirements for cumulative impact analysis (see CEQA Guidelines § 15130(f)). As a note, the CEQA Guidelines were amended in response to SB 97. In particular, the CEQA Guidelines were

amended to specify that compliance with a GHG emissions reduction plan renders a cumulative impact insignificant.

Per CEQA Guidelines § 15064(h)(3), a project's incremental contribution to a cumulative impact can be found not cumulatively considerable if the project would comply with an approved plan or mitigation program that provides specific requirements that would avoid or substantially lessen the cumulative problem within the geographic area of the project. To qualify, such plans or programs must be specified in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency. Examples of such programs include a "water quality control plan, air quality attainment or maintenance plan, integrated waste management plan, habitat conservation plan, natural community conservation plans [and] plans or regulations for the reduction of greenhouse gas emissions." Put another way, CEQA Guidelines § 15064(h)(3) allows a lead agency to make a finding of less than significant for GHG emissions if a project complies with adopted programs, plans, policies and/or other regulatory strategies to reduce GHG emissions.

The significance of the Project's GHG emissions is evaluated consistent with CEQA Guidelines § 15064.4(b)(2) by considering whether the Project complies with applicable plans, policies, regulations and requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions. The ICAPCD has not adopted a GHG significance threshold. As previously described, Section 15064.7(c) of the CEQA Guidelines specifies that "[w]hen adopting or using thresholds of significance, a lead agency may consider thresholds of significance previously adopted or recommended by other public agencies, or recommended by experts, provided the decision of the lead agency to adopt such thresholds is supported by substantial evidence" (14 CCR 15064.7(c)). Thus, in the absence of any GHG emissions significance thresholds the projected emissions are compared to the South Coast Air Quality Management (SCAQMD) numeric threshold of 3,000 metric tons of CO_2e annually. While significance thresholds used in the South Coast Air Basin are not binding on the ICAPCD, they are instructive for comparison purposes. This threshold is also appropriate as the SCAQMD GHG thresholds were formulated based on similar geography and climate patterns as found in Imperial County and are also employed for use in CEQA GHG analyses in the Riverside County portion of the SSAB, the same air basin that encompasses the proposed Project. Therefore, the 3,000-metric ton of CO_2e threshold is appropriate for this analysis.

In *Center for Biological Diversity v. Department of Fish and Wildlife* (2015) 62 Cal. 4th 2014, 213, 221, 227, following its review of various potential GHG thresholds proposed in an academic study [Crockett, *Addressing the Significance of Greenhouse Gas Emissions: California's Search for Regulatory Certainty in an Uncertain World* (July 2011), 4 Golden Gate U. Envtl. L. J. 203], the California Supreme Court identified the use of numeric bright-line thresholds as a potential pathway for compliance with CEQA GHG requirements. The study found numeric bright line thresholds designed to determine when small projects were so small as to not cause a cumulatively considerable impact on global climate change was consistent with CEQA. Specifically, Public Resources Code section 21003(f) provides it is a policy of the state that "[a]ll persons and public agencies involved in the environmental review process be responsible for carrying out the process in the most efficient, expeditious manner in order to conserve the available

financial, governmental, physical and social resources with the objective that those resources may be better applied toward the mitigation of actual significant effects on the environment." The Supreme Court-reviewed study noted, "[s]ubjecting the smallest projects to the full panoply of CEQA requirements, even though the public benefit would be minimal, would not be consistent with implementing the statute in the most efficient, expeditious manner. Nor would it be consistent with applying lead agencies' scarce resources toward mitigating actual significant climate change impacts." (Crockett, *Addressing the Significance of Greenhouse Gas Emissions: California's Search for Regulatory Certainty in an Uncertain World* (July 2011), 4 Golden Gate U. Envtl. L. J. 203, 221, 227.)

3.3.2 *Methodology*

Where GHG emission quantification was required, emissions were modeled using the CalEEMod, version 2016.3.2. CalEEMod is a statewide land use emissions computer model designed to quantify potential GHG emissions associated with both construction and operations from a variety of land use projects. Project GHG emissions were calculated using a combination of model defaults for Imperial County and information provided by the Project proponent, such as construction timing and equipment used (see Attachment B).

3.3.3 *Impact Analysis*

Generation of GHG Emissions

Project Construction

Construction-related activities that would generate GHG emissions include worker commute trips, haul trucks carrying supplies and materials to and from the Project site, and off-road construction equipment (e.g., water trucks, boom trucks, cranes). Table 3-2 illustrates the specific construction generated GHG emissions that would result from construction of the Project. Consistent with SCAQMD recommendations, Project construction GHG emissions have been amortized over the expected life of the Project, which is considered to be 30 years for an electrical transmission line project. Once construction is complete, the generation of these GHG emissions would cease.

To date the ICAPCD has not adopted GHG significance thresholds applicable to potential development. As previously described, Section 15064.7(c) of the CEQA Guidelines specifies that "[w]hen adopting or using thresholds of significance, a lead agency may consider thresholds of significance previously adopted or recommended by other public agencies, or recommended by experts, provided the decision of the lead agency to adopt such thresholds is supported by substantial evidence" (14 CCR 15064.7(c)). Thus, in the absence of any GHG emissions significance thresholds the projected emissions are compared to the South Coast Air Quality Management (SCAQMD) numeric threshold of 3,000 metric tons of CO_2e annually. While significance thresholds used in the South Coast Air Basin are not binding on the ICAPCD, they are instructive for comparison purposes. This threshold is also appropriate as the SCAQMD GHG thresholds were formulated based on similar geography and climate patterns as found in Imperial County and are also employed for use in CEQA GHG analyses in the Riverside County portion of the SSAB, the same air basin that encompasses the proposed project. Therefore, the 3,000-metric ton of CO_2e threshold is

appropriate for this analysis. The Project is also assessed for consistency with regulations or requirements adopted by the 2008 Climate Change Scoping Plan and subsequent updates.

Table 3-2. Construction-Related Greenhouse Gas Emissions

Emissions Source	CO_2e (Metric Tons/ Year)
Construction in 2021	1,292
Construction in 2022	1,625
Total Emissions of Project (amortized over 30-year life of Project)	**97**
Significance Threshold	*3,000*
Exceed Significance Threshold?	**No**

Source: CalEEMod version 2016.3.2. Refer to Attachment A for Model Data Outputs.

As shown in Table 3-2, Project would result in the generation of approximately 97 metric tons of CO_2e annualized over the lifetime of the Project, which is below the SCAQMD threshold. As previously described, this significance threshold is not binding on the Project, yet in the absence of an established threshold from the ICAPCD it is instructive for comparison purposes. This threshold is also appropriate for use in this analysis as the SCAQMD GHG thresholds were formulated based on similar geography and climate patterns as found in Imperial County and are also employed for use in CEQA GHG analyses in the Riverside County portion of the SSAB, the same air basin that encompasses the proposed Project.

Operations

The proposed Project would not include the provision of new permanent stationary or mobile sources of GHG emissions, and therefore, by its very nature, would not generate quantifiable GHG emissions from Project operations. In addition, once the proposed Project is implemented, there would be no increase in automobile trips to the area. While it is anticipated that the proposed Project would require intermittent maintenance, maintenance would be minimal requiring a negligible amount of traffic trips on an annual basis. Further, the Project proposes installing and upgrading transmission lines for the purpose of transmitting clean renewable energy from a solar generation facility. Solar plants generate far less GHG life-cycle emissions (approximately 83 to 94 percent less) than fossil-fueled energy plants. Thus, the Project would potentially assist in the displacement of CO_2e over the course of 30 years, helping to offset any GHG life-cycle emissions generated by any construction activities associated with the proposed Project.

Operational-generated emissions would not exceed the significance threshold of 3,000 metric tons of CO_2e annually.

Conflict with any Applicable Plan, Policy, or Regulation of an Agency Adopted for the Purpose of Reducing the Emissions of Greenhouse Gases

The Project would not conflict with any adopted plans, policies, or regulations adopted for the purpose of reducing GHG emissions. The proposed Project is subject to compliance with SB 32. As discussed

previously, the proposed Project-generated GHG emissions would not surpass the SCAQMD's GHG significance thresholds, which were prepared with the purpose of complying with statewide GHG-reduction efforts. Additionally, once implementation of the Project is complete it would not be a source of operational GHG emissions.

4.0 REFERENCES

CAPCOA. 2017. California Emissions Estimator Model (CalEEMod), version 2016.3.2.

____. 2013. Health Effects. http://www.capcoa.org/health-effects/.

CARB. 2020a. Air Quality Data Statistics. http://www.arb.ca.gov/adam/index.html.

____. 2020b. California Greenhouse Gas Emission Inventory 2020 Edition. https://ww3.arb.ca.gov/cc/inventory/data/data.htm

____. 2019. State and Federal Area Designation Maps. http://www.arb.ca.gov/desig/adm/adm.htm.

____. 2018. SB 375 Regional Greenhouse Gas Emissions Reduction Targets. https://ww3.arb.ca.gov/cc/sb375/finaltargets2018.pdf

____. 2017a. California's 2017 Climate Change Scoping Plan. https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

____. 2016. 2016 Sustainable Communities Strategy (SCS) · ARB Acceptance of GHG Quantification Determination.

____. 2014. First Update to the Climate Change Scoping Plan: Building on the Framework. May 2014. http://www.arb.ca.gov/cc/scopingplan/document/ updatedscopingplan2013.htm.

____. 2008. Climate Change Scoping Plan Appendices (Appendix F).

____. 2005. Air Quality and Land Use Handbook

Crockett, Alexander G. 2011. Addressing the Significance of Greenhouse Gas Emissions Under CEQA: California's Search for Regulatory Certainty in an Uncertain World.

DOC. 2000. *A General Location Guide for Ultramafic Rocks in California-Areas More Likely to Contain Naturally Occurring Asbestos.*

IPCC. 2014. Climate Change 2014 Synthesis Report: Approved Summary for Policymakers. http://www.ipcc.ch/.

____. 2013. Carbon and Other Biogeochemical Cycles. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. http://www.climatechange2013.org/ images/report/WG1AR5_ALL_FINAL.pdf.

ICAPCD. 2017. *Air Quality Handbook.*

____. 2010. *Final 2009 1997 8-Hour Ozone Modified Air Quality Management Plan.*

SCAQMD (South Coast Air Quality Management District). 2003. Air Quality Management Plan.

____. 1992. 1992 Federal Attainment Plan for Carbon Monoxide.

USEPA. 2016a. Climate Change – Greenhouse Gas Emissions: Carbon Dioxide. http://www.epa.gov/climatechange/emissions/co2.html.

_____. 2016b. Methane. https://www3.epa.gov/climatechange/ghgemissions/gases/ch4.html.

_____. 2016c. Nitrous Oxide. https://www3.epa.gov/climatechange/ghgemissions/gases/n2o.html.

_____. 2002. Health Assessment Document for Diesel Engine Exhaust. https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=300055PV.TXT.

LIST OF ATTACHMENTS

Attachment A – CalEEMod Output Files – Criteria Air Pollutant Emissions

Attachment B – CalEEMod Output Files – Greenhouse Gas Emissions

ATTACHMENT A

CalEEMod Output Files – Criteria Air Pollutant Emissions

DATA, EQUIPMENT AND TIME ESTIMATE – General Information

Please provide all applicable data. Note that all listed equipment will be assumed to operate 8 hours daily unless otherwise indicated.

Provided data can be estimates. Any data not known will be supplied with modeling software defaults

Project: _Vega S-Line Transmission Line Upgrade and New Pole Installation

Land Use Type	Units/ SF
Lay Down Yard	30,000

Building Demolition

Tons of Demolished Material	
OR	
Building Square Footage	

Earthwork

Total Cut (cubic yards)	3420
Total Fill (cubic yards)	3420

Start Dates (For One Phase Projects)

Construction Activity	(Month/ Year)	Duration (Months)
Demolition (if applicable)	3/22/2022	5/31/2022
Site Preparation		
Grading	8/31/2021	1/20/2022
Construction	9/27/2021	3/21/2022
Paving		
Painting		

Start Dates (For Multi- Phase Projects)

Construction Activity	(Month/ Year)	Duration (Months)
PHASE 1		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		
PHASE 2		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		
PHASE 3		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		

Construction Equipment- Demolition

Equipment	# of Units	Model Year	
Bore/Drill Rigs	2	TBD	
Concrete/Industrial Saws			
Crane	3	2018	
Crawler Tractors			
Crushing/Processing Equip.			
Excavators			
Graders			
Off-Highway Tractors			
Off-Highway Trucks			
Other Equipment	15	2018 (newer) / Tier 4	Bucket Trucks (6), Air Compressors (3), Boom Lifts (6),
Pavers			
Paving Equipment			
Pile Drivers			
Rollers			
Rough Terrain Forklifts	2	2018 - Tier 4	
Rubber Tired Dozers			
Rubber Tired Loaders			
Scrapers			
Signal Boards			
Skid Steer Loaders	2	2018 - Tier 4	
Surfacing Equipment			
Tractors/Loaders/Backhoes	2	2018 - Tier 4	
Trenchers			
Water Trucks	3	2018	
Dump Trucks	2	2018	
Semi Tractor	4	2018	
Light Duty P/U's	12	2019 (or newer)	

Construction Equipment- Grading

Equipment	# of Units	Model Year
Bore/Drill Rigs	2	2018 - Tier 4
Concrete/Industrial Saws		
Crane	2	2018 - Tier 4
Crawler Tractors		
Crushing/Processing Equip.		
Excavators		
Graders		
Off-Highway Tractors		
Off-Highway Trucks		
Other Equipment		
Pavers		
Paving Equipment		
Pile Drivers		
Rollers		
Rough Terrain Forklifts	2	2018 - Tier 4
Rubber Tired Dozers		
Rubber Tired Loaders	2	2018 - Tier 4
Scrapers		
Signal Boards		
Skid Steer Loaders	2	2018 - Tier 4
Surfacing Equipment		
Tractors/Loaders/Backhoes		
Trenchers		

*Other Equipment: Bucket Trucks (6), Air Compressors (3), Boom Lifts (6), Drum Puller (1), Wire Puller (1), Wire Tensioner (1), & Wire Reeler (3)

Construction Equipment- Construction

Equipment	# of Units	Model Year
Bore/Drill Rigs	2	TBD
Concrete/Industrial Saws		
Crane	3	2018
Crawler Tractors		
Crushing/Processing Equip.		
Excavators		
Graders		
Off-Highway Tractors		
Off-Highway Trucks		
*Other Equipment	21	2018 (newer) / Tier 4
Pavers		
Paving Equipment		
Pile Drivers		
Rollers		
Rough Terrain Forklifts	2	2018 - Tier 4
Rubber Tired Dozers		
Rubber Tired Loaders		
Scrapers		
Signal Boards		
Skid Steer Loaders	2	2018 - Tier 4
Surfacing Equipment		
Tractors/Loaders/Backhoes	2	2018 - Tier 4
Trenchers		
Water Trucks	3	2018
Dump Trucks	2	2018
Semi Tractor	4	2018
Light Duty P/U's	12	2019 (or newer)

CalEEMod Equipment Equivelents

CalEEMod Equipment Equivelents
*Rough Terrain Forklifts = Boom Lifts
*Off-Highway Trucks1 = Bucket Trucks
*Off-Highway Trucks2 = Water Trucks
*Off-Highway Trucks = Dump Trucks
*Off-Highway Trucks = Semi Tractors
*Off-Highway Trucks3 = Light Duty P/U's
*Other Construction Equipment = Drum Puller
*Other Construction Equipment = Wire Puller
*Other Construction Equipment = Wire Tensioner
*Other Construction Equipment = Wire Reeler

Vega S-Line Unmitigated

Imperial County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Other Non-Asphalt Surfaces	411.00	Acre	411.00	17,903,160.00	0

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.4	**Precipitation Freq (Days)**	12
Climate Zone	15			**Operational Year**	2023
Utility Company	Imperial Irrigation District				
CO2 Intensity (lb/MWhr)	1270.9	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Project Timeframes and Phases updated per Project Applicant questionnaire

Off-road Equipment - No architectural coating phase

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Off-road Equipment - Equipment list updated per Project Applicant Questionnaire

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Trips and VMT - Average Daily Trips account for 2 trips per equipment type for worker trips, default factor used to quantify vendor trips

On-road Fugitive Dust - Majority of roadways surrounding project area are paved, 5% accounts for the 7 miles of transmission line on dirt roadways

Architectural Coating - No architectural coating phase

Road Dust - 5% unpaved roadway accounts for 7 miles of transmission line unpaved

Construction Off-road Equipment Mitigation - Engine Tier updated per Project Applicant questionnaire

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	8.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	54.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	18.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	4.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final

Vega S-Line Unmitigated - Imperial County, Summer

tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	7,750.00	126.00
tblConstructionPhase	NumDays	500.00	51.00
tblConstructionPhase	NumDays	775.00	103.00
tblGrading	AcresOfGrading	0.00	1,937.50
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural

tblRoadDust	RoadPercentPave	50	95
tblTripsAndVMT	VendorTripNumber	2,934.00	41.00
tblTripsAndVMT	WorkerTripNumber	7,519.00	106.00
tblTripsAndVMT	WorkerTripNumber	118.00	94.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	19.3737	182.5061	149.9280	0.4056	151.7919	7.2171	159.0090	15.5486	6.6704	22.2189	0.0000	39,383.6106	39,383.6106	11.7311	0.0000	39,676.8870
2022	17.1972	149.5387	144.2315	0.4053	151.7919	5.8536	157.6454	15.5486	5.4119	20.9604	0.0000	39,349.8454	39,349.8454	11.7212	0.0000	39,642.8739
Maximum	**19.3737**	**182.5061**	**149.9280**	**0.4056**	**151.7919**	**7.2171**	**159.0090**	**15.5486**	**6.6704**	**22.2189**	**0.0000**	**39,383.6106**	**39,383.6106**	**11.7311**	**0.0000**	**39,676.8870**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	6.4761	39.6377	199.1436	0.4056	151.7919	0.9417	152.7336	15.5486	0.9113	16.4599	0.0000	39,383.6106	39,383.6106	11.7311	0.0000	39,676.8870
2022	6.2599	36.2386	198.2511	0.4053	151.7919	0.8638	152.6557	15.5486	0.8396	16.3882	0.0000	39,349.8454	39,349.8454	11.7212	0.0000	39,642.8739
Maximum	**6.4761**	**39.6377**	**199.1436**	**0.4056**	**151.7919**	**0.9417**	**152.7336**	**15.5486**	**0.9113**	**16.4599**	**0.0000**	**39,383.6106**	**39,383.6106**	**11.7311**	**0.0000**	**39,676.8870**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**65.17**	**77.15**	**-35.10**	**0.00**	**0.00**	**86.19**	**3.56**	**0.00**	**85.51**	**23.93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Grading	Grading	8/31/2021	1/20/2022	5	103	
2	Building Construction	Building Construction	9/27/2021	3/21/2022	5	126	
3	Demolition	Demolition	3/22/2022	5/31/2022	5	51	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 1937.5

Acres of Paving: 411

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Grading	Bore/Drill Rigs	2	8.00	221	0.50
Grading	Cranes	2	8.00	231	0.29
Grading	Excavators	0	8.00	158	0.38
Grading	Graders	0	8.00	187	0.41
Grading	Rough Terrain Forklifts	2	8.00	100	0.40
Grading	Rubber Tired Dozers	0	8.00	247	0.40
Grading	Scrapers	0	8.00	367	0.48

Vega S-Line Unmitigated - Imperial County, Summer

Grading	Skid Steer Loaders	2	8.00	65	0.37
Grading	Tractors/Loaders/Backhoes	0	8.00	97	0.37
Building Construction	Air Compressors	3	8.00	78	0.48
Building Construction	Bore/Drill Rigs	2	8.00	221	0.50
Building Construction	Cranes	3	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Off-Highway Trucks	15	8.00	402	0.38
Building Construction	Off-Highway Trucks	12	1.00	402	0.38
Building Construction	Other Construction Equipment	6	8.00	172	0.42
Building Construction	Rough Terrain Forklifts	8	8.00	100	0.40
Building Construction	Skid Steer Loaders	2	8.00	65	0.37
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Demolition	Air Compressors	3	8.00	78	0.48
Demolition	Bore/Drill Rigs	2	8.00	221	0.50
Demolition	Concrete/Industrial Saws	0	8.00	81	0.73
Demolition	Cranes	3	8.00	231	0.29
Demolition	Excavators	0	8.00	158	0.38
Demolition	Off-Highway Trucks	15	8.00	402	0.38
Demolition	Off-Highway Trucks	12	1.00	402	0.38
Demolition	Rough Terrain Forklifts	6	8.00	100	0.40
Demolition	Rough Terrain Forklifts	2	8.00	100	0.40
Demolition	Rubber Tired Dozers	0	8.00	247	0.40
Demolition	Skid Steer Loaders	2	8.00	65	0.37
Demolition	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Grading	8	20.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	53	106.00	41.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Demolition	47	94.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 Grading - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.7395	20.9758	15.4818	0.0414		0.7836	0.7836		0.7209	0.7209		4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**1.7395**	**20.9758**	**15.4818**	**0.0414**	**19.9487**	**0.7836**	**20.7324**	**2.1540**	**0.7209**	**2.8749**		**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1576	0.1048	1.2167	1.5300e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		151.0169	151.0169	0.0118		151.3128
Total	**0.1576**	**0.1048**	**1.2167**	**1.5300e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**151.0169**	**151.0169**	**0.0118**		**151.3128**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	0.8446	9.3512	17.7059	0.0414		0.2202	0.2202		0.2056	0.2056	0.0000	4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**0.8446**	**9.3512**	**17.7059**	**0.0414**	**19.9487**	**0.2202**	**20.1690**	**2.1540**	**0.2056**	**2.3596**	**0.0000**	**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1576	0.1048	1.2167	1.5300e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		151.0169	151.0169	0.0118		151.3128
Total	**0.1576**	**0.1048**	**1.2167**	**1.5300e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**151.0169**	**151.0169**	**0.0118**		**151.3128**

3.2 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.5571	17.7192	15.2181	0.0415		0.6652	0.6652		0.6120	0.6120		4,013.0738	4,013.0738	1.2979		4,045.5216
Total	**1.5571**	**17.7192**	**15.2181**	**0.0415**	**19.9487**	**0.6652**	**20.6140**	**2.1540**	**0.6120**	**2.7660**		**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5216**

3.2 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1470	0.0962	1.1146	1.4700e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		145.5040	145.5040	0.0108		145.7741
Total	**0.1470**	**0.0962**	**1.1146**	**1.4700e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**145.5040**	**145.5040**	**0.0108**		**145.7741**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	0.7764	7.8385	17.6403	0.0415		0.1825	0.1825		0.1708	0.1708	0.0000	4,013.0738	4,013.0738	1.2979		4,045.5215
Total	**0.7764**	**7.8385**	**17.6403**	**0.0415**	**19.9487**	**0.1825**	**20.1312**	**2.1540**	**0.1708**	**2.3248**	**0.0000**	**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5215**

3.2 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1470	0.0962	1.1146	1.4700e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		145.5040	145.5040	0.0108		145.7741
Total	**0.1470**	**0.0962**	**1.1146**	**1.4700e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**145.5040**	**145.5040**	**0.0108**		**145.7741**

3.3 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	16.4567	156.2364	125.5142	0.3380		6.4135	6.4135		5.9305	5.9305		32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**16.4567**	**156.2364**	**125.5142**	**0.3380**		**6.4135**	**6.4135**		**5.9305**	**5.9305**		**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1847	4.6339	1.2666	0.0165	36.3379	0.0139	36.3518	3.7088	0.0133	3.7221		1,722.1578	1,722.1578	0.0706		1,723.9218
Worker	0.8351	0.5552	6.4486	8.1000e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		800.3898	800.3898	0.0627		801.9580
Total	**1.0199**	**5.1891**	**7.7152**	**0.0246**	**116.6836**	**0.0190**	**116.7026**	**11.8572**	**0.0180**	**11.8751**		**2,522.5476**	**2,522.5476**	**0.1333**		**2,525.8799**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.4541	24.9926	172.5057	0.3380		0.7015	0.7015		0.6869	0.6869	0.0000	32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**4.4541**	**24.9926**	**172.5057**	**0.3380**		**0.7015**	**0.7015**		**0.6869**	**0.6869**	**0.0000**	**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1847	4.6339	1.2666	0.0165	36.3379	0.0139	36.3518	3.7088	0.0133	3.7221		1,722.1578	1,722.1578	0.0706		1,723.9218
Worker	0.8351	0.5552	6.4486	8.1000e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		800.3898	800.3898	0.0627		801.9580
Total	**1.0199**	**5.1891**	**7.7152**	**0.0246**	**116.6836**	**0.0190**	**116.7026**	**11.8572**	**0.0180**	**11.8751**		**2,522.5476**	**2,522.5476**	**0.1333**		**2,525.8799**

3.3 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	14.5425	126.8994	120.8426	0.3382		5.1707	5.1707		4.7832	4.7832		32,711.0748	32,711.0748	10.2886		32,968.2903
Total	**14.5425**	**126.8994**	**120.8426**	**0.3382**		**5.1707**	**5.1707**		**4.7832**	**4.7832**		**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2903**

3.3 Building Construction - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1712	4.3143	1.1490	0.0164	36.3379	0.0118	36.3497	3.7088	0.0113	3.7201		1,709.0217	1,709.0217	0.0665		1,710.6851
Worker	0.7793	0.5096	5.9072	7.8000e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		771.1711	771.1711	0.0573		772.6029
Total	**0.9505**	**4.8239**	**7.0562**	**0.0242**	**116.6836**	**0.0167**	**116.7002**	**11.8572**	**0.0158**	**11.8729**		**2,480.1928**	**2,480.1928**	**0.1238**		**2,483.2880**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.3860	23.4799	172.4401	0.3382		0.6638	0.6638		0.6521	0.6521	0.0000	32,711.0748	32,711.0748	10.2886		32,968.2902
Total	**4.3860**	**23.4799**	**172.4401**	**0.3382**		**0.6638**	**0.6638**		**0.6521**	**0.6521**	**0.0000**	**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2902**

3.3 Building Construction - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1712	4.3143	1.1490	0.0164	36.3379	0.0118	36.3497	3.7088	0.0113	3.7201		1,709.0217	1,709.0217	0.0665		1,710.6851
Worker	0.7793	0.5096	5.9072	7.8000e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		771.1711	771.1711	0.0573		772.6029
Total	**0.9505**	**4.8239**	**7.0562**	**0.0242**	**116.6836**	**0.0167**	**116.7002**	**11.8572**	**0.0158**	**11.8729**		**2,480.1928**	**2,480.1928**	**0.1238**		**2,483.2880**

3.4 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	12.4677	105.9968	97.9901	0.3041		4.0641	4.0641		3.7651	3.7651		29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**12.4677**	**105.9968**	**97.9901**	**0.3041**		**4.0641**	**4.0641**		**3.7651**	**3.7651**		**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.6911	0.4519	5.2384	6.9100e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		683.8687	683.8687	0.0508		685.1384
Total	**0.6911**	**0.4519**	**5.2384**	**6.9100e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**683.8687**	**683.8687**	**0.0508**		**685.1384**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.9634	21.6487	145.7154	0.3041		0.6074	0.6074		0.5958	0.5958	0.0000	29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**3.9634**	**21.6487**	**145.7154**	**0.3041**		**0.6074**	**0.6074**		**0.5958**	**0.5958**	**0.0000**	**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.6911	0.4519	5.2384	6.9100e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		683.8687	683.8687	0.0508		685.1384
Total	**0.6911**	**0.4519**	**5.2384**	**6.9100e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**683.8687**	**683.8687**	**0.0508**		**685.1384**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Other Non-Asphalt Surfaces	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Other Non-Asphalt Surfaces	16.40	9.50	11.90	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Other Non-Asphalt Surfaces	0.519925	0.031155	0.160764	0.115847	0.015498	0.004819	0.018987	0.121625	0.003553	0.001235	0.005240	0.000729	0.000624

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Unmitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Vega S-Line Unmitigated

Imperial County, Winter

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Other Non-Asphalt Surfaces	411.00	Acre	411.00	17,903,160.00	0

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.4	**Precipitation Freq (Days)**	12
Climate Zone	15			**Operational Year**	2023
Utility Company	Imperial Irrigation District				
CO2 Intensity (lb/MWhr)	1270.9	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Project Timeframes and Phases updated per Project Applicant questionnaire

Off-road Equipment - No architectural coating phase

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Off-road Equipment - Equipment list updated per Project Applicant Questionnaire

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Trips and VMT - Average Daily Trips account for 2 trips per equipment type for worker trips, default factor used to quantify vendor trips

On-road Fugitive Dust - Majority of roadways surrounding project area are paved, 5% accounts for the 7 miles of transmission line on dirt roadways

Architectural Coating - No architectural coating phase

Road Dust - 5% unpaved roadway accounts for 7 miles of transmission line unpaved

Construction Off-road Equipment Mitigation - Engine Tier updated per Project Applicant questionnaire

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	8.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	54.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	18.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	4.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final

Vega S-Line Unmitigated - Imperial County, Winter

tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	7,750.00	126.00
tblConstructionPhase	NumDays	500.00	51.00
tblConstructionPhase	NumDays	775.00	103.00
tblGrading	AcresOfGrading	0.00	1,937.50
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural

tblRoadDust	RoadPercentPave	50	95
tblTripsAndVMT	VendorTripNumber	2,934.00	41.00
tblTripsAndVMT	WorkerTripNumber	7,519.00	106.00
tblTripsAndVMT	WorkerTripNumber	118.00	94.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	19.2195	182.6409	148.0123	0.4035	151.7919	7.2175	159.0093	15.5486	6.6707	22.2193	0.0000	39,179.1728	39,179.1728	11.7235	0.0000	39,472.2608
2022	17.0571	149.6458	142.4751	0.4033	151.7919	5.8539	157.6458	15.5486	5.4122	20.9608	0.0000	39,150.9973	39,150.9973	11.7150	0.0000	39,443.8716
Maximum	**19.2195**	**182.6409**	**148.0123**	**0.4035**	**151.7919**	**7.2175**	**159.0093**	**15.5486**	**6.6707**	**22.2193**	**0.0000**	**39,179.1728**	**39,179.1728**	**11.7235**	**0.0000**	**39,472.2608**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	6.3219	39.7725	197.2279	0.4035	151.7919	0.9421	152.7339	15.5486	0.9117	16.4602	0.0000	39,179.1727	39,179.1727	11.7235	0.0000	39,472.2607
2022	6.1199	36.3457	196.4948	0.4033	151.7919	0.8642	152.6560	15.5486	0.8399	16.3885	0.0000	39,150.9973	39,150.9973	11.7150	0.0000	39,443.8716
Maximum	**6.3219**	**39.7725**	**197.2279**	**0.4035**	**151.7919**	**0.9421**	**152.7339**	**15.5486**	**0.9117**	**16.4602**	**0.0000**	**39,179.1727**	**39,179.1727**	**11.7235**	**0.0000**	**39,472.2607**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	65.70	77.09	-35.54	0.00	0.00	86.18	3.56	0.00	85.50	23.93	0.00	0.00	0.00	0.00	0.00	0.00

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Grading	Grading	8/31/2021	1/20/2022	5	103	
2	Building Construction	Building Construction	9/27/2021	3/21/2022	5	126	
3	Demolition	Demolition	3/22/2022	5/31/2022	5	51	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 1937.5

Acres of Paving: 411

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Grading	Bore/Drill Rigs	2	8.00	221	0.50
Grading	Cranes	2	8.00	231	0.29
Grading	Excavators	0	8.00	158	0.38
Grading	Graders	0	8.00	187	0.41
Grading	Rough Terrain Forklifts	2	8.00	100	0.40
Grading	Rubber Tired Dozers	0	8.00	247	0.40
Grading	Scrapers	0	8.00	367	0.48

Vega S-Line Unmitigated - Imperial County, Winter

Grading	Skid Steer Loaders	2	8.00	65	0.37
Grading	Tractors/Loaders/Backhoes	0	8.00	97	0.37
Building Construction	Air Compressors	3	8.00	78	0.48
Building Construction	Bore/Drill Rigs	2	8.00	221	0.50
Building Construction	Cranes	3	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Off-Highway Trucks	15	8.00	402	0.38
Building Construction	Off-Highway Trucks	12	1.00	402	0.38
Building Construction	Other Construction Equipment	6	8.00	172	0.42
Building Construction	Rough Terrain Forklifts	8	8.00	100	0.40
Building Construction	Skid Steer Loaders	2	8.00	65	0.37
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Demolition	Air Compressors	3	8.00	78	0.48
Demolition	Bore/Drill Rigs	2	8.00	221	0.50
Demolition	Concrete/Industrial Saws	0	8.00	81	0.73
Demolition	Cranes	3	8.00	231	0.29
Demolition	Excavators	0	8.00	158	0.38
Demolition	Off-Highway Trucks	15	8.00	402	0.38
Demolition	Off-Highway Trucks	12	1.00	402	0.38
Demolition	Rough Terrain Forklifts	6	8.00	100	0.40
Demolition	Rough Terrain Forklifts	2	8.00	100	0.40
Demolition	Rubber Tired Dozers	0	8.00	247	0.40
Demolition	Skid Steer Loaders	2	8.00	65	0.37
Demolition	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Grading	8	20.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	53	106.00	41.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Demolition	47	94.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 Grading - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.7395	20.9758	15.4818	0.0414		0.7836	0.7836		0.7209	0.7209		4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**1.7395**	**20.9758**	**15.4818**	**0.0414**	**19.9487**	**0.7836**	**20.7324**	**2.1540**	**0.7209**	**2.8749**		**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1321	0.1100	0.8864	1.2800e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		126.4644	126.4644	9.3800e-003		126.6989
Total	**0.1321**	**0.1100**	**0.8864**	**1.2800e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**126.4644**	**126.4644**	**9.3800e-003**		**126.6989**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	0.8446	9.3512	17.7059	0.0414		0.2202	0.2202		0.2056	0.2056	0.0000	4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**0.8446**	**9.3512**	**17.7059**	**0.0414**	**19.9487**	**0.2202**	**20.1690**	**2.1540**	**0.2056**	**2.3596**	**0.0000**	**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1321	0.1100	0.8864	1.2800e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		126.4644	126.4644	9.3800e-003		126.6989
Total	**0.1321**	**0.1100**	**0.8864**	**1.2800e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**126.4644**	**126.4644**	**9.3800e-003**		**126.6989**

3.2 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.5571	17.7192	15.2181	0.0415		0.6652	0.6652		0.6120	0.6120		4,013.0738	4,013.0738	1.2979		4,045.5216
Total	**1.5571**	**17.7192**	**15.2181**	**0.0415**	**19.9487**	**0.6652**	**20.6140**	**2.1540**	**0.6120**	**2.7660**		**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5216**

3.2 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1238	0.1008	0.8107	1.2300e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		121.8478	121.8478	8.6000e-003		122.0628
Total	**0.1238**	**0.1008**	**0.8107**	**1.2300e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**121.8478**	**121.8478**	**8.6000e-003**		**122.0628**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	0.7764	7.8385	17.6403	0.0415		0.1825	0.1825		0.1708	0.1708	0.0000	4,013.0738	4,013.0738	1.2979		4,045.5215
Total	**0.7764**	**7.8385**	**17.6403**	**0.0415**	**19.9487**	**0.1825**	**20.1312**	**2.1540**	**0.1708**	**2.3248**	**0.0000**	**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5215**

3.2 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1238	0.1008	0.8107	1.2300e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		121.8478	121.8478	8.6000e-003		122.0628
Total	**0.1238**	**0.1008**	**0.8107**	**1.2300e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**121.8478**	**121.8478**	**8.6000e-003**		**122.0628**

3.3 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	16.4567	156.2364	125.5142	0.3380		6.4135	6.4135		5.9305	5.9305		32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**16.4567**	**156.2364**	**125.5142**	**0.3380**		**6.4135**	**6.4135**		**5.9305**	**5.9305**		**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1910	4.7357	1.4319	0.0160	36.3379	0.0142	36.3522	3.7088	0.0136	3.7224		1,672.4009	1,672.4009	0.0785		1,674.3631
Worker	0.7001	0.5830	4.6980	6.7700e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		670.2613	670.2613	0.0497		671.5044
Total	**0.8911**	**5.3187**	**6.1299**	**0.0228**	**116.6836**	**0.0194**	**116.7029**	**11.8572**	**0.0183**	**11.8755**		**2,342.6622**	**2,342.6622**	**0.1282**		**2,345.8675**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.4541	24.9926	172.5057	0.3380		0.7015	0.7015		0.6869	0.6869	0.0000	32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**4.4541**	**24.9926**	**172.5057**	**0.3380**		**0.7015**	**0.7015**		**0.6869**	**0.6869**	**0.0000**	**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1910	4.7357	1.4319	0.0160	36.3379	0.0142	36.3522	3.7088	0.0136	3.7224		1,672.4009	1,672.4009	0.0785		1,674.3631
Worker	0.7001	0.5830	4.6980	6.7700e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		670.2613	670.2613	0.0497		671.5044
Total	**0.8911**	**5.3187**	**6.1299**	**0.0228**	**116.6836**	**0.0194**	**116.7029**	**11.8572**	**0.0183**	**11.8755**		**2,342.6622**	**2,342.6622**	**0.1282**		**2,345.8675**

3.3 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	14.5425	126.8994	120.8426	0.3382		5.1707	5.1707		4.7832	4.7832		32,711.0748	32,711.0748	10.2886		32,968.2903
Total	**14.5425**	**126.8994**	**120.8426**	**0.3382**		**5.1707**	**5.1707**		**4.7832**	**4.7832**		**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2903**

3.3 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1773	4.3922	1.3069	0.0159	36.3379	0.0121	36.3500	3.7088	0.0116	3.7204		1,659.2078	1,659.2078	0.0743		1,661.0640
Worker	0.6563	0.5342	4.2968	6.5200e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		645.7931	645.7931	0.0456		646.9330
Total	**0.8336**	**4.9264**	**5.6037**	**0.0224**	**116.6836**	**0.0170**	**116.7006**	**11.8572**	**0.0161**	**11.8732**		**2,305.0009**	**2,305.0009**	**0.1199**		**2,307.9970**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.3860	23.4799	172.4401	0.3382		0.6638	0.6638		0.6521	0.6521	0.0000	32,711.0748	32,711.0748	10.2886		32,968.2902
Total	**4.3860**	**23.4799**	**172.4401**	**0.3382**		**0.6638**	**0.6638**		**0.6521**	**0.6521**	**0.0000**	**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2902**

3.3 Building Construction - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1773	4.3922	1.3069	0.0159	36.3379	0.0121	36.3500	3.7088	0.0116	3.7204		1,659.2078	1,659.2078	0.0743		1,661.0640
Worker	0.6563	0.5342	4.2968	6.5200e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		645.7931	645.7931	0.0456		646.9330
Total	**0.8336**	**4.9264**	**5.6037**	**0.0224**	**116.6836**	**0.0170**	**116.7006**	**11.8572**	**0.0161**	**11.8732**		**2,305.0009**	**2,305.0009**	**0.1199**		**2,307.9970**

3.4 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	12.4677	105.9968	97.9901	0.3041		4.0641	4.0641		3.7651	3.7651		29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**12.4677**	**105.9968**	**97.9901**	**0.3041**		**4.0641**	**4.0641**		**3.7651**	**3.7651**		**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.5820	0.4737	3.8104	5.7800e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		572.6844	572.6844	0.0404		573.6953
Total	**0.5820**	**0.4737**	**3.8104**	**5.7800e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**572.6844**	**572.6844**	**0.0404**		**573.6953**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.9634	21.6487	145.7154	0.3041		0.6074	0.6074		0.5958	0.5958	0.0000	29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**3.9634**	**21.6487**	**145.7154**	**0.3041**		**0.6074**	**0.6074**		**0.5958**	**0.5958**	**0.0000**	**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.5820	0.4737	3.8104	5.7800e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		572.6844	572.6844	0.0404		573.6953
Total	**0.5820**	**0.4737**	**3.8104**	**5.7800e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**572.6844**	**572.6844**	**0.0404**		**573.6953**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Other Non-Asphalt Surfaces	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Other Non-Asphalt Surfaces	16.40	9.50	11.90	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Other Non-Asphalt Surfaces	0.519925	0.031155	0.160764	0.115847	0.015498	0.004819	0.018987	0.121625	0.003553	0.001235	0.005240	0.000729	0.000624

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Unmitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Vega S-Line Mitigated

Imperial County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Other Non-Asphalt Surfaces	411.00	Acre	411.00	17,903,160.00	0

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.4	**Precipitation Freq (Days)**	12
Climate Zone	15			**Operational Year**	2023
Utility Company	Imperial Irrigation District				
CO2 Intensity (lb/MWhr)	1270.9	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Project Timeframes and Phases updated per Project Applicant questionnaire

Off-road Equipment - No architectural coating phase

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Off-road Equipment - Equipment list updated per Project Applicant Questionnaire

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Trips and VMT - Average Daily Trips account for 2 trips per equipment type for worker trips, default factor used to quantify vendor trips

On-road Fugitive Dust - Majority of roadways surrounding project area are paved, 5% accounts for the 7 miles of transmission line on dirt roadways

Architectural Coating - No architectural coating phase

Road Dust - Mitigation requiring worker commutes to utilize paved-only roadways

Construction Off-road Equipment Mitigation - Engine Tier updated per Project Applicant questionnaire; Mitigation requirement: Water exposed areas 3 times per day for Fugitive Dust reduction

Vehicle Trips - Average Daily Trips account for routine maintenance and monitoring activities

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	8.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	54.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	18.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	4.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final

Vega S-Line Mitigated - Imperial County, Summer

tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	7,750.00	126.00
tblConstructionPhase	NumDays	500.00	51.00
tblConstructionPhase	NumDays	775.00	103.00
tblGrading	AcresOfGrading	0.00	1,937.50
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00

tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblRoadDust	RoadPercentPave	50	100
tblTripsAndVMT	VendorTripNumber	2,934.00	41.00
tblTripsAndVMT	WorkerTripNumber	7,519.00	106.00
tblTripsAndVMT	WorkerTripNumber	118.00	94.00
tblVehicleTrips	ST_TR	0.00	0.10
tblVehicleTrips	SU_TR	0.00	0.10
tblVehicleTrips	WD_TR	0.00	0.10

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	19.3737	182.5061	149.9280	0.4056	151.7919	7.2171	159.0090	15.5486	6.6704	22.2189	0.0000	39,383.6106	39,383.6106	11.7311	0.0000	39,676.8870
2022	17.1972	149.5387	144.2315	0.4053	151.7919	5.8536	157.6454	15.5486	5.4119	20.9604	0.0000	39,349.8454	39,349.8454	11.7212	0.0000	39,642.8739
Maximum	**19.3737**	**182.5061**	**149.9280**	**0.4056**	**151.7919**	**7.2171**	**159.0090**	**15.5486**	**6.6704**	**22.2189**	**0.0000**	**39,383.6106**	**39,383.6106**	**11.7311**	**0.0000**	**39,676.8870**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	6.4761	39.6377	199.1436	0.4056	139.6232	0.9417	140.5649	14.2346	0.9113	15.1459	0.0000	39,383.6106	39,383.6106	11.7311	0.0000	39,676.8870
2022	6.2599	36.2386	198.2511	0.4053	139.6232	0.8638	140.4870	14.2346	0.8396	15.0742	0.0000	39,349.8454	39,349.8454	11.7212	0.0000	39,642.8739
Maximum	**6.4761**	**39.6377**	**199.1436**	**0.4056**	**139.6232**	**0.9417**	**140.5649**	**14.2346**	**0.9113**	**15.1459**	**0.0000**	**39,383.6106**	**39,383.6106**	**11.7311**	**0.0000**	**39,676.8870**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	65.17	77.15	-35.10	0.00	8.02	86.19	11.24	8.45	85.51	30.01	0.00	0.00	0.00	0.00	0.00	0.00

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Grading	Grading	8/31/2021	1/20/2022	5	103	
2	Building Construction	Building Construction	9/27/2021	3/21/2022	5	126	
3	Demolition	Demolition	3/22/2022	5/31/2022	5	51	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 1937.5

Acres of Paving: 411

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Grading	Bore/Drill Rigs	2	8.00	221	0.50
Grading	Cranes	2	8.00	231	0.29
Grading	Excavators	0	8.00	158	0.38
Grading	Graders	0	8.00	187	0.41
Grading	Rough Terrain Forklifts	2	8.00	100	0.40
Grading	Rubber Tired Dozers	0	8.00	247	0.40
Grading	Scrapers	0	8.00	367	0.48

Vega S-Line Mitigated - Imperial County, Summer

Grading	Skid Steer Loaders	2	8.00	65	0.37
Grading	Tractors/Loaders/Backhoes	0	8.00	97	0.37
Building Construction	Air Compressors	3	8.00	78	0.48
Building Construction	Bore/Drill Rigs	2	8.00	221	0.50
Building Construction	Cranes	3	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Off-Highway Trucks	15	8.00	402	0.38
Building Construction	Off-Highway Trucks	12	1.00	402	0.38
Building Construction	Other Construction Equipment	6	8.00	172	0.42
Building Construction	Rough Terrain Forklifts	8	8.00	100	0.40
Building Construction	Skid Steer Loaders	2	8.00	65	0.37
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Demolition	Air Compressors	3	8.00	78	0.48
Demolition	Bore/Drill Rigs	2	8.00	221	0.50
Demolition	Concrete/Industrial Saws	0	8.00	81	0.73
Demolition	Cranes	3	8.00	231	0.29
Demolition	Excavators	0	8.00	158	0.38
Demolition	Off-Highway Trucks	15	8.00	402	0.38
Demolition	Off-Highway Trucks	12	1.00	402	0.38
Demolition	Rough Terrain Forklifts	6	8.00	100	0.40
Demolition	Rough Terrain Forklifts	2	8.00	100	0.40
Demolition	Rubber Tired Dozers	0	8.00	247	0.40
Demolition	Skid Steer Loaders	2	8.00	65	0.37
Demolition	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Grading	8	20.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	53	106.00	41.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Demolition	47	94.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

3.2 Grading - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.7395	20.9758	15.4818	0.0414		0.7836	0.7836		0.7209	0.7209		4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**1.7395**	**20.9758**	**15.4818**	**0.0414**	**19.9487**	**0.7836**	**20.7324**	**2.1540**	**0.7209**	**2.8749**		**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1576	0.1048	1.2167	1.5300e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		151.0169	151.0169	0.0118		151.3128
Total	**0.1576**	**0.1048**	**1.2167**	**1.5300e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**151.0169**	**151.0169**	**0.0118**		**151.3128**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					7.7800	0.0000	7.7800	0.8401	0.0000	0.8401			0.0000			0.0000
Off-Road	0.8446	9.3512	17.7059	0.0414		0.2202	0.2202		0.2056	0.2056	0.0000	4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**0.8446**	**9.3512**	**17.7059**	**0.0414**	**7.7800**	**0.2202**	**8.0003**	**0.8401**	**0.2056**	**1.0456**	**0.0000**	**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1576	0.1048	1.2167	1.5300e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		151.0169	151.0169	0.0118		151.3128
Total	**0.1576**	**0.1048**	**1.2167**	**1.5300e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**151.0169**	**151.0169**	**0.0118**		**151.3128**

3.2 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.5571	17.7192	15.2181	0.0415		0.6652	0.6652		0.6120	0.6120		4,013.0738	4,013.0738	1.2979		4,045.5216
Total	**1.5571**	**17.7192**	**15.2181**	**0.0415**	**19.9487**	**0.6652**	**20.6140**	**2.1540**	**0.6120**	**2.7660**		**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5216**

3.2 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1470	0.0962	1.1146	1.4700e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		145.5040	145.5040	0.0108		145.7741
Total	**0.1470**	**0.0962**	**1.1146**	**1.4700e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**145.5040**	**145.5040**	**0.0108**		**145.7741**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					7.7800	0.0000	7.7800	0.8401	0.0000	0.8401			0.0000			0.0000
Off-Road	0.7764	7.8385	17.6403	0.0415		0.1825	0.1825		0.1708	0.1708	0.0000	4,013.0738	4,013.0738	1.2979		4,045.5215
Total	**0.7764**	**7.8385**	**17.6403**	**0.0415**	**7.7800**	**0.1825**	**7.9625**	**0.8401**	**0.1708**	**1.0109**	**0.0000**	**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5215**

3.2 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1470	0.0962	1.1146	1.4700e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		145.5040	145.5040	0.0108		145.7741
Total	**0.1470**	**0.0962**	**1.1146**	**1.4700e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**145.5040**	**145.5040**	**0.0108**		**145.7741**

3.3 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	16.4567	156.2364	125.5142	0.3380		6.4135	6.4135		5.9305	5.9305		32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**16.4567**	**156.2364**	**125.5142**	**0.3380**		**6.4135**	**6.4135**		**5.9305**	**5.9305**		**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1847	4.6339	1.2666	0.0165	36.3379	0.0139	36.3518	3.7088	0.0133	3.7221		1,722.1578	1,722.1578	0.0706		1,723.9218
Worker	0.8351	0.5552	6.4486	8.1000e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		800.3898	800.3898	0.0627		801.9580
Total	**1.0199**	**5.1891**	**7.7152**	**0.0246**	**116.6836**	**0.0190**	**116.7026**	**11.8572**	**0.0180**	**11.8751**		**2,522.5476**	**2,522.5476**	**0.1333**		**2,525.8799**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.4541	24.9926	172.5057	0.3380		0.7015	0.7015		0.6869	0.6869	0.0000	32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**4.4541**	**24.9926**	**172.5057**	**0.3380**		**0.7015**	**0.7015**		**0.6869**	**0.6869**	**0.0000**	**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1847	4.6339	1.2666	0.0165	36.3379	0.0139	36.3518	3.7088	0.0133	3.7221		1,722.1578	1,722.1578	0.0706		1,723.9218
Worker	0.8351	0.5552	6.4486	8.1000e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		800.3898	800.3898	0.0627		801.9580
Total	**1.0199**	**5.1891**	**7.7152**	**0.0246**	**116.6836**	**0.0190**	**116.7026**	**11.8572**	**0.0180**	**11.8751**		**2,522.5476**	**2,522.5476**	**0.1333**		**2,525.8799**

3.3 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	14.5425	126.8994	120.8426	0.3382		5.1707	5.1707		4.7832	4.7832		32,711.0748	32,711.0748	10.2886		32,968.2903
Total	**14.5425**	**126.8994**	**120.8426**	**0.3382**		**5.1707**	**5.1707**		**4.7832**	**4.7832**		**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2903**

3.3 Building Construction - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1712	4.3143	1.1490	0.0164	36.3379	0.0118	36.3497	3.7088	0.0113	3.7201		1,709.0217	1,709.0217	0.0665		1,710.6851
Worker	0.7793	0.5096	5.9072	7.8000e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		771.1711	771.1711	0.0573		772.6029
Total	**0.9505**	**4.8239**	**7.0562**	**0.0242**	**116.6836**	**0.0167**	**116.7002**	**11.8572**	**0.0158**	**11.8729**		**2,480.1928**	**2,480.1928**	**0.1238**		**2,483.2880**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.3860	23.4799	172.4401	0.3382		0.6638	0.6638		0.6521	0.6521	0.0000	32,711.0748	32,711.0748	10.2886		32,968.2902
Total	**4.3860**	**23.4799**	**172.4401**	**0.3382**		**0.6638**	**0.6638**		**0.6521**	**0.6521**	**0.0000**	**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2902**

3.3 Building Construction - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1712	4.3143	1.1490	0.0164	36.3379	0.0118	36.3497	3.7088	0.0113	3.7201		1,709.0217	1,709.0217	0.0665		1,710.6851
Worker	0.7793	0.5096	5.9072	7.8000e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		771.1711	771.1711	0.0573		772.6029
Total	**0.9505**	**4.8239**	**7.0562**	**0.0242**	**116.6836**	**0.0167**	**116.7002**	**11.8572**	**0.0158**	**11.8729**		**2,480.1928**	**2,480.1928**	**0.1238**		**2,483.2880**

3.4 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	12.4677	105.9968	97.9901	0.3041		4.0641	4.0641		3.7651	3.7651		29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**12.4677**	**105.9968**	**97.9901**	**0.3041**		**4.0641**	**4.0641**		**3.7651**	**3.7651**		**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.6911	0.4519	5.2384	6.9100e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		683.8687	683.8687	0.0508		685.1384
Total	**0.6911**	**0.4519**	**5.2384**	**6.9100e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**683.8687**	**683.8687**	**0.0508**		**685.1384**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.9634	21.6487	145.7154	0.3041		0.6074	0.6074		0.5958	0.5958	0.0000	29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**3.9634**	**21.6487**	**145.7154**	**0.3041**		**0.6074**	**0.6074**		**0.5958**	**0.5958**	**0.0000**	**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.6911	0.4519	5.2384	6.9100e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		683.8687	683.8687	0.0508		685.1384
Total	**0.6911**	**0.4519**	**5.2384**	**6.9100e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**683.8687**	**683.8687**	**0.0508**		**685.1384**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Other Non-Asphalt Surfaces	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Other Non-Asphalt Surfaces	16.40	9.50	11.90	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Other Non-Asphalt Surfaces	0.519925	0.031155	0.160764	0.115847	0.015498	0.004819	0.018987	0.121625	0.003553	0.001235	0.005240	0.000729	0.000624

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Unmitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Vega S-Line Mitigated

Imperial County, Winter

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Other Non-Asphalt Surfaces	411.00	Acre	411.00	17,903,160.00	0

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.4	**Precipitation Freq (Days)**	12
Climate Zone	15			**Operational Year**	2023
Utility Company	Imperial Irrigation District				
CO2 Intensity (lb/MWhr)	1270.9	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Project Timeframes and Phases updated per Project Applicant questionnaire

Off-road Equipment - No architectural coating phase

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Off-road Equipment - Equipment list updated per Project Applicant Questionnaire

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Trips and VMT - Average Daily Trips account for 2 trips per equipment type for worker trips, default factor used to quantify vendor trips

On-road Fugitive Dust - Majority of roadways surrounding project area are paved, 5% accounts for the 7 miles of transmission line on dirt roadways

Architectural Coating - No architectural coating phase

Road Dust - Mitigation requiring worker commutes to utilize paved-only roadways

Construction Off-road Equipment Mitigation - Engine Tier updated per Project Applicant questionnaire; Mitigation requirement: Water exposed areas 3 times per day for Fugitive Dust reduction

Vehicle Trips - Average Daily Trips account for routine maintenance and monitoring activities

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	8.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	54.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	18.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	4.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final

Vega S-Line Mitigated - Imperial County, Winter

tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	7,750.00	126.00
tblConstructionPhase	NumDays	500.00	51.00
tblConstructionPhase	NumDays	775.00	103.00
tblGrading	AcresOfGrading	0.00	1,937.50
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00

tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblRoadDust	RoadPercentPave	50	100
tblTripsAndVMT	VendorTripNumber	2,934.00	41.00
tblTripsAndVMT	WorkerTripNumber	7,519.00	106.00
tblTripsAndVMT	WorkerTripNumber	118.00	94.00
tblVehicleTrips	ST_TR	0.00	0.10
tblVehicleTrips	SU_TR	0.00	0.10
tblVehicleTrips	WD_TR	0.00	0.10

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	19.2195	182.6409	148.0123	0.4035	151.7919	7.2175	159.0093	15.5486	6.6707	22.2193	0.0000	39,179.1728	39,179.1728	11.7235	0.0000	39,472.2608
2022	17.0571	149.6458	142.4751	0.4033	151.7919	5.8539	157.6458	15.5486	5.4122	20.9608	0.0000	39,150.9973	39,150.9973	11.7150	0.0000	39,443.8716
Maximum	**19.2195**	**182.6409**	**148.0123**	**0.4035**	**151.7919**	**7.2175**	**159.0093**	**15.5486**	**6.6707**	**22.2193**	**0.0000**	**39,179.1728**	**39,179.1728**	**11.7235**	**0.0000**	**39,472.2608**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2021	6.3219	39.7725	197.2279	0.4035	139.6232	0.9421	140.5652	14.2346	0.9117	15.1463	0.0000	39,179.1727	39,179.1727	11.7235	0.0000	39,472.2607
2022	6.1199	36.3457	196.4948	0.4033	139.6232	0.8642	140.4873	14.2346	0.8399	15.0745	0.0000	39,150.9973	39,150.9973	11.7150	0.0000	39,443.8716
Maximum	**6.3219**	**39.7725**	**197.2279**	**0.4035**	**139.6232**	**0.9421**	**140.5652**	**14.2346**	**0.9117**	**15.1463**	**0.0000**	**39,179.1727**	**39,179.1727**	**11.7235**	**0.0000**	**39,472.2607**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	65.70	77.09	-35.54	0.00	8.02	86.18	11.24	8.45	85.50	30.01	0.00	0.00	0.00	0.00	0.00	0.00

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**	**0.0000**	**1.5000e-004**	**1.5000e-004**	**0.0000**	**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**	**0.0000**	**0.0959**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Grading	Grading	8/31/2021	1/20/2022	5	103	
2	Building Construction	Building Construction	9/27/2021	3/21/2022	5	126	
3	Demolition	Demolition	3/22/2022	5/31/2022	5	51	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 1937.5

Acres of Paving: 411

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Grading	Bore/Drill Rigs	2	8.00	221	0.50
Grading	Cranes	2	8.00	231	0.29
Grading	Excavators	0	8.00	158	0.38
Grading	Graders	0	8.00	187	0.41
Grading	Rough Terrain Forklifts	2	8.00	100	0.40
Grading	Rubber Tired Dozers	0	8.00	247	0.40
Grading	Scrapers	0	8.00	367	0.48

Grading	Skid Steer Loaders	2	8.00	65	0.37
Grading	Tractors/Loaders/Backhoes	0	8.00	97	0.37
Building Construction	Air Compressors	3	8.00	78	0.48
Building Construction	Bore/Drill Rigs	2	8.00	221	0.50
Building Construction	Cranes	3	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Off-Highway Trucks	15	8.00	402	0.38
Building Construction	Off-Highway Trucks	12	1.00	402	0.38
Building Construction	Other Construction Equipment	6	8.00	172	0.42
Building Construction	Rough Terrain Forklifts	8	8.00	100	0.40
Building Construction	Skid Steer Loaders	2	8.00	65	0.37
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Demolition	Air Compressors	3	8.00	78	0.48
Demolition	Bore/Drill Rigs	2	8.00	221	0.50
Demolition	Concrete/Industrial Saws	0	8.00	81	0.73
Demolition	Cranes	3	8.00	231	0.29
Demolition	Excavators	0	8.00	158	0.38
Demolition	Off-Highway Trucks	15	8.00	402	0.38
Demolition	Off-Highway Trucks	12	1.00	402	0.38
Demolition	Rough Terrain Forklifts	6	8.00	100	0.40
Demolition	Rough Terrain Forklifts	2	8.00	100	0.40
Demolition	Rubber Tired Dozers	0	8.00	247	0.40
Demolition	Skid Steer Loaders	2	8.00	65	0.37
Demolition	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Grading	8	20.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	53	106.00	41.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Demolition	47	94.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

3.2 Grading - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.7395	20.9758	15.4818	0.0414		0.7836	0.7836		0.7209	0.7209		4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**1.7395**	**20.9758**	**15.4818**	**0.0414**	**19.9487**	**0.7836**	**20.7324**	**2.1540**	**0.7209**	**2.8749**		**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1321	0.1100	0.8864	1.2800e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		126.4644	126.4644	9.3800e-003		126.6989
Total	**0.1321**	**0.1100**	**0.8864**	**1.2800e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**126.4644**	**126.4644**	**9.3800e-003**		**126.6989**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					7.7800	0.0000	7.7800	0.8401	0.0000	0.8401			0.0000			0.0000
Off-Road	0.8446	9.3512	17.7059	0.0414		0.2202	0.2202		0.2056	0.2056	0.0000	4,009.5376	4,009.5376	1.2968		4,041.9568
Total	**0.8446**	**9.3512**	**17.7059**	**0.0414**	**7.7800**	**0.2202**	**8.0003**	**0.8401**	**0.2056**	**1.0456**	**0.0000**	**4,009.5376**	**4,009.5376**	**1.2968**		**4,041.9568**

3.2 Grading - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1321	0.1100	0.8864	1.2800e-003	15.1596	9.6000e-004	15.1605	1.5374	8.9000e-004	1.5383		126.4644	126.4644	9.3800e-003		126.6989
Total	**0.1321**	**0.1100**	**0.8864**	**1.2800e-003**	**15.1596**	**9.6000e-004**	**15.1605**	**1.5374**	**8.9000e-004**	**1.5383**		**126.4644**	**126.4644**	**9.3800e-003**		**126.6989**

3.2 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					19.9487	0.0000	19.9487	2.1540	0.0000	2.1540			0.0000			0.0000
Off-Road	1.5571	17.7192	15.2181	0.0415		0.6652	0.6652		0.6120	0.6120		4,013.0738	4,013.0738	1.2979		4,045.5216
Total	**1.5571**	**17.7192**	**15.2181**	**0.0415**	**19.9487**	**0.6652**	**20.6140**	**2.1540**	**0.6120**	**2.7660**		**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5216**

3.2 Grading - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1238	0.1008	0.8107	1.2300e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		121.8478	121.8478	8.6000e-003		122.0628
Total	**0.1238**	**0.1008**	**0.8107**	**1.2300e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**121.8478**	**121.8478**	**8.6000e-003**		**122.0628**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					7.7800	0.0000	7.7800	0.8401	0.0000	0.8401			0.0000			0.0000
Off-Road	0.7764	7.8385	17.6403	0.0415		0.1825	0.1825		0.1708	0.1708	0.0000	4,013.0738	4,013.0738	1.2979		4,045.5215
Total	**0.7764**	**7.8385**	**17.6403**	**0.0415**	**7.7800**	**0.1825**	**7.9625**	**0.8401**	**0.1708**	**1.0109**	**0.0000**	**4,013.0738**	**4,013.0738**	**1.2979**		**4,045.5215**

3.2 Grading - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1238	0.1008	0.8107	1.2300e-003	15.1596	9.2000e-004	15.1605	1.5374	8.5000e-004	1.5383		121.8478	121.8478	8.6000e-003		122.0628
Total	**0.1238**	**0.1008**	**0.8107**	**1.2300e-003**	**15.1596**	**9.2000e-004**	**15.1605**	**1.5374**	**8.5000e-004**	**1.5383**		**121.8478**	**121.8478**	**8.6000e-003**		**122.0628**

3.3 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	16.4567	156.2364	125.5142	0.3380		6.4135	6.4135		5.9305	5.9305		32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**16.4567**	**156.2364**	**125.5142**	**0.3380**		**6.4135**	**6.4135**		**5.9305**	**5.9305**		**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1910	4.7357	1.4319	0.0160	36.3379	0.0142	36.3522	3.7088	0.0136	3.7224		1,672.4009	1,672.4009	0.0785		1,674.3631
Worker	0.7001	0.5830	4.6980	6.7700e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		670.2613	670.2613	0.0497		671.5044
Total	**0.8911**	**5.3187**	**6.1299**	**0.0228**	**116.6836**	**0.0194**	**116.7029**	**11.8572**	**0.0183**	**11.8755**		**2,342.6622**	**2,342.6622**	**0.1282**		**2,345.8675**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.4541	24.9926	172.5057	0.3380		0.7015	0.7015		0.6869	0.6869	0.0000	32,700.5085	32,700.5085	10.2892		32,957.7375
Total	**4.4541**	**24.9926**	**172.5057**	**0.3380**		**0.7015**	**0.7015**		**0.6869**	**0.6869**	**0.0000**	**32,700.5085**	**32,700.5085**	**10.2892**		**32,957.7375**

3.3 Building Construction - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1910	4.7357	1.4319	0.0160	36.3379	0.0142	36.3522	3.7088	0.0136	3.7224		1,672.4009	1,672.4009	0.0785		1,674.3631
Worker	0.7001	0.5830	4.6980	6.7700e-003	80.3457	5.1100e-003	80.3508	8.1484	4.7000e-003	8.1531		670.2613	670.2613	0.0497		671.5044
Total	**0.8911**	**5.3187**	**6.1299**	**0.0228**	**116.6836**	**0.0194**	**116.7029**	**11.8572**	**0.0183**	**11.8755**		**2,342.6622**	**2,342.6622**	**0.1282**		**2,345.8675**

3.3 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	14.5425	126.8994	120.8426	0.3382		5.1707	5.1707		4.7832	4.7832		32,711.0748	32,711.0748	10.2886		32,968.2903
Total	**14.5425**	**126.8994**	**120.8426**	**0.3382**		**5.1707**	**5.1707**		**4.7832**	**4.7832**		**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2903**

3.3 Building Construction - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1773	4.3922	1.3069	0.0159	36.3379	0.0121	36.3500	3.7088	0.0116	3.7204		1,659.2078	1,659.2078	0.0743		1,661.0640
Worker	0.6563	0.5342	4.2968	6.5200e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		645.7931	645.7931	0.0456		646.9330
Total	**0.8336**	**4.9264**	**5.6037**	**0.0224**	**116.6836**	**0.0170**	**116.7006**	**11.8572**	**0.0161**	**11.8732**		**2,305.0009**	**2,305.0009**	**0.1199**		**2,307.9970**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	4.3860	23.4799	172.4401	0.3382		0.6638	0.6638		0.6521	0.6521	0.0000	32,711.0748	32,711.0748	10.2886		32,968.2902
Total	**4.3860**	**23.4799**	**172.4401**	**0.3382**		**0.6638**	**0.6638**		**0.6521**	**0.6521**	**0.0000**	**32,711.0748**	**32,711.0748**	**10.2886**		**32,968.2902**

3.3 Building Construction - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.1773	4.3922	1.3069	0.0159	36.3379	0.0121	36.3500	3.7088	0.0116	3.7204		1,659.2078	1,659.2078	0.0743		1,661.0640
Worker	0.6563	0.5342	4.2968	6.5200e-003	80.3457	4.8800e-003	80.3505	8.1484	4.5000e-003	8.1529		645.7931	645.7931	0.0456		646.9330
Total	**0.8336**	**4.9264**	**5.6037**	**0.0224**	**116.6836**	**0.0170**	**116.7006**	**11.8572**	**0.0161**	**11.8732**		**2,305.0009**	**2,305.0009**	**0.1199**		**2,307.9970**

3.4 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	12.4677	105.9968	97.9901	0.3041		4.0641	4.0641		3.7651	3.7651		29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**12.4677**	**105.9968**	**97.9901**	**0.3041**		**4.0641**	**4.0641**		**3.7651**	**3.7651**		**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.5820	0.4737	3.8104	5.7800e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		572.6844	572.6844	0.0404		573.6953
Total	**0.5820**	**0.4737**	**3.8104**	**5.7800e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**572.6844**	**572.6844**	**0.0404**		**573.6953**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.9634	21.6487	145.7154	0.3041		0.6074	0.6074		0.5958	0.5958	0.0000	29,405.9584	29,405.9584	9.2197		29,636.4503
Total	**3.9634**	**21.6487**	**145.7154**	**0.3041**		**0.6074**	**0.6074**		**0.5958**	**0.5958**	**0.0000**	**29,405.9584**	**29,405.9584**	**9.2197**		**29,636.4503**

3.4 Demolition - 2022

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.5820	0.4737	3.8104	5.7800e-003	71.2499	4.3300e-003	71.2542	7.2259	3.9900e-003	7.2299		572.6844	572.6844	0.0404		573.6953
Total	**0.5820**	**0.4737**	**3.8104**	**5.7800e-003**	**71.2499**	**4.3300e-003**	**71.2542**	**7.2259**	**3.9900e-003**	**7.2299**		**572.6844**	**572.6844**	**0.0404**		**573.6953**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Other Non-Asphalt Surfaces	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Other Non-Asphalt Surfaces	16.40	9.50	11.90	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Other Non-Asphalt Surfaces	0.519925	0.031155	0.160764	0.115847	0.015498	0.004819	0.018987	0.121625	0.003553	0.001235	0.005240	0.000729	0.000624

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Unmitigated	8.3913	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	2.0461					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	6.3413					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.8900e-003	3.8000e-004	0.0420	0.0000		1.5000e-004	1.5000e-004		1.5000e-004	1.5000e-004		0.0900	0.0900	2.4000e-004		0.0959
Total	**8.3913**	**3.8000e-004**	**0.0420**	**0.0000**		**1.5000e-004**	**1.5000e-004**		**1.5000e-004**	**1.5000e-004**		**0.0900**	**0.0900**	**2.4000e-004**		**0.0959**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

ATTACHMENT B

CalEEMod Output Files – Greenhouse Gas Emissions

DATA, EQUIPMENT AND TIME ESTIMATE – General Information

Please provide all applicable data. Note that all listed equipment will be assumed to operate 8 hours daily unless otherwise indicated.

Provided data can be estimates. Any data not known will be supplied with modeling software defaults

Project: Vega S-Line Transmission Line Upgrade and New Pole Installation

Land Use Type	Units/ SF
Lay Down Yard	30,000

Building Demolition

Tons of Demolished Material	
OR	
Building Square Footage	

Earthwork

Total Cut (cubic yards)	3420
Total Fill (cubic yards)	3420

Start Dates (For One Phase Projects)

Construction Activity	(Month/ Year)	Duration (Months)
Demolition (if applicable)	3/22/2022	5/31/2022
Site Preparation		
Grading	8/31/2021	1/20/2022
Construction	9/27/2021	3/21/2022
Paving		
Painting		

Start Dates (For Multi- Phase Projects)

Construction Activity	(Month/ Year)	Duration (Months)
PHASE 1		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		
PHASE 2		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		
PHASE 3		
Demolition (if applicable)		
Site Preparation		
Grading		
Construction		
Paving		
Painting		

Construction Equipment- Demolition

Equipment	# of Units	Model Year
Bore/Drill Rigs	2	TBD
Concrete/Industrial Saws		
Crane	3	2018
Crawler Tractors		
Crushing/Processing Equip.		
Excavators		
Graders		
Off-Highway Tractors		
Off-Highway Trucks		
Other Equipment	15	2018 (newer) / Tier 4
Pavers		
Paving Equipment		
Pile Drivers		
Rollers		
Rough Terrain Forklifts	2	2018 - Tier 4
Rubber Tired Dozers		
Rubber Tired Loaders		
Scrapers		
Signal Boards		
Skid Steer Loaders	2	2018 - Tier 4
Surfacing Equipment		
Tractors/Loaders/Backhoes	2	2018 - Tier 4
Trenchers		
Water Trucks	3	2018
Dump Trucks	2	2018
Semi Tractor	4	2018
Light Duty P/U's	12	2019 (or newer)

Bucket Trucks (6), Air Compressors (3), Boom Lifts (6),

Construction Equipment- Grading

Equipment	# of Units	Model Year
Bore/Drill Rigs	2	2018 - Tier 4
Concrete/Industrial Saws		
Crane	2	2018 - Tier 4
Crawler Tractors		
Crushing/Processing Equip.		
Excavators		
Graders		
Off-Highway Tractors		
Off-Highway Trucks		
Other Equipment		
Pavers		
Paving Equipment		
Pile Drivers		
Rollers		
Rough Terrain Forklifts	2	2018 - Tier 4
Rubber Tired Dozers		
Rubber Tired Loaders	2	2018 - Tier 4
Scrapers		
Signal Boards		
Skid Steer Loaders	2	2018 - Tier 4
Surfacing Equipment		
Tractors/Loaders/Backhoes		
Trenchers		

*Other Equipment: Bucket Trucks (6), Air Compressors (3), Boom Lifts (6), Drum Puller (1), Wire Puller (1), Wire Tensioner (1), & Wire Reeler (3)

Construction Equipment- Construction

Equipment	# of Units	Model Year
Bore/Drill Rigs	2	TBD
Concrete/Industrial Saws		
Crane	3	2018
Crawler Tractors		
Crushing/Processing Equip.		
Excavators		
Graders		
Off-Highway Tractors		
Off-Highway Trucks		
*Other Equipment	21	2018 (newer) / Tier 4
Pavers		
Paving Equipment		
Pile Drivers		
Rollers		
Rough Terrain Forklifts	2	2018 - Tier 4
Rubber Tired Dozers		
Rubber Tired Loaders		
Scrapers		
Signal Boards		
Skid Steer Loaders	2	2018 - Tier 4
Surfacing Equipment		
Tractors/Loaders/Backhoes	2	2018 - Tier 4
Trenchers		
Water Trucks	3	2018
Dump Trucks	2	2018
Semi Tractor	4	2018
Light Duty P/U's	12	2019 (or newer)

CalEEMod Equipment Equivelents

CalEEMod Equipment Equivelents
*Rough Terrain Forklifts = Boom Lifts
*Off-Highway Trucks1 = Bucket Trucks
*Off-Highway Trucks2 = Water Trucks
*Off-Highway Trucks = Dump Trucks
*Off-Highway Trucks = Semi Tractors
*Off-Highway Trucks3 = Light Duty P/U's
*Other Construction Equipment = Drum Puller
*Other Construction Equipment = Wire Puller
*Other Construction Equipment = Wire Tensioner
*Other Construction Equipment = Wire Reeler

Vega S-Line Unmitigated

Imperial County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Other Non-Asphalt Surfaces	411.00	Acre	411.00	17,903,160.00	0

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.4	**Precipitation Freq (Days)**	12
Climate Zone	15			**Operational Year**	2023
Utility Company	Imperial Irrigation District				
CO2 Intensity (lb/MWhr)	1270.9	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Vega S-Line Unmitigated - Imperial County, Annual

Project Characteristics -

Land Use -

Construction Phase - Project Timeframes and Phases updated per Project Applicant questionnaire

Off-road Equipment - No architectural coating phase

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Off-road Equipment - Equipment list updated per Project Applicant Questionnaire

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Trips and VMT - Average Daily Trips account for 2 trips per equipment type for worker trips, default factor used to quantify vendor trips

On-road Fugitive Dust - Majority of roadways surrounding project area are paved, 5% accounts for the 7 miles of transmission line on dirt roadways

Architectural Coating - No architectural coating phase

Road Dust - 5% unpaved roadway accounts for 7 miles of transmission line unpaved

Construction Off-road Equipment Mitigation - Engine Tier updated per Project Applicant questionnaire

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	8.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	54.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	18.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	4.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final

Vega S-Line Unmitigated - Imperial County, Annual

tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	7,750.00	126.00
tblConstructionPhase	NumDays	500.00	51.00
tblConstructionPhase	NumDays	775.00	103.00
tblGrading	AcresOfGrading	0.00	1,937.50
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural

tblRoadDust	RoadPercentPave	50	95
tblTripsAndVMT	VendorTripNumber	2,934.00	41.00
tblTripsAndVMT	WorkerTripNumber	7,519.00	106.00
tblTripsAndVMT	WorkerTripNumber	118.00	94.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2021	0.6907	6.5936	5.3540	0.0146	5.6307	0.2601	5.8908	0.5788	0.2403	0.8191	0.0000	1,282.6640	1,282.6640	0.3835	0.0000	1,292.2520
2022	0.7754	6.5315	6.2699	0.0183	6.0482	0.2537	6.3019	0.6210	0.2348	0.8558	0.0000	1,612.3723	1,612.3723	0.4870	0.0000	1,624.5466
Maximum	**0.7754**	**6.5936**	**6.2699**	**0.0183**	**6.0482**	**0.2601**	**6.3019**	**0.6210**	**0.2403**	**0.8558**	**0.0000**	**1,612.3723**	**1,612.3723**	**0.4870**	**0.0000**	**1,624.5466**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2021	0.2308	1.4828	7.0976	0.0146	5.6307	0.0351	5.6658	0.5788	0.0339	0.6127	0.0000	1,282.6626	1,282.6626	0.3835	0.0000	1,292.2506
2022	0.2687	1.4157	8.9486	0.0183	6.0482	0.0359	6.0842	0.6210	0.0352	0.6562	0.0000	1,612.3705	1,612.3705	0.4870	0.0000	1,624.5448
Maximum	**0.2687**	**1.4828**	**8.9486**	**0.0183**	**6.0482**	**0.0359**	**6.0842**	**0.6210**	**0.0352**	**0.6562**	**0.0000**	**1,612.3705**	**1,612.3705**	**0.4870**	**0.0000**	**1,624.5448**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**65.93**	**77.92**	**-38.05**	**0.00**	**0.00**	**86.18**	**3.63**	**0.00**	**85.46**	**24.24**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	8-31-2021	11-29-2021	4.8355	1.1545
2	11-30-2021	2-27-2022	5.4955	1.2865
3	2-28-2022	5-30-2022	4.1465	0.9328
4	5-31-2022	8-30-2022	0.0427	0.0096
		Highest	5.4955	1.2865

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Grading	Grading	8/31/2021	1/20/2022	5	103	
2	Building Construction	Building Construction	9/27/2021	3/21/2022	5	126	
3	Demolition	Demolition	3/22/2022	5/31/2022	5	51	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 1937.5

Acres of Paving: 411

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Grading	Bore/Drill Rigs	2	8.00	221	0.50
Grading	Cranes	2	8.00	231	0.29
Grading	Excavators	0	8.00	158	0.38
Grading	Graders	0	8.00	187	0.41
Grading	Rough Terrain Forklifts	2	8.00	100	0.40
Grading	Rubber Tired Dozers	0	8.00	247	0.40
Grading	Scrapers	0	8.00	367	0.48
Grading	Skid Steer Loaders	2	8.00	65	0.37
Grading	Tractors/Loaders/Backhoes	0	8.00	97	0.37
Building Construction	Air Compressors	3	8.00	78	0.48
Building Construction	Bore/Drill Rigs	2	8.00	221	0.50
Building Construction	Cranes	3	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Off-Highway Trucks	15	8.00	402	0.38
Building Construction	Off-Highway Trucks	12	1.00	402	0.38
Building Construction	Other Construction Equipment	6	8.00	172	0.42
Building Construction	Rough Terrain Forklifts	8	8.00	100	0.40

Building Construction	Skid Steer Loaders	2	8.00	65	0.37
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Demolition	Air Compressors	3	8.00	78	0.48
Demolition	Bore/Drill Rigs	2	8.00	221	0.50
Demolition	Concrete/Industrial Saws	0	8.00	81	0.73
Demolition	Cranes	3	8.00	231	0.29
Demolition	Excavators	0	8.00	158	0.38
Demolition	Off-Highway Trucks	15	8.00	402	0.38
Demolition	Off-Highway Trucks	12	1.00	402	0.38
Demolition	Rough Terrain Forklifts	6	8.00	100	0.40
Demolition	Rough Terrain Forklifts	2	8.00	100	0.40
Demolition	Rubber Tired Dozers	0	8.00	247	0.40
Demolition	Skid Steer Loaders	2	8.00	65	0.37
Demolition	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Grading	8	20.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	53	106.00	41.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Demolition	47	94.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

3.2 Grading - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.0274	0.0000	1.0274	0.1109	0.0000	0.1109	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0774	0.9334	0.6889	1.8400e-003		0.0349	0.0349		0.0321	0.0321	0.0000	161.8639	161.8639	0.0524	0.0000	163.1727
Total	**0.0774**	**0.9334**	**0.6889**	**1.8400e-003**	**1.0274**	**0.0349**	**1.0622**	**0.1109**	**0.0321**	**0.1430**	**0.0000**	**161.8639**	**161.8639**	**0.0524**	**0.0000**	**163.1727**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.9800e-003	4.8300e-003	0.0436	6.0000e-005	0.6526	4.0000e-005	0.6526	0.0662	4.0000e-005	0.0663	0.0000	5.5129	5.5129	4.1000e-004	0.0000	5.5232
Total	**5.9800e-003**	**4.8300e-003**	**0.0436**	**6.0000e-005**	**0.6526**	**4.0000e-005**	**0.6526**	**0.0662**	**4.0000e-005**	**0.0663**	**0.0000**	**5.5129**	**5.5129**	**4.1000e-004**	**0.0000**	**5.5232**

3.2 Grading - 2021

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.0274	0.0000	1.0274	0.1109	0.0000	0.1109	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0376	0.4161	0.7879	1.8400e-003		9.8000e-003	9.8000e-003		9.1500e-003	9.1500e-003	0.0000	161.8637	161.8637	0.0524	0.0000	163.1725
Total	**0.0376**	**0.4161**	**0.7879**	**1.8400e-003**	**1.0274**	**9.8000e-003**	**1.0372**	**0.1109**	**9.1500e-003**	**0.1201**	**0.0000**	**161.8637**	**161.8637**	**0.0524**	**0.0000**	**163.1725**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.9800e-003	4.8300e-003	0.0436	6.0000e-005	0.6526	4.0000e-005	0.6526	0.0662	4.0000e-005	0.0663	0.0000	5.5129	5.5129	4.1000e-004	0.0000	5.5232
Total	**5.9800e-003**	**4.8300e-003**	**0.0436**	**6.0000e-005**	**0.6526**	**4.0000e-005**	**0.6526**	**0.0662**	**4.0000e-005**	**0.0663**	**0.0000**	**5.5129**	**5.5129**	**4.1000e-004**	**0.0000**	**5.5232**

3.2 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.0274	0.0000	1.0274	0.1109	0.0000	0.1109	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0109	0.1240	0.1065	2.9000e-004		4.6600e-003	4.6600e-003		4.2800e-003	4.2800e-003	0.0000	25.4842	25.4842	8.2400e-003	0.0000	25.6903
Total	**0.0109**	**0.1240**	**0.1065**	**2.9000e-004**	**1.0274**	**4.6600e-003**	**1.0320**	**0.1109**	**4.2800e-003**	**0.1152**	**0.0000**	**25.4842**	**25.4842**	**8.2400e-003**	**0.0000**	**25.6903**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.8000e-004	7.0000e-004	6.2900e-003	1.0000e-005	0.1027	1.0000e-005	0.1027	0.0104	1.0000e-005	0.0104	0.0000	0.8355	0.8355	6.0000e-005	0.0000	0.8370
Total	**8.8000e-004**	**7.0000e-004**	**6.2900e-003**	**1.0000e-005**	**0.1027**	**1.0000e-005**	**0.1027**	**0.0104**	**1.0000e-005**	**0.0104**	**0.0000**	**0.8355**	**0.8355**	**6.0000e-005**	**0.0000**	**0.8370**

3.2 Grading - 2022

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.0274	0.0000	1.0274	0.1109	0.0000	0.1109	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	5.4400e-003	0.0549	0.1235	2.9000e-004		1.2800e-003	1.2800e-003		1.2000e-003	1.2000e-003	0.0000	25.4842	25.4842	8.2400e-003	0.0000	25.6902
Total	**5.4400e-003**	**0.0549**	**0.1235**	**2.9000e-004**	**1.0274**	**1.2800e-003**	**1.0286**	**0.1109**	**1.2000e-003**	**0.1121**	**0.0000**	**25.4842**	**25.4842**	**8.2400e-003**	**0.0000**	**25.6902**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.8000e-004	7.0000e-004	6.2900e-003	1.0000e-005	0.1027	1.0000e-005	0.1027	0.0104	1.0000e-005	0.0104	0.0000	0.8355	0.8355	6.0000e-005	0.0000	0.8370
Total	**8.8000e-004**	**7.0000e-004**	**6.2900e-003**	**1.0000e-005**	**0.1027**	**1.0000e-005**	**0.1027**	**0.0104**	**1.0000e-005**	**0.0104**	**0.0000**	**0.8355**	**0.8355**	**6.0000e-005**	**0.0000**	**0.8370**

3.3 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.5760	5.4683	4.3930	0.0118		0.2245	0.2245		0.2076	0.2076	0.0000	1,038.2891	1,038.2891	0.3267	0.0000	1,046.4565
Total	**0.5760**	**5.4683**	**4.3930**	**0.0118**		**0.2245**	**0.2245**		**0.2076**	**0.2076**	**0.0000**	**1,038.2891**	**1,038.2891**	**0.3267**	**0.0000**	**1,046.4565**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	6.4500e-003	0.1670	0.0465	5.7000e-004	1.2304	4.9000e-004	1.2309	0.1257	4.7000e-004	0.1261	0.0000	54.0175	54.0175	2.3400e-003	0.0000	54.0761
Worker	0.0249	0.0201	0.1819	2.6000e-004	2.7204	1.8000e-004	2.7205	0.2760	1.6000e-004	0.2762	0.0000	22.9806	22.9806	1.7200e-003	0.0000	23.0236
Total	**0.0314**	**0.1871**	**0.2284**	**8.3000e-004**	**3.9508**	**6.7000e-004**	**3.9515**	**0.4017**	**6.3000e-004**	**0.4023**	**0.0000**	**76.9982**	**76.9982**	**4.0600e-003**	**0.0000**	**77.0997**

3.3 Building Construction - 2021

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1559	0.8747	6.0377	0.0118		0.0246	0.0246		0.0240	0.0240	0.0000	1,038.2879	1,038.2879	0.3267	0.0000	1,046.4552
Total	**0.1559**	**0.8747**	**6.0377**	**0.0118**		**0.0246**	**0.0246**		**0.0240**	**0.0240**	**0.0000**	**1,038.2879**	**1,038.2879**	**0.3267**	**0.0000**	**1,046.4552**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	6.4500e-003	0.1670	0.0465	5.7000e-004	1.2304	4.9000e-004	1.2309	0.1257	4.7000e-004	0.1261	0.0000	54.0175	54.0175	2.3400e-003	0.0000	54.0761
Worker	0.0249	0.0201	0.1819	2.6000e-004	2.7204	1.8000e-004	2.7205	0.2760	1.6000e-004	0.2762	0.0000	22.9806	22.9806	1.7200e-003	0.0000	23.0236
Total	**0.0314**	**0.1871**	**0.2284**	**8.3000e-004**	**3.9508**	**6.7000e-004**	**3.9515**	**0.4017**	**6.3000e-004**	**0.4023**	**0.0000**	**76.9982**	**76.9982**	**4.0600e-003**	**0.0000**	**77.0997**

3.3 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.4072	3.5532	3.3836	9.4700e-003		0.1448	0.1448		0.1339	0.1339	0.0000	830.8997	830.8997	0.2613	0.0000	837.4332
Total	**0.4072**	**3.5532**	**3.3836**	**9.4700e-003**		**0.1448**	**0.1448**		**0.1339**	**0.1339**	**0.0000**	**830.8997**	**830.8997**	**0.2613**	**0.0000**	**837.4332**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.7900e-003	0.1240	0.0339	4.5000e-004	0.9843	3.3000e-004	0.9847	0.1005	3.2000e-004	0.1009	0.0000	42.8797	42.8797	1.7700e-003	0.0000	42.9240
Worker	0.0187	0.0148	0.1333	2.0000e-004	2.1763	1.4000e-004	2.1764	0.2208	1.3000e-004	0.2209	0.0000	17.7134	17.7134	1.2600e-003	0.0000	17.7449
Total	**0.0234**	**0.1387**	**0.1672**	**6.5000e-004**	**3.1606**	**4.7000e-004**	**3.1611**	**0.3213**	**4.5000e-004**	**0.3218**	**0.0000**	**60.5931**	**60.5931**	**3.0300e-003**	**0.0000**	**60.6689**

3.3 Building Construction - 2022

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1228	0.6574	4.8283	9.4700e-003		0.0186	0.0186		0.0183	0.0183	0.0000	830.8987	830.8987	0.2613	0.0000	837.4322
Total	**0.1228**	**0.6574**	**4.8283**	**9.4700e-003**		**0.0186**	**0.0186**		**0.0183**	**0.0183**	**0.0000**	**830.8987**	**830.8987**	**0.2613**	**0.0000**	**837.4322**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.7900e-003	0.1240	0.0339	4.5000e-004	0.9843	3.3000e-004	0.9847	0.1005	3.2000e-004	0.1009	0.0000	42.8797	42.8797	1.7700e-003	0.0000	42.9240
Worker	0.0187	0.0148	0.1333	2.0000e-004	2.1763	1.4000e-004	2.1764	0.2208	1.3000e-004	0.2209	0.0000	17.7134	17.7134	1.2600e-003	0.0000	17.7449
Total	**0.0234**	**0.1387**	**0.1672**	**6.5000e-004**	**3.1606**	**4.7000e-004**	**3.1611**	**0.3213**	**4.5000e-004**	**0.3218**	**0.0000**	**60.5931**	**60.5931**	**3.0300e-003**	**0.0000**	**60.6689**

3.4 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3179	2.7029	2.4988	7.7500e-003		0.1036	0.1036		0.0960	0.0960	0.0000	680.2542	680.2542	0.2133	0.0000	685.5863
Total	**0.3179**	**2.7029**	**2.4988**	**7.7500e-003**		**0.1036**	**0.1036**		**0.0960**	**0.0960**	**0.0000**	**680.2542**	**680.2542**	**0.2133**	**0.0000**	**685.5863**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0151	0.0119	0.1077	1.6000e-004	1.7576	1.1000e-004	1.7577	0.1783	1.0000e-004	0.1784	0.0000	14.3056	14.3056	1.0200e-003	0.0000	14.3310
Total	**0.0151**	**0.0119**	**0.1077**	**1.6000e-004**	**1.7576**	**1.1000e-004**	**1.7577**	**0.1783**	**1.0000e-004**	**0.1784**	**0.0000**	**14.3056**	**14.3056**	**1.0200e-003**	**0.0000**	**14.3310**

3.4 Demolition - 2022

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1011	0.5520	3.7157	7.7500e-003		0.0155	0.0155		0.0152	0.0152	0.0000	680.2534	680.2534	0.2133	0.0000	685.5854
Total	**0.1011**	**0.5520**	**3.7157**	**7.7500e-003**		**0.0155**	**0.0155**		**0.0152**	**0.0152**	**0.0000**	**680.2534**	**680.2534**	**0.2133**	**0.0000**	**685.5854**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0151	0.0119	0.1077	1.6000e-004	1.7576	1.1000e-004	1.7577	0.1783	1.0000e-004	0.1784	0.0000	14.3056	14.3056	1.0200e-003	0.0000	14.3310
Total	**0.0151**	**0.0119**	**0.1077**	**1.6000e-004**	**1.7576**	**1.1000e-004**	**1.7577**	**0.1783**	**1.0000e-004**	**0.1784**	**0.0000**	**14.3056**	**14.3056**	**1.0200e-003**	**0.0000**	**14.3310**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Other Non-Asphalt Surfaces	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Other Non-Asphalt Surfaces	16.40	9.50	11.90	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Other Non-Asphalt Surfaces	0.519925	0.031155	0.160764	0.115847	0.015498	0.004819	0.018987	0.121625	0.003553	0.001235	0.005240	0.000729	0.000624

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Unmitigated	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.3734					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.1573					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.5000e-004	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.3734					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.1573					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.5000e-004	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Other Non-Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Other Non-Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Vega S-Line Mitigated

Imperial County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Other Non-Asphalt Surfaces	411.00	Acre	411.00	17,903,160.00	0

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.4	**Precipitation Freq (Days)**	12
Climate Zone	15			**Operational Year**	2023
Utility Company	Imperial Irrigation District				
CO2 Intensity (lb/MWhr)	1270.9	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Vega S-Line Mitigated - Imperial County, Annual

Project Characteristics -

Land Use -

Construction Phase - Project Timeframes and Phases updated per Project Applicant questionnaire

Off-road Equipment - No architectural coating phase

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Off-road Equipment - Equipment list updated per Project Applicant Questionnaire

Off-road Equipment - Equipment list updated per Project Applicant questionnaire

Trips and VMT - Average Daily Trips account for 2 trips per equipment type for worker trips, default factor used to quantify vendor trips

On-road Fugitive Dust - Majority of roadways surrounding project area are paved, 5% accounts for the 7 miles of transmission line on dirt roadways

Architectural Coating - No architectural coating phase

Road Dust - Mitigation requiring worker commutes to utilize paved-only roadways

Construction Off-road Equipment Mitigation - Engine Tier updated per Project Applicant questionnaire; Mitigation requirement: Water exposed areas 3 times per day for Fugitive Dust reduction

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterUnpavedRoadMoistureContent	0	0.5
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	0	40
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	8.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	54.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	18.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	6.00
tblConstEquipMitigation	NumberOfEquipmentMitigated	0.00	4.00
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final

Vega S-Line Mitigated - Imperial County, Annual

tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstEquipMitigation	Tier	No Change	Tier 4 Final
tblConstructionPhase	NumDays	7,750.00	126.00
tblConstructionPhase	NumDays	500.00	51.00
tblConstructionPhase	NumDays	775.00	103.00
tblGrading	AcresOfGrading	0.00	1,937.50
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	3.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	VendorPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblOnRoadDust	WorkerPercentPave	50.00	95.00
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural

tblRoadDust	RoadPercentPave	50	100
tblTripsAndVMT	VendorTripNumber	2,934.00	41.00
tblTripsAndVMT	WorkerTripNumber	7,519.00	106.00
tblTripsAndVMT	WorkerTripNumber	118.00	94.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2021	0.6907	6.5936	5.3540	0.0146	5.6307	0.2601	5.8908	0.5788	0.2403	0.8191	0.0000	1,282.6640	1,282.6640	0.3835	0.0000	1,292.2520
2022	0.7754	6.5315	6.2699	0.0183	6.0482	0.2537	6.3019	0.6210	0.2348	0.8558	0.0000	1,612.3723	1,612.3723	0.4870	0.0000	1,624.5466
Maximum	**0.7754**	**6.5936**	**6.2699**	**0.0183**	**6.0482**	**0.2601**	**6.3019**	**0.6210**	**0.2403**	**0.8558**	**0.0000**	**1,612.3723**	**1,612.3723**	**0.4870**	**0.0000**	**1,624.5466**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2021	0.2308	1.4828	7.0976	0.0146	5.0041	0.0351	5.0391	0.5112	0.0339	0.5450	0.0000	1,282.6626	1,282.6626	0.3835	0.0000	1,292.2506
2022	0.2687	1.4157	8.9486	0.0183	5.4216	0.0359	5.4575	0.5533	0.0352	0.5885	0.0000	1,612.3705	1,612.3705	0.4870	0.0000	1,624.5448
Maximum	**0.2687**	**1.4828**	**8.9486**	**0.0183**	**5.4216**	**0.0359**	**5.4575**	**0.5533**	**0.0352**	**0.5885**	**0.0000**	**1,612.3705**	**1,612.3705**	**0.4870**	**0.0000**	**1,624.5448**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	65.93	77.92	-38.05	0.00	10.73	86.18	13.91	11.28	85.46	32.32	0.00	0.00	0.00	0.00	0.00	0.00

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	8-31-2021	11-29-2021	4.8355	1.1545
2	11-30-2021	2-27-2022	5.4955	1.2865
3	2-28-2022	5-30-2022	4.1465	0.9328
4	5-31-2022	8-30-2022	0.0427	0.0096
		Highest	5.4955	1.2865

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Grading	Grading	8/31/2021	1/20/2022	5	103	
2	Building Construction	Building Construction	9/27/2021	3/21/2022	5	126	
3	Demolition	Demolition	3/22/2022	5/31/2022	5	51	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 1937.5

Acres of Paving: 411

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Grading	Bore/Drill Rigs	2	8.00	221	0.50
Grading	Cranes	2	8.00	231	0.29
Grading	Excavators	0	8.00	158	0.38
Grading	Graders	0	8.00	187	0.41
Grading	Rough Terrain Forklifts	2	8.00	100	0.40
Grading	Rubber Tired Dozers	0	8.00	247	0.40
Grading	Scrapers	0	8.00	367	0.48
Grading	Skid Steer Loaders	2	8.00	65	0.37
Grading	Tractors/Loaders/Backhoes	0	8.00	97	0.37
Building Construction	Air Compressors	3	8.00	78	0.48
Building Construction	Bore/Drill Rigs	2	8.00	221	0.50
Building Construction	Cranes	3	7.00	231	0.29
Building Construction	Forklifts	0	8.00	89	0.20
Building Construction	Generator Sets	0	8.00	84	0.74
Building Construction	Off-Highway Trucks	15	8.00	402	0.38
Building Construction	Off-Highway Trucks	12	1.00	402	0.38
Building Construction	Other Construction Equipment	6	8.00	172	0.42
Building Construction	Rough Terrain Forklifts	8	8.00	100	0.40

Building Construction	Skid Steer Loaders	2	8.00	65	0.37
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Building Construction	Welders	0	8.00	46	0.45
Demolition	Air Compressors	3	8.00	78	0.48
Demolition	Bore/Drill Rigs	2	8.00	221	0.50
Demolition	Concrete/Industrial Saws	0	8.00	81	0.73
Demolition	Cranes	3	8.00	231	0.29
Demolition	Excavators	0	8.00	158	0.38
Demolition	Off-Highway Trucks	15	8.00	402	0.38
Demolition	Off-Highway Trucks	12	1.00	402	0.38
Demolition	Rough Terrain Forklifts	6	8.00	100	0.40
Demolition	Rough Terrain Forklifts	2	8.00	100	0.40
Demolition	Rubber Tired Dozers	0	8.00	247	0.40
Demolition	Skid Steer Loaders	2	8.00	65	0.37
Demolition	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Grading	8	20.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	53	106.00	41.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT
Demolition	47	94.00	0.00	0.00	10.20	11.90	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

3.2 Grading - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.0274	0.0000	1.0274	0.1109	0.0000	0.1109	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0774	0.9334	0.6889	1.8400e-003		0.0349	0.0349		0.0321	0.0321	0.0000	161.8639	161.8639	0.0524	0.0000	163.1727
Total	**0.0774**	**0.9334**	**0.6889**	**1.8400e-003**	**1.0274**	**0.0349**	**1.0622**	**0.1109**	**0.0321**	**0.1430**	**0.0000**	**161.8639**	**161.8639**	**0.0524**	**0.0000**	**163.1727**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.9800e-003	4.8300e-003	0.0436	6.0000e-005	0.6526	4.0000e-005	0.6526	0.0662	4.0000e-005	0.0663	0.0000	5.5129	5.5129	4.1000e-004	0.0000	5.5232
Total	**5.9800e-003**	**4.8300e-003**	**0.0436**	**6.0000e-005**	**0.6526**	**4.0000e-005**	**0.6526**	**0.0662**	**4.0000e-005**	**0.0663**	**0.0000**	**5.5129**	**5.5129**	**4.1000e-004**	**0.0000**	**5.5232**

3.2 Grading - 2021

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.4007	0.0000	0.4007	0.0433	0.0000	0.0433	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0376	0.4161	0.7879	1.8400e-003		9.8000e-003	9.8000e-003		9.1500e-003	9.1500e-003	0.0000	161.8637	161.8637	0.0524	0.0000	163.1725
Total	**0.0376**	**0.4161**	**0.7879**	**1.8400e-003**	**0.4007**	**9.8000e-003**	**0.4105**	**0.0433**	**9.1500e-003**	**0.0524**	**0.0000**	**161.8637**	**161.8637**	**0.0524**	**0.0000**	**163.1725**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.9800e-003	4.8300e-003	0.0436	6.0000e-005	0.6526	4.0000e-005	0.6526	0.0662	4.0000e-005	0.0663	0.0000	5.5129	5.5129	4.1000e-004	0.0000	5.5232
Total	**5.9800e-003**	**4.8300e-003**	**0.0436**	**6.0000e-005**	**0.6526**	**4.0000e-005**	**0.6526**	**0.0662**	**4.0000e-005**	**0.0663**	**0.0000**	**5.5129**	**5.5129**	**4.1000e-004**	**0.0000**	**5.5232**

3.2 Grading - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.0274	0.0000	1.0274	0.1109	0.0000	0.1109	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0109	0.1240	0.1065	2.9000e-004		4.6600e-003	4.6600e-003		4.2800e-003	4.2800e-003	0.0000	25.4842	25.4842	8.2400e-003	0.0000	25.6903
Total	**0.0109**	**0.1240**	**0.1065**	**2.9000e-004**	**1.0274**	**4.6600e-003**	**1.0320**	**0.1109**	**4.2800e-003**	**0.1152**	**0.0000**	**25.4842**	**25.4842**	**8.2400e-003**	**0.0000**	**25.6903**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.8000e-004	7.0000e-004	6.2900e-003	1.0000e-005	0.1027	1.0000e-005	0.1027	0.0104	1.0000e-005	0.0104	0.0000	0.8355	0.8355	6.0000e-005	0.0000	0.8370
Total	**8.8000e-004**	**7.0000e-004**	**6.2900e-003**	**1.0000e-005**	**0.1027**	**1.0000e-005**	**0.1027**	**0.0104**	**1.0000e-005**	**0.0104**	**0.0000**	**0.8355**	**0.8355**	**6.0000e-005**	**0.0000**	**0.8370**

3.2 Grading - 2022

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.4007	0.0000	0.4007	0.0433	0.0000	0.0433	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	5.4400e-003	0.0549	0.1235	2.9000e-004		1.2800e-003	1.2800e-003		1.2000e-003	1.2000e-003	0.0000	25.4842	25.4842	8.2400e-003	0.0000	25.6902
Total	**5.4400e-003**	**0.0549**	**0.1235**	**2.9000e-004**	**0.4007**	**1.2800e-003**	**0.4020**	**0.0433**	**1.2000e-003**	**0.0445**	**0.0000**	**25.4842**	**25.4842**	**8.2400e-003**	**0.0000**	**25.6902**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	8.8000e-004	7.0000e-004	6.2900e-003	1.0000e-005	0.1027	1.0000e-005	0.1027	0.0104	1.0000e-005	0.0104	0.0000	0.8355	0.8355	6.0000e-005	0.0000	0.8370
Total	**8.8000e-004**	**7.0000e-004**	**6.2900e-003**	**1.0000e-005**	**0.1027**	**1.0000e-005**	**0.1027**	**0.0104**	**1.0000e-005**	**0.0104**	**0.0000**	**0.8355**	**0.8355**	**6.0000e-005**	**0.0000**	**0.8370**

3.3 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.5760	5.4683	4.3930	0.0118		0.2245	0.2245		0.2076	0.2076	0.0000	1,038.2891	1,038.2891	0.3267	0.0000	1,046.4565
Total	**0.5760**	**5.4683**	**4.3930**	**0.0118**		**0.2245**	**0.2245**		**0.2076**	**0.2076**	**0.0000**	**1,038.2891**	**1,038.2891**	**0.3267**	**0.0000**	**1,046.4565**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	6.4500e-003	0.1670	0.0465	5.7000e-004	1.2304	4.9000e-004	1.2309	0.1257	4.7000e-004	0.1261	0.0000	54.0175	54.0175	2.3400e-003	0.0000	54.0761
Worker	0.0249	0.0201	0.1819	2.6000e-004	2.7204	1.8000e-004	2.7205	0.2760	1.6000e-004	0.2762	0.0000	22.9806	22.9806	1.7200e-003	0.0000	23.0236
Total	**0.0314**	**0.1871**	**0.2284**	**8.3000e-004**	**3.9508**	**6.7000e-004**	**3.9515**	**0.4017**	**6.3000e-004**	**0.4023**	**0.0000**	**76.9982**	**76.9982**	**4.0600e-003**	**0.0000**	**77.0997**

3.3 Building Construction - 2021

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1559	0.8747	6.0377	0.0118		0.0246	0.0246		0.0240	0.0240	0.0000	1,038.2879	1,038.2879	0.3267	0.0000	1,046.4552
Total	**0.1559**	**0.8747**	**6.0377**	**0.0118**		**0.0246**	**0.0246**		**0.0240**	**0.0240**	**0.0000**	**1,038.2879**	**1,038.2879**	**0.3267**	**0.0000**	**1,046.4552**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	6.4500e-003	0.1670	0.0465	5.7000e-004	1.2304	4.9000e-004	1.2309	0.1257	4.7000e-004	0.1261	0.0000	54.0175	54.0175	2.3400e-003	0.0000	54.0761
Worker	0.0249	0.0201	0.1819	2.6000e-004	2.7204	1.8000e-004	2.7205	0.2760	1.6000e-004	0.2762	0.0000	22.9806	22.9806	1.7200e-003	0.0000	23.0236
Total	**0.0314**	**0.1871**	**0.2284**	**8.3000e-004**	**3.9508**	**6.7000e-004**	**3.9515**	**0.4017**	**6.3000e-004**	**0.4023**	**0.0000**	**76.9982**	**76.9982**	**4.0600e-003**	**0.0000**	**77.0997**

3.3 Building Construction - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.4072	3.5532	3.3836	9.4700e-003		0.1448	0.1448		0.1339	0.1339	0.0000	830.8997	830.8997	0.2613	0.0000	837.4332
Total	**0.4072**	**3.5532**	**3.3836**	**9.4700e-003**		**0.1448**	**0.1448**		**0.1339**	**0.1339**	**0.0000**	**830.8997**	**830.8997**	**0.2613**	**0.0000**	**837.4332**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.7900e-003	0.1240	0.0339	4.5000e-004	0.9843	3.3000e-004	0.9847	0.1005	3.2000e-004	0.1009	0.0000	42.8797	42.8797	1.7700e-003	0.0000	42.9240
Worker	0.0187	0.0148	0.1333	2.0000e-004	2.1763	1.4000e-004	2.1764	0.2208	1.3000e-004	0.2209	0.0000	17.7134	17.7134	1.2600e-003	0.0000	17.7449
Total	**0.0234**	**0.1387**	**0.1672**	**6.5000e-004**	**3.1606**	**4.7000e-004**	**3.1611**	**0.3213**	**4.5000e-004**	**0.3218**	**0.0000**	**60.5931**	**60.5931**	**3.0300e-003**	**0.0000**	**60.6689**

3.3 Building Construction - 2022

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1228	0.6574	4.8283	9.4700e-003		0.0186	0.0186		0.0183	0.0183	0.0000	830.8987	830.8987	0.2613	0.0000	837.4322
Total	**0.1228**	**0.6574**	**4.8283**	**9.4700e-003**		**0.0186**	**0.0186**		**0.0183**	**0.0183**	**0.0000**	**830.8987**	**830.8987**	**0.2613**	**0.0000**	**837.4322**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	4.7900e-003	0.1240	0.0339	4.5000e-004	0.9843	3.3000e-004	0.9847	0.1005	3.2000e-004	0.1009	0.0000	42.8797	42.8797	1.7700e-003	0.0000	42.9240
Worker	0.0187	0.0148	0.1333	2.0000e-004	2.1763	1.4000e-004	2.1764	0.2208	1.3000e-004	0.2209	0.0000	17.7134	17.7134	1.2600e-003	0.0000	17.7449
Total	**0.0234**	**0.1387**	**0.1672**	**6.5000e-004**	**3.1606**	**4.7000e-004**	**3.1611**	**0.3213**	**4.5000e-004**	**0.3218**	**0.0000**	**60.5931**	**60.5931**	**3.0300e-003**	**0.0000**	**60.6689**

3.4 Demolition - 2022

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3179	2.7029	2.4988	7.7500e-003		0.1036	0.1036		0.0960	0.0960	0.0000	680.2542	680.2542	0.2133	0.0000	685.5863
Total	**0.3179**	**2.7029**	**2.4988**	**7.7500e-003**		**0.1036**	**0.1036**		**0.0960**	**0.0960**	**0.0000**	**680.2542**	**680.2542**	**0.2133**	**0.0000**	**685.5863**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0151	0.0119	0.1077	1.6000e-004	1.7576	1.1000e-004	1.7577	0.1783	1.0000e-004	0.1784	0.0000	14.3056	14.3056	1.0200e-003	0.0000	14.3310
Total	**0.0151**	**0.0119**	**0.1077**	**1.6000e-004**	**1.7576**	**1.1000e-004**	**1.7577**	**0.1783**	**1.0000e-004**	**0.1784**	**0.0000**	**14.3056**	**14.3056**	**1.0200e-003**	**0.0000**	**14.3310**

3.4 Demolition - 2022

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1011	0.5520	3.7157	7.7500e-003		0.0155	0.0155		0.0152	0.0152	0.0000	680.2534	680.2534	0.2133	0.0000	685.5854
Total	**0.1011**	**0.5520**	**3.7157**	**7.7500e-003**		**0.0155**	**0.0155**		**0.0152**	**0.0152**	**0.0000**	**680.2534**	**680.2534**	**0.2133**	**0.0000**	**685.5854**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0151	0.0119	0.1077	1.6000e-004	1.7576	1.1000e-004	1.7577	0.1783	1.0000e-004	0.1784	0.0000	14.3056	14.3056	1.0200e-003	0.0000	14.3310
Total	**0.0151**	**0.0119**	**0.1077**	**1.6000e-004**	**1.7576**	**1.1000e-004**	**1.7577**	**0.1783**	**1.0000e-004**	**0.1784**	**0.0000**	**14.3056**	**14.3056**	**1.0200e-003**	**0.0000**	**14.3310**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Other Non-Asphalt Surfaces	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Other Non-Asphalt Surfaces	16.40	9.50	11.90	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Other Non-Asphalt Surfaces	0.519925	0.031155	0.160764	0.115847	0.015498	0.004819	0.018987	0.121625	0.003553	0.001235	0.005240	0.000729	0.000624

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Unmitigated	1.5311	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.3734					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.1573					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.5000e-004	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

6.2 Area by SubCategory

Mitigated

SubCategory	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	tons/yr										MT/yr					
Architectural Coating	0.3734					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.1573					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.5000e-004	3.0000e-005	3.7800e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	7.3400e-003	7.3400e-003	2.0000e-005	0.0000	7.8300e-003
Total	**1.5311**	**3.0000e-005**	**3.7800e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**7.3400e-003**	**7.3400e-003**	**2.0000e-005**	**0.0000**	**7.8300e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Other Non-Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Other Non-Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Other Non-Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

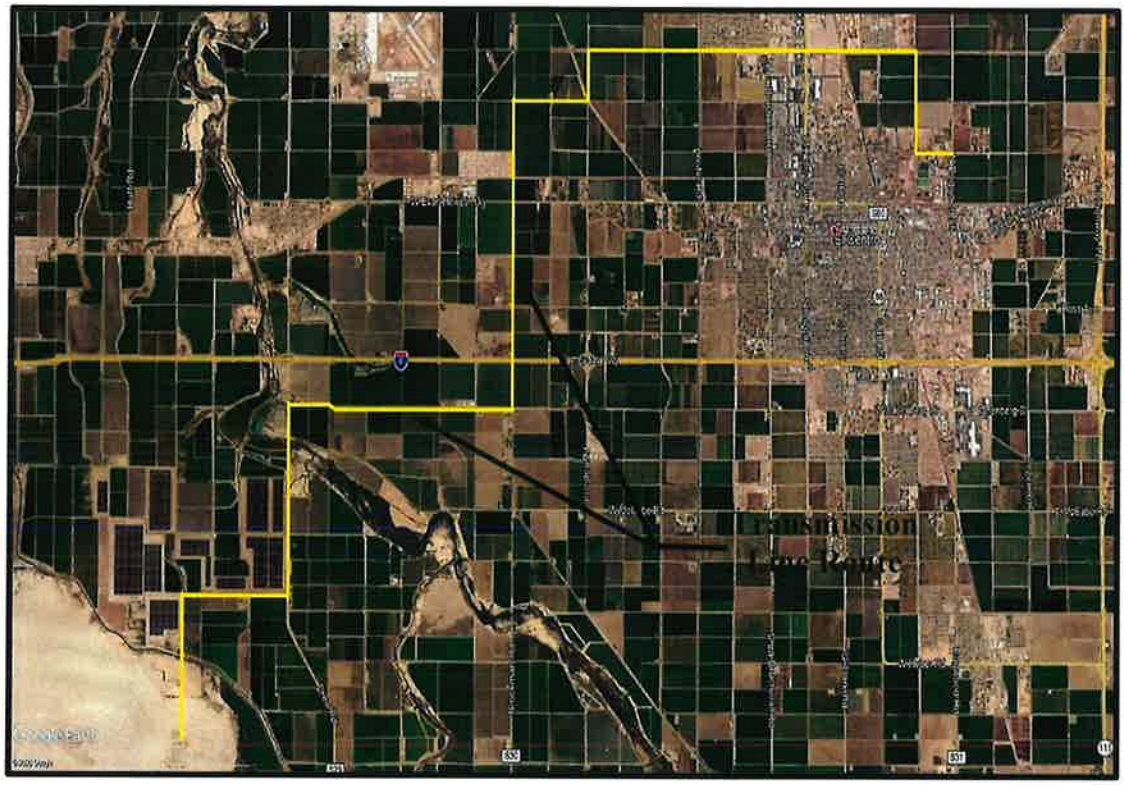
Geotechnical Report

230 kV "S' Transmission Line Upgrade

Imperial County, California

Prepared for:

IID Power Dept.
333 E. Barioni Blvd.
Imperial, CA 92251



LANDMARK
Geo-Engineers and Geologists

Prepared by:
Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243
(760) 370-3000

September 2020

LANDMARK
Geo-Engineers and Geologists

780 N. 4th Street
El Centro, CA 92243
(760) 370-3000
(760) 337-8900 fax

77-948 Wildcat Drive
Palm Desert, CA 92211
(760) 360-0665
(760) 360-0521 fax

September 18, 2020

Mr. Carlos Alfaro
IID Power Department
333 E. Barioni Boulevard
Imperial, CA 92251

Geotechnical Report
230 kV "S" Line Upgrade
Imperial County, California
LCI Report No. LE20107

Dear Mr. Alfaro:

At your request, Landmark Consultants, Inc. conducted subsurface exploration along the alignment for the proposed upgrade of the 230 kV "S" transmission line from the Liebert Substation to the El Centro Switching Station in El Centro, California. The Imperial Irrigation District (IID) is planning to replace the existing transmission line wooden power poles with steel monopoles supported on drilled pier foundations.

This executive summary presents ***selected*** elements of our findings and professional opinions. This summary ***may not*** present all details needed for the proper application of our findings and professional opinions. Our findings, professional opinions, and application options are ***best related through reading the full report***, and are best evaluated with the active participation of the engineer of record who developed them. The findings of this study are summarized below:

- Subsurface soils encountered during the field exploration generally consist of interbedded layers of loose to very dense sands (SP), silty sands (SM) and sandy silts (ML) and firm to hard clays (CL-CH) and clayey silts (ML).

- Interpretive engineering parameters of the subsurface soil used for design of cast-in-place drilled piers (EPRI MFAD and Allpile Computer Programs) are provided in Section 4 of this report.

- The risk of liquefaction induced settlement is low to moderate. Liquefaction may occur in isolated silt and sand layers between depths of 5 to 50 feet below ground surface. Potential liquefaction induced settlements of 0 to 3 inches have been calculated for the project reach.

- The clay soils are aggressive to concrete and steel. Imperial Irrigation District Standard Concrete Specifications are adequate for mitigating aggressive soils in this project, consisting of a minimum of 7.0 sacks of Type V Portland Cement per cubic yard of concrete (5,000 psi) with a maximum water/cement ratio of 0.45 (by weight).

- Foundation designs should provide a minimum concrete cover of five (5) inches around steel reinforcing or embedded steel components to mitigate corrosive soil conditions.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. If you have any questions or comments regarding our findings, please call our office at (760) 370-3000.

Respectfully Submitted,
Landmark Consultants, Inc.

Jeffrey O. Lyon, PE
CEO/Principal Engineer

Steven K. Williams, PG, CEG
Senior Engineering Geologist

Julian R. Avalos, PE
Senior Engineer

Peter E. LaBrucherie, PE
Principal Engineer

TABLE OF CONTENTS

Appendices

Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical exploration and subsurface soil testing for the proposed upgrade of the 230 kV "S" transmission line located between the Liebert Substation and the El Centro Switching Station in El Centro, California. A site map of the proposed transmission line alignment was provided by the IID prior to our investigation.

The new power transmission poles are planned to consist of a steel monopole with drilled pier foundation.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 50 feet of subsurface soil at the location provided by the IID for evaluation of physical/engineering soil properties. Professional opinions were developed from field and laboratory test data and are provided in this report regarding geotechnical conditions at the pole sites and the effect on design and construction.

The scope of our services consisted of the following:

- Field exploration and in-situ testing of the site soils at the specified location and depth.
- Laboratory testing for physical and/or chemical properties of selected samples.
- Review of the available literature and publications pertaining to local geology, faulting, and seismicity.
- Engineering analysis and evaluation of the data collected.
- Preparation of this report presenting our findings and professional opinions regarding the geotechnical aspects of project design and construction.

This report addresses the following geotechnical parameters:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, near source factors, and site seismic accelerations
- Liquefaction potential and its mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above parameters are presented for the following:

- Allowable soil bearing pressures and expected settlements
- Excavation conditions and deep foundation installation
- Mitigation of the potential effects of salt concentrations in native soil to concrete mixes and steel reinforcement
- Seismic design parameters

Our scope of work for this report did not include an evaluation of the site for the presence of environmentally hazardous materials or conditions.

1.3 Authorization

The Imperial Irrigation District Power Department provided authorization to proceed with our work through Work Order #6 in accordance with Service Agreement #8100002255. We conducted our work in general accordance with our written proposal dated May 20, 2020.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on August 12, 13 and 14, 2020 using Kehoe Testing and Engineering, Inc. of Huntington Beach, California to advance nineteen (19) electric cone penetrometer (CPT) soundings to an approximate depth of 50 feet below existing ground surface. The approximately CPT locations (23 locations) were established in the field by IID personnel.

Landmark obtained subsurface exploration data for four (4) pre-marked locations (CPT-20 through CPT-23) from previously geotechnical reports performed for the IID Power Department. Initially exploration was performed for CPT-23 location on October 18, 2006 for the relocation of seven (7) transmission towers for the A/B transmission power line project. The subsurface exploration was conducted by Holguin, Fahan and Associates of Irvine, California. The previously subsurface exploratory sounding was performed at an approximate depth of 70 feet below existing ground surface.

Subsequent exploration was performed for CPT-20, 21 and 22 locations on November 30, 2011 for the upgrade of a section of the 230 kV "S" power transmission line which extends from the SDG&E Substation to El Centro Generating Station in El Centro, California. The previously exploration was conducted using Middle Earth Geo-Testing, Inc. of Orange, California to advance three (3) electric cone penetrometer (CPT) soundings to approximate depth of 50 feet below existing ground surface.

The soundings were made at the locations shown on the Site and Exploration Plan (Plates A-2a though A-2f). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernible site features. Shallow (3-foot deep) mechanical auger borings (8-inch diameter) were made adjacent to the CPT soundings in order to obtain near surface soil samples for laboratory analysis.

CPT soundings provide a continuous profile of the soil stratigraphy with readings every 2.5cm (1 inch) in depth. Direct sampling for visual and physical confirmation of soil properties has been used by our firm to establish direct correlations with CPT exploration in this geographical region.

The CPT exploration was conducted by hydraulically advancing an instrumented Hogentogler 15cm^2 conical probe into the ground at a rate of 2cm per second using a 30-ton truck as a reaction mass. An electronic data acquisition system recorded a nearly continuous log of the resistance of the soil against the cone tip (Qc) and soil friction against the cone sleeve (Fs) as the probe was advanced. Empirical relationships (Robertson and Campanella, 1989) were then applied to the data to give a continuous profile of the soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, phi (□) angle (soil friction angle), undrained shear strength (S_u) of clays and over-consolidation ratio (OCR). These correlations may then be used to evaluate vertical and lateral soil bearing capacities and consolidation characteristics of the subsurface soil.

Interpretive logs of the CPT soundings are presented on Plates B-1 through B-23 in Appendix B. A key to the interpretation of CPT soundings is presented on Plate B-24. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

Additionally, groundwater observation wells were installed within nineteen (19) CPT locations. No groundwater wells were installed on subsurface exploration locations performed on CPT-20 though CPT-23 for the previous geotechnical reports performed on 2006 and 2011 for the IID Power Department.

Observation wells installation was performed on September 1 and 2, 2020 using 2R Drilling of Ontario, California to advance nineteen (19) wells to a depth of 20 feet below existing ground surface. The observation wells were advanced with a truck-mounted, CME 55 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers. Groundwater observation wells were installed within each of the CPT locations to allow for measurement of static groundwater levels. The observation wells were constructed with 2-inch diameter PVC well screen (10 feet long) placed at the base of the well and 10 feet of blank (solid) PVC risers placed from the top of the well screen to ground surface. The screened portion of the well was encased in a cloth filter sock to inhibit fine particles from entering the observation well. The boring annulus was backfilled with native soil auger cuttings. A screw compression rubber plug was placed in each well, surrounded with an 8-inch cast iron hand well and concrete, to allow for future groundwater level measurements.

2.2 Laboratory Testing

Laboratory tests were conducted on a selected bulk soil sample obtained from a hand auger boring made adjacent to the CPT locations to aid in classification and evaluation of selected engineering properties of the near surface soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods)

The laboratory test results are presented in Appendix C. Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were either extrapolated from correlations with the subsurface CPT data or from data obtained from the field and laboratory testing program.

Section 3
DISCUSSION

3.1 Site Conditions

The existing 230 kv "S-line" transmission line is located in the southwestern portion of the Imperial Valley of southeastern California. The S-line runs approximately 17 miles from the Liebert Substation on Liebert Road north of the Westside Main Canal to the El Centro Generating Station located at 485 E. Villa Avenue in northeastern El Centro, California. The transmission line is located adjacent to paved County roadways and agricultural field roads in a predominantly agricultural area of the Imperial Valley. A portion of the transmission line (from CPT-4 to CPT-2) is located in a residential/commercial area of the cities of El Centro and Imperial.

The transmission route ranges in elevation from approximately 25 to 55 feet below mean sea level (MSL) (El. 975 to 945 local datum) in the Imperial Valley region of the California low desert. The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water to an elevation of 43± feet above MSL. Annual rainfall in this arid region is less than 3 inches per year with four months of average summertime temperatures of 100 °F to 120 °F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Salton Trough region of the Colorado Desert physiographic province of southeastern California. The Salton Trough is a topographic and geologic structural depression resulting extending from the San Gorgonio Pass to the Gulf of California (Norris & Webb, 1990). The Salton Trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments deposited since the Miocene Epoch (Morton, 1977).

Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The Imperial Valley is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The Late Pleistocene to Holocene lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed fresh water lakes. Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California.

3.3 Subsurface Soil

Subsurface soils encountered during field exploration conducted on October 18, 2006, November 30, 2011 and August 12, 13 and 14, 2020 generally consist of interbedded layers of loose to very dense sands (SP), silty sands (SM) and sandy silts (ML) and firm to hard clays (CL-CH) and clayey silts (ML). The subsurface logs (Plates B-1 through B-23) depict the stratigraphic relationships of the various soil types at each corner pole location. Variations in subsurface stratigraphy may occur between the points of exploration. The stratification lines shown on the subsurface log represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

3.4 Groundwater

Groundwater depths were measured in 2" diameter by 20' deep groundwater PVC monitoring wells as noted in Table 3.

Table 3. Groundwater Depths

CPT Location	Groundwater Depth, ft	CPT Location	Groundwater Depth, ft
CPT-1	10.0	CPT-11	12.7
CPT-2	12.2	CPT-12	15.3
CPT-3	7.8	CPT-13	12.8
CPT-4	8.2	CPT-14	>20.0
CPT-5	11.0	CPT-15	17.8
CPT-6	8.8	CPT-16	6.8
CPT-7	6.8	CPT-17	6.2
CPT-8	5.3	CPT-18	6.6
CPT-9	8.2	CPT-19	7.3
CPT-10	9.2	---	---

Groundwater was measured in the observation wells at a depth of 5.3 to deeper than 20.0 feet on September 11, 2020, approximately ten (10) days after installation of the wells. The depth to groundwater was measured to existing ground elevation at each observation well. There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, site landscape watering, drainage, and site grading. The referenced groundwater levels should not be interpreted to represent an accurate or permanent condition.

3.5 Faulting

The transmission line route is located in the seismically active Imperial Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. The San Andreas Fault System is comprised of the San Andreas, San Jacinto, and Elsinore Fault Zones in southern California. The Imperial fault represents a transition from the more continuous San Andreas fault to a more nearly echelon pattern characteristic of the faults under the Gulf of California (USGS, 1990). A computer-aided search was made of known faults or seismic zones that lie proximal to the project route (Table 1).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along Holocene-active or pre-Holocene faults (CGS, 2018b). Earthquake Fault Zones are regulatory zones that address the hazard of surface fault rupture.

A Holocene-active fault is one that has ruptured during Holocene time (within the last 11,700 years). A pre-Holocene fault is a fault that has not ruptured in the last 11,700 years. Pre-Holocene faults may still be capable of surface rupture in the future, but are not regulated by the A-P act.

Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2018a) indicates that the nearest mapped Earthquake Fault Zone are as follows:

Table 4. Nearest Mapped Earthquake Faults

CPT Location	Fault Name	Approximate Distance (miles)	Direction from the CPT Location
CPT-1	Imperial	3.2	NE
CPT-2	Imperial	2.5	NE
CPT-3	Imperial	2.0	NE
CPT-4	Superstition Hills	0.5	NW
CPT-5	Superstition Hills	1.0	NW
CPT-6	Superstition Hills	1.3	NW
CPT-7	Superstition Hills	2.0	NW
CPT-8	Superstition Hills	2.6	NW
CPT-9	Superstition Hills	3.1	NW
CPT-10	Superstition Hills	4.4	NW
CPT-11	Superstition Hills	4.9	NW
CPT-12	Unnamed 1*	4.8	SW
CPT-13	Unnamed 1*	3.9	SW
CPT-14	Unnamed 1*	3.7	SW
CPT-15	Unnamed 1*	3.6	SW
CPT-16	Unnamed 1*	3.1	SW
CPT-17	Unnamed 1*	2.5	SW
CPT-18	Unnamed 1*	1.7	SW
CPT-19	Unnamed 1*	1.7	SW
CPT-20	Superstition Hills	2.4	NW
CPT-21	Superstition Hills	3.5	NW
CPT-22	Superstition Hills	3.9	NW
CPT-23	Imperial	1.7	NE

* Fault identified during field mapping of surface rupture after the 2010 El Mayor-Cucapah Earthquake.

3.6 General Ground Motion Analysis

The transmission line route is considered likely to be subjected to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

CBC General Ground Motion Parameters: The 2019 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Web Application (SEAOC, 2020) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for soil site class effects (PGA_M) value in accordance with 2019 CBC Section 1803.5.12 ($PGA_M = F_{PGA}*PGA$) for the different CPT locations are as follows:

Table 5. Peak Ground Acceleration

CPT Location	Peak Ground Acceleration (g)	CPT Location	Peak Ground Acceleration (g)
CPT-1	0.73	CPT-13	0.57
CPT-2	0.79	CPT-14	0.55
CPT-3	0.83	CPT-15	0.55
CPT-4	0.97	CPT-16	0.55
CPT-5	0.95	CPT-17	0.55
CPT-6	0.91	CPT-18	0.55
CPT-7	0.83	CPT-19	0.55
CPT-8	0.77	CPT-20	0.78
CPT-9	0.71	CPT-21	0.67
CPT-10	0.60	CPT-22	0.63
CPT-11	0.56	CPT-23	0.77
CPT-12	0.56	---	---

Note: Design earthquake ground motion parameters are provided in Tables 2-1 through 2-23.

3.7 Seismic and Other Hazards

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Imperial, Laguna Salada, Cerro Prieto, and Superstition Hills faults.
- **Surface Rupture.** The California Geological Survey has established Earthquake Fault Zones in accordance with the 1972 Alquist-Priolo Earthquake Fault Zone Act. The Earthquake Fault Zones consists of boundary zones surrounding faults or fault segments determined to be sufficiently active, well-defined, and mappable for some distance. The project route does not lie within an A-P Earthquake Fault Zone; therefore, surface fault rupture is considered to be low at the project site.
- **Liquefaction and lateral spreading.** Liquefaction is a potential design consideration because of underlying saturated sandy substrata. Although the Imperial Valley has not yet been evaluated for seismic hazards by the California Geological Survey seismic hazards zonation program, liquefaction is well documented in the Imperial Valley after strong seismic events (McCrink, et al, 2001 and Rymer et al, 2001). The potential for liquefaction at the pole sites is discussed in more detail in Section 3.8.

Other Potential Geologic Hazards

- **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps, aerial photographs and topographic maps of the region and no indications of landslides were observed during our site investigation.
- **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.
- **Tsunamis, seiches, and flooding.** The site is not located near any large bodies of water, so the threat of tsunami, seiches, or other seismically-induced flooding is unlikely.
- **Flooding.** Based on our review of FEMA (2008) FIRM Panels which encompasses the transmission line route, the transmission line route is located in Flood Zone X, an area determined to be outside the 0.2% annual chance (500-year) floodplain.
- **Collapsible soils.** Collapsible soil generally consists of dry, loose, low-density material that have the potential collapse and compact (decrease in volume) when subjected to the addition of water or excessive loading. Soils found to be most susceptible to collapse include loess (fine grained wind-blown soils), young alluvium fan deposits in semi-arid to arid climates, debris flow deposits and residual soil deposits.

Due to the cohesive nature of the subsurface soils and shallow groundwater, the potential for hydro-collapse of the subsurface soils along the pole line route is considered very low.

- **Expansive soil.** In general, much of the near surface soils in the Imperial Valley consist of silty clays and clays which are moderate to highly expansive. The expansive soil conditions should not affect the deep foundations planned for the power poles.

3.8 Liquefaction

Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations.

Methods of Analysis: Liquefaction potential at each corner pole was evaluated using the 1997 NCEER Liquefaction Workshop methods. The 1997 NCEER methods utilize direct SPT blow counts or CPT cone readings from site exploration and earthquake magnitude/PGA estimates from the seismic hazard analysis. The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio (CSR) versus a corrected blow count $N_{1(60)}$ or Qc_{1N}. PGA_M values of 0.55g to 0.97g were used in the analysis with groundwater depths between 5 to 20 feet and a threshold factor of safety (FS) of 1.3.

The computer program CLiq (Version 2.2.0.32, Geologismiki, 2017) was utilized for liquefaction assessment at the project site. The estimated settlements have been adjusted for transition zones between layers and the post liquefaction volumetric strain has been weighed with depth (Robertson, 2014 and Cetin et al., 2009).

The fines content of the liquefiable sands and silts increases their liquefaction resistance in that more ground motion cycles are required to fully develop the increased pore pressures. The CPT tip pressures (Qc) were adjusted to an equivalent clean sand pressure ($Q_{tn,cs}$) in accordance with NCEER (1998). The soil encountered at the point of exploration included saturated silts and silty sands that could liquefy during a Maximum Considered Earthquake. Liquefaction can occur within several isolated silt and sand layers between depths of 7 to 50 feet.

The likely triggering mechanism for liquefaction appears to be strong groundshaking associated with the rupture of the nearby faults. The analysis is summarized in the table below.

Table 6. Summary of Liquefaction Analysis

CPT Location	Depth To First Liquefiable Zone (ft)	Potential Induced Settlement (in)
CPT-1	30.5	< ¼
CPT-2	13.5	1½
CPT-3	8.0	2½
CPT-4	11.5	1½
CPT-5	20.0	¼
CPT-6	13.0	¼
CPT-7	9.5	1¾
CPT-8	5.0	2¾
CPT-9	15.5	1½
CPT-10	9.5	2
CPT-11	15.0	1½
CPT-12	15.0	½
CPT-13	18.0	¾
CPT-14	20.0	2¼
CPT-15	21.0	¾
CPT-16	12.0	1¾
CPT-17	9.0	1¼
CPT-18	6.0	1¾
CPT-19	7.0	2
CPT-20	9.5	3
CPT-21	8.5	¼
CPT-22	11.0	1¼
CPT-23	---	0.0

Computer printouts of the liquefaction analyses are provided in Appendix D.

Liquefaction Induced Ground Failure: Based on research from Ishihara (1985) and Youd and Garris (1995) small ground fissure or sand boil formation is unlikely because of the thickness of the overlying unliquefiable soil. Sand boils are conical piles of sand derived from the upward flow of groundwater caused by excess porewater pressures created during strong ground shaking. Sand boils are not inherently damaging by themselves, but are an indication that liquefaction occurred at depth (Jones, 2003). Liquefaction induced lateral spreading is not expected to occur at the pole sites due to the planar topography. According to Youd (2005), if the liquefiable layer lies at a depth greater that about twice the height of a free face, lateral spread is not likely to develop.

Mitigation: Based on an estimate of less than 3.0 inch of liquefaction induced settlements, no ground improvement for liquefaction mitigation is required at the pole sites.

Section 4
DESIGN CRITERIA

4.1 Drilled Pier Foundations

The new steel power poles are planned be supported by a cast-in-place, drilled piers. Design criteria are provided below for the drilled pier foundations.

Vertical Capacity: Vertical capacity for 48, 60 and 72 inch diameter shafts are presented in Appendix E. Capacities for other shaft sizes can be determined in direct proportion to shaft diameters. Point bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.5. The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads such as from wind or seismic forces. The allowable vertical shaft capacities are based on the supporting capacity of the soil.

Lateral Capacity: The allowable lateral capacities for a 48, 60 and 72 inch diameter shafts are given in the tables shown below. The allowable horizontal deflection has been assumed to be one-half inch (0.50 inch).

Table 7a – CPT-1 Lateral Capacities

Shaft Diameter (in.)	**48**		**60**		**72**	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	47.0	141.5	53.8	171.1	60.2	192.0
Maximum Moment (foot-kips)	200	-1500	225.8	-1841.7	249.2	-2075
@Depth from Pier Head (ft.)	8.0	0	8.0	0	8.0	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	76.1	152.5	89	212.5	99.5	281
Maximum Moment (foot-kips)	496.7	-1616.7	581.7	-2875	643.3	-4391.7
@Depth from Pier Head (ft.)	12.7	0	12.7	0	12.8	0

Table 7b – CPT-2 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	49.8	151	57	203.7	63.5	243.5
Maximum Moment (foot-kips)	222.5	-1691.7	250.8	-2491.7	275	-3066.7
@Depth from Pier Head (ft.)	8.5	0	8.5	0	8.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	77.7	166	93.5	236.5	105.8	332
Maximum Moment (foot-kips)	516.7	-1758.3	640	-3183.3	723.3	-5325
@Depth from Pier Head (ft.)	12.8	0	13.3	0	13.3	0

Table 7c – CPT-3 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	52.7	183.8	60.5	300	67.5	425
Maximum Moment (foot-kips)	247.5	-2166.7	280.8	-4016.7	308.3	-6033.3
@Depth from Pier Head (ft.)	9.0	0	9.0	0	9.0	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	91	212	119.5	324	138	469
Maximum Moment (foot-kips)	710.8	-2141.7	1025	-4016.7	1200	-6841.7
@Depth from Pier Head (ft.)	14.5	0	15.0	0	15.0	0

Table 7d – CPT-4 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	31.6	112	35.5	144.2	39.2	166
Maximum Moment (foot-kips)	146.7	-1350	162.5	-1841.7	177.5	-2150
@Depth from Pier Head (ft.)	8.8	0	8.8	0	8.8	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	46.5	121.2	53.7	179.5	60	2415.5
Maximum Moment (foot-kips)	298.3	-1500	346.7	-2716.7	387.5	-4008.3
@Depth from Pier Head (ft.)	12.0	0	12.3	0	12.3	0

Table 7e – CPT-5 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	29.9	100	33.8	117	37.5	131
Maximum Moment (foot-kips)	133.3	-1108.3	149.2	-1308.3	-164.2	-1475
@Depth from Pier Head (ft.)	8.5	0	8.5	0	8.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	54.6	125.5	64.2	186.8	71.6	268.8
Maximum Moment (foot-kips)	400	-1516.7	479.2	-2866.7	534.2	-4850
@Depth from Pier Head (ft.)	13.6	0	13.7	0	13.8	0

Table 7f – CPT-6 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	40	159	43.6	206	46.5	229
Maximum Moment (foot-kips)	210.8	-1925	224.2	-2633.3	233.3	-2941.7
@Depth from Pier Head (ft.)	8.5	0	8.5	0	8.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	63.6	166	72.5	233	79	310
Maximum Moment (foot-kips)	465.8	-1866.7	531.7	-3258.3	573.3	-5058.3
@Depth from Pier Head (ft.)	13.5	0	13.5	0	13.6	0

Table 7g – CPT-7 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	40	134	45.3	177	49.7	208
Maximum Moment (foot-kips)	185	-1575	206.7	-2241.7	224.2	-2700
@Depth from Pier Head (ft.)	8.5	0	8.5	0	8.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	62.3	144	72.7	210	81	291
Maximum Moment (foot-kips)	419.2	-1641.7	496.7	-3016.7	551.7	-4775
@Depth from Pier Head (ft.)	13.0	0	13.1	0	13.2	0

Table 7h – CPT-8 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	30.3	164.5	31.5	239	32.5	294
Maximum Moment (foot-kips)	155	-2008.3	164.2	-3158.3	171.7	-4000
@Depth from Pier Head (ft.)	8.3	0	8.5	0	8.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	65.5	174	76.6	250	82.5	335
Maximum Moment (foot-kips)	550.8	-1833.3	675.8	-3375	739.2	-5341.7
@Depth from Pier Head (ft.)	13.8	0	13.8	0	14.0	0

Table 7i – CPT-9 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	67	209	69.2	257.5	70.5	291
Maximum Moment (foot-kips)	352.5	-1966.7	365.8	-2525	374.2	-2866.7
@Depth from Pier Head (ft.)	7.8	0	7.8	0	7.8	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	110.5	218	131.6	296	142	395
Maximum Moment (foot-kips)	705.8	-1991.7	866.7	-3458.3	950	-5550
@Depth from Pier Head (ft.)	9.6	0	9.7	0	9.7	0

Table 7j – CPT-10 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	50	207	55.5	293	59.7	360
Maximum Moment (foot-kips)	250	-2225	283.3	-3475	309.2	-4433.3
@Depth from Pier Head (ft.)	8.0	0	8.0	0	8.0	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	77	215	89.5	300	98.6	394
Maximum Moment (foot-kips)	496.7	-2158.3	592.5	-3666.7	658.3	-5533.3
@Depth from Pier Head (ft.)	10.7	0	10.8	0	10.8	0

Table 7k – CPT-11 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	53.5	166	61	197	68	219
Maximum Moment (foot-kips)	205	-1583.3	229.2	-1908.3	250.8	-2125
@Depth from Pier Head (ft.)	7.5	0	7.5	0	7.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	82.5	173	96.3	237	107	311
Maximum Moment (foot-kips)	463.3	-1708.3	542.5	-2966.7	595	-4550
@Depth from Pier Head (ft.)	10.8	0	11.0	0	11.0	0

Table 7l – CPT-12 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	48.5	182	54	255	58.5	302
Maximum Moment (foot-kips)	229.2	-2116.7	249.2	-3183.3	263.3	-3825
@Depth from Pier Head (ft.)	8.7	0	8.7	0	8.7	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	82.4	199	101	280	113	370
Maximum Moment (foot-kips)	613.3	-2033.3	785	-3616.7	875	-5666.7
@Depth from Pier Head (ft.)	13.3	0	13.5	0	13.5	0

Table 7m – CPT-13 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	34.8	122	39.2	158	43.2	188
Maximum Moment (foot-kips)	172.5	-1475	191.7	-2025	209.2	-2491.7
@Depth from Pier Head (ft.)	8.7	0	8.7	0	8.7	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	55.2	133	64	195	70.5	272
Maximum Moment (foot-kips)	386.7	-1583.3	450.8	-2900	493.3	-4641.7
@Depth from Pier Head (ft.)	12.4	0	12.5	0	12.6	0

Table 7n – CPT-14 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	35.7	141	40.8	216	45	280
Maximum Moment (foot-kips)	171.7	-1783.3	195.8	-2991.7	214.2	-4025
@Depth from Pier Head (ft.)	9.0	0	9.0	0	9.0	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	53	149	63.1	233	72	339
Maximum Moment (foot-kips)	357.5	-1791.7	440	-3375	512.5	-5541.7
@Depth from Pier Head (ft.)	12.7	0	13.0	0	13.3	0

Table 7o – CPT-15 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	77.5	272	84	401	87	535
Maximum Moment (foot-kips)	406.7	-2666.7	450	-4341.7	473.3	-6925
@Depth from Pier Head (ft.)	8.7	0	8.7	0	8.8	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	121	314	159	429	180	585
Maximum Moment (foot-kips)	850	-2691.7	1241.7	-4591.7	1475	7625
@Depth from Pier Head (ft.)	12.0	0	13.4	0	14.0	0

Table 7p – CPT-16 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	46	161	51.8	221	57	268
Maximum Moment (foot-kips)	208.3	-1841.7	231.7	-2733.3	251.7	-3433.3
@Depth from Pier Head (ft.)	8.7	0	8.7	0	8.7	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	79	183	98	261	110	366
Maximum Moment (foot-kips)	574.2	-1900	755	-3433.3	850	-5825
@Depth from Pier Head (ft.)	13.5	0	13.8	0	14.0	0

Table 7q – CPT-17 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	33.4	115	38	145	42.5	177
Maximum Moment (foot-kips)	162.5	-1425	184.2	-1883.3	205.8	-2391.7
@Depth from Pier Head (ft.)	9.2	0	9.2	0	9.2	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	60.5	144	74.5	212	84	325
Maximum Moment (foot-kips)	490.8	-1683.3	641.7	-3141.7	727.5	-5650
@Depth from Pier Head (ft.)	15.5	0	16.0	0	16.4	0

Table 7r – CPT-18 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	38.5	159	39.5	198	40.5	225
Maximum Moment (foot-kips)	207.5	-1833.3	214.2	-2475	217.5	-2933.3
@Depth from Pier Head (ft.)	7.8	0	7.8	0	7.8	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	70	174	81	235	87	328
Maximum Moment (foot-kips)	530	-1833.3	645	-3233.3	701.7	-5500
@Depth from Pier Head (ft.)	14.0	0	14.3	0	14.5	0

Table 7s – CPT-19 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	83	266	93	420	100	580
Maximum Moment (foot-kips)	401.7	-2650	450.8	-4891.7	487.5	-7283.3
@Depth from Pier Head (ft.)		0		0		0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	132	302	175	443	199	628
Maximum Moment (foot-kips)	908.3	-2625	1316.7	-4691.7	1541.7	-7891.7
@Depth from Pier Head (ft.)		0		0		0

Table 7t – CPT-20 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	47.6	170	55	252	61	322
Maximum Moment (foot-kips)	223.3	-1966.7	260	-3208.3	287.5	-4250
@Depth from Pier Head (ft.)	9.3	0	9.3	0	9.3	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	76	181	94	268	108.5	377
Maximum Moment (foot-kips)	533.3	-1916.7	696.7	-3500	822.5	-5733.3
@Depth from Pier Head (ft.)	13.0	0	13.0	0	13.0	0

Table 7u – CPT-21 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	64	245	72.5	405	79.5	580
Maximum Moment (foot-kips)	385.8	-2658.3	435	-5066.7	470	-7816.7
@Depth from Pier Head (ft.)	10.5	0	10.5	0	10.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	107	278	137	434	157	610
Maximum Moment (foot-kips)	866.7	-2625	1158.3	-4941.7	1341.7	-8175
@Depth from Pier Head (ft.)	12.0	0	12.3	0	12.5	0

Table 7v – CPT-22 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	65	243	71	356	75.5	451
Maximum Moment (foot-kips)	356.7	-2483.3	380.8	-4083.3	395.8	-5466.7
@Depth from Pier Head (ft.)	8.5	0	8.5	0	8.5	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	107.5	268	137	375	154	500
Maximum Moment (foot-kips)	764.2	-2441.7	1025	-4233.3	1166.7	-6833.3
@Depth from Pier Head (ft.)	11.2	0	11.5	0	12.0	0

Table 7w – CPT-23 Lateral Capacities

Shaft Diameter (in.)	48		60		72	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Length (ft.)	20	20	20	20	20	20
Lateral Capacity (kips)	54.5	206	62	350	68.5	513
Maximum Moment (foot-kips)	287.5	-2383.3	325.8	-4625	356.7	-7225
@Depth from Pier Head (ft.)	10.0	0	10.0	0	10.0	0
Minimum Length (ft.)	30	30	30	30	30	30
Lateral Capacity (kips)	96	235	124.3	364	142.5	535
Maximum Moment (foot-kips)	795.8	-2333.3	1100	4358.3	1275	-7408.3
@Depth from Pier Head (ft.)	13.3	0	13.5	0	13.5	0

Uplift Capacity: Pole capacity in tension may be assumed to be 50% of the compression capacity.

Soil Parameters: Interpretive engineering soil parameters of the subsurface soil for EPRI MFAD and Allpile Computer Programs are presented in the tables below for the transmission pole locations.

Table 8a – CPT-1 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-CH	0 to 29	125	0°	1.00	0.6	200	1.0
ML	29 to 34	120	26°	0.50	0.5	225	1.0
CL-CH	34 to 40	125	0°	0.75	0.5	135	1.0
ML	40 to 50	120	26°	0.50	0.5	225	1.0

Table 8b – CPT-2 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-ML	0 to 18	125	0°	1.00	0.6	200	1.0
SM	18 to 25	115	33°	0.0	1.2	40	1.0
CL	25 to 28	125	0°	1.30	1.0	375	1.0
SM	28 to 30	115	34°	0.0	1.5	50	1.0
CL	30 to 32	125	0°	2.00	1.4	700	1.0
SM	32 to 34	115	34°	0.0	1.5	50	1.0
ML	34 to 50	120	26°	0.60	0.70	315	1.0

Table 8c – CPT-3 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-ML	0 to 14	125	0°	1.00	0.6	200	1.0
SP	14 to 34	115	36°	0.0	2.4	85	1.0
SM	34 to 36	115	33°	0.0	1.3	45	1.0
SP	36 to 50	115	36°	0.0	2.4	85	1.0

Table 8d – CPT-4 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL	0 to 18	125	0°	0.70	0.4	100	1.0
SM	18 to 23	115	30°	0.0	0.8	25	1.0
ML-CL	23 to 30	120	0°	0.50	0.3	65	1.0
SM	30 to 41	115	30°	0.0	0.8	25	1.0
SM	41 to 43	115	34°	0.0	1.5	50	1.0
SM	43 to 48	115	30°	0.0	0.8	25	1.0
SP	48 to 50	115	35°	0.0	2.1	75	1.0

Table 8e – CPT-5 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL	0 to 20	125	0°	0.70	0.4	100	1.0
SM	20 to 22	115	34°	0.0	1.4	45	1.0
CL	22 to 37	125	0°	1.25	0.8	325	1.0
ML-SM	37 to 41	115	32°	0.0	0.8	35	1.0
ML	41 to 50	115	26°	0.5	0.5	225	1.0

Table 8f – CPT-6 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL	0 to 7	125	0°	0.70	0.4	100	1.0
SM	7 to 9	115	32°	0.0	1.0	35	1.0
ML-CL	9 to 14	120	0°	0.70	0.3	100	1.0
CL-CH	14 to 22	125	0°	1.25	0.8	325	1.0
SM	22 to 23	115	33°	0.0	1.2	40	1.0
CL-ML	23 to 40	120	0°	0.85	0.5	185	1.0
CL	40 to 50	125	0°	1.30	1.0	375	1.0

Table 8g – CPT-7 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL	0 to 18	125	0°	0.85	0.5	185	1.0
SM	18 to 23	115	32°	0.0	1.0	35	1.0
ML-CL	23 to 28	120	0°	0.75	0.4	135	1.0
SM	28 to 33	115	30°	0.0	0.8	25	1.0
ML-CL	33 to 47	120	0°	0.85	0.5	185	1.0
SM-ML	47 to 49	115	32°	0.0	1.0	35	1.0

Table 8h – CPT-8 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
SM-ML	0 to 8	115	29°	0.0	0.6	20	1.0
ML-CL	8 to 13	120	0°	0.75	0.4	135	1.0
SM	13 to 18	115	34°	0.0	1.5	50	1.0
ML-CL	18 to 24	120	0°	0.50	0.3	65	1.0
SM-ML	24 to 27	115	33°	0.0	1.2	40	1.0
ML	27 to 50	115	24°	0.30	0.4	100	1.0

Table 8i – CPT-9 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
SM	0 to 5	115	32°	0.0	1.0	35	1.0
SM	5 to 10	115	35°	0.0	1.9	75	1.0
ML-CL	10 to 18	120	0°	0.85	0.5	185	1.0
CL	18 to 21	125	0°	1.30	1.0	375	1.0
SM	21 to 30	115	33°	0.0	1.2	40	1.0
ML	30 to 38	120	24°	0.45	0.5	180	1.0
SP	38 to 50	115	38°	0.0	3.4	110	1.0

Table 8j – CPT-10 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
SM-ML	0 to 5	115	32°	0.0	1.0	35	1.0
ML	5 to 9	120	24°	0.40	0.4	140	1.0
SM-ML	9 to 19	115	32°	0.0	1.0	35	1.0
ML-CL	19 to 22	120	0°	0.70	0.4	100	1.0
SM	22 to 24	115	31°	0.0	0.9	30	1.0
ML-CL	24 to 31	120	0°	0.50	0.3	65	1.0
SP	31 to 43	115	38°	0.0	3.4	110	1.0
ML-CL	43 to 50	120	0°	0.85	0.5	185	1.0

Table 8k – CPT-11 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-CH	0 to 8	125	0°	1.25	0.8	325	1.0
SM-ML	8 to 12	115	30°	0.0	0.8	25	1.0
CL-ML	12 to 22	120	0°	0.75	0.4	135	1.0
SM-ML	22 to 28	115	30°	0.0	0.8	25	1.0
ML-CL	28 to 37	120	0°	0.5	0.3	65	1.0
SM	37 to 45	115	33°	0.0	1.2	40	1.0
ML-CL	45 to 50	120	0°	0.75	0.4	135	1.0

Table 8l – CPT-12 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
ML-CL	0 to 11	120	0°	1.0	0.6	200	1.0
SM-ML	11 to 16	115	32°	0.0	1.0	35	1.0
CL-CH	16 to 26	125	0°	1.25	0.8	325	1.0
SM	26 to 30	115	34°	0.0	1.4	45	1.0
ML	30 to 35	120	24°	0.4	0.4	140	1.0
ML-CL	35 to 40	120	0°	0.75	0.4	135	1.0
ML	40 to 45	115	22°	0.20	0.2	50	1.0
SP	45 to 49	115	38°	0.0	3.4	110	1.0

Table 8m – CPT-13 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
ML-CL	0 to 6	120	0°	0.70	0.4	100	1.0
CL-CH	6 to 15	125	0°	0.85	0.5	185	1.0
ML-CL	15 to 18	120	0°	0.50	0.3	65	1.0
SM	18 to 22	115	32°	0.0	1.0	35	1.0
ML-CL	22 to 33	120	0°	1.00	0.6	200	1.0
SP-SM	33 to 37	115	35°	0.0	2.1	75	1.0
ML-CL	37 to 46	120	0°	0.70	0.4	100	1.0
SP-SM	46 to 50	115	35°	0.0	2.1	75	1.0

Table 8n – CPT-14 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-ML	0 to 14	120	0°	0.75	0.4	135	1.0
ML	14 to 16	120	24°	0.40	0.4	140	1.0
SM	16 to 24	115	33°	0.0	1.3	45	1.0
ML-CL	24 to 30	120	0°	0.5	0.3	65	1.0
SP-SM	30 to 42	115	34°	0.0	1.5	50	1.0
ML-SM	42 to 45	115	33°	0.0	1.2	40	1.0
SP	45 to 50	115	38°	0.0	3.4	110	1.0

Table 8o – CPT-15 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
SM	0 to 16	115	34°	0.0	1.5	50	1.0
SP-SM	16 to 33	115	38°	0.0	3.4	110	1.0
ML-SM	33 to 35	115	32°	0.0	1.0	35	1.0
SP	35 to 37	115	36°	0.0	2.4	85	1.0
ML	37 to 40	115	26°	0.50	0.5	225	1.0
SM	40 to 43	115	34°	0.0	1.5	50	1.0
ML-CL	43 to 46	120	0°	1.0	0.6	200	1.0
SM	46 to 50	115	34°	0.0	1.5	50	1.0

Table 8p – CPT-16 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-CH	0 to 13	125	0°	1.0	0.6	200	1.0
ML-SM	13 to 17	115	31°	0.0	0.9	30	1.0
ML-CL	17 to 19	120	0°	0.75	0.4	135	1.0
SM	19 to 22	115	34°	0.0	1.5	50	1.0
ML-SM	22 to 23	115	30°	0.0	0.8	25	1.0
SW	23 to 31	115	38°	0.0	3.4	110	1.0
SM	31 to 33	115	34°	0.0	1.5	50	1.0
SP	33 to 36	115	35°	0.0	2.1	75	1.0
ML-SM	36 to 39	115	33°	0.0	1.2	40	1.0
CL-ML	39 to 50	120	0°	1.50	1.2	500	1.0

Table 8q – CPT-17 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-ML	0 to 19	120	0°	0.70	0.4	100	1.0
SP-SM	19 to 36	115	37°	0.0	2.9	100	1.0
SM-ML	36 to 40	115	32°	0.0	1.0	35	1.0
ML	40 to 45	115	30°	0.0	0.8	25	1.0
CL-ML	45 to 50	120	0°	1.50	1.2	500	1.0

Table 8r – CPT-18 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
ML	0 to 6	115	29°	0.0	0.6	20	1.0
SM	6 to 8	115	33°	0.0	1.2	40	1.0
ML	8 to 11	115	28°	0.0	0.4	15	1.0
CL-CH	11 to 19	125	0°	1.30	1.0	375	1.0
SM-ML	19 to 20	115	34°	0.0	1.5	50	1.0
ML	20 to 22	115	29°	0.0	0.6	20	1.0
SP-SM	22 to 34	115	35°	0.0	2.1	75	1.0
ML-CL	34 to 47	120	0°	1.25	0.8	325	1.0
SM	47 to 50	115	38°	0.0	3.4	110	1.0

Table 8s – CPT-19 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
SP-SM	0 to 7	115	34°	0.0	1.5	50	1.0
ML	7 to 10	115	29°	0.0	0.6	20	1.0
SP-SM	10 to 26	115	36°	0.0	2.4	85	1.0
ML	26 to 28	115	32°	0.0	1.0	35	1.0
SP-SM	28 to 46	115	36°	0.0	2.4	85	1.0
ML	46 to 50	120	26°	0.50	0.5	225	1.0

Table 8t – CPT-20 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-CH	0 to 12	125	0°	1.0	0.6	200	1.0
ML	12 to 15	120	26°	0.50	0.6	225	1.0
ML-SM	15 to 27	115	32°	0.0	1.0	35	1.0
CL-ML	27 to 31	120	0°	1.0	0.6	200	1.0
SP-SM	31 to 45	115	36°	0.0	2.4	85	1.0
ML-SM	45 to 47	115	30°	0.0	0.8	25	1.0
CL-CH	47 to 50	125	0°	2.00	1.4	700	1.0

Table 8u – CPT-21 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-CH	0 to 10	125	0°	1.0	0.6	200	1.0
SP-SM	10 to 26	115	37°	0.0	2.9	100	1.0
CL-CH	26 to 31	125	0°	1.0	0.6	200	1.0
SM	31 to 33	115	34°	0.0	1.4	45	1.0
CL-CH	33 to 44	125	0°	1.0	0.6	200	1.0
SM	44 to 49	115	34°	0.0	1.4	45	1.0

Table 8v – CPT-22 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-CH	0 to 7	125	0°	1.0	0.6	200	1.0
SM	7 to 10	115	35°	0.0	2.1	75	1.0
SM-ML	10 to 20	115	33°	0.0	1.2	40	1.0
SP-SM	20 to 26	115	37°	0.0	2.9	100	1.0
SM	26 to 29	115	34°	0.0	1.5	50	1.0
SP-SM	29 to 31	115	37°	0.0	2.9	100	1.0
SM	31 to 33	115	34°	0.0	1.5	50	1.0
SP-SM	33 to 50	115	38°	0.0	3.4	110	1.0

Table 8w – CPT-23 Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Pressuremeter Deformation Modulus (ksi)	Lateral Soil Modulus, k (pci)	Strength Reduction Factor
CL-CH	0 to 12	125	0°	1.0	0.6	200	1.0
SM	12 to 20	115	37°	0.0	2.9	100	1.0
CL-CH	20 to 50	125	0°	1.3	1.0	375	1.0

Note: Soil strength parameters obtained from field data and laboratory testing were modified (reduced) based on our engineering judgment and our previous experience in the general region.

***Installation*:** The drilled piers shall be placed in conformance to ACI 336 guidelines. Excavation for piers should be inspected by the geotechnical consultant. A tremie pipe should be used to pour concrete from the bottom up and to ensure less than five feet of free fall. The drilled pier requires casing below groundwater to prevent caving or lateral deformation. Groundwater is expected to be encountered between 5 to 20 feet below ground surface.

The structural steel and concrete should be placed immediately after drilling. Prior to placing any structural steel or concrete, loose soil or slough material should be removed from the bottom of the drilled pier excavation.

4.2 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the transmission line route (Plates C-1 through C-5). The native soils were found to have S0 (low) to S2 (severe) levels of sulfate ion concentration (565 to 7,188ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The following table provides American Concrete Institute (ACI) recommended cement types, water-cement ratio and minimum compressive strengths for concrete in contact with soils:

Table 9. Concrete Mix Design Criteria due to Soluble Sulfate Exposure

Sulfate Exposure Class	Water-soluble Sulfate (SO_4) in soil, ppm	Cement Type	Maximum Water-Cement Ratio by weight	Minimum Strength f'c (psi)
S0	0-1,000	–	–	–
S1	1,000-2,000	II	0.50	4,000
S2	2,000-20,000	V	0.45	4,500
S3	Over 20,000	V (plus Pozzolon)	0.45	4,500

Note: From ACI 318-14 Table 19.3.1.1 and Table 19.3.2.1

Imperial Irrigation District Standards require a minimum of 7.0 sacks of Type V Portland Cement per cubic yard of concrete (5,000 psi) with a maximum water/cement ratio of 0.45 (by weight) be used for concrete placed in contact with native soil on this project. This requirement satisfies mitigation required for concrete mixes in contact with aggressive soils.

The native soil has moderate to very severe levels of chloride ion concentration (250 to 17,260 ppm). Chloride ions can cause corrosion of reinforcing steel, anchor bolts and other buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes.

Foundation designs shall provide a minimum concrete cover of five (5) inches around steel reinforcing or embedded components (rebar, anchor bolts, etc.). If the 5 inch concrete edge distance cannot be achieved, all embedded steel components (rebar, anchor bolts, etc.) shall be epoxy coated for corrosion protection (in accordance with ASTM D3963/A934). Concrete should be thoroughly vibrated within the top five (5) feet of the pier to reduce permeability of the concrete where exposed to atmospheric wet/dry cycles.

4.3 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the Imperial, Superstition Hills, Cerro Prieto, and Laguna Salada faults. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the California Building Code for Site Class D using the seismic coefficients given in Section 3.6 and Table 2 of this report.

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The professional opinions and conclusions within this report are based on current information regarding the proposed upgrade of the 230 kV "S" transmission line located between the Liebert Substation and the El Centro Switching Station in El Centro, California. The conclusions and professional opinions of this report are invalid if:

- Structural loads change from those stated or the structures are relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

This report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Imperial County at the time the report was prepared. No express or implied warranties are made in connection with our services.

Findings and professional opinions in this report are based on selected points of field exploration, geologic literature, limited laboratory testing, and our understanding of the proposed project. Our analysis of data and professional opinions presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. The nature and extend of such variations may not become evident until, during or after construction. If variations are detected, we should immediately be notified as these conditions may require additional studies, consultation, and possible design revisions.

Environmental or hazardous materials evaluations were not performed by Landmark for this project. Landmark will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

The client has responsibility to see that all parties to the project including designer, contractor, and subcontractor are made aware of this entire report within a reasonable time from its issuance. This report should be considered invalid for periods after two years from the date of report issuance without a review of the validity of the findings and professional opinions by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice. This report is based upon government regulations in effect at the time of preparation of this report. Future changes or modifications to these regulations may require modification of this report. Land or facility use, on and off-site conditions, regulations, design criteria, procedures, or other factors may change over time, which may require additional work. Any party other than the client who wishes to use this report shall notify Landmark of such intended use. Based on the intended use of the report, Landmark may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Landmark from any liability resulting from the use of this report by any unauthorized party and client agrees to defend, indemnify, and hold Landmark harmless from any claim or liability associated with such unauthorized use or non-compliance.

This report contains information that may be useful in the preparation of contract specifications. However, the report is not worded is such a manner that we recommend its use as a construction specification document without proper modification. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Plan Review

Landmark Consultants, Inc. should be retained during development of design and construction documents to check that the geotechnical professional opinions are appropriate for the proposed project and that the geotechnical professional opinions are properly interpreted and incorporated into the documents. Landmark should have the opportunity to review the final design plans and specifications for the project prior to the issuance of such for bidding.

Governmental agencies may require review of the plans by the geotechnical engineer of record for compliance to the geotechnical report.

5.3 Additional Services

We recommend that Landmark Consultant be retained to provide the tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

Landmark Consultants, Inc. professional opinions for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and foundation construction. Accordingly, the findings and professional opinions in this report are made contingent upon the opportunity for Landmark Consultants to observe grading operations and foundation excavations for the proposed construction.

If parties other than Landmark Consultants, Inc. are engaged to provide observation and testing services during construction, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the professional opinions in this report and/or by providing alternative professional guidance.

Additional information concerning the scope and cost of these services can be obtained from our office.

Section 6
REFERENCES

American Concrete Institute (ACI), 2013, ACI Manual of Concrete Practice 302.1R-04.

American Society of Civil Engineers (ASCE), 2016, Minimum Design Loads for Buildings and Other Structures: ASCE Standard 7-16.

Boulanger, R. W., and Idriss, I. M., 2006, "Liquefaction susceptibility criteria for silts and clays." J. Geotechnical and Geoenvironmental Eng., ASCE 132(11), 1413–1426.

Bryant, W. A. and Hart, E. W., 2007, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zone Maps: California Geologic Survey, Special Publication 42, 42 p.

California Building Standards Commission, 2020, 2019 California Building Code. California Code of Regulations, Title 24, Part 2, Vol. 2 of 2.

California Division of Mines and Geology (CDMG), 1996, California Fault Parameters: available at http://www.consrv.ca.gov/dmg/shezp/fltindex.html.

California Geological Survey (CGS), 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A, 98p.

California Geological Survey (CGS), 2020a, Fault Activity Map of California http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#.

California Geological Survey (CGS), 2020b, Alquist-Priolo Earthquake Fault Zone Maps. http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps

Cetin. K.O., Bilge, H.T., Wu, J., Kammerer, A.M. and Seed, R.B., 2009a. Probabilistic model for cyclic straining of saturated clean sands. J. of Geotechnical and Geoenvironmental Eng., ASCE 135(3), pp 371-386.

Cetin. K.O., Bilge, H.T., Wu, J., Kammerer, A.M. and Seed, R.B., 2009b. Probabilistic model for assessment of cyclically induced reconsolidation (volumetric) settlements. J. of Geotechnical and Geoenvironmental Eng., ASCE 135(3), pp 387-398.

Cetin, K. O., Seed, R. B., Der Kiureghian, A., Tokimatsu, K., Harder, L. F., Jr., Kayen, R. E., and Moss, R. E. S., 2004, Standard penetration test-based probabilistic and deterministic assessment of seismic soil liquefaction potential: ASCE JGGE, Vol., 130, No. 12, p. 1314-1340.

Geologismiki, 2017, CLiq Computer Program, www.geologismiki.gr

Federal Emergency Management Agency (FEMA), 2008, Flood Insurance Rate Map (FIRM), Imperial County, California and Incorporated Areas. Dated September 26, 2008.

Idriss, I. M. and Boulanger, R. W., 2008, Soil liquefaction during earthquakes. Monograph MNO-12. Earthquake Engineering Research Institute, Oakland, CA. 261 p.

Ishihara, K. (1985), Stability of natural deposits during earthquakes, Proc. 11th Int. Conf. On Soil Mech. And Found. Engrg., Vol. 1, A. A. Balkema, Rotterdam, The Netherlands, 321-376.

Ishihara, K., and Yoshimine, M., 1992, "Evaluation of settlements in sand deposits following liquefaction during earthquakes", Soils and Foundations, pp. 173-188.

Jenkins, O. P., 1962, Geologic Map of California, San Diego – El Centro Sheet, 1:250,000 scale, California Division of Mines and Geology.

Jennings, C. W., 1994, Fault Activity Map of California and Adjacent Areas: California Division of Mines and Geology, DMG Geologic Map No. 6.

Jones, A. L., 2003, An Analytical Model and Application for Ground Surface Effects from Liquefaction, PhD. Dissertation, University of Washington, 362 p.

McCrink, T. P., Pridmore, C. L., Tinsley, J. C., Sickler, R. R., Brandenberg, S. J., and Stewart, J. P., 2011, Liquefaction and Other Ground Failures in Imperial County, California, from the April 4, 2010, El Mayor—Cucapah Earthquake, CGS Special Report 220, USGS Open File Report 2011-1071, 84 p.

Morton, P. K., 1977, Geology and mineral resources of Imperial County, California: California Division of Mines and Geology, County Report No. 7, 104 p.

National Center for Earthquake Engineering Research (NCEER), 1997, Proceedings of the NCEER Workshop on Liquefaction Resistance of Soils. Salt Lake City, Utah, NCEER Technical Report NCEER-97-0022.

Norris and Webb, 1990, Geology of California, 2nd Edition, John Wiley and Sons.

Robertson, P. K., 2014, Seismic liquefaction CPT-based methods: EERI 1st Workshop on Geotechnical Earthquake Engineering – Liquefaction Evaluation, Mapping, Simulation and Mitigation. UC San Diego Campus, 10/12/2014.

Rymer, M.J., Treiman, J.A., Kendrick, K.J., Lienkaemper, J.J., Weldon, R.J., Bilham, R., Wei, M., Fielding, E.J., Hernandez, J.L., Olson, B.P.E., Irvine, P.J., Knepprath, N., Sickler, R.R., Tong, .X., and Siem, M.E., 2011, Triggered surface slips in southern California associated with the 2010 El Mayor-Cucapah, Baja California, Mexico, earthquake: U.S. Geological Survey Open-File Report 2010-1333 and California Geological Survey Special Report 221, 62 p., available at http://pubs.usgs.gov/of/2010/1333/

Structural Engineers Association of California (SEAOC), 2020, Seismic Design Maps Web Application, available at https://seismicmaps.org/

Tokimatsu, K., and Seed, H. B., 1987, "Evaluation of settlements in sands due to earthquake shaking," J. Geotechnical Eng., ASCE 113(GT8), 861–78.

U.S. Geological Survey (USGS), 1990, The San Andreas Fault System, California, Professional Paper 1515.

Wallace, R.E., 1990, The San Andreas Fault System, California, U.S. Geological Survey Professional Paper 1515, 283p.Wire Reinforcement Institute (WRI/CRSI), 2003, Design of Slab-on-Ground Foundations, Tech Facts TF 700-R-03, 23 p.

Wright, H. M., J. A. Vazquez, D. E. Champion, A. T. Calvert, M. T. Mangan, M. Stelten, K. M. Cooper, C. Herzig, and A. Schriener Jr.,2015, Episodic Holocene eruption of the Salton Buttes rhyolites, California, from paleomagnetic, U-Th, and Ar/Ar dating, Geochem. Geophys. Geosyst., 16, 1198–1210, doi:10.1002/2015GC005714.

Youd, T. L., 2005, Liquefaction-induced flow, lateral spread, and ground oscillation, GSA Abstracts with Programs, Vol. 37, No. 7, p. 252.

Youd, T. L. and Garris, C. T., 1995, Liquefaction induced ground surface disruption: ASCE Geotechnical Journal, Vol. 121, No. 11.

Youd, T. L. and Wieczorek, G. F., 1982, Liquefaction and secondary ground failure, *in* The Imperial Valley California Earthquake of October 15, 1979: USGS Professional Paper 1254, p. 223-246.

Youd, T. L., Idriss, I. M., Andrus, R. D., Arango, I., Castro, G., Christian, J. T., Dobry, R., Liam Finn,W. D., Harder, L. F., Jr., Hynes, M. E., Ishihara, K., Koester, J. P., Laio, S. S. C., Marcuson, III,W. F., Martin, G. R., Mitchell, J. K., Moriwaki, Y., Power, M. S., Robertson, P. K., Seed, R. B., Stokoe, II, K. H., 2001, "Liquefaction resistance of soils: Summary report from the 1996 NCEER and 1998 NCEER/NSF workshops on evaluation of liquefaction resistance of soils," Journal Geotechnical and Geoenvironmental Engineering, Volume 127 No. 10 pp. 817–833.

TABLES

Table 1-1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Imperial	3.2	5.1	7	62 ± 6	20 ± 5
Superstition Hills	3.7	5.9	6.6	23 ± 2	4 ± 2
Brawley *	4.5	7.2			
Rico *	8.3	13.3			
Superstition Mountain	10.0	16.0	6.6	24 ± 2	5 ± 3
Unnamed 2*	11.5	18.4			
Unnamed 1*	12.6	20.1			
Yuha*	14.4	23.1			
Shell Beds	17.0	27.2			
Yuha Well *	17.3	27.7			
Borrego (Mexico)*	18.4	29.4			
Laguna Salada	19.2	30.7	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	20.6	33.0			
Cerro Prieto *	21.3	34.0			
Painted Gorge Wash*	21.6	34.6			
Pescadores (Mexico)*	23.4	37.4			
Elmore Ranch	23.5	37.6	6.6	29 ± 3	1 ± 0.5
Cucapah (Mexico)*	24.6	39.4			
Ocotillo*	24.9	39.8			
Elsinore - Coyote Mountain	28.3	45.3	6.8	39 ± 4	4 ± 2
San Jacinto - Borrego	29.8	47.6	6.6	29 ± 3	4 ± 2
Algodones *	35.1	56.2			

* Note: Faults not included in CGS database.

Table 2-1
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

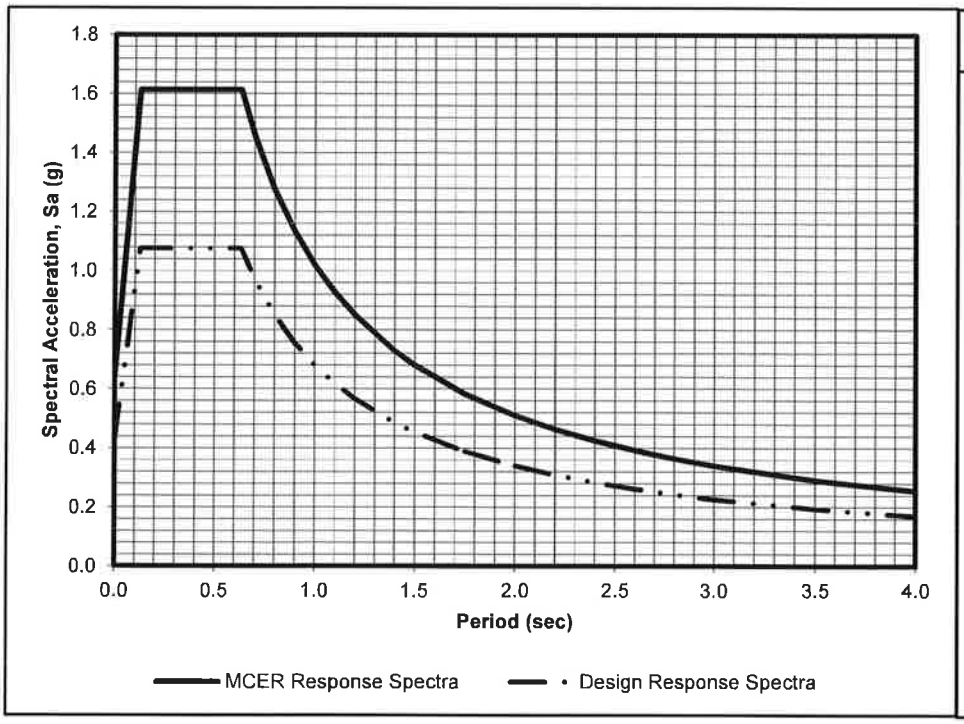
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.8040	N	
Longitude:	-115.5441	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.614 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.614 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.076 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.958		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.930		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.13 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.63 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.73 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.43	0.65
0.13	1.08	1.61
0.63	1.08	1.61
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-2
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Imperial	2.5	4.0	7	62 ± 6	20 ± 5
Superstition Hills	3.4	5.5	6.6	23 ± 2	4 ± 2
Brawley *	4.2	6.7			
Rico *	8.4	13.4			
Superstition Mountain	9.5	15.2	6.6	24 ± 2	5 ± 3
Unnamed 2*	12.2	19.6			
Unnamed 1*	13.0	20.8			
Yuha*	14.9	23.8			
Shell Beds	17.3	27.6			
Yuha Well *	17.5	28.0			
Borrego (Mexico)*	19.3	30.8			
Laguna Salada	19.9	31.9	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	20.8	33.3			
Painted Gorge Wash*	21.4	34.3			
Cerro Prieto *	22.2	35.5			
Elmore Ranch	22.9	36.6	6.6	29 ± 3	1 ± 0.5
Pescadores (Mexico)*	24.3	38.9			
Ocotillo*	25.0	40.0			
Cucapah (Mexico)*	25.6	40.9			
Elsinore - Coyote Mountain	28.3	45.4	6.8	39 ± 4	4 ± 2
San Jacinto - Borrego	29.3	46.9	6.6	29 ± 3	4 ± 2
Algodones *	35.1	56.1			

* Note: Faults not included in CGS database.

Table 2-2
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

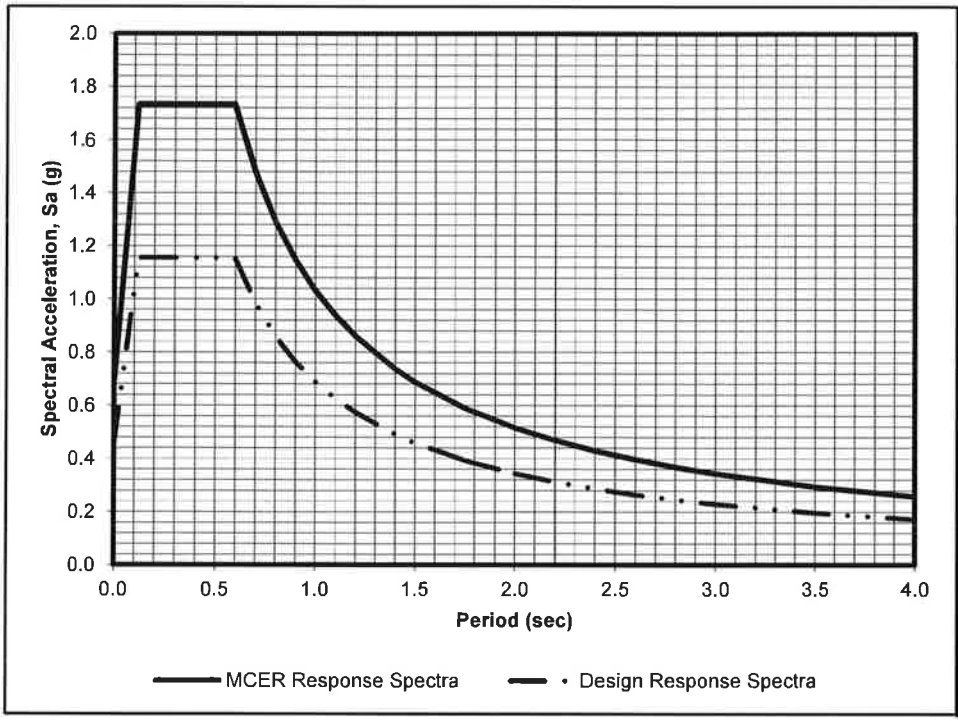
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.8179	N	
Longitude:	-115.5439	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.733 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.607 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.733 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.032 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.155 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.688 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.956		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.928		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.60 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.79 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.46	0.69
0.12	1.16	1.73
0.60	1.16	1.73
0.70	0.98	1.47
0.80	0.86	1.29
0.90	0.76	1.15
1.00	0.69	1.03
1.10	0.63	0.94
1.20	0.57	0.86
1.20	0.57	0.86
1.40	0.49	0.74
1.50	0.46	0.69
1.75	0.39	0.59
2.00	0.34	0.52
2.20	0.31	0.47
2.40	0.29	0.43
2.60	0.26	0.40
2.80	0.25	0.37
3.00	0.23	0.34
3.50	0.20	0.29
4.00	0.17	0.26

Table 1-3
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	2.0	3.1	6.6	23 ± 2	4 ± 2
Imperial	3.8	6.1	7	62 ± 6	20 ± 5
Brawley *	5.7	9.0			
Superstition Mountain	8.2	13.1	6.6	24 ± 2	5 ± 3
Rico *	9.8	15.8			
Unnamed 2*	11.4	18.2			
Unnamed 1*	11.7	18.7			
Yuha*	13.6	21.8			
Shell Beds	15.8	25.3			
Yuha Well *	16.0	25.6			
Borrego (Mexico)*	18.8	30.1			
Laguna Salada	19.1	30.5	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	19.3	30.9			
Painted Gorge Wash*	20.0	31.9			
Elmore Ranch	21.7	34.8	6.6	29 ± 3	1 ± 0.5
Cerro Prieto *	22.7	36.2			
Ocotillo*	23.5	37.6			
Pescadores (Mexico)*	24.4	39.0			
Cucapah (Mexico)*	25.7	41.2			
Elsinore - Coyote Mountain	26.9	43.0	6.8	39 ± 4	4 ± 2
San Jacinto - Borrego	28.0	44.8	6.6	29 ± 3	4 ± 2
Algodones *	36.5	58.5			

* Note: Faults not included in CGS database.

Table 2-3
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

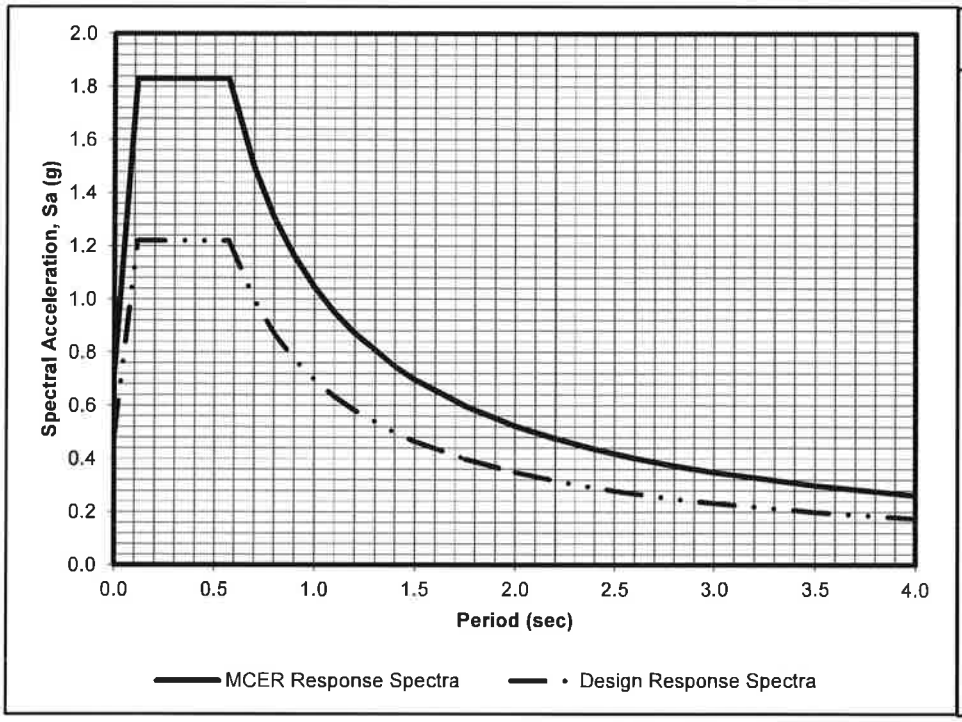
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.8185	N	
Longitude:	-115.5696	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.830 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.615 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.830 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.046 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.220 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.697 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.958		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.928		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.11 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.57 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.83 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.49	0.73
0.11	1.22	1.83
0.57	1.22	1.83
0.70	1.00	1.49
0.80	0.87	1.31
0.90	0.77	1.16
1.00	0.70	1.05
1.10	0.63	0.95
1.20	0.58	0.87
1.20	0.58	0.87
1.40	0.50	0.75
1.50	0.46	0.70
1.75	0.40	0.60
2.00	0.35	0.52
2.20	0.32	0.48
2.40	0.29	0.44
2.60	0.27	0.40
2.80	0.25	0.37
3.00	0.23	0.35
3.50	0.20	0.30
4.00	0.17	0.26

Table 1-4
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	0.5	0.9	6.6	23 ± 2	4 ± 2
Imperial	5.2	8.3	7	62 ± 6	20 ± 5
Superstition Mountain	7.0	11.2	6.6	24 ± 2	5 ± 3
Brawley *	7.1	11.4			
Unnamed 1*	10.4	16.7			
Unnamed 2*	10.6	17.0			
Rico *	11.3	18.1			
Yuha*	12.4	19.9			
Shell Beds	14.4	23.0			
Yuha Well *	14.6	23.3			
Laguna Salada	17.6	28.2	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	17.9	28.6			
Borrego (Mexico)*	18.5	29.6			
Painted Gorge Wash*	18.5	29.6			
Elmore Ranch	20.7	33.1	6.6	29 ± 3	1 ± 0.5
Ocotillo*	22.0	35.2			
Cerro Prieto *	23.1	37.0			
Pescadores (Mexico)*	24.4	39.1			
Elsinore - Coyote Mountain	25.4	40.6	6.8	39 ± 4	4 ± 2
Cucapah (Mexico)*	26.0	41.5			
San Jacinto - Borrego	26.7	42.7	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	37.5	60.0	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-4
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

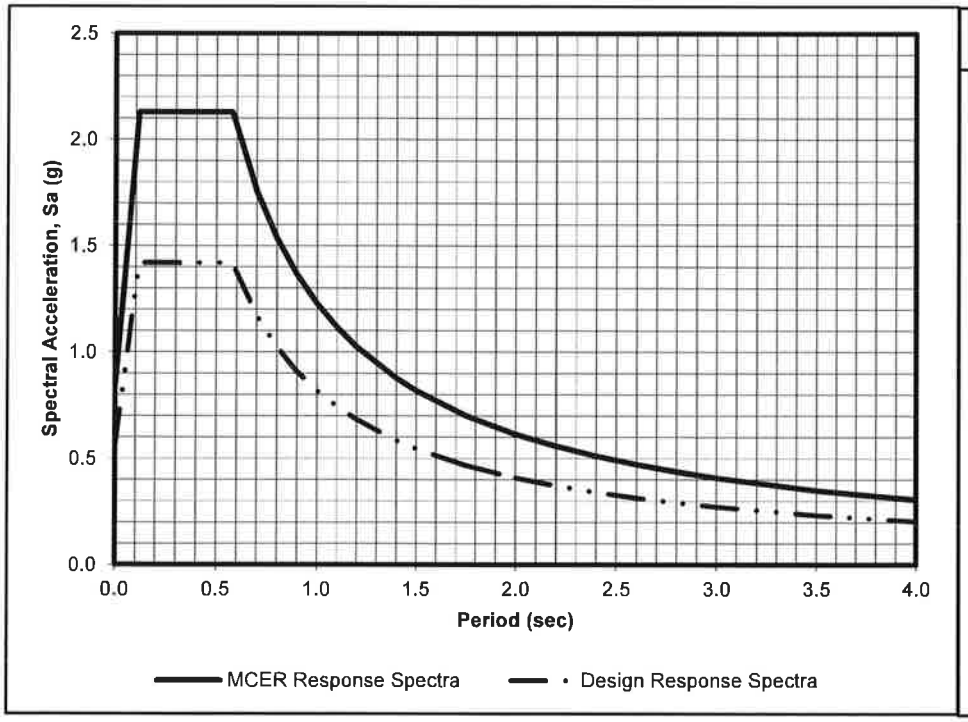
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.8184	N	
Longitude:	-115.5954	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	2.129 g		CBC Figure 1613.3.1(1)
Mapped MCE_R 1 second Spectral Response	S_1	0.722 g		CBC Figure 1613.3.1(2)
Short Period (0.2 s) Site Coefficient	F_a	1.00		CBC Table 1613.3.3(1)
Long Period (1.0 s) Site Coefficient	F_v	1.70		CBC Table 1613.3.3(2)
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	2.129 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.227 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.419 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.818 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.959		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.928		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.58 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.97 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.57	0.85
0.12	1.42	2.13
0.58	1.42	2.13
0.70	1.17	1.75
0.80	1.02	1.53
0.90	0.91	1.36
1.00	0.82	1.23
1.10	0.74	1.12
1.20	0.68	1.02
1.20	0.68	1.02
1.40	0.58	0.88
1.50	0.55	0.82
1.75	0.47	0.70
2.00	0.41	0.61
2.20	0.37	0.56
2.40	0.34	0.51
2.60	0.31	0.47
2.80	0.29	0.44
3.00	0.27	0.41
3.50	0.23	0.35
4.00	0.20	0.31

Table 1-5
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	1.0	1.5	6.6	23 ± 2	4 ± 2
Superstition Mountain	6.0	9.6	6.6	24 ± 2	5 ± 3
Imperial	6.5	10.4	7	62 ± 6	20 ± 5
Brawley *	8.6	13.8			
Unnamed 1*	9.3	14.8			
Unnamed 2*	10.0	16.0			
Yuha*	11.3	18.0			
Rico *	12.8	20.5			
Shell Beds	13.0	20.8			
Yuha Well *	13.2	21.0			
Laguna Salada	16.2	26.0	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	16.4	26.3			
Painted Gorge Wash*	17.0	27.3			
Borrego (Mexico)*	18.2	29.2			
Elmore Ranch	19.7	31.5	6.6	29 ± 3	1 ± 0.5
Ocotillo*	20.6	32.9			
Cerro Prieto *	23.7	38.0			
Elsinore - Coyote Mountain	23.9	38.2	6.8	39 ± 4	4 ± 2
Pescadores (Mexico)*	24.6	39.3			
San Jacinto - Borrego	25.4	40.7	6.6	29 ± 3	4 ± 2
Cucapah (Mexico)*	26.3	42.0			
San Andreas - Coachella	37.3	59.6	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-5
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

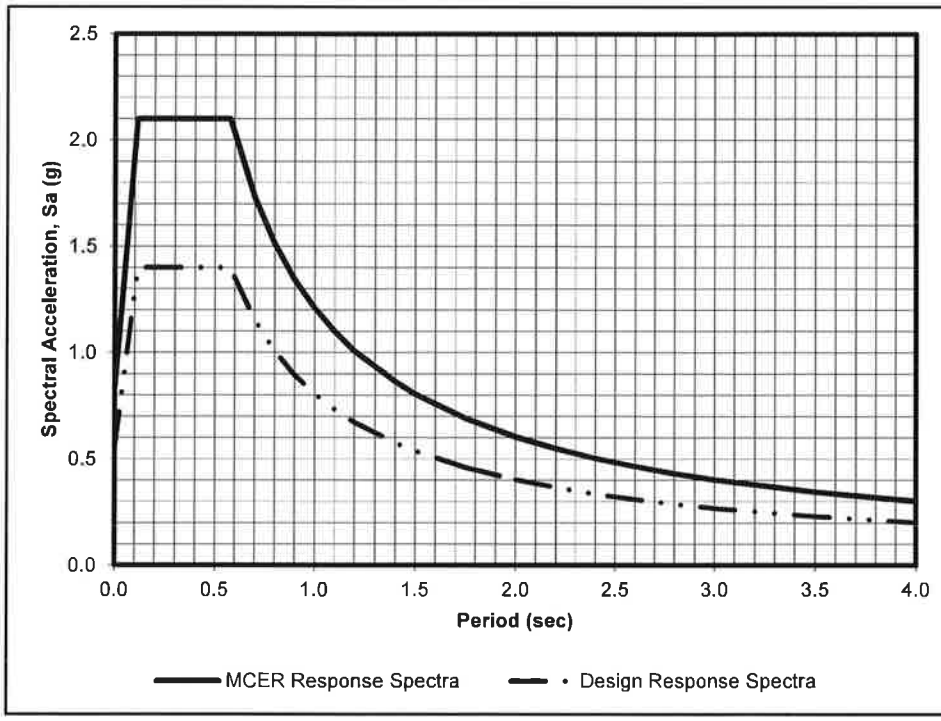
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	32.8185 N	
Longitude:	-115.6209 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	2.100 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.711 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	2.100 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.209 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.400 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.806 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.959		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.929		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.58 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.95 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.56	0.84
0.12	1.40	2.10
0.58	1.40	2.10
0.70	1.15	1.73
0.80	1.01	1.51
0.90	0.90	1.34
1.00	0.81	1.21
1.10	0.73	1.10
1.20	0.67	1.01
1.20	0.67	1.01
1.40	0.58	0.86
1.50	0.54	0.81
1.75	0.46	0.69
2.00	0.40	0.60
2.20	0.37	0.55
2.40	0.34	0.50
2.60	0.31	0.46
2.80	0.29	0.43
3.00	0.27	0.40
3.50	0.23	0.35
4.00	0.20	0.30

Table 1-6
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	1.3	2.1	6.6	23 ± 2	4 ± 2
Superstition Mountain	6.4	10.2	6.6	24 ± 2	5 ± 3
Imperial	6.8	10.8	7	62 ± 6	20 ± 5
Brawley *	8.7	13.9			
Unnamed 1*	9.0	14.4			
Unnamed 2*	9.6	15.3			
Yuha*	11.0	17.6			
Rico *	12.8	20.5			
Shell Beds	12.9	20.6			
Yuha Well *	13.0	20.8			
Laguna Salada	16.1	25.7	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	16.3	26.1			
Painted Gorge Wash*	17.2	27.5			
Borrego (Mexico)*	17.8	28.4			
Elmore Ranch	20.0	32.0	6.6	29 ± 3	1 ± 0.5
Ocotillo*	20.5	32.8			
Cerro Prieto *	23.3	37.3			
Elsinore - Coyote Mountain	23.9	38.2	6.8	39 ± 4	4 ± 2
Pescadores (Mexico)*	24.1	38.6			
San Jacinto - Borrego	25.7	41.1	6.6	29 ± 3	4 ± 2
Cucapah (Mexico)*	25.8	41.3			
San Andreas - Coachella	37.7	60.4	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-6
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

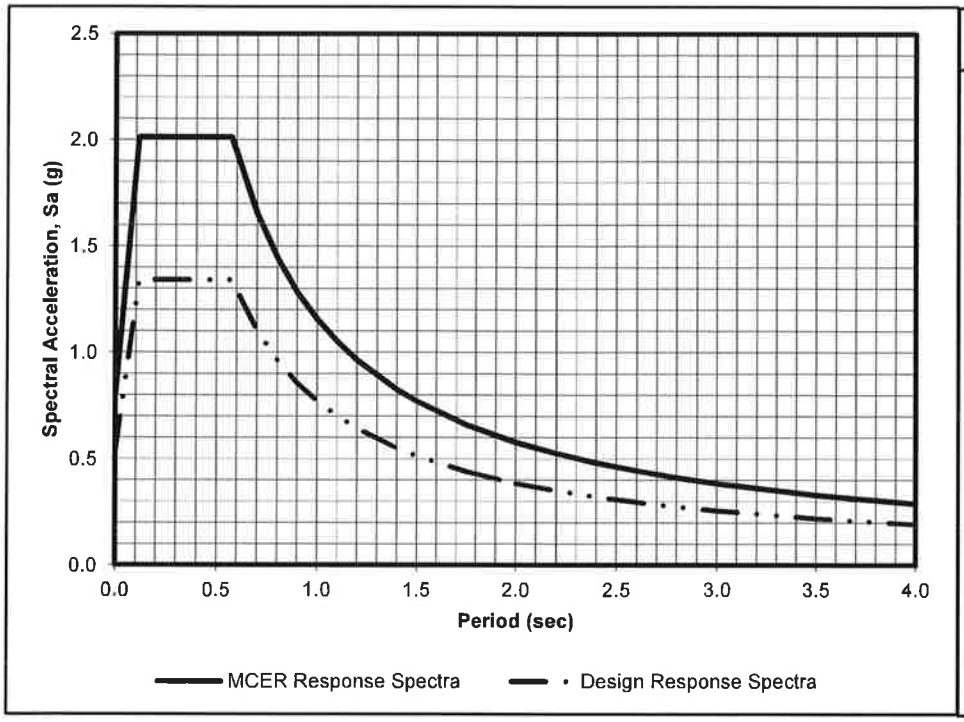
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.8117	N	
Longitude:	-115.6208	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	2.012 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.680 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	2.012 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.156 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.341 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.771 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.959		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.929		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.11 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.57 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.91 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.54	0.80
0.11	1.34	2.01
0.57	1.34	2.01
0.70	1.10	1.65
0.80	0.96	1.45
0.90	0.86	1.28
1.00	0.77	1.16
1.10	0.70	1.05
1.20	0.64	0.96
1.20	0.64	0.96
1.40	0.55	0.83
1.50	0.51	0.77
1.75	0.44	0.66
2.00	0.39	0.58
2.20	0.35	0.53
2.40	0.32	0.48
2.60	0.30	0.44
2.80	0.28	0.41
3.00	0.26	0.39
3.50	0.22	0.33
4.00	0.19	0.29

Table 1-7
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	2.0	3.2	6.6	23 ± 2	4 ± 2
Superstition Mountain	5.9	9.4	6.6	24 ± 2	5 ± 3
Imperial	7.6	12.1	7	62 ± 6	20 ± 5
Unnamed 1*	8.2	13.1			
Unnamed 2*	9.2	14.8			
Brawley *	9.6	15.4			
Yuha*	10.2	16.3			
Shell Beds	11.9	19.1			
Yuha Well *	12.1	19.3			
Rico *	13.8	22.0			
Laguna Salada	15.1	24.2	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	15.4	24.6			
Painted Gorge Wash*	16.2	26.0			
Borrego (Mexico)*	17.6	28.2			
Elmore Ranch	19.4	31.1	6.6	29 ± 3	1 ± 0.5
Ocotillo*	19.5	31.3			
Elsinore - Coyote Mountain	22.9	36.6	6.8	39 ± 4	4 ± 2
Cerro Prieto *	23.7	37.9			
Pescadores (Mexico)*	24.2	38.8			
San Jacinto - Borrego	24.9	39.9	6.6	29 ± 3	4 ± 2
Cucapah (Mexico)*	26.0	41.6			
San Andreas - Coachella	37.6	60.2	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-7
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

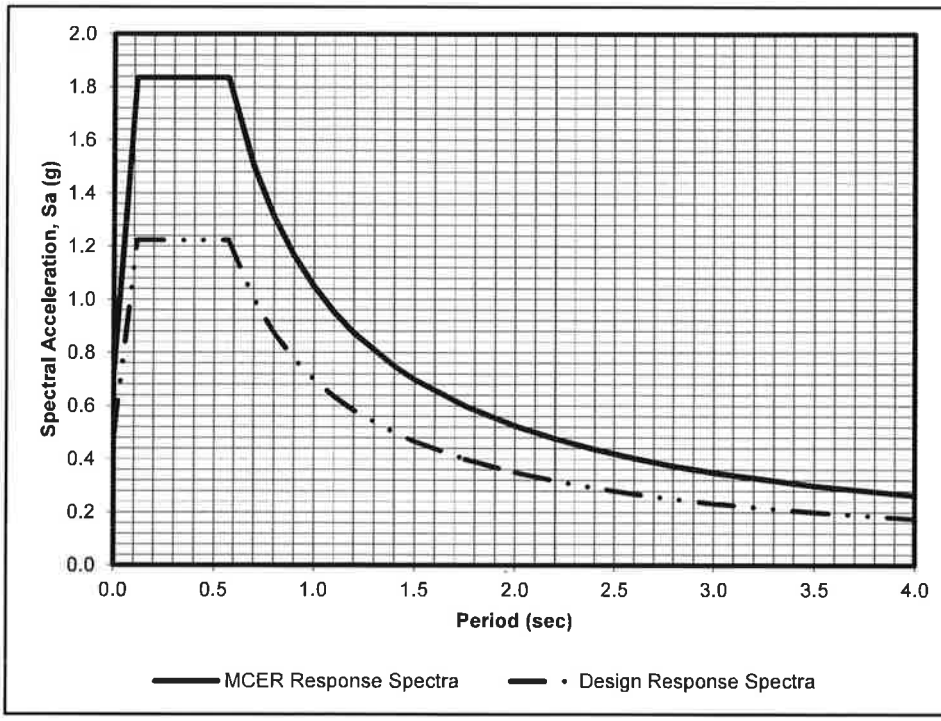
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.8110	N	
Longitude:	-115.6376	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.836 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.617 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.836 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.049 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.224 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.699 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.960		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.930		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.11 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.57 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.83 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.49	0.73
0.11	1.22	1.84
0.57	1.22	1.84
0.70	1.00	1.50
0.80	0.87	1.31
0.90	0.78	1.17
1.00	0.70	1.05
1.10	0.64	0.95
1.20	0.58	0.87
1.20	0.58	0.87
1.40	0.50	0.75
1.50	0.47	0.70
1.75	0.40	0.60
2.00	0.35	0.52
2.20	0.32	0.48
2.40	0.29	0.44
2.60	0.27	0.40
2.80	0.25	0.37
3.00	0.23	0.35
3.50	0.20	0.30
4.00	0.17	0.26

Table 1-8
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	2.6	4.1	6.6	23 ± 2	4 ± 2
Superstition Mountain	6.5	10.5	6.6	24 ± 2	5 ± 3
Unnamed 1*	7.7	12.3			
Imperial	8.0	12.8	7	62 ± 6	20 ± 5
Unnamed 2*	8.5	13.6			
Yuha*	9.7	15.5			
Brawley *	9.8	15.6			
Shell Beds	11.7	18.7			
Yuha Well *	11.9	19.0			
Rico *	13.7	22.0			
Laguna Salada	14.9	23.8	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	15.2	24.3			
Painted Gorge Wash*	16.5	26.4			
Borrego (Mexico)*	16.9	27.0			
Ocotillo*	19.4	31.1			
Elmore Ranch	20.1	32.1	6.6	29 ± 3	1 ± 0.5
Elsinore - Coyote Mountain	22.8	36.6	6.8	39 ± 4	4 ± 2
Cerro Prieto *	23.0	36.8			
Pescadores (Mexico)*	23.5	37.6			
Cucapah (Mexico)*	25.3	40.4			
San Jacinto - Borrego	25.4	40.6	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	38.4	61.4	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-8
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

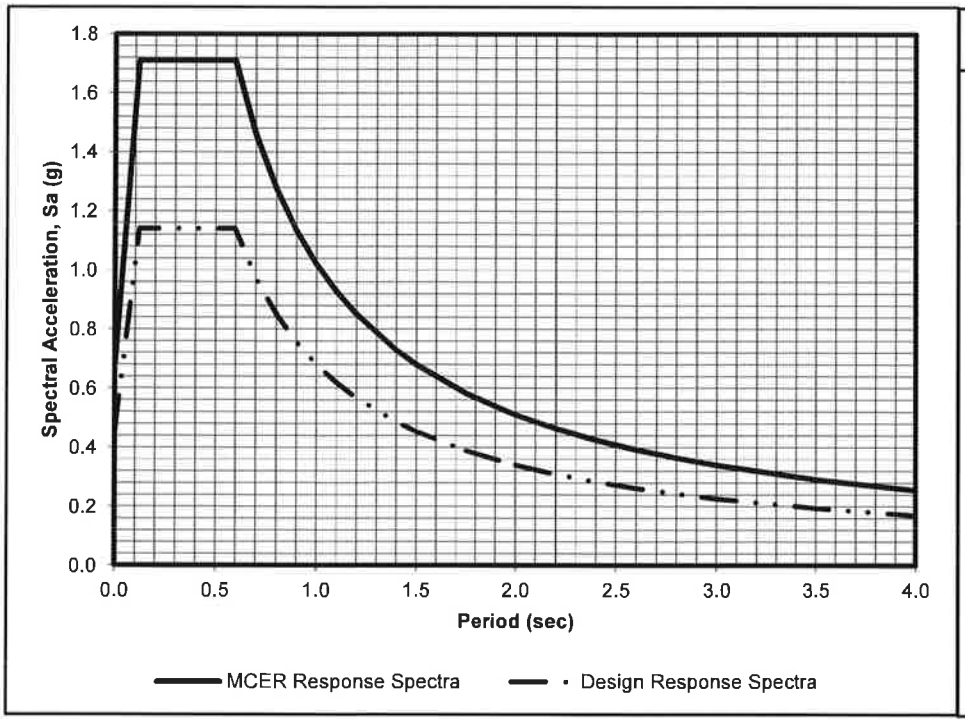
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	32.7998 N	
Longitude:	-115.6376 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.711 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.711 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.141 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.961		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.932		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.60 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.77 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.46	0.68
0.12	1.14	1.71
0.60	1.14	1.71
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-9
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	3.1	5.0	6.6	23 ± 2	4 ± 2
Superstition Mountain	7.2	11.6	6.6	24 ± 2	5 ± 3
Unnamed 1*	7.3	11.6			
Unnamed 2*	7.7	12.4			
Imperial	8.3	13.3	7	62 ± 6	20 ± 5
Yuha*	9.2	14.8			
Brawley *	9.9	15.9			
Shell Beds	11.5	18.4			
Yuha Well *	11.8	18.8			
Rico *	13.8	22.0			
Laguna Salada	14.6	23.4	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	15.1	24.2			
Borrego (Mexico)*	16.1	25.8			
Painted Gorge Wash*	16.7	26.8			
Ocotillo*	19.4	31.0			
Elmore Ranch	20.7	33.1	6.6	29 ± 3	1 ± 0.5
Cerro Prieto *	22.3	35.7			
Pescadores (Mexico)*	22.7	36.4			
Elsinore - Coyote Mountain	22.8	36.5	6.8	39 ± 4	4 ± 2
Cucapah (Mexico)*	24.5	39.3			
San Jacinto - Borrego	25.8	41.3	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	39.2	62.6	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-9
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

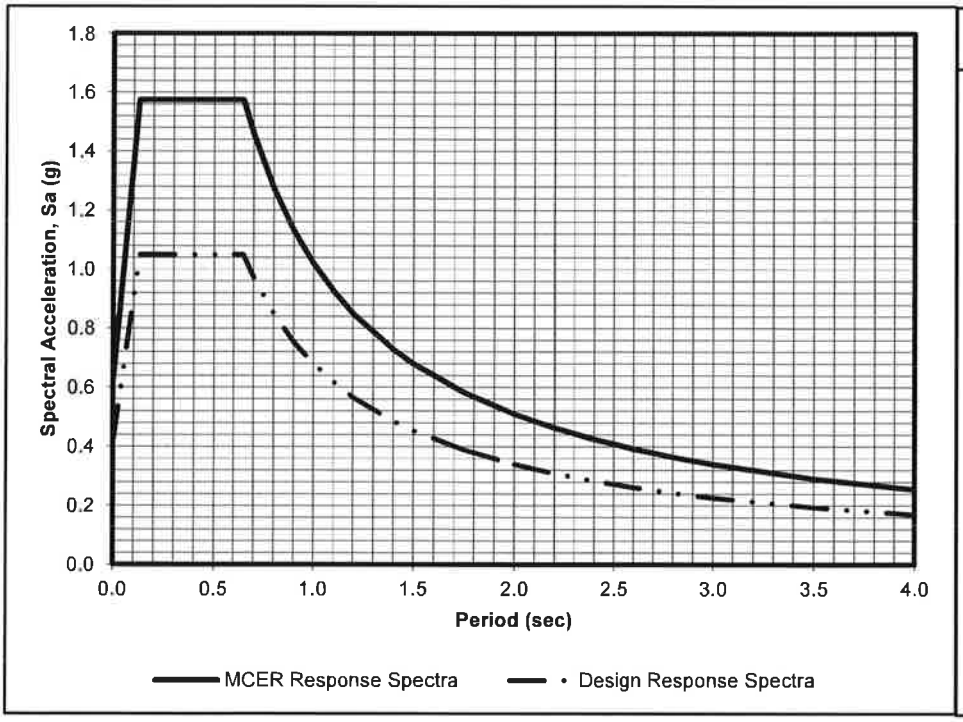
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7887	N	
Longitude:	-115.6376	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.575 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.575 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.050 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.964		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.934		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.13 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.65 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.71 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.42	0.63
0.13	1.05	1.58
0.65	1.05	1.58
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-10
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	4.4	7.0	6.6	23 ± 2	4 ± 2
Unnamed 2*	6.3	10.2			
Unnamed 1*	6.6	10.5			
Yuha*	8.4	13.5			
Superstition Mountain	8.6	13.8	6.6	24 ± 2	5 ± 3
Imperial	9.0	14.4	7	62 ± 6	20 ± 5
Brawley *	10.5	16.8			
Shell Beds	11.2	18.0			
Yuha Well *	11.6	18.6			
Rico *	14.0	22.3			
Laguna Salada	14.0	22.4	7	67 ± 7	3.5 ± 1.5
Borrego (Mexico)*	14.6	23.4			
Vista de Anza*	14.9	23.9			
Painted Gorge Wash*	17.3	27.6			
Ocotillo*	19.3	30.8			
Cerro Prieto *	21.1	33.7			
Pescadores (Mexico)*	21.3	34.0			
Elmore Ranch	21.9	35.0	6.6	29 ± 3	1 ± 0.5
Elsinore - Coyote Mountain	22.8	36.6	6.8	39 ± 4	4 ± 2
Cucapah (Mexico)*	23.1	37.0			
San Jacinto - Borrego	26.8	42.8	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	40.6	65.0	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-10
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

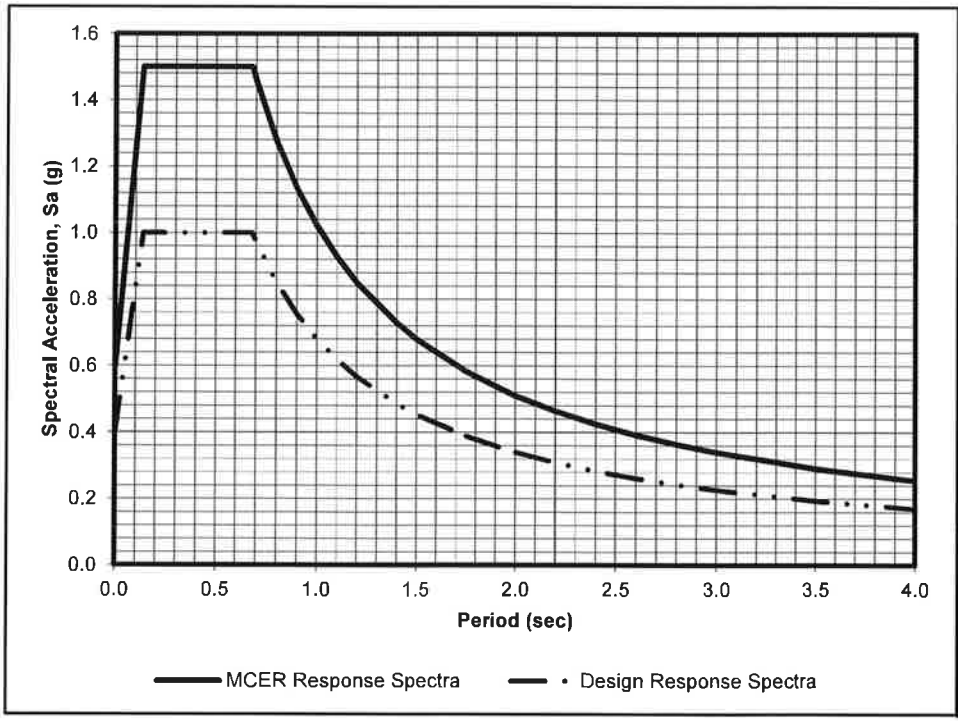
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7673	N	
Longitude:	-115.6382	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.968		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.937		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.60 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-11
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	4.9	7.9	6.6	23 ± 2	4 ± 2
Unnamed 1*	5.6	9.0			
Unnamed 2*	6.0	9.6			
Yuha*	7.5	12.1			
Superstition Mountain	8.4	13.4	6.6	24 ± 2	5 ± 3
Imperial	9.9	15.8	7	62 ± 6	20 ± 5
Shell Beds	10.3	16.4			
Yuha Well *	10.6	17.0			
Brawley *	11.4	18.3			
Laguna Salada	13.0	20.9	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	13.9	22.3			
Borrego (Mexico)*	14.5	23.3			
Rico *	14.9	23.9			
Painted Gorge Wash*	16.4	26.3			
Ocotillo*	18.3	29.3			
Elmore Ranch	21.4	34.2	6.6	29 ± 3	1 ± 0.5
Pescadores (Mexico)*	21.5	34.4			
Cerro Prieto *	21.6	34.5			
Elsinore - Coyote Mountain	21.9	35.0	6.8	39 ± 4	4 ± 2
Cucapah (Mexico)*	23.4	37.5			
San Jacinto - Borrego	26.0	41.7	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	40.5	64.9	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-11
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

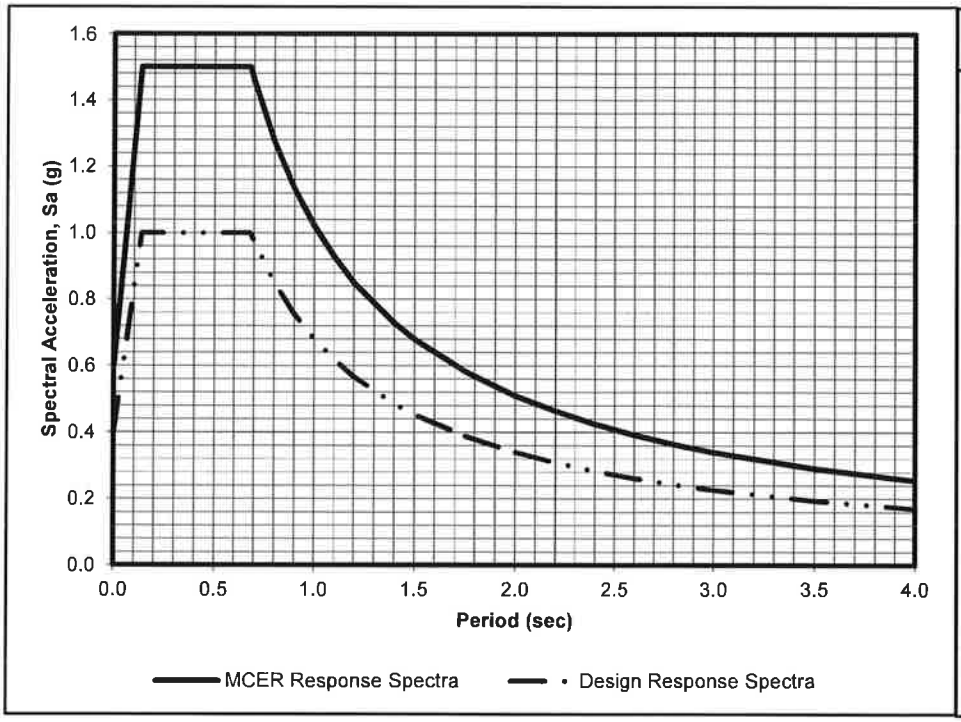
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7668	N	
Longitude:	-115.6551	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.969		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.938		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.56 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-12
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	4.8	7.6			
Superstition Hills	5.6	8.9	6.6	23 ± 2	4 ± 2
Unnamed 2*	5.9	9.4			
Yuha*	6.7	10.7			
Superstition Mountain	8.2	13.1	6.6	24 ± 2	5 ± 3
Shell Beds	9.3	14.8			
Yuha Well *	9.6	15.4			
Imperial	10.8	17.2	7	62 ± 6	20 ± 5
Laguna Salada	12.1	19.4	7	67 ± 7	3.5 ± 1.5
Brawley *	12.3	19.7			
Vista de Anza*	13.0	20.7			
Borrego (Mexico)*	14.6	23.3			
Painted Gorge Wash*	15.5	24.7			
Rico *	15.9	25.4			
Ocotillo*	17.3	27.7			
Elsinore - Coyote Mountain	20.9	33.4	6.8	39 ± 4	4 ± 2
Elmore Ranch	20.9	33.5	6.6	29 ± 3	1 ± 0.5
Pescadores (Mexico)*	21.7	34.8			
Cerro Prieto *	22.1	35.4			
Cucapah (Mexico)*	23.8	38.1			
San Jacinto - Borrego	25.3	40.5	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	40.5	64.7	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-12
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

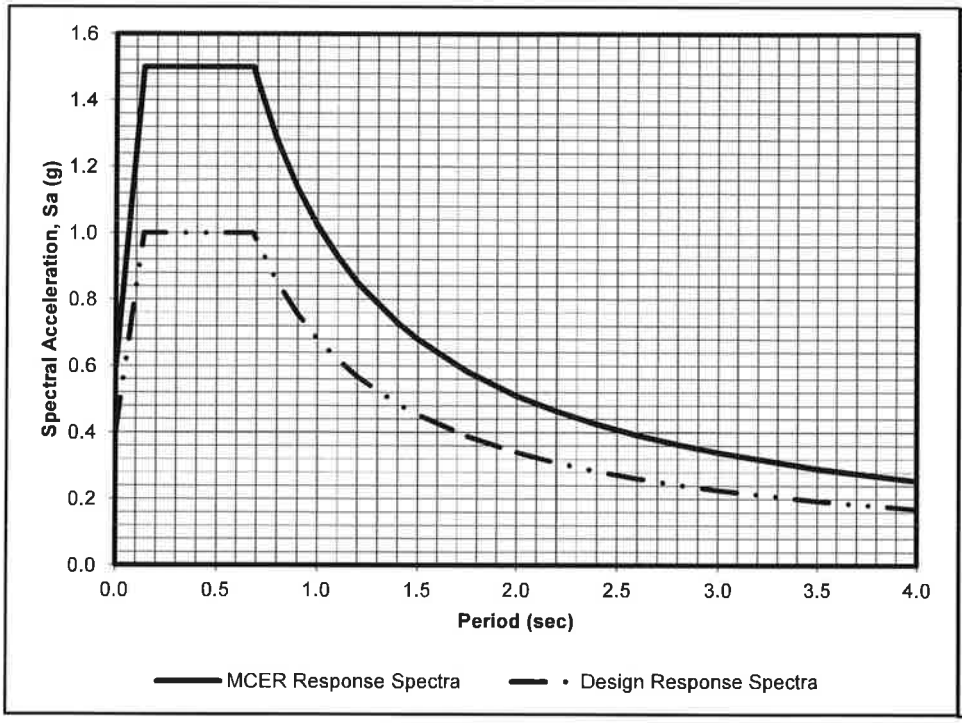
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7668	N	
Longitude:	-115.6721	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.968		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.937		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.56 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-13
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	3.9	6.3			
Yuha*	5.9	9.5			
Unnamed 2*	5.9	9.5			
Superstition Hills	6.4	10.2	6.6	23 ± 2	4 ± 2
Superstition Mountain	8.1	13.0	6.6	24 ± 2	5 ± 3
Shell Beds	8.2	13.2			
Yuha Well *	8.6	13.7			
Laguna Salada	11.2	17.9	7	67 ± 7	3.5 ± 1.5
Imperial	11.7	18.8	7	62 ± 6	20 ± 5
Vista de Anza*	11.9	19.1			
Brawley *	13.3	21.3			
Painted Gorge Wash*	14.4	23.1			
Borrego (Mexico)*	14.7	23.5			
Ocotillo*	16.2	26.0			
Rico *	16.9	27.1			
Elsinore - Coyote Mountain	19.8	31.7	6.8	39 ± 4	4 ± 2
Elmore Ranch	20.4	32.6	6.6	29 ± 3	1 ± 0.5
Pescadores (Mexico)*	22.1	35.4			
Cerro Prieto *	22.8	36.4			
Cucapah (Mexico)*	24.2	38.8			
San Jacinto - Borrego	24.5	39.3	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	40.4	64.6	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-13
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

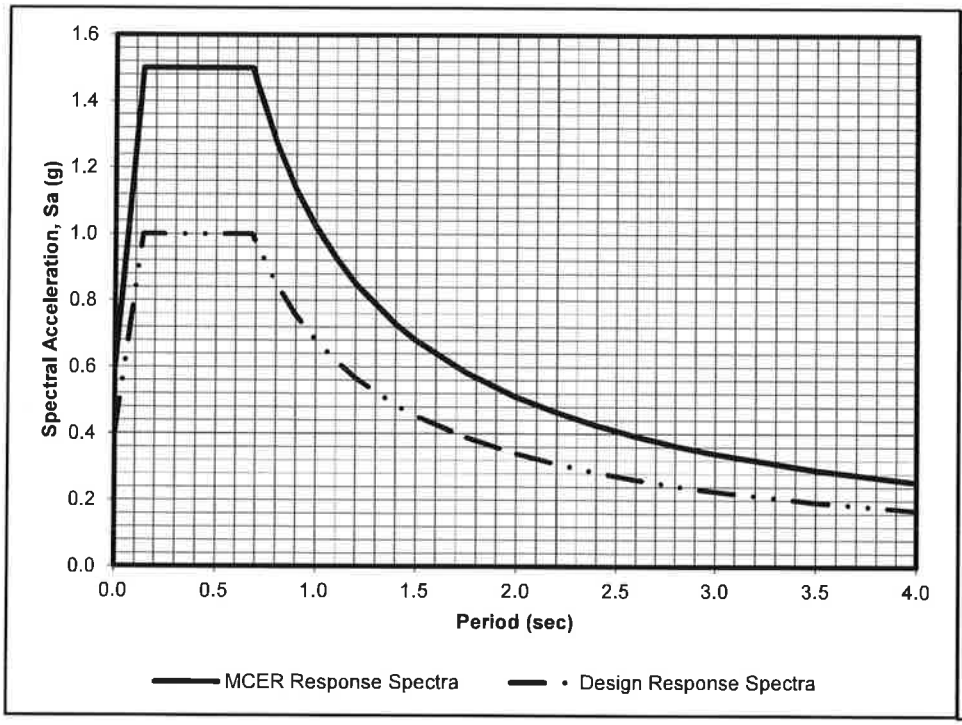
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7672	N	
Longitude:	-115.6902	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.968		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.936		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.57 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-14
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	3.7	6.0			
Unnamed 2*	5.6	9.0			
Yuha*	5.7	9.2			
Superstition Hills	6.5	10.5	6.6	23 ± 2	4 ± 2
Shell Beds	8.2	13.1			
Superstition Mountain	8.4	13.5	6.6	24 ± 2	5 ± 3
Yuha Well *	8.6	13.7			
Laguna Salada	11.0	17.6	7	67 ± 7	3.5 ± 1.5
Imperial	11.8	19.0	7	62 ± 6	20 ± 5
Vista de Anza*	11.9	19.0			
Brawley *	13.4	21.4			
Borrego (Mexico)*	14.4	23.0			
Painted Gorge Wash*	14.5	23.3			
Ocotillo*	16.3	26.0			
Rico *	17.0	27.2			
Elsinore - Coyote Mountain	19.9	31.8	6.8	39 ± 4	4 ± 2
Elmore Ranch	20.7	33.1	6.6	29 ± 3	1 ± 0.5
Pescadores (Mexico)*	21.8	34.9			
Cerro Prieto *	22.5	36.1			
Cucapah (Mexico)*	24.0	38.4			
San Jacinto - Borrego	24.7	39.6	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	40.6	65.0	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-14
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

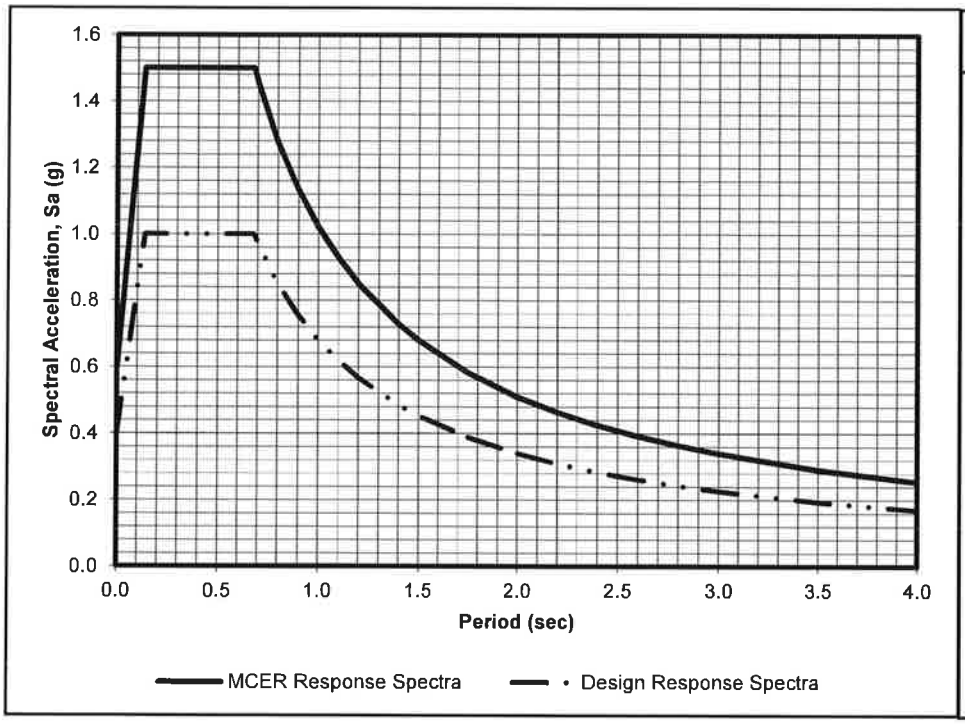
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7631	N	
Longitude:	-115.6901	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.968		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.936		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.55 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-15
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	3.6	5.7			
Unnamed 2*	5.3	8.5			
Yuha*	5.5	8.9			
Superstition Hills	6.7	10.8	6.6	23 ± 2	4 ± 2
Shell Beds	8.2	13.1			
Yuha Well *	8.6	13.7			
Superstition Mountain	8.7	14.0	6.6	24 ± 2	5 ± 3
Laguna Salada	10.9	17.5	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	11.9	19.0			
Imperial	12.0	19.2	7	62 ± 6	20 ± 5
Brawley *	13.5	21.6			
Borrego (Mexico)*	14.1	22.6			
Painted Gorge Wash*	14.6	23.4			
Ocotillo*	16.3	26.0			
Rico *	17.0	27.2			
Elsinore - Coyote Mountain	19.9	31.8	6.8	39 ± 4	4 ± 2
Elmore Ranch	20.9	33.5	6.6	29 ± 3	1 ± 0.5
Pescadores (Mexico)*	21.5	34.5			
Cerro Prieto *	22.3	35.7			
Cucapah (Mexico)*	23.7	37.9			
San Jacinto - Borrego	25.0	39.9	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	41.0	65.5	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-15
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

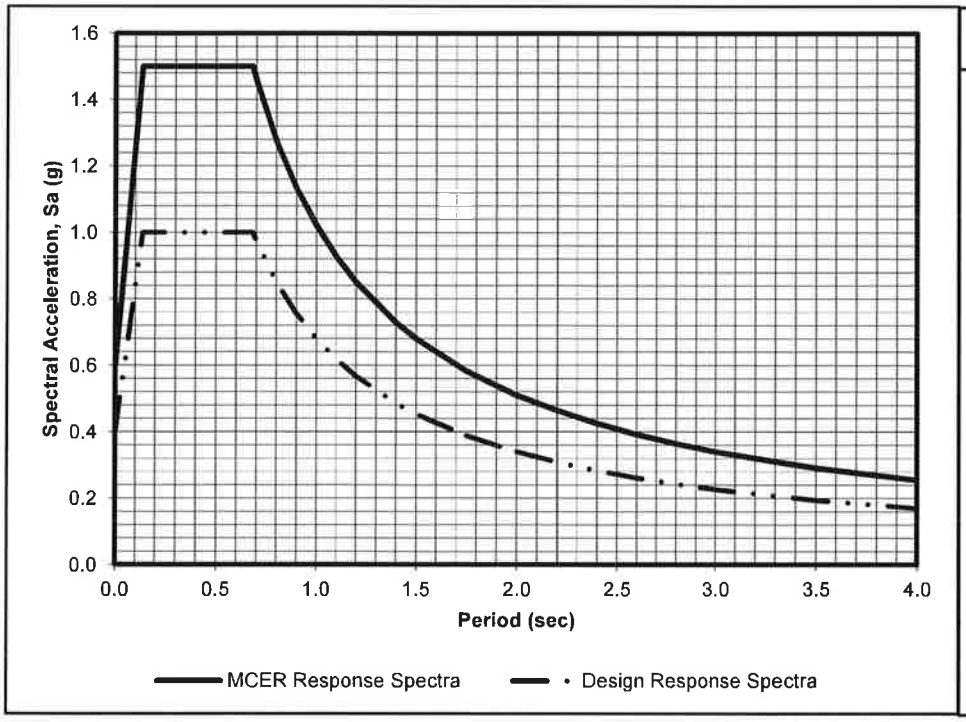
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7586	N	
Longitude:	-115.6902	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.968		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.936		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.55 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-16
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	3.1	5.0			
Unnamed 2*	4.1	6.6			
Yuha*	4.9	7.8			
Superstition Hills	7.6	12.2	6.6	23 ± 2	4 ± 2
Shell Beds	8.2	13.1			
Yuha Well *	8.7	13.9			
Superstition Mountain	10.0	15.9	6.6	24 ± 2	5 ± 3
Laguna Salada	10.4	16.7	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	11.7	18.7			
Imperial	12.5	20.1	7	62 ± 6	20 ± 5
Borrego (Mexico)*	12.9	20.6			
Brawley *	14.0	22.4			
Painted Gorge Wash*	15.1	24.1			
Ocotillo*	16.3	26.1			
Rico *	17.3	27.7			
Elsinore - Coyote Mountain	20.0	32.1	6.8	39 ± 4	4 ± 2
Pescadores (Mexico)*	20.4	32.6			
Cerro Prieto *	21.4	34.2			
Elmore Ranch	22.1	35.3	6.6	29 ± 3	1 ± 0.5
Cucapah (Mexico)*	22.6	36.2			
San Jacinto - Borrego	25.9	41.4	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	42.2	67.5	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-16
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

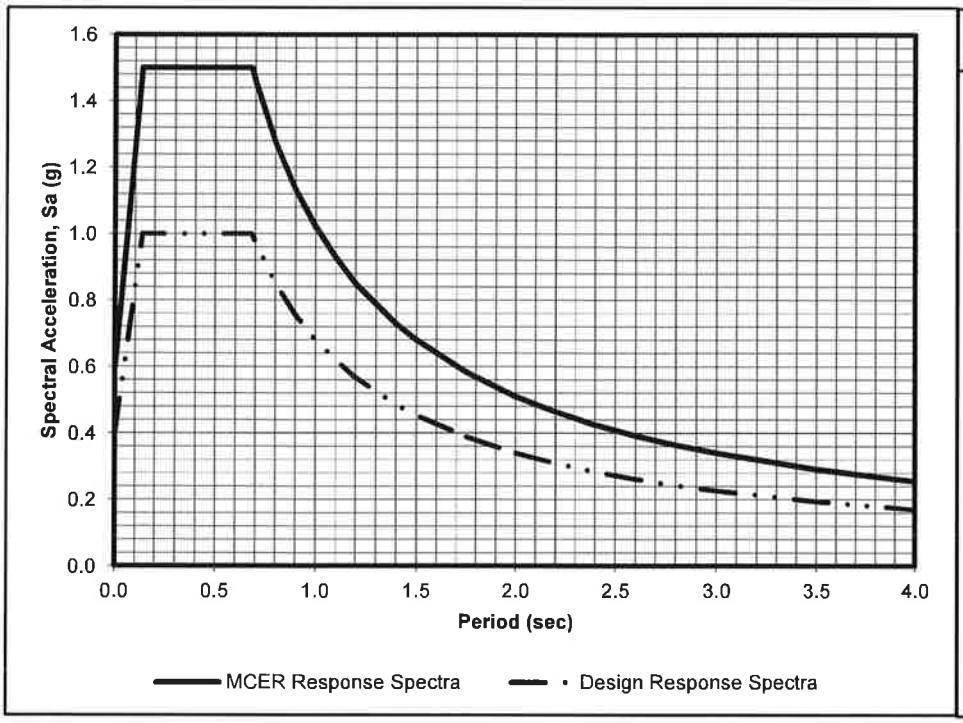
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	32.7407 N	
Longitude:	-115.6906 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.967		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.935		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.55 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-17
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	2.5	4.0			
Unnamed 2*	4.2	6.8			
Yuha*	4.3	6.9			
Shell Beds	7.6	12.2			
Superstition Hills	8.0	12.9	6.6	23 ± 2	4 ± 2
Yuha Well *	8.1	13.0			
Laguna Salada	9.9	15.8	7	67 ± 7	3.5 ± 1.5
Superstition Mountain	10.0	16.0	6.6	24 ± 2	5 ± 3
Vista de Anza*	11.1	17.8			
Borrego (Mexico)*	13.0	20.7			
Imperial	13.1	20.9	7	62 ± 6	20 ± 5
Painted Gorge Wash*	14.5	23.3			
Brawley *	14.6	23.3			
Ocotillo*	15.7	25.2			
Rico *	17.9	28.6			
Elsinore - Coyote Mountain	19.5	31.1	6.8	39 ± 4	4 ± 2
Pescadores (Mexico)*	20.6	33.0			
Cerro Prieto *	21.7	34.8			
Elmore Ranch	21.8	34.9	6.6	29 ± 3	1 ± 0.5
Cucapah (Mexico)*	22.9	36.6			
San Jacinto - Borrego	25.5	40.8	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	42.2	67.5	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-17
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

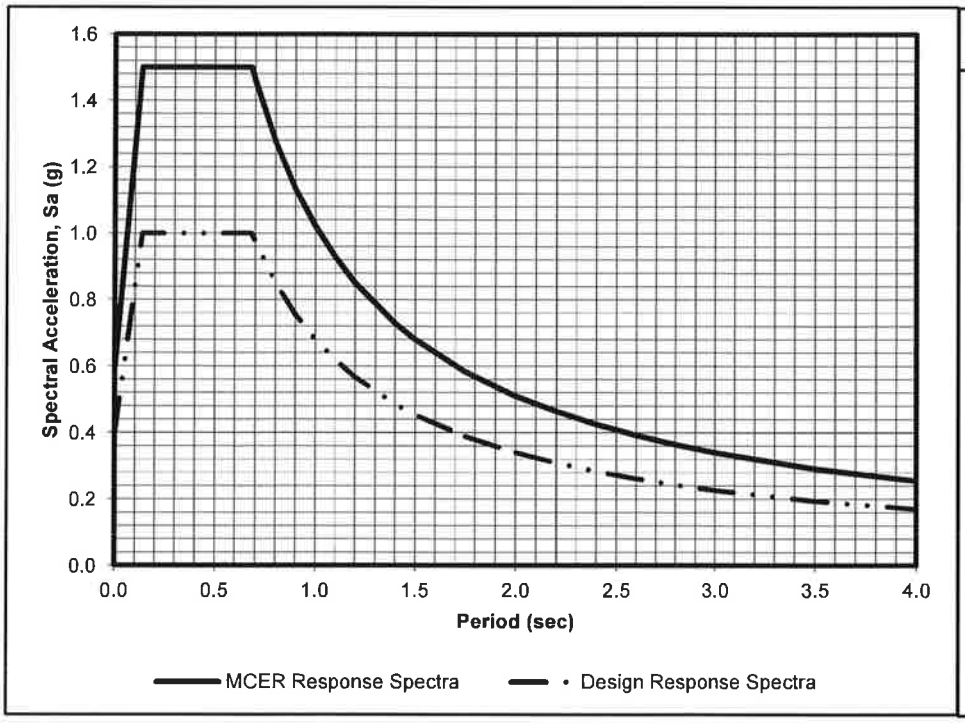
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7404	N	
Longitude:	-115.7008	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.966		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.935		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.55 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-18
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	1.7	2.8			
Yuha*	3.6	5.8			
Unnamed 2*	4.5	7.2			
Shell Beds	6.8	10.9			
Yuha Well *	7.3	11.8			
Superstition Hills	8.6	13.8	6.6	23 ± 2	4 ± 2
Laguna Salada	9.1	14.6	7	67 ± 7	3.5 ± 1.5
Superstition Mountain	10.1	16.2	6.6	24 ± 2	5 ± 3
Vista de Anza*	10.3	16.5			
Borrego (Mexico)*	13.1	21.0			
Imperial	13.8	22.1	7	62 ± 6	20 ± 5
Painted Gorge Wash*	13.8	22.1			
Ocotillo*	14.9	23.9			
Brawley *	15.3	24.5			
Elsinore - Coyote Mountain	18.7	29.9	6.8	39 ± 4	4 ± 2
Rico *	18.7	29.9			
Pescadores (Mexico)*	20.9	33.5			
Elmore Ranch	21.6	34.5	6.6	29 ± 3	1 ± 0.5
Cerro Prieto *	22.3	35.6			
Cucapah (Mexico)*	23.2	37.2			
San Jacinto - Borrego	25.0	40.0	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	42.2	67.5	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-18
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

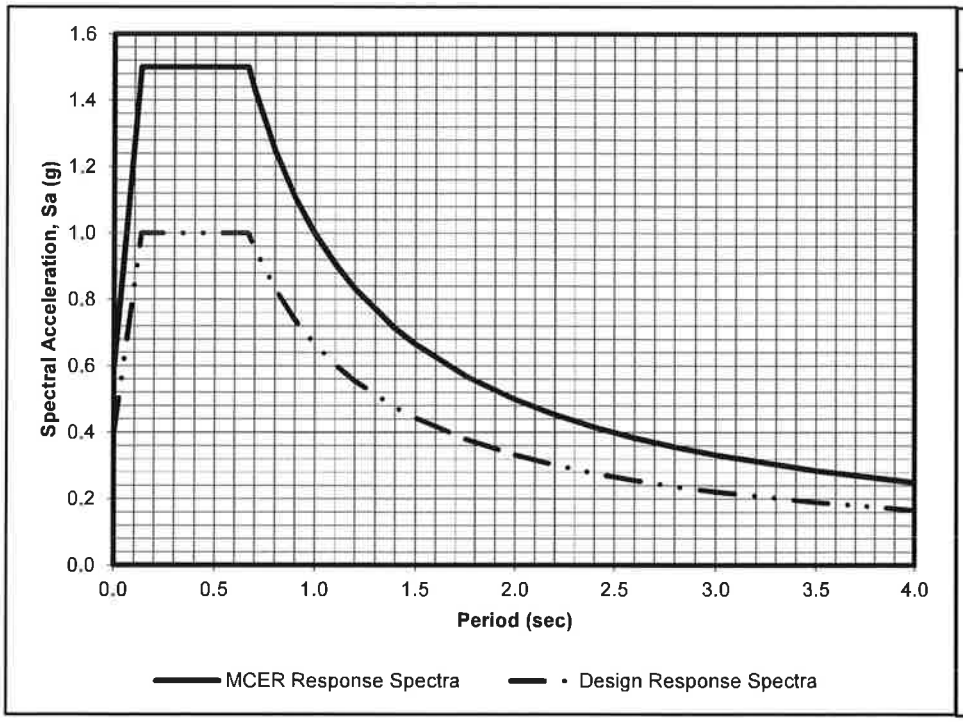
			ASCE 7-16 Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.7401	N	
Longitude:	-115.7147	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.580 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.72	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	0.998 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.665 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.963		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.935		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.13 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.67 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.55 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.13	1.00	1.50
0.67	1.00	1.50
0.70	0.95	1.43
0.80	0.83	1.25
0.90	0.74	1.11
1.00	0.67	1.00
1.10	0.60	0.91
1.20	0.55	0.83
1.20	0.55	0.83
1.40	0.48	0.71
1.50	0.44	0.67
1.75	0.38	0.57
2.00	0.33	0.50
2.20	0.30	0.45
2.40	0.28	0.42
2.60	0.26	0.38
2.80	0.24	0.36
3.00	0.22	0.33
3.50	0.19	0.29
4.00	0.17	0.25

Table 1-19
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 1*	1.7	2.6			
Yuha*	3.4	5.4			
Unnamed 2*	4.1	6.6			
Shell Beds	6.9	11.0			
Yuha Well *	7.5	12.0			
Laguna Salada	8.9	14.3	7	67 ± 7	3.5 ± 1.5
Superstition Hills	9.0	14.3	6.6	23 ± 2	4 ± 2
Vista de Anza*	10.2	16.4			
Superstition Mountain	10.6	16.9	6.6	24 ± 2	5 ± 3
Borrego (Mexico)*	12.7	20.3			
Imperial	14.0	22.4	7	62 ± 6	20 ± 5
Painted Gorge Wash*	14.0	22.5			
Ocotillo*	15.0	24.0			
Brawley *	15.5	24.8			
Elsinore - Coyote Mountain	18.8	30.0	6.8	39 ± 4	4 ± 2
Rico *	18.8	30.0			
Pescadores (Mexico)*	20.5	32.8			
Cerro Prieto *	21.9	35.1			
Elmore Ranch	22.0	35.2	6.6	29 ± 3	1 ± 0.5
Cucapah (Mexico)*	22.8	36.5			
San Jacinto - Borrego	25.3	40.5	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	42.6	68.2	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-19
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

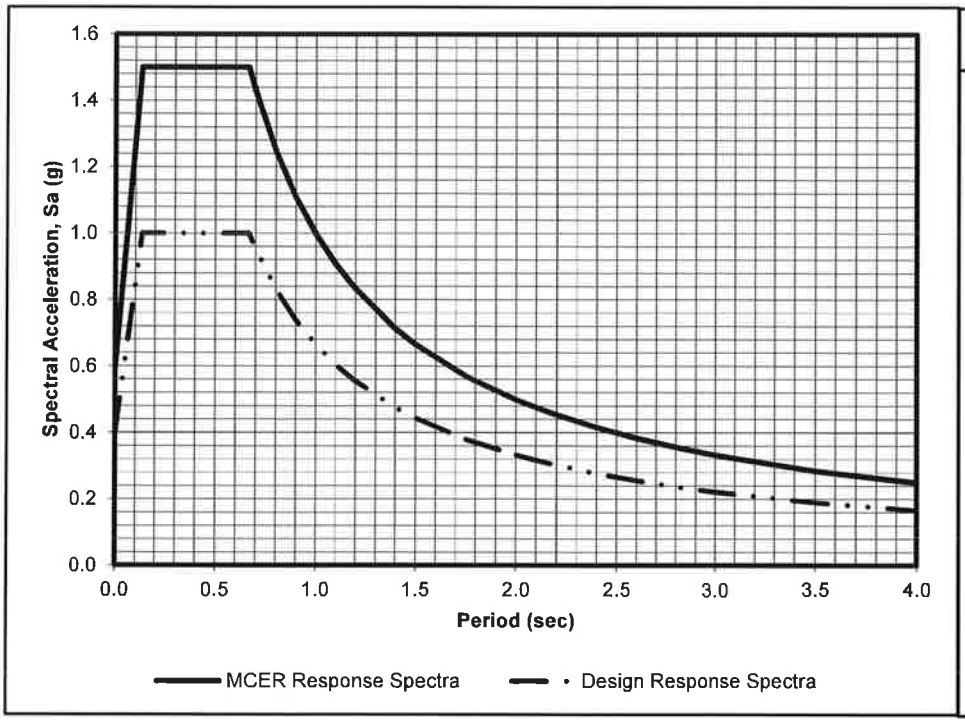
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	32.7334 N	
Longitude:	-115.7146 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.580 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.72	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	0.998 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.665 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.962		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.935		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.13 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.67 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.55 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.13	1.00	1.50
0.67	1.00	1.50
0.70	0.95	1.43
0.80	0.83	1.25
0.90	0.74	1.11
1.00	0.67	1.00
1.10	0.60	0.91
1.20	0.55	0.83
1.20	0.55	0.83
1.40	0.48	0.71
1.50	0.44	0.67
1.75	0.38	0.57
2.00	0.33	0.50
2.20	0.30	0.45
2.40	0.28	0.42
2.60	0.26	0.38
2.80	0.24	0.36
3.00	0.22	0.33
3.50	0.19	0.29
4.00	0.17	0.25

Table 1-20
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	2.4	3.8	6.6	23 ± 2	4 ± 2
Imperial	3.4	5.5	7	62 ± 6	20 ± 5
Brawley *	5.2	8.4			
Superstition Mountain	8.6	13.7	6.6	24 ± 2	5 ± 3
Rico *	9.4	15.1			
Unnamed 2*	11.6	18.6			
Unnamed 1*	12.1	19.3			
Yuha*	14.0	22.4			
Shell Beds	16.2	26.0			
Yuha Well *	16.4	26.3			
Borrego (Mexico)*	18.9	30.3			
Laguna Salada	19.3	30.9	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	19.7	31.6			
Painted Gorge Wash*	20.4	32.6			
Elmore Ranch	22.1	35.3	6.6	29 ± 3	1 ± 0.5
Cerro Prieto *	22.5	36.0			
Ocotillo*	23.9	38.3			
Pescadores (Mexico)*	24.3	38.9			
Cucapah (Mexico)*	25.7	41.1			
Elsinore - Coyote Mountain	27.3	43.7	6.8	39 ± 4	4 ± 2
San Jacinto - Borrego	28.4	45.4	6.6	29 ± 3	4 ± 2
Algodones *	36.1	57.8			

* Note: Faults not included in CGS database.

Table 2-20
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

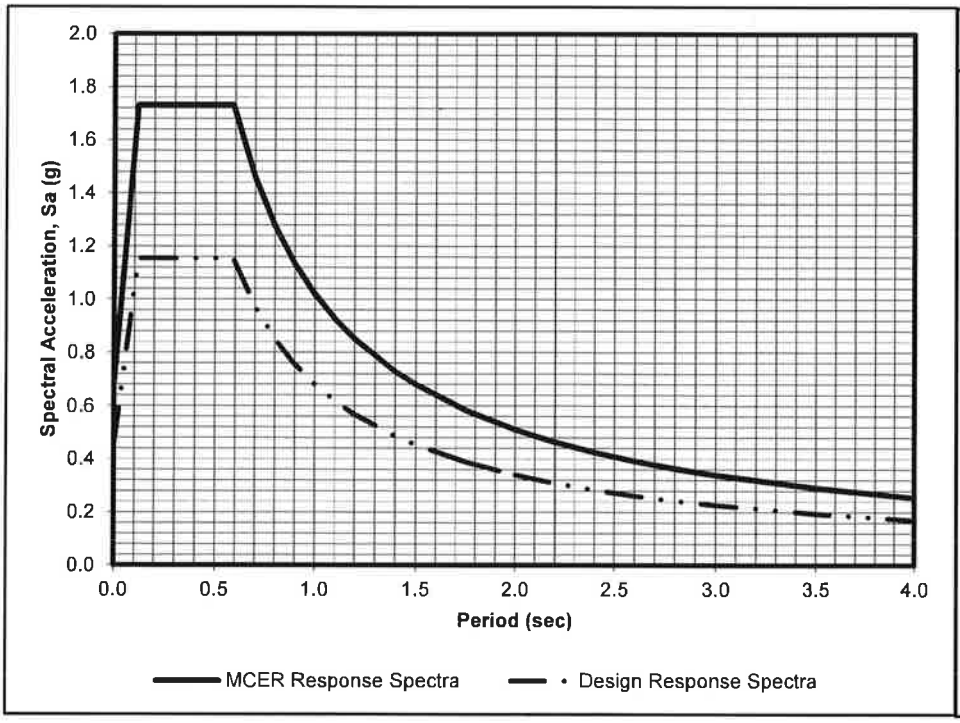
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	32.8182 N	
Longitude:	-115.5622 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.732 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.732 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.155 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.958		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.926		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.59 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.78 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.46	0.69
0.12	1.15	1.73
0.59	1.15	1.73
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-21
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	3.5	5.6	6.6	23 ± 2	4 ± 2
Unnamed 1*	7.0	11.2			
Unnamed 2*	7.3	11.6			
Superstition Mountain	7.7	12.3	6.6	24 ± 2	5 ± 3
Imperial	8.5	13.6	7	62 ± 6	20 ± 5
Yuha*	8.9	14.3			
Brawley *	10.1	16.2			
Shell Beds	11.4	18.2			
Yuha Well *	11.7	18.7			
Rico *	13.8	22.1			
Laguna Salada	14.3	22.9	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	15.0	24.1			
Borrego (Mexico)*	15.6	25.0			
Painted Gorge Wash*	16.9	27.0			
Ocotillo*	19.3	30.9			
Elmore Ranch	21.1	33.7	6.6	29 ± 3	1 ± 0.5
Cerro Prieto *	21.9	35.1			
Pescadores (Mexico)*	22.2	35.6			
Elsinore - Coyote Mountain	22.8	36.5	6.8	39 ± 4	4 ± 2
Cucapah (Mexico)*	24.1	38.5			
San Jacinto - Borrego	26.1	41.8	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	39.6	63.4	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-21
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

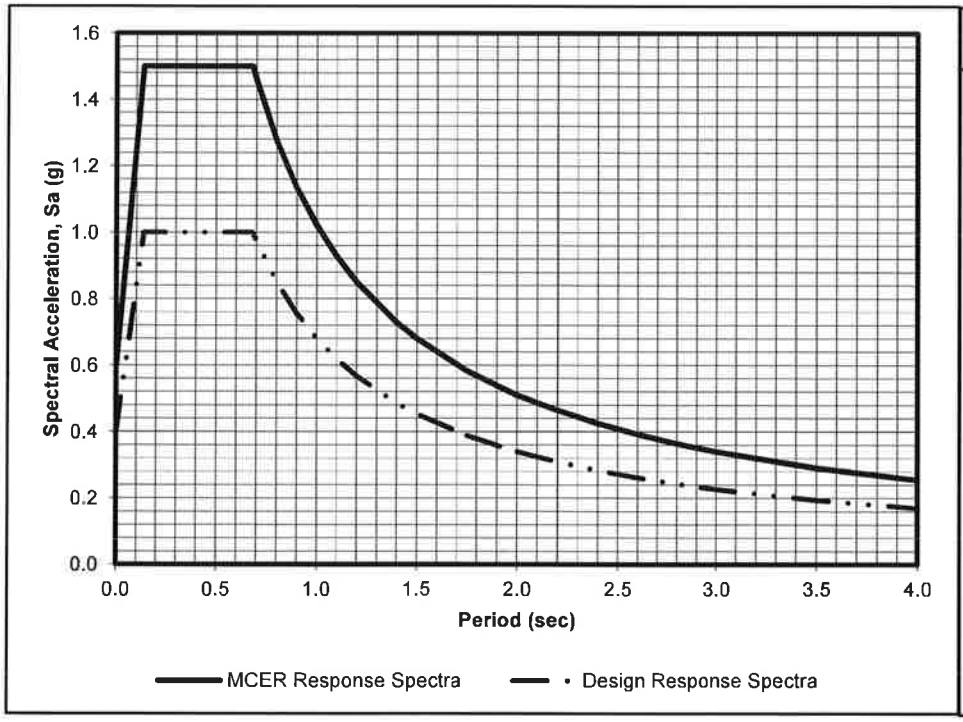
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	32.7816 N	
Longitude:	-115.6379 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.965		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.935		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.67 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-22
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Superstition Hills	3.9	6.3	6.6	23 ± 2	4 ± 2
Unnamed 1*	6.8	10.8			
Unnamed 2*	6.8	10.9			
Superstition Mountain	8.2	13.1	6.6	24 ± 2	5 ± 3
Yuha*	8.7	13.9			
Imperial	8.7	14.0	7	62 ± 6	20 ± 5
Brawley *	10.3	16.5			
Shell Beds	11.3	18.1			
Yuha Well *	11.6	18.6			
Rico *	13.9	22.2			
Laguna Salada	14.2	22.6	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	15.0	24.0			
Borrego (Mexico)*	15.1	24.2			
Painted Gorge Wash*	17.1	27.4			
Ocotillo*	19.3	30.9			
Cerro Prieto *	21.5	34.3			
Elmore Ranch	21.5	34.4	6.6	29 ± 3	1 ± 0.5
Pescadores (Mexico)*	21.7	34.8			
Elsinore - Coyote Mountain	22.8	36.6	6.8	39 ± 4	4 ± 2
Cucapah (Mexico)*	23.6	37.7			
San Jacinto - Borrego	26.5	42.3	6.6	29 ± 3	4 ± 2
San Andreas - Coachella	40.1	64.2	7.2	96 ± 10	25 ± 5

* Note: Faults not included in CGS database.

Table 2-22
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

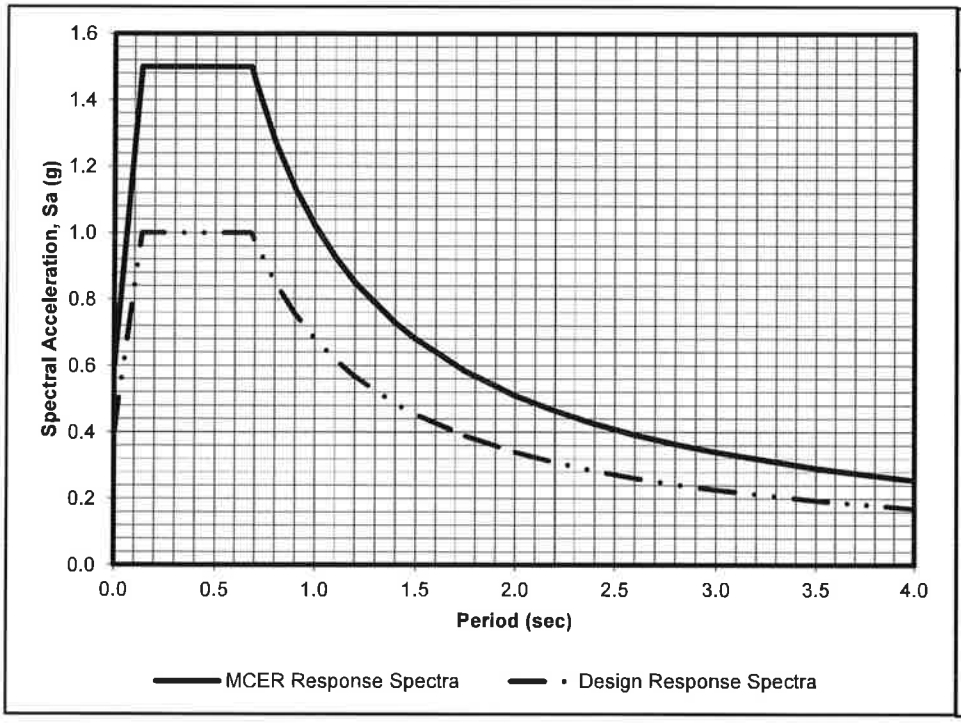
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	32.7742 N	
Longitude:	-115.6378 W	
Risk Category:	I	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.967		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.936		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.63 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

Table 1-23
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Imperial	1.7	2.7	7	62 ± 6	20 ± 5
Brawley *	3.6	5.8			
Superstition Hills	3.9	6.3	6.6	23 ± 2	4 ± 2
Rico *	8.0	12.8			
Superstition Mountain	9.5	15.2	6.6	24 ± 2	5 ± 3
Unnamed 2*	13.2	21.1			
Unnamed 1*	13.8	22.1			
Yuha*	15.7	25.2			
Shell Beds	17.9	28.7			
Yuha Well *	18.1	29.0			
Borrego (Mexico)*	20.2	32.4			
Laguna Salada	20.9	33.4	7	67 ± 7	3.5 ± 1.5
Vista de Anza*	21.4	34.3			
Painted Gorge Wash*	21.7	34.8			
Elmore Ranch	22.7	36.3	6.6	29 ± 3	1 ± 0.5
Cerro Prieto *	23.0	36.7			
Pescadores (Mexico)*	25.2	40.4			
Ocotillo*	25.6	40.9			
Cucapah (Mexico)*	26.4	42.3			
Elsinore - Coyote Mountain	28.9	46.2	6.8	39 ± 4	4 ± 2
San Jacinto - Borrego	29.3	46.9	6.6	29 ± 3	4 ± 2
Algodones *	34.6	55.3			

* Note: Faults not included in CGS database.

Table 2-23
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

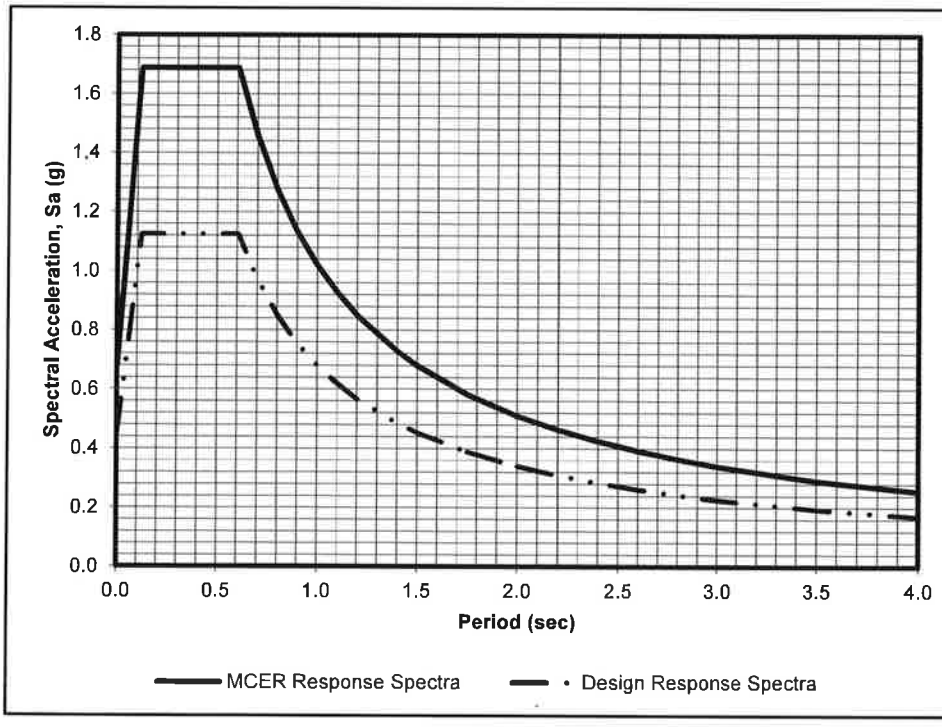
			ASCE 7-16 Reference
Soil Site Class:	D		Table 20.3-1
Latitude:	32.8306	N	
Longitude:	-115.5360	W	
Risk Category:	I		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.688 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.70	CBC Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.688 g	$= F_a * S_s$	CBC Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= F_v * S_1$	CBC Equation 16-38

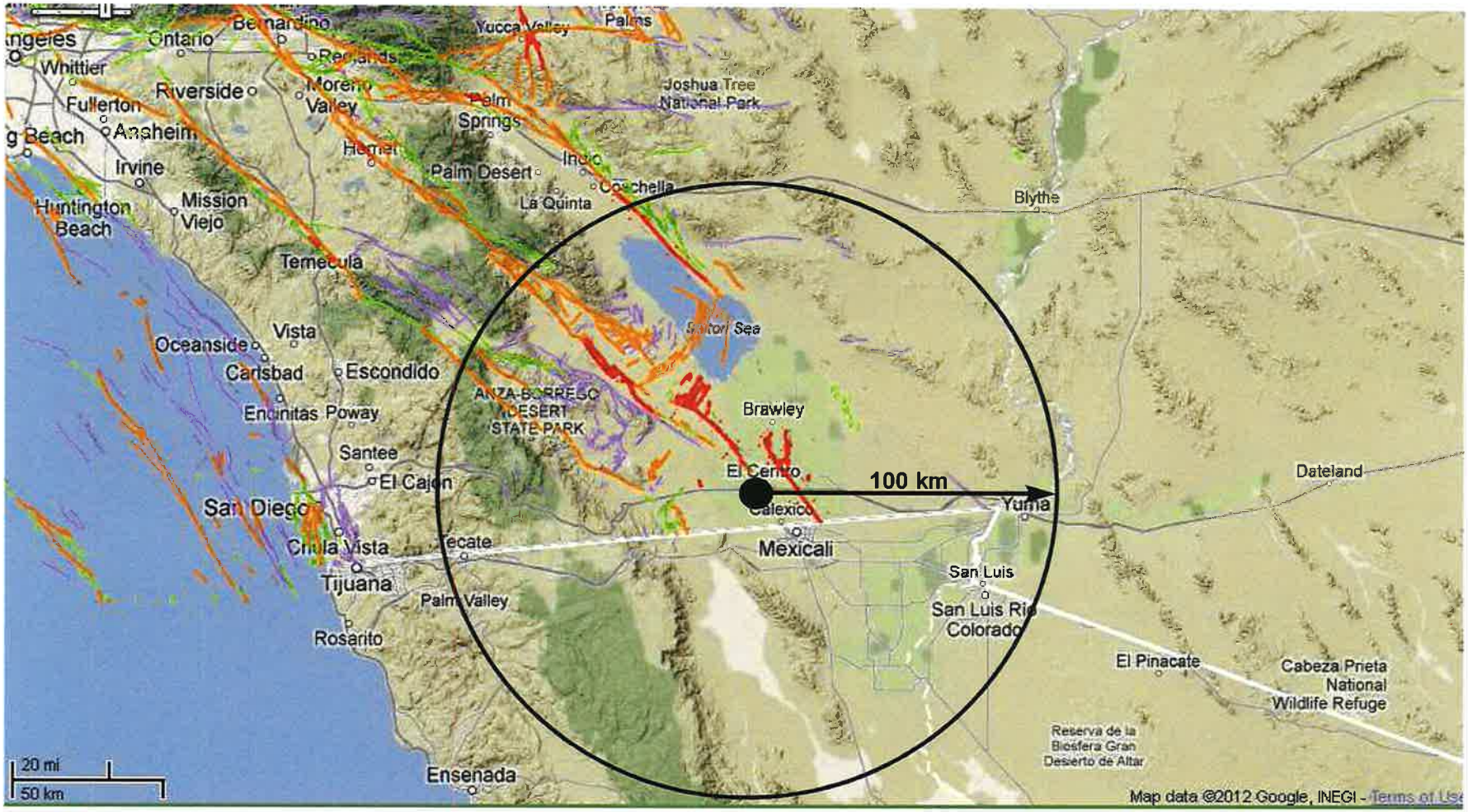
Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.125 g	$= 2/3*S_{MS}$	CBC Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.956		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.928		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.60 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.77 g		ASCE Equation 11.8-1



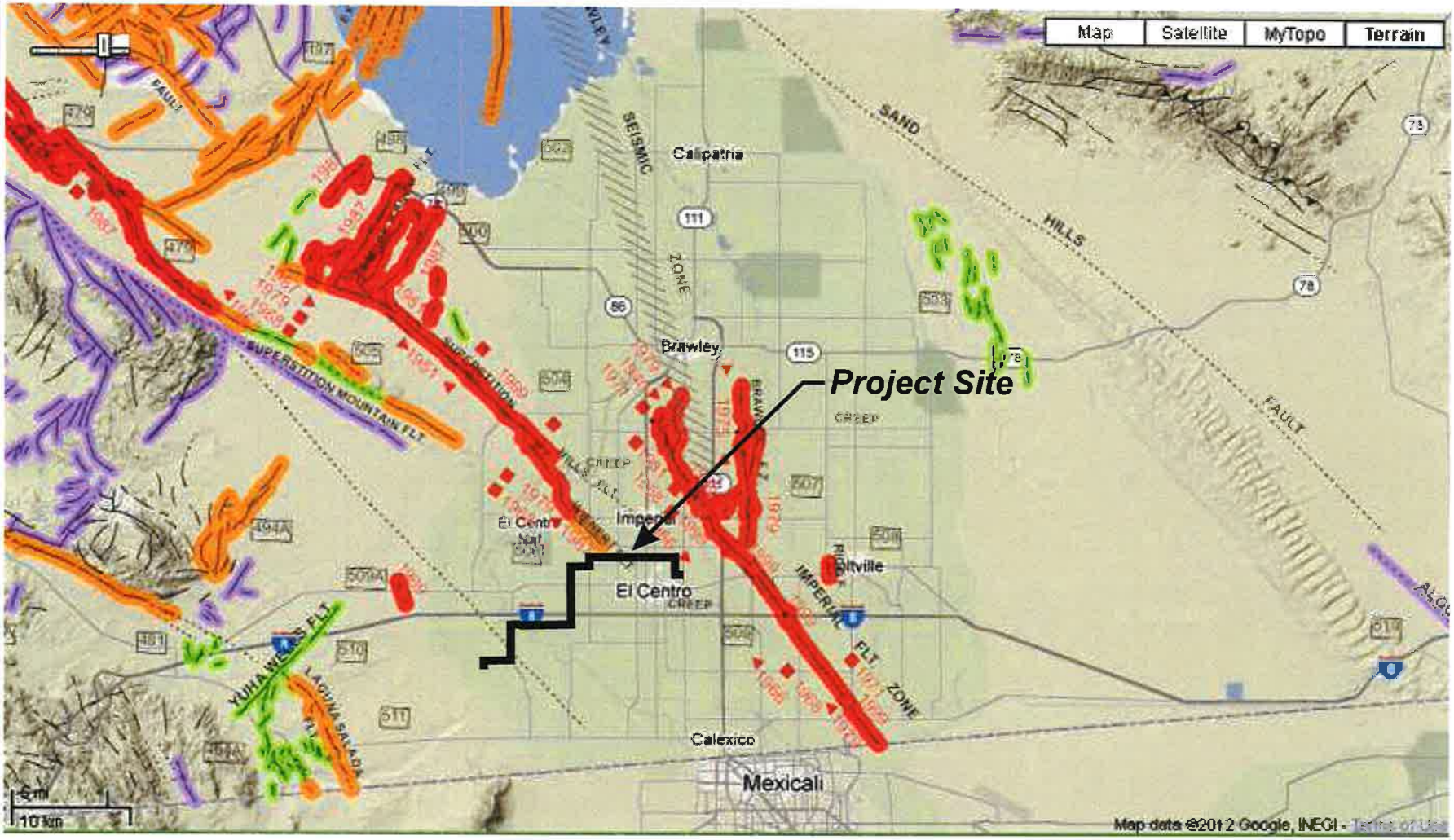
Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.45	0.68
0.12	1.13	1.69
0.60	1.13	1.69
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
3.50	0.19	0.29
4.00	0.17	0.26

FIGURES



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

LANDMARK Geo-Engineers and Geologists Project No.: LE20113	Regional Fault Map	Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

LANDMARK Geo-Engineers and Geologists Project No.: LE20107	Map of Local Faults	Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.

A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Fault Map Legend

Figure 3a

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
						ON LAND	OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	200		? ? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	11,700		? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000		?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

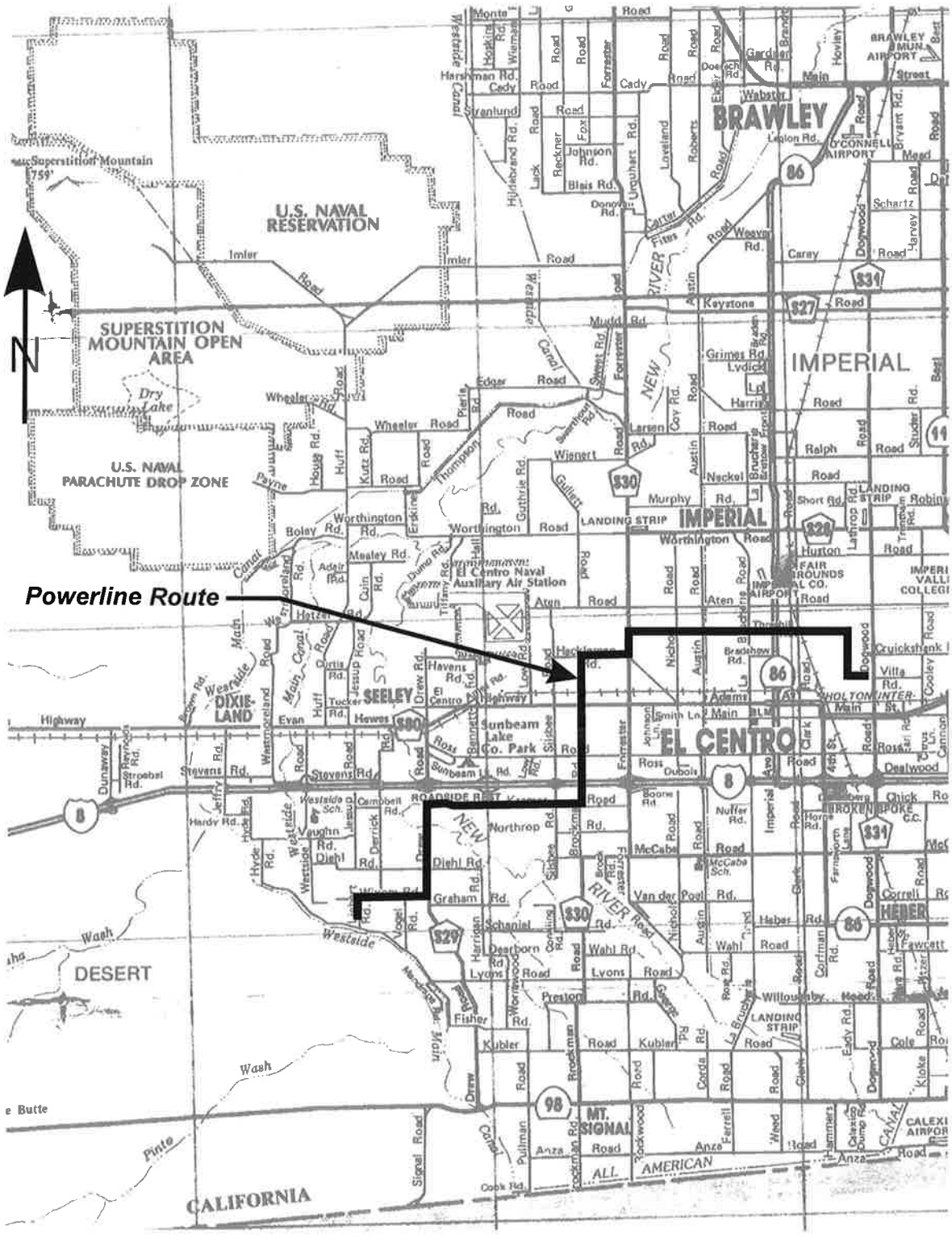
LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Fault Map Legend

Figure 3b

APPENDIX A

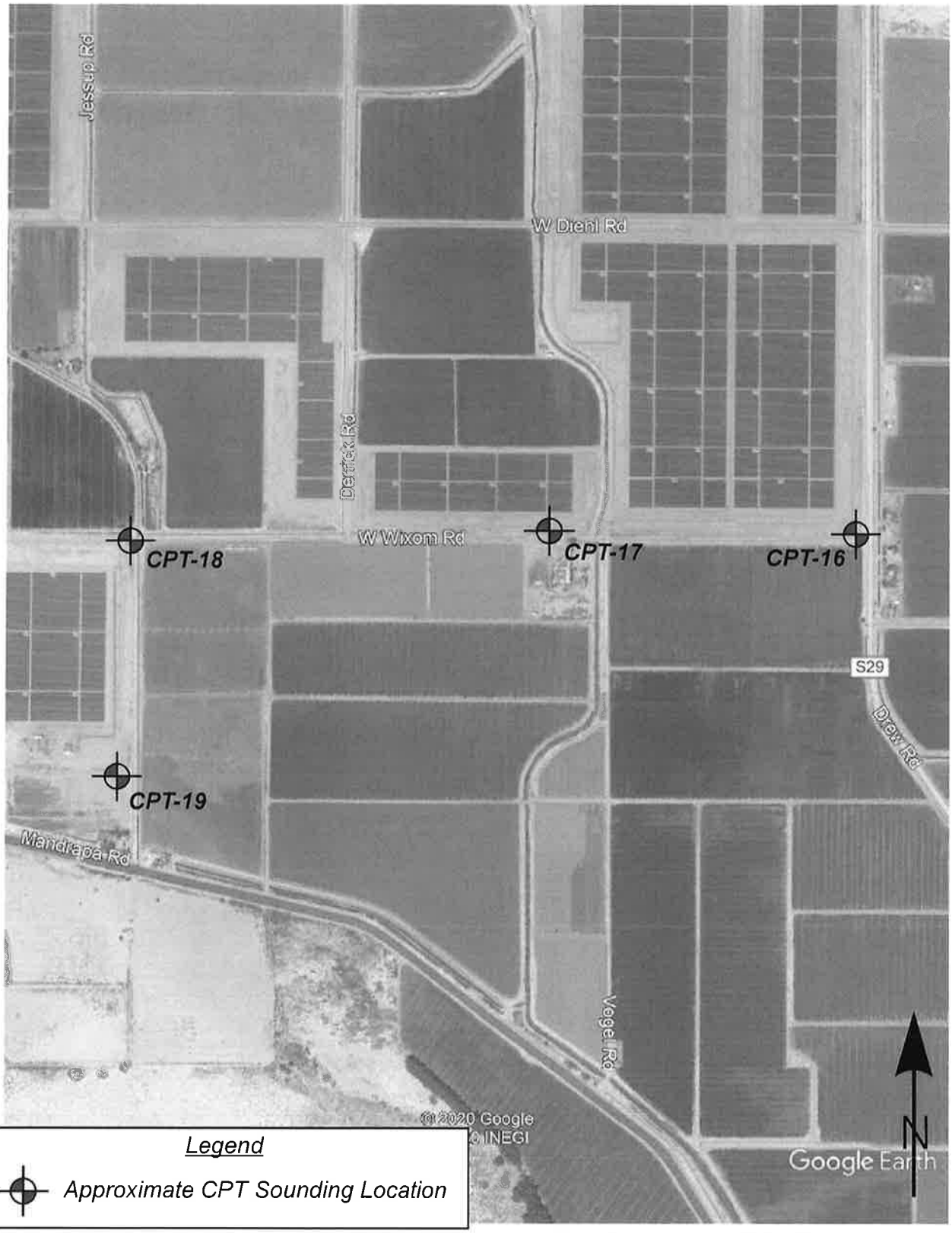


LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Vicinity Map

Plate A-1



Legend

Approximate CPT Sounding Location

LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Site and Exploration Map**	**Plate** **A-2a**

Legend

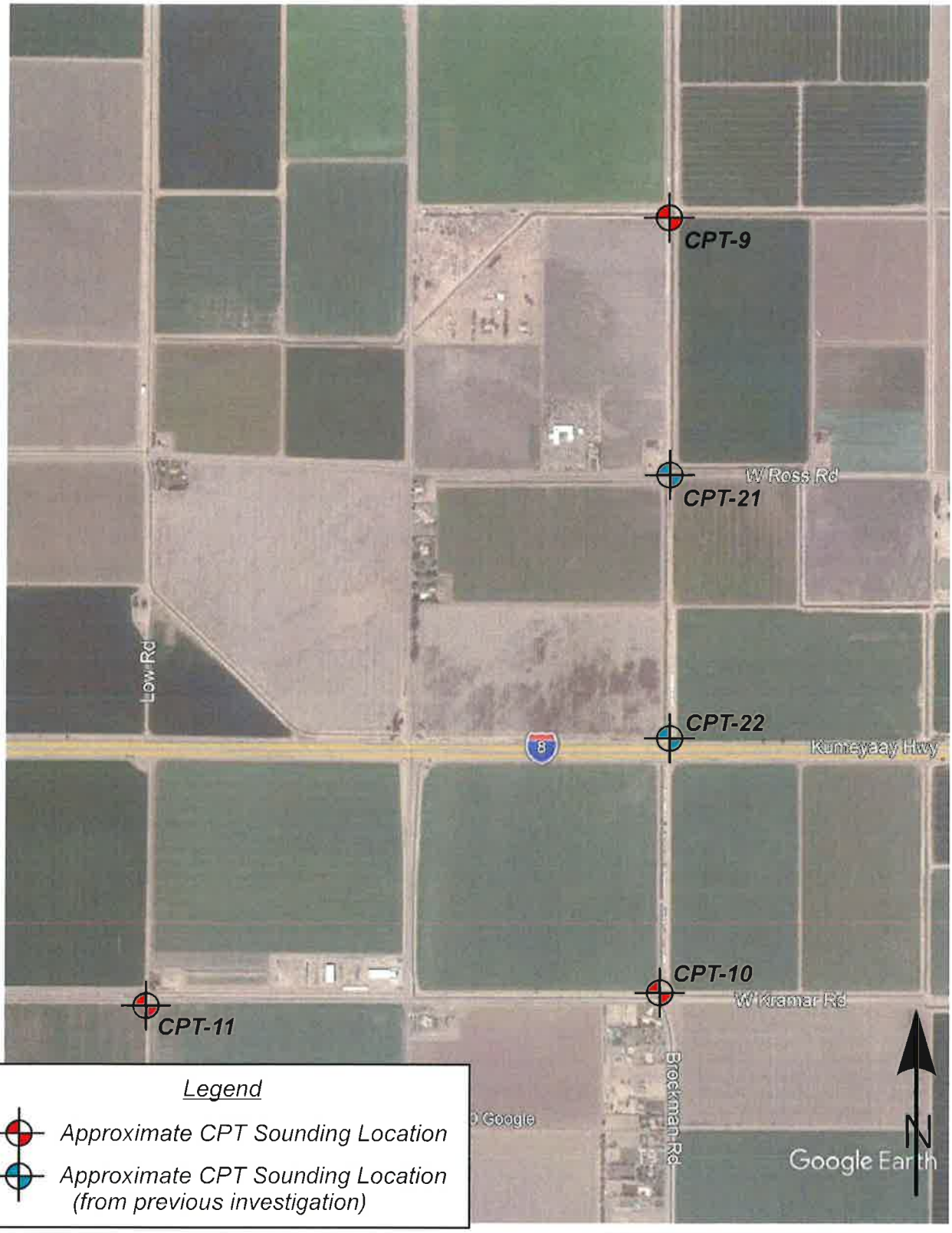
Approximate CPT Sounding Location

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Site and Exploration Map

Plate
A-2b



Legend

Approximate CPT Sounding Location

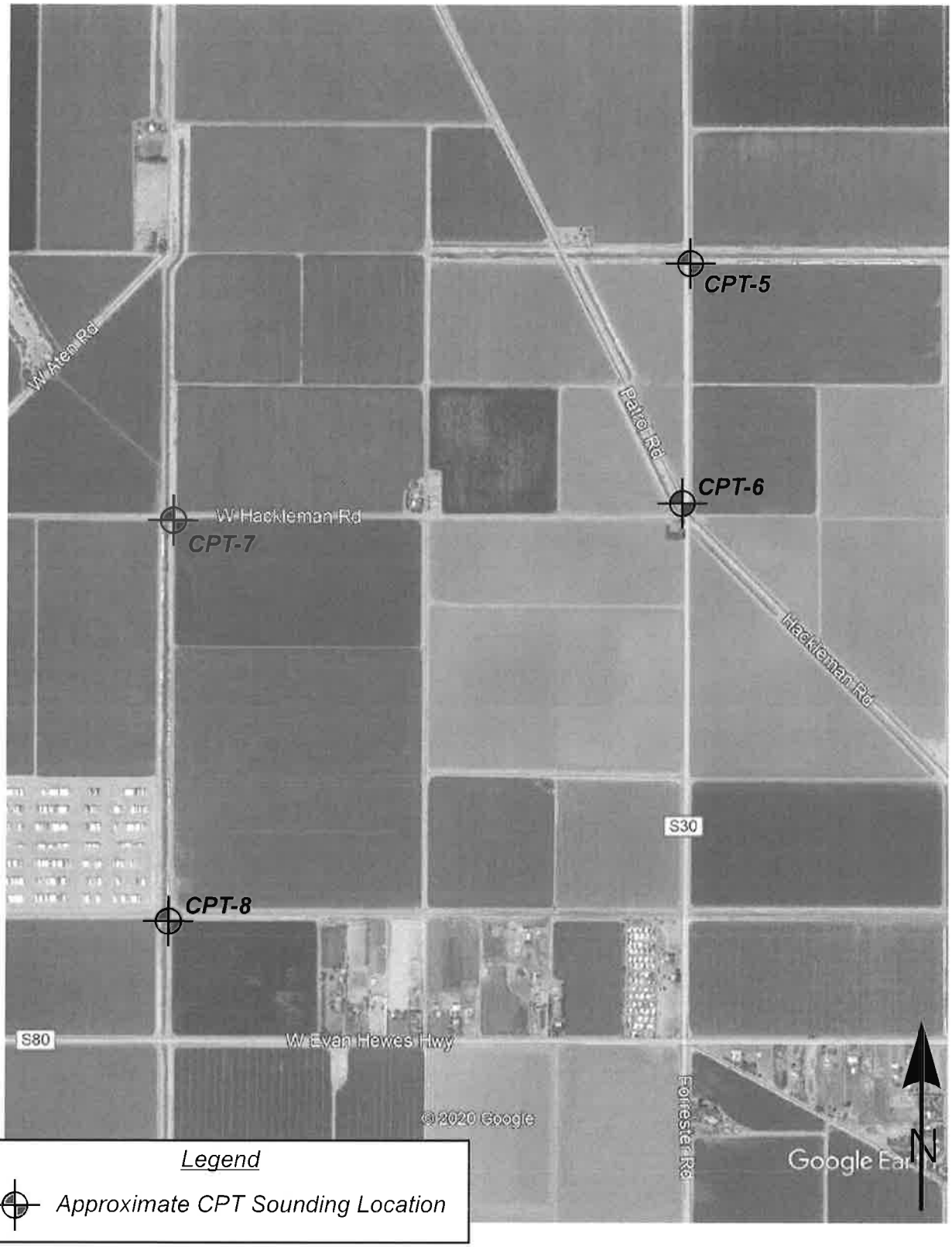
Approximate CPT Sounding Location (from previous investigation)

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Site and Exploration Map

Plate
A-2c



Legend

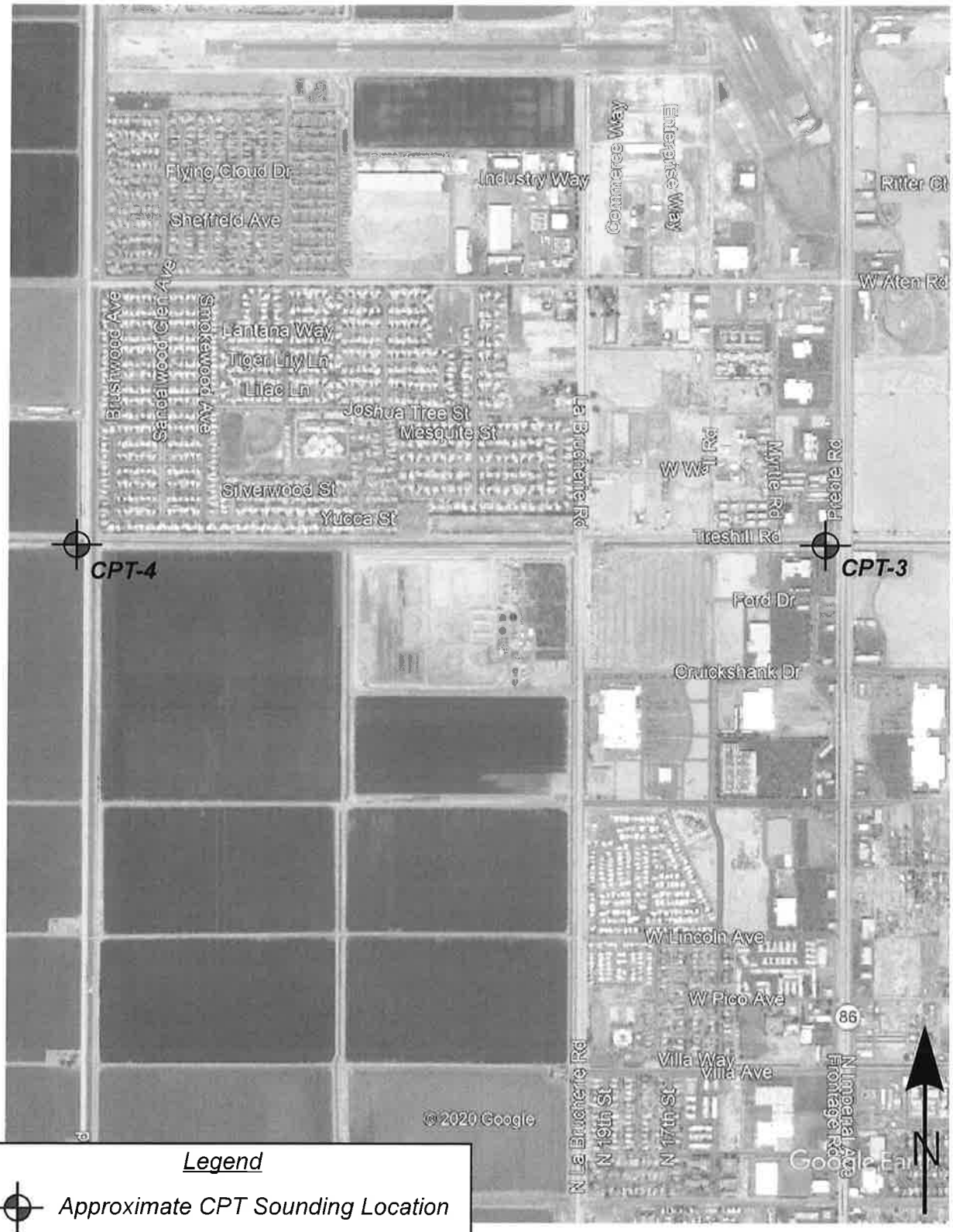
Approximate CPT Sounding Location

LANDMARK
Geo-Engineers and Geologists

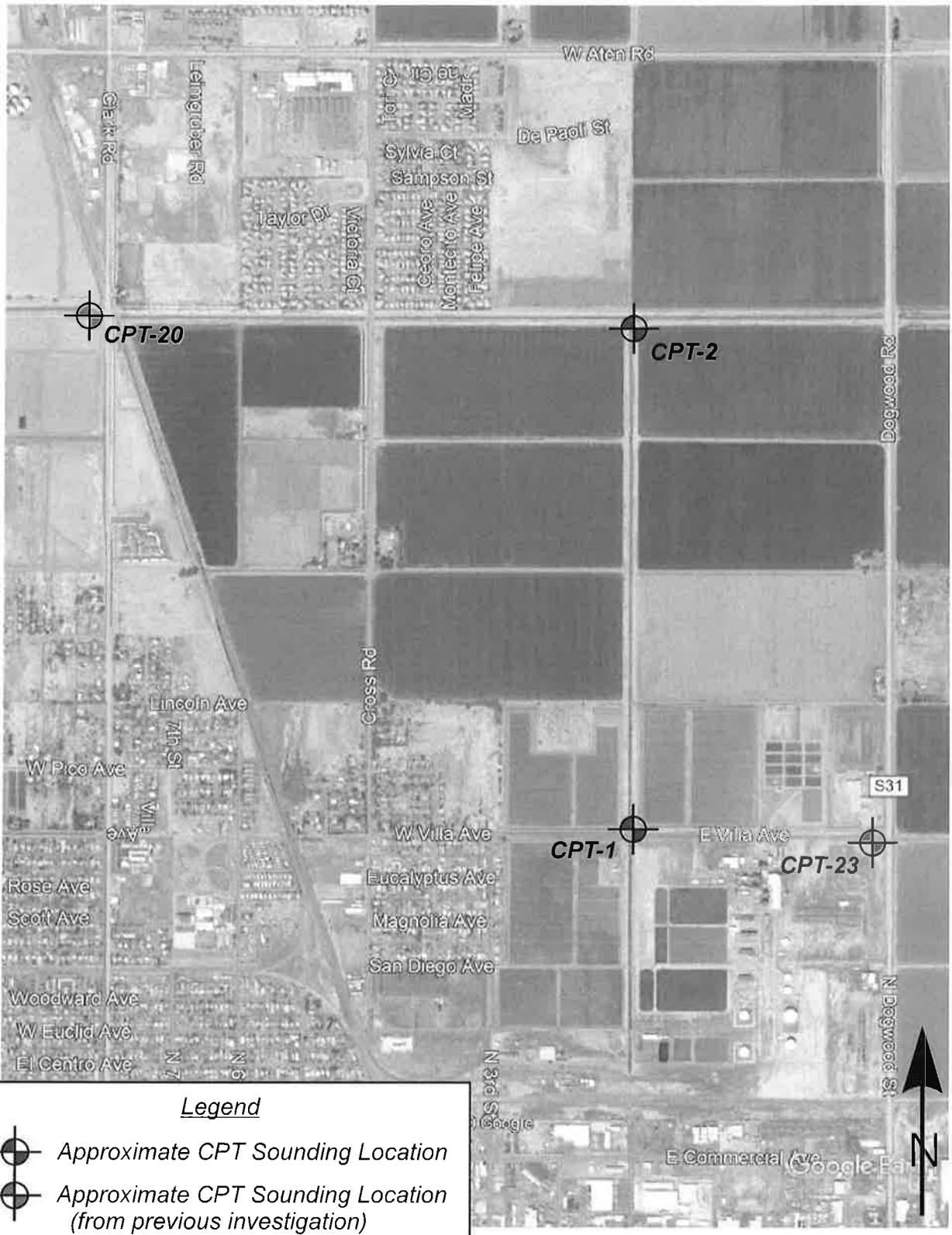
Project No.: LE20107

Site and Exploration Map

Plate
A-2d



LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Site and Exploration Map**	**Plate** **A-2e**



Legend

Approximate CPT Sounding Location

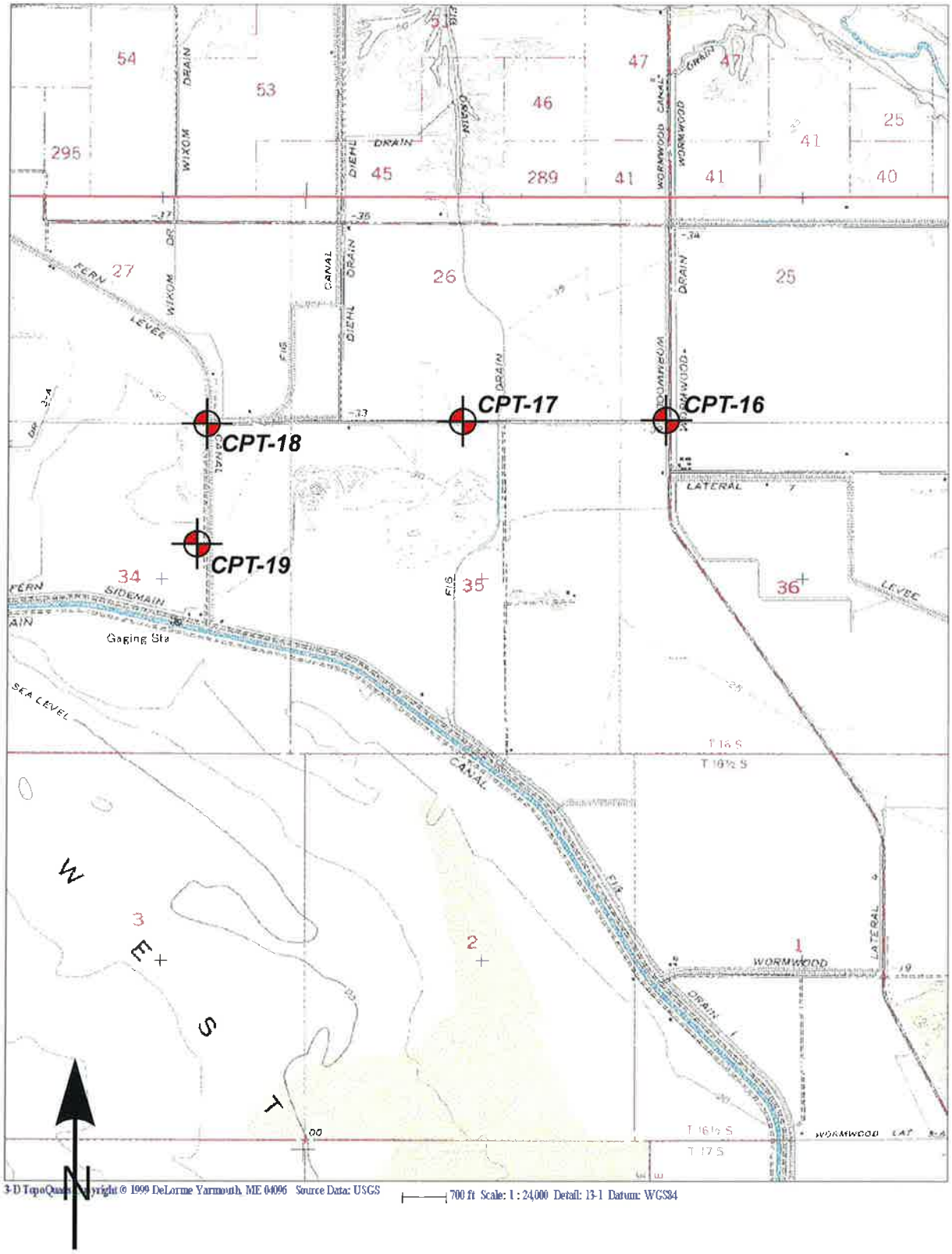
Approximate CPT Sounding Location (from previous investigation)

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Site and Exploration Map

Plate A-2f

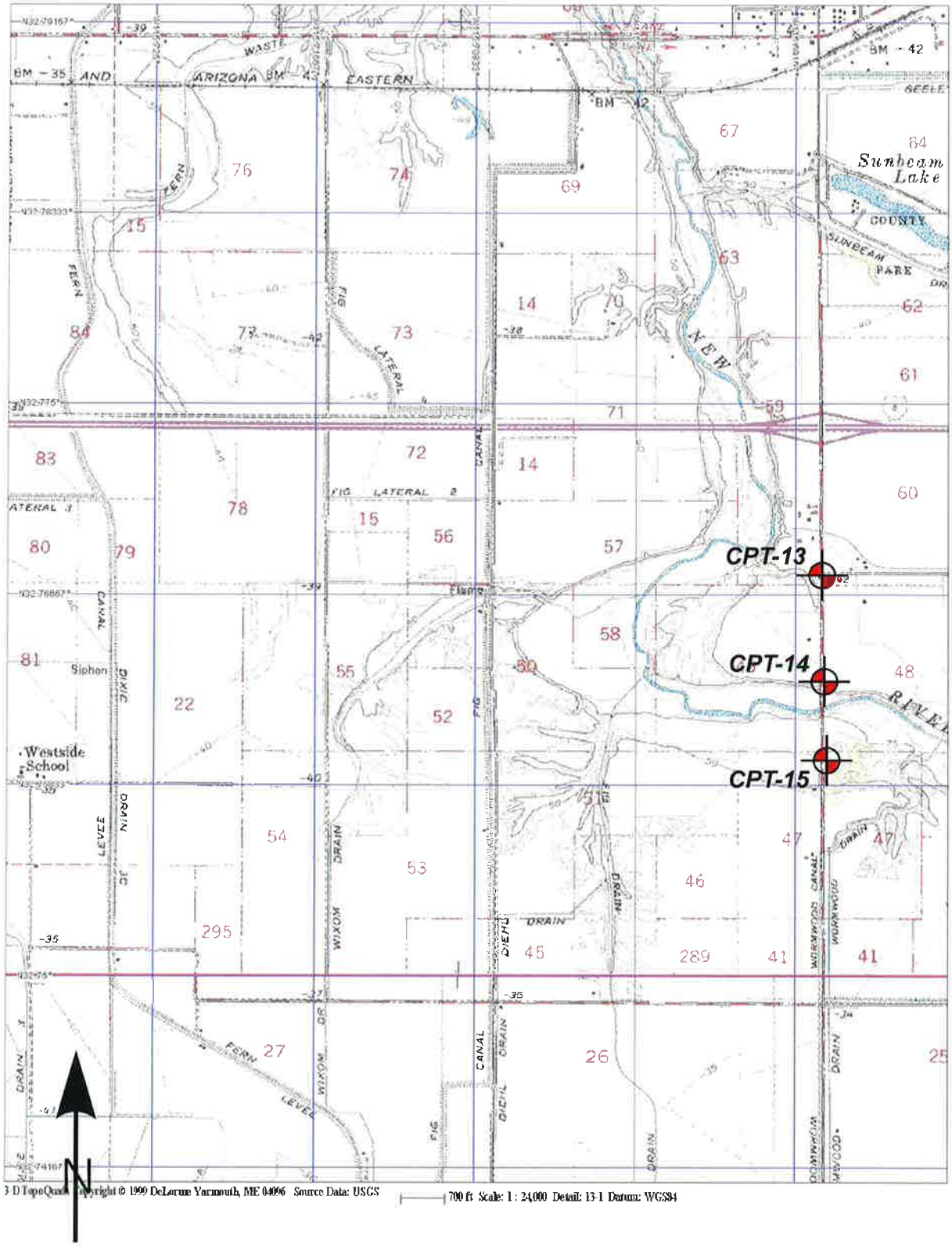


LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Topographic Map

Plate
A-3a

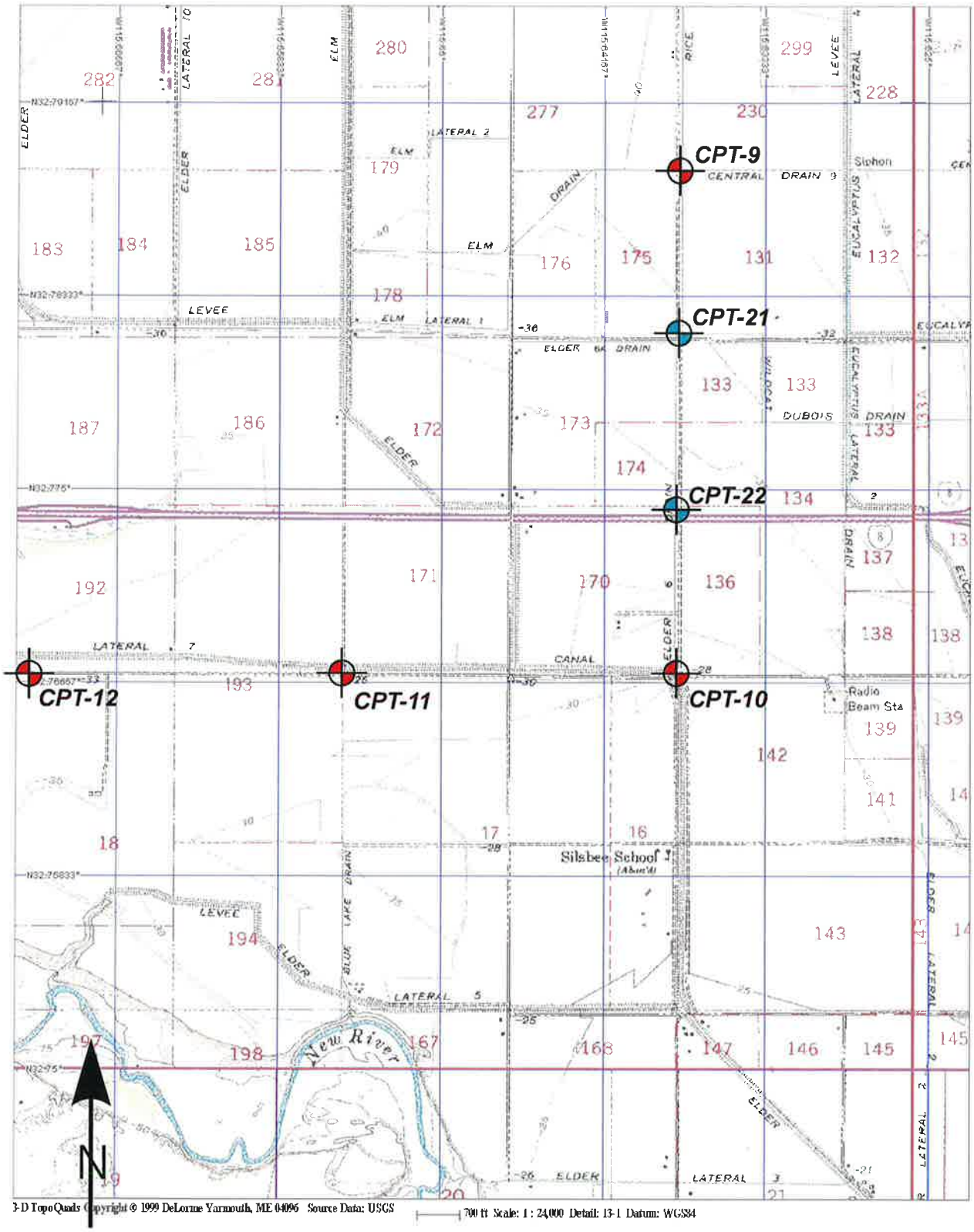


LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Topographic Map

Plate
A-3b

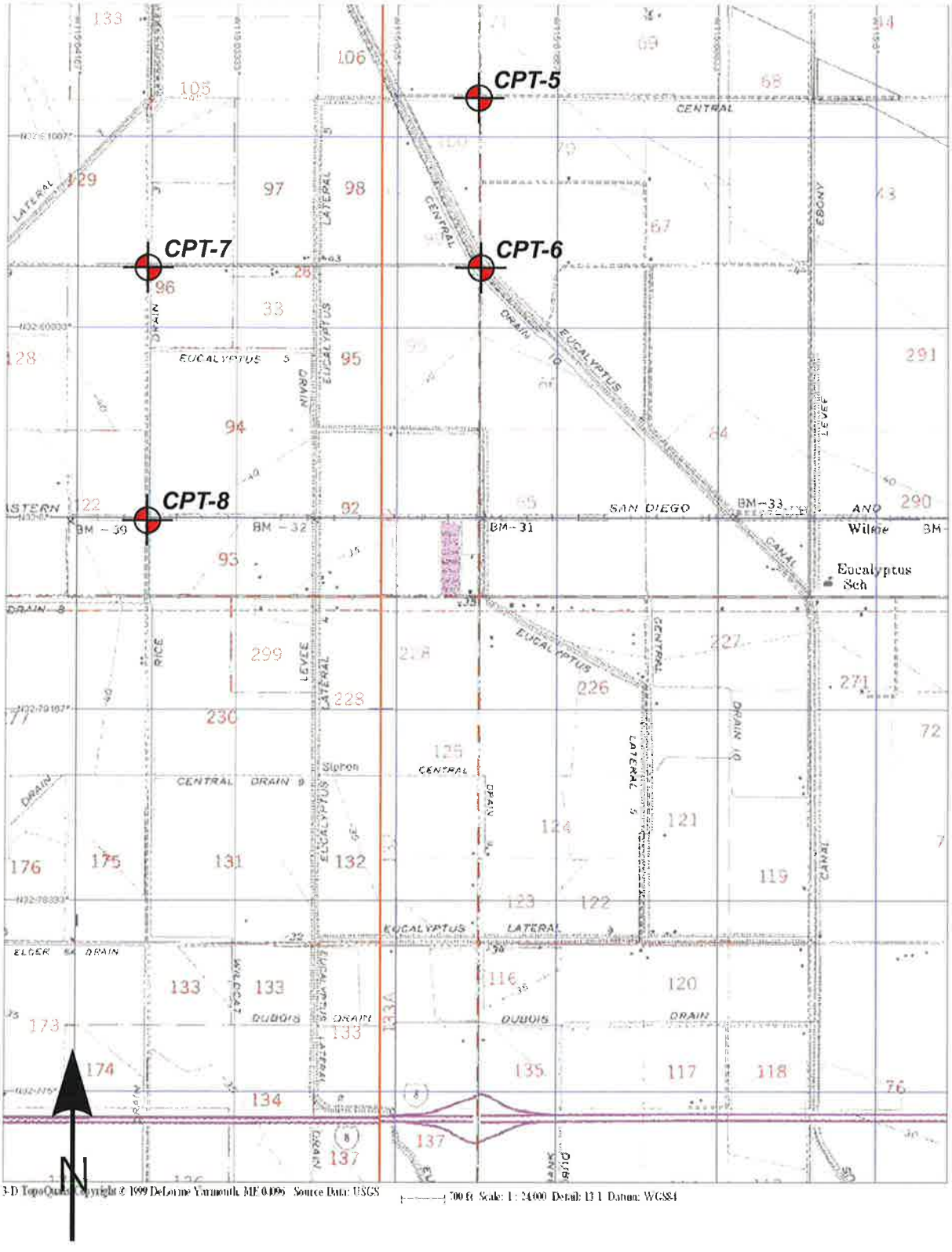


LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Topographic Map

Plate
A-3c

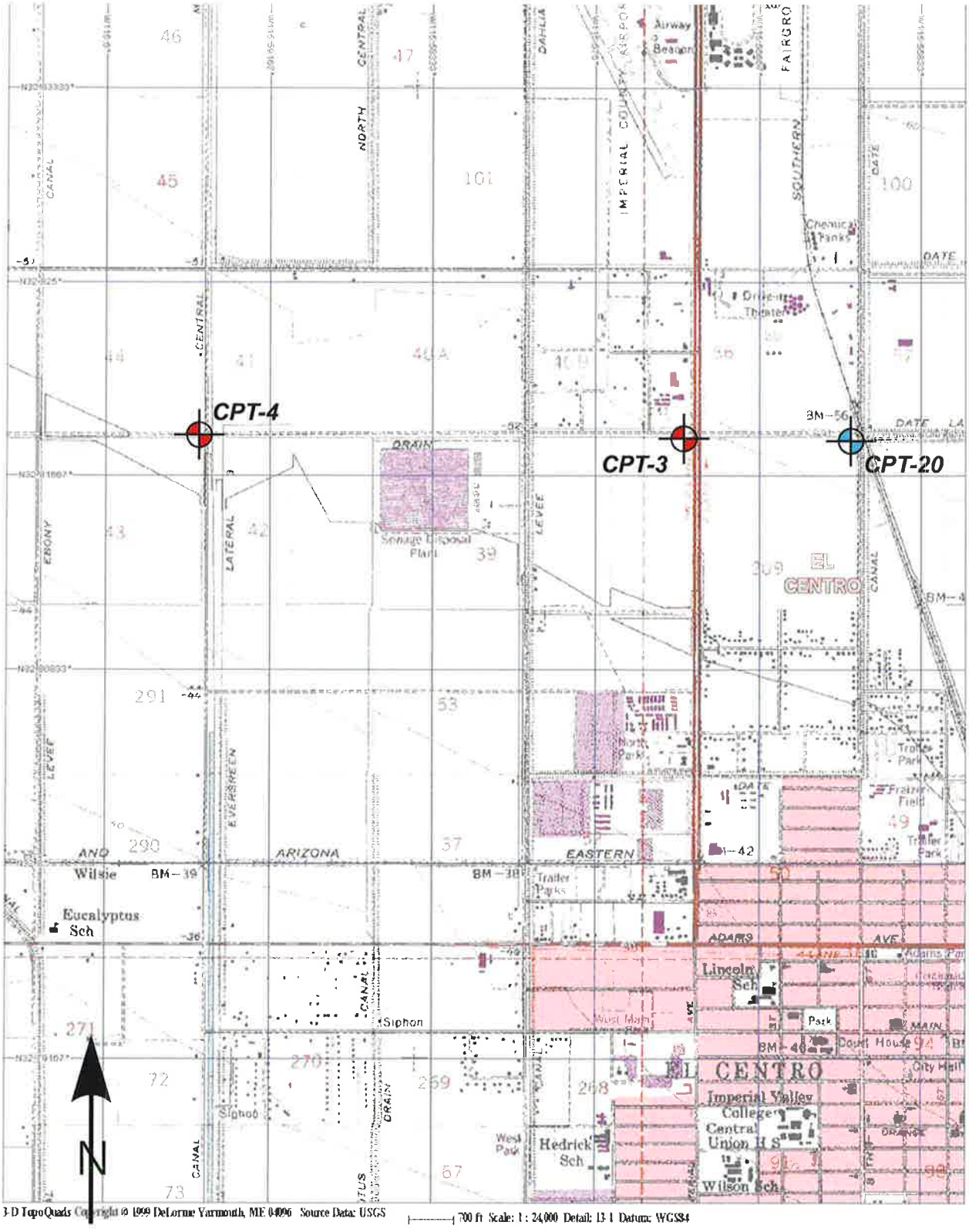


LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Topographic Map

Plate
A-3d

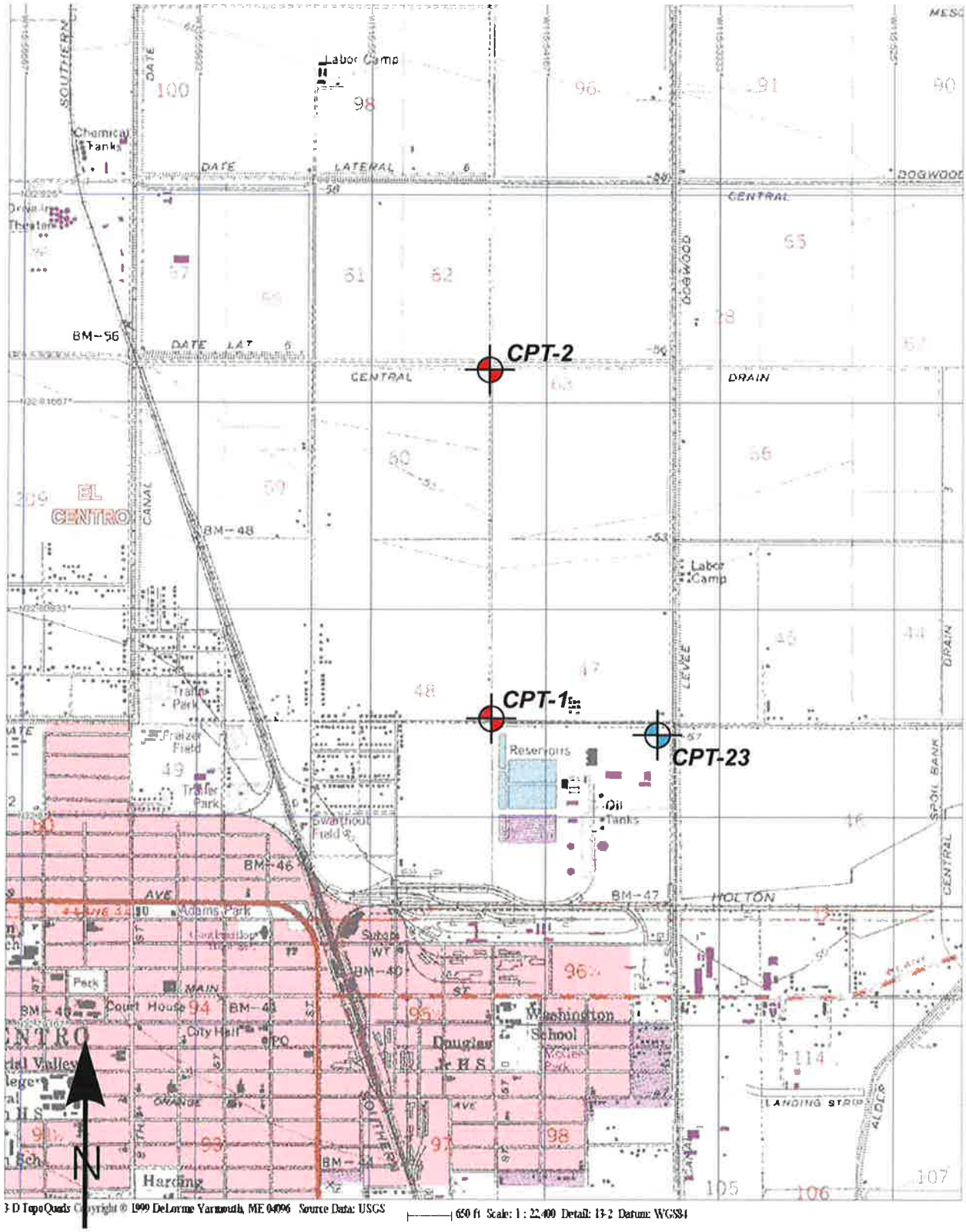


LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Topographic Map

Plate
A-3e



LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Topographic Map

Plate
A-3f

APPENDIX B

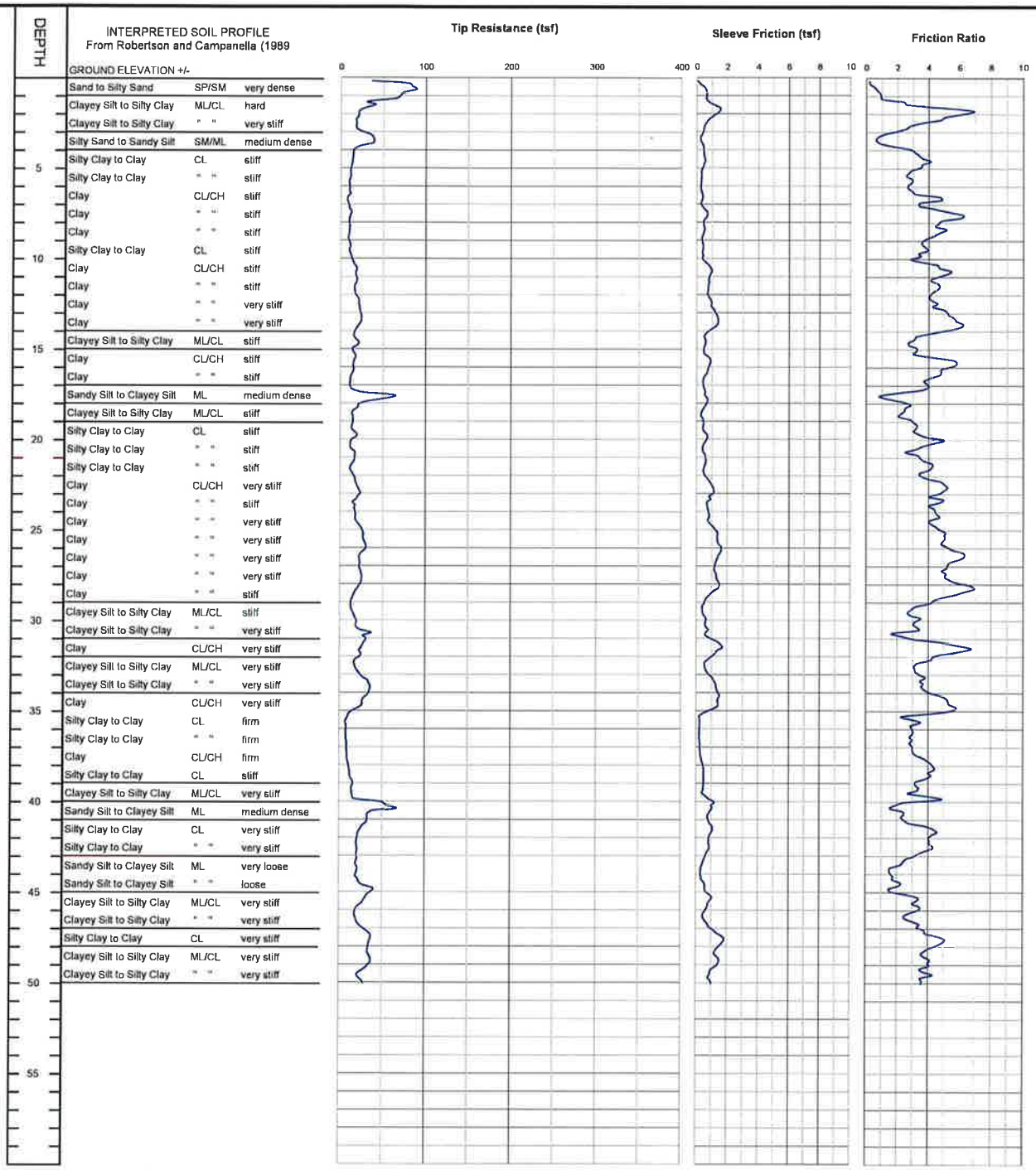
CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/12/2020

CONE SOUNDING DATA CPT-1



Sand to Silty Sand	SP/SM	very dense
Clayey Silt to Silty Clay	ML/CL	hard
Clayey Silt to Silty Clay	" "	very stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	medium dense
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	stiff
Clay	CL/CH	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	very stiff
Clay	CL/CH	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clay	CL/CH	very stiff
Silty Clay to Clay	CL	firm
Silty Clay to Clay	" "	firm
Clay	CL/CH	firm
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	medium dense
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff

END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-1

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-1 Est. GWT (ft): 10 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	66.76	0.34	Sand to Silty Sand	SP/SM	very dense	115	12	126.2	10	122	45		
0.30	1.0	77.31	0.84	Sand to Silty Sand	SP/SM	very dense	115	14	146.1	15	110	43		
0.45	1.5	45.03	2.02	Sandy Silt to Clayey Silt	ML	dense	115	13	85.1	40	87	40		
0.60	2.0	24.20	6.09	Clay	CL/CH	very stiff	125	19		85			1.42	>10
0.75	2.5	18.94	4.48	Clay	CL/CH	very stiff	125	15		85			1.11	>10
0.93	3.0	20.33	2.40	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		65			1.19	>10
1.08	3.5	37.13	0.80	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	70.2	30	67	37		
1.23	4.0	25.84	1.87	Sandy Silt to Clayey Silt	ML	medium dense	115	7	48.8	50	54	36		
1.38	4.5	14.48	3.38	Silty Clay to Clay	CL	stiff	125	8		85			0.84	>10
1.53	5.0	12.96	3.76	Silty Clay to Clay	CL	stiff	125	7		90			0.75	>10
1.68	5.5	11.44	2.79	Silty Clay to Clay	CL	stiff	125	7		85			0.65	>10
1.83	6.0	10.32	2.77	Silty Clay to Clay	CL	stiff	125	6		90			0.59	>10
1.98	6.5	10.03	3.62	Clay	CL/CH	stiff	125	8		100			0.57	>10
2.13	7.0	8.71	3.90	Clay	CL/CH	firm	125	7		100			0.49	8.27
2.28	7.5	11.52	5.27	Clay	CL/CH	stiff	125	9		100			0.65	>10
2.45	8.0	10.09	5.21	Clay	CL/CH	stiff	125	8		100			0.57	8.41
2.60	8.5	10.29	4.79	Clay	CL/CH	stiff	125	8		100			0.58	7.70
2.75	9.0	9.45	3.97	Clay	CL/CH	stiff	125	8		100			0.52	6.10
2.90	9.5	10.84	3.79	Clay	CL/CH	stiff	125	9		100			0.60	6.88
3.05	10.0	12.30	3.24	Silty Clay to Clay	CL	stiff	125	7		95			0.69	>10
3.20	10.5	16.84	4.33	Clay	CL/CH	stiff	125	13		95			0.95	>10
3.35	11.0	18.22	5.06	Clay	CL/CH	very stiff	125	15		100			1.03	>10
3.50	11.5	18.11	4.43	Clay	CL/CH	very stiff	125	14		95			1.03	>10
3.65	12.0	17.01	4.34	Clay	CL/CH	stiff	125	14		95			0.96	>10
3.80	12.5	21.24	4.30	Silty Clay to Clay	CL	very stiff	125	12		90			1.21	>10
3.95	13.0	22.73	4.82	Clay	CL/CH	very stiff	125	18		90			1.30	>10
4.13	13.5	24.54	5.57	Clay	CL/CH	very stiff	125	20		95			1.40	>10
4.28	14.0	19.71	5.77	Clay	CL/CH	very stiff	125	16		100			1.12	>10
4.43	14.5	16.50	3.47	Silty Clay to Clay	CL	stiff	125	9		95			0.93	>10
4.58	15.0	18.91	2.91	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		85			1.07	>10
4.73	15.5	16.44	3.49	Silty Clay to Clay	CL	stiff	125	9		100			0.92	>10
4.88	16.0	15.52	5.47	Clay	CL/CH	stiff	125	12		100			0.87	7.27
5.03	16.5	13.25	4.53	Clay	CL/CH	stiff	125	11		100			0.73	5.42
5.18	17.0	11.29	3.87	Clay	CL/CH	stiff	125	9		100			0.62	4.09
5.33	17.5	35.06	2.18	Sandy Silt to Clayey Silt	ML	medium dense	115	10	37.5	60	43	34		
5.48	18.0	35.69	2.15	Sandy Silt to Clayey Silt	ML	medium dense	115	10	37.8	60	44	34		
5.65	18.5	16.67	2.41	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		90			0.93	>10
5.80	19.0	14.74	2.64	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.82	>10
5.95	19.5	14.11	3.16	Silty Clay to Clay	CL	stiff	125	8		100			0.78	6.54
6.10	20.0	16.96	4.10	Silty Clay to Clay	CL	stiff	125	10		100			0.94	8.85
6.25	20.5	12.12	3.72	Silty Clay to Clay	CL	stiff	125	7		100			0.66	4.89
6.40	21.0	16.97	3.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	>10
6.55	21.5	14.08	4.07	Clay	CL/CH	stiff	125	11		100			0.77	4.57
6.70	22.0	13.59	3.65	Silty Clay to Clay	CL	stiff	125	8		100			0.74	5.42
6.85	22.5	18.10	4.60	Clay	CL/CH	very stiff	125	14		100			1.01	6.54
7.00	23.0	22.33	4.96	Clay	CL/CH	very stiff	125	18		100			1.26	9.19
7.18	23.5	18.16	4.56	Clay	CL/CH	very stiff	125	15		100			1.01	6.21
7.33	24.0	17.19	4.26	Clay	CL/CH	stiff	125	14		100			0.95	5.53
7.48	24.5	18.05	4.43	Clay	CL/CH	very stiff	125	14		100			1.00	5.88
7.63	25.0	22.96	4.40	Silty Clay to Clay	CL	very stiff	125	13		100			1.29	>10
7.78	25.5	27.07	5.03	Clay	CL/CH	very stiff	125	22		100			1.53	>10
7.93	26.0	29.55	4.96	Clay	CL/CH	very stiff	125	24		100			1.67	>10
8.08	26.5	24.92	6.01	Clay	CL/CH	very stiff	125	20		100			1.40	9.39
8.23	27.0	23.05	5.28	Clay	CL/CH	very stiff	125	18		100			1.29	7.85
8.38	27.5	25.01	4.97	Clay	CL/CH	very stiff	125	20		100			1.40	8.85
8.53	28.0	24.29	5.93	Clay	CL/CH	very stiff	125	19		100			1.36	8.14
8.68	28.5	18.25	6.30	Clay	CL/CH	very stiff	125	15		100			1.01	5.00
8.85	29.0	13.68	4.41	Clay	CL/CH	stiff	125	11		100			0.74	3.21
9.00	29.5	13.59	2.91	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.73	5.10
9.15	30.0	18.02	3.17	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.99	8.14
9.30	30.5	20.37	3.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.13	>10
9.45	31.0	31.84	2.34	Sandy Silt to Clayey Silt	ML	loose	115	9	27.8	80	35	33		
9.60	31.5	27.02	5.80	Clay	CL/CH	very stiff	125	22		100			1.52	8.56
9.75	32.0	23.80	5.10	Clay	CL/CH	very stiff	125	19		100			1.33	6.65
9.90	32.5	17.62	3.51	Silty Clay to Clay	CL	stiff	125	10		100			0.96	5.10
10.05	33.0	21.18	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.17	9.79
10.20	33.5	31.30	3.65	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		95			1.76	>10
10.38	34.0	35.29	3.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		95			2.00	>10
10.53	34.5	29.03	5.02	Clay	CL/CH	very stiff	125	23		100			1.63	8.56
10.68	35.0	22.53	5.55	Clay	CL/CH	very stiff	125	18		100			1.25	5.42
10.83	35.5	9.95	3.16	Silty Clay to Clay	CL	stiff	125	6		100			0.50	2.00
10.98	36.0	7.44	3.12	Clay	CL/CH	firm	125	6		100			0.36	1.05
11.13	36.5	7.63	2.95	Silty Clay to Clay	CL	firm	125	4		100			0.37	1.25
11.28	37.0	8.57	2.91	Silty Clay to Clay	CL	firm	125	5		100			0.42	1.50
11.43	37.5	8.91	3.27	Silty Clay to Clay	CL	firm	125	5		100			0.44	1.56
11.58	38.0	10.20	4.17	Clay	CL/CH	stiff	125	8		100			0.51	1.50
11.73	38.5	11.98	4.19	Clay	CL/CH	stiff	125	10		100			0.62	1.92

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-1

Est. GWT (ft): 10

Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	14.94	3.40	Silty Clay to Clay	CL	stiff	125	9		100			0.79	3.21
12.05	39.5	14.48	3.13	Silty Clay to Clay	CL	stiff	125	8		100			0.76	3.07
12.20	40.0	27.30	3.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.52	>10
12.35	40.5	53.46	1.94	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	42.0	65	47	**35**		
12.50	41.0	33.02	2.40	Sandy Silt to Clayey Silt	ML	loose	115	9	25.9	90	33	**33**		
12.65	41.5	27.85	3.67	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.55	>10
12.80	42.0	21.87	4.27	Silty Clay to Clay	CL	very stiff	125	12		100			1.19	5.31
12.95	42.5	20.49	4.15	Silty Clay to Clay	CL	very stiff	125	12		100			1.11	4.68
13.10	43.0	20.75	3.52	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.13	6.43
13.25	43.5	20.09	2.40	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.09	6.00
13.40	44.0	20.89	1.58	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.9	100	18	**31**		
13.58	44.5	21.70	1.92	Sandy Silt to Clayey Silt	ML	very loose	115	6	16.5	100	19	**31**		
13.73	45.0	35.38	1.75	Sandy Silt to Clayey Silt	ML	loose	115	10	26.7	80	34	**33**		
13.88	45.5	31.30	3.09	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.74	>10
14.03	46.0	22.93	3.29	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.25	6.88
14.18	46.5	18.77	2.65	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.00	4.89
14.33	47.0	24.96	3.38	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.37	7.85
14.48	47.5	36.41	4.48	Silty Clay to Clay	CL	hard	125	21		100			2.04	>10
14.63	48.0	34.92	4.56	Silty Clay to Clay	CL	very stiff	125	20		100			1.95	>10
14.78	48.5	34.69	3.71	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		100			1.94	>10
14.93	49.0	36.05	4.06	Clayey Silt to Silty Clay	ML/CL	hard	120	14		100			2.02	>10
15.10	49.5	25.75	3.84	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.41	7.70
15.25	50.0	26.04	3.56	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.43	7.70

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

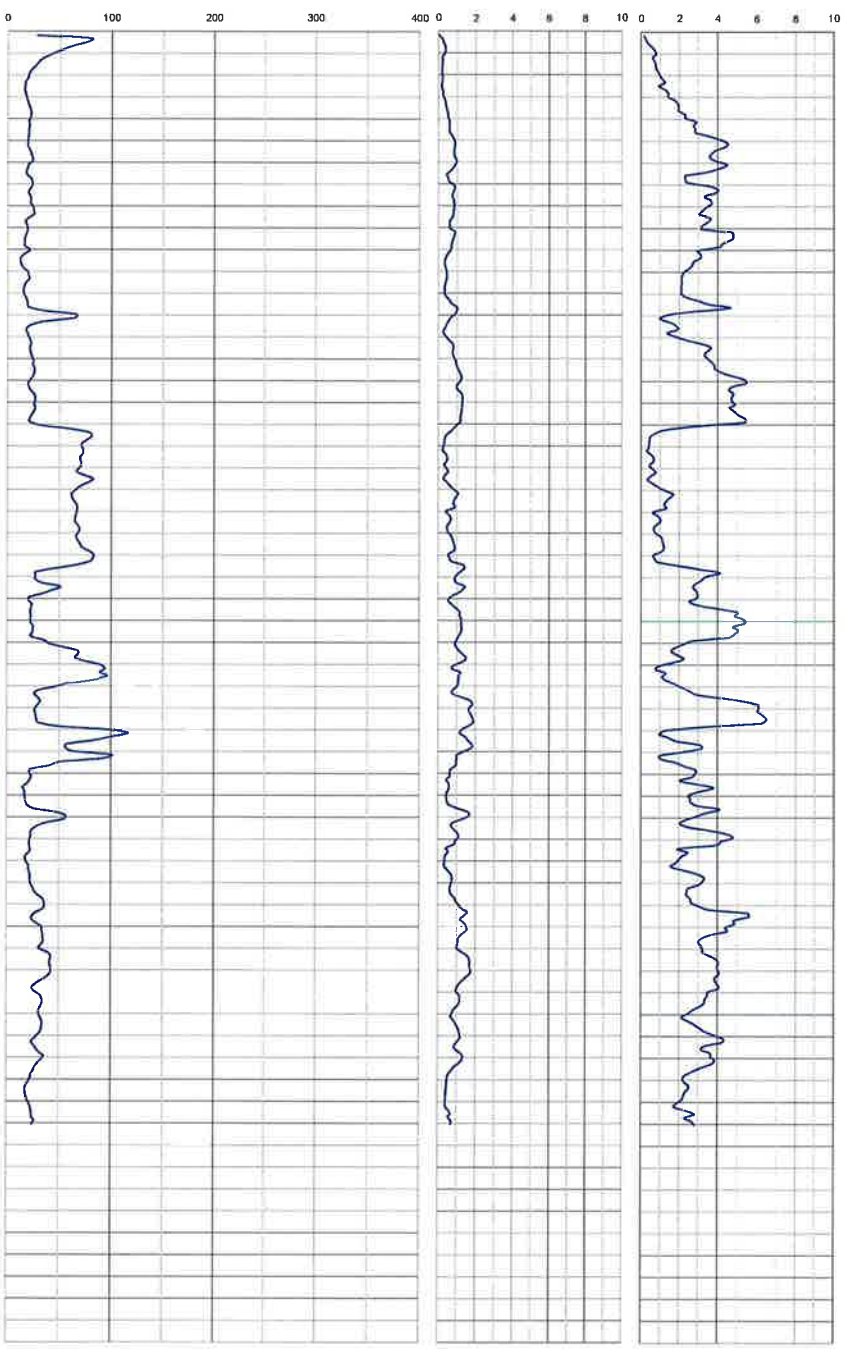
CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/12/2020

CONE SOUNDING DATA CPT-2

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
5	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
10	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
15	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Silty Clay to Clay	CL	very stiff
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	medium dense
20	Sand to Silty Sand	" "	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
25	Sandy Silt to Clayey Silt	" "	loose
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
30	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	hard
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
35	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Sandy Silt to Clayey Silt	ML	loose
40	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	hard
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
45	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
50	Sandy Silt to Clayey Silt	ML	loose
55			



END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-2

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-2

Est. GWT (ft): 12

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	62.40	0.25	Sand to Silty Sand	SP/SM	very dense	115	11	118.0	10	120	45		
0.30	1.0	53.94	0.69	Sand to Silty Sand	SP/SM	very dense	115	10	102.0	20	100	42		
0.45	1.5	32.23	0.69	Silty Sand to Sandy Silt	SM/ML	dense	115	7	60.9	30	77	39		
0.60	2.0	22.63	0.89	Silty Sand to Sandy Silt	SM/ML	medium dense	115	5	42.8	40	62	37		
0.75	2.5	17.94	1.10	Sandy Silt to Clayey Silt	ML	medium dense	115	5	33.9	50	51	35		
0.93	3.0	17.19	1.37	Sandy Silt to Clayey Silt	ML	medium dense	115	5	32.5	55	47	35		
1.08	3.5	20.01	1.89	Sandy Silt to Clayey Silt	ML	medium dense	115	6	37.8	60	49	35		
1.23	4.0	22.28	2.21	Sandy Silt to Clayey Silt	ML	medium dense	115	6	42.1	60	50	35		
1.38	4.5	20.85	2.82	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		65			1.21	>10
1.53	5.0	20.19	3.50	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		75			1.17	>10
1.68	5.5	20.75	4.13	Silty Clay to Clay	CL	very stiff	125	12		80			1.20	>10
1.83	6.0	22.86	4.00	Silty Clay to Clay	CL	very stiff	125	13		75			1.32	>10
1.98	6.5	18.83	3.31	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		75			1.09	>10
2.13	7.0	23.44	2.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		65			1.36	>10
2.28	7.5	21.25	3.72	Silty Clay to Clay	CL	very stiff	125	12		75			1.22	>10
2.45	8.0	23.29	3.55	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		70			1.34	>10
2.60	8.5	23.69	3.28	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		65			1.36	>10
2.75	9.0	18.52	3.29	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		75			1.06	>10
2.90	9.5	17.54	4.72	Clay	CL/CH	stiff	125	14		90			1.00	>10
3.05	10.0	18.37	3.77	Silty Clay to Clay	CL	very stiff	125	10		85			1.05	>10
3.20	10.5	13.94	2.99	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		90			0.78	>10
3.35	11.0	15.84	2.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.89	>10
3.50	11.5	19.75	2.12	Sandy Silt to Clayey Silt	ML	loose	115	6	23.5	70	30	32		
3.65	12.0	15.70	2.10	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.88	>10
3.80	12.5	18.46	2.96	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		85			1.04	>10
3.95	13.0	40.95	2.90	Sandy Silt to Clayey Silt	ML	medium dense	115	12	46.7	60	50	35		
4.13	13.5	40.86	1.44	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	46.1	45	50	35		
4.28	14.0	19.18	1.70	Sandy Silt to Clayey Silt	ML	loose	115	5	21.5	70	27	32		
4.43	14.5	22.08	3.05	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		80			1.25	>10
4.58	15.0	22.89	3.41	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		85			1.30	>10
4.73	15.5	25.30	3.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		85			1.44	>10
4.88	16.0	23.57	4.91	Clay	CL/CH	very stiff	125	19		95			1.34	>10
5.03	16.5	22.51	4.71	Clay	CL/CH	very stiff	125	18		100			1.28	>10
5.18	17.0	26.54	4.77	Clay	CL/CH	very stiff	125	21		95			1.51	>10
5.33	17.5	25.33	4.79	Clay	CL/CH	very stiff	125	20		95			1.44	>10
5.48	18.0	25.31	4.55	Silty Clay to Clay	CL	very stiff	125	14		95			1.44	>10
5.65	18.5	73.72	0.84	Sand to Silty Sand	SP/SM	medium dense	115	13	76.0	25	64	37		
5.80	19.0	73.74	0.41	Sand to Silty Sand	SP/SM	medium dense	115	13	75.5	20	64	37		
5.95	19.5	72.23	0.50	Sand to Silty Sand	SP/SM	medium dense	115	13	73.4	20	63	37		
6.10	20.0	70.38	0.56	Sand to Silty Sand	SP/SM	medium dense	115	13	71.0	25	62	37		
6.25	20.5	74.87	0.53	Sand to Silty Sand	SP/SM	medium dense	115	14	75.0	20	64	37		
6.40	21.0	71.25	0.92	Sand to Silty Sand	SP/SM	medium dense	115	13	70.9	30	62	37		
6.55	21.5	62.58	1.50	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	61.8	40	58	36		
6.70	22.0	66.91	1.05	Sand to Silty Sand	SP/SM	medium dense	115	12	65.7	35	60	36		
6.85	22.5	65.46	0.94	Sand to Silty Sand	SP/SM	medium dense	115	12	63.8	35	59	36		
7.00	23.0	68.64	0.72	Sand to Silty Sand	SP/SM	medium dense	115	12	66.5	30	60	36		
7.18	23.5	67.83	1.11	Sand to Silty Sand	SP/SM	medium dense	115	12	65.3	35	60	36		
7.33	24.0	77.58	0.98	Sand to Silty Sand	SP/SM	medium dense	115	14	74.2	30	64	37		
7.48	24.5	76.45	1.18	Sand to Silty Sand	SP/SM	medium dense	115	14	72.6	35	63	37		
7.63	25.0	33.48	3.53	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		85			1.91	>10
7.78	25.5	37.32	2.92	Sandy Silt to Clayey Silt	ML	medium dense	115	11	35.0	75	41	34		
7.93	26.0	33.13	2.92	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		80			1.88	>10
8.08	26.5	22.73	3.61	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.27	>10
8.23	27.0	22.83	5.16	Clay	CL/CH	very stiff	125	18		100			1.28	7.70
8.38	27.5	24.73	4.87	Clay	CL/CH	very stiff	125	20		100			1.39	8.70
8.53	28.0	33.15	3.14	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		85			1.88	>10
8.68	28.5	63.89	1.75	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	57.6	50	56	36		
8.85	29.0	78.33	1.62	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	70.2	45	62	37		
9.00	29.5	93.62	1.06	Sand to Silty Sand	SP/SM	medium dense	115	17	83.5	30	67	37		
9.15	30.0	62.45	1.73	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	55.4	50	55	36		
9.30	30.5	28.81	3.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		90			1.62	>10
9.45	31.0	29.70	5.84	Clay	CL/CH	very stiff	125	24		100			1.67	>10
9.60	31.5	27.79	6.27	Clay	CL/CH	very stiff	125	22		100			1.56	9.00
9.75	32.0	58.11	3.62	Clayey Silt to Silty Clay	ML/CL	hard	120	23		70			3.34	>10
9.90	32.5	100.29	1.43	Sand to Silty Sand	SP/SM	medium dense	115	18	86.4	35	68	38		
10.05	33.0	58.89	2.82	Sandy Silt to Clayey Silt	ML	medium dense	115	17	50.4	65	52	35		
10.20	33.5	82.12	1.31	Sand to Silty Sand	SP/SM	medium dense	115	15	70.0	40	62	37		
10.38	34.0	29.13	2.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		90			1.64	>10
10.53	34.5	21.91	2.54	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.21	>10
10.68	35.0	16.54	3.14	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.89	5.88
10.83	35.5	18.75	2.70	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	7.13
10.98	36.0	43.05	3.47	Clayey Silt to Silty Clay	ML/CL	hard	120	17		85			2.45	>10
11.13	36.5	36.12	2.63	Sandy Silt to Clayey Silt	ML	loose	115	10	29.8	85	37	33		
11.28	37.0	22.63	4.48	Clay	CL/CH	very stiff	125	18		100			1.25	5.21
11.43	37.5	22.20	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	9.00
11.58	38.0	18.58	1.99	Sandy Silt to Clayey Silt	ML	very loose	115	5	15.1	100	17	30		
11.73	38.5	21.51	2.23	Sandy Silt to Clayey Silt	ML	loose	115	6	17.4	100	21	31		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-2 | Est. GWT (ft): 12 | Phi Correlation: 0 (0-Schm(78),1-R&C(83),2-PHT(74))

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	22.75	3.19	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.25	8.85
12.05	39.5	27.09	2.42	Sandy Silt to Clayey Silt	ML	loose	115	8	21.7	95	27	32		
12.20	40.0	35.65	2.75	Sandy Silt to Clayey Silt	ML	loose	115	10	28.5	90	35	33		
12.35	40.5	29.27	4.88	Clay	CL/CH	very stiff	125	23		100			1.63	7.13
12.50	41.0	29.18	4.70	Silty Clay to Clay	CL	very stiff	125	17		100			1.63	9.39
12.65	41.5	34.68	3.75	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		100			1.95	>10
12.80	42.0	33.35	3.10	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		95			1.87	>10
12.95	42.5	41.12	3.60	Clayey Silt to Silty Clay	ML/CL	hard	120	16		90			2.33	>10
13.10	43.0	42.07	4.02	Clayey Silt to Silty Clay	ML/CL	hard	120	17		95			2.38	>10
13.25	43.5	37.78	3.94	Clayey Silt to Silty Clay	ML/CL	hard	120	15		100			2.13	>10
13.40	44.0	26.62	3.85	Silty Clay to Clay	CL	very stiff	125	15		100			1.47	7.00
13.58	44.5	33.70	3.38	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.89	>10
13.73	45.0	32.03	2.75	Sandy Silt to Clayey Silt	ML	loose	115	9	24.4	95	31	32		
13.88	45.5	33.41	2.45	Sandy Silt to Clayey Silt	ML	loose	115	10	25.3	90	32	32		
14.03	46.0	32.55	3.41	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.82	>10
14.18	46.5	25.96	3.97	Silty Clay to Clay	CL	very stiff	125	15		100			1.43	6.32
14.33	47.0	32.35	3.58	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.80	>10
14.48	47.5	28.03	3.22	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.55	>10
14.63	48.0	22.95	2.28	Sandy Silt to Clayey Silt	ML	loose	115	7	17.0	100	20	31		
14.78	48.5	18.66	2.42	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			1.00	4.68
14.93	49.0	20.24	2.08	Sandy Silt to Clayey Silt	ML	very loose	115	6	14.9	100	16	30		
15.10	49.5	23.78	2.29	Sandy Silt to Clayey Silt	ML	loose	115	7	17.4	100	21	31		
15.25	50.0	25.39	2.57	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.39	7.56

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/12/2020

CONE SOUNDING DATA CPT-3

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Sand to Silty Sand	" "	very dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
5	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
10	Clayey Silt to Silty Clay	" "	stiff
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	loose
	Sand to Silty Sand	SP/SM	dense
15	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand	SP	very dense
	Sand to Silty Sand	SP/SM	very dense
	Sand to Silty Sand	" "	dense
20	Sand to Silty Sand	" "	medium dense
	Sand	SP	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
25	Sand	" "	dense
	Sand	" "	dense
	Sand	" "	very dense
	Sand	" "	dense
	Sand	" "	dense
30	Sand	" "	dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand to Silty Sand	SP/SM	dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
35	Silty Sand to Sandy Silt	" "	medium dense
	Sand	SP	very dense
	Sand	" "	very dense
	Sand	" "	dense
	Sand	" "	dense
40	Sand	" "	very dense
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	dense
	Sand	" "	dense
	Sand	" "	dense
45	Sand	" "	dense
	Sand	" "	dense
	Sand	" "	dense
	Sand	" "	very dense
	Sand	" "	very dense
50			
55			

END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-3

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-3

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	31.60	0.32	Silty Sand to Sandy Silt	SM/ML	very dense	115	7	59.7	20	100	42		
0.30	1.0	75.96	0.74	Sand to Silty Sand	SP/SM	very dense	115	14	143.6	15	110	43		
0.45	1.5	68.72	0.88	Sand to Silty Sand	SP/SM	very dense	115	12	129.9	20	99	42		
0.60	2.0	47.62	1.04	Silty Sand to Sandy Silt	SM/ML	dense	115	11	90.0	25	84	40		
0.75	2.5	33.67	2.30	Sandy Silt to Clayey Silt	ML	medium dense	115	10	63.6	50	70	38		
0.93	3.0	25.42	3.69	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		70			1.49	>10
1.08	3.5	19.67	3.73	Silty Clay to Clay	CL	very stiff	125	11		75			1.15	>10
1.23	4.0	17.14	3.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		75			1.00	>10
1.38	4.5	16.68	2.40	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		70			0.97	>10
1.53	5.0	15.58	1.98	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		65			0.90	>10
1.68	5.5	18.46	3.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		75			1.07	>10
1.83	6.0	23.95	4.32	Silty Clay to Clay	CL	very stiff	125	14		75			1.39	>10
1.98	6.5	21.22	4.90	Clay	CL/CH	very stiff	125	17		80			1.23	>10
2.13	7.0	17.94	4.38	Clay	CL/CH	very stiff	125	14		85			1.03	>10
2.28	7.5	31.60	3.19	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		60			1.83	>10
2.45	8.0	35.20	2.43	Sandy Silt to Clayey Silt	ML	medium dense	115	10	50.3	50	52	35		
2.60	8.5	36.83	1.43	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	51.9	35	53	35		
2.75	9.0	37.29	0.74	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	51.8	25	53	35		
2.90	9.5	17.22	2.53	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		70			0.98	>10
3.05	10.0	18.49	1.99	Sandy Silt to Clayey Silt	ML	loose	115	5	25.0	65	32	32		
3.20	10.5	12.48	2.44	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.70	>10
3.35	11.0	21.28	2.08	Sandy Silt to Clayey Silt	ML	loose	115	6	28.0	60	35	33		
3.50	11.5	17.86	2.75	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		75			1.02	>10
3.65	12.0	12.85	4.46	Clay	CL/CH	stiff	125	10		100			0.72	9.19
3.80	12.5	12.13	3.44	Silty Clay to Clay	CL	stiff	125	7		100			0.68	>10
3.95	13.0	10.21	2.43	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.56	>10
4.13	13.5	11.33	2.77	Silty Clay to Clay	CL	stiff	125	6		100			0.63	8.41
4.28	14.0	26.19	1.43	Sandy Silt to Clayey Silt	ML	loose	115	7	32.0	55	39	33		
4.43	14.5	64.18	0.69	Sand to Silty Sand	SP/SM	medium dense	115	12	77.6	20	65	37		
4.58	15.0	114.67	0.67	Sand	SP	dense	110	18	137.3	10	82	39		
4.73	15.5	127.64	0.69	Sand	SP	dense	110	20	151.5	10	85	40		
4.88	16.0	75.24	1.25	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	88.5	30	69	38		
5.03	16.5	67.72	0.98	Sand to Silty Sand	SP/SM	medium dense	115	12	78.9	25	65	37		
5.18	17.0	128.59	0.67	Sand	SP	dense	110	20	148.4	10	84	40		
5.33	17.5	187.65	0.88	Sand	SP	very dense	110	29	214.8	10	95	41		
5.48	18.0	249.90	0.96	Sand	SP	very dense	110	38	283.8	10	103	42		
5.65	18.5	225.60	1.13	Sand	SP	very dense	110	35	254.1	10	100	42		
5.80	19.0	118.72	1.49	Sand to Silty Sand	SP/SM	dense	115	22	132.6	25	81	39		
5.95	19.5	86.20	0.87	Sand to Silty Sand	SP/SM	dense	115	16	95.5	20	71	38		
6.10	20.0	96.71	0.59	Sand	SP	dense	110	15	106.3	15	74	38		
6.25	20.5	78.44	0.88	Sand to Silty Sand	SP/SM	medium dense	115	14	85.5	25	68	37		
6.40	21.0	72.17	1.22	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	78.0	30	65	37		
6.55	21.5	171.98	0.64	Sand	SP	very dense	110	26	184.5	10	91	41		
6.70	22.0	242.11	0.86	Sand	SP	very dense	110	37	257.9	10	100	42		
6.85	22.5	276.70	0.90	Sand	SP	very dense	110	43	292.6	10	104	43		
7.00	23.0	238.88	1.00	Sand	SP	very dense	110	37	250.9	10	100	42		
7.18	23.5	206.74	0.97	Sand	SP	very dense	110	32	215.6	15	95	41		
7.33	24.0	207.02	0.85	Sand	SP	very dense	110	32	214.5	10	95	41		
7.48	24.5	212.05	0.97	Sand	SP	very dense	110	33	218.2	15	96	41		
7.63	25.0	187.30	1.10	Sand	SP	very dense	110	29	191.5	15	92	41		
7.78	25.5	174.56	0.98	Sand	SP	dense	110	27	177.3	15	89	41		
7.93	26.0	176.59	0.79	Sand	SP	dense	110	27	178.2	15	90	41		
8.08	26.5	164.72	0.99	Sand	SP	dense	110	25	165.1	15	87	40		
8.23	27.0	175.28	0.85	Sand	SP	dense	110	27	174.6	15	89	40		
8.38	27.5	213.87	0.98	Sand	SP	very dense	110	33	211.8	15	95	41		
8.53	28.0	190.72	1.20	Sand	SP	very dense	110	29	187.7	20	91	41		
8.68	28.5	156.88	1.00	Sand	SP	dense	110	24	153.5	20	85	40		
8.85	29.0	128.70	1.01	Sand to Silty Sand	SP/SM	dense	115	23	125.1	20	79	39		
9.00	29.5	111.97	0.92	Sand to Silty Sand	SP/SM	dense	115	20	108.1	25	75	38		
9.15	30.0	131.06	0.77	Sand	SP	dense	110	20	125.8	20	79	39		
9.30	30.5	140.58	0.92	Sand	SP	dense	110	22	134.1	20	81	39		
9.45	31.0	145.36	0.88	Sand	SP	dense	110	22	137.9	20	82	39		
9.60	31.5	177.12	0.77	Sand	SP	dense	110	27	167.1	15	88	40		
9.75	32.0	213.11	0.75	Sand	SP	very dense	110	33	199.9	10	93	41		
9.90	32.5	208.55	0.97	Sand	SP	very dense	110	32	194.6	15	92	41		
10.05	33.0	202.31	0.92	Sand	SP	very dense	110	31	187.7	15	91	41		
10.20	33.5	240.75	0.83	Sand	SP	very dense	110	37	222.2	10	96	41		
10.38	34.0	144.06	1.95	Silty Sand to Sandy Silt	SM/ML	dense	115	32	132.2	35	81	39		
10.53	34.5	46.35	2.48	Sandy Silt to Clayey Silt	ML	medium dense	115	13	42.3	65	47	35		
10.68	35.0	58.79	1.70	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	53.3	50	54	36		
10.83	35.5	53.74	2.61	Sandy Silt to Clayey Silt	ML	medium dense	115	15	48.5	65	51	35		
10.98	36.0	88.19	1.87	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	79.1	45	66	37		
11.13	36.5	198.55	0.71	Sand	SP	dense	110	31	177.2	15	89	41		
11.28	37.0	283.08	0.93	Sand	SP	very dense	110	44	251.3	10	100	42		
11.43	37.5	239.57	1.20	Sand	SP	very dense	110	37	211.7	20	95	41		
11.58	38.0	198.43	0.91	Sand	SP	dense	110	31	174.5	15	89	40		
11.73	38.5	204.44	0.88	Sand	SP	dense	110	31	178.9	15	90	41		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-3

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	197.08	0.91	Sand	SP	dense	110	30	171.6	15	88	40		
12.05	39.5	208.90	0.92	Sand	SP	very dense	110	32	181.0	15	90	41		
12.20	40.0	205.59	0.98	Sand	SP	dense	110	32	177.3	20	89	41		
12.35	40.5	240.18	0.93	Sand	SP	very dense	110	37	206.2	15	94	41		
12.50	41.0	197.77	1.19	Sand	SP	dense	110	30	169.0	20	88	40		
12.65	41.5	117.11	1.06	Sand to Silty Sand	SP/SM	dense	115	21	99.6	30	72	38		
12.80	42.0	110.44	0.62	Sand	SP	dense	110	17	93.5	25	70	38		
12.95	42.5	117.29	0.77	Sand	SP	dense	110	18	98.8	25	72	38		
13.10	43.0	160.22	0.72	Sand	SP	dense	110	25	134.4	20	81	39		
13.25	43.5	185.03	0.91	Sand	SP	dense	110	28	154.5	20	85	40		
13.40	44.0	182.01	0.80	Sand	SP	dense	110	28	151.4	20	85	40		
13.58	44.5	218.79	0.76	Sand	SP	very dense	110	34	181.2	15	90	41		
13.73	45.0	180.66	0.92	Sand	SP	dense	110	28	148.9	20	84	40		
13.88	45.5	136.26	0.77	Sand	SP	dense	110	21	111.9	25	76	39		
14.03	46.0	165.91	0.44	Sand	SP	dense	110	26	135.6	15	81	39		
14.18	46.5	228.91	0.79	Sand	SP	very dense	110	35	186.3	15	91	41		
14.33	47.0	170.09	0.83	Sand	SP	dense	110	26	137.9	20	82	39		
14.48	47.5	176.69	0.79	Sand	SP	dense	110	27	142.6	20	83	40		
14.63	48.0	211.34	0.81	Sand	SP	dense	110	33	169.9	15	88	40		
14.78	48.5	247.74	0.80	Sand	SP	very dense	110	38	198.4	15	93	41		
14.93	49.0	293.57	0.76	Sand	SP	very dense	110	45	234.1	10	98	42		
15.10	49.5	306.21	0.88	Sand	SP	very dense	110	47	243.3	15	99	42		
15.25	50.0	283.02	0.68	Sand	SP	very dense	110	44	223.9	10	96	41		

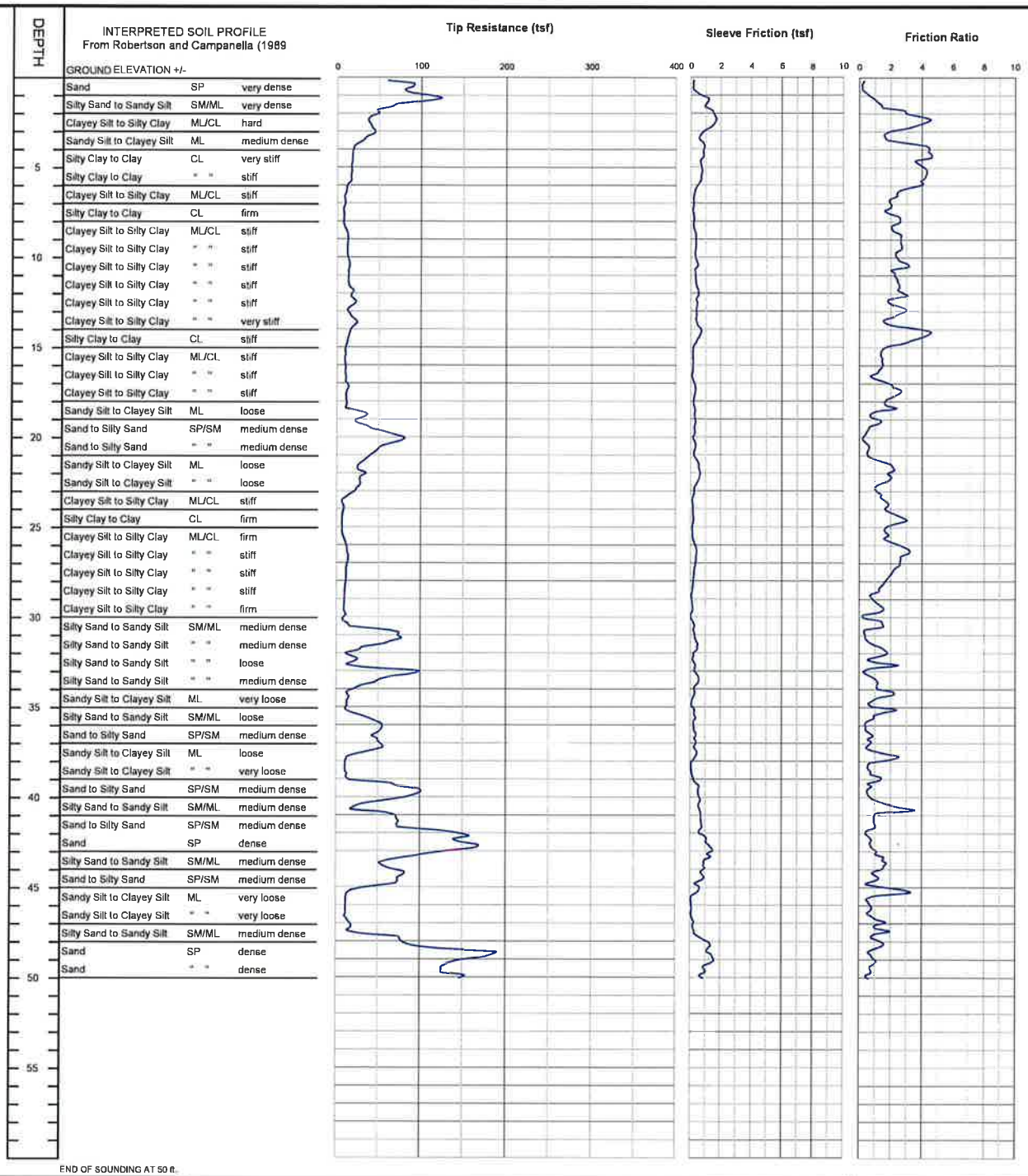
CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/12/2020

CONE SOUNDING DATA CPT-4



Sand	SP	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Clayey Silt to Silty Clay	ML/CL	hard
Sandy Silt to Clayey Silt	ML	medium dense
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Clay to Clay	CL	firm
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	loose
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	medium dense
Sandy Silt to Clayey Silt	ML	loose
Sandy Silt to Clayey Silt	" "	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Clay to Clay	CL	firm
Clayey Silt to Silty Clay	ML/CL	firm
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	firm
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	loose
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	very loose
Silty Sand to Sandy Silt	SM/ML	loose
Sand to Silty Sand	SP/SM	medium dense
Sandy Silt to Clayey Silt	ML	loose
Sandy Silt to Clayey Silt	" "	very loose
Sand to Silty Sand	SP/SM	medium dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sand	SP	dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand	SP	dense
Sand	" "	dense

END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-4

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-4

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: 17 Phi (deg.)	Su (tsf)	OCR
0.15	0.5	80.88	0.22	Sand	SP	very dense	110	12	152.9	5	129	46		
0.30	1.0	92.52	0.42	Sand	SP	very dense	110	14	174.9	5	116	44		
0.45	1.5	99.93	1.15	Sand to Silty Sand	SP/SM	very dense	115	18	188.9	15	111	44		
0.60	2.0	54.19	2.45	Sandy Silt to Clayey Silt	ML	dense	115	15	102.4	40	88	40		
0.75	2.5	38.91	4.23	Silty Clay to Clay	CL	hard	125	22		60			2.28	>10
0.93	3.0	42.55	2.92	Sandy Silt to Clayey Silt	ML	dense	115	12	80.4	50	74	38		
1.08	3.5	37.21	1.68	Sandy Silt to Clayey Silt	ML	medium dense	115	11	70.3	40	67	37		
1.23	4.0	22.32	3.91	Silty Clay to Clay	CL	very stiff	125	13		75			1.30	>10
1.38	4.5	18.24	4.54	Clay	CL/CH	very stiff	125	15		85			1.06	>10
1.53	5.0	17.41	3.80	Silty Clay to Clay	CL	very stiff	125	10		80			1.01	>10
1.68	5.5	16.75	4.24	Clay	CL/CH	stiff	125	13		85			0.97	>10
1.83	6.0	13.67	3.78	Silty Clay to Clay	CL	stiff	125	8		90			0.78	>10
1.98	6.5	10.08	2.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		90			0.57	>10
2.13	7.0	9.22	1.98	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.52	>10
2.28	7.5	7.87	1.84	Clayey Silt to Silty Clay	ML/CL	firm	120	3		90			0.44	>10
2.45	8.0	7.85	2.55	Silty Clay to Clay	CL	firm	125	4		100			0.43	7.27
2.60	8.5	9.77	2.11	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.55	>10
2.75	9.0	12.76	2.64	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.72	>10
2.90	9.5	12.30	2.67	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.69	>10
3.05	10.0	12.50	2.36	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.70	>10
3.20	10.5	14.45	2.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.82	>10
3.35	11.0	13.50	2.17	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.76	>10
3.50	11.5	13.49	2.45	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.76	>10
3.65	12.0	17.58	2.62	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		75			1.00	>10
3.80	12.5	19.60	2.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.12	>10
3.95	13.0	15.20	2.64	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.86	>10
4.13	13.5	18.13	2.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		70			1.03	>10
4.28	14.0	20.54	2.52	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		75			1.17	>10
4.43	14.5	14.45	4.29	Clay	CL/CH	stiff	125	12		100			0.81	9.00
4.58	15.0	11.64	2.61	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.65	>10
4.73	15.5	9.91	1.39	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		90			0.54	7.85
4.88	16.0	9.76	1.45	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		95			0.53	7.27
5.03	16.5	10.06	1.02	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.55	7.41
5.18	17.0	11.43	1.58	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.63	9.19
5.33	17.5	12.18	2.44	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.67	>10
5.48	18.0	11.06	1.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		95			0.61	8.00
5.65	18.5	16.29	1.71	Sandy Silt to Clayey Silt	ML	loose	115	5	18.1	80	22	31		
5.80	19.0	30.74	0.94	Silty Sand to Sandy Silt	SM/ML	medium dense	115	7	33.8	45	40	34		
5.95	19.5	34.62	0.84	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	37.8	40	44	34		
6.10	20.0	69.25	0.33	Sand to Silty Sand	SP/SM	medium dense	115	13	75.0	15	64	37		
6.25	20.5	64.33	0.46	Sand to Silty Sand	SP/SM	medium dense	115	12	69.1	20	62	37		
6.40	21.0	44.65	0.53	Sand to Silty Sand	SP/SM	medium dense	115	8	47.6	30	51	35		
6.55	21.5	31.32	1.43	Sandy Silt to Clayey Silt	ML	loose	115	9	33.1	55	40	34		
6.70	22.0	28.65	2.05	Sandy Silt to Clayey Silt	ML	loose	115	8	30.1	70	37	33		
6.85	22.5	28.13	1.88	Sandy Silt to Clayey Silt	ML	loose	115	8	29.3	65	36	33		
7.00	23.0	24.62	1.09	Sandy Silt to Clayey Silt	ML	loose	115	7	25.4	60	32	32		
7.18	23.5	11.64	1.40	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.63	6.32
7.33	24.0	7.64	1.75	Clayey Silt to Silty Clay	ML/CL	firm	120	3		100			0.40	3.21
7.48	24.5	6.84	2.33	Silty Clay to Clay	CL	firm	125	4		100			0.35	2.00
7.63	25.0	6.22	2.37	Silty Clay to Clay	CL	firm	125	4		100			0.31	1.70
7.78	25.5	6.69	1.72	Silty Clay to Clay	CL	firm	125	4		100			0.34	1.84
7.93	26.0	9.73	1.95	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.51	4.09
8.08	26.5	12.65	2.97	Silty Clay to Clay	CL	stiff	125	7		100			0.69	4.57
8.23	27.0	12.93	2.60	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.70	6.32
8.38	27.5	11.40	2.15	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	5.00
8.53	28.0	11.18	1.73	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.60	4.68
8.68	28.5	10.03	1.32	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.53	3.83
8.85	29.0	9.54	0.80	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.50	3.50
9.00	29.5	9.02	1.36	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.47	3.21
9.15	30.0	9.48	0.61	Sensitive fine grained	ML	firm	120	5		100			0.49	3.91
9.30	30.5	12.73	1.45	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	5.21
9.45	31.0	66.92	0.35	Sand to Silty Sand	SP/SM	medium dense	115	12	61.5	25	58	36		
9.60	31.5	65.66	0.62	Sand to Silty Sand	SP/SM	medium dense	115	12	60.0	30	57	36		
9.75	32.0	23.22	1.61	Sandy Silt to Clayey Silt	ML	loose	115	7	21.1	80	27	32		
9.90	32.5	20.89	0.94	Sandy Silt to Clayey Silt	ML	loose	115	6	18.9	75	23	31		
10.05	33.0	49.85	1.18	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	44.8	50	49	35		
10.20	33.5	69.27	0.78	Sand to Silty Sand	SP/SM	medium dense	115	13	61.9	35	58	36		
10.38	34.0	32.44	1.15	Silty Sand to Sandy Silt	SM/ML	loose	115	7	28.8	60	36	33		
10.53	34.5	13.86	1.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.74	5.21
10.68	35.0	12.52	0.76	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.0	95	7	29		
10.83	35.5	18.33	1.62	Sandy Silt to Clayey Silt	ML	very loose	115	5	16.0	95	18	31		
10.98	36.0	46.23	0.60	Sand to Silty Sand	SP/SM	medium dense	115	8	40.2	40	46	34		
11.13	36.5	50.06	0.60	Sand to Silty Sand	SP/SM	medium dense	115	9	43.3	40	48	35		
11.28	37.0	51.18	0.64	Sand to Silty Sand	SP/SM	medium dense	115	9	44.0	40	48	35		
11.43	37.5	41.52	1.01	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	35.5	55	42	34		
11.58	38.0	12.30	1.73	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.65	3.74
11.73	38.5	10.62	0.62	Sandy Silt to Clayey Silt	ML	very loose	115	3	9.0	100	1	28		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/12/2020

CONE SOUNDING: CPT-4

Est. GWT (ft): 8

Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	13.73	1.14	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.6	100	9	29		
12.05	39.5	78.06	0.63	Sand to Silty Sand	SP/SM	medium dense	115	14	65.4	30	60	36		
12.20	40.0	91.60	0.62	Sand to Silty Sand	SP/SM	medium dense	115	17	76.4	25	65	37		
12.35	40.5	37.01	1.82	Sandy Silt to Clayey Silt	ML	loose	115	11	30.7	70	38	33		
12.50	41.0	49.16	1.89	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	40.6	65	46	34		
12.65	41.5	72.86	0.99	Sand to Silty Sand	SP/SM	medium dense	115	13	59.9	40	57	36		
12.80	42.0	112.72	0.66	Sand	SP	dense	110	17	92.3	25	70	38		
12.95	42.5	148.63	0.70	Sand	SP	dense	110	23	121.2	20	78	39		
13.10	43.0	155.33	0.90	Sand	SP	dense	110	24	126.1	25	79	39		
13.25	43.5	86.00	1.37	Sand to Silty Sand	SP/SM	medium dense	115	16	69.5	40	62	37		
13.40	44.0	57.66	1.60	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	46.4	55	50	35		
13.58	44.5	78.61	1.04	Sand to Silty Sand	SP/SM	medium dense	115	14	63.0	40	59	36		
13.73	45.0	62.55	0.93	Sand to Silty Sand	SP/SM	medium dense	115	11	49.9	45	52	35		
13.88	45.5	16.06	2.37	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.86	4.68
14.03	46.0	11.81	0.58	Sandy Silt to Clayey Silt	ML	very loose	115	3	9.3	100	2	28		
14.18	46.5	11.73	0.68	Sandy Silt to Clayey Silt	ML	very loose	115	3	9.2	100	2	28		
14.33	47.0	14.29	1.16	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.2	100	8	29		
14.48	47.5	20.71	1.33	Sandy Silt to Clayey Silt	ML	very loose	115	6	16.2	95	19	31		
14.63	48.0	77.38	1.17	Sand to Silty Sand	SP/SM	medium dense	115	14	60.1	45	57	36		
14.78	48.5	134.38	1.01	Sand to Silty Sand	SP/SM	dense	115	24	104.0	30	74	38		
14.93	49.0	166.27	0.92	Sand	SP	dense	110	26	128.1	25	80	39		
15.10	49.5	128.02	0.82	Sand	SP	dense	110	20	98.3	30	72	38		
15.25	50.0	141.71	0.60	Sand	SP	dense	110	22	108.4	20	75	38		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

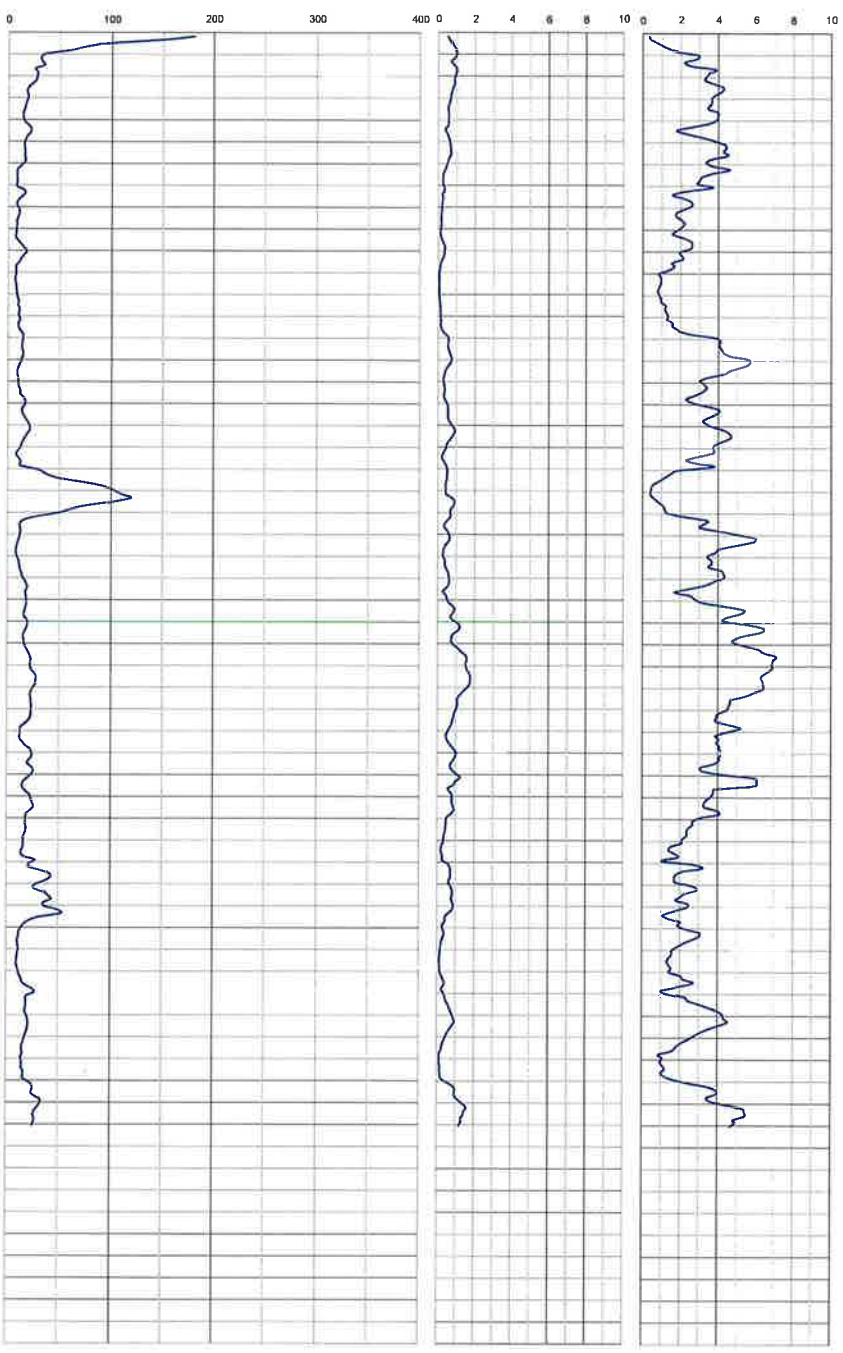
LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-5

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	stiff
5	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	stiff
	Clay	CL/CH	firm
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
10	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sensitive fine grained	ML	firm
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
15	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Clay to Clay	CL	stiff
	Clay	CL/CH	stiff
20	Clayey Silt to Silty Clay	ML/CL	stiff
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	medium dense
	Silty Clay to Clay	CL	stiff
	Clay	CL/CH	firm
25	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
30	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
35	Clay	CL/CH	stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	very loose
	Sandy Silt to Clayey Silt	" "	loose
40	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	very loose
45	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	very stiff
	Sandy Silt to Clayey Silt	ML	very loose
	Sandy Silt to Clayey Silt	" "	very loose
	Clayey Silt to Silty Clay	ML/CL	very stiff
50	Clay	CL/CH	very stiff
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-5

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-5
Est. GWT (ft): 11
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	141.45	0.51	Sand	SP	very dense	110	22	267.4	5	145	48		
0.30	1.0	55.31	1.93	Silty Sand to Sandy Silt	SM/ML	very dense	115	12	104.5	35	101	42		
0.45	1.5	32.97	2.55	Sandy Silt to Clayey Silt	ML	dense	115	9	62.3	50	78	39		
0.60	2.0	27.23	3.61	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		65			1.60	>10
0.75	2.5	23.73	3.78	Silty Clay to Clay	CL	very stiff	125	14		70			1.39	>10
0.93	3.0	18.64	3.94	Silty Clay to Clay	CL	very stiff	125	11		80			1.09	>10
1.08	3.5	16.85	3.58	Silty Clay to Clay	CL	stiff	125	10		80			0.98	>10
1.23	4.0	14.64	3.97	Silty Clay to Clay	CL	stiff	125	8		90			0.85	>10
1.38	4.5	19.50	2.68	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		65			1.13	>10
1.53	5.0	18.46	3.09	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		75			1.07	>10
1.68	5.5	15.79	4.39	Clay	CL/CH	stiff	125	13		90			0.91	>10
1.83	6.0	15.10	3.59	Silty Clay to Clay	CL	stiff	125	9		85			0.87	>10
1.98	6.5	8.72	3.84	Clay	CL/CH	firm	125	7		100			0.49	9.79
2.13	7.0	8.77	3.23	Silty Clay to Clay	CL	firm	125	5		100			0.49	>10
2.28	7.5	14.64	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		70			0.84	>10
2.45	8.0	9.43	2.47	Silty Clay to Clay	CL	stiff	125	5		90			0.53	>10
2.60	8.5	10.01	1.87	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.56	>10
2.75	9.0	8.26	2.03	Clayey Silt to Silty Clay	ML/CL	firm	120	3		95			0.45	8.85
2.90	9.5	8.23	2.07	Clayey Silt to Silty Clay	ML/CL	firm	120	3		100			0.45	8.00
3.05	10.0	15.24	2.38	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.86	>10
3.20	10.5	13.00	1.91	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.73	>10
3.35	11.0	7.80	1.32	Clayey Silt to Silty Clay	ML/CL	firm	120	3		95			0.42	5.53
3.50	11.5	7.22	0.96	Sensitive fine grained	ML	firm	120	4		95			0.39	5.65
3.65	12.0	8.23	0.84	Sensitive fine grained	ML	firm	120	4		85			0.44	6.76
3.80	12.5	9.75	1.06	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.53	7.27
3.95	13.0	10.79	1.26	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.59	8.56
4.13	13.5	10.73	1.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		90			0.59	8.14
4.28	14.0	13.43	2.79	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.75	>10
4.43	14.5	13.89	4.11	Clay	CL/CH	stiff	125	11		100			0.77	6.43
4.58	15.0	14.24	4.85	Clay	CL/CH	stiff	125	11		100			0.79	6.54
4.73	15.5	11.07	5.23	Clay	CL/CH	stiff	125	9		100			0.61	4.18
4.88	16.0	9.64	3.54	Clay	CL/CH	stiff	125	8		100			0.52	3.35
5.03	16.5	11.59	3.13	Silty Clay to Clay	CL	stiff	125	7		100			0.63	5.42
5.18	17.0	16.22	2.73	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		95			0.91	>10
5.33	17.5	14.44	3.88	Silty Clay to Clay	CL	stiff	125	8		100			0.80	7.41
5.48	18.0	19.62	3.47	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		95			1.10	>10
5.65	18.5	18.90	4.57	Clay	CL/CH	very stiff	125	15		100			1.06	8.56
5.80	19.0	13.37	3.91	Clay	CL/CH	stiff	125	11		100			0.73	4.57
5.95	19.5	9.60	3.03	Silty Clay to Clay	CL	stiff	125	5		100			0.51	3.43
6.10	20.0	17.66	2.87	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		95			0.98	>10
6.25	20.5	45.30	1.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	45.5	45	49	35		
6.40	21.0	93.04	0.48	Sand	SP	dense	110	14	92.9	15	70	38		
6.55	21.5	111.82	0.66	Sand	SP	dense	110	17	111.0	20	76	39		
6.70	22.0	64.43	1.21	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	63.5	35	59	36		
6.85	22.5	20.22	2.99	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		95			1.13	>10
7.00	23.0	12.28	4.08	Clay	CL/CH	stiff	125	10		100			0.66	3.43
7.18	23.5	10.21	5.62	Clay	CL/CH	stiff	125	8		100			0.54	2.57
7.33	24.0	8.46	3.78	Clay	CL/CH	firm	125	7		100			0.44	1.92
7.48	24.5	11.07	3.61	Silty Clay to Clay	CL	stiff	125	6		100			0.59	3.43
7.63	25.0	13.49	4.26	Clay	CL/CH	stiff	125	11		100			0.73	3.58
7.78	25.5	18.15	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.00	>10
7.93	26.0	17.90	2.34	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.99	>10
8.08	26.5	17.52	4.56	Clay	CL/CH	stiff	125	14		100			0.97	5.00
8.23	27.0	18.26	4.80	Clay	CL/CH	very stiff	125	15		100			1.01	5.21
8.38	27.5	17.23	6.05	Clay	CL/CH	stiff	125	14		100			0.95	4.68
8.53	28.0	16.05	5.02	Clay	CL/CH	stiff	125	13		100			0.88	4.09
8.68	28.5	20.13	6.52	Clay	CL/CH	very stiff	125	16		100			1.12	5.76
8.85	29.0	22.58	6.89	Clay	CL/CH	very stiff	125	18		100			1.26	6.76
9.00	29.5	26.37	6.48	Clay	CL/CH	very stiff	125	21		100			1.48	8.70
9.15	30.0	26.52	6.42	Clay	CL/CH	very stiff	125	21		100			1.49	8.70
9.30	30.5	22.69	5.37	Clay	CL/CH	very stiff	125	18		100			1.26	6.43
9.45	31.0	23.21	4.55	Silty Clay to Clay	CL	very stiff	125	13		100			1.29	8.70
9.60	31.5	22.26	3.94	Silty Clay to Clay	CL	very stiff	125	13		100			1.24	7.85
9.75	32.0	14.41	4.78	Clay	CL/CH	stiff	125	12		100			0.77	3.07
9.90	32.5	13.29	3.96	Clay	CL/CH	stiff	125	11		100			0.71	2.65
10.05	33.0	21.05	4.17	Silty Clay to Clay	CL	very stiff	125	12		100			1.16	6.65
10.20	33.5	21.89	3.97	Silty Clay to Clay	CL	very stiff	125	13		100			1.21	6.88
10.38	34.0	24.42	3.55	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.36	>10
10.53	34.5	17.40	6.04	Clay	CL/CH	stiff	125	14		100			0.94	3.66
10.68	35.0	19.01	3.76	Silty Clay to Clay	CL	very stiff	125	11		100			1.04	5.21
10.83	35.5	24.65	3.33	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.37	>10
10.98	36.0	20.31	3.70	Silty Clay to Clay	CL	very stiff	125	12		100			1.11	5.65
11.13	36.5	18.45	2.53	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.00	6.43
11.28	37.0	16.45	2.19	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.88	5.21
11.43	37.5	15.04	1.56	Sandy Silt to Clayey Silt	ML	very loose	115	4	12.2	100	10	29		
11.58	38.0	21.97	1.88	Sandy Silt to Clayey Silt	ML	loose	115	6	17.7	100	21	31		
11.73	38.5	33.05	2.38	Sandy Silt to Clayey Silt	ML	loose	115	9	26.5	85	33	33		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-5 Est. GWT (ft): 11 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	34.94	2.05	Sandy Silt to Clayey Silt	ML	loose	115	10	27.9	80	35	33		
12.05	39.5	34.83	2.42	Sandy Silt to Clayey Silt	ML	loose	115	10	27.7	85	35	33		
12.20	40.0	38.74	2.20	Sandy Silt to Clayey Silt	ML	loose	115	11	30.6	80	38	33		
12.35	40.5	44.84	1.39	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	35.3	65	42	34		
12.50	41.0	17.57	2.07	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	5.21
12.65	41.5	11.94	2.91	Silty Clay to Clay	CL	stiff	125	7		100			0.61	2.13
12.80	42.0	11.50	1.88	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.58	2.65
12.95	42.5	10.61	1.45	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.53	2.27
13.10	43.0	10.84	1.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.54	2.34
13.25	43.5	14.09	2.31	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.73	3.43
13.40	44.0	23.73	1.46	Sandy Silt to Clayey Silt	ML	loose	115	7	18.1	95	22	31		
13.58	44.5	19.50	2.59	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.05	5.53
13.73	45.0	18.98	3.97	Silty Clay to Clay	CL	very stiff	125	11		100			1.02	3.83
13.88	45.5	21.08	4.29	Silty Clay to Clay	CL	very stiff	125	12		100			1.14	4.47
14.03	46.0	19.65	3.07	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.06	5.31
14.18	46.5	16.42	2.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	3.91
14.33	47.0	15.27	1.13	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.3	100	8	29		
14.48	47.5	15.76	1.10	Sandy Silt to Clayey Silt	ML	very loose	115	5	11.7	100	9	29		
14.63	48.0	18.75	1.80	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.8	100	14	30		
14.78	48.5	25.25	3.81	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.38	7.70
14.93	49.0	31.81	3.83	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.77	>10
15.10	49.5	28.07	5.38	Clay	CL/CH	very stiff	125	22		100			1.55	5.00
15.25	50.0	26.75	4.80	Clay	CL/CH	very stiff	125	21		100			1.47	4.57

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

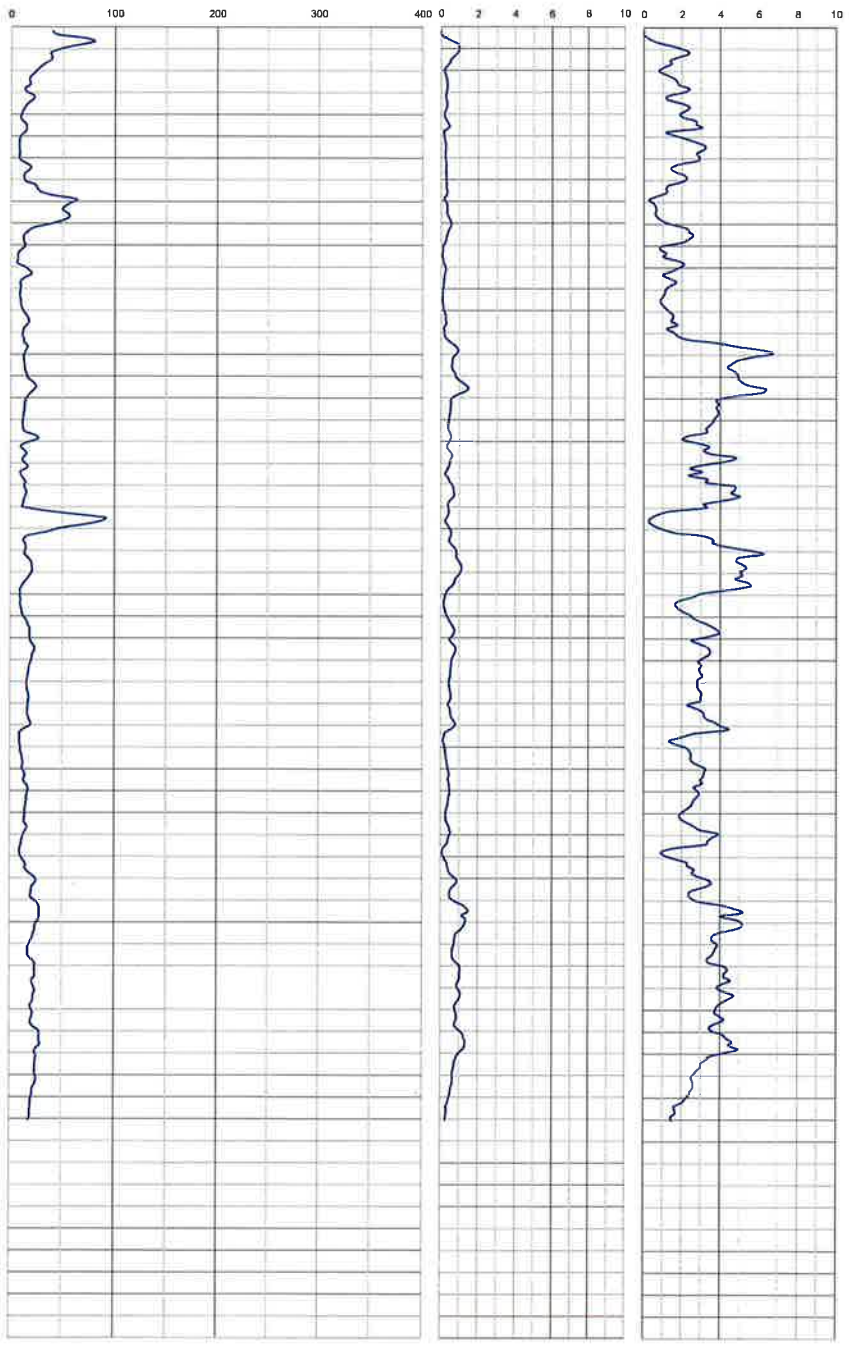
LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-6

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
5	Silty Clay to Clay	CL	firm
	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
10	Clayey Silt to Silty Clay	" "	firm
	Sandy Silt to Clayey Silt	ML	very loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	loose
	Clay	CL/CH	stiff
15	Clay	" "	stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Clay to Clay	CL	stiff
20	Silty Clay to Clay	" "	stiff
	Clay	CL/CH	stiff
	Sand to Silty Sand	SP/SM	medium dense
	Silty Clay to Clay	CL	stiff
	Clay	CL/CH	very stiff
25	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
30	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
35	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
40	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
45	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
50	Sandy Silt to Clayey Silt	ML	very loose
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-6

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-6
Est. GWT (ft): 9
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	52.00	0.09	Sand to Silty Sand	SP/SM	very dense	115	9	98.3	5	115	44		
0.30	1.0	63.79	1.40	Silty Sand to Sandy Silt	SM/ML	very dense	115	14	120.6	25	105	43		
0.45	1.5	38.91	1.90	Sandy Silt to Clayey Silt	ML	dense	115	11	73.6	40	83	40		
0.60	2.0	28.85	1.10	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	54.5	40	69	38		
0.75	2.5	19.19	1.49	Sandy Silt to Clayey Silt	ML	medium dense	115	5	36.3	55	53	35		
0.93	3.0	15.70	2.12	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		70			0.91	>10
1.08	3.5	20.16	1.47	Sandy Silt to Clayey Silt	ML	medium dense	115	6	38.1	50	49	35		
1.23	4.0	12.14	2.19	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		75			0.70	>10
1.38	4.5	11.47	2.53	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.66	>10
1.53	5.0	13.20	1.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		70			0.76	>10
1.68	5.5	8.09	2.85	Silty Clay to Clay	CL	firm	125	5		100			0.46	>10
1.83	6.0	8.51	2.86	Silty Clay to Clay	CL	firm	125	5		100			0.48	>10
1.98	6.5	16.85	1.64	Sandy Silt to Clayey Silt	ML	loose	115	5	27.0	60	34	33		
2.13	7.0	13.37	2.11	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		75			0.76	>10
2.28	7.5	25.86	1.22	Sandy Silt to Clayey Silt	ML	medium dense	115	7	38.4	45	44	34		
2.45	8.0	54.24	0.49	Sand to Silty Sand	SP/SM	medium dense	115	10	78.0	15	65	37		
2.60	8.5	52.34	0.63	Sand to Silty Sand	SP/SM	medium dense	115	10	73.0	20	63	37		
2.75	9.0	47.48	1.08	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	64.4	30	59	36		
2.90	9.5	16.80	2.42	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		70			0.96	>10
3.05	10.0	12.97	1.74	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		75			0.73	>10
3.20	10.5	8.20	1.03	Sensitive fine grained	ML	firm	120	4		80			0.45	>10
3.35	11.0	8.98	1.89	Clayey Silt to Silty Clay	ML/CL	firm	120	4		95			0.49	9.00
3.50	11.5	16.88	1.26	Sandy Silt to Clayey Silt	ML	loose	115	5	21.5	60	27	32		
3.65	12.0	9.32	1.41	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.51	8.85
3.80	12.5	9.00	1.00	Clayey Silt to Silty Clay	ML/CL	firm	120	4		80			0.49	8.00
3.95	13.0	10.38	1.09	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		80			0.57	>10
4.13	13.5	15.99	1.50	Sandy Silt to Clayey Silt	ML	loose	115	5	19.4	70	24	31		
4.28	14.0	13.63	1.51	Sandy Silt to Clayey Silt	ML	very loose	115	4	16.4	75	19	31		
4.43	14.5	12.28	2.61	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.68	>10
4.58	15.0	14.87	5.79	Clay	CL/CH	stiff	125	12		100			0.83	8.56
4.73	15.5	12.83	5.04	Clay	CL/CH	stiff	125	10		100			0.71	6.43
4.88	16.0	14.97	4.74	Clay	CL/CH	stiff	125	12		100			0.84	8.00
5.03	16.5	22.83	5.64	Clay	CL/CH	very stiff	125	18		100			1.30	>10
5.18	17.0	16.74	4.84	Clay	CL/CH	stiff	125	13		100			0.94	9.19
5.33	17.5	13.40	3.87	Clay	CL/CH	stiff	125	11		100			0.74	6.00
5.48	18.0	12.14	3.74	Silty Clay to Clay	CL	stiff	125	7		100			0.67	6.32
5.65	18.5	12.51	3.34	Silty Clay to Clay	CL	stiff	125	7		100			0.69	6.43
5.80	19.0	22.03	2.39	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		80			1.25	>10
5.95	19.5	12.65	3.35	Silty Clay to Clay	CL	stiff	125	7		100			0.70	6.21
6.10	20.0	13.09	4.14	Clay	CL/CH	stiff	125	10		100			0.72	4.89
6.25	20.5	12.14	2.62	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.66	7.41
6.40	21.0	13.20	3.79	Silty Clay to Clay	CL	stiff	125	8		100			0.73	6.10
6.55	21.5	14.58	4.79	Clay	CL/CH	stiff	125	12		100			0.81	5.42
6.70	22.0	12.45	3.52	Silty Clay to Clay	CL	stiff	125	7		100			0.68	5.21
6.85	22.5	60.94	0.80	Sand to Silty Sand	SP/SM	medium dense	115	11	62.0	30	58	36		
7.00	23.0	67.62	0.59	Sand to Silty Sand	SP/SM	medium dense	115	12	68.3	25	61	37		
7.18	23.5	21.37	2.81	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		90			1.20	>10
7.33	24.0	14.38	4.52	Clay	CL/CH	stiff	125	12		100			0.79	4.57
7.48	24.5	16.54	5.35	Clay	CL/CH	stiff	125	13		100			0.92	5.65
7.63	25.0	20.74	5.19	Clay	CL/CH	very stiff	125	17		100			1.16	8.14
7.78	25.5	16.25	5.13	Clay	CL/CH	stiff	125	13		100			0.90	5.21
7.93	26.0	10.07	4.33	Clay	CL/CH	stiff	125	8		100			0.53	2.49
8.08	26.5	9.76	1.96	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.51	3.74
8.23	27.0	12.28	2.37	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.66	5.42
8.38	27.5	17.40	3.45	Silty Clay to Clay	CL	stiff	125	10		100			0.96	6.88
8.53	28.0	18.81	3.30	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.04	>10
8.68	28.5	22.38	3.24	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.25	>10
8.85	29.0	20.82	3.13	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.16	>10
9.00	29.5	18.15	2.97	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.00	9.59
9.15	30.0	16.45	2.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.90	7.70
9.30	30.5	16.74	2.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.92	7.85
9.45	31.0	17.60	2.74	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.97	8.41
9.60	31.5	16.85	2.99	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.92	7.56
9.75	32.0	18.92	3.68	Silty Clay to Clay	CL	very stiff	125	11		100			1.04	6.54
9.90	32.5	10.44	3.06	Silty Clay to Clay	CL	stiff	125	6		100			0.54	2.57
10.05	33.0	9.52	1.75	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.49	2.91
10.20	33.5	10.84	2.45	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.56	3.43
10.38	34.0	12.05	2.91	Silty Clay to Clay	CL	stiff	125	7		100			0.64	3.07
10.53	34.5	13.77	3.08	Silty Clay to Clay	CL	stiff	125	8		100			0.74	3.58
10.68	35.0	16.25	2.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.88	6.10
10.83	35.5	16.14	2.75	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.87	6.00
10.98	36.0	14.67	2.28	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.79	5.00
11.13	36.5	14.56	2.21	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	4.78
11.28	37.0	13.92	3.50	Silty Clay to Clay	CL	stiff	125	8		100			0.74	3.35
11.43	37.5	10.75	2.79	Silty Clay to Clay	CL	stiff	125	6		100			0.55	2.27
11.58	38.0	10.21	1.20	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.52	2.65
11.73	38.5	14.67	2.40	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	4.47

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-6

Est. GWT (ft): 9

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	21.91	2.94	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.21	8.85
12.05	39.5	22.12	3.05	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	8.85
12.20	40.0	21.83	2.60	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.20	8.56
12.35	40.5	28.34	4.69	Silty Clay to Clay	CL	very stiff	125	16		100			1.58	9.79
12.50	41.0	27.42	4.65	Clay	CL/CH	very stiff	125	22		100			1.53	6.65
12.65	41.5	23.81	4.41	Silty Clay to Clay	CL	very stiff	125	14		100			1.31	6.65
12.80	42.0	20.48	3.69	Silty Clay to Clay	CL	very stiff	125	12		100			1.12	5.10
12.95	42.5	17.63	3.67	Silty Clay to Clay	CL	stiff	125	10		100			0.95	4.00
13.10	43.0	22.72	3.65	Silty Clay to Clay	CL	very stiff	125	13		100			1.25	5.88
13.25	43.5	24.19	4.28	Silty Clay to Clay	CL	very stiff	125	14		100			1.33	6.43
13.40	44.0	22.29	4.16	Silty Clay to Clay	CL	very stiff	125	13		100			1.22	5.53
13.58	44.5	23.35	4.45	Silty Clay to Clay	CL	very stiff	125	13		100			1.28	5.88
13.73	45.0	20.97	3.93	Silty Clay to Clay	CL	very stiff	125	12		100			1.14	4.78
13.88	45.5	21.48	3.98	Silty Clay to Clay	CL	very stiff	125	12		100			1.17	5.00
14.03	46.0	23.67	3.60	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.30	7.85
14.18	46.5	28.62	4.36	Silty Clay to Clay	CL	very stiff	125	16		100			1.59	7.85
14.33	47.0	26.23	4.31	Silty Clay to Clay	CL	very stiff	125	15		100			1.45	6.54
14.48	47.5	24.88	3.09	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.37	8.27
14.63	48.0	24.82	2.64	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.36	8.14
14.78	48.5	24.16	2.57	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.32	7.56
14.93	49.0	21.43	2.33	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.16	6.10
15.10	49.5	20.19	1.78	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.0	100	16	30		
15.25	50.0	19.27	1.54	Sandy Silt to Clayey Silt	ML	very loose	115	6	14.2	100	15	30		

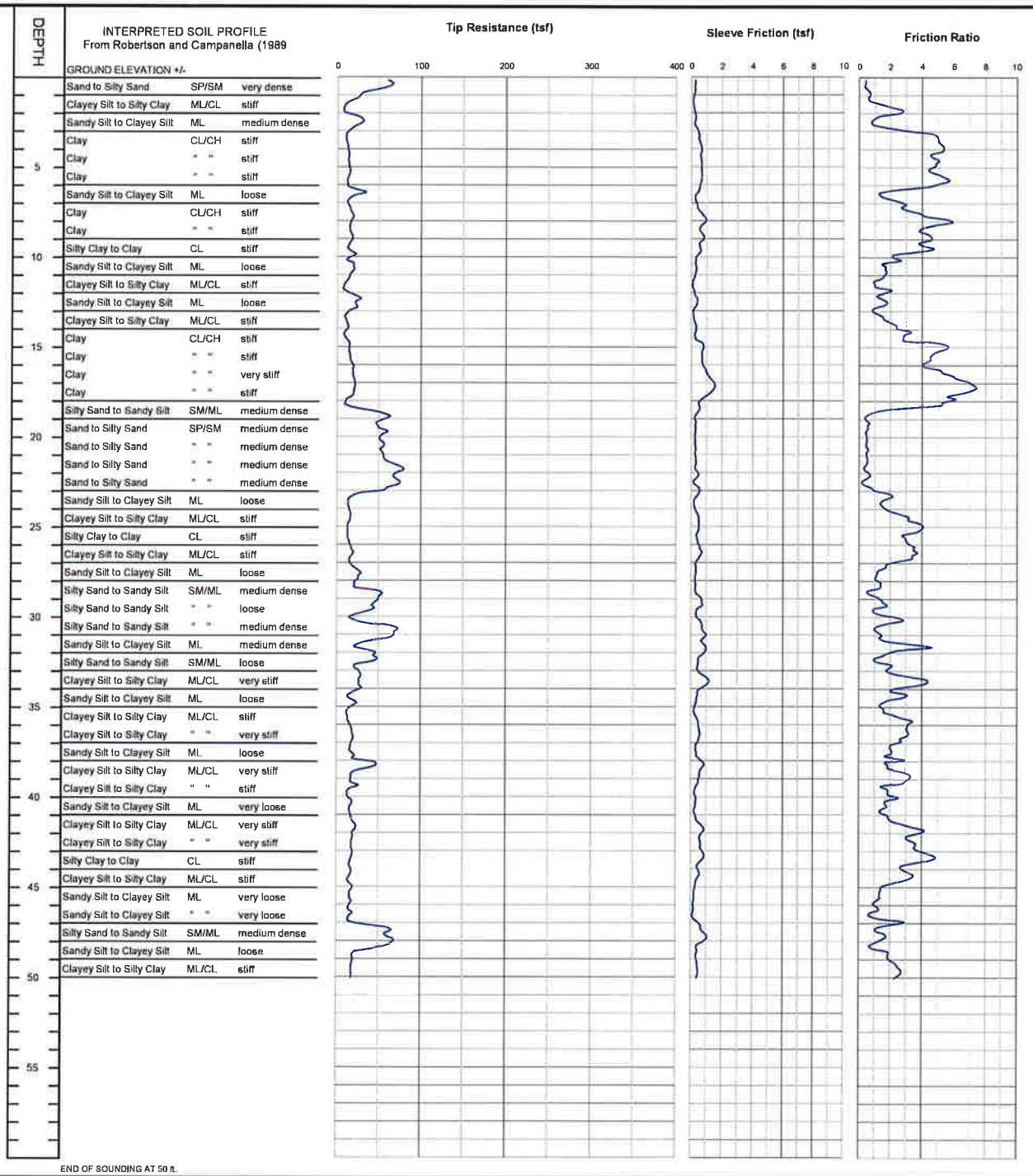
CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-7



Sand to Silty Sand	SP/SM	very dense
Clayey Silt to Silty Clay	ML/CL	stiff
Sandy Silt to Clayey Silt	ML	medium dense
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	loose
Clay	CL/CH	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	medium dense
Sand to Silty Sand	" "	medium dense
Sand to Silty Sand	" "	medium dense
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Sandy Silt to Clayey Silt	ML	loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	loose
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	medium dense
Silty Sand to Sandy Silt	SM/ML	loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff

END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-7

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-7
Est. GWT (ft): 7
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	63.26	0.42	Sand to Silty Sand	SP/SM	very dense	115	12	119.6	10	121	45		
0.30	1.0	36.30	0.66	Silty Sand to Sandy Silt	SM/ML	dense	115	8	68.6	25	88	40		
0.45	1.5	16.60	0.90	Sandy Silt to Clayey Silt	ML	medium dense	115	5	31.4	50	57	36		
0.60	2.0	8.32	2.50	Silty Clay to Clay	CL	firm	125	5		95			0.48	>10
0.75	2.5	27.59	1.05	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	52.2	40	64	37		
0.93	3.0	19.10	1.94	Sandy Silt to Clayey Silt	ML	medium dense	115	5	36.1	60	50	35		
1.08	3.5	10.50	4.86	Clay	CL/CH	stiff	125	8		100			0.61	>10
1.23	4.0	12.00	5.24	Clay	CL/CH	stiff	125	10		100			0.69	>10
1.38	4.5	13.49	4.85	Clay	CL/CH	stiff	125	11		95			0.78	>10
1.53	5.0	13.61	4.95	Clay	CL/CH	stiff	125	11		95			0.78	>10
1.68	5.5	14.07	4.91	Clay	CL/CH	stiff	125	11		95			0.81	>10
1.83	6.0	12.31	5.06	Clay	CL/CH	stiff	125	10		100			0.70	>10
1.98	6.5	25.63	1.71	Sandy Silt to Clayey Silt	ML	medium dense	115	7	40.6	50	46	34		
2.13	7.0	13.26	2.46	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.76	>10
2.28	7.5	15.97	3.23	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.91	>10
2.45	8.0	17.72	5.21	Clay	CL/CH	very stiff	125	14		90			1.02	>10
2.60	8.5	14.84	4.23	Clay	CL/CH	stiff	125	12		90			0.85	>10
2.75	9.0	17.43	4.51	Clay	CL/CH	stiff	125	14		85			1.00	>10
2.90	9.5	13.66	4.22	Clay	CL/CH	stiff	125	11		95			0.78	>10
3.05	10.0	17.92	2.72	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		70			1.03	>10
3.20	10.5	16.66	1.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		65			0.95	>10
3.35	11.0	17.58	1.68	Sandy Silt to Clayey Silt	ML	loose	115	5	23.6	60	30	32		
3.50	11.5	11.33	1.15	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		70			0.63	>10
3.65	12.0	9.61	1.60	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.53	>10
3.80	12.5	24.05	1.46	Sandy Silt to Clayey Silt	ML	loose	115	7	31.0	50	38	33		
3.95	13.0	20.31	1.20	Sandy Silt to Clayey Silt	ML	loose	115	6	25.9	55	33	33		
4.13	13.5	10.30	1.43	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.57	>10
4.28	14.0	12.44	2.31	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.70	>10
4.43	14.5	8.98	3.03	Silty Clay to Clay	CL	firm	125	5		100			0.49	5.53
4.58	15.0	13.66	4.44	Clay	CL/CH	stiff	125	11		100			0.77	8.27
4.73	15.5	14.59	5.09	Clay	CL/CH	stiff	125	12		100			0.82	9.00
4.88	16.0	17.26	4.33	Clay	CL/CH	stiff	125	14		100			0.98	>10
5.03	16.5	18.70	5.42	Clay	CL/CH	very stiff	125	15		100			1.06	>10
5.18	17.0	20.66	6.73	Clay	CL/CH	very stiff	125	17		100			1.17	>10
5.33	17.5	20.17	6.97	Clay	CL/CH	very stiff	125	16		100			1.14	>10
5.48	18.0	13.23	5.67	Clay	CL/CH	stiff	125	11		100			0.74	6.21
5.65	18.5	23.88	3.06	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		80			1.36	>10
5.80	19.0	58.46	0.52	Sand to Silty Sand	SP/SM	medium dense	115	11	65.1	20	60	36		
5.95	19.5	48.87	0.60	Sand to Silty Sand	SP/SM	medium dense	115	9	54.0	30	54	36		
6.10	20.0	55.38	0.47	Sand to Silty Sand	SP/SM	medium dense	115	10	60.6	25	58	36		
6.25	20.5	54.57	0.48	Sand to Silty Sand	SP/SM	medium dense	115	10	59.2	25	57	36		
6.40	21.0	53.82	0.52	Sand to Silty Sand	SP/SM	medium dense	115	10	58.0	25	56	36		
6.55	21.5	60.84	0.52	Sand to Silty Sand	SP/SM	medium dense	115	11	65.0	25	60	36		
6.70	22.0	75.78	0.45	Sand to Silty Sand	SP/SM	medium dense	115	14	80.3	20	66	37		
6.85	22.5	70.85	0.45	Sand to Silty Sand	SP/SM	medium dense	115	13	74.5	20	64	37		
7.00	23.0	63.29	0.73	Sand to Silty Sand	SP/SM	medium dense	115	12	66.1	30	60	36		
7.18	23.5	19.25	1.90	Sandy Silt to Clayey Silt	ML	loose	115	5	19.9	80	25	31		
7.33	24.0	13.58	1.51	Sandy Silt to Clayey Silt	ML	very loose	115	4	14.0	90	14	30		
7.48	24.5	15.85	2.63	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.88	>10
7.63	25.0	14.10	3.68	Silty Clay to Clay	CL	stiff	125	8		100			0.77	6.10
7.78	25.5	12.77	3.47	Silty Clay to Clay	CL	stiff	125	7		100			0.70	5.10
7.93	26.0	14.04	3.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.77	8.00
8.08	26.5	17.82	3.53	Silty Clay to Clay	CL	stiff	125	10		100			0.99	8.56
8.23	27.0	15.54	2.53	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.86	9.19
8.38	27.5	24.46	1.39	Sandy Silt to Clayey Silt	ML	loose	115	7	23.8	70	30	32		
8.53	28.0	23.90	1.18	Sandy Silt to Clayey Silt	ML	loose	115	7	23.1	70	29	32		
8.68	28.5	30.67	1.11	Silty Sand to Sandy Silt	SM/ML	loose	115	7	29.5	60	36	33		
8.85	29.0	51.64	1.08	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	49.3	45	52	35		
9.00	29.5	44.13	1.46	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	41.9	55	47	35		
9.15	30.0	24.83	1.61	Sandy Silt to Clayey Silt	ML	loose	115	7	23.4	75	30	32		
9.30	30.5	40.59	1.95	Sandy Silt to Clayey Silt	ML	medium dense	115	12	38.0	65	44	34		
9.45	31.0	70.16	1.24	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	65.4	40	60	36		
9.60	31.5	42.15	2.12	Sandy Silt to Clayey Silt	ML	medium dense	115	12	39.0	65	45	34		
9.75	32.0	35.07	3.05	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		80			2.00	>10
9.90	32.5	44.91	1.21	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	41.1	50	46	34		
10.05	33.0	23.16	1.94	Sandy Silt to Clayey Silt	ML	loose	115	7	21.1	85	26	32		
10.20	33.5	27.76	3.24	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		95			1.57	>10
10.38	34.0	27.79	3.44	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		95			1.57	>10
10.53	34.5	16.77	2.65	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.92	7.41
10.68	35.0	21.03	1.54	Sandy Silt to Clayey Silt	ML	loose	115	6	18.7	85	23	31		
10.83	35.5	12.92	1.81	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.69	4.57
10.98	36.0	14.30	3.11	Silty Clay to Clay	CL	stiff	125	8		100			0.77	3.91
11.13	36.5	18.31	3.10	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.00	8.00
11.28	37.0	18.24	2.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			1.00	7.70
11.43	37.5	16.89	2.06	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.92	6.65
11.58	38.0	28.83	2.14	Sandy Silt to Clayey Silt	ML	loose	115	8	24.7	85	31	32		
11.73	38.5	36.36	2.16	Sandy Silt to Clayey Silt	ML	loose	115	10	31.0	75	38	33		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-7 | Est. GWT (ft): 7 | Phi Correlation: 0 | 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	17.29	3.21	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	6.54
12.05	39.5	20.05	2.02	Sandy Silt to Clayey Silt	ML	loose	115	6	16.9	100	20	31		
12.20	40.0	13.32	2.11	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.70	4.09
12.35	40.5	17.72	1.75	Sandy Silt to Clayey Silt	ML	very loose	115	5	14.8	100	16	30		
12.50	41.0	16.28	1.56	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.5	100	13	30		
12.65	41.5	20.31	2.29	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.11	8.00
12.80	42.0	21.23	3.83	Silty Clay to Clay	CL	very stiff	125	12		100			1.17	6.10
12.95	42.5	18.84	3.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.03	6.65
13.10	43.0	18.38	3.67	Silty Clay to Clay	CL	stiff	125	11		100			1.00	4.68
13.25	43.5	18.24	4.62	Clay	CL/CH	stiff	125	15		100			0.99	3.58
13.40	44.0	16.25	3.02	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	5.00
13.58	44.5	16.54	3.27	Silty Clay to Clay	CL	stiff	125	9		100			0.89	3.74
13.73	45.0	16.28	2.10	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	4.78
13.88	45.5	16.89	1.38	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.4	100	13	30		
14.03	46.0	16.95	1.13	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.4	100	13	30		
14.18	46.5	16.38	1.07	Sandy Silt to Clayey Silt	ML	very loose	115	5	12.9	100	12	30		
14.33	47.0	19.61	1.76	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.4	100	17	30		
14.48	47.5	61.59	1.30	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	48.0	50	51	35		
14.63	48.0	65.65	1.44	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	51.0	55	53	35		
14.78	48.5	42.15	1.16	Silty Sand to Sandy Silt	SM/ML	loose	115	9	32.6	65	39	34		
14.93	49.0	19.65	1.93	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.1	100	17	30		
15.10	49.5	18.21	2.51	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.98	5.10
15.25	50.0	18.12	2.52	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.97	5.00

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

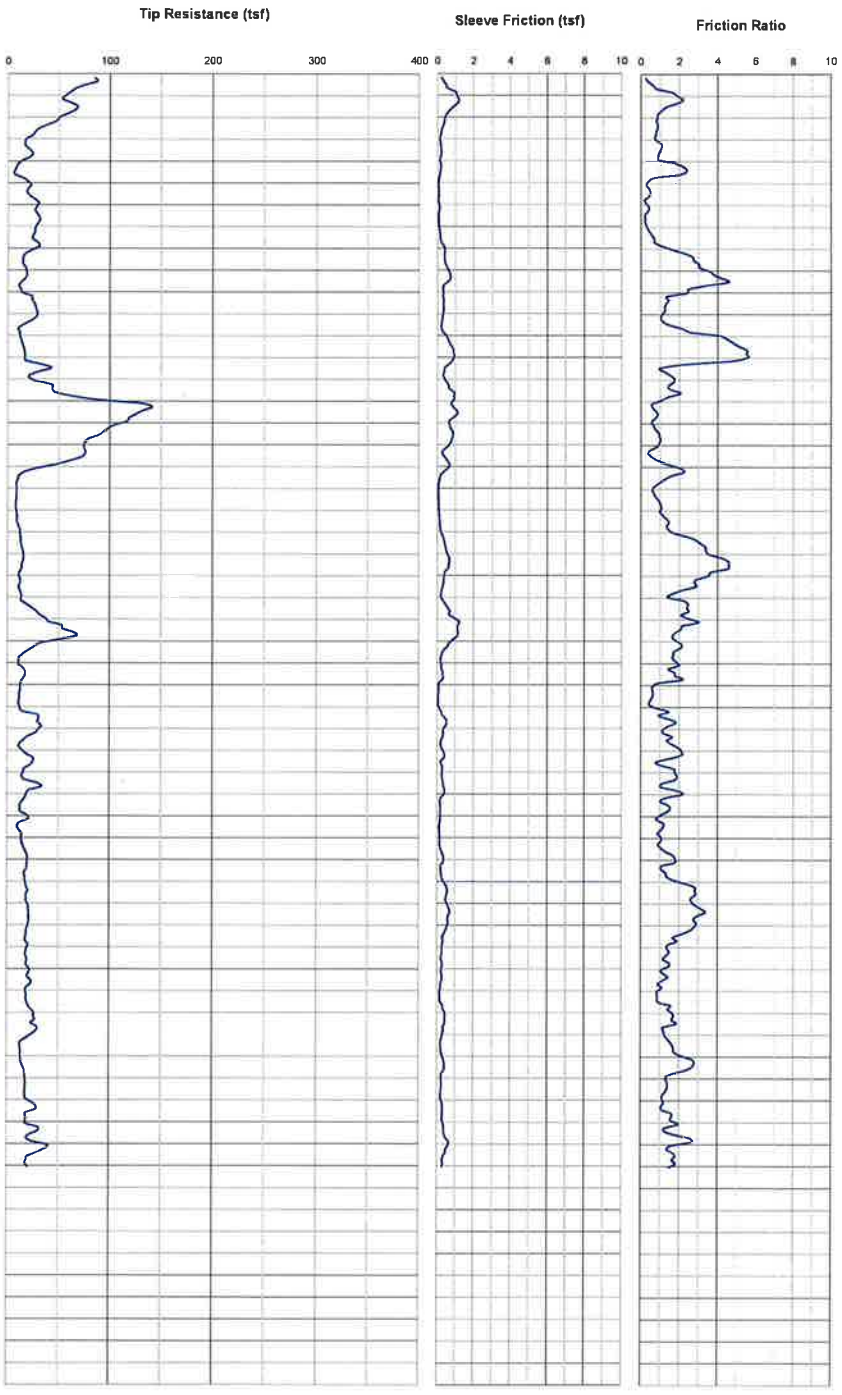
LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-8

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	very dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
5	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
10	Silty Clay to Clay	CL	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clay	CL/CH	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
15	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand	SP	dense
	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
20	Sensitive fine grained	ML	firm
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clay	CL/CH	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
25	Sandy Silt to Clayey Silt	ML	loose
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	loose
	Sandy Silt to Clayey Silt	" "	very loose
	Sandy Silt to Clayey Silt	" "	very loose
30	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	very loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	very loose
35	Sandy Silt to Clayey Silt	" "	very loose
	Sandy Silt to Clayey Silt	" "	very loose
	Sandy Silt to Clayey Silt	" "	very loose
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
40	Sandy Silt to Clayey Silt	ML	very loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
45	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	very loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
50	Sandy Silt to Clayey Silt	" "	loose
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-8

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-8

Est. GWT (ft): 5

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	82.95	0.43	Sand to Silty Sand	SP/SM	very dense	115	15	156.8	10	129	46		
0.30	1.0	61.33	1.46	Silty Sand to Sandy Silt	SM/ML	very dense	115	14	115.9	30	104	43		
0.45	1.5	61.39	1.80	Silty Sand to Sandy Silt	SM/ML	very dense	115	14	116.0	30	96	41		
0.60	2.0	58.57	0.96	Silty Sand to Sandy Silt	SM/ML	dense	115	13	110.7	20	90	41		
0.75	2.5	39.89	0.86	Silty Sand to Sandy Silt	SM/ML	dense	115	9	75.4	25	75	38		
0.93	3.0	23.11	0.77	Silty Sand to Sandy Silt	SM/ML	medium dense	115	5	43.7	40	56	36		
1.08	3.5	18.19	1.00	Sandy Silt to Clayey Silt	ML	medium dense	115	5	34.4	50	46	34		
1.23	4.0	20.44	0.88	Sandy Silt to Clayey Silt	ML	medium dense	115	6	38.6	45	47	35		
1.38	4.5	8.26	2.19	Silty Clay to Clay	CL	firm	125	5		90			0.47	>10
1.53	5.0	13.56	0.99	Sandy Silt to Clayey Silt	ML	loose	115	4	25.1	55	32	32		
1.68	5.5	20.59	0.38	Silty Sand to Sandy Silt	SM/ML	medium dense	115	5	37.3	30	43	34		
1.83	6.0	28.41	0.30	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	50.3	20	52	35		
1.98	6.5	28.76	0.28	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	49.8	20	52	35		
2.13	7.0	28.72	0.27	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	48.7	20	51	35		
2.28	7.5	25.21	0.59	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	42.0	30	47	35		
2.45	8.0	28.35	1.18	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	46.3	40	50	35		
2.60	8.5	15.76	2.59	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.91	>10
2.75	9.0	16.69	3.23	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		80			0.96	>10
2.90	9.5	16.38	4.23	Clay	CL/CH	stiff	125	13		85			0.94	>10
3.05	10.0	12.58	2.74	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.72	>10
3.20	10.5	24.32	1.36	Sandy Silt to Clayey Silt	ML	medium dense	115	7	36.2	45	42	34		
3.35	11.0	28.09	1.20	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	41.2	40	46	34		
3.50	11.5	21.07	1.23	Sandy Silt to Clayey Silt	ML	loose	115	6	30.4	50	37	33		
3.65	12.0	11.20	2.97	Silty Clay to Clay	CL	stiff	125	6		90			0.63	>10
3.80	12.5	13.88	4.84	Clay	CL/CH	stiff	125	11		100			0.79	>10
3.95	13.0	16.41	5.57	Clay	CL/CH	stiff	125	13		95			0.94	>10
4.13	13.5	30.34	2.67	Sandy Silt to Clayey Silt	ML	medium dense	115	9	41.2	55	46	34		
4.28	14.0	25.08	1.50	Sandy Silt to Clayey Silt	ML	medium dense	115	7	33.6	50	40	34		
4.43	14.5	39.03	1.55	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	51.7	40	53	35		
4.58	15.0	65.91	1.53	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	86.2	30	68	38		
4.73	15.5	135.42	0.66	Sand	SP	dense	110	21	175.2	10	89	40		
4.88	16.0	117.04	0.71	Sand	SP	dense	110	18	149.8	10	84	40		
5.03	16.5	94.32	0.87	Sand to Silty Sand	SP/SM	dense	115	17	119.4	15	78	39		
5.18	17.0	76.90	0.93	Sand to Silty Sand	SP/SM	dense	115	14	96.3	20	71	38		
5.33	17.5	74.95	0.46	Sand to Silty Sand	SP/SM	dense	115	14	92.9	15	70	38		
5.48	18.0	46.49	1.45	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	57.0	40	56	36		
5.65	18.5	13.04	1.71	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.73	>10
5.80	19.0	8.72	0.76	Sensitive fine grained	ML	firm	120	4		85			0.47	8.14
5.95	19.5	8.52	0.80	Sensitive fine grained	ML	firm	120	4		85			0.46	7.41
6.10	20.0	8.12	1.02	Sensitive fine grained	ML	firm	120	4		95			0.44	6.54
6.25	20.5	9.04	1.29	Clayey Silt to Silty Clay	ML/CL	firm	120	4		95			0.49	6.32
6.40	21.0	11.34	1.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.63	9.19
6.55	21.5	12.72	2.76	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.71	>10
6.70	22.0	14.51	3.44	Silty Clay to Clay	CL	stiff	125	8		100			0.81	9.59
6.85	22.5	14.87	4.45	Clay	CL/CH	stiff	125	12		100			0.83	7.13
7.00	23.0	12.14	3.92	Clay	CL/CH	stiff	125	10		100			0.67	5.00
7.18	23.5	11.83	2.87	Silty Clay to Clay	CL	stiff	125	7		100			0.65	6.00
7.33	24.0	12.69	1.73	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.70	9.00
7.48	24.5	18.08	2.37	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		85			1.02	>10
7.63	25.0	32.21	2.36	Sandy Silt to Clayey Silt	ML	medium dense	115	9	34.3	65	41	34		
7.78	25.5	49.25	2.42	Sandy Silt to Clayey Silt	ML	medium dense	115	14	52.0	55	53	35		
7.93	26.0	60.90	1.72	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	63.8	45	59	36		
8.08	26.5	23.36	1.91	Sandy Silt to Clayey Silt	ML	loose	115	7	24.3	75	31	32		
8.23	27.0	11.25	1.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	6.21
8.38	27.5	16.66	1.67	Sandy Silt to Clayey Silt	ML	loose	115	5	17.1	85	20	31		
8.53	28.0	13.41	1.21	Sandy Silt to Clayey Silt	ML	very loose	115	4	13.6	90	14	30		
8.68	28.5	11.92	0.61	Sandy Silt to Clayey Silt	ML	very loose	115	3	12.0	80	10	29		
8.85	29.0	11.34	0.58	Sandy Silt to Clayey Silt	ML	very loose	115	3	11.4	85	8	29		
9.00	29.5	25.07	1.29	Sandy Silt to Clayey Silt	ML	loose	115	7	25.0	65	31	32		
9.15	30.0	31.08	1.47	Sandy Silt to Clayey Silt	ML	loose	115	9	30.7	60	38	33		
9.30	30.5	21.04	1.39	Sandy Silt to Clayey Silt	ML	loose	115	6	20.7	75	26	32		
9.45	31.0	13.01	1.89	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.71	6.43
9.60	31.5	23.14	1.48	Sandy Silt to Clayey Silt	ML	loose	115	7	22.4	75	28	32		
9.75	32.0	18.08	1.54	Sandy Silt to Clayey Silt	ML	loose	115	5	17.4	85	21	31		
9.90	32.5	20.00	1.59	Sandy Silt to Clayey Silt	ML	loose	115	6	19.1	85	24	31		
10.05	33.0	24.55	1.71	Sandy Silt to Clayey Silt	ML	loose	115	7	23.3	75	29	32		
10.20	33.5	14.91	1.24	Sandy Silt to Clayey Silt	ML	very loose	115	4	14.1	90	15	30		
10.38	34.0	15.05	1.28	Sandy Silt to Clayey Silt	ML	very loose	115	4	14.1	95	15	30		
10.53	34.5	14.27	1.05	Sandy Silt to Clayey Silt	ML	very loose	115	4	13.3	90	13	30		
10.68	35.0	13.04	1.00	Sandy Silt to Clayey Silt	ML	very loose	115	4	12.1	95	10	29		
10.83	35.5	14.97	1.00	Sandy Silt to Clayey Silt	ML	very loose	115	4	13.8	90	14	30		
10.98	36.0	18.91	1.57	Sandy Silt to Clayey Silt	ML	loose	115	5	17.3	90	21	31		
11.13	36.5	18.48	1.32	Sandy Silt to Clayey Silt	ML	very loose	115	5	16.8	85	20	31		
11.28	37.0	17.66	1.80	Sandy Silt to Clayey Silt	ML	very loose	115	5	16.0	95	18	31		
11.43	37.5	19.28	2.84	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.07	>10
11.58	38.0	19.24	2.70	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.06	9.79
11.73	38.5	21.01	3.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.17	>10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-8

Est. GWT (ft): 5

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	20.75	2.81	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.15	>10
12.05	39.5	18.52	2.12	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.02	8.41
12.20	40.0	19.20	1.56	Sandy Silt to Clayey Silt	ML	very loose	115	5	16.8	95	20	31		
12.35	40.5	18.65	1.33	Sandy Silt to Clayey Silt	ML	very loose	115	5	16.2	90	19	31		
12.50	41.0	20.18	1.33	Sandy Silt to Clayey Silt	ML	loose	115	6	17.4	90	21	31		
12.65	41.5	21.42	1.24	Sandy Silt to Clayey Silt	ML	loose	115	6	18.4	85	23	31		
12.80	42.0	20.26	0.95	Sandy Silt to Clayey Silt	ML	loose	115	6	17.3	80	21	31		
12.95	42.5	18.94	0.89	Sandy Silt to Clayey Silt	ML	very loose	115	5	16.1	85	19	31		
13.10	43.0	23.31	1.54	Sandy Silt to Clayey Silt	ML	loose	115	7	19.8	85	25	31		
13.25	43.5	25.56	1.72	Sandy Silt to Clayey Silt	ML	loose	115	7	21.6	85	27	32		
13.40	44.0	27.74	1.20	Silty Sand to Sandy Silt	SM/ML	loose	115	6	23.3	75	29	32		
13.58	44.5	15.40	1.50	Sandy Silt to Clayey Silt	ML	very loose	115	4	12.9	100	12	30		
13.73	45.0	13.15	1.85	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.69	3.91
13.88	45.5	14.51	2.72	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.77	4.47
14.03	46.0	17.53	1.72	Sandy Silt to Clayey Silt	ML	very loose	115	5	14.4	100	15	30		
14.18	46.5	18.16	1.38	Sandy Silt to Clayey Silt	ML	very loose	115	5	14.9	100	16	30		
14.33	47.0	19.49	1.18	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.9	95	18	31		
14.48	47.5	25.36	1.27	Sandy Silt to Clayey Silt	ML	loose	115	7	20.6	80	26	32		
14.63	48.0	18.57	1.71	Sandy Silt to Clayey Silt	ML	very loose	115	5	15.0	100	16	30		
14.78	48.5	28.03	1.45	Sandy Silt to Clayey Silt	ML	loose	115	8	22.5	80	28	32		
14.93	49.0	28.24	2.26	Sandy Silt to Clayey Silt	ML	loose	115	8	22.6	95	29	32		
15.10	49.5	28.75	1.62	Sandy Silt to Clayey Silt	ML	loose	115	8	22.9	85	29	32		
15.25	50.0	19.31	1.65	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.3	100	17	30		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

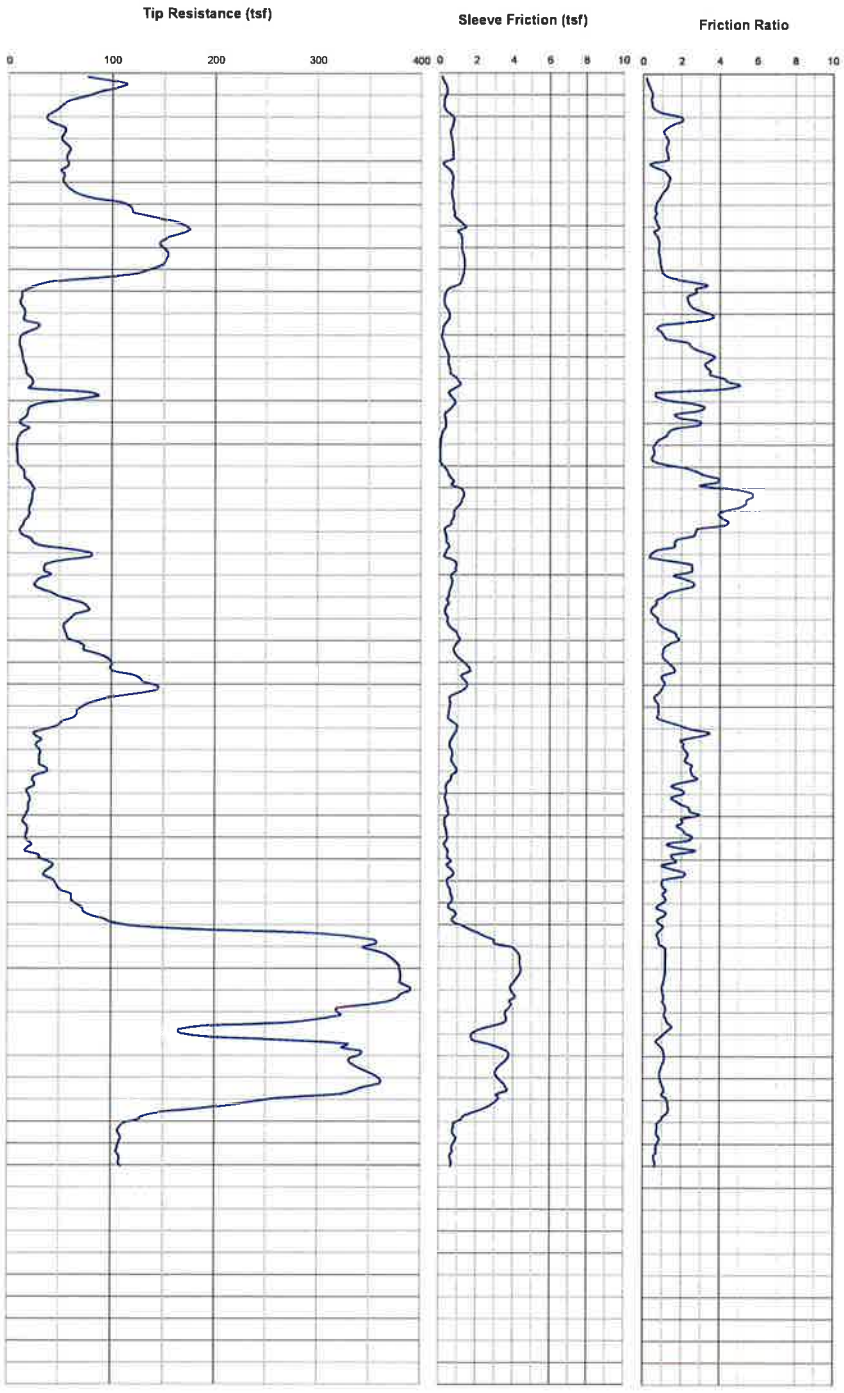
LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-9

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand	SP	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Silty Sand to Sandy Silt	" "	dense
	Silty Sand to Sandy Silt	" "	dense
	Silty Sand to Sandy Silt	" "	dense
5	Sand to Silty Sand	SP/SM	dense
	Sand	SP	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sandy Silt to Clayey Silt	ML	medium dense
10	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Clay to Clay	CL	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
15	Clayey Silt to Silty Clay	ML/CL	very stiff
	Sandy Silt to Clayey Silt	ML	very loose
	Sensitive fine grained	ML	firm
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
20	Silty Clay to Clay	CL	stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
25	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
30	Sandy Silt to Clayey Silt	ML	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Clayey Silt to Silty Clay	ML/CL	stiff
35	Sandy Silt to Clayey Silt	ML	loose
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand	SP	very dense
40	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
45	Sand	" "	very dense
	Sand	" "	very dense
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	medium dense
	Sand	" "	medium dense
50			
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-9

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-9

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	95.88	0.22	Sand	SP	very dense	110	15	181.2	5	134	47		
0.30	1.0	91.47	0.43	Sand	SP	very dense	110	14	172.9	10	116	44		
0.45	1.5	57.38	0.45	Sand to Silty Sand	SP/SM	very dense	115	10	108.5	15	95	41		
0.60	2.0	41.64	1.24	Silty Sand to Sandy Silt	SM/ML	dense	115	9	78.7	30	80	39		
0.75	2.5	44.89	1.66	Silty Sand to Sandy Silt	SM/ML	dense	115	10	84.9	35	78	39		
0.93	3.0	52.83	1.17	Silty Sand to Sandy Silt	SM/ML	dense	115	12	99.9	25	80	39		
1.08	3.5	55.85	1.25	Silty Sand to Sandy Silt	SM/ML	dense	115	12	105.6	25	79	39		
1.23	4.0	56.56	1.28	Silty Sand to Sandy Silt	SM/ML	dense	115	13	106.9	25	78	39		
1.38	4.5	54.64	0.69	Sand to Silty Sand	SP/SM	dense	115	10	103.3	20	75	38		
1.53	5.0	52.89	1.33	Silty Sand to Sandy Silt	SM/ML	dense	115	12	98.8	30	72	38		
1.68	5.5	61.16	1.12	Silty Sand to Sandy Silt	SM/ML	dense	115	14	108.7	25	75	38		
1.83	6.0	103.01	0.72	Sand to Silty Sand	SP/SM	dense	115	19	174.8	10	89	40		
1.98	6.5	125.60	0.64	Sand	SP	very dense	110	19	204.6	10	94	41		
2.13	7.0	163.50	0.74	Sand	SP	very dense	110	25	256.6	5	100	42		
2.28	7.5	163.93	0.68	Sand	SP	very dense	110	25	248.5	5	99	42		
2.45	8.0	147.53	0.81	Sand	SP	very dense	110	23	216.5	10	95	41		
2.60	8.5	152.74	0.84	Sand	SP	very dense	110	23	221.2	10	96	41		
2.75	9.0	142.15	0.94	Sand	SP	very dense	110	22	203.2	10	93	41		
2.90	9.5	87.02	1.60	Silty Sand to Sandy Silt	SM/ML	dense	115	19	122.7	25	79	39		
3.05	10.0	21.29	2.95	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		70			1.22	>10
3.20	10.5	11.74	2.34	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.66	>10
3.35	11.0	14.27	2.96	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.81	>10
3.50	11.5	19.45	2.59	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.11	>10
3.65	12.0	20.29	0.90	Sandy Silt to Clayey Silt	ML	loose	115	6	26.7	45	33	33		
3.80	12.5	10.36	2.00	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		90			0.58	>10
3.95	13.0	12.58	3.27	Silty Clay to Clay	CL	stiff	125	7		95			0.71	>10
4.13	13.5	14.82	3.33	Silty Clay to Clay	CL	stiff	125	8		90			0.84	>10
4.28	14.0	18.48	3.73	Silty Clay to Clay	CL	very stiff	125	11		85			1.05	>10
4.43	14.5	21.64	4.53	Clay	CL/CH	very stiff	125	17		90			1.24	>10
4.58	15.0	76.05	0.83	Sand to Silty Sand	SP/SM	dense	115	14	92.7	20	70	38		
4.73	15.5	24.72	2.87	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		70			1.42	>10
4.88	16.0	14.42	2.35	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.81	>10
5.03	16.5	14.68	1.41	Sandy Silt to Clayey Silt	ML	loose	115	4	17.3	75	21	31		
5.18	17.0	8.20	0.68	Sensitive fine grained	ML	firm	120	4		85			0.44	6.54
5.33	17.5	8.17	0.52	Sensitive fine grained	ML	firm	120	4		80			0.44	6.32
5.48	18.0	9.73	1.24	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		90			0.53	6.76
5.65	18.5	15.31	3.28	Silty Clay to Clay	CL	stiff	125	9		100			0.86	>10
5.80	19.0	22.39	3.82	Silty Clay to Clay	CL	very stiff	125	13		90			1.27	>10
5.95	19.5	22.79	5.59	Clay	CL/CH	very stiff	125	18		100			1.30	>10
6.10	20.0	20.54	4.82	Clay	CL/CH	very stiff	125	16		100			1.16	>10
6.25	20.5	17.96	4.15	Silty Clay to Clay	CL	very stiff	125	10		100			1.01	>10
6.40	21.0	12.32	3.27	Silty Clay to Clay	CL	stiff	125	7		100			0.68	6.10
6.55	21.5	19.94	2.01	Sandy Silt to Clayey Silt	ML	loose	115	6	21.3	80	27	32		
6.70	22.0	58.41	0.91	Sand to Silty Sand	SP/SM	medium dense	115	11	61.9	30	58	36		
6.85	22.5	56.37	1.43	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	59.3	40	57	36		
7.00	23.0	37.12	2.21	Sandy Silt to Clayey Silt	ML	medium dense	115	11	38.7	60	44	34		
7.18	23.5	27.61	2.45	Sandy Silt to Clayey Silt	ML	loose	115	8	28.6	75	36	33		
7.33	24.0	40.37	1.42	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	41.5	50	47	35		
7.48	24.5	69.58	0.62	Sand to Silty Sand	SP/SM	medium dense	115	13	71.0	25	62	37		
7.63	25.0	67.93	0.56	Sand to Silty Sand	SP/SM	medium dense	115	12	68.8	25	61	37		
7.78	25.5	54.87	0.96	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	55.2	35	55	36		
7.93	26.0	56.83	1.76	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	56.8	45	56	36		
8.08	26.5	74.84	1.16	Sand to Silty Sand	SP/SM	medium dense	115	14	74.3	35	64	37		
8.23	27.0	97.63	1.24	Sand to Silty Sand	SP/SM	dense	115	18	96.2	30	71	38		
8.38	27.5	106.98	1.42	Sand to Silty Sand	SP/SM	dense	115	19	104.7	30	74	38		
8.53	28.0	133.83	1.05	Sand to Silty Sand	SP/SM	dense	115	24	130.2	20	80	39		
8.68	28.5	124.11	0.78	Sand	SP	dense	110	19	120.0	20	78	39		
8.85	29.0	79.13	0.73	Sand to Silty Sand	SP/SM	medium dense	115	14	76.0	25	64	37		
9.00	29.5	65.37	0.78	Sand to Silty Sand	SP/SM	medium dense	115	12	62.4	30	59	36		
9.15	30.0	46.70	1.92	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	44.3	55	48	35		
9.30	30.5	28.08	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		85			1.59	>10
9.45	31.0	28.76	2.12	Sandy Silt to Clayey Silt	ML	loose	115	8	26.9	75	34	33		
9.60	31.5	30.43	2.25	Sandy Silt to Clayey Silt	ML	loose	115	9	28.3	75	35	33		
9.75	32.0	35.08	2.49	Sandy Silt to Clayey Silt	ML	loose	115	10	32.5	75	39	33		
9.90	32.5	24.92	2.43	Sandy Silt to Clayey Silt	ML	loose	115	7	22.9	85	29	32		
10.05	33.0	20.63	1.87	Sandy Silt to Clayey Silt	ML	loose	115	6	18.9	90	23	31		
10.20	33.5	20.52	1.71	Sandy Silt to Clayey Silt	ML	loose	115	6	18.7	90	23	31		
10.38	34.0	18.67	2.59	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.03	9.59
10.53	34.5	15.83	1.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.86	6.76
10.68	35.0	18.01	2.26	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.99	8.41
10.83	35.5	20.20	1.79	Sandy Silt to Clayey Silt	ML	loose	115	6	17.9	90	22	31		
10.98	36.0	25.81	1.92	Sandy Silt to Clayey Silt	ML	loose	115	7	22.8	85	29	32		
11.13	36.5	39.69	1.58	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	34.8	65	41	34		
11.28	37.0	41.38	1.39	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	36.1	60	42	34		
11.43	37.5	53.41	1.09	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	46.4	45	50	35		
11.58	38.0	63.42	1.05	Sand to Silty Sand	SP/SM	medium dense	115	12	54.8	40	55	36		
11.73	38.5	75.33	1.00	Sand to Silty Sand	SP/SM	medium dense	115	14	64.8	35	60	36		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-9

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	103.93	0.87	Sand to Silty Sand	SP/SM	medium dense	115	19	88.9	30	69	38		
12.05	39.5	265.88	0.80	Sand	SP	very dense	110	41	226.3	10	97	42		
12.20	40.0	352.66	0.94	Sand	SP	very dense	110	54	298.8	10	105	43		
12.35	40.5	365.55	1.17	Sand	SP	very dense	110	56	308.3	15	106	43		
12.50	41.0	378.16	1.16	Sand	SP	very dense	110	58	317.5	15	107	43		
12.65	41.5	380.52	1.13	Sand	SP	very dense	110	59	318.1	15	107	43		
12.80	42.0	386.65	1.02	Sand	SP	very dense	110	59	321.8	10	107	43		
12.95	42.5	376.63	1.06	Sand	SP	very dense	110	58	312.1	10	106	43		
13.10	43.0	328.94	1.15	Sand	SP	very dense	110	51	271.4	15	102	42		
13.25	43.5	299.03	1.21	Sand	SP	very dense	110	46	245.7	15	99	42		
13.40	44.0	174.20	1.30	Sand to Silty Sand	SP/SM	dense	115	32	142.5	25	83	40		
13.58	44.5	265.30	0.81	Sand	SP	very dense	110	41	216.1	15	95	41		
13.73	45.0	335.97	1.06	Sand	SP	very dense	110	52	272.5	15	102	42		
13.88	45.5	332.98	1.06	Sand	SP	very dense	110	51	269.0	15	102	42		
14.03	46.0	350.53	0.88	Sand	SP	very dense	110	54	282.0	10	103	42		
14.18	46.5	355.83	0.98	Sand	SP	very dense	110	55	285.1	15	103	42		
14.33	47.0	290.29	1.14	Sand	SP	very dense	110	45	231.6	15	97	42		
14.48	47.5	180.93	1.31	Sand to Silty Sand	SP/SM	dense	115	33	143.8	25	83	40		
14.63	48.0	122.78	0.91	Sand to Silty Sand	SP/SM	dense	115	22	97.1	30	72	38		
14.78	48.5	107.48	0.72	Sand	SP	medium dense	110	17	84.7	30	68	37		
14.93	49.0	107.99	0.79	Sand to Silty Sand	SP/SM	medium dense	115	20	84.7	30	68	37		
15.10	49.5	106.21	0.64	Sand	SP	medium dense	110	16	83.0	25	67	37		
15.25	50.0	108.05	0.60	Sand	SP	medium dense	110	17	84.1	25	67	37		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

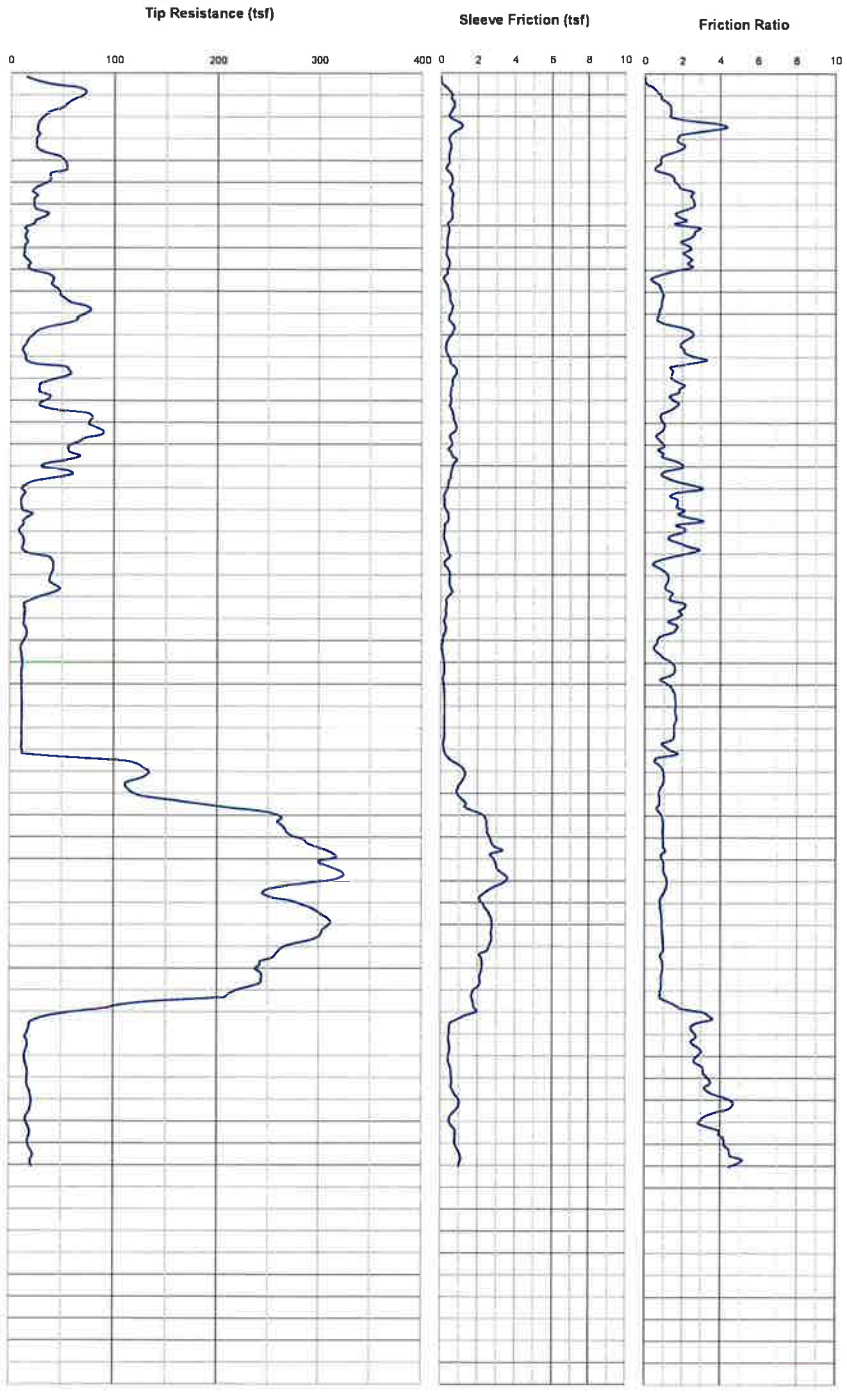
LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-10

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
5	Silty Sand to Sandy Silt	" "	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
10	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
15	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
20	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
25	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	very loose
	Sandy Silt to Clayey Silt	" "	very loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
30	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sand to Silty Sand	SP/SM	medium dense
	Sand	SP	dense
	Sand	" "	dense
35	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
40	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand to Silty Sand	SP/SM	dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
45	Clayey Silt to Silty Clay	" "	stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	very stiff
50	Clay	CL/CH	very stiff
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-10 Est. GWT (ft): 9 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	26.73	0.05	Silty Sand to Sandy Silt	SM/ML	very dense	115	6	50.5	15	95	41		
0.30	1.0	69.73	0.64	Sand to Silty Sand	SP/SM	very dense	115	13	131.8	15	107	43		
0.45	1.5	58.51	1.14	Silty Sand to Sandy Silt	SM/ML	very dense	115	13	110.6	25	95	41		
0.60	2.0	38.75	1.37	Silty Sand to Sandy Silt	SM/ML	dense	115	9	73.3	35	78	39		
0.75	2.5	27.14	3.50	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		65			1.59	>10
0.93	3.0	26.61	2.29	Sandy Silt to Clayey Silt	ML	medium dense	115	8	50.3	55	60	36		
1.08	3.5	25.43	1.96	Sandy Silt to Clayey Silt	ML	medium dense	115	7	48.1	50	56	36		
1.23	4.0	43.04	1.07	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	81.4	30	69	38		
1.38	4.5	53.57	0.66	Sand to Silty Sand	SP/SM	dense	115	10	101.3	20	74	38		
1.53	5.0	38.64	1.45	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	71.7	35	63	37		
1.68	5.5	25.72	2.19	Sandy Silt to Clayey Silt	ML	medium dense	115	7	45.4	55	49	35		
1.83	6.0	22.78	2.60	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		60			1.32	>10
1.98	6.5	31.70	1.86	Sandy Silt to Clayey Silt	ML	medium dense	115	9	51.2	45	53	35		
2.13	7.0	20.40	2.24	Sandy Silt to Clayey Silt	ML	loose	115	6	31.7	60	39	33		
2.28	7.5	14.96	2.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.86	>10
2.45	8.0	14.47	2.22	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		70			0.82	>10
2.60	8.5	14.12	2.28	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.80	>10
2.75	9.0	18.99	2.13	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		65			1.09	>10
2.90	9.5	39.58	0.57	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	53.2	25	54	36		
3.05	10.0	44.27	0.83	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	58.7	25	57	36		
3.20	10.5	53.22	0.91	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	69.8	25	62	37		
3.35	11.0	74.71	0.78	Sand to Silty Sand	SP/SM	dense	115	14	96.8	20	72	38		
3.50	11.5	60.09	0.83	Sand to Silty Sand	SP/SM	medium dense	115	11	77.0	25	65	37		
3.65	12.0	27.50	2.38	Sandy Silt to Clayey Silt	ML	medium dense	115	8	34.8	60	41	34		
3.80	12.5	16.11	2.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.91	>10
3.95	13.0	13.18	2.27	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.74	>10
4.13	13.5	29.89	2.33	Sandy Silt to Clayey Silt	ML	medium dense	115	9	36.6	60	43	34		
4.28	14.0	54.28	1.42	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	65.7	35	60	36		
4.43	14.5	31.10	1.89	Sandy Silt to Clayey Silt	ML	medium dense	115	9	37.3	55	43	34		
4.58	15.0	34.55	1.52	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	41.0	50	46	34		
4.73	15.5	33.56	1.58	Sandy Silt to Clayey Silt	ML	medium dense	115	10	39.4	50	45	34		
4.88	16.0	76.66	0.89	Sand to Silty Sand	SP/SM	medium dense	115	14	89.3	25	69	38		
5.03	16.5	87.16	0.80	Sand to Silty Sand	SP/SM	dense	115	16	100.5	20	73	38		
5.18	17.0	64.44	0.86	Sand to Silty Sand	SP/SM	medium dense	115	12	73.7	25	63	37		
5.33	17.5	60.70	0.84	Sand to Silty Sand	SP/SM	medium dense	115	11	68.8	25	61	37		
5.48	18.0	40.51	1.82	Sandy Silt to Clayey Silt	ML	medium dense	115	12	45.5	50	49	35		
5.65	18.5	52.88	1.03	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	58.9	35	57	36		
5.80	19.0	16.31	2.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		90			0.91	>10
5.95	19.5	12.40	1.54	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.68	9.00
6.10	20.0	11.22	1.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.61	7.13
6.25	20.5	16.91	2.42	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		90			0.95	>10
6.40	21.0	10.27	1.95	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.56	5.88
6.55	21.5	12.45	1.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.68	8.00
6.70	22.0	13.92	2.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.77	9.59
6.85	22.5	39.67	0.80	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	41.2	40	46	34		
7.00	23.0	40.63	0.99	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	41.9	45	47	35		
7.18	23.5	40.08	1.16	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	41.0	45	46	34		
7.33	24.0	40.16	1.30	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	40.8	50	46	34		
7.48	24.5	16.28	1.85	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		90			0.90	>10
7.63	25.0	13.98	1.81	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		95			0.77	8.14
7.78	25.5	14.07	1.52	Sandy Silt to Clayey Silt	ML	very loose	115	4	14.0	95	14	30		
7.93	26.0	15.30	0.99	Sandy Silt to Clayey Silt	ML	very loose	115	4	15.1	80	17	30		
8.08	26.5	10.92	0.59	Sandy Silt to Clayey Silt	ML	very loose	115	3	10.7	85	6	29		
8.23	27.0	11.71	1.26	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.63	5.42
8.38	27.5	11.13	1.51	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.60	4.89
8.53	28.0	11.14	1.07	Sandy Silt to Clayey Silt	ML	very loose	115	3	10.7	100	6	29		
8.68	28.5	11.42	1.54	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	4.78
8.85	29.0	11.56	1.62	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.62	4.78
9.00	29.5	11.48	1.63	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	4.68
9.15	30.0	11.28	1.57	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.60	4.37
9.30	30.5	11.42	1.51	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	4.37
9.45	31.0	11.30	1.11	Sandy Silt to Clayey Silt	ML	very loose	115	3	10.4	100	6	29		
9.60	31.5	59.67	0.96	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	54.7	40	55	36		
9.75	32.0	128.79	0.86	Sand	SP	dense	110	20	117.4	20	77	39		
9.90	32.5	123.04	0.98	Sand to Silty Sand	SP/SM	dense	115	22	111.5	25	76	39		
10.05	33.0	114.61	0.78	Sand	SP	dense	110	18	103.3	25	73	38		
10.20	33.5	155.72	0.76	Sand	SP	dense	110	24	139.7	20	82	40		
10.38	34.0	235.61	0.73	Sand	SP	very dense	110	36	210.3	10	94	41		
10.53	34.5	262.04	0.93	Sand	SP	very dense	110	40	232.7	15	97	42		
10.68	35.0	269.67	0.94	Sand	SP	very dense	110	41	238.3	15	98	42		
10.83	35.5	290.47	0.95	Sand	SP	very dense	110	45	255.5	15	100	42		
10.98	36.0	313.05	0.94	Sand	SP	very dense	110	48	274.0	10	102	42		
11.13	36.5	309.89	0.97	Sand	SP	very dense	110	48	269.9	10	102	42		
11.28	37.0	311.04	1.12	Sand	SP	very dense	110	48	269.6	15	102	42		
11.43	37.5	252.32	1.04	Sand	SP	very dense	110	39	217.7	15	95	41		
11.58	38.0	268.26	0.81	Sand	SP	very dense	110	41	230.4	10	97	42		
11.73	38.5	297.92	0.84	Sand	SP	very dense	110	46	254.7	10	100	42		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-10

Est. GWT (ft): 9

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	310.14	0.88	Sand	SP	very dense	110	48	263.9	10	101	42		
12.05	39.5	302.46	0.90	Sand	SP	very dense	110	47	256.2	10	100	42		
12.20	40.0	277.81	0.95	Sand	SP	very dense	110	43	234.3	15	98	42		
12.35	40.5	257.70	0.87	Sand	SP	very dense	110	40	216.4	15	95	41		
12.50	41.0	240.58	0.92	Sand	SP	very dense	110	37	201.1	15	93	41		
12.65	41.5	242.97	0.87	Sand	SP	very dense	110	37	202.2	15	93	41		
12.80	42.0	231.41	0.84	Sand	SP	very dense	110	36	191.7	15	92	41		
12.95	42.5	187.22	0.94	Sand	SP	dense	110	29	154.5	20	85	40		
13.10	43.0	87.83	2.22	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	72.1	50	63	37		
13.25	43.5	28.63	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.60	>10
13.40	44.0	18.10	2.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.98	6.10
13.58	44.5	16.60	2.60	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.89	5.21
13.73	45.0	15.74	2.91	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.84	4.68
13.88	45.5	15.50	2.78	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.83	4.47
14.03	46.0	17.49	3.17	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	5.42
14.18	46.5	17.32	3.36	Silty Clay to Clay	CL	stiff	125	10		100			0.93	3.91
14.33	47.0	20.60	4.02	Silty Clay to Clay	CL	very stiff	125	12		100			1.12	5.10
14.48	47.5	19.94	4.23	Silty Clay to Clay	CL	very stiff	125	11		100			1.08	4.68
14.63	48.0	16.37	3.02	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	4.57
14.78	48.5	19.39	3.75	Silty Clay to Clay	CL	very stiff	125	11		100			1.05	4.37
14.93	49.0	18.35	4.18	Silty Clay to Clay	CL	stiff	125	10		100			0.99	3.91
15.10	49.5	21.43	4.49	Clay	CL/CH	very stiff	125	17		100			1.17	3.91
15.25	50.0	21.17	4.86	Clay	CL/CH	very stiff	125	17		100			1.15	3.74

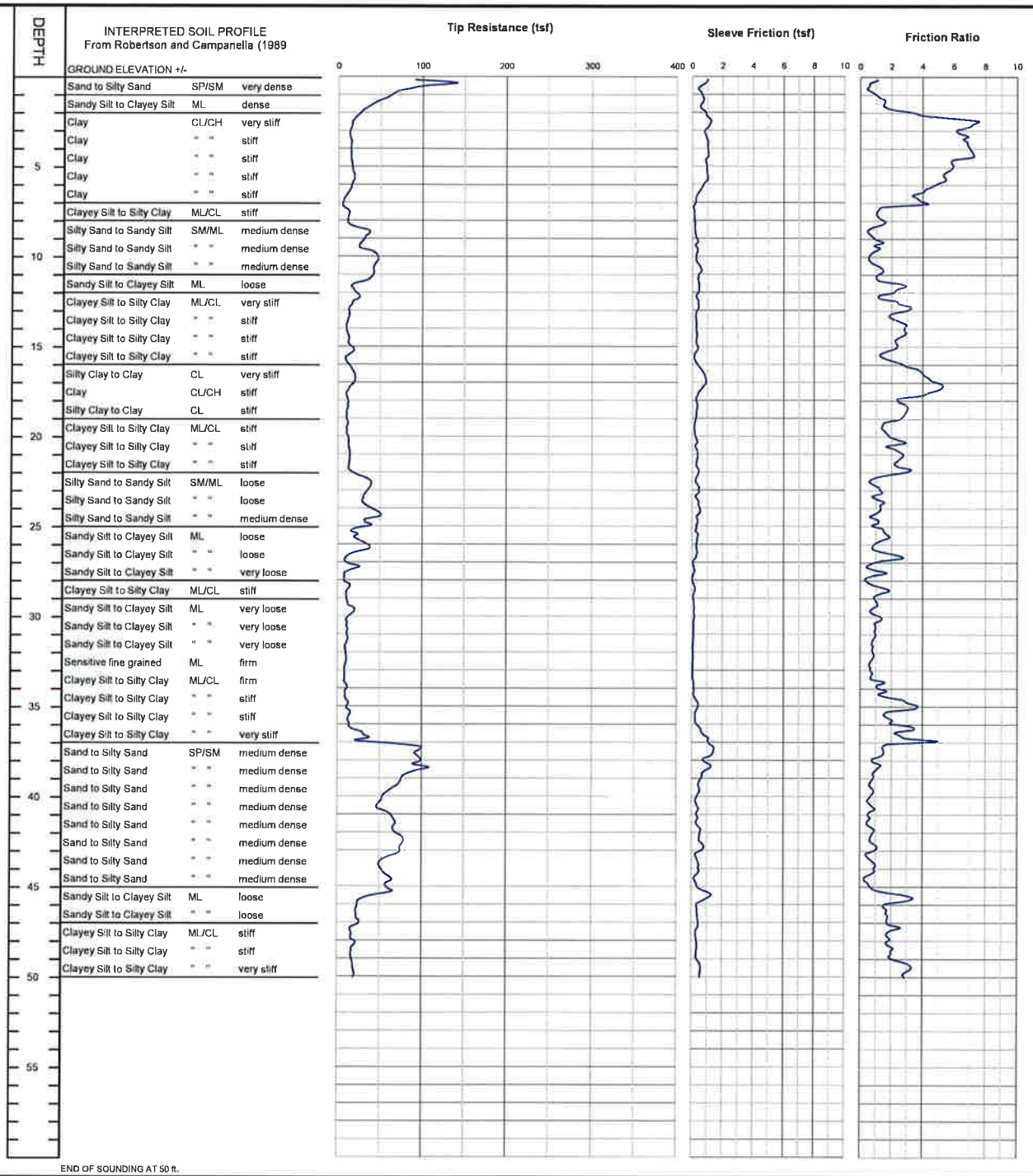
CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-11



END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-11

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-11 Est. GWT (ft): 13 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Densily or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	112.05	0.78	Sand to Silty Sand	SP/SM	very dense	115	20	211.8	10	138	47		
0.30	1.0	73.53	0.75	Sand to Silty Sand	SP/SM	very dense	115	13	139.0	15	109	43		
0.45	1.5	49.42	1.44	Silty Sand to Sandy Silt	SM/ML	dense	115	11	93.4	30	90	41		
0.60	2.0	31.16	2.31	Sandy Silt to Clayey Silt	ML	dense	115	9	58.9	50	71	38		
0.75	2.5	19.66	5.75	Clay	CL/CH	very stiff	125	16		90			1.15	>10
0.93	3.0	15.00	6.78	Clay	CL/CH	stiff	125	12		100			0.87	>10
1.08	3.5	13.48	6.61	Clay	CL/CH	stiff	125	11		100			0.78	>10
1.23	4.0	14.72	6.91	Clay	CL/CH	stiff	125	12		100			0.85	>10
1.38	4.5	14.66	7.19	Clay	CL/CH	stiff	125	12		100			0.85	>10
1.53	5.0	15.44	5.90	Clay	CL/CH	stiff	125	12		100			0.89	>10
1.68	5.5	17.68	5.53	Clay	CL/CH	very stiff	125	14		90			1.02	>10
1.83	6.0	16.50	5.02	Clay	CL/CH	stiff	125	13		90			0.95	>10
1.98	6.5	11.81	3.84	Clay	CL/CH	stiff	125	9		95			0.67	>10
2.13	7.0	6.01	3.94	Clay	CL/CH	firm	125	5		100			0.33	4.37
2.28	7.5	9.83	1.20	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		70			0.55	>10
2.45	8.0	11.30	1.32	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		70			0.64	>10
2.60	8.5	23.46	0.86	Silty Sand to Sandy Silt	SM/ML	loose	115	5	32.2	40	39	33		
2.75	9.0	33.03	0.78	Silty Sand to Sandy Silt	SM/ML	medium dense	115	7	44.1	30	48	35		
2.90	9.5	25.87	1.20	Sandy Silt to Clayey Silt	ML	medium dense	115	7	33.6	45	40	34		
3.05	10.0	43.78	0.71	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	55.5	25	55	36		
3.20	10.5	44.56	0.82	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	55.2	30	55	36		
3.35	11.0	41.51	1.31	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	50.2	40	52	35		
3.50	11.5	30.27	1.54	Sandy Silt to Clayey Silt	ML	medium dense	115	9	35.8	50	42	34		
3.65	12.0	17.76	2.51	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		80			1.00	>10
3.80	12.5	22.13	1.59	Sandy Silt to Clayey Silt	ML	loose	115	6	25.1	65	32	32		
3.95	13.0	13.83	2.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.77	>10
4.13	13.5	12.39	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.68	9.39
4.28	14.0	9.92	2.76	Silty Clay to Clay	CL	stiff	125	6		100			0.54	4.37
4.43	14.5	11.01	2.78	Silty Clay to Clay	CL	stiff	125	6		100			0.60	5.10
4.58	15.0	12.56	2.31	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.69	8.56
4.73	15.5	16.33	1.71	Sandy Silt to Clayey Silt	ML	loose	115	5	17.4	80	21	31		
4.88	16.0	10.61	2.23	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.57	6.00
5.03	16.5	17.77	3.88	Silty Clay to Clay	CL	stiff	125	10		100			0.99	>10
5.18	17.0	18.91	4.71	Clay	CL/CH	very stiff	125	15		100			1.06	8.41
5.33	17.5	11.76	4.86	Clay	CL/CH	stiff	125	9		100			0.64	3.74
5.48	18.0	10.75	2.90	Silty Clay to Clay	CL	stiff	125	6		100			0.58	4.00
5.65	18.5	10.98	2.98	Silty Clay to Clay	CL	stiff	125	6		100			0.59	4.00
5.80	19.0	9.86	2.68	Silty Clay to Clay	CL	stiff	125	6		100			0.52	3.35
5.95	19.5	10.75	1.46	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.58	5.00
6.10	20.0	10.75	1.75	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.58	4.89
6.25	20.5	12.30	2.36	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.67	6.00
6.40	21.0	13.54	2.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.74	6.76
6.55	21.5	13.31	2.39	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.72	6.54
6.70	22.0	13.66	2.82	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.74	6.65
6.85	22.5	31.85	0.99	Silty Sand to Sandy Silt	SM/ML	loose	115	7	30.3	55	37	33		
7.00	23.0	37.43	1.09	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	35.4	50	42	34		
7.18	23.5	30.80	1.07	Silty Sand to Sandy Silt	SM/ML	loose	115	7	28.9	60	36	33		
7.33	24.0	32.66	1.38	Silty Sand to Sandy Silt	SM/ML	loose	115	7	30.5	60	37	33		
7.48	24.5	48.24	0.94	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	44.8	45	49	35		
7.63	25.0	34.74	1.01	Silty Sand to Sandy Silt	SM/ML	loose	115	8	32.1	55	39	33		
7.78	25.5	20.12	1.55	Sandy Silt to Clayey Silt	ML	loose	115	6	18.5	85	23	31		
7.93	26.0	25.04	1.40	Sandy Silt to Clayey Silt	ML	loose	115	7	22.8	75	29	32		
8.08	26.5	27.62	1.37	Sandy Silt to Clayey Silt	ML	loose	115	8	25.0	70	32	32		
8.23	27.0	10.01	1.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.52	3.35
8.38	27.5	17.02	1.01	Sandy Silt to Clayey Silt	ML	very loose	115	5	15.3	85	17	30		
8.53	28.0	7.59	0.51	Sensitive fine grained	ML	firm	120	4		100			0.38	2.41
8.68	28.5	12.82	1.36	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	4.57
8.85	29.0	9.92	1.06	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.51	3.07
9.00	29.5	14.26	0.99	Sandy Silt to Clayey Silt	ML	very loose	115	4	12.5	95	11	30		
9.15	30.0	16.01	0.96	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.9	90	14	30		
9.30	30.5	10.40	1.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.54	3.14
9.45	31.0	11.07	0.96	Sandy Silt to Clayey Silt	ML	very loose	115	3	9.5	100	3	28		
9.60	31.5	11.12	0.81	Sandy Silt to Clayey Silt	ML	very loose	115	3	9.5	100	3	28		
9.75	32.0	8.94	0.81	Sensitive fine grained	ML	firm	120	4		100			0.45	2.82
9.90	32.5	10.03	0.78	Sandy Silt to Clayey Silt	ML	#N/A	115	3	8.5	100	0	28		
10.05	33.0	8.48	0.63	Sensitive fine grained	ML	firm	120	4		100			0.42	2.49
10.20	33.5	8.19	0.74	Sensitive fine grained	ML	firm	120	4		100			0.40	2.27
10.38	34.0	9.92	1.27	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.50	2.57
10.53	34.5	8.88	1.51	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.44	2.13
10.68	35.0	11.44	3.16	Silty Clay to Clay	CL	stiff	125	7		100			0.59	2.41
10.83	35.5	13.26	2.27	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.70	3.83
10.98	36.0	12.66	1.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.66	3.50
11.13	36.5	22.55	2.89	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.24	9.00
11.28	37.0	41.94	3.19	Clayey Silt to Silty Clay	ML/CL	hard	120	17		85			2.38	>10
11.43	37.5	96.30	1.48	Sand to Silty Sand	SP/SM	medium dense	115	18	77.5	40	65	37		
11.58	38.0	96.82	0.99	Sand to Silty Sand	SP/SM	medium dense	115	18	77.6	35	65	37		
11.73	38.5	97.39	1.15	Sand to Silty Sand	SP/SM	medium dense	115	18	77.7	35	65	37		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-11 Est. GWT (ft): 13 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	78.82	0.82	Sand to Silty Sand	SP/SM	medium dense	115	14	62.6	35	59	36		
12.05	39.5	70.00	0.69	Sand to Silty Sand	SP/SM	medium dense	115	13	55.4	35	55	36		
12.20	40.0	56.46	0.76	Sand to Silty Sand	SP/SM	medium dense	115	10	44.5	45	49	35		
12.35	40.5	49.44	0.62	Sand to Silty Sand	SP/SM	medium dense	115	9	38.8	45	44	34		
12.50	41.0	56.77	0.70	Sand to Silty Sand	SP/SM	medium dense	115	10	44.3	45	48	35		
12.65	41.5	67.30	0.54	Sand to Silty Sand	SP/SM	medium dense	115	12	52.3	35	53	35		
12.80	42.0	66.56	0.82	Sand to Silty Sand	SP/SM	medium dense	115	12	51.5	40	53	35		
12.95	42.5	76.87	0.68	Sand to Silty Sand	SP/SM	medium dense	115	14	59.3	35	57	36		
13.10	43.0	74.62	1.00	Sand to Silty Sand	SP/SM	medium dense	115	14	57.3	45	56	36		
13.25	43.5	61.77	0.51	Sand to Silty Sand	SP/SM	medium dense	115	11	47.2	40	50	35		
13.40	44.0	49.90	0.93	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	38.0	55	44	34		
13.58	44.5	57.81	0.65	Sand to Silty Sand	SP/SM	medium dense	115	11	43.8	45	48	35		
13.73	45.0	59.99	0.48	Sand to Silty Sand	SP/SM	medium dense	115	11	45.3	40	49	35		
13.88	45.5	57.61	1.70	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	43.3	60	48	35		
14.03	46.0	27.05	2.70	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.49	9.59
14.18	46.5	22.55	1.63	Sandy Silt to Clayey Silt	ML	very loose	115	6	16.8	100	20	31		
14.33	47.0	24.08	1.77	Sandy Silt to Clayey Silt	ML	loose	115	7	17.9	100	22	31		
14.48	47.5	16.24	2.12	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.85	3.74
14.63	48.0	18.20	1.80	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.4	100	13	30		
14.78	48.5	18.08	1.98	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.96	4.37
14.93	49.0	16.62	2.04	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	3.74
15.10	49.5	18.57	3.16	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.99	4.47
15.25	50.0	19.84	2.88	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.06	4.89

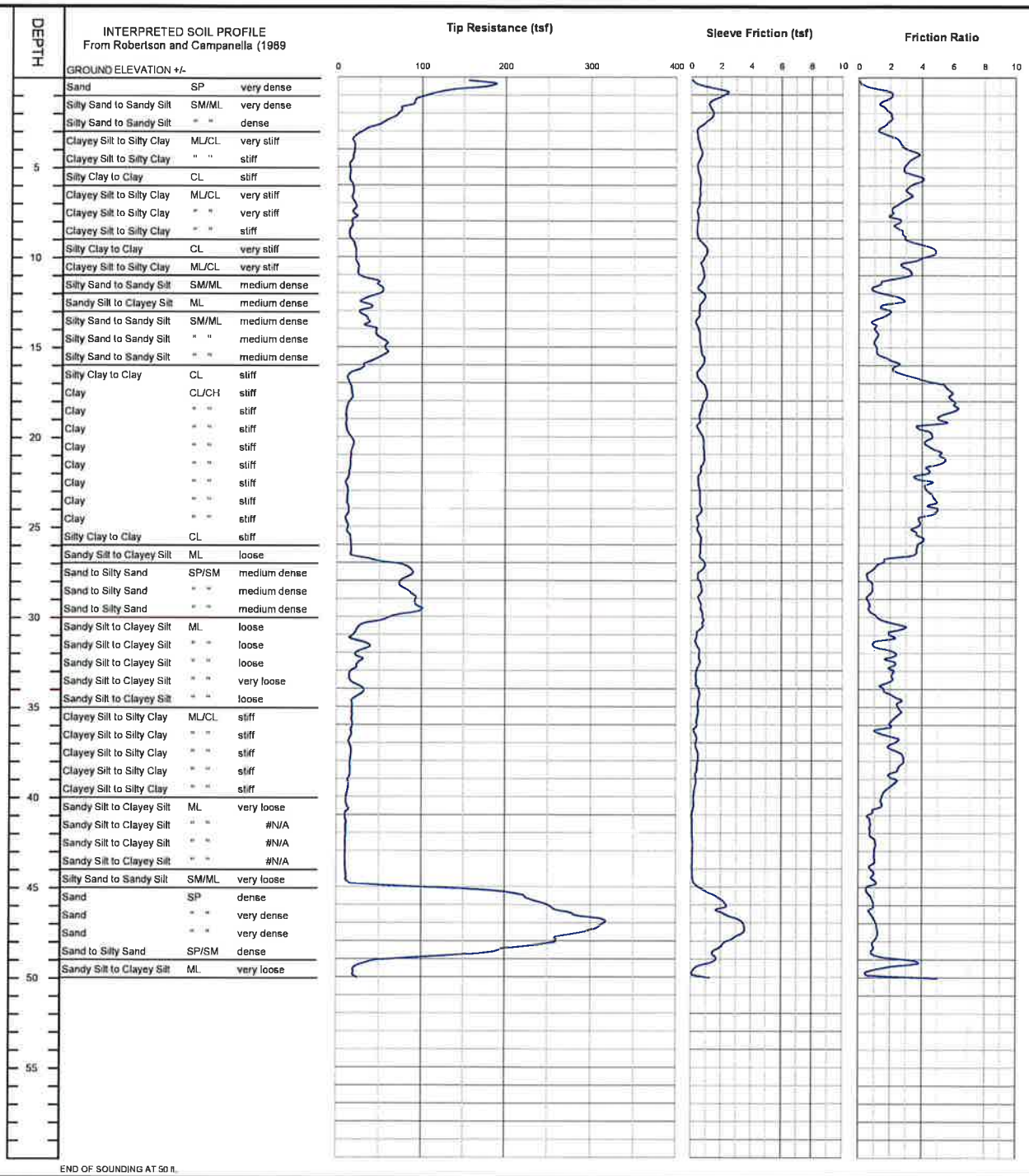
CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-12



Sand	SP	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	dense
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Sandy Silt to Clayey Silt	ML	medium dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Sandy Silt to Clayey Silt	ML	loose
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	medium dense
Sand to Silty Sand	" "	medium dense
Sandy Silt to Clayey Silt	ML	loose
Sandy Silt to Clayey Silt	" "	loose
Sandy Silt to Clayey Silt	" "	loose
Sandy Silt to Clayey Silt	" "	very loose
Sandy Silt to Clayey Silt	" "	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	#N/A
Sandy Silt to Clayey Silt	" "	#N/A
Sandy Silt to Clayey Silt	" "	#N/A
Silty Sand to Sandy Silt	SM/ML	very loose
Sand	SP	dense
Sand	" "	very dense
Sand	" "	very dense
Sand to Silty Sand	SP/SM	dense
Sandy Silt to Clayey Silt	ML	very loose

END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-12

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-12
Est. GWT (ft): 15
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	174.38	0.20	Sand	SP	very dense	110	27	329.6	0	151	49		
0.30	1.0	120.82	1.80	Silty Sand to Sandy Silt	SM/ML	very dense	115	27	228.4	20	124	45		
0.45	1.5	91.69	1.59	Silty Sand to Sandy Silt	SM/ML	very dense	115	20	173.3	25	108	43		
0.60	2.0	74.58	1.81	Silty Sand to Sandy Silt	SM/ML	very dense	115	17	141.0	30	97	42		
0.75	2.5	61.84	2.02	Silty Sand to Sandy Silt	SM/ML	dense	115	14	116.9	35	88	40		
0.93	3.0	38.71	1.44	Silty Sand to Sandy Silt	SM/ML	dense	115	9	73.2	35	71	38		
1.08	3.5	20.34	2.05	Sandy Silt to Clayey Silt	ML	medium dense	115	6	38.4	60	49	35		
1.23	4.0	19.65	2.74	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.14	>10
1.38	4.5	18.73	3.61	Silty Clay to Clay	CL	very stiff	125	11		75			1.09	>10
1.53	5.0	15.11	3.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.87	>10
1.68	5.5	14.39	3.35	Silty Clay to Clay	CL	stiff	125	8		85			0.83	>10
1.83	6.0	16.74	3.55	Silty Clay to Clay	CL	stiff	125	10		80			0.96	>10
1.98	6.5	18.09	3.18	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		75			1.04	>10
2.13	7.0	19.36	2.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.12	>10
2.28	7.5	19.64	2.14	Sandy Silt to Clayey Silt	ML	loose	115	6	29.2	60	36	33		
2.45	8.0	19.18	2.38	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		65			1.10	>10
2.60	8.5	15.65	2.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.89	>10
2.75	9.0	14.99	2.88	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.85	>10
2.90	9.5	20.33	4.16	Silty Clay to Clay	CL	very stiff	125	12		80			1.16	>10
3.05	10.0	21.40	4.54	Clay	CL/CH	very stiff	125	17		85			1.22	>10
3.20	10.5	23.39	3.02	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		70			1.34	>10
3.35	11.0	24.56	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		75			1.41	>10
3.50	11.5	43.57	1.75	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	51.8	45	53	35		
3.65	12.0	52.69	1.04	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	61.3	30	58	36		
3.80	12.5	33.42	2.57	Sandy Silt to Clayey Silt	ML	medium dense	115	10	38.1	60	44	34		
3.95	13.0	35.29	1.60	Sandy Silt to Clayey Silt	ML	medium dense	115	10	39.5	50	45	34		
4.13	13.5	32.55	1.49	Sandy Silt to Clayey Silt	ML	medium dense	115	9	35.7	55	42	34		
4.28	14.0	38.71	0.94	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	41.7	40	47	35		
4.43	14.5	46.88	1.14	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	49.7	40	52	35		
4.58	15.0	56.86	1.01	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	59.2	35	57	36		
4.73	15.5	57.12	1.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	59.1	35	57	36		
4.88	16.0	37.98	2.16	Sandy Silt to Clayey Silt	ML	medium dense	115	11	39.0	60	45	34		
5.03	16.5	18.06	2.53	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		90			1.01	>10
5.18	17.0	13.52	4.50	Clay	CL/CH	stiff	125	11		100			0.74	4.37
5.33	17.5	16.88	5.74	Clay	CL/CH	stiff	125	14		100			0.94	6.21
5.48	18.0	15.96	5.90	Clay	CL/CH	stiff	125	13		100			0.88	5.53
5.65	18.5	11.25	6.13	Clay	CL/CH	stiff	125	9		100			0.60	3.14
5.80	19.0	10.50	5.18	Clay	CL/CH	stiff	125	8		100			0.56	2.82
5.95	19.5	10.44	4.33	Clay	CL/CH	stiff	125	8		100			0.56	2.73
6.10	20.0	14.04	4.57	Clay	CL/CH	stiff	125	11		100			0.77	4.00
6.25	20.5	18.75	4.28	Clay	CL/CH	very stiff	125	15		100			1.04	6.32
6.40	21.0	16.48	5.03	Clay	CL/CH	stiff	125	13		100			0.91	5.00
6.55	21.5	15.66	5.28	Clay	CL/CH	stiff	125	13		100			0.86	4.47
6.70	22.0	14.55	4.37	Clay	CL/CH	stiff	125	12		100			0.79	3.91
6.85	22.5	11.82	3.94	Clay	CL/CH	stiff	125	9		100			0.63	2.82
7.00	23.0	11.88	4.23	Clay	CL/CH	stiff	125	10		100			0.63	2.82
7.18	23.5	12.02	4.67	Clay	CL/CH	stiff	125	10		100			0.64	2.82
7.33	24.0	12.65	4.71	Clay	CL/CH	stiff	125	10		100			0.68	3.00
7.48	24.5	11.91	4.45	Clay	CL/CH	stiff	125	10		100			0.63	2.65
7.63	25.0	11.65	3.81	Clay	CL/CH	stiff	125	9		100			0.62	2.49
7.78	25.5	12.93	3.54	Silty Clay to Clay	CL	stiff	125	7		100			0.69	3.58
7.93	26.0	15.91	3.96	Silty Clay to Clay	CL	stiff	125	9		100			0.86	4.78
8.08	26.5	16.53	3.57	Silty Clay to Clay	CL	stiff	125	9		100			0.90	5.00
8.23	27.0	54.50	1.48	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	47.6	50	51	35		
8.38	27.5	87.66	0.78	Sand to Silty Sand	SP/SM	medium dense	115	16	76.2	30	64	37		
8.53	28.0	78.93	0.63	Sand to Silty Sand	SP/SM	medium dense	115	14	68.3	30	61	37		
8.68	28.5	79.35	0.85	Sand to Silty Sand	SP/SM	medium dense	115	14	68.3	35	61	37		
8.85	29.0	91.49	0.58	Sand to Silty Sand	SP/SM	medium dense	115	17	78.3	25	65	37		
9.00	29.5	95.80	0.65	Sand to Silty Sand	SP/SM	medium dense	115	17	81.6	25	66	37		
9.15	30.0	76.91	0.98	Sand to Silty Sand	SP/SM	medium dense	115	14	65.2	35	60	36		
9.30	30.5	37.10	2.27	Sandy Silt to Clayey Silt	ML	loose	115	11	31.3	75	38	33		
9.45	31.0	21.31	2.16	Sandy Silt to Clayey Silt	ML	loose	115	6	17.9	100	22	31		
9.60	31.5	26.08	1.42	Sandy Silt to Clayey Silt	ML	loose	115	7	21.8	80	27	32		
9.75	32.0	30.14	1.76	Sandy Silt to Clayey Silt	ML	loose	115	9	25.0	80	32	32		
9.90	32.5	26.55	2.07	Sandy Silt to Clayey Silt	ML	loose	115	8	22.0	90	28	32		
10.05	33.0	20.99	2.14	Sandy Silt to Clayey Silt	ML	loose	115	6	17.3	100	21	31		
10.20	33.5	14.84	2.12	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.79	4.47
10.38	34.0	24.68	1.58	Sandy Silt to Clayey Silt	ML	loose	115	7	20.1	85	25	32		
10.53	34.5	27.34	1.99	Sandy Silt to Clayey Silt	ML	loose	115	8	22.2	90	28	32		
10.68	35.0	17.77	2.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.96	5.88
10.83	35.5	17.95	2.58	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.97	5.88
10.98	36.0	17.80	2.09	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.96	5.65
11.13	36.5	17.24	1.55	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.7	100	14	30		
11.28	37.0	14.73	2.29	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	4.00
11.43	37.5	16.88	2.29	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.90	4.89
11.58	38.0	15.96	2.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.85	4.37
11.73	38.5	15.61	2.51	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.83	4.18

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-12 Est. GWT (ft): 15 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	14.41	2.11	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.76	3.66
12.05	39.5	13.83	2.04	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.72	3.43
12.20	40.0	11.91	1.52	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	2.73
12.35	40.5	11.62	1.43	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.59	2.57
12.50	41.0	11.71	0.77	Sandy Silt to Clayey Silt	ML	very loose	115	3	8.9	100	1	28		
12.65	41.5	10.78	0.72	Sandy Silt to Clayey Silt	ML	#N/A	115	3	8.2	100	-1	28		
12.80	42.0	10.64	0.70	Sandy Silt to Clayey Silt	ML	#N/A	115	3	8.1	100	-2	28		
12.95	42.5	10.44	0.94	Sandy Silt to Clayey Silt	ML	#N/A	115	3	7.9	100	-3	28		
13.10	43.0	10.47	1.03	Sandy Silt to Clayey Silt	ML	#N/A	115	3	7.9	100	-3	28		
13.25	43.5	10.07	0.98	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.49	1.92
13.40	44.0	10.32	0.81	Sandy Silt to Clayey Silt	ML	#N/A	115	3	7.7	100	-3	28		
13.58	44.5	11.07	0.89	Sandy Silt to Clayey Silt	ML	#N/A	115	3	8.2	100	-1	28		
13.73	45.0	34.11	0.89	Silty Sand to Sandy Silt	SM/ML	loose	115	8	25.2	70	32	32		
13.88	45.5	193.13	0.58	Sand	SP	dense	110	30	142.4	15	83	40		
14.03	46.0	236.09	0.88	Sand	SP	dense	110	36	173.4	20	89	40		
14.18	46.5	263.56	0.77	Sand	SP	very dense	110	41	193.0	15	92	41		
14.33	47.0	306.69	1.01	Sand	SP	very dense	110	47	223.8	15	96	41		
14.48	47.5	294.77	1.20	Sand	SP	very dense	110	45	214.4	20	95	41		
14.63	48.0	259.49	1.02	Sand	SP	very dense	110	40	188.1	20	91	41		
14.78	48.5	205.84	0.88	Sand	SP	dense	110	32	148.7	20	84	40		
14.93	49.0	101.52	2.01	Silty Sand to Sandy Silt	SM/ML	medium dense	115	23	73.1	50	63	37		
15.10	49.5	25.17	2.31	Sandy Silt to Clayey Silt	ML	loose	115	7	18.1	100	22	31		
15.25	50.0	21.51	2.01	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.4	100	17	30		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

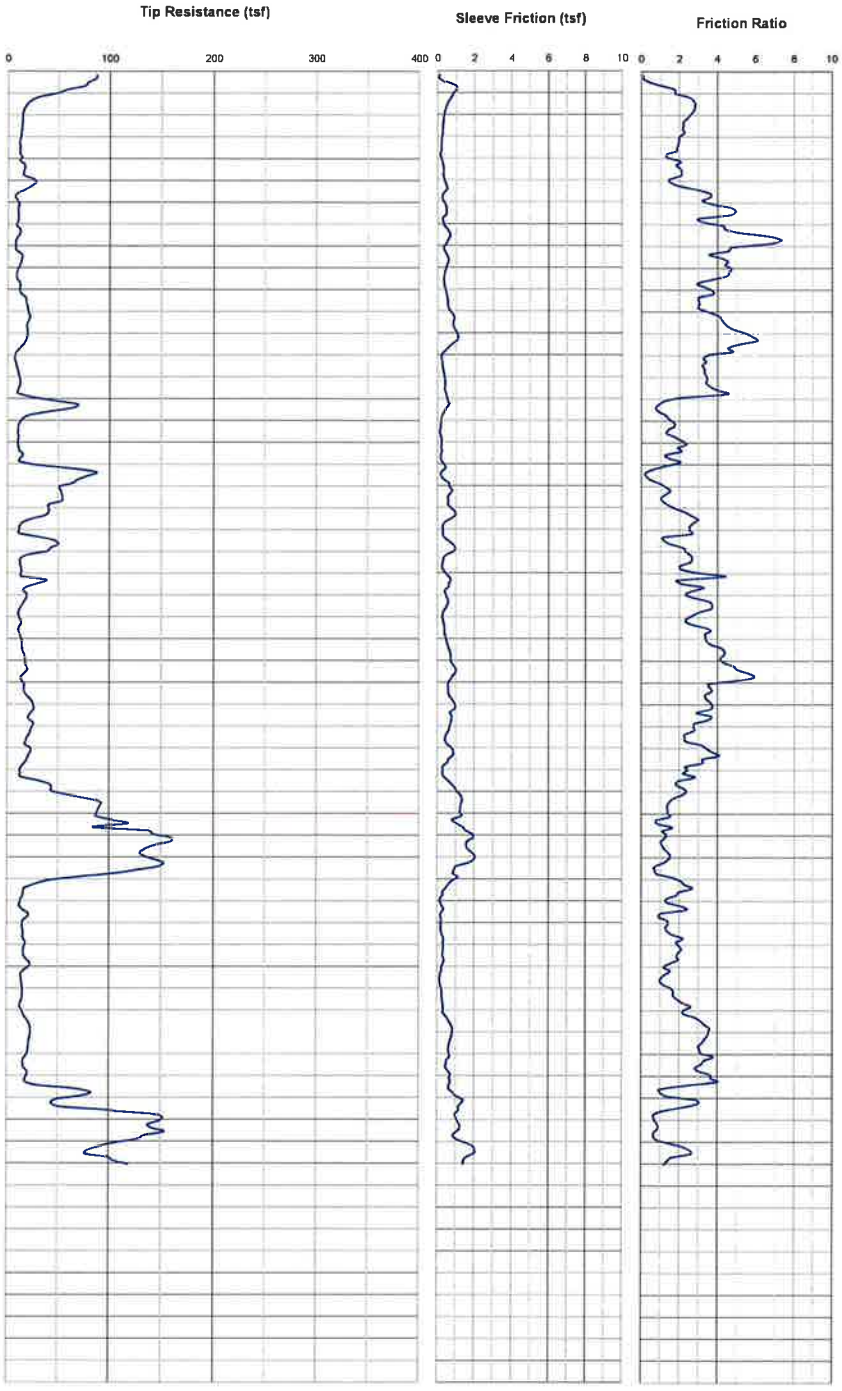
CONE SOUNDING DATA CPT-13

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH			
0	Sand to Silty Sand	SP/SM	very dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
5	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	stiff
10	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clay	CL/CH	very stiff
	Clay	" "	stiff
	Silty Clay to Clay	CL	firm
15	Silty Clay to Clay	" "	stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	very loose
	Sand to Silty Sand	SP/SM	medium dense
20	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	very stiff
25	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	stiff
	Clay	CL/CH	stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
30	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	loose
	Silty Sand to Sandy Silt	SM/ML	medium dense
35	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	very loose
40	Sandy Silt to Clayey Silt	" "	very loose
	Sandy Silt to Clayey Silt	" "	very loose
	Sandy Silt to Clayey Silt	" "	very loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	very stiff
45	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand	SP	dense
50	Silty Sand to Sandy Silt	SM/ML	medium dense
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-13

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-13
Est. GWT (ft): 13
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	84.08	0.24	Sand	SP	very dense	110	13	158.9	5	130	46		
0.30	1.0	61.44	1.58	Silty Sand to Sandy Silt	SM/ML	very dense	115	14	116.1	30	104	43		
0.45	1.5	24.70	2.68	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		60			1.45	>10
0.60	2.0	15.28	2.71	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.89	>10
0.75	2.5	13.99	2.28	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.82	>10
0.93	3.0	13.13	2.15	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		75			0.76	>10
1.08	3.5	11.64	1.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		75			0.67	>10
1.23	4.0	12.47	1.53	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		70			0.72	>10
1.38	4.5	14.94	1.99	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		70			0.86	>10
1.53	5.0	18.70	1.89	Sandy Silt to Clayey Silt	ML	medium dense	115	5	34.3	60	41	34		
1.68	5.5	19.37	2.57	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		65			1.12	>10
1.83	6.0	9.25	3.54	Clay	CL/CH	stiff	125	7		100			0.52	>10
1.98	6.5	10.20	4.75	Clay	CL/CH	stiff	125	8		100			0.58	>10
2.13	7.0	9.48	3.52	Clay	CL/CH	stiff	125	8		100			0.53	>10
2.28	7.5	11.40	5.43	Clay	CL/CH	stiff	125	9		100			0.65	>10
2.45	8.0	7.79	6.26	Clay	CL/CH	firm	125	6		100			0.43	5.53
2.60	8.5	11.86	4.12	Clay	CL/CH	stiff	125	9		100			0.67	>10
2.75	9.0	11.64	4.56	Clay	CL/CH	stiff	125	9		100			0.65	8.85
2.90	9.5	8.88	4.26	Clay	CL/CH	firm	125	7		100			0.49	5.10
3.05	10.0	11.84	3.30	Silty Clay to Clay	CL	stiff	125	7		100			0.66	>10
3.20	10.5	15.91	3.28	Silty Clay to Clay	CL	stiff	125	9		90			0.90	>10
3.35	11.0	19.25	3.18	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		80			1.09	>10
3.50	11.5	20.77	4.19	Silty Clay to Clay	CL	very stiff	125	12		90			1.18	>10
3.65	12.0	18.90	4.98	Clay	CL/CH	very stiff	125	15		100			1.07	>10
3.80	12.5	17.75	5.67	Clay	CL/CH	very stiff	125	14		100			1.00	>10
3.95	13.0	9.93	4.32	Clay	CL/CH	stiff	125	8		100			0.54	3.58
4.13	13.5	7.64	3.29	Clay	CL/CH	firm	125	6		100			0.40	2.41
4.28	14.0	10.20	3.35	Silty Clay to Clay	CL	stiff	125	6		100			0.55	4.47
4.43	14.5	11.92	3.51	Silty Clay to Clay	CL	stiff	125	7		100			0.65	5.65
4.58	15.0	14.71	3.55	Silty Clay to Clay	CL	stiff	125	8		100			0.82	7.70
4.73	15.5	59.78	0.95	Sand to Silty Sand	SP/SM	medium dense	115	11	62.9	30	59	36		
4.88	16.0	22.10	1.36	Sandy Silt to Clayey Silt	ML	loose	115	6	23.1	65	29	32		
5.03	16.5	10.22	1.49	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.55	5.31
5.18	17.0	10.23	2.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.55	5.21
5.33	17.5	12.56	1.76	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.69	7.13
5.48	18.0	18.27	1.61	Sandy Silt to Clayey Silt	ML	loose	115	5	18.5	80	23	31		
5.65	18.5	77.15	0.38	Sand to Silty Sand	SP/SM	medium dense	115	14	77.5	20	65	37		
5.80	19.0	61.16	0.92	Sand to Silty Sand	SP/SM	medium dense	115	11	61.0	35	58	36		
5.95	19.5	53.11	1.27	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	52.6	45	54	35		
6.10	20.0	44.61	1.45	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	43.9	50	48	35		
6.25	20.5	33.70	2.63	Sandy Silt to Clayey Silt	ML	loose	115	10	32.9	75	40	34		
6.40	21.0	12.55	2.60	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	6.00
6.55	21.5	29.01	1.66	Sandy Silt to Clayey Silt	ML	loose	115	8	28.0	65	35	33		
6.70	22.0	44.03	2.05	Sandy Silt to Clayey Silt	ML	medium dense	115	13	42.2	60	47	35		
6.85	22.5	15.05	2.60	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.82	7.70
7.00	23.0	13.21	2.39	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.72	6.00
7.18	23.5	27.20	2.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		85			1.54	>10
7.33	24.0	17.78	2.75	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.98	>10
7.48	24.5	16.32	3.37	Silty Clay to Clay	CL	stiff	125	9		100			0.89	5.88
7.63	25.0	11.32	3.10	Silty Clay to Clay	CL	stiff	125	6		100			0.60	3.28
7.78	25.5	12.84	2.64	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.69	5.10
7.93	26.0	11.92	3.46	Silty Clay to Clay	CL	stiff	125	7		100			0.63	3.35
8.08	26.5	14.61	3.92	Silty Clay to Clay	CL	stiff	125	8		100			0.79	4.47
8.23	27.0	17.15	4.25	Clay	CL/CH	stiff	125	14		100			0.94	4.37
8.38	27.5	18.44	5.14	Clay	CL/CH	very stiff	125	15		100			1.01	4.78
8.53	28.0	14.62	4.80	Clay	CL/CH	stiff	125	12		100			0.79	3.35
8.68	28.5	16.86	3.56	Silty Clay to Clay	CL	stiff	125	10		100			0.92	5.21
8.85	29.0	23.75	3.57	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.32	>10
9.00	29.5	23.67	3.41	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.32	>10
9.15	30.0	23.84	3.03	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.33	>10
9.30	30.5	21.29	2.45	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.18	>10
9.45	31.0	19.50	2.97	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.07	8.27
9.60	31.5	20.88	3.67	Silty Clay to Clay	CL	very stiff	125	12		100			1.15	6.54
9.75	32.0	14.62	2.66	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	4.89
9.90	32.5	18.27	2.33	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			1.00	6.88
10.05	33.0	42.80	2.12	Sandy Silt to Clayey Silt	ML	medium dense	115	12	35.7	70	42	34		
10.20	33.5	76.52	1.75	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	63.6	50	59	36		
10.38	34.0	89.45	1.38	Sand to Silty Sand	SP/SM	medium dense	115	16	74.0	40	64	37		
10.53	34.5	102.61	1.05	Sand to Silty Sand	SP/SM	medium dense	115	19	84.4	35	67	37		
10.68	35.0	121.45	1.36	Sand to Silty Sand	SP/SM	dense	115	22	99.5	35	72	38		
10.83	35.5	154.37	1.12	Sand to Silty Sand	SP/SM	dense	115	28	125.8	25	79	39		
10.98	36.0	132.62	1.38	Sand to Silty Sand	SP/SM	dense	115	24	107.6	35	75	38		
11.13	36.5	142.69	0.99	Sand	SP	dense	110	22	115.3	25	77	39		
11.28	37.0	69.89	1.52	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	56.2	50	55	36		
11.43	37.5	20.25	2.32	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.10	7.00
11.58	38.0	14.07	1.50	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.2	100	8	29		
11.73	38.5	15.89	1.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.85	4.57

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-13 | Est. GWT (ft): 13 | Phi Correlation: 0 | 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	17.29	1.22	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.7	100	14	30		
12.05	39.5	15.51	1.44	Sandy Silt to Clayey Silt	ML	very loose	115	4	12.2	100	10	29		
12.20	40.0	16.98	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.91	4.89
12.35	40.5	16.30	1.97	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	4.47
12.50	41.0	21.11	1.54	Sandy Silt to Clayey Silt	ML	very loose	115	6	16.4	100	19	31		
12.65	41.5	14.68	1.28	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.3	100	8	29		
12.80	42.0	14.82	1.27	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.4	100	8	29		
12.95	42.5	15.22	1.76	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.80	3.83
13.10	43.0	13.59	2.34	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.70	3.21
13.25	43.5	17.84	2.73	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.95	4.78
13.40	44.0	22.81	3.48	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.24	7.00
13.58	44.5	22.20	3.35	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.21	6.65
13.73	45.0	20.80	3.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.12	5.88
13.88	45.5	16.69	3.43	Silty Clay to Clay	CL	stiff	125	10		100			0.88	3.14
14.03	46.0	18.76	3.17	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.00	4.78
14.18	46.5	21.57	3.32	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.17	6.00
14.33	47.0	67.46	1.57	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	49.7	55	52	35		
14.48	47.5	64.98	2.14	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	47.7	65	51	35		
14.63	48.0	148.22	0.70	Sand	SP	dense	110	23	108.4	25	75	38		
14.78	48.5	144.54	0.81	Sand	SP	dense	110	22	105.4	25	74	38		
14.93	49.0	122.92	0.96	Sand to Silty Sand	SP/SM	medium dense	115	22	89.3	35	69	38		
15.10	49.5	82.27	2.45	Sandy Silt to Clayey Silt	ML	medium dense	115	24	59.5	60	57	36		
15.25	50.0	107.32	1.40	Sand to Silty Sand	SP/SM	medium dense	115	20	77.4	45	65	37		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

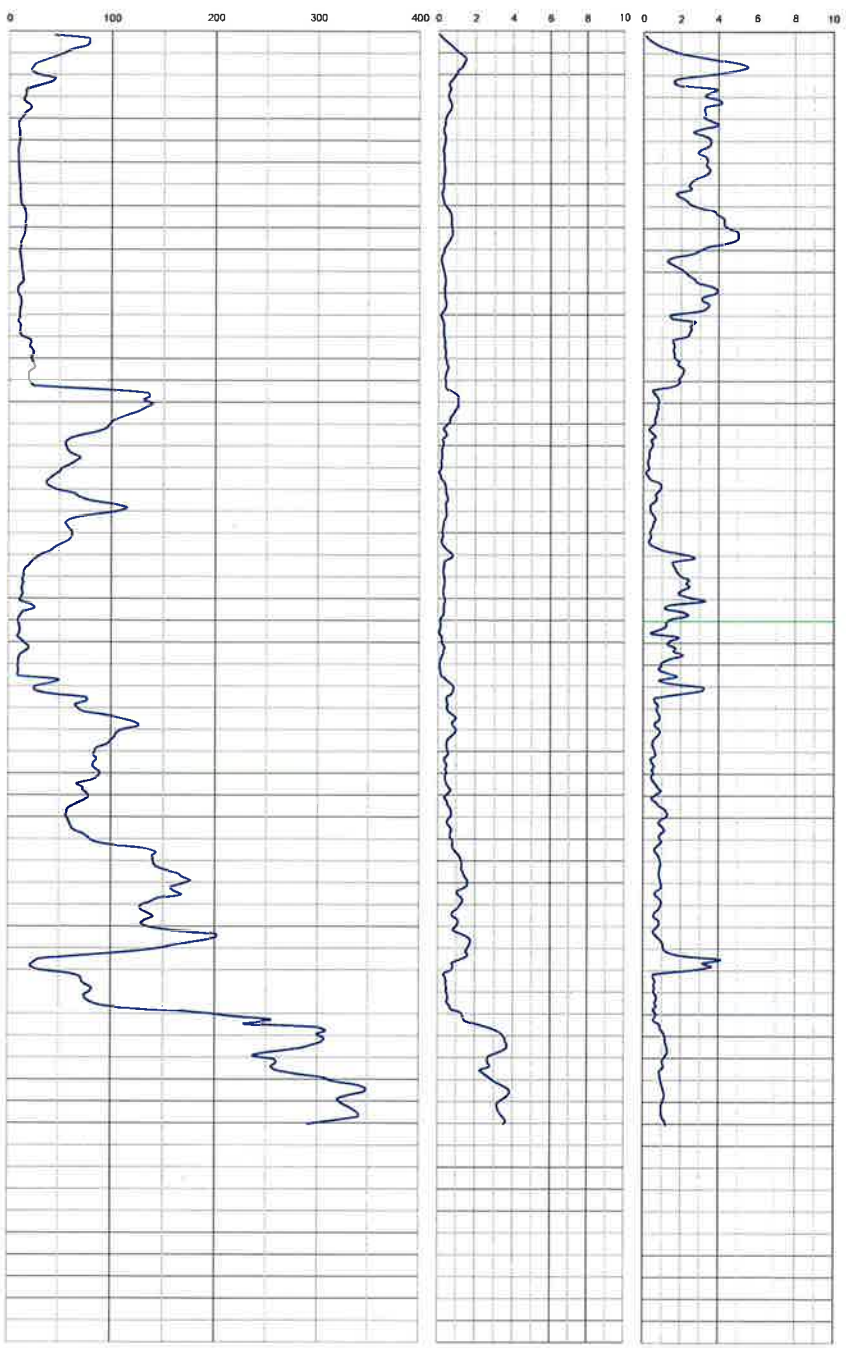
LOCATION: See Site and Boring Location Plan

DATE: 8/13/2020

CONE SOUNDING DATA CPT-14

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Silty Clay to Clay	CL	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
5	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Clay to Clay	CL	stiff
10	Clay	CL/CH	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	loose
15	Sandy Silt to Clayey Silt	" "	loose
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	medium dense
20	Sand to Silty Sand	" "	medium dense
	Sand to Silty Sand	" "	medium dense
	Sand to Silty Sand	" "	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	very loose
25	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	very loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	loose
30	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand	SP	medium dense
	Sand	" "	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	medium dense
35	Sand to Silty Sand	" "	medium dense
	Sand to Silty Sand	" "	medium dense
	Sand	SP	dense
	Sand	" "	dense
	Sand	" "	dense
40	Sand	" "	dense
	Sand	" "	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand	SP	medium dense
45	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
50			
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-14

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-14 | Est. GWT (ft): 20 | Phi Correlation: 0 | 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	67.30	0.32	Sand to Silty Sand	SP/SM	very dense	115	12	127.2	10	123	45		
0.30	1.0	64.31	1.44	Silty Sand to Sandy Silt	SM/ML	very dense	115	14	121.6	25	105	43		
0.45	1.5	35.93	4.09	Clayey Silt to Silty Clay	ML/CL	hard	120	14		60			2.11	>10
0.60	2.0	24.72	4.56	Clay	CL/CH	very stiff	125	20		75			1.45	>10
0.75	2.5	38.32	1.82	Sandy Silt to Clayey Silt	ML	dense	115	11	72.4	40	73	38		
0.93	3.0	16.64	3.57	Silty Clay to Clay	CL	stiff	125	10		80			0.97	>10
1.08	3.5	17.25	3.81	Silty Clay to Clay	CL	very stiff	125	10		80			1.00	>10
1.23	4.0	16.15	3.24	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.94	>10
1.38	4.5	9.54	3.61	Clay	CL/CH	stiff	125	8		100			0.55	>10
1.53	5.0	10.34	3.16	Silty Clay to Clay	CL	stiff	125	6		95			0.59	>10
1.68	5.5	9.14	3.23	Silty Clay to Clay	CL	stiff	125	5		100			0.52	>10
1.83	6.0	8.97	3.36	Clay	CL/CH	stiff	125	7		100			0.51	>10
1.98	6.5	9.49	3.41	Silty Clay to Clay	CL	stiff	125	5		100			0.54	>10
2.13	7.0	10.26	2.59	Silty Clay to Clay	CL	stiff	125	6		90			0.58	>10
2.28	7.5	10.81	2.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		80			0.61	>10
2.45	8.0	12.30	2.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.70	>10
2.60	8.5	16.10	3.93	Silty Clay to Clay	CL	stiff	125	9		85			0.92	>10
2.75	9.0	15.98	4.39	Clay	CL/CH	stiff	125	13		90			0.91	>10
2.90	9.5	14.51	4.96	Clay	CL/CH	stiff	125	12		100			0.82	>10
3.05	10.0	11.36	3.65	Silty Clay to Clay	CL	stiff	125	6		100			0.63	9.00
3.20	10.5	11.13	1.80	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.62	>10
3.35	11.0	12.39	1.90	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.69	>10
3.50	11.5	13.57	2.66	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		95			0.76	>10
3.65	12.0	8.88	3.78	Clay	CL/CH	firm	125	7		100			0.48	3.43
3.80	12.5	11.56	3.25	Silty Clay to Clay	CL	stiff	125	7		100			0.64	6.21
3.95	13.0	10.69	2.60	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.58	7.00
4.13	13.5	10.23	2.25	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.55	6.10
4.28	14.0	11.44	2.44	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.62	6.88
4.43	14.5	20.87	1.61	Sandy Silt to Clayey Silt	ML	loose	115	6	21.8	70	27	32		
4.58	15.0	23.14	1.63	Sandy Silt to Clayey Silt	ML	loose	115	7	23.7	70	30	32		
4.73	15.5	24.29	1.95	Sandy Silt to Clayey Silt	ML	loose	115	7	24.5	75	31	32		
4.88	16.0	20.08	1.99	Sandy Silt to Clayey Silt	ML	loose	115	6	20.0	80	25	31		
5.03	16.5	83.11	0.88	Sand to Silty Sand	SP/SM	medium dense	115	15	81.4	25	66	37		
5.18	17.0	135.77	0.77	Sand	SP	dense	110	21	131.2	20	80	39		
5.33	17.5	125.91	0.73	Sand	SP	dense	110	19	120.0	20	78	39		
5.48	18.0	102.11	0.56	Sand	SP	dense	110	16	96.1	20	71	38		
5.65	18.5	82.16	0.47	Sand to Silty Sand	SP/SM	medium dense	115	15	76.3	20	64	37		
5.80	19.0	57.10	0.45	Sand to Silty Sand	SP/SM	medium dense	115	10	52.4	30	53	35		
5.95	19.5	63.67	0.31	Sand to Silty Sand	SP/SM	medium dense	115	12	57.6	25	56	36		
6.10	20.0	59.45	0.26	Sand to Silty Sand	SP/SM	medium dense	115	11	53.2	25	54	36		
6.25	20.5	44.56	0.25	Sand to Silty Sand	SP/SM	medium dense	115	8	39.6	30	45	34		
6.40	21.0	41.45	0.89	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	36.7	50	43	34		
6.55	21.5	70.72	0.66	Sand to Silty Sand	SP/SM	medium dense	115	13	62.2	30	58	36		
6.70	22.0	107.65	0.39	Sand	SP	dense	110	17	94.2	15	71	38		
6.85	22.5	67.50	0.57	Sand to Silty Sand	SP/SM	medium dense	115	12	58.8	30	57	36		
7.00	23.0	60.02	0.41	Sand to Silty Sand	SP/SM	medium dense	115	11	52.0	30	53	35		
7.18	23.5	57.95	0.35	Sand to Silty Sand	SP/SM	medium dense	115	11	49.9	30	52	35		
7.33	24.0	39.84	1.40	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	34.2	60	41	34		
7.48	24.5	23.57	1.96	Sandy Silt to Clayey Silt	ML	loose	115	7	20.1	90	25	32		
7.63	25.0	15.39	1.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.83	5.42
7.78	25.5	13.74	2.38	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.73	4.37
7.93	26.0	13.05	2.14	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.69	4.00
8.08	26.5	18.50	1.97	Sandy Silt to Clayey Silt	ML	very loose	115	5	15.4	100	17	30		
8.23	27.0	10.21	1.69	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.52	2.65
8.38	27.5	10.61	0.82	Sandy Silt to Clayey Silt	ML	very loose	115	3	8.8	100	1	28		
8.53	28.0	12.76	1.53	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.67	3.58
8.68	28.5	16.21	1.81	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.3	100	13	30		
8.85	29.0	9.52	1.14	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.48	2.27
9.00	29.5	9.66	1.29	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.48	2.27
9.15	30.0	38.86	1.84	Sandy Silt to Clayey Silt	ML	loose	115	11	31.4	70	38	33		
9.30	30.5	47.56	1.84	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	38.2	65	44	34		
9.45	31.0	70.29	0.69	Sand to Silty Sand	SP/SM	medium dense	115	13	56.2	35	55	36		
9.60	31.5	94.20	0.82	Sand to Silty Sand	SP/SM	medium dense	115	17	75.0	30	64	37		
9.75	32.0	120.42	0.71	Sand	SP	dense	110	19	95.4	25	71	38		
9.90	32.5	102.62	0.67	Sand to Silty Sand	SP/SM	medium dense	115	19	81.0	30	66	37		
10.05	33.0	89.60	0.54	Sand to Silty Sand	SP/SM	medium dense	115	16	70.4	30	62	37		
10.20	33.5	84.89	0.50	Sand to Silty Sand	SP/SM	medium dense	115	15	66.4	30	60	36		
10.38	34.0	86.33	0.51	Sand to Silty Sand	SP/SM	medium dense	115	16	67.3	30	61	37		
10.53	34.5	78.99	0.51	Sand to Silty Sand	SP/SM	medium dense	115	14	61.3	30	58	36		
10.68	35.0	74.86	0.78	Sand to Silty Sand	SP/SM	medium dense	115	14	57.8	40	56	36		
10.83	35.5	71.58	0.63	Sand to Silty Sand	SP/SM	medium dense	115	13	55.1	35	55	36		
10.98	36.0	57.46	1.20	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	44.0	55	48	35		
11.13	36.5	61.05	0.97	Sand to Silty Sand	SP/SM	medium dense	115	11	46.6	50	50	35		
11.28	37.0	77.73	0.90	Sand to Silty Sand	SP/SM	medium dense	115	14	59.1	40	57	36		
11.43	37.5	124.21	0.68	Sand	SP	dense	110	19	94.1	25	71	38		
11.58	38.0	140.40	0.85	Sand	SP	dense	110	22	106.0	25	74	38		
11.73	38.5	152.24	0.86	Sand	SP	dense	110	23	114.5	25	76	39		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/13/2020

CONE SOUNDING: CPT-14
Est. GWT (ft): 20
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	171.21	0.89	Sand	SP	dense	110	26	128.3	25	80	39		
12.05	39.5	162.01	0.75	Sand	SP	dense	110	25	121.0	25	78	39		
12.20	40.0	137.90	0.91	Sand	SP	dense	110	21	102.6	30	73	38		
12.35	40.5	134.76	0.65	Sand	SP	dense	110	21	99.9	25	72	38		
12.50	41.0	132.26	0.78	Sand	SP	dense	110	20	97.7	30	72	38		
12.65	41.5	186.71	0.65	Sand	SP	dense	110	29	137.5	20	82	39		
12.80	42.0	162.47	1.03	Sand	SP	dense	110	25	119.2	30	78	39		
12.95	42.5	73.91	2.52	Sandy Silt to Clayey Silt	ML	medium dense	115	21	54.1	65	54	36		
13.10	43.0	25.84	3.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.42	7.85
13.25	43.5	67.49	0.58	Sand to Silty Sand	SP/SM	medium dense	115	12	49.0	40	51	35		
13.40	44.0	79.20	0.56	Sand to Silty Sand	SP/SM	medium dense	115	14	57.3	35	56	36		
13.58	44.5	77.47	0.66	Sand to Silty Sand	SP/SM	medium dense	115	14	55.8	40	55	36		
13.73	45.0	139.71	0.63	Sand	SP	dense	110	21	100.3	25	73	38		
13.88	45.5	234.08	0.68	Sand	SP	dense	110	36	167.5	15	88	40		
14.03	46.0	301.98	1.01	Sand	SP	very dense	110	46	215.4	20	95	41		
14.18	46.5	301.78	1.20	Sand	SP	very dense	110	46	214.6	20	95	41		
14.33	47.0	257.38	1.19	Sand	SP	very dense	110	40	182.4	25	90	41		
14.48	47.5	258.11	0.99	Sand	SP	very dense	110	40	182.4	20	90	41		
14.63	48.0	299.10	0.91	Sand	SP	very dense	110	46	210.7	15	94	41		
14.78	48.5	344.04	1.05	Sand	SP	very dense	110	53	241.6	15	99	42		
14.93	49.0	325.06	1.07	Sand	SP	very dense	110	50	227.5	20	97	42		
15.10	49.5	335.70	0.96	Sand	SP	very dense	110	52	234.3	15	98	42		
15.25	50.0	316.04	1.12	Sand	SP	very dense	110	49	219.9	20	96	41		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

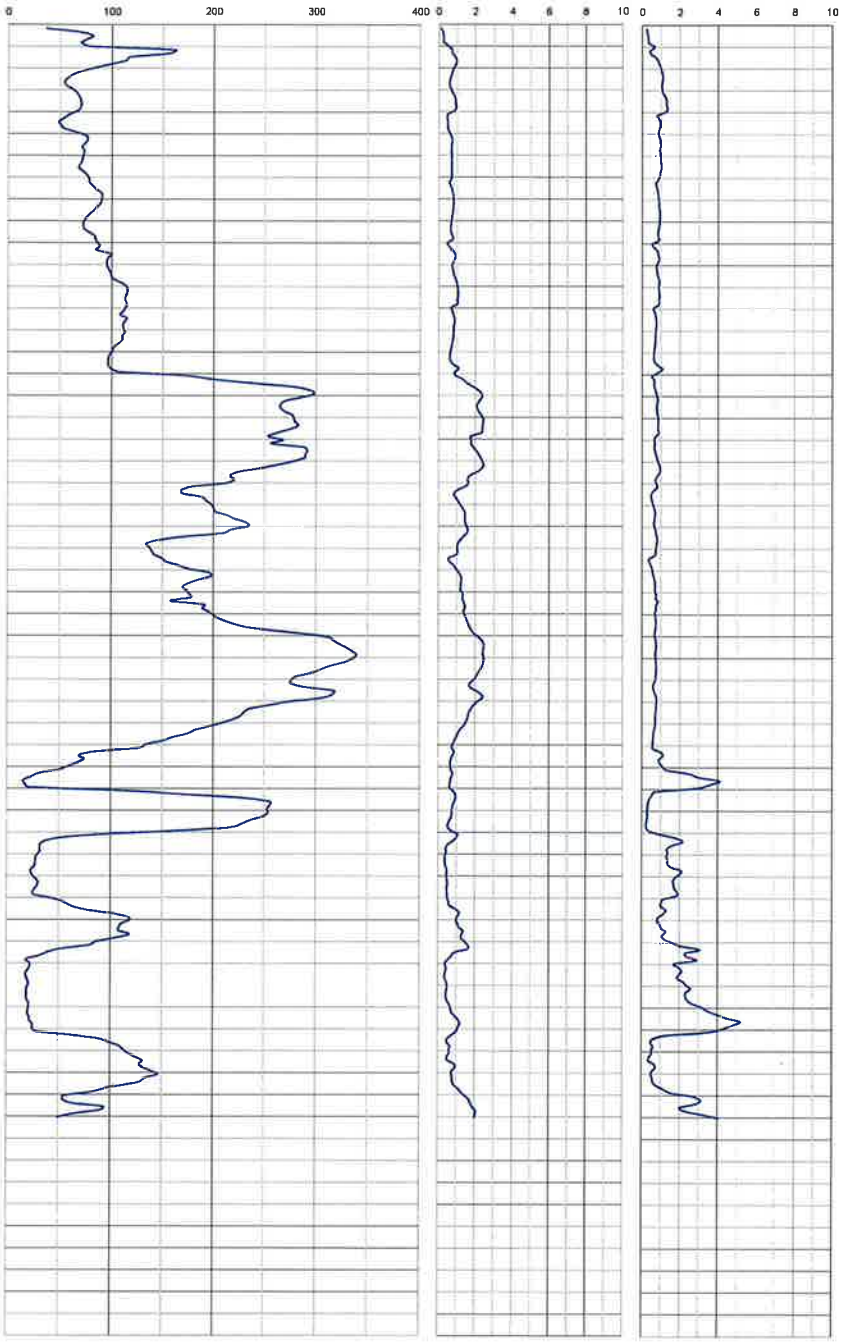
LOCATION: See Site and Boring Location Plan

DATE: 8/14/2020

CONE SOUNDING DATA CPT-15

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Sand	SP	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Silty Sand to Sandy Silt	" "	dense
5	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
10	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand	SP	dense
	Sand	" "	dense
	Sand	" "	dense
15	Sand	" "	dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
20	Sand	" "	very dense
	Sand	" "	dense
	Sand	" "	very dense
	Sand	" "	dense
	Sand	" "	dense
25	Sand	" "	dense
	Sand	" "	dense
	Sand	" "	very dense
	Gravelly Sand to Sand	SW	very dense
	Sand	SP	very dense
30	Gravelly Sand to Sand	SW	very dense
	Sand	SP	very dense
	Sand	" "	dense
	Sand to Silty Sand	SP/SM	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
35	Sand	SP	dense
	Sand	" "	dense
	Sandy Silt to Clayey Silt	ML	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
40	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	medium dense
	Sandy Silt to Clayey Silt	ML	loose
	Sandy Silt to Clayey Silt	" "	very loose
	Clayey Silt to Silty Clay	ML/CL	very stiff
45	Silty Clay to Clay	CL	very stiff
	Sand to Silty Sand	SP/SM	medium dense
	Sand	SP	dense
	Sand to Silty Sand	SP/SM	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
50			
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-15

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-15
Est. GWT (ft): 18
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	62.34	0.28	Sand to Silty Sand	SP/SM	very dense	115	11	117.8	10	120	45		
0.30	1.0	75.00	0.46	Sand to Silty Sand	SP/SM	very dense	115	14	141.8	10	110	43		
0.45	1.5	145.27	0.56	Sand	SP	very dense	110	22	274.6	5	122	45		
0.60	2.0	98.47	0.93	Sand to Silty Sand	SP/SM	very dense	115	18	186.1	15	105	43		
0.75	2.5	63.40	1.09	Silty Sand to Sandy Silt	SM/ML	dense	115	14	119.9	25	89	40		
0.93	3.0	57.39	1.07	Silty Sand to Sandy Silt	SM/ML	dense	115	13	108.5	25	83	40		
1.08	3.5	68.04	1.22	Silty Sand to Sandy Silt	SM/ML	dense	115	15	128.6	25	85	40		
1.23	4.0	68.98	1.31	Silty Sand to Sandy Silt	SM/ML	dense	115	15	130.4	25	83	40		
1.38	4.5	53.82	0.89	Silty Sand to Sandy Silt	SM/ML	dense	115	12	101.7	25	74	38		
1.53	5.0	56.70	0.90	Sand to Silty Sand	SP/SM	dense	115	10	105.7	20	74	38		
1.68	5.5	74.54	0.93	Sand to Silty Sand	SP/SM	dense	115	14	132.2	20	81	39		
1.83	6.0	72.55	0.95	Sand to Silty Sand	SP/SM	dense	115	13	122.9	20	79	39		
1.98	6.5	69.56	0.99	Sand to Silty Sand	SP/SM	dense	115	13	113.0	20	76	39		
2.13	7.0	75.60	0.92	Sand to Silty Sand	SP/SM	dense	115	14	118.2	20	77	39		
2.28	7.5	81.81	0.78	Sand to Silty Sand	SP/SM	dense	115	15	123.4	15	79	39		
2.45	8.0	90.24	0.87	Sand to Silty Sand	SP/SM	dense	115	16	131.6	15	81	39		
2.60	8.5	85.53	0.92	Sand to Silty Sand	SP/SM	dense	115	16	120.9	15	78	39		
2.75	9.0	75.52	0.93	Sand to Silty Sand	SP/SM	dense	115	14	103.6	20	74	38		
2.90	9.5	74.62	0.87	Sand to Silty Sand	SP/SM	dense	115	14	99.6	20	72	38		
3.05	10.0	84.89	0.77	Sand to Silty Sand	SP/SM	dense	115	15	110.4	15	75	39		
3.20	10.5	91.22	0.77	Sand to Silty Sand	SP/SM	dense	115	17	115.6	15	77	39		
3.35	11.0	95.68	0.85	Sand to Silty Sand	SP/SM	dense	115	17	118.4	15	77	39		
3.50	11.5	97.92	0.80	Sand to Silty Sand	SP/SM	dense	115	18	118.5	15	77	39		
3.65	12.0	107.73	0.89	Sand to Silty Sand	SP/SM	dense	115	20	127.5	15	80	39		
3.80	12.5	114.61	0.91	Sand to Silty Sand	SP/SM	dense	115	21	132.9	15	81	39		
3.95	13.0	113.63	0.80	Sand to Silty Sand	SP/SM	dense	115	21	129.1	15	80	39		
4.13	13.5	111.27	0.71	Sand	SP	dense	110	17	124.1	15	79	39		
4.28	14.0	111.30	0.74	Sand	SP	dense	110	17	121.9	15	78	39		
4.43	14.5	111.21	0.70	Sand	SP	dense	110	17	119.8	15	78	39		
4.58	15.0	103.28	0.66	Sand to Silty Sand	SP/SM	dense	115	19	109.3	15	75	39		
4.73	15.5	97.24	0.63	Sand	SP	dense	110	15	101.3	20	73	38		
4.88	16.0	118.34	0.82	Sand	SP	dense	110	18	121.4	20	78	39		
5.03	16.5	235.15	0.65	Sand	SP	very dense	110	36	237.5	10	98	42		
5.18	17.0	292.74	0.77	Sand	SP	very dense	110	45	291.4	10	104	43		
5.33	17.5	266.93	0.80	Sand	SP	very dense	110	41	262.0	10	101	42		
5.48	18.0	274.76	0.83	Sand	SP	very dense	110	42	266.0	10	101	42		
5.65	18.5	278.61	0.85	Sand	SP	very dense	110	43	268.1	10	102	42		
5.80	19.0	261.04	0.75	Sand	SP	very dense	110	40	249.7	10	100	42		
5.95	19.5	278.64	0.68	Sand	SP	very dense	110	43	265.1	10	101	42		
6.10	20.0	284.66	0.80	Sand	SP	very dense	110	44	269.3	10	102	42		
6.25	20.5	242.14	0.94	Sand	SP	very dense	110	37	227.8	15	97	42		
6.40	21.0	216.19	0.75	Sand	SP	very dense	110	33	202.2	10	93	41		
6.55	21.5	172.45	0.64	Sand	SP	dense	110	27	160.4	15	86	40		
6.70	22.0	193.03	0.54	Sand	SP	dense	110	30	178.6	10	90	41		
6.85	22.5	204.74	0.67	Sand	SP	very dense	110	31	188.4	10	91	41		
7.00	23.0	228.99	0.64	Sand	SP	very dense	110	35	209.6	10	94	41		
7.18	23.5	199.36	0.75	Sand	SP	very dense	110	31	181.6	15	90	41		
7.33	24.0	139.03	0.77	Sand	SP	dense	110	21	126.0	20	79	39		
7.48	24.5	143.29	0.60	Sand	SP	dense	110	22	129.2	15	80	39		
7.63	25.0	164.75	0.47	Sand	SP	dense	110	25	147.7	10	84	40		
7.78	25.5	192.89	0.61	Sand	SP	dense	110	30	172.1	10	89	40		
7.93	26.0	173.04	0.69	Sand	SP	dense	110	27	153.6	15	85	40		
8.08	26.5	175.82	0.77	Sand	SP	dense	110	27	155.3	15	85	40		
8.23	27.0	194.67	0.72	Sand	SP	dense	110	30	171.1	15	88	40		
8.38	27.5	216.51	0.73	Sand	SP	very dense	110	33	189.4	15	91	41		
8.53	28.0	283.13	0.69	Sand	SP	very dense	110	44	246.5	10	99	42		
8.68	28.5	323.91	0.75	Gravelly Sand to Sand	SW	very dense	115	43	280.6	10	103	42		
8.85	29.0	336.73	0.72	Gravelly Sand to Sand	SW	very dense	115	45	290.2	10	104	43		
9.00	29.5	315.92	0.75	Gravelly Sand to Sand	SW	very dense	115	42	270.9	10	102	42		
9.15	30.0	284.35	0.72	Sand	SP	very dense	110	44	242.6	10	99	42		
9.30	30.5	294.67	0.62	Gravelly Sand to Sand	SW	very dense	115	39	250.2	10	100	42		
9.45	31.0	299.27	0.76	Sand	SP	very dense	110	46	252.9	10	100	42		
9.60	31.5	240.35	0.74	Sand	SP	very dense	110	37	202.2	15	93	41		
9.75	32.0	218.06	0.71	Sand	SP	very dense	110	34	182.7	15	90	41		
9.90	32.5	183.62	0.64	Sand	SP	dense	110	28	153.1	15	85	40		
10.05	33.0	148.18	0.59	Sand	SP	dense	110	23	123.0	20	79	39		
10.20	33.5	93.98	0.91	Sand to Silty Sand	SP/SM	medium dense	115	17	77.7	30	65	37		
10.38	34.0	67.46	0.99	Sand to Silty Sand	SP/SM	medium dense	115	12	55.5	40	55	36		
10.53	34.5	34.98	2.28	Sandy Silt to Clayey Silt	ML	loose	115	10	28.6	80	36	33		
10.68	35.0	17.81	3.57	Silty Clay to Clay	CL	stiff	125	10		100			0.96	4.37
10.83	35.5	174.16	0.55	Sand	SP	dense	110	27	141.2	15	83	40		
10.98	36.0	254.68	0.31	Gravelly Sand to Sand	SW	very dense	115	34	205.6	5	94	41		
11.13	36.5	242.14	0.27	Gravelly Sand to Sand	SW	very dense	115	32	194.6	5	92	41		
11.28	37.0	163.20	0.57	Sand	SP	dense	110	25	130.6	15	80	39		
11.43	37.5	40.24	1.87	Sandy Silt to Clayey Silt	ML	loose	115	11	32.1	70	39	33		
11.58	38.0	30.61	1.35	Silty Sand to Sandy Silt	SM/ML	loose	115	7	24.3	75	31	32		
11.73	38.5	27.07	1.42	Sandy Silt to Clayey Silt	ML	loose	115	8	21.4	80	27	32		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-15
Est. GWT (ft): 18
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	24.02	1.95	Sandy Silt to Clayey Silt	ML	loose	115	7	18.9	95	23	31		
12.05	39.5	28.94	1.69	Sandy Silt to Clayey Silt	ML	loose	115	8	22.7	85	29	32		
12.20	40.0	31.61	1.64	Sandy Silt to Clayey Silt	ML	loose	115	9	24.7	80	31	32		
12.35	40.5	64.38	1.12	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	50.0	50	52	35		
12.50	41.0	111.36	0.97	Sand to Silty Sand	SP/SM	medium dense	115	20	86.1	30	68	38		
12.65	41.5	108.89	1.09	Sand to Silty Sand	SP/SM	medium dense	115	20	83.9	35	67	37		
12.80	42.0	102.85	1.33	Sand to Silty Sand	SP/SM	medium dense	115	19	78.9	40	65	37		
12.95	42.5	57.39	2.48	Sandy Silt to Clayey Silt	ML	medium dense	115	16	43.8	70	48	35		
13.10	43.0	23.91	2.34	Sandy Silt to Clayey Silt	ML	loose	115	7	18.2	100	22	31		
13.25	43.5	20.14	2.02	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.3	100	17	30		
13.40	44.0	19.99	2.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.08	5.65
13.58	44.5	19.02	2.41	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	5.10
13.73	45.0	20.42	2.72	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.10	5.65
13.88	45.5	20.74	3.93	Silty Clay to Clay	CL	very stiff	125	12		100			1.12	4.18
14.03	46.0	23.91	4.75	Clay	CL/CH	very stiff	125	19		100			1.31	4.09
14.18	46.5	60.67	1.80	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	44.8	65	49	35		
14.33	47.0	108.55	0.54	Sand	SP	medium dense	110	17	79.9	25	66	37		
14.48	47.5	127.93	0.49	Sand	SP	dense	110	20	93.8	25	71	38		
14.63	48.0	138.75	0.60	Sand	SP	dense	110	21	101.4	25	73	38		
14.78	48.5	124.19	0.67	Sand	SP	medium dense	110	19	90.4	25	70	38		
14.93	49.0	76.21	1.83	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	55.3	55	55	36		
15.10	49.5	69.70	2.68	Sandy Silt to Clayey Silt	ML	medium dense	115	20	50.4	70	52	35		
15.25	50.0	67.95	3.17	Sandy Silt to Clayey Silt	ML	medium dense	115	19	49.0	75	51	35		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

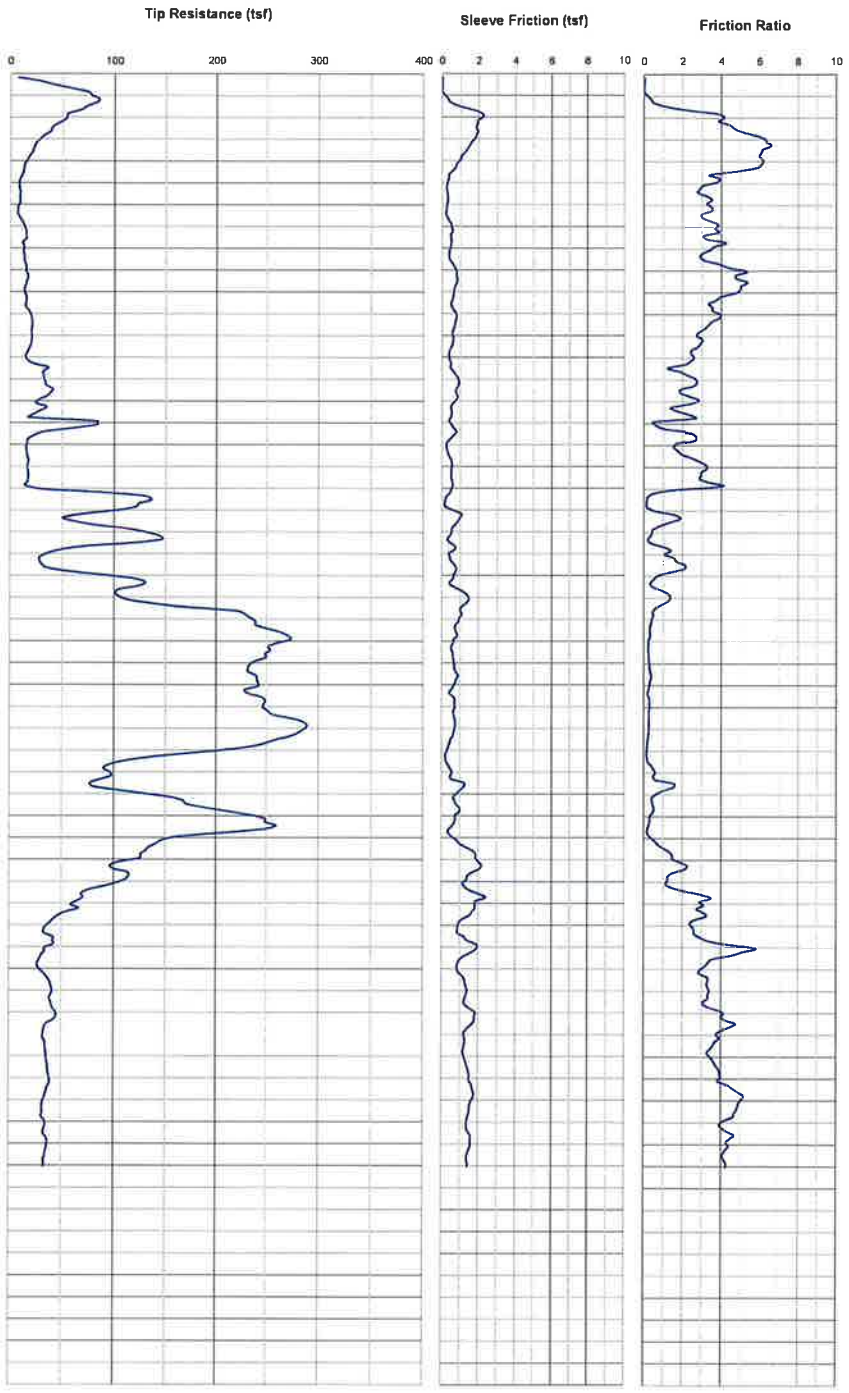
LOCATION: See Site and Boring Location Plan

DATE: 8/14/2020

CONE SOUNDING DATA CPT-16

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	very dense
	Silty Clay to Clay	CL	hard
	Clay	CL/CH	very stiff
5	Clay	" "	stiff
	Silty Clay to Clay	CL	firm
	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	stiff
10	Clay	CL/CH	stiff
	Silty Clay to Clay	CL	stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
15	Sandy Silt to Clayey Silt	" "	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	very stiff
20	Sand	SP	dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand	SP	dense
25	Sand	" "	very dense
	Gravelly Sand to Sand	SW	very dense
	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
30	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
	Sand	SP	dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand	SP	dense
35	Gravelly Sand to Sand	SW	very dense
	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	medium dense
40	Clayey Silt to Silty Clay	ML/CL	hard
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	hard
	Clayey Silt to Silty Clay	" "	hard
	Clayey Silt to Silty Clay	" "	hard
45	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	hard
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Silty Clay to Clay	" "	very stiff
50	Silty Clay to Clay	" "	very stiff
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-16

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-16

Est. GWT (ft): 7

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	26.04	0.01	Silty Sand to Sandy Silt	SM/ML	very dense	115	6	49.2	25	95	41		
0.30	1.0	70.10	0.07	Sand to Silty Sand	SP/SM	very dense	115	13	132.5	5	108	43		
0.45	1.5	80.08	0.69	Sand to Silty Sand	SP/SM	very dense	115	15	151.4	15	104	43		
0.60	2.0	58.85	3.47	Clayey Silt to Silty Clay	ML/CL	hard	120	24		45			3.46	>10
0.75	2.5	44.72	4.30	Silty Clay to Clay	CL	hard	125	26		60			2.62	>10
0.93	3.0	33.18	5.69	Clay	CL/CH	very stiff	125	27		75			1.94	>10
1.08	3.5	23.15	6.37	Clay	CL/CH	very stiff	125	19		90			1.35	>10
1.23	4.0	17.78	6.08	Clay	CL/CH	very stiff	125	14		95			1.03	>10
1.38	4.5	12.62	5.58	Clay	CL/CH	stiff	125	10		100			0.73	>10
1.53	5.0	9.46	3.68	Clay	CL/CH	stiff	125	8		100			0.54	>10
1.68	5.5	8.61	2.99	Silty Clay to Clay	CL	firm	125	5		100			0.49	>10
1.83	6.0	8.15	3.41	Clay	CL/CH	firm	125	7		100			0.46	>10
1.98	6.5	7.31	3.17	Clay	CL/CH	firm	125	6		100			0.41	6.88
2.13	7.0	12.25	3.64	Silty Clay to Clay	CL	stiff	125	7		90			0.70	>10
2.28	7.5	14.72	3.40	Silty Clay to Clay	CL	stiff	125	8		85			0.84	>10
2.45	8.0	12.07	3.76	Clay	CL/CH	stiff	125	10		95			0.68	>10
2.60	8.5	12.72	3.02	Silty Clay to Clay	CL	stiff	125	7		85			0.72	>10
2.75	9.0	14.48	4.55	Clay	CL/CH	stiff	125	12		95			0.82	>10
2.90	9.5	15.83	4.96	Clay	CL/CH	stiff	125	13		95			0.90	>10
3.05	10.0	13.48	4.91	Clay	CL/CH	stiff	125	11		100			0.76	>10
3.20	10.5	14.68	3.68	Silty Clay to Clay	CL	stiff	125	8		90			0.83	>10
3.35	11.0	16.86	3.67	Silty Clay to Clay	CL	stiff	125	10		85			0.96	>10
3.50	11.5	20.28	3.56	Silty Clay to Clay	CL	very stiff	125	12		80			1.16	>10
3.65	12.0	19.91	2.88	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		75			1.14	>10
3.80	12.5	19.33	2.91	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		75			1.10	>10
3.95	13.0	15.41	2.49	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.87	>10
4.13	13.5	25.16	1.91	Sandy Silt to Clayey Silt	ML	loose	115	7	31.3	60	38	33		
4.28	14.0	31.55	2.26	Sandy Silt to Clayey Silt	ML	medium dense	115	9	38.8	55	45	34		
4.43	14.5	36.14	2.38	Sandy Silt to Clayey Silt	ML	medium dense	115	10	44.0	55	48	35		
4.58	15.0	33.50	2.37	Sandy Silt to Clayey Silt	ML	medium dense	115	10	40.4	60	46	34		
4.73	15.5	29.28	1.81	Sandy Silt to Clayey Silt	ML	medium dense	115	8	34.9	55	41	34		
4.88	16.0	51.52	1.51	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	60.9	40	58	36		
5.03	16.5	37.46	2.09	Sandy Silt to Clayey Silt	ML	medium dense	115	11	43.8	55	48	35		
5.18	17.0	15.75	1.96	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.89	>10
5.33	17.5	15.57	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.87	>10
5.48	18.0	16.46	3.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		95			0.93	>10
5.65	18.5	16.64	2.93	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		90			0.93	>10
5.80	19.0	20.22	3.02	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		85			1.14	>10
5.95	19.5	119.84	0.26	Sand	SP	dense	110	18	132.3	5	81	39		
6.10	20.0	114.79	0.30	Sand	SP	dense	110	18	125.8	10	79	39		
6.25	20.5	59.77	1.61	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	65.0	40	60	36		
6.40	21.0	107.48	0.56	Sand	SP	dense	110	17	116.0	15	77	39		
6.55	21.5	136.56	0.29	Sand	SP	dense	110	21	146.3	5	84	40		
6.70	22.0	50.19	1.15	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	53.4	40	54	36		
6.85	22.5	28.75	1.76	Sandy Silt to Clayey Silt	ML	loose	115	8	30.3	65	37	33		
7.00	23.0	61.50	1.35	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	64.4	40	59	36		
7.18	23.5	124.45	0.41	Sand	SP	dense	110	19	129.3	10	80	39		
7.33	24.0	103.54	1.14	Sand to Silty Sand	SP/SM	dense	115	19	106.8	25	74	38		
7.48	24.5	141.43	0.92	Sand	SP	dense	110	22	144.9	20	83	40		
7.63	25.0	227.60	0.44	Sand	SP	very dense	110	35	231.7	5	97	42		
7.78	25.5	243.29	0.32	Gravelly Sand to Sand	SW	very dense	115	32	246.0	0	99	42		
7.93	26.0	269.33	0.27	Gravelly Sand to Sand	SW	very dense	115	36	270.4	0	102	42		
8.08	26.5	253.39	0.22	Gravelly Sand to Sand	SW	very dense	115	34	252.6	0	100	42		
8.23	27.0	240.77	0.26	Gravelly Sand to Sand	SW	very dense	115	32	238.4	0	98	42		
8.38	27.5	234.27	0.32	Gravelly Sand to Sand	SW	very dense	115	31	230.4	5	97	42		
8.53	28.0	241.28	0.29	Gravelly Sand to Sand	SW	very dense	115	32	235.7	0	98	42		
8.68	28.5	234.63	0.22	Gravelly Sand to Sand	SW	very dense	115	31	227.7	0	97	42		
8.85	29.0	247.48	0.28	Gravelly Sand to Sand	SW	very dense	115	33	238.6	0	98	42		
9.00	29.5	260.24	0.25	Gravelly Sand to Sand	SW	very dense	115	35	249.3	0	99	42		
9.15	30.0	287.17	0.24	Gravelly Sand to Sand	SW	very dense	115	38	273.4	0	102	42		
9.30	30.5	270.51	0.20	Gravelly Sand to Sand	SW	very dense	115	36	255.9	0	100	42		
9.45	31.0	228.03	0.15	Gravelly Sand to Sand	SW	very dense	115	30	214.4	0	95	41		
9.60	31.5	134.07	0.15	Sand	SP	dense	110	21	125.3	5	79	39		
9.75	32.0	93.48	0.47	Sand	SP	medium dense	110	14	86.9	20	68	38		
9.90	32.5	87.40	0.87	Sand to Silty Sand	SP/SM	medium dense	115	16	80.8	30	66	37		
10.05	33.0	103.32	1.04	Sand to Silty Sand	SP/SM	dense	115	19	94.9	30	71	38		
10.20	33.5	164.67	0.42	Sand	SP	dense	110	25	150.5	10	85	40		
10.38	34.0	212.03	0.42	Sand	SP	very dense	110	33	192.7	5	92	41		
10.53	34.5	252.35	0.26	Gravelly Sand to Sand	SW	very dense	115	34	228.1	5	97	42		
10.68	35.0	204.91	0.22	Sand	SP	very dense	110	32	184.3	5	91	41		
10.83	35.5	140.41	0.73	Sand	SP	dense	110	22	125.6	20	79	39		
10.98	36.0	127.33	1.41	Sand to Silty Sand	SP/SM	dense	115	23	113.3	30	76	39		
11.13	36.5	103.93	1.91	Silty Sand to Sandy Silt	SM/ML	dense	115	23	92.0	40	70	38		
11.28	37.0	108.77	1.18	Sand to Silty Sand	SP/SM	dense	115	20	95.8	30	71	38		
11.43	37.5	76.84	2.13	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	67.3	50	61	37		
11.58	38.0	64.28	3.14	Sandy Silt to Clayey Silt	ML	medium dense	115	18	56.0	65	55	36		
11.73	38.5	55.53	3.00	Sandy Silt to Clayey Silt	ML	medium dense	115	16	48.1	70	51	35		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-16 Est. GWT (ft): 7 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	38.55	2.52	Sandy Silt to Clayey Silt	ML	loose	115	11	33.2	75	40	34		
12.05	39.5	36.14	2.70	Sandy Silt to Clayey Silt	ML	loose	115	10	31.0	80	38	33		
12.20	40.0	39.12	4.50	Silty Clay to Clay	CL	hard	125	22		95			2.22	>10
12.35	40.5	31.03	4.36	Silty Clay to Clay	CL	very stiff	125	18		100			1.75	>10
12.50	41.0	27.48	3.12	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.54	>10
12.65	41.5	35.08	3.14	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		90			1.98	>10
12.80	42.0	40.10	3.31	Clayey Silt to Silty Clay	ML/CL	hard	120	16		85			2.28	>10
12.95	42.5	39.24	3.21	Clayey Silt to Silty Clay	ML/CL	hard	120	16		85			2.23	>10
13.10	43.0	42.25	3.65	Clayey Silt to Silty Clay	ML/CL	hard	120	17		85			2.40	>10
13.25	43.5	41.13	4.30	Silty Clay to Clay	CL	hard	125	24		95			2.34	>10
13.40	44.0	32.81	4.03	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.85	>10
13.58	44.5	33.27	3.72	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.87	>10
13.73	45.0	34.94	3.36	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		95			1.97	>10
13.88	45.5	36.11	3.65	Clayey Silt to Silty Clay	ML/CL	hard	120	14		95			2.04	>10
14.03	46.0	37.37	3.93	Clayey Silt to Silty Clay	ML/CL	hard	120	15		95			2.11	>10
14.18	46.5	37.80	4.22	Silty Clay to Clay	CL	hard	125	22		100			2.14	>10
14.33	47.0	33.71	4.98	Clay	CL/CH	very stiff	125	27		100			1.89	9.19
14.48	47.5	31.41	4.78	Silty Clay to Clay	CL	very stiff	125	18		100			1.76	>10
14.63	48.0	32.93	4.23	Silty Clay to Clay	CL	very stiff	125	19		100			1.85	>10
14.78	48.5	33.21	4.32	Silty Clay to Clay	CL	very stiff	125	19		100			1.86	>10
14.93	49.0	36.14	4.37	Silty Clay to Clay	CL	hard	125	21		100			2.03	>10
15.10	49.5	34.76	4.14	Silty Clay to Clay	CL	very stiff	125	20		100			1.95	>10
15.25	50.0	33.03	4.21	Silty Clay to Clay	CL	very stiff	125	19		100			1.85	>10

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

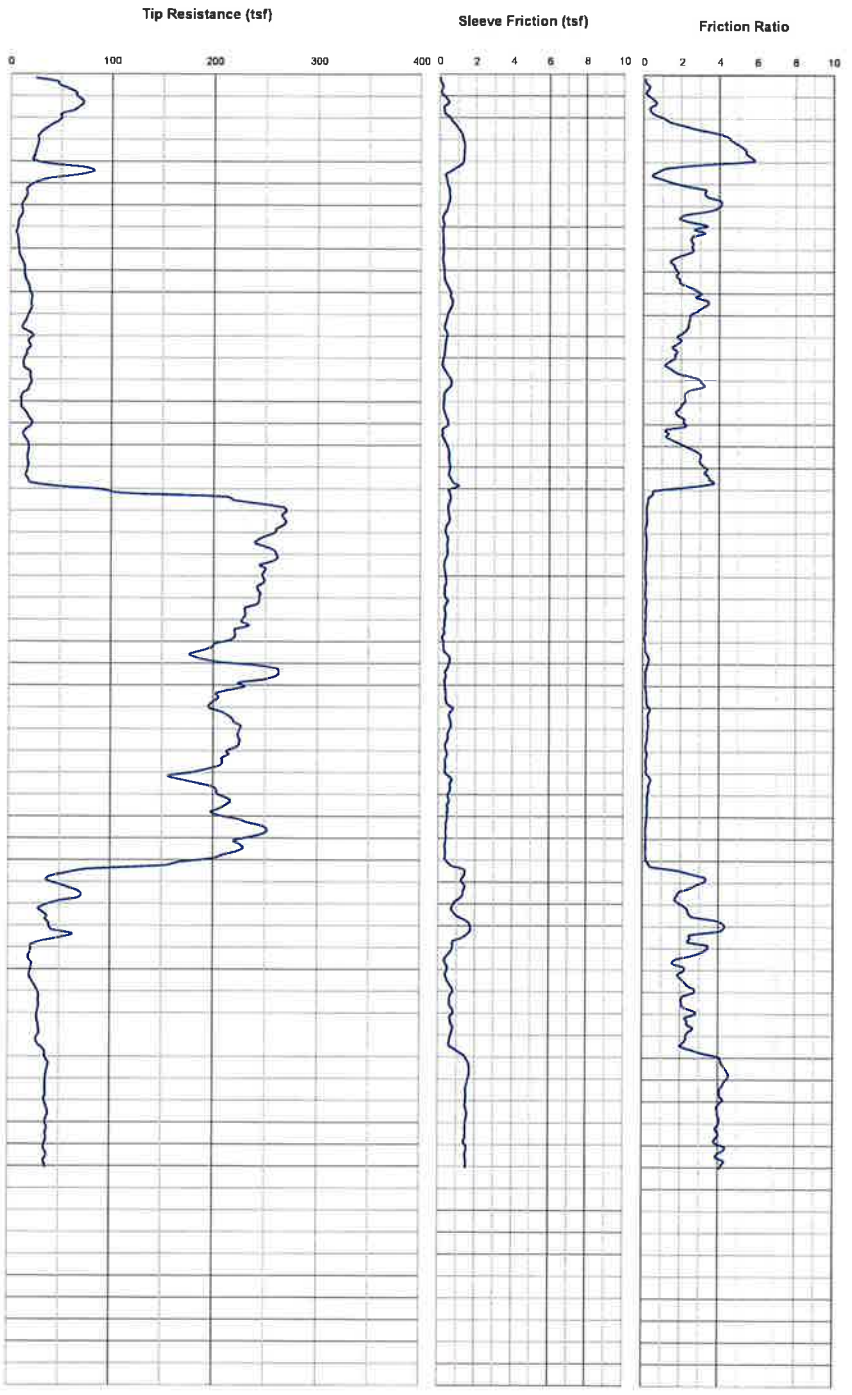
LOCATION: See Site and Boring Location Plan

DATE: 8/14/2020

CONE SOUNDING DATA CPT-17

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand to Silty Sand	SP/SM	very dense
	Sand to Silty Sand	" "	very dense
	Clayey Silt to Silty Clay	ML/CL	hard
	Clay	CL/CH	very stiff
5	Silty Sand to Sandy Silt	SM/ML	dense
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Silty Clay to Clay	" "	firm
	Clayey Silt to Silty Clay	ML/CL	stiff
10	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	loose
	Sandy Silt to Clayey Silt	" "	loose
15	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	loose
	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
20	Gravelly Sand to Sand	SW	very dense
	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
25	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
	Sand	SP	very dense
	Gravelly Sand to Sand	SW	very dense
	Sand	SP	very dense
30	Gravelly Sand to Sand	SW	very dense
	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
	Sand	SP	dense
	Gravelly Sand to Sand	SW	very dense
35	Gravelly Sand to Sand	" "	very dense
	Gravelly Sand to Sand	" "	very dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	hard
40	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
	Sandy Silt to Clayey Silt	" "	loose
45	Sandy Silt to Clayey Silt	" "	loose
	Silty Clay to Clay	CL	hard
	Clayey Silt to Silty Clay	ML/CL	hard
	Clayey Silt to Silty Clay	" "	hard
	Clayey Silt to Silty Clay	" "	hard
50	Clayey Silt to Silty Clay	" "	hard
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-17

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-17

Est. GWT (ft): 6

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	39.60	0.18	Sand to Silty Sand	SP/SM	very dense	115	7	74.9	15	107	43		
0.30	1.0	62.09	0.25	Sand to Silty Sand	SP/SM	very dense	115	11	117.4	10	104	43		
0.45	1.5	69.46	0.54	Sand to Silty Sand	SP/SM	very dense	115	13	131.3	15	100	42		
0.60	2.0	54.18	0.69	Sand to Silty Sand	SP/SM	dense	115	10	102.4	20	87	40		
0.75	2.5	40.96	2.07	Sandy Silt to Clayey Silt	ML	dense	115	12	77.4	40	75	39		
0.93	3.0	28.33	4.24	Silty Clay to Clay	CL	very stiff	125	16		70			1.66	>10
1.08	3.5	26.06	5.15	Clay	CL/CH	very stiff	125	21		75			1.52	>10
1.23	4.0	23.06	5.64	Clay	CL/CH	very stiff	125	18		85			1.34	>10
1.38	4.5	65.77	1.67	Silty Sand to Sandy Silt	SM/ML	dense	115	15	124.3	30	80	39		
1.53	5.0	44.38	0.99	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	81.4	30	66	37		
1.68	5.5	16.78	3.06	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		75			0.97	>10
1.83	6.0	12.08	4.04	Clay	CL/CH	stiff	125	10		95			0.69	>10
1.98	6.5	10.64	2.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.61	>10
2.13	7.0	7.19	2.85	Silty Clay to Clay	CL	firm	125	4		100			0.40	9.39
2.28	7.5	6.64	2.78	Silty Clay to Clay	CL	firm	125	4		100			0.37	7.56
2.45	8.0	7.82	2.61	Silty Clay to Clay	CL	firm	125	4		100			0.44	9.59
2.60	8.5	9.98	1.78	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		80			0.56	>10
2.75	9.0	13.52	1.73	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		70			0.77	>10
2.90	9.5	15.01	1.87	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		65			0.86	>10
3.05	10.0	19.04	2.72	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.09	>10
3.20	10.5	20.71	3.18	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.19	>10
3.35	11.0	19.33	2.76	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.11	>10
3.50	11.5	14.49	2.41	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		75			0.82	>10
3.65	12.0	18.00	2.05	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		65			1.03	>10
3.80	12.5	18.92	1.78	Sandy Silt to Clayey Silt	ML	loose	115	5	25.2	60	32	32		
3.95	13.0	15.68	1.72	Sandy Silt to Clayey Silt	ML	loose	115	4	20.7	70	26	32		
4.13	13.5	13.46	1.33	Sandy Silt to Clayey Silt	ML	loose	115	4	17.5	70	21	31		
4.28	14.0	19.76	2.31	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.13	>10
4.43	14.5	19.24	2.91	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		75			1.10	>10
4.58	15.0	11.45	2.21	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.64	>10
4.73	15.5	12.25	1.90	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		85			0.68	>10
4.88	16.0	19.46	2.09	Sandy Silt to Clayey Silt	ML	loose	115	6	23.9	70	30	32		
5.03	16.5	14.18	1.25	Sandy Silt to Clayey Silt	ML	loose	115	4	17.2	70	21	31		
5.18	17.0	17.43	2.00	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		75			0.99	>10
5.33	17.5	17.54	2.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		85			0.99	>10
5.48	18.0	17.57	3.15	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		90			0.99	>10
5.65	18.5	16.60	3.39	Silty Clay to Clay	CL	stiff	125	9		95			0.94	>10
5.80	19.0	52.00	2.22	Sandy Silt to Clayey Silt	ML	medium dense	115	15	59.8	45	57	36		
5.95	19.5	180.33	0.36	Sand	SP	very dense	110	28	205.7	5	94	41		
6.10	20.0	260.71	0.19	Gravelly Sand to Sand	SW	very dense	115	35	294.9	0	104	43		
6.25	20.5	267.62	0.20	Gravelly Sand to Sand	SW	very dense	115	36	300.0	0	105	43		
6.40	21.0	261.78	0.14	Gravelly Sand to Sand	SW	very dense	115	35	291.0	-5	104	43		
6.55	21.5	243.77	0.18	Gravelly Sand to Sand	SW	very dense	115	33	268.6	0	102	42		
6.70	22.0	255.88	0.18	Gravelly Sand to Sand	SW	very dense	115	34	279.6	0	103	42		
6.85	22.5	253.90	0.13	Gravelly Sand to Sand	SW	very dense	115	34	275.2	-5	102	42		
7.00	23.0	247.80	0.13	Gravelly Sand to Sand	SW	very dense	115	33	266.4	0	101	42		
7.18	23.5	245.84	0.15	Gravelly Sand to Sand	SW	very dense	115	33	262.2	0	101	42		
7.33	24.0	243.20	0.13	Gravelly Sand to Sand	SW	very dense	115	32	257.4	0	100	42		
7.48	24.5	238.28	0.16	Gravelly Sand to Sand	SW	very dense	115	32	250.2	0	100	42		
7.63	25.0	229.34	0.15	Gravelly Sand to Sand	SW	very dense	115	31	239.0	0	98	42		
7.78	25.5	227.04	0.12	Gravelly Sand to Sand	SW	very dense	115	30	234.8	0	98	42		
7.93	26.0	219.08	0.10	Gravelly Sand to Sand	SW	very dense	115	29	224.9	0	96	41		
8.08	26.5	191.05	0.16	Sand	SP	very dense	110	29	194.8	0	92	41		
8.23	27.0	207.74	0.28	Sand	SP	very dense	110	32	210.4	5	94	41		
8.38	27.5	261.57	0.15	Gravelly Sand to Sand	SW	very dense	115	35	263.2	0	101	42		
8.53	28.0	234.40	0.13	Gravelly Sand to Sand	SW	very dense	115	31	234.2	0	98	42		
8.68	28.5	207.13	0.18	Gravelly Sand to Sand	SW	very dense	115	28	205.5	0	94	41		
8.85	29.0	197.64	0.27	Sand	SP	very dense	110	30	194.9	5	92	41		
9.00	29.5	212.77	0.28	Sand	SP	very dense	110	33	208.5	5	94	41		
9.15	30.0	223.61	0.28	Gravelly Sand to Sand	SW	very dense	115	30	217.7	5	95	41		
9.30	30.5	224.00	0.22	Gravelly Sand to Sand	SW	very dense	115	30	216.7	0	95	41		
9.45	31.0	219.64	0.17	Gravelly Sand to Sand	SW	very dense	115	29	211.1	0	95	41		
9.60	31.5	210.70	0.18	Gravelly Sand to Sand	SW	very dense	115	28	201.2	0	93	41		
9.75	32.0	193.44	0.19	Sand	SP	very dense	110	30	183.6	5	90	41		
9.90	32.5	170.35	0.37	Sand	SP	dense	110	26	160.8	10	87	40		
10.05	33.0	201.90	0.29	Sand	SP	very dense	110	31	189.5	5	91	41		
10.20	33.5	213.87	0.24	Gravelly Sand to Sand	SW	very dense	115	29	199.6	5	93	41		
10.38	34.0	203.22	0.23	Sand	SP	very dense	110	31	188.6	5	91	41		
10.53	34.5	234.80	0.18	Gravelly Sand to Sand	SW	very dense	115	31	216.7	0	95	41		
10.68	35.0	245.07	0.16	Gravelly Sand to Sand	SW	very dense	115	33	224.8	0	96	41		
10.83	35.5	224.68	0.16	Gravelly Sand to Sand	SW	very dense	115	30	204.9	0	94	41		
10.98	36.0	210.38	0.17	Gravelly Sand to Sand	SW	very dense	115	28	190.8	0	92	41		
11.13	36.5	113.52	1.27	Sand to Silty Sand	SP/SM	dense	115	21	102.4	30	73	38		
11.28	37.0	41.73	3.15	Clayey Silt to Silty Clay	ML/CL	hard	120	17		75			2.39	>10
11.43	37.5	65.86	2.09	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	58.7	55	57	36		
11.58	38.0	50.27	1.93	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	44.6	60	49	35		
11.73	38.5	33.62	2.49	Sandy Silt to Clayey Silt	ML	loose	115	10	29.6	80	37	33		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-17

Est. GWT (ft): 6

Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	38.57	4.15	Clayey Silt to Silty Clay	ML/CL	hard	120	15		90			2.20	>10
12.05	39.5	52.57	3.02	Sandy Silt to Clayey Silt	ML	medium dense	115	15	45.8	70	49	35		
12.20	40.0	25.89	3.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.45	>10
12.35	40.5	20.56	2.37	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.13	9.59
12.50	41.0	22.49	1.99	Sandy Silt to Clayey Silt	ML	loose	115	6	19.3	95	24	31		
12.65	41.5	21.28	2.04	Sandy Silt to Clayey Silt	ML	loose	115	6	18.2	95	22	31		
12.80	42.0	27.01	2.61	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		95			1.51	>10
12.95	42.5	29.81	2.11	Sandy Silt to Clayey Silt	ML	loose	115	9	25.2	85	32	32		
13.10	43.0	29.15	2.54	Sandy Silt to Clayey Silt	ML	loose	115	8	24.5	90	31	32		
13.25	43.5	28.56	2.34	Sandy Silt to Clayey Silt	ML	loose	115	8	23.9	90	30	32		
13.40	44.0	29.88	2.48	Sandy Silt to Clayey Silt	ML	loose	115	9	24.9	90	31	32		
13.58	44.5	28.33	2.16	Sandy Silt to Clayey Silt	ML	loose	115	8	23.4	90	30	32		
13.73	45.0	35.35	3.24	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		90			2.00	>10
13.88	45.5	38.65	4.22	Silty Clay to Clay	CL	hard	125	22		95			2.19	>10
14.03	46.0	37.42	4.50	Silty Clay to Clay	CL	hard	125	21		100			2.12	>10
14.18	46.5	36.68	4.21	Silty Clay to Clay	CL	hard	125	21		100			2.07	>10
14.33	47.0	36.35	4.13	Clayey Silt to Silty Clay	ML/CL	hard	120	15		100			2.05	>10
14.48	47.5	38.45	3.96	Clayey Silt to Silty Clay	ML/CL	hard	120	15		95			2.18	>10
14.63	48.0	37.36	4.04	Clayey Silt to Silty Clay	ML/CL	hard	120	15		100			2.11	>10
14.78	48.5	37.50	3.95	Clayey Silt to Silty Clay	ML/CL	hard	120	15		100			2.12	>10
14.93	49.0	36.55	4.00	Clayey Silt to Silty Clay	ML/CL	hard	120	15		100			2.06	>10
15.10	49.5	36.93	4.06	Clayey Silt to Silty Clay	ML/CL	hard	120	15		100			2.08	>10
15.25	50.0	36.01	4.20	Silty Clay to Clay	CL	hard	125	21		100			2.03	>10

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

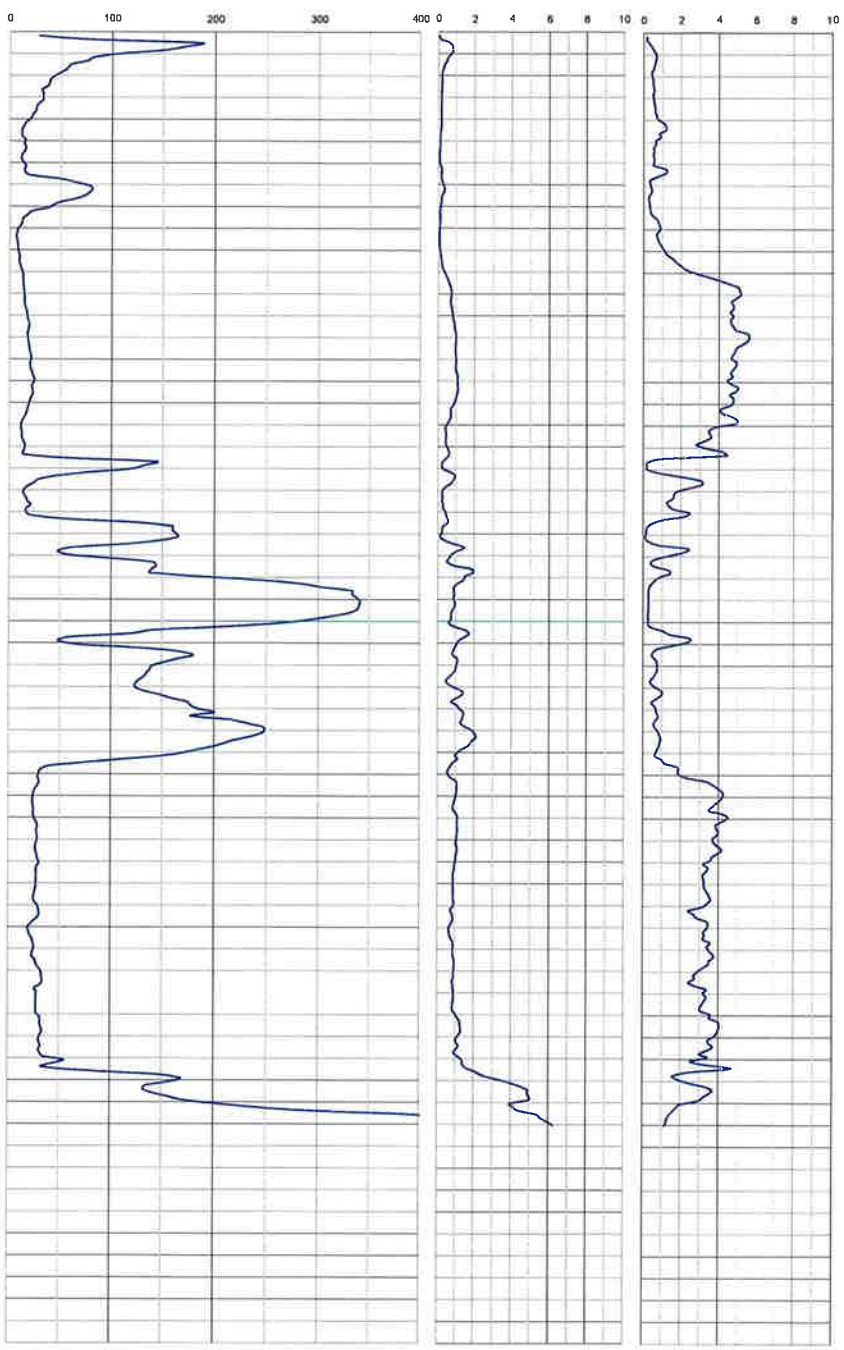
LOCATION: See Site and Boring Location Plan

DATE: 8/14/2020

CONE SOUNDING DATA CPT-18

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand	SP	very dense
	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sandy Silt to Clayey Silt	ML	loose
5	Sandy Silt to Clayey Silt	" "	loose
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	dense
	Sandy Silt to Clayey Silt	ML	loose
	Sensitive fine grained	ML	firm
10	Clayey Silt to Silty Clay	ML/CL	stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
15	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	stiff
	Silty Clay to Clay	CL	stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
20	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	loose
	Sand	SP	dense
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	dense
25	Gravelly Sand to Sand	SW	very dense
	Gravelly Sand to Sand	" "	very dense
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	dense
	Sand	" "	dense
30	Sand	" "	dense
	Sand	" "	very dense
	Sand	" "	very dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
35	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
40	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
45	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	dense
50	Sand	SP	very dense
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-18

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-18
Est. GWT (ft): 7
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	97.00	0.21	Sand	SP	very dense	110	15	183.4	5	134	47		
0.30	1.0	143.40	0.55	Sand	SP	very dense	110	22	271.1	5	129	46		
0.45	1.5	72.89	0.61	Sand to Silty Sand	SP/SM	very dense	115	13	137.8	15	102	42		
0.60	2.0	51.12	0.45	Sand to Silty Sand	SP/SM	dense	115	9	96.6	15	86	40		
0.75	2.5	38.40	0.49	Silty Sand to Sandy Silt	SM/ML	dense	115	9	72.6	20	74	38		
0.93	3.0	31.87	0.51	Silty Sand to Sandy Silt	SM/ML	medium dense	115	7	60.3	25	65	37		
1.08	3.5	28.28	0.56	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	53.5	30	59	36		
1.23	4.0	22.55	0.66	Silty Sand to Sandy Silt	SM/ML	medium dense	115	5	42.6	35	50	35		
1.38	4.5	13.89	1.12	Sandy Silt to Clayey Silt	ML	loose	115	4	26.3	60	34	33		
1.53	5.0	12.80	0.79	Sandy Silt to Clayey Silt	ML	loose	115	4	23.9	55	30	32		
1.68	5.5	13.96	0.55	Sandy Silt to Clayey Silt	ML	loose	115	4	24.8	45	31	32		
1.83	6.0	12.71	0.53	Sandy Silt to Clayey Silt	ML	loose	115	4	21.6	50	27	32		
1.98	6.5	16.23	1.03	Sandy Silt to Clayey Silt	ML	loose	115	5	26.4	50	33	33		
2.13	7.0	64.21	0.35	Sand to Silty Sand	SP/SM	dense	115	12	100.5	10	73	38		
2.28	7.5	76.29	0.34	Sand to Silty Sand	SP/SM	dense	115	14	117.5	10	77	39		
2.45	8.0	46.37	0.30	Sand to Silty Sand	SP/SM	medium dense	115	8	70.2	15	62	37		
2.60	8.5	17.26	0.50	Sandy Silt to Clayey Silt	ML	loose	115	5	25.7	40	32	33		
2.75	9.0	10.01	0.83	Sandy Silt to Clayey Silt	ML	very loose	115	3	14.7	65	16	30		
2.90	9.5	6.64	0.72	Sensitive fine grained	ML	firm	120	3		75			0.36	>10
3.05	10.0	7.77	0.99	Sensitive fine grained	ML	firm	120	4		75			0.43	>10
3.20	10.5	9.23	1.50	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		80			0.51	>10
3.35	11.0	11.19	2.30	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.63	>10
3.50	11.5	12.86	3.94	Clay	CL/CH	stiff	125	10		95			0.73	>10
3.65	12.0	13.66	5.10	Clay	CL/CH	stiff	125	11		100			0.77	>10
3.80	12.5	14.44	4.79	Clay	CL/CH	stiff	125	12		100			0.82	>10
3.95	13.0	16.37	4.71	Clay	CL/CH	stiff	125	13		95			0.93	>10
4.13	13.5	18.38	4.68	Clay	CL/CH	very stiff	125	15		90			1.05	>10
4.28	14.0	17.72	5.34	Clay	CL/CH	very stiff	125	14		100			1.01	>10
4.43	14.5	18.41	5.21	Clay	CL/CH	very stiff	125	15		100			1.05	>10
4.58	15.0	20.19	4.75	Clay	CL/CH	very stiff	125	16		90			1.15	>10
4.73	15.5	20.02	4.85	Clay	CL/CH	very stiff	125	16		95			1.14	>10
4.88	16.0	22.85	4.60	Clay	CL/CH	very stiff	125	18		90			1.31	>10
5.03	16.5	22.09	4.83	Clay	CL/CH	very stiff	125	18		90			1.26	>10
5.18	17.0	19.71	4.71	Clay	CL/CH	very stiff	125	16		95			1.12	>10
5.33	17.5	16.51	4.23	Clay	CL/CH	stiff	125	13		100			0.93	>10
5.48	18.0	12.02	4.55	Clay	CL/CH	stiff	125	10		100			0.67	5.53
5.65	18.5	11.85	3.51	Silty Clay to Clay	CL	stiff	125	7		100			0.65	6.76
5.80	19.0	14.33	3.11	Silty Clay to Clay	CL	stiff	125	8		100			0.80	9.19
5.95	19.5	27.71	3.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		75			1.59	>10
6.10	20.0	132.16	0.19	Sand	SP	dense	110	20	146.1	5	84	40		
6.25	20.5	50.20	2.02	Sandy Silt to Clayey Silt	ML	medium dense	115	14	55.1	50	55	36		
6.40	21.0	18.01	2.45	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		85			1.01	>10
6.55	21.5	15.94	1.47	Sandy Silt to Clayey Silt	ML	loose	115	5	17.2	80	20	31		
6.70	22.0	17.89	1.80	Sandy Silt to Clayey Silt	ML	loose	115	5	19.1	80	24	31		
6.85	22.5	67.00	1.20	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	71.1	35	62	37		
7.00	23.0	160.75	0.15	Sand	SP	dense	110	25	169.3	0	88	40		
7.18	23.5	142.49	0.37	Sand	SP	dense	110	22	149.0	10	84	40		
7.33	24.0	54.89	1.96	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	57.0	50	56	36		
7.48	24.5	128.65	0.52	Sand	SP	dense	110	20	132.6	10	81	39		
7.63	25.0	154.22	1.18	Sand to Silty Sand	SP/SM	dense	115	28	157.9	20	86	40		
7.78	25.5	275.85	0.42	Gravelly Sand to Sand	SW	very dense	115	37	280.4	5	103	42		
7.93	26.0	334.81	0.26	Gravelly Sand to Sand	SW	very dense	115	45	337.9	0	108	43		
8.08	26.5	338.07	0.26	Gravelly Sand to Sand	SW	very dense	115	45	338.8	0	109	43		
8.23	27.0	291.39	0.24	Gravelly Sand to Sand	SW	very dense	115	39	290.0	0	104	43		
8.38	27.5	157.59	0.96	Sand	SP	dense	110	24	155.8	20	86	40		
8.53	28.0	57.27	2.15	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	56.3	50	56	36		
8.68	28.5	158.66	0.56	Sand	SP	dense	110	24	154.9	10	85	40		
8.85	29.0	152.41	0.69	Sand	SP	dense	110	23	147.9	15	84	40		
9.00	29.5	135.12	0.61	Sand	SP	dense	110	21	130.4	15	80	39		
9.15	30.0	125.04	0.51	Sand	SP	dense	110	19	119.9	15	78	39		
9.30	30.5	146.11	0.86	Sand	SP	dense	110	22	139.3	20	82	40		
9.45	31.0	178.82	0.56	Sand	SP	dense	110	28	169.6	10	88	40		
9.60	31.5	198.12	0.70	Sand	SP	very dense	110	30	186.8	10	91	41		
9.75	32.0	241.56	0.64	Sand	SP	very dense	110	37	226.5	10	97	42		
9.90	32.5	229.74	0.87	Sand	SP	very dense	110	35	214.2	15	95	41		
10.05	33.0	190.35	0.74	Sand	SP	dense	110	29	176.5	15	89	40		
10.20	33.5	114.44	0.90	Sand to Silty Sand	SP/SM	dense	115	21	105.5	25	74	38		
10.38	34.0	33.02	1.85	Sandy Silt to Clayey Silt	ML	loose	115	9	30.3	70	37	33		
10.53	34.5	29.08	3.11	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		90			1.64	>10
10.68	35.0	25.17	4.13	Silty Clay to Clay	CL	very stiff	125	14		100			1.41	>10
10.83	35.5	23.62	3.86	Silty Clay to Clay	CL	very stiff	125	13		100			1.32	>10
10.98	36.0	24.34	4.04	Silty Clay to Clay	CL	very stiff	125	14		100			1.36	>10
11.13	36.5	27.29	3.98	Silty Clay to Clay	CL	very stiff	125	16		100			1.53	>10
11.28	37.0	27.76	3.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.56	>10
11.43	37.5	26.50	4.02	Silty Clay to Clay	CL	very stiff	125	15		100			1.49	>10
11.58	38.0	28.74	3.47	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		95			1.62	>10
11.73	38.5	27.45	3.31	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.54	>10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-18
Est. GWT (ft): 7
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	27.19	3.20	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.52	>10
12.05	39.5	25.66	3.39	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.43	>10
12.20	40.0	26.37	3.36	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.47	>10
12.35	40.5	29.60	2.64	Sandy Silt to Clayey Silt	ML	loose	115	8	25.1	90	32	32		
12.50	41.0	22.09	3.38	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	>10
12.65	41.5	21.43	3.20	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.18	9.39
12.80	42.0	24.62	3.47	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.37	>10
12.95	42.5	24.39	3.62	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.35	>10
13.10	43.0	29.20	3.17	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		100			1.64	>10
13.25	43.5	33.04	2.62	Sandy Silt to Clayey Silt	ML	loose	115	9	27.1	90	34	33		
13.40	44.0	28.40	3.10	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.59	>10
13.58	44.5	27.22	3.24	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.52	>10
13.73	45.0	27.53	3.22	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.53	>10
13.88	45.5	31.27	3.83	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.75	>10
14.03	46.0	32.19	3.90	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.81	>10
14.18	46.5	30.78	3.54	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		100			1.72	>10
14.33	47.0	37.82	3.07	Clayey Silt to Silty Clay	ML/CL	hard	120	15		90			2.14	>10
14.48	47.5	51.98	3.50	Clayey Silt to Silty Clay	ML/CL	hard	120	21		80			2.97	>10
14.63	48.0	158.22	1.94	Silty Sand to Sandy Silt	SM/ML	dense	115	35	124.4	35	79	39		
14.78	48.5	136.07	3.46	Sandy Silt to Clayey Silt	ML	dense	115	39	106.5	55	74	38		
14.93	49.0	175.02	2.70	Silty Sand to Sandy Silt	SM/ML	dense	115	39	136.4	40	82	39		
15.10	49.5	303.93	1.57	Sand to Silty Sand	SP/SM	very dense	115	55	235.8	20	98	42		
15.25	50.0	488.68	1.21	Sand	SP	very dense	110	75	377.7	15	112	44		

CLIENT: IID Power Dept
PROJECT: S-Line Upgrades - Imperial County, CA

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight

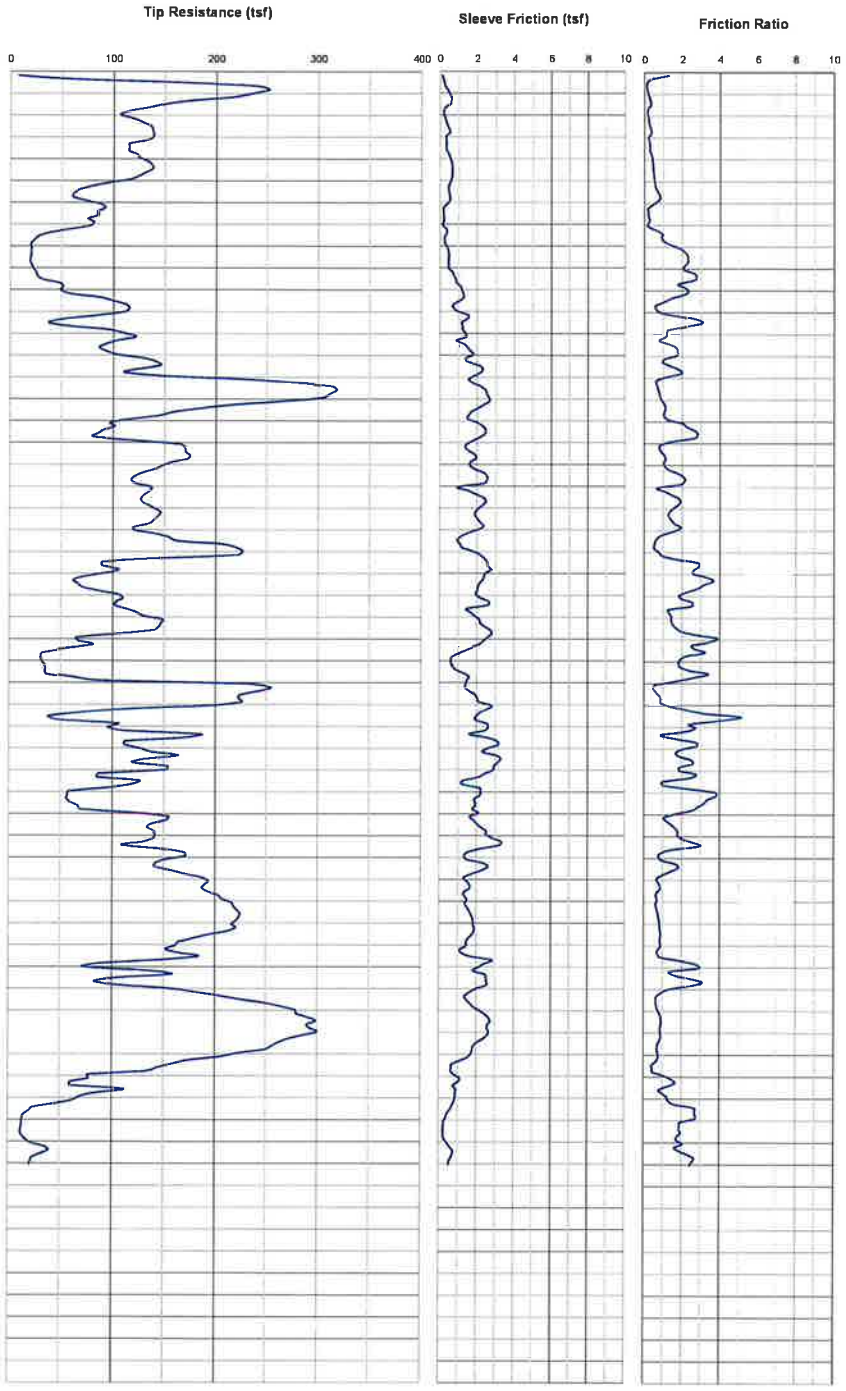
LOCATION: See Site and Boring Location Plan

DATE: 8/14/2020

CONE SOUNDING DATA CPT-19

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sand	SP	very dense
	Sand	" "	very dense
	Sand	" "	very dense
	Sand	" "	very dense
5	Sand	" "	very dense
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sandy Silt to Clayey Silt	ML	loose
	Sandy Silt to Clayey Silt	" "	medium dense
10	Sand to Silty Sand	SP/SM	dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
	Sand	SP	very dense
15	Sand to Silty Sand	SP/SM	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Sand	SP	very dense
	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
20	Sand to Silty Sand	" "	dense
	Sand	SP	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	dense
25	Silty Sand to Sandy Silt	" "	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand	SP	very dense
	Sandy Silt to Clayey Silt	ML	medium dense
30	Silty Sand to Sandy Silt	SM/ML	dense
	Silty Sand to Sandy Silt	" "	dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Sand to Silty Sand	SP/SM	dense
35	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand	SP	dense
	Sand	" "	very dense
	Sand	" "	dense
40	Sand to Silty Sand	SP/SM	dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Sand	SP	very dense
	Sand	" "	very dense
	Sand	" "	very dense
45	Sand	" "	dense
	Sand to Silty Sand	SP/SM	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	loose
50			
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-19

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-19

Est. GWT (ft): 7

Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	78.88	0.56	Sand to Silty Sand	SP/SM	very dense	115	14	149.1	10	127	46		
0.30	1.0	243.18	0.16	Gravelly Sand to Sand	SW	very dense	115	32	459.7	-5	144	48		
0.45	1.5	181.90	0.31	Sand	SP	very dense	110	28	343.9	0	128	46		
0.60	2.0	119.67	0.19	Sand	SP	very dense	110	18	226.2	0	111	44		
0.75	2.5	127.50	0.26	Sand	SP	very dense	110	20	241.0	0	109	43		
0.93	3.0	138.49	0.32	Sand	SP	very dense	110	21	261.8	0	109	43		
1.08	3.5	121.95	0.28	Sand	SP	very dense	110	19	230.5	0	103	42		
1.23	4.0	121.23	0.36	Sand	SP	very dense	110	19	229.2	5	100	42		
1.38	4.5	136.42	0.46	Sand	SP	very dense	110	21	257.9	5	102	42		
1.53	5.0	124.51	0.51	Sand	SP	very dense	110	19	235.4	5	98	42		
1.68	5.5	75.34	0.65	Sand to Silty Sand	SP/SM	dense	115	14	135.6	15	81	39		
1.83	6.0	74.64	0.65	Sand to Silty Sand	SP/SM	dense	115	14	128.1	15	80	39		
1.98	6.5	87.60	0.20	Sand	SP	dense	110	13	144.2	5	83	40		
2.13	7.0	77.99	0.23	Sand	SP	dense	110	12	123.6	5	79	39		
2.28	7.5	40.33	0.83	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	62.9	25	59	36		
2.45	8.0	21.37	1.39	Sandy Silt to Clayey Silt	ML	loose	115	6	32.8	50	40	34		
2.60	8.5	20.08	2.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		60			1.16	>10
2.75	9.0	21.00	2.16	Sandy Silt to Clayey Silt	ML	loose	115	6	31.2	60	38	33		
2.90	9.5	27.96	2.68	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		55			1.62	>10
3.05	10.0	49.65	2.08	Sandy Silt to Clayey Silt	ML	medium dense	115	14	71.4	40	63	37		
3.20	10.5	81.67	1.54	Silty Sand to Sandy Silt	SM/ML	dense	115	18	115.8	25	77	39		
3.35	11.0	113.00	0.70	Sand	SP	dense	110	17	158.1	10	86	40		
3.50	11.5	59.12	2.50	Sandy Silt to Clayey Silt	ML	medium dense	115	17	81.7	40	67	37		
3.65	12.0	86.65	1.56	Silty Sand to Sandy Silt	SM/ML	dense	115	19	118.1	25	77	39		
3.80	12.5	106.61	1.09	Sand to Silty Sand	SP/SM	dense	115	19	143.5	15	83	40		
3.95	13.0	94.42	1.71	Silty Sand to Sandy Silt	SM/ML	dense	115	21	125.5	25	79	39		
4.13	13.5	139.29	1.15	Sand to Silty Sand	SP/SM	very dense	115	25	183.0	15	90	41		
4.28	14.0	129.60	1.67	Sand to Silty Sand	SP/SM	dense	115	24	168.2	20	88	40		
4.43	14.5	275.94	0.67	Sand	SP	very dense	110	42	354.2	5	110	43		
4.58	15.0	311.21	0.82	Sand	SP	very dense	110	48	395.4	5	113	44		
4.73	15.5	222.60	1.07	Sand	SP	very dense	110	34	280.0	10	103	42		
4.88	16.0	129.56	1.35	Sand to Silty Sand	SP/SM	dense	115	24	161.3	20	87	40		
5.03	16.5	93.06	2.59	Sandy Silt to Clayey Silt	ML	dense	115	27	114.6	35	77	39		
5.18	17.0	122.03	1.68	Sand to Silty Sand	SP/SM	dense	115	22	148.8	25	84	40		
5.33	17.5	171.80	0.93	Sand	SP	very dense	110	26	207.4	10	94	41		
5.48	18.0	158.88	1.09	Sand	SP	very dense	110	24	190.1	15	91	41		
5.65	18.5	130.52	1.74	Sand to Silty Sand	SP/SM	dense	115	24	154.7	25	85	40		
5.80	19.0	125.63	1.59	Sand to Silty Sand	SP/SM	dense	115	23	147.4	25	84	40		
5.95	19.5	131.29	1.47	Sand to Silty Sand	SP/SM	dense	115	24	152.6	20	85	40		
6.10	20.0	134.55	1.70	Sand to Silty Sand	SP/SM	dense	115	24	155.0	25	85	40		
6.25	20.5	143.43	1.35	Sand to Silty Sand	SP/SM	dense	115	26	163.7	20	87	40		
6.40	21.0	125.57	1.73	Sand to Silty Sand	SP/SM	dense	115	23	142.0	25	83	40		
6.55	21.5	152.04	0.76	Sand	SP	dense	110	23	170.5	10	88	40		
6.70	22.0	218.58	0.62	Sand	SP	very dense	110	34	243.2	5	99	42		
6.85	22.5	149.65	1.85	Silty Sand to Sandy Silt	SM/ML	dense	115	33	165.2	25	87	40		
7.00	23.0	96.36	2.69	Sandy Silt to Clayey Silt	ML	dense	115	28	105.5	40	74	38		
7.18	23.5	66.74	3.39	Sandy Silt to Clayey Silt	ML	medium dense	115	19	72.5	55	63	37		
7.33	24.0	87.45	2.34	Silty Sand to Sandy Silt	SM/ML	dense	115	19	94.2	40	71	38		
7.48	24.5	105.00	2.36	Silty Sand to Sandy Silt	SM/ML	dense	115	23	112.2	35	76	39		
7.63	25.0	121.66	1.35	Sand to Silty Sand	SP/SM	dense	115	22	128.9	25	80	39		
7.78	25.5	146.74	1.52	Sand to Silty Sand	SP/SM	dense	115	27	154.3	25	85	40		
7.93	26.0	103.13	2.83	Sandy Silt to Clayey Silt	ML	dense	115	29	107.6	40	75	38		
8.08	26.5	59.53	2.98	Sandy Silt to Clayey Silt	ML	medium dense	115	17	61.7	55	58	36		
8.23	27.0	31.73	1.97	Sandy Silt to Clayey Silt	ML	loose	115	9	32.6	65	39	34		
8.38	27.5	36.28	2.58	Sandy Silt to Clayey Silt	ML	medium dense	115	10	37.0	70	43	34		
8.53	28.0	126.72	1.62	Sand to Silty Sand	SP/SM	dense	115	23	128.4	30	80	39		
8.68	28.5	240.21	0.69	Sand	SP	very dense	110	37	241.8	10	99	42		
8.85	29.0	214.49	1.09	Sand	SP	very dense	110	33	214.5	15	95	41		
9.00	29.5	72.72	3.54	Sandy Silt to Clayey Silt	ML	medium dense	115	21	72.3	60	63	37		
9.15	30.0	82.82	3.04	Sandy Silt to Clayey Silt	ML	medium dense	115	24	81.7	50	67	37		
9.30	30.5	154.11	1.54	Sand to Silty Sand	SP/SM	dense	115	28	151.1	25	85	40		
9.45	31.0	117.11	2.52	Silty Sand to Sandy Silt	SM/ML	dense	115	26	114.0	40	76	39		
9.60	31.5	144.21	2.03	Silty Sand to Sandy Silt	SM/ML	dense	115	32	139.5	30	82	40		
9.75	32.0	141.62	2.13	Silty Sand to Sandy Silt	SM/ML	dense	115	31	136.1	35	82	39		
9.90	32.5	99.71	2.07	Silty Sand to Sandy Silt	SM/ML	dense	115	22	95.2	40	71	38		
10.05	33.0	90.19	2.37	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	85.6	45	68	38		
10.20	33.5	57.34	3.47	Clayey Silt to Silty Clay	ML/CL	hard	120	23		65			3.31	>10
10.38	34.0	86.36	2.38	Silty Sand to Sandy Silt	SM/ML	medium dense	115	19	80.9	45	66	37		
10.53	34.5	148.58	1.23	Sand to Silty Sand	SP/SM	dense	115	27	138.4	25	82	39		
10.68	35.0	138.34	1.74	Sand to Silty Sand	SP/SM	dense	115	25	128.0	30	80	39		
10.83	35.5	126.87	2.50	Silty Sand to Sandy Silt	SM/ML	dense	115	28	116.7	40	77	39		
10.98	36.0	162.10	1.04	Sand	SP	dense	110	25	148.3	20	84	40		
11.13	36.5	147.77	1.48	Sand to Silty Sand	SP/SM	dense	115	27	134.5	30	81	39		
11.28	37.0	183.28	0.82	Sand	SP	dense	110	28	165.9	15	87	40		
11.43	37.5	189.98	0.80	Sand	SP	dense	110	29	171.1	15	88	40		
11.58	38.0	208.51	0.66	Sand	SP	very dense	110	32	186.8	10	91	41		
11.73	38.5	221.08	0.70	Sand	SP	very dense	110	34	197.1	10	93	41		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: S-Line Upgrades - Imperial County, CA **Project No:** LE20107 **Date:** 8/14/2020

CONE SOUNDING: CPT-19
Est. GWT (ft): 7
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	220.04	0.81	Sand	SP	very dense	110	34	195.2	15	92	41		
12.05	39.5	208.30	0.87	Sand	SP	very dense	110	32	183.8	15	90	41		
12.20	40.0	168.12	0.88	Sand	SP	dense	110	26	147.7	20	84	40		
12.35	40.5	166.62	0.78	Sand	SP	dense	110	26	145.6	20	84	40		
12.50	41.0	101.75	2.56	Silty Sand to Sandy Silt	SM/ML	medium dense	115	23	88.5	50	69	38		
12.65	41.5	132.39	1.77	Silty Sand to Sandy Silt	SM/ML	dense	115	29	114.5	35	76	39		
12.80	42.0	115.04	2.24	Silty Sand to Sandy Silt	SM/ML	dense	115	26	99.0	45	72	38		
12.95	42.5	203.27	0.74	Sand	SP	dense	110	31	174.1	15	89	40		
13.10	43.0	263.91	0.70	Sand	SP	very dense	110	41	225.0	10	96	42		
13.25	43.5	289.37	0.90	Sand	SP	very dense	110	45	245.6	15	99	42		
13.40	44.0	294.03	0.89	Sand	SP	very dense	110	45	248.4	15	99	42		
13.56	44.5	272.60	0.84	Sand	SP	very dense	110	42	229.3	15	97	42		
13.73	45.0	242.11	0.74	Sand	SP	very dense	110	37	202.7	15	93	41		
13.88	45.5	178.50	0.62	Sand	SP	dense	110	27	148.8	15	84	40		
14.03	46.0	118.29	0.67	Sand	SP	dense	110	18	98.2	25	72	38		
14.18	46.5	66.11	1.46	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	54.6	50	55	36		
14.33	47.0	82.79	1.10	Sand to Silty Sand	SP/SM	medium dense	115	15	68.1	40	61	37		
14.48	47.5	30.81	2.33	Sandy Silt to Clayey Silt	ML	loose	115	9	25.2	90	32	32		
14.63	48.0	14.07	2.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.74	4.09
14.78	48.5	12.46	1.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.65	3.35
14.93	49.0	17.66	1.86	Sandy Silt to Clayey Silt	ML	very loose	115	5	14.2	100	15	30		
15.10	49.5	35.67	1.95	Sandy Silt to Clayey Silt	ML	loose	115	10	28.6	80	36	33		
15.25	50.0	22.21	2.56	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	8.27

CLIENT: IID Power Department
PROJECT: 230 kV "S" Line Upgrades -- Imperial County, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight

LOCATION: See Site and Boring Location Plan

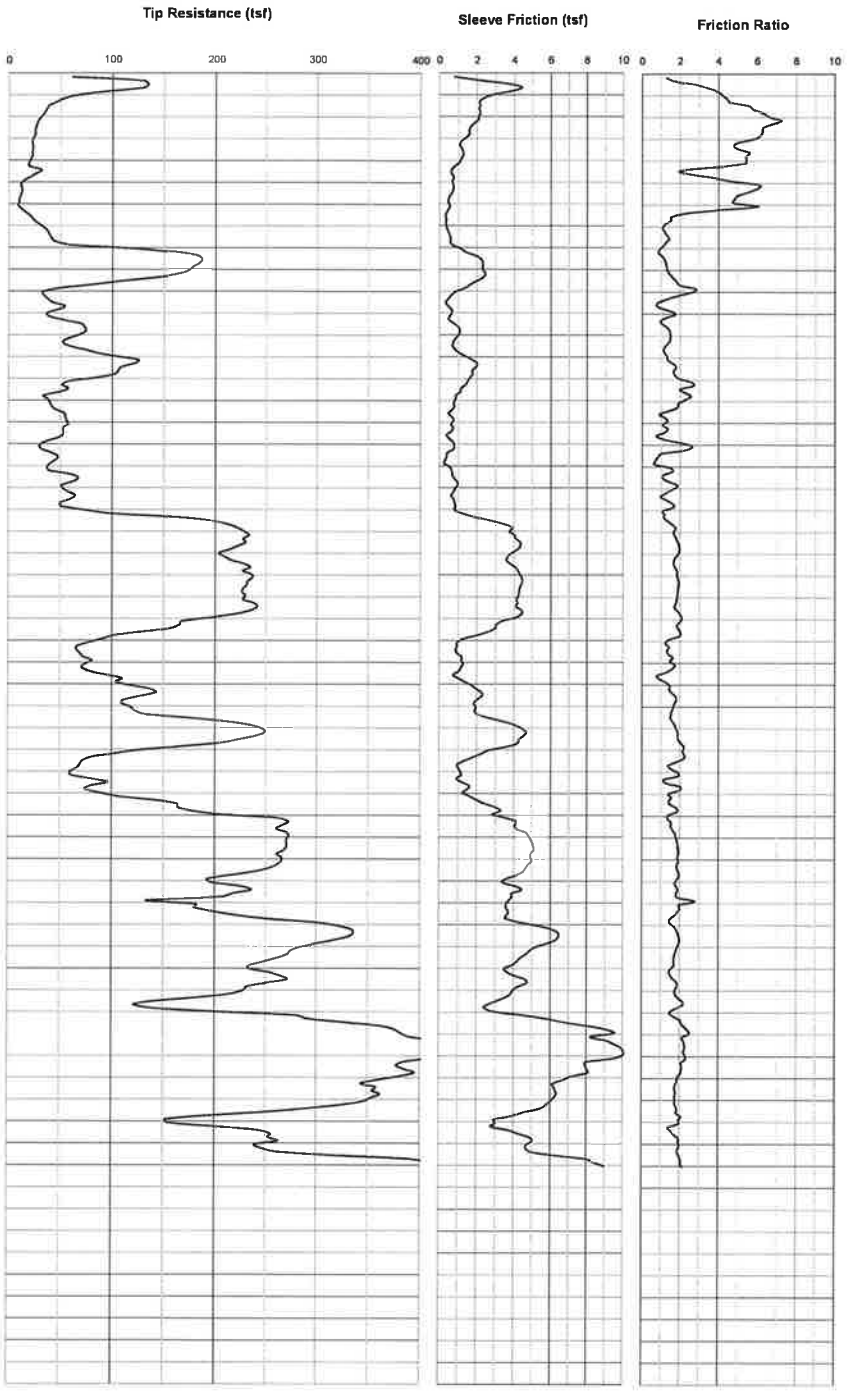
DATE: 11/30/2011

CONE SOUNDING DATA CPT-20

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH			
	Sandy Silt to Clayey Silt	ML	very dense
	Clay	CL/CH	hard
	Clay	" "	very stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
5	Clay	CL/CH	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Sand	SP	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
10	Silty Sand to Sandy Silt	" "	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sand to Silty Sand	SP/SM	dense
15	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
20	Silty Sand to Sandy Silt	" "	medium dense
	Sand to Silty Sand	SP/SM	very dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	very dense
25	Sand to Silty Sand	" "	very dense
	Silty Sand to Sandy Silt	SM/ML	dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
30	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	very dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Sand to Silty Sand	SP/SM	dense
35	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	very dense
40	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	very dense
45	Sand to Clayey Sand	SP/SC	very dense
	Sand to Silty Sand	SP/SM	very dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	very dense
50	Sand to Silty Sand	" "	very dense
55			



END OF SOUNDING AT 50 ft.

Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-20

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades -- Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

CONE SOUNDING: CPT-20
Est. GWT (ft): 8
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	108.51	1.89	Silty Sand to Sandy Silt	SM/ML	very dense	115	24	205.1	25	137	47		
0.30	1.0	97.89	3.86	Clayey Silt to Silty Clay	ML/CL	hard	120	39		40			5.76	>10
0.45	1.5	45.82	4.88	Silty Clay to Clay	CL	hard	125	26		60			2.69	>10
0.60	2.0	34.20	6.23	Clay	CL/CH	hard	125	27		75			2.01	>10
0.75	2.5	27.28	6.75	Clay	CL/CH	very stiff	125	22		85			1.60	>10
0.93	3.0	24.77	6.10	Clay	CL/CH	very stiff	125	20		85			1.45	>10
1.08	3.5	22.73	4.94	Clay	CL/CH	very stiff	125	18		80			1.33	>10
1.23	4.0	22.01	5.46	Clay	CL/CH	very stiff	125	18		85			1.28	>10
1.38	4.5	23.51	3.79	Silty Clay to Clay	CL	very stiff	125	13		70			1.37	>10
1.53	5.0	20.30	3.61	Silty Clay to Clay	CL	very stiff	125	12		75			1.18	>10
1.68	5.5	11.86	5.65	Clay	CL/CH	stiff	125	9		100			0.68	>10
1.83	6.0	9.47	5.21	Clay	CL/CH	stiff	125	8		100			0.54	>10
1.98	6.5	16.68	2.51	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		70			0.96	>10
2.13	7.0	28.64	1.25	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	43.2	40	48	35		
2.28	7.5	39.09	1.29	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	57.0	35	56	36		
2.45	8.0	76.33	1.08	Sand to Silty Sand	SP/SM	dense	115	14	107.9	20	75	38		
2.60	8.5	176.38	1.04	Sand	SP	very dense	110	27	246.1	10	99	42		
2.75	9.0	179.29	1.29	Sand to Silty Sand	SP/SM	very dense	115	33	247.0	10	99	42		
2.90	9.5	139.25	1.64	Sand to Silty Sand	SP/SM	very dense	115	25	189.3	20	91	41		
3.05	10.0	54.03	2.45	Sandy Silt to Clayey Silt	ML	medium dense	115	15	72.5	40	63	37		
3.20	10.5	37.86	1.27	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	50.2	35	52	35		
3.35	11.0	46.14	1.30	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	60.4	35	58	36		
3.50	11.5	54.83	1.12	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	71.0	30	62	37		
3.65	12.0	71.98	1.43	Silty Sand to Sandy Silt	SM/ML	dense	115	16	92.1	30	70	38		
3.80	12.5	55.48	1.35	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	70.2	30	62	37		
3.95	13.0	85.57	1.21	Sand to Silty Sand	SP/SM	dense	115	16	107.1	25	75	38		
4.13	13.5	118.39	1.60	Sand to Silty Sand	SP/SM	dense	115	22	146.6	25	84	40		
4.28	14.0	97.79	1.75	Silty Sand to Sandy Silt	SM/ML	dense	115	22	119.8	25	78	39		
4.43	14.5	55.70	2.41	Sandy Silt to Clayey Silt	ML	medium dense	115	16	67.5	45	61	37		
4.58	15.0	40.38	2.35	Sandy Silt to Clayey Silt	ML	medium dense	115	12	48.5	55	51	35		
4.73	15.5	42.27	1.74	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	50.2	45	52	35		
4.88	16.0	55.53	1.12	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	65.4	30	60	36		
5.03	16.5	52.79	1.09	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	61.5	35	58	36		
5.18	17.0	36.63	1.92	Sandy Silt to Clayey Silt	ML	medium dense	115	10	42.3	55	47	35		
5.33	17.5	40.35	1.38	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	46.2	45	50	35		
5.48	18.0	40.84	0.94	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	46.3	35	50	35		
5.65	18.5	55.38	1.28	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	62.2	35	58	36		
5.80	19.0	55.55	1.64	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	61.9	40	58	36		
5.95	19.5	60.70	1.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	67.1	35	61	36		
6.10	20.0	58.28	1.44	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	63.8	40	59	36		
6.25	20.5	153.08	1.23	Sand to Silty Sand	SP/SM	dense	115	28	166.3	20	88	40		
6.40	21.0	221.17	1.67	Sand to Silty Sand	SP/SM	very dense	115	40	238.4	20	98	42		
6.55	21.5	230.26	1.80	Sand to Silty Sand	SP/SM	very dense	115	42	246.2	20	99	42		
6.70	22.0	213.36	1.94	Sand to Silty Sand	SP/SM	very dense	115	39	226.3	20	97	42		
6.85	22.5	217.97	1.69	Sand to Silty Sand	SP/SM	very dense	115	40	229.4	20	97	42		
7.00	23.0	232.78	1.80	Sand to Silty Sand	SP/SM	very dense	115	42	243.1	20	99	42		
7.18	23.5	232.89	1.90	Sand to Silty Sand	SP/SM	very dense	115	42	241.4	20	99	42		
7.33	24.0	227.99	1.87	Sand to Silty Sand	SP/SM	very dense	115	41	234.6	20	98	42		
7.48	24.5	235.73	1.76	Sand to Silty Sand	SP/SM	very dense	115	43	240.8	20	98	42		
7.63	25.0	217.07	1.99	Sand to Silty Sand	SP/SM	very dense	115	39	220.1	25	96	41		
7.78	25.5	163.64	1.91	Silty Sand to Sandy Silt	SM/ML	dense	115	36	164.8	25	87	40		
7.93	26.0	107.26	1.79	Silty Sand to Sandy Silt	SM/ML	dense	115	24	107.3	35	75	38		
8.08	26.5	69.74	1.33	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	69.3	35	62	37		
8.23	27.0	75.66	1.60	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	74.6	40	64	37		
8.38	27.5	80.98	1.24	Sand to Silty Sand	SP/SM	medium dense	115	15	79.3	35	66	37		
8.53	28.0	111.01	1.22	Sand to Silty Sand	SP/SM	dense	115	20	108.0	25	75	38		
8.68	28.5	135.96	1.61	Sand to Silty Sand	SP/SM	dense	115	25	131.5	30	81	39		
8.85	29.0	113.32	1.70	Silty Sand to Sandy Silt	SM/ML	dense	115	25	108.9	35	75	38		
9.00	29.5	142.40	1.53	Sand to Silty Sand	SP/SM	dense	115	26	135.9	25	82	39		
9.15	30.0	229.51	1.72	Sand to Silty Sand	SP/SM	very dense	115	42	217.7	20	95	41		
9.30	30.5	237.43	1.89	Sand to Silty Sand	SP/SM	very dense	115	43	223.8	25	96	41		
9.45	31.0	166.54	2.14	Silty Sand to Sandy Silt	SM/ML	dense	115	37	156.0	30	86	40		
9.60	31.5	85.15	2.10	Silty Sand to Sandy Silt	SM/ML	medium dense	115	19	79.3	45	66	37		
9.75	32.0	65.32	1.59	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	60.5	45	58	36		
9.90	32.5	78.80	1.45	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	72.5	40	63	37		
10.05	33.0	81.55	1.80	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	74.6	45	64	37		
10.20	33.5	137.79	1.49	Sand to Silty Sand	SP/SM	dense	115	25	125.3	30	79	39		
10.38	34.0	182.61	1.69	Sand to Silty Sand	SP/SM	dense	115	33	165.1	25	87	40		
10.53	34.5	267.01	1.47	Sand to Silty Sand	SP/SM	very dense	115	49	240.1	20	98	42		
10.68	35.0	268.00	1.70	Sand to Silty Sand	SP/SM	very dense	115	49	239.7	20	98	42		
10.83	35.5	270.56	1.86	Sand to Silty Sand	SP/SM	very dense	115	49	240.6	25	98	42		
10.98	36.0	264.85	1.90	Sand to Silty Sand	SP/SM	very dense	115	48	234.2	25	98	42		
11.13	36.5	254.11	1.87	Sand to Silty Sand	SP/SM	very dense	115	46	223.5	25	96	41		
11.28	37.0	201.26	1.84	Sand to Silty Sand	SP/SM	dense	115	37	176.1	30	89	40		
11.43	37.5	226.54	1.83	Sand to Silty Sand	SP/SM	very dense	115	41	197.2	25	93	41		
11.58	38.0	173.91	2.22	Silty Sand to Sandy Silt	SM/ML	dense	115	39	150.6	35	85	40		
11.73	38.5	198.80	1.84	Sand to Silty Sand	SP/SM	dense	115	36	171.2	30	88	40		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades -- Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

CONE SOUNDING: CPT-20

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	287.80	1.51	Sand to Silty Sand	SP/SM	very dense	115	52	246.6	20	99	42		
12.05	39.5	334.19	1.88	Sand to Silty Sand	SP/SM	very dense	115	61	284.9	20	103	42		
12.20	40.0	300.08	1.92	Sand to Silty Sand	SP/SM	very dense	115	55	254.6	25	100	42		
12.35	40.5	268.38	1.73	Sand to Silty Sand	SP/SM	very dense	115	49	226.5	25	97	42		
12.50	41.0	238.37	1.62	Sand to Silty Sand	SP/SM	very dense	115	43	200.2	25	93	41		
12.65	41.5	263.02	1.57	Sand to Silty Sand	SP/SM	very dense	115	48	219.8	20	96	41		
12.80	42.0	237.24	1.81	Sand to Silty Sand	SP/SM	very dense	115	43	197.3	25	93	41		
12.95	42.5	182.19	1.95	Sand to Silty Sand	SP/SM	dense	115	33	150.8	30	85	40		
13.10	43.0	153.46	1.78	Sand to Silty Sand	SP/SM	dense	115	28	126.4	35	79	39		
13.25	43.5	299.96	1.90	Sand to Silty Sand	SP/SM	very dense	115	55	246.0	25	99	42		
13.40	44.0	373.88	2.38	Sand to Clayey Sand	SP/SC	very dense	115	187	305.2	25	105	43		
13.58	44.5	408.30	2.18	Sand to Silty Sand	SP/SM	very dense	115	74	331.7	25	108	43		
13.73	45.0	445.26	2.24	Sand to Clayey Sand	SP/SC	very dense	115	223	360.1	25	110	43		
13.88	45.5	390.83	2.16	Sand to Silty Sand	SP/SM	very dense	115	71	314.7	25	106	43		
14.03	46.0	386.90	2.00	Sand to Silty Sand	SP/SM	very dense	115	70	310.1	25	106	43		
14.18	46.5	353.94	1.79	Sand to Silty Sand	SP/SM	very dense	115	64	282.4	20	103	42		
14.33	47.0	354.12	1.75	Sand to Silty Sand	SP/SM	very dense	115	64	281.3	20	103	42		
14.48	47.5	287.48	1.82	Sand to Silty Sand	SP/SM	very dense	115	52	227.4	25	97	42		
14.63	48.0	166.53	1.99	Silty Sand to Sandy Silt	SM/ML	dense	115	37	131.2	35	80	39		
14.78	48.5	233.28	1.54	Sand to Silty Sand	SP/SM	very dense	115	42	182.9	25	90	41		
14.93	49.0	251.80	1.95	Sand to Silty Sand	SP/SM	very dense	115	46	196.6	30	92	41		
15.10	49.5	273.88	1.92	Sand to Silty Sand	SP/SM	very dense	115	50	213.0	25	95	41		
15.25	50.0	407.10	2.08	Sand to Silty Sand	SP/SM	very dense	115	74	315.2	25	106	43		

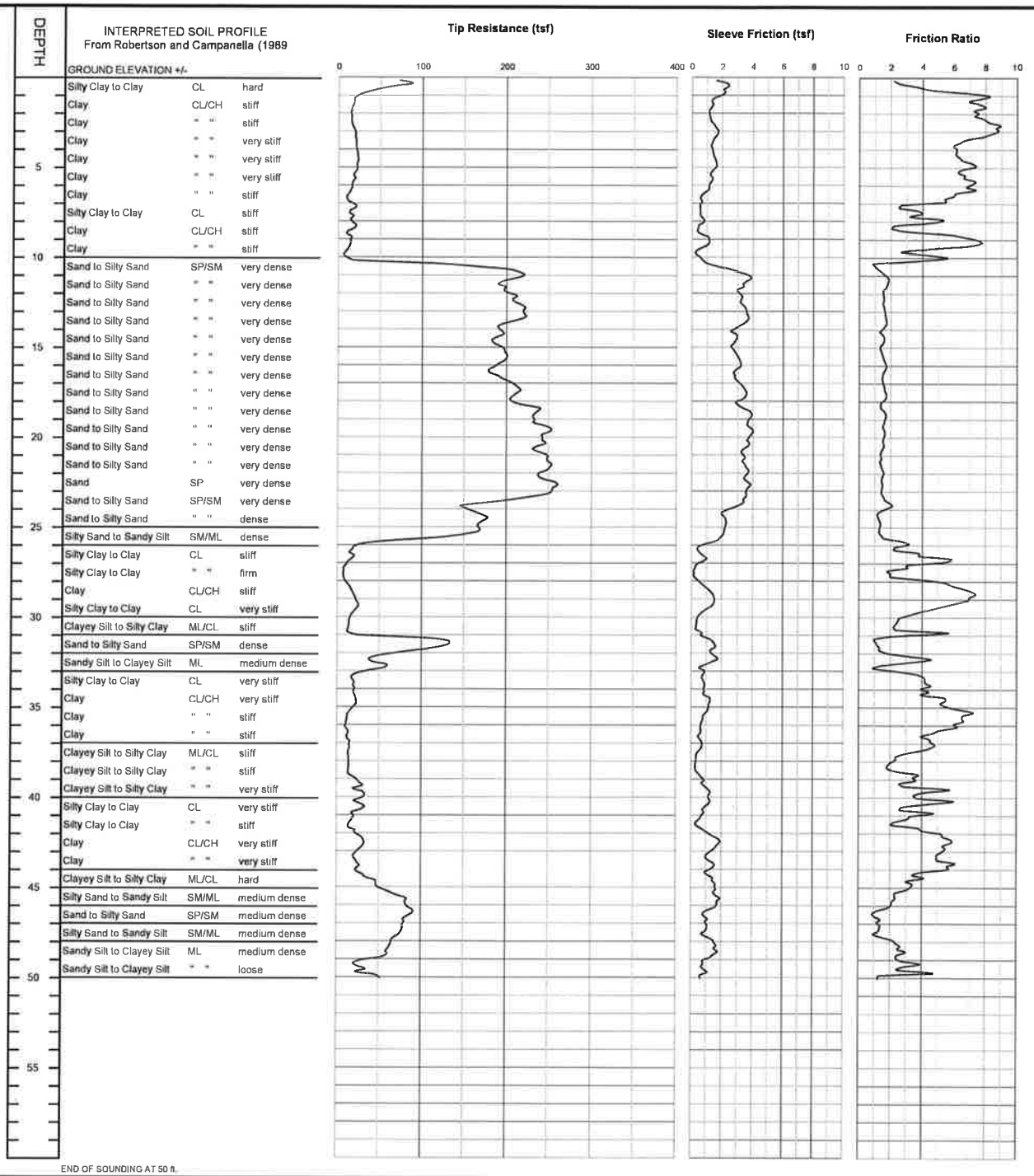
CLIENT: IID Power Department
PROJECT: 230 kV "S" Line Upgrades -- Imperial County, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 11/30/2011

CONE SOUNDING DATA CPT-21



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-21

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades -- Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

CONE SOUNDING: CPT-21

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	75.37	2.85	Sandy Silt to Clayey Silt	ML	very dense	115	22	142.5	35	126	46		
0.30	1.0	34.25	6.45	Clay	CL/CH	hard	125	27		75			2.01	>10
0.45	1.5	18.56	7.42	Clay	CL/CH	very stiff	125	15		100			1.09	>10
0.60	2.0	15.61	7.62	Clay	CL/CH	stiff	125	12		100			0.91	>10
0.75	2.5	15.54	7.82	Clay	CL/CH	stiff	125	12		100			0.91	>10
0.93	3.0	17.99	8.80	Clay	CL/CH	very stiff	125	14		100			1.05	>10
1.08	3.5	20.44	7.60	Clay	CL/CH	very stiff	125	16		100			1.19	>10
1.23	4.0	21.15	6.17	Clay	CL/CH	very stiff	125	17		90			1.23	>10
1.38	4.5	22.68	6.22	Clay	CL/CH	very stiff	125	18		90			1.32	>10
1.53	5.0	22.65	7.03	Clay	CL/CH	very stiff	125	18		90			1.32	>10
1.68	5.5	20.19	6.53	Clay	CL/CH	very stiff	125	16		95			1.17	>10
1.83	6.0	16.75	7.09	Clay	CL/CH	stiff	125	13		100			0.96	>10
1.98	6.5	12.85	6.50	Clay	CL/CH	stiff	125	10		100			0.73	>10
2.13	7.0	14.04	4.52	Clay	CL/CH	stiff	125	11		95			0.80	>10
2.28	7.5	16.43	3.41	Silty Clay to Clay	CL	stiff	125	9		80			0.94	>10
2.45	8.0	16.45	4.39	Clay	CL/CH	stiff	125	13		85			0.94	>10
2.60	8.5	17.26	2.44	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		70			0.99	>10
2.75	9.0	13.47	6.62	Clay	CL/CH	stiff	125	11		100			0.76	>10
2.90	9.5	13.21	6.33	Clay	CL/CH	stiff	125	11		100			0.75	>10
3.05	10.0	8.39	4.20	Clay	CL/CH	firm	125	7		100			0.46	4.78
3.20	10.5	98.92	1.83	Silty Sand to Sandy Silt	SM/ML	dense	115	22	128.8	25	80	39		
3.35	11.0	212.81	1.44	Sand to Silty Sand	SP/SM	very dense	115	39	273.9	15	102	42		
3.50	11.5	198.55	1.82	Sand to Silty Sand	SP/SM	very dense	115	36	252.6	20	100	42		
3.65	12.0	199.26	1.58	Sand to Silty Sand	SP/SM	very dense	115	36	250.7	15	100	42		
3.80	12.5	209.60	1.54	Sand to Silty Sand	SP/SM	very dense	115	38	260.9	15	101	42		
3.95	13.0	219.59	1.57	Sand to Silty Sand	SP/SM	very dense	115	40	270.4	15	102	42		
4.13	13.5	219.31	1.67	Sand to Silty Sand	SP/SM	very dense	115	40	267.2	15	102	42		
4.28	14.0	194.00	1.62	Sand to Silty Sand	SP/SM	very dense	115	35	234.0	20	98	42		
4.43	14.5	192.93	1.45	Sand to Silty Sand	SP/SM	very dense	115	35	230.4	15	97	42		
4.58	15.0	186.46	1.46	Sand to Silty Sand	SP/SM	very dense	115	34	220.5	15	96	41		
4.73	15.5	198.53	1.42	Sand to Silty Sand	SP/SM	very dense	115	36	232.5	15	97	42		
4.88	16.0	193.20	1.63	Sand to Silty Sand	SP/SM	very dense	115	35	224.1	20	96	41		
5.03	16.5	182.83	1.54	Sand to Silty Sand	SP/SM	very dense	115	33	210.1	20	94	41		
5.18	17.0	202.38	1.49	Sand to Silty Sand	SP/SM	very dense	115	37	230.5	15	97	42		
5.33	17.5	213.69	1.63	Sand to Silty Sand	SP/SM	very dense	115	39	241.2	20	98	42		
5.48	18.0	206.30	1.57	Sand to Silty Sand	SP/SM	very dense	115	38	230.8	20	97	42		
5.65	18.5	232.42	1.45	Sand to Silty Sand	SP/SM	very dense	115	42	257.8	15	100	42		
5.80	19.0	232.25	1.66	Sand to Silty Sand	SP/SM	very dense	115	42	255.5	20	100	42		
5.95	19.5	243.25	1.54	Sand to Silty Sand	SP/SM	very dense	115	44	265.3	15	101	42		
6.10	20.0	245.12	1.58	Sand to Silty Sand	SP/SM	very dense	115	45	265.2	15	101	42		
6.25	20.5	241.50	1.53	Sand to Silty Sand	SP/SM	very dense	115	44	259.2	15	101	42		
6.40	21.0	239.66	1.39	Sand to Silty Sand	SP/SM	very dense	115	44	255.2	15	100	42		
6.55	21.5	250.03	1.36	Sand to Silty Sand	SP/SM	very dense	115	45	264.1	15	101	42		
6.70	22.0	245.97	1.48	Sand to Silty Sand	SP/SM	very dense	115	45	257.9	15	100	42		
6.85	22.5	245.29	1.44	Sand to Silty Sand	SP/SM	very dense	115	45	255.2	15	100	42		
7.00	23.0	256.51	1.44	Sand	SP	very dense	110	39	265.0	15	101	42		
7.18	23.5	228.80	1.53	Sand to Silty Sand	SP/SM	very dense	115	42	234.7	20	98	42		
7.33	24.0	158.69	1.90	Silty Sand to Sandy Silt	SM/ML	dense	115	35	161.6	25	87	40		
7.48	24.5	169.94	1.22	Sand to Silty Sand	SP/SM	dense	115	31	171.8	20	88	40		
7.63	25.0	169.06	1.32	Sand to Silty Sand	SP/SM	dense	115	31	169.7	20	88	40		
7.78	25.5	160.12	1.32	Sand to Silty Sand	SP/SM	dense	115	29	159.6	20	86	40		
7.93	26.0	69.55	2.45	Sandy Silt to Clayey Silt	ML	medium dense	115	20	68.9	50	61	37		
8.08	26.5	17.82	3.03	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.99	>10
8.23	27.0	13.48	4.77	Clay	CL/CH	stiff	125	11		100			0.73	3.91
8.38	27.5	7.26	2.30	Silty Clay to Clay	CL	firm	125	4		100			0.37	1.92
8.53	28.0	8.31	3.82	Clay	CL/CH	firm	125	7		100			0.43	1.84
8.68	28.5	15.38	6.46	Clay	CL/CH	stiff	125	12		100			0.84	4.47
8.85	29.0	20.59	7.10	Clay	CL/CH	very stiff	125	16		100			1.15	7.00
9.00	29.5	23.98	5.30	Clay	CL/CH	very stiff	125	19		100			1.35	9.19
9.15	30.0	17.12	3.17	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	9.00
9.30	30.5	13.73	2.33	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.74	6.00
9.45	31.0	16.72	3.49	Silty Clay to Clay	CL	stiff	125	10		100			0.92	6.00
9.60	31.5	124.23	1.06	Sand to Silty Sand	SP/SM	dense	115	23	113.6	25	76	39		
9.75	32.0	95.55	1.49	Silty Sand to Sandy Silt	SM/ML	medium dense	115	21	86.9	35	68	38		
9.90	32.5	42.22	3.70	Clayey Silt to Silty Clay	ML/CL	hard	120	17		80			2.42	>10
10.05	33.0	50.88	1.58	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	45.7	55	49	35		
10.20	33.5	19.22	3.97	Silty Clay to Clay	CL	very stiff	125	11		100			1.06	6.76
10.38	34.0	20.12	4.23	Silty Clay to Clay	CL	very stiff	125	11		100			1.11	7.13
10.53	34.5	20.61	4.59	Clay	CL/CH	very stiff	125	16		100			1.14	5.65
10.68	35.0	21.94	5.39	Clay	CL/CH	very stiff	125	18		100			1.22	6.10
10.83	35.5	14.54	6.74	Clay	CL/CH	stiff	125	12		100			0.78	3.21
10.98	36.0	11.11	6.38	Clay	CL/CH	stiff	125	9		100			0.58	2.13
11.13	36.5	11.73	4.99	Clay	CL/CH	stiff	125	9		100			0.61	2.27
11.28	37.0	13.99	4.61	Clay	CL/CH	stiff	125	11		100			0.75	2.91
11.43	37.5	13.89	3.72	Silty Clay to Clay	CL	stiff	125	8		100			0.74	3.43
11.58	38.0	13.88	2.21	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.74	4.47
11.73	38.5	13.74	2.02	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.73	4.28

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades -- Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

CONE SOUNDING: CPT-21

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	19.06	3.60	Silty Clay to Clay	CL	very stiff	125	11		100			1.04	5.31
12.05	39.5	25.64	3.73	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.43	>10
12.20	40.0	31.50	3.79	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.77	>10
12.35	40.5	27.02	4.32	Silty Clay to Clay	CL	very stiff	125	15		100			1.51	9.39
12.50	41.0	22.24	3.56	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.23	9.00
12.65	41.5	16.20	2.47	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.87	5.10
12.80	42.0	19.07	4.34	Silty Clay to Clay	CL	very stiff	125	11		100			1.04	4.78
12.95	42.5	30.55	5.68	Clay	CL/CH	very stiff	125	24		100			1.71	8.00
13.10	43.0	28.36	5.37	Clay	CL/CH	very stiff	125	23		100			1.58	6.88
13.25	43.5	20.95	4.98	Clay	CL/CH	very stiff	125	17		100			1.14	4.18
13.40	44.0	24.93	5.80	Clay	CL/CH	very stiff	125	20		100			1.38	5.42
13.58	44.5	29.90	3.83	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		100			1.67	>10
13.73	45.0	46.97	3.24	Clayey Silt to Silty Clay	ML/CL	hard	120	19		85			2.67	>10
13.88	45.5	63.22	2.54	Sandy Silt to Clayey Silt	ML	medium dense	115	18	49.4	65	52	35		
14.03	46.0	82.42	2.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	64.1	55	59	36		
14.18	46.5	88.84	1.32	Sand to Silty Sand	SP/SM	medium dense	115	16	68.8	45	61	37		
14.33	47.0	80.98	1.24	Sand to Silty Sand	SP/SM	medium dense	115	15	62.5	45	59	36		
14.48	47.5	76.86	1.18	Sand to Silty Sand	SP/SM	medium dense	115	14	59.0	45	57	36		
14.63	48.0	66.97	2.02	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	51.2	60	53	35		
14.78	48.5	61.39	2.71	Sandy Silt to Clayey Silt	ML	medium dense	115	18	46.8	70	50	35		
14.93	49.0	47.66	2.51	Sandy Silt to Clayey Silt	ML	medium dense	115	14	36.2	80	42	34		
15.10	49.5	27.15	3.07	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.50	>10
15.25	50.0	40.86	2.42	Sandy Silt to Clayey Silt	ML	loose	115	12	30.7	85	38	33		

CLIENT: IID Power Department
PROJECT: 230 kV "S" Line Upgrades -- Imperial County, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight

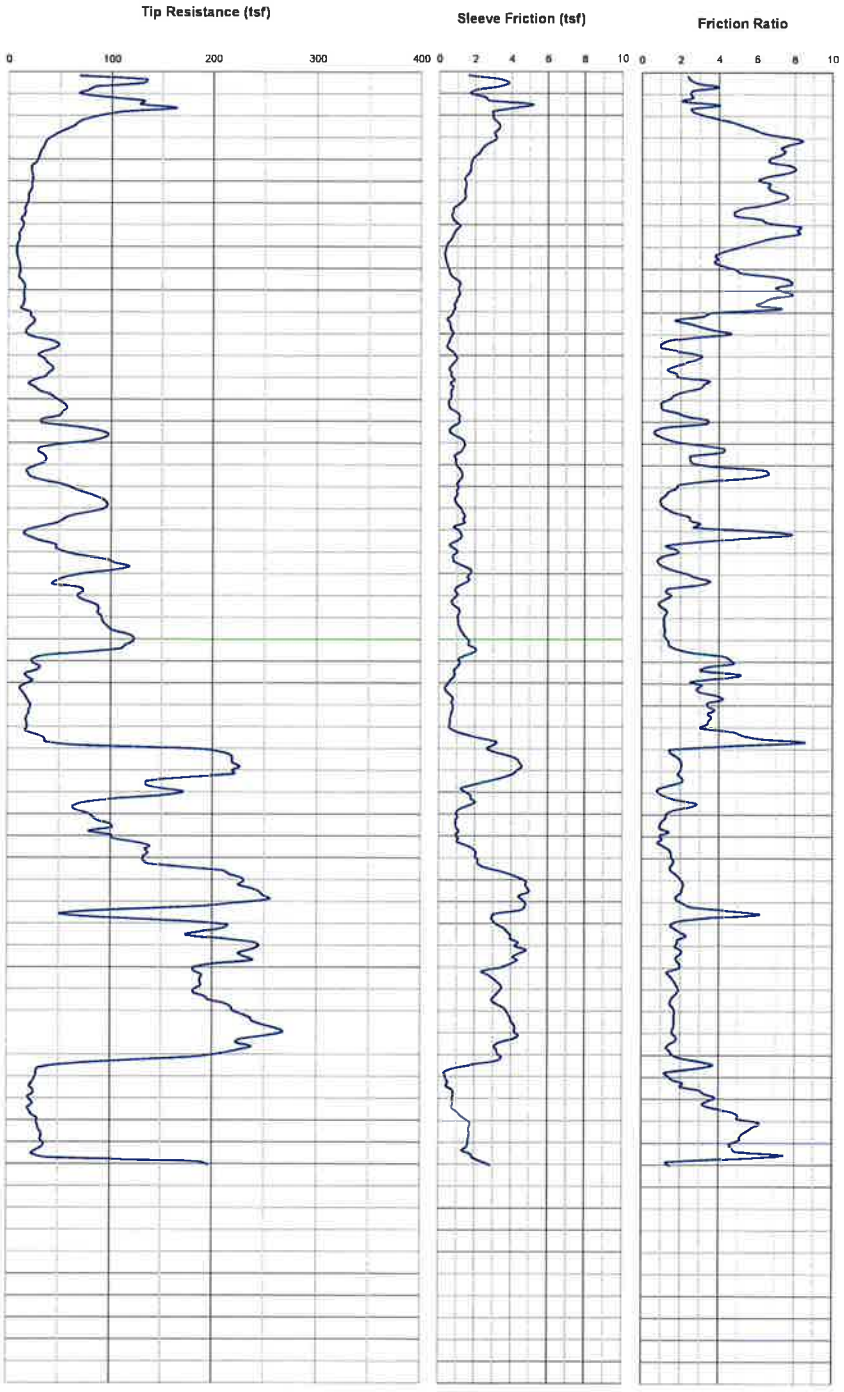
LOCATION: See Site and Boring Location Plan

DATE: 11/30/2011

CONE SOUNDING DATA CPT-22

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Sandy Silt to Clayey Silt	ML	very dense
	Silty Sand to Sandy Silt	SM/ML	very dense
	Clay	CL/CH	hard
	Clay	" "	very stiff
5	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
10	Clay	" "	stiff
	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Sandy Silt to Clayey Silt	" "	medium dense
15	Sandy Silt to Clayey Silt	" "	medium dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Silty Sand to Sandy Silt	" "	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	very stiff
20	Sand to Silty Sand	SP/SM	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	hard
	Sand to Silty Sand	SP/SM	dense
	Sandy Silt to Clayey Silt	ML	medium dense
25	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	dense
	Sandy Silt to Clayey Silt	ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	stiff
30	Clayey Silt to Silty Clay	ML/CL	very stiff
	Overconsolidated Soil	??	medium dense
	Sand to Silty Sand	SP/SM	very dense
	Sand to Silty Sand	" "	dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
35	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	very dense
	Sandy Silt to Clayey Silt	ML	dense
40	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	very dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	very dense
45	Sand to Silty Sand	" "	very dense
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clay	CL/CH	very stiff
	Clay	" "	very stiff
50	Clayey Silt to Silty Clay	ML/CL	hard
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-22

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades – Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

CONE SOUNDING: CPT-22

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	111.35	2.60	Silty Sand to Sandy Silt	SM/ML	very dense	115	25	210.5	30	137	47		
0.30	1.0	77.07	3.03	Sandy Silt to Clayey Silt	ML	very dense	115	22	145.7	40	110	43		
0.45	1.5	119.04	2.91	Sandy Silt to Clayey Silt	ML	very dense	115	34	225.0	30	116	44		
0.60	2.0	121.86	2.84	Silty Sand to Sandy Silt	SM/ML	very dense	115	27	230.4	30	111	44		
0.75	2.5	68.13	4.70	Overconsolidated Soil	??	very dense	120	68	128.8	50	90	41		
0.93	3.0	47.89	6.63	Clay	CL/CH	hard	125	38		70			2.81	>10
1.08	3.5	34.89	7.82	Clay	CL/CH	hard	125	28		85			2.04	>10
1.23	4.0	29.64	7.12	Clay	CL/CH	very stiff	125	24		85			1.73	>10
1.38	4.5	23.68	7.51	Clay	CL/CH	very stiff	125	19		95			1.38	>10
1.53	5.0	22.75	6.75	Clay	CL/CH	very stiff	125	18		90			1.32	>10
1.68	5.5	21.13	6.89	Clay	CL/CH	very stiff	125	17		95			1.22	>10
1.83	6.0	18.23	6.99	Clay	CL/CH	very stiff	125	15		100			1.05	>10
1.98	6.5	15.48	4.93	Clay	CL/CH	stiff	125	12		95			0.89	>10
2.13	7.0	13.27	7.03	Clay	CL/CH	stiff	125	11		100			0.76	>10
2.28	7.5	10.79	7.77	Clay	CL/CH	stiff	125	9		100			0.61	>10
2.45	8.0	8.72	5.53	Clay	CL/CH	firm	125	7		100			0.48	6.43
2.60	8.5	8.21	3.97	Clay	CL/CH	firm	125	7		100			0.45	5.53
2.75	9.0	10.58	4.28	Clay	CL/CH	stiff	125	8		100			0.59	8.14
2.90	9.5	10.92	6.60	Clay	CL/CH	stiff	125	9		100			0.61	8.14
3.05	10.0	15.08	7.37	Clay	CL/CH	stiff	125	12		100			0.86	>10
3.20	10.5	14.74	6.97	Clay	CL/CH	stiff	125	12		100			0.83	>10
3.35	11.0	15.72	5.58	Clay	CL/CH	stiff	125	13		100			0.89	>10
3.50	11.5	23.49	2.45	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		65			1.35	>10
3.65	12.0	17.95	3.82	Silty Clay to Clay	CL	very stiff	125	10		90			1.02	>10
3.80	12.5	38.84	1.62	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	48.3	45	51	35		
3.95	13.0	36.56	2.03	Sandy Silt to Clayey Silt	ML	medium dense	115	10	45.0	50	49	35		
4.13	13.5	37.75	2.25	Sandy Silt to Clayey Silt	ML	medium dense	115	11	46.0	55	50	35		
4.28	14.0	39.13	1.64	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	47.2	45	50	35		
4.43	14.5	23.07	3.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		80			1.32	>10
4.58	15.0	38.51	1.78	Sandy Silt to Clayey Silt	ML	medium dense	115	11	45.4	50	49	35		
4.73	15.5	54.26	1.03	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	63.4	30	59	36		
4.88	16.0	41.56	2.72	Sandy Silt to Clayey Silt	ML	medium dense	115	12	48.1	55	51	35		
5.03	16.5	82.32	0.84	Sand to Silty Sand	SP/SM	dense	115	15	94.5	20	71	38		
5.18	17.0	73.34	1.95	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	83.4	35	67	37		
5.33	17.5	31.60	3.63	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		75			1.82	>10
5.48	18.0	32.60	2.92	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		70			1.87	>10
5.65	18.5	19.54	6.28	Clay	CL/CH	very stiff	125	16		100			1.10	>10
5.80	19.0	48.52	2.38	Sandy Silt to Clayey Silt	ML	medium dense	115	14	53.1	55	54	36		
5.95	19.5	80.96	1.19	Sand to Silty Sand	SP/SM	medium dense	115	15	87.9	30	69	38		
6.10	20.0	94.66	1.12	Sand to Silty Sand	SP/SM	dense	115	17	101.9	25	73	38		
6.25	20.5	62.67	2.21	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	67.0	45	61	36		
6.40	21.0	31.19	3.96	Silty Clay to Clay	CL	very stiff	125	18		80			1.79	>10
6.55	21.5	23.76	5.37	Clay	CL/CH	very stiff	125	19		100			1.35	>10
6.70	22.0	49.31	1.61	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	51.3	45	53	35		
6.85	22.5	89.63	0.93	Sand to Silty Sand	SP/SM	dense	115	16	92.6	25	70	38		
7.00	23.0	99.19	1.72	Silty Sand to Sandy Silt	SM/ML	dense	115	22	101.7	35	73	38		
7.18	23.5	49.19	3.12	Sandy Silt to Clayey Silt	ML	medium dense	115	14	50.1	65	52	35		
7.33	24.0	70.03	1.38	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	70.8	35	62	37		
7.48	24.5	78.53	1.00	Sand to Silty Sand	SP/SM	medium dense	115	14	78.8	30	65	37		
7.63	25.0	88.54	1.22	Sand to Silty Sand	SP/SM	medium dense	115	16	88.2	30	69	38		
7.78	25.5	94.12	1.14	Sand to Silty Sand	SP/SM	dense	115	17	93.2	30	70	38		
7.93	26.0	113.65	1.19	Sand to Silty Sand	SP/SM	dense	115	21	111.7	25	76	39		
8.08	26.5	104.97	1.81	Silty Sand to Sandy Silt	SM/ML	dense	115	23	102.5	35	73	38		
8.23	27.0	27.14	4.52	Silty Clay to Clay	CL	very stiff	125	16		100			1.54	>10
8.38	27.5	25.17	3.82	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		95			1.42	>10
8.53	28.0	19.50	3.30	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.09	>10
8.68	28.5	13.92	3.25	Silty Clay to Clay	CL	stiff	125	8		100			0.76	4.89
8.85	29.0	20.32	3.68	Silty Clay to Clay	CL	very stiff	125	12		100			1.13	9.19
9.00	29.5	19.51	3.57	Silty Clay to Clay	CL	very stiff	125	11		100			1.08	8.27
9.15	30.0	18.14	3.26	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.00	>10
9.30	30.5	27.12	5.35	Clay	CL/CH	very stiff	125	22		100			1.53	>10
9.45	31.0	95.98	4.85	Overconsolidated Soil	??	medium dense	120	96	87.9	65	69	38		
9.60	31.5	216.05	1.76	Sand to Silty Sand	SP/SM	very dense	115	39	196.7	25	92	41		
9.75	32.0	221.74	2.01	Sand to Silty Sand	SP/SM	very dense	115	40	200.8	25	93	41		
9.90	32.5	175.95	2.00	Silty Sand to Sandy Silt	SM/ML	dense	115	39	158.4	30	86	40		
10.05	33.0	151.97	1.04	Sand	SP	dense	110	23	136.1	20	82	39		
10.20	33.5	107.88	1.91	Silty Sand to Sandy Silt	SM/ML	dense	115	24	96.1	40	71	38		
10.38	34.0	69.52	1.76	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	61.6	50	58	36		
10.53	34.5	90.35	1.07	Sand to Silty Sand	SP/SM	medium dense	115	16	79.6	35	66	37		
10.68	35.0	93.28	1.10	Sand to Silty Sand	SP/SM	medium dense	115	17	81.7	35	67	37		
10.83	35.5	121.09	1.00	Sand to Silty Sand	SP/SM	dense	115	22	105.6	25	74	38		
10.98	36.0	134.37	1.48	Sand to Silty Sand	SP/SM	dense	115	24	116.5	30	77	39		
11.13	36.5	162.89	1.55	Sand to Silty Sand	SP/SM	dense	115	30	140.5	30	83	40		
11.28	37.0	224.90	1.95	Sand to Silty Sand	SP/SM	very dense	115	41	193.0	30	92	41		
11.43	37.5	236.60	2.07	Sand to Silty Sand	SP/SM	very dense	115	43	202.0	30	93	41		
11.58	38.0	242.01	1.91	Sand to Silty Sand	SP/SM	very dense	115	44	205.6	25	94	41		
11.73	38.5	110.76	4.44	Overconsolidated Soil	??	dense	120	111	93.6	60	71	38		

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades -- Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

CONE SOUNDING: CPT-22

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	156.77	2.19	Silty Sand to Sandy Silt	SM/ML	dense	115	35	131.8	35	81	39		
12.05	39.5	191.49	2.00	Silty Sand to Sandy Silt	SM/ML	dense	115	43	160.2	30	86	40		
12.20	40.0	232.14	1.81	Sand to Silty Sand	SP/SM	very dense	115	42	193.3	25	92	41		
12.35	40.5	231.14	1.93	Sand to Silty Sand	SP/SM	very dense	115	42	191.5	30	92	41		
12.50	41.0	206.72	1.90	Sand to Silty Sand	SP/SM	dense	115	38	170.5	30	88	40		
12.65	41.5	186.76	1.45	Sand to Silty Sand	SP/SM	dense	115	34	153.3	25	85	40		
12.80	42.0	186.54	1.81	Sand to Silty Sand	SP/SM	dense	115	34	152.4	30	85	40		
12.95	42.5	190.41	1.63	Sand to Silty Sand	SP/SM	dense	115	35	154.8	30	85	40		
13.10	43.0	216.62	1.59	Sand to Silty Sand	SP/SM	dense	115	39	175.4	25	89	40		
13.25	43.5	234.52	1.68	Sand to Silty Sand	SP/SM	very dense	115	43	189.0	25	91	41		
13.40	44.0	259.83	1.61	Sand to Silty Sand	SP/SM	very dense	115	47	208.4	25	94	41		
13.58	44.5	233.68	1.67	Sand to Silty Sand	SP/SM	very dense	115	42	186.6	25	91	41		
13.73	45.0	223.19	1.43	Sand to Silty Sand	SP/SM	dense	115	41	177.5	25	89	41		
13.88	45.5	112.28	2.87	Sandy Silt to Clayey Silt	ML	medium dense	115	32	88.9	55	69	38		
14.03	46.0	28.85	1.78	Sandy Silt to Clayey Silt	ML	loose	115	8	22.7	85	29	32		
14.18	46.5	24.17	1.90	Sandy Silt to Clayey Silt	ML	loose	115	7	19.0	95	23	31		
14.33	47.0	23.38	3.36	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.28	8.41
14.48	47.5	22.26	3.85	Silty Clay to Clay	CL	very stiff	125	13		100			1.22	5.42
14.63	48.0	27.36	5.36	Clay	CL/CH	very stiff	125	22		100			1.52	5.88
14.78	48.5	31.11	5.49	Clay	CL/CH	very stiff	125	25		100			1.74	7.00
14.93	49.0	33.93	4.89	Clay	CL/CH	very stiff	125	27		100			1.90	8.14
15.10	49.5	28.61	5.63	Clay	CL/CH	very stiff	125	23		100			1.59	6.00
15.25	50.0	140.39	2.49	Silty Sand to Sandy Silt	SM/ML	dense	115	31	106.6	45	74	38		

CLIENT: IID Power Department
PROJECT: A/B Transmission Line – Imperial County, CA

CONE PENETROMETER: Fugro Truck Mounted Electric Cone
Cone with 23 ton reaction weight

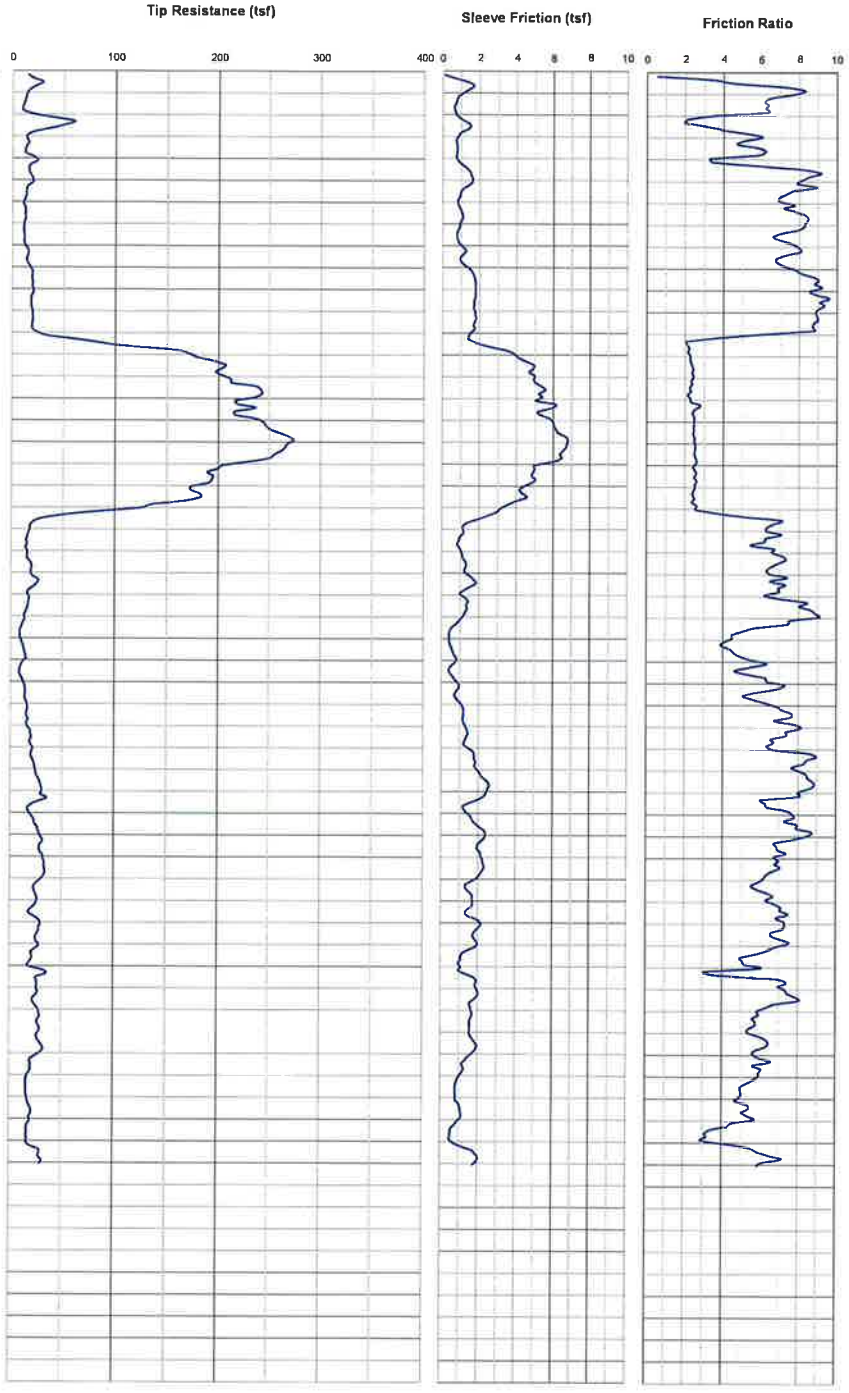
LOCATION: See Site and Boring Location Plan

DATE: 10/18/2006

CONE SOUNDING DATA CPT-23

DEPTH	INTERPRETED SOIL PROFILE From Robertson and Campanella (1989		
	GROUND ELEVATION +/-		
	Clay	CL/CH	very stiff
	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	hard
	Clay	CL/CH	stiff
5	Clay	" "	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
10	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Silty Sand to Sandy Silt	SM/ML	dense
	Silty Sand to Sandy Silt	" "	very dense
15	Silty Sand to Sandy Silt	" "	very dense
	Silty Sand to Sandy Silt	" "	very dense
	Silty Sand to Sandy Silt	" "	very dense
	Silty Sand to Sandy Silt	" "	very dense
	Silty Sand to Sandy Silt	" "	dense
20	Clay	CL/CH	hard
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	stiff
25	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
30	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
35	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
40	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
45	Clay	" "	very stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	stiff
50	Clay	CL/CH	very stiff
55			

END OF SOUNDING AT 50 ft.



Project No.		PLATE
LE20107	LANDMARK Geo-Engineers and Geologists	B-23

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades – Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

CONE SOUNDING: CPT-23

Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	21.54	2.88	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		65			1.27	>10
0.30	1.0	18.04	7.75	Clay	CL/CH	very stiff	125	14		100			1.06	>10
0.45	1.5	11.98	6.36	Clay	CL/CH	stiff	125	10		100			0.70	>10
0.60	2.0	13.46	5.40	Clay	CL/CH	stiff	125	11		100			0.79	>10
0.75	2.5	50.70	2.36	Sandy Silt to Clayey Silt	ML	dense	115	14	95.8	40	81	39		
0.93	3.0	22.98	5.05	Clay	CL/CH	very stiff	125	18		80			1.34	>10
1.08	3.5	14.40	5.23	Clay	CL/CH	stiff	125	12		95			0.84	>10
1.23	4.0	15.64	5.13	Clay	CL/CH	stiff	125	13		95			0.91	>10
1.38	4.5	19.05	5.79	Clay	CL/CH	very stiff	125	15		90			1.11	>10
1.53	5.0	17.73	8.62	Clay	CL/CH	very stiff	125	14		100			1.03	>10
1.68	5.5	15.34	7.95	Clay	CL/CH	stiff	125	12		100			0.88	>10
1.83	6.0	11.81	7.21	Clay	CL/CH	stiff	125	9		100			0.67	>10
1.98	6.5	12.49	7.81	Clay	CL/CH	stiff	125	10		100			0.71	>10
2.13	7.0	11.80	8.34	Clay	CL/CH	stiff	125	9		100			0.67	>10
2.28	7.5	11.20	7.14	Clay	CL/CH	stiff	125	9		100			0.63	>10
2.45	8.0	12.06	7.59	Clay	CL/CH	stiff	125	10		100			0.68	>10
2.60	8.5	14.95	7.39	Clay	CL/CH	stiff	125	12		100			0.85	>10
2.75	9.0	16.00	7.23	Clay	CL/CH	stiff	125	13		100			0.91	>10
2.90	9.5	19.25	8.60	Clay	CL/CH	very stiff	125	15		100			1.10	>10
3.05	10.0	19.90	8.86	Clay	CL/CH	very stiff	125	16		100			1.14	>10
3.20	10.5	18.87	9.21	Clay	CL/CH	very stiff	125	15		100			1.08	>10
3.35	11.0	18.72	9.07	Clay	CL/CH	very stiff	125	15		100			1.07	>10
3.50	11.5	19.64	8.90	Clay	CL/CH	very stiff	125	16		100			1.12	>10
3.65	12.0	20.92	7.89	Clay	CL/CH	very stiff	125	17		100			1.19	>10
3.80	12.5	63.77	2.70	Sandy Silt to Clayey Silt	ML	medium dense	115	18	78.7	45	65	37		
3.95	13.0	149.79	2.21	Silty Sand to Sandy Silt	SM/ML	very dense	115	33	183.0	25	90	41		
4.13	13.5	194.20	2.32	Silty Sand to Sandy Silt	SM/ML	very dense	115	43	234.8	25	98	42		
4.28	14.0	201.42	2.41	Silty Sand to Sandy Silt	SM/ML	very dense	115	45	241.1	25	98	42		
4.43	14.5	220.56	2.31	Silty Sand to Sandy Silt	SM/ML	very dense	115	49	261.4	20	101	42		
4.58	15.0	240.34	2.25	Silty Sand to Sandy Silt	SM/ML	very dense	115	53	282.1	20	103	42		
4.73	15.5	223.87	2.55	Silty Sand to Sandy Silt	SM/ML	very dense	115	50	260.3	25	101	42		
4.88	16.0	228.08	2.44	Silty Sand to Sandy Silt	SM/ML	very dense	115	51	262.7	25	101	42		
5.03	16.5	252.08	2.44	Silty Sand to Sandy Silt	SM/ML	very dense	115	56	287.7	25	104	43		
5.18	17.0	269.94	2.50	Silty Sand to Sandy Silt	SM/ML	very dense	115	60	305.4	25	105	43		
5.33	17.5	260.53	2.50	Silty Sand to Sandy Silt	SM/ML	very dense	115	58	292.1	25	104	43		
5.48	18.0	228.77	2.53	Silty Sand to Sandy Silt	SM/ML	very dense	115	51	254.3	25	100	42		
5.65	18.5	194.34	2.52	Silty Sand to Sandy Silt	SM/ML	very dense	115	43	214.2	25	95	41		
5.80	19.0	185.67	2.54	Silty Sand to Sandy Silt	SM/ML	very dense	115	41	202.9	30	93	41		
5.95	19.5	179.38	2.43	Silty Sand to Sandy Silt	SM/ML	very dense	115	40	194.5	30	92	41		
6.10	20.0	142.68	2.51	Silty Sand to Sandy Silt	SM/ML	dense	115	32	153.4	35	85	40		
6.25	20.5	53.14	5.23	Clay	CL/CH	hard	125	43		75			3.08	>10
6.40	21.0	18.50	6.44	Clay	CL/CH	very stiff	125	15		100			1.04	8.70
6.55	21.5	15.20	6.51	Clay	CL/CH	stiff	125	12		100			0.84	6.00
6.70	22.0	14.80	6.25	Clay	CL/CH	stiff	125	12		100			0.82	5.53
6.85	22.5	16.22	7.12	Clay	CL/CH	stiff	125	13		100			0.90	6.32
7.00	23.0	19.28	6.44	Clay	CL/CH	very stiff	125	15		100			1.08	8.27
7.18	23.5	23.89	7.05	Clay	CL/CH	very stiff	125	19		100			1.35	>10
7.33	24.0	17.87	6.69	Clay	CL/CH	stiff	125	14		100			1.00	6.76
7.48	24.5	16.77	7.87	Clay	CL/CH	stiff	125	13		100			0.93	6.00
7.63	25.0	14.04	8.87	Clay	CL/CH	stiff	125	11		100			0.77	4.28
7.78	25.5	11.61	6.87	Clay	CL/CH	stiff	125	9		100			0.62	3.21
7.93	26.0	8.86	4.64	Clay	CL/CH	firm	125	7		100			0.46	2.13
8.08	26.5	11.57	4.22	Clay	CL/CH	stiff	125	9		100			0.62	3.07
8.23	27.0	13.23	5.57	Clay	CL/CH	stiff	125	11		100			0.72	3.58
8.38	27.5	8.78	5.12	Clay	CL/CH	firm	125	7		100			0.45	2.00
8.53	28.0	11.28	6.61	Clay	CL/CH	stiff	125	9		100			0.60	2.82
8.68	28.5	13.67	5.91	Clay	CL/CH	stiff	125	11		100			0.74	3.58
8.85	29.0	14.70	6.24	Clay	CL/CH	stiff	125	12		100			0.80	3.83
9.00	29.5	15.62	7.42	Clay	CL/CH	stiff	125	12		100			0.85	4.09
9.15	30.0	16.00	7.55	Clay	CL/CH	stiff	125	13		100			0.87	4.18
9.30	30.5	19.26	7.08	Clay	CL/CH	very stiff	125	15		100			1.07	5.53
9.45	31.0	19.65	6.59	Clay	CL/CH	very stiff	125	16		100			1.09	5.65
9.60	31.5	20.11	8.62	Clay	CL/CH	very stiff	125	16		100			1.11	5.76
9.75	32.0	23.05	7.98	Clay	CL/CH	very stiff	125	18		100			1.29	7.00
9.90	32.5	25.87	8.56	Clay	CL/CH	very stiff	125	21		100			1.45	8.41
10.05	33.0	29.72	8.45	Clay	CL/CH	very stiff	125	24		100			1.68	>10
10.20	33.5	30.21	6.77	Clay	CL/CH	very stiff	125	24		100			1.70	>10
10.38	34.0	17.83	7.10	Clay	CL/CH	stiff	125	14		100			0.98	4.18
10.53	34.5	22.09	7.65	Clay	CL/CH	very stiff	125	18		100			1.22	5.88
10.68	35.0	26.75	8.38	Clay	CL/CH	very stiff	125	21		100			1.50	8.00
10.83	35.5	29.95	7.12	Clay	CL/CH	very stiff	125	24		100			1.69	9.79
10.98	36.0	29.36	6.98	Clay	CL/CH	very stiff	125	23		100			1.65	9.00
11.13	36.5	32.76	6.87	Clay	CL/CH	very stiff	125	26		100			1.85	>10
11.28	37.0	31.16	6.14	Clay	CL/CH	very stiff	125	25		100			1.75	9.79
11.43	37.5	23.41	5.89	Clay	CL/CH	very stiff	125	19		100			1.30	5.76
11.58	38.0	25.60	6.57	Clay	CL/CH	very stiff	125	20		100			1.42	6.54
11.73	38.5	20.45	7.21	Clay	CL/CH	very stiff	125	16		100			1.12	4.47

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: 230 kV "S" Line Upgrades – Imperial County, CA **Project No:** LE11252 **Date:** 10/30/2011

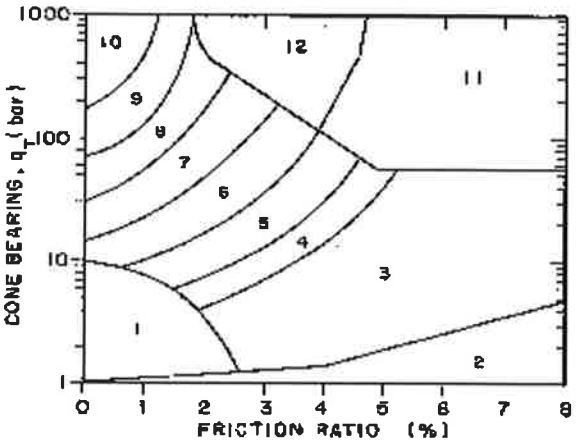
CONE SOUNDING: CPT-23
Est. GWT (ft): 8

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
11.88	39.0	26.82	7.12	Clay	CL/CH	very stiff	125	21		100			1.49	6.76
12.05	39.5	27.39	6.78	Clay	CL/CH	very stiff	125	22		100			1.53	6.88
12.20	40.0	26.19	7.17	Clay	CL/CH	very stiff	125	21		100			1.46	6.32
12.35	40.5	22.32	5.70	Clay	CL/CH	very stiff	125	18		100			1.23	4.78
12.50	41.0	19.00	5.43	Clay	CL/CH	very stiff	125	15		100			1.03	3.66
12.65	41.5	31.02	4.62	Silty Clay to Clay	CL	very stiff	125	18		100			1.74	>10
12.80	42.0	26.21	7.22	Clay	CL/CH	very stiff	125	21		100			1.45	5.88
12.95	42.5	24.81	7.78	Clay	CL/CH	very stiff	125	20		100			1.37	5.31
13.10	43.0	25.23	6.34	Clay	CL/CH	very stiff	125	20		100			1.39	5.31
13.25	43.5	28.11	5.78	Clay	CL/CH	very stiff	125	22		100			1.56	6.32
13.40	44.0	28.25	5.49	Clay	CL/CH	very stiff	125	23		100			1.57	6.21
13.58	44.5	27.31	6.25	Clay	CL/CH	very stiff	125	22		100			1.51	5.76
13.73	45.0	31.39	5.88	Clay	CL/CH	very stiff	125	25		100			1.75	7.13
13.88	45.5	21.61	6.04	Clay	CL/CH	very stiff	125	17		100			1.18	3.83
14.03	46.0	19.46	5.98	Clay	CL/CH	very stiff	125	16		100			1.05	3.28
14.18	46.5	16.40	5.31	Clay	CL/CH	stiff	125	13		100			0.87	2.57
14.33	47.0	16.61	4.90	Clay	CL/CH	stiff	125	13		100			0.88	2.57
14.48	47.5	19.72	5.28	Clay	CL/CH	very stiff	125	16		100			1.06	3.21
14.63	48.0	20.16	5.19	Clay	CL/CH	very stiff	125	16		100			1.09	3.28
14.78	48.5	17.26	3.61	Silty Clay to Clay	CL	stiff	125	10		100			0.91	3.21
14.93	49.0	16.95	3.44	Silty Clay to Clay	CL	stiff	125	10		100			0.90	3.14
15.10	49.5	26.15	5.90	Clay	CL/CH	very stiff	125	21		100			1.44	4.57
15.25	50.0	30.01	6.40	Clay	CL/CH	very stiff	125	24		100			1.66	5.76

Simplified Soil Classification Chart

After Robertson & Campanella (1989)



Geotechnical Parameters from CPT Data:

Equivalent SPT N(60) blow count = Qc/(Qc/N Ratio)

N1(60) = Cn*N(60) Normalized SPT blow count

Cn = 1/(p'o)^0.5 < 1.6 max. from Liao & Whitman (1986)

p'o = effective overburden pressure (tsf) using unit densities given below and estimated groundwater table.

Dr = Relative density (%) from Jamiolkowski et. al. (1986) relationship

= -98 +68*log(Qc/p'o^0.5) where Qc, p'o in tonne/sqm

Note: 1 tonne/sqm = 0.1024 tsf, 1 bar =1.0443 tsf

Phi = Friction Angle estimated from either:

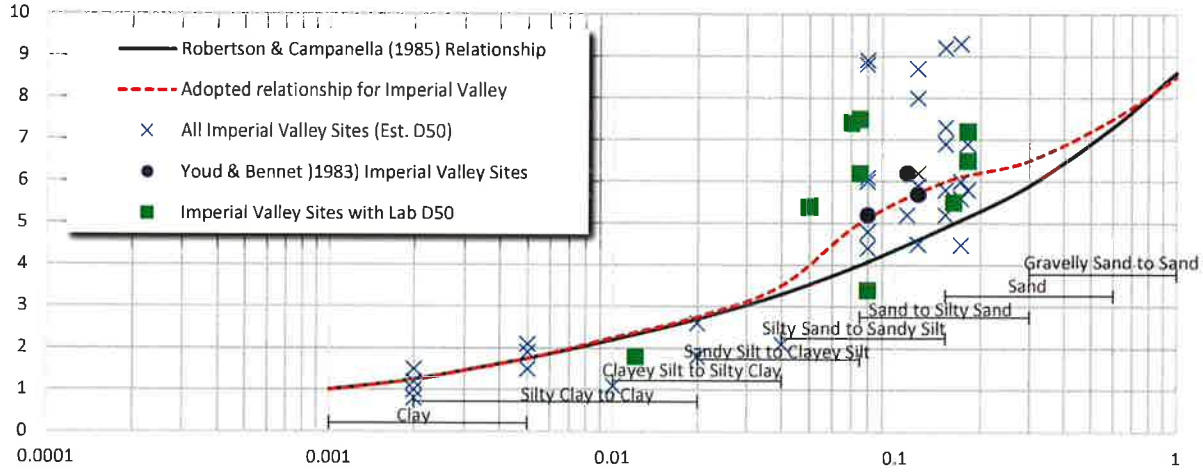
1. Roberton & Campanella (1983) chart:
   Phi = 5.3 + 24*(log(Qc/p'o))+3(log(Qc/p'o))^2
2. Peck, Hansen & Thornburn (1974) N-Phi Correlation
3. Schmertman (1978) chart [Phi = 28+0.14*Dr for fine uniform sands]

Su = undrained shear strength (tsf)

= (Qc-p'o)/Nk where Nk varies from 10 to 22, 17 for OC clays

OCR = Overconsolidation Ratio estimated from Schmertman (1978) chart using Su/p'o ratio and estimated normal consolidated Su/p'o

Variation of Qc/N Ratio with Grain Size



Note: Assumed Properties and Adopted Qc/N Ratio based on correlations from Imperial Valley, California soils

Table of Soil Types and Assumed Properties

Zone	Soil Classification	UCS	Density (pcf)	R&C Qc/N	Adopted Qc/N	Est. PI	Fines (%)	D50 (mm)
1	Sensitive fine grained	ML	120	2	2	NP-15	65-100	0.02
2	Organic Material	OL/OH	120	1	1	--	--	--
3	Clay	CL/CH	125	1	1.25	25-40+	90-100	0.002
4	Silty Clay to Clay	CL	125	1.5	2	15-40	90-100	0.01
5	Clayey Silt to Silty Clay	ML/CL	120	2	2.75	25-May	90-100	0.02
6	Sandy Silt to Clayey Silt	ML	115	2.5	3.5	NP-10	65-100	0.04
7	Silty Sand to Sandy Silt	SM/ML	115	3	5	NP	35-75	0.075
8	Sand to Silty Sand	SP/SM	115	4	6	NP	May-35	0.15
9	Sand	SP	110	5	6.5	NP	0-5	0.3
10	Gravelly Sand to Sand	SW	115	6	7.5	NP	0-5	0.6
11	Overconsolidated Soil	--	120	1	1	NP	90-100	0.01
12	Sand to Clayey Sand	SP/SC	115	2	2	NP-5	--	--

Su (tsf)	Consistency
0-0.13	very soft
0.13-.25	soft
0.25-0.5	firm
0.5-1.0	stiff
1.0-2.0	very stiff
>2.0	hard
Dr (%)	**Relative Density**
0-15	very loose
15-35	loose
35-65	medium dense
65-85	dense
>85	very dense

LANDMARK
Geo-Engineers and Geologists

Project No: LE20107

Key to CPT Interpretation of Logs

Plate B-24

APPENDIX C

LANDMARK CONSULTANTS, INC.

CLIENT: Imperial Irrigation District
PROJECT: 230 kV "S" Line Upgrade - El Centro, CA
JOB No.: LE20107
DATE: 08/19/20

CHEMICAL ANALYSIS

Boring:	CPT-1	CPT-2	CPT-3	CPT-4	CPT-5	Caltrans
Sample Depth, ft:	0-3	0-3	0-3	0-3	0-3	Method
pH:	7.58	7.77	8.78	7.76	7.31	643
Electrical Conductivity (mmhos):	2.77	0.86	8.78	6.86	7.31	424
Resistivity (ohm-cm):	200	310	40	65	60	643
Chloride (Cl), ppm:	1,120	490	17,260	10,960	9,400	422
Sulfate (SO4), ppm:	3,789	565	3,828	4,848	5,670	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Selected Chemical Test Results

Plate C-1

LANDMARK CONSULTANTS, INC.

CLIENT: Imperial Irrigation District
PROJECT: 230 kV "S" Line Upgrade - El Centro, CA
JOB No.: LE20107
DATE: 08/19/20

CHEMICAL ANALYSIS

Boring: / Sample Depth, ft:	CPT-6 0-3	CPT-7 0-3	CPT-8 0-3	CPT-9 0-3	CPT-10 0-3	Caltrans Method
pH:	7.58	7.56	7.56	7.12	6.99	643
Electrical Conductivity (mmhos):	2.13	1.46	1.09	4.02	4.47	424
Resistivity (ohm-cm):	360	390	430	165	120	643
Chloride (Cl), ppm:	640	580	400	2,260	4,060	422
Sulfate (SO4), ppm:	3,636	2,196	1,359	5,970	4,314	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Selected Chemical Test Results

Plate C-2

LANDMARK CONSULTANTS, INC.

CLIENT: Imperial Irrigation District
PROJECT: 230 kV "S" Line Upgrade - El Centro, CA
JOB No.: LE20107
DATE: 08/19/20

CHEMICAL ANALYSIS

Boring: / Sample Depth, ft:	CPT-11 0-3	CPT-12 0-3	CPT-13 0-3	CPT-14 0-3	CPT-15 0-3	Caltrans Method
pH:	6.99	7.16	7.39	7.11	7.5	643
Electrical Conductivity (mmhos):	4.09	2.33	2.24	4.68	0.86	424
Resistivity (ohm-cm):	190	280	300	180	580	643
Chloride (Cl), ppm:	3,400	880	940	2,200	270	422
Sulfate (SO4), ppm:	3,540	3,120	3,414	7,188	739	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Selected Chemical Test Results

Plate C-3

LANDMARK CONSULTANTS, INC.

CLIENT: Imperial Irrigation District
PROJECT: 230 kV "S" Line Upgrade - El Centro, CA
JOB No.: LE20107
DATE: 08/19/20

CHEMICAL ANALYSIS

Boring: / Sample Depth, ft:	CPT-16 0-3	CPT-17 0-3	CPT-18 0-3	CPT-19 0-3	CPT-20 0-3	Caltrans Method
pH:	7.09	7.06	7.59	7.16	7.55	643
Electrical Conductivity (mmhos):	2.15	1.86	0.88	0.92	5.58	424
Resistivity (ohm-cm):	200	300	500	500	120	643
Chloride (Cl), ppm:	790	580	300	250	6,520	422
Sulfate (SO4), ppm:	2,436	2,871	618	667	4,710	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Selected Chemical Test Results

Plate C-4

LANDMARK CONSULTANTS, INC.

CLIENT: Imperial Irrigation District
PROJECT: 230 kV "S" Line Upgrade - El Centro, CA
JOB No.: LE20107
DATE: 08/19/20

CHEMICAL ANALYSIS

Boring:	CPT-21	CPT-22	Caltrans Method
Sample Depth, ft:	0-3	0-3	
pH:	7.46	7.43	643
Electrical Conductivity (mmhos):	5.09	3.88	424
Resistivity (ohm-cm):	130	140	643
Chloride (Cl), ppm:	5,320	3,700	422
Sulfate (SO4), ppm:	4,272	2,472	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Selected Chemical Test Results

Plate C-5

APPENDIX D

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

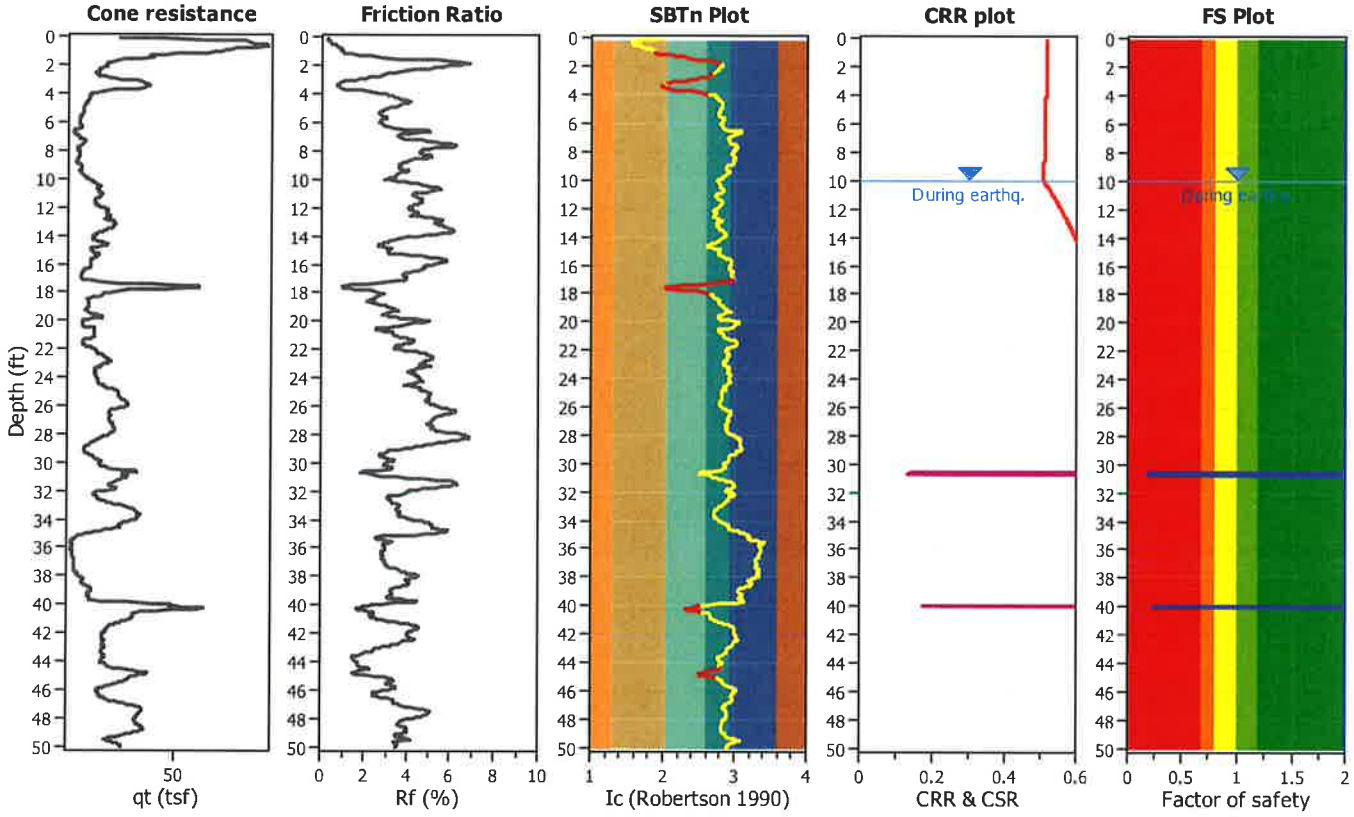
LIQUEFACTION ANALYSIS REPORT

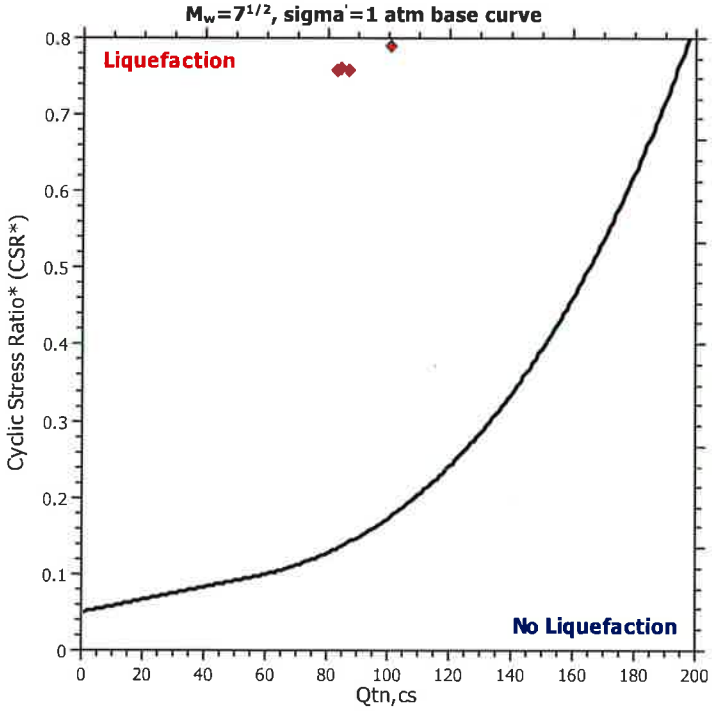
Project title : S-Line Upgrades **Location : Imperial County, CA**

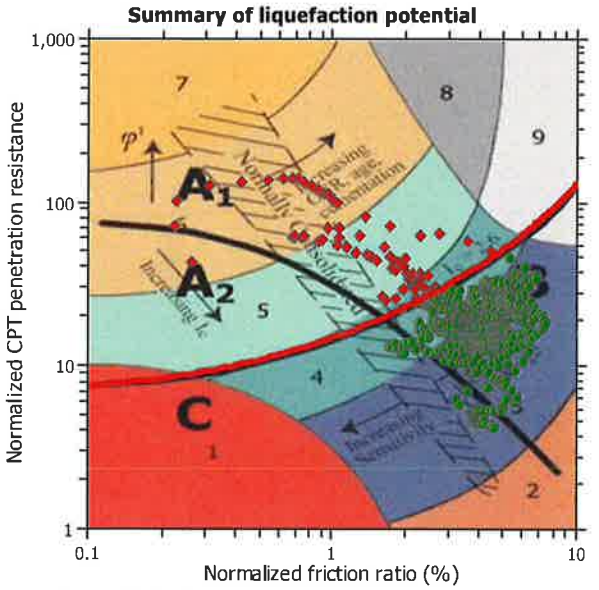
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	10.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.73	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

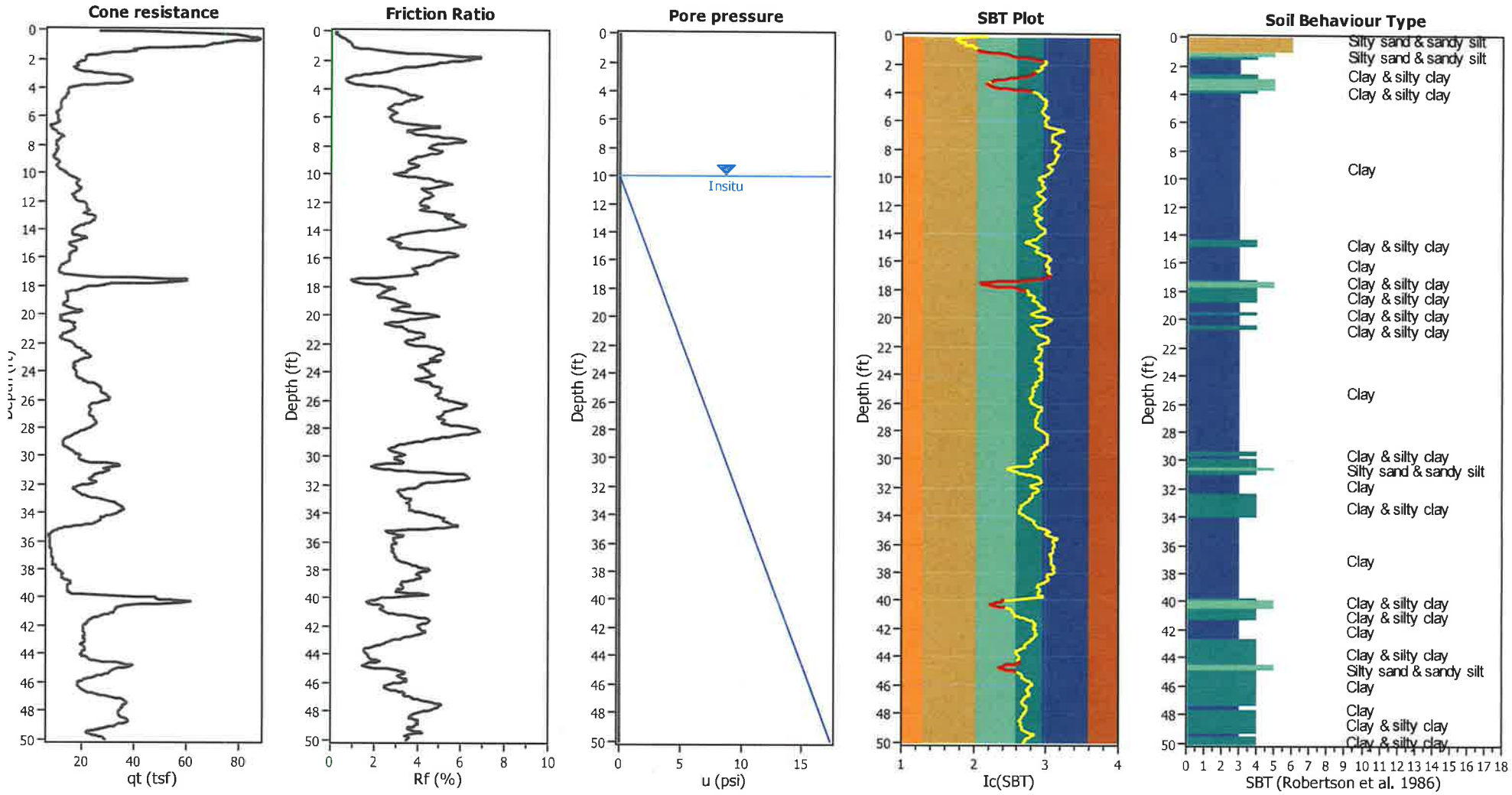






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



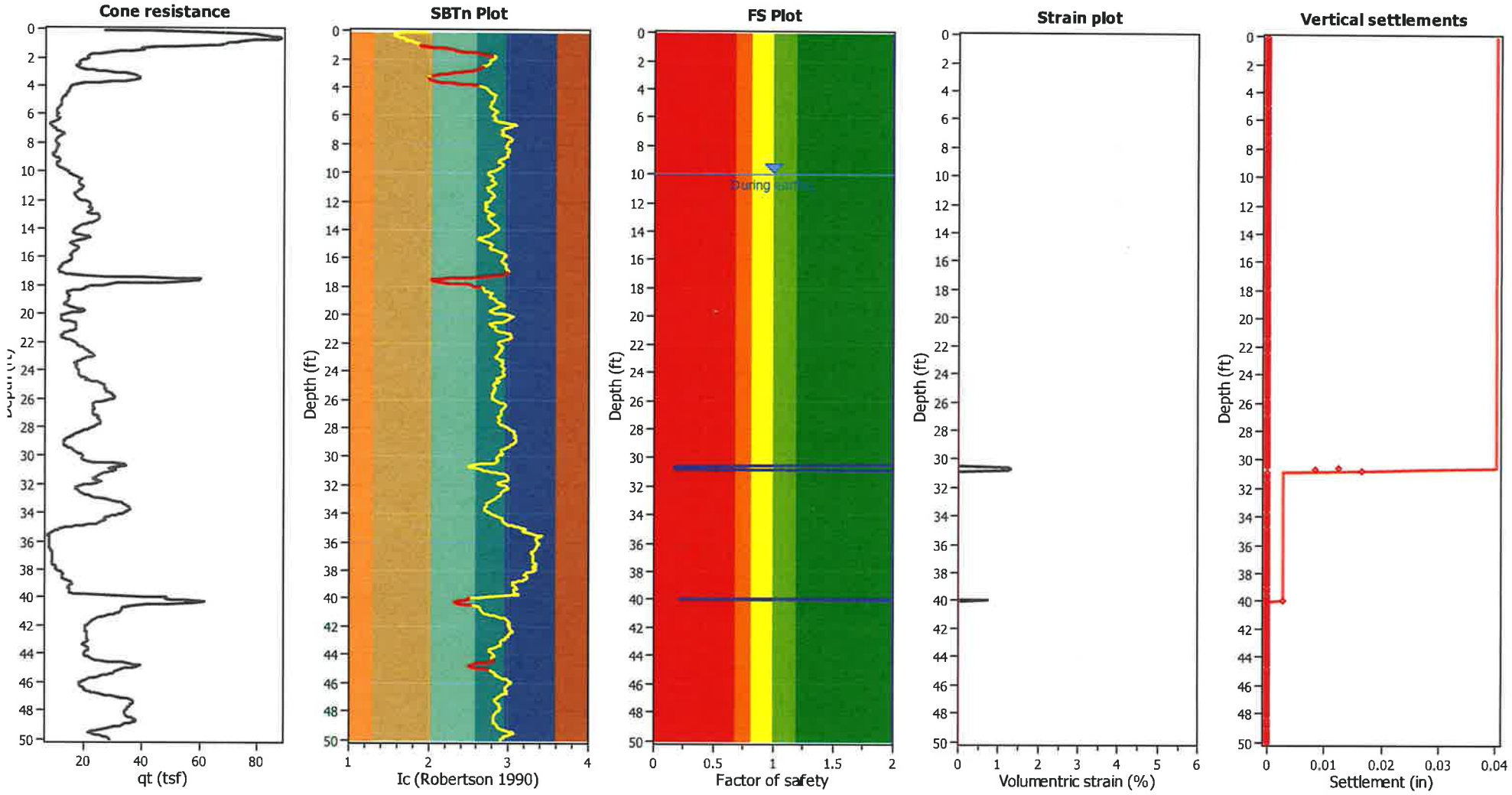
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	10.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.73	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	10.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.02	91.10	2.00	0.00	0.83	0.00	10.07	96.49	2.00	0.00	0.83	0.00
10.14	103.70	2.00	0.00	0.83	0.00	10.19	109.72	2.00	0.00	0.83	0.00
10.24	115.82	2.00	0.00	0.83	0.00	10.33	121.57	2.00	0.00	0.82	0.00
10.38	127.79	2.00	0.00	0.82	0.00	10.47	132.01	2.00	0.00	0.82	0.00
10.52	136.50	2.00	0.00	0.82	0.00	10.61	139.37	2.00	0.00	0.82	0.00
10.66	140.61	2.00	0.00	0.82	0.00	10.71	138.64	2.00	0.00	0.82	0.00
10.81	134.92	2.00	0.00	0.82	0.00	10.91	131.41	2.00	0.00	0.82	0.00
10.96	128.74	2.00	0.00	0.81	0.00	11.00	127.04	2.00	0.00	0.81	0.00
11.04	125.56	2.00	0.00	0.81	0.00	11.10	125.88	2.00	0.00	0.81	0.00
11.26	126.66	2.00	0.00	0.81	0.00	11.31	127.46	2.00	0.00	0.81	0.00
11.35	126.62	2.00	0.00	0.81	0.00	11.41	125.35	2.00	0.00	0.81	0.00
11.47	123.97	2.00	0.00	0.81	0.00	11.53	123.31	2.00	0.00	0.80	0.00
11.57	123.07	2.00	0.00	0.80	0.00	11.62	122.73	2.00	0.00	0.80	0.00
11.71	121.65	2.00	0.00	0.80	0.00	11.77	120.27	2.00	0.00	0.80	0.00
11.84	119.12	2.00	0.00	0.80	0.00	11.88	119.66	2.00	0.00	0.80	0.00
11.99	121.15	2.00	0.00	0.80	0.00	12.05	124.33	2.00	0.00	0.80	0.00
12.15	126.92	2.00	0.00	0.79	0.00	12.20	129.44	2.00	0.00	0.79	0.00
12.25	132.52	2.00	0.00	0.79	0.00	12.37	134.28	2.00	0.00	0.79	0.00
12.46	129.57	2.00	0.00	0.79	0.00	12.52	127.74	2.00	0.00	0.79	0.00
12.58	128.70	2.00	0.00	0.79	0.00	12.64	136.71	2.00	0.00	0.79	0.00
12.68	140.67	2.00	0.00	0.79	0.00	12.74	144.16	2.00	0.00	0.78	0.00
12.85	147.32	2.00	0.00	0.78	0.00	12.87	149.42	2.00	0.00	0.78	0.00
12.93	150.47	2.00	0.00	0.78	0.00	13.01	151.60	2.00	0.00	0.78	0.00
13.08	153.75	2.00	0.00	0.78	0.00	13.15	155.80	2.00	0.00	0.78	0.00
13.20	157.21	2.00	0.00	0.78	0.00	13.26	158.64	2.00	0.00	0.78	0.00
13.38	159.22	2.00	0.00	0.77	0.00	13.42	159.67	2.00	0.00	0.77	0.00
13.46	159.42	2.00	0.00	0.77	0.00	13.56	158.65	2.00	0.00	0.77	0.00
13.62	156.29	2.00	0.00	0.77	0.00	13.68	152.66	2.00	0.00	0.77	0.00
13.73	146.71	2.00	0.00	0.77	0.00	13.82	138.86	2.00	0.00	0.77	0.00
13.89	130.04	2.00	0.00	0.76	0.00	13.95	122.44	2.00	0.00	0.76	0.00
13.99	116.25	2.00	0.00	0.76	0.00	14.05	108.85	2.00	0.00	0.76	0.00
14.17	101.82	2.00	0.00	0.76	0.00	14.26	96.84	2.00	0.00	0.76	0.00
14.32	96.42	2.00	0.00	0.76	0.00	14.39	97.38	2.00	0.00	0.76	0.00
14.43	98.53	2.00	0.00	0.76	0.00	14.49	98.77	2.00	0.00	0.75	0.00
14.54	98.22	2.00	0.00	0.75	0.00	14.60	97.43	2.00	0.00	0.75	0.00
14.66	96.89	2.00	0.00	0.75	0.00	14.70	96.78	2.00	0.00	0.75	0.00
14.82	96.33	2.00	0.00	0.75	0.00	14.88	95.20	2.00	0.00	0.75	0.00
14.92	93.09	2.00	0.00	0.75	0.00	14.98	92.18	2.00	0.00	0.75	0.00
15.04	91.36	2.00	0.00	0.75	0.00	15.10	92.72	2.00	0.00	0.74	0.00
15.20	95.81	2.00	0.00	0.74	0.00	15.27	101.54	2.00	0.00	0.74	0.00
15.32	108.36	2.00	0.00	0.74	0.00	15.37	114.49	2.00	0.00	0.74	0.00
15.44	119.98	2.00	0.00	0.74	0.00	15.49	124.34	2.00	0.00	0.74	0.00
15.57	126.61	2.00	0.00	0.74	0.00	15.68	127.21	2.00	0.00	0.73	0.00
15.72	126.53	2.00	0.00	0.73	0.00	15.79	125.45	2.00	0.00	0.73	0.00
15.84	124.03	2.00	0.00	0.73	0.00	15.89	120.70	2.00	0.00	0.73	0.00
16.06	117.21	2.00	0.00	0.73	0.00	16.12	114.30	2.00	0.00	0.73	0.00
16.16	113.44	2.00	0.00	0.73	0.00	16.22	111.97	2.00	0.00	0.73	0.00
16.28	109.87	2.00	0.00	0.72	0.00	16.33	107.30	2.00	0.00	0.72	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.38	104.43	2.00	0.00	0.72	0.00	16.44	100.66	2.00	0.00	0.72	0.00
16.51	97.00	2.00	0.00	0.72	0.00	16.56	93.35	2.00	0.00	0.72	0.00
16.66	90.80	2.00	0.00	0.72	0.00	16.71	89.07	2.00	0.00	0.72	0.00
16.82	88.55	2.00	0.00	0.71	0.00	16.87	88.55	2.00	0.00	0.71	0.00
16.93	88.75	2.00	0.00	0.71	0.00	16.99	89.60	2.00	0.00	0.71	0.00
17.04	90.81	2.00	0.00	0.71	0.00	17.09	92.05	2.00	0.00	0.71	0.00
17.14	93.33	2.00	0.00	0.71	0.00	17.20	94.57	2.00	0.00	0.71	0.00
17.26	93.42	2.00	0.00	0.71	0.00	17.36	89.24	2.00	0.00	0.71	0.00
17.41	86.36	2.00	0.00	0.70	0.00	17.48	88.42	2.00	0.00	0.70	0.00
17.53	92.34	2.00	0.00	0.70	0.00	17.63	94.86	2.00	0.00	0.70	0.00
17.70	96.15	2.00	0.00	0.70	0.00	17.75	97.56	2.00	0.00	0.70	0.00
17.80	98.54	2.00	0.00	0.70	0.00	17.85	97.98	2.00	0.00	0.70	0.00
17.97	97.45	2.00	0.00	0.70	0.00	18.02	97.02	2.00	0.00	0.69	0.00
18.07	97.13	2.00	0.00	0.69	0.00	18.11	94.73	2.00	0.00	0.69	0.00
18.19	90.08	2.00	0.00	0.69	0.00	18.29	84.63	2.00	0.00	0.69	0.00
18.35	80.08	2.00	0.00	0.69	0.00	18.42	77.22	2.00	0.00	0.69	0.00
18.46	74.93	2.00	0.00	0.69	0.00	18.51	73.66	2.00	0.00	0.69	0.00
18.58	72.74	2.00	0.00	0.69	0.00	18.68	74.05	2.00	0.00	0.68	0.00
18.77	77.76	2.00	0.00	0.68	0.00	18.86	82.60	2.00	0.00	0.68	0.00
18.91	85.62	2.00	0.00	0.68	0.00	19.00	86.66	2.00	0.00	0.68	0.00
19.04	86.67	2.00	0.00	0.68	0.00	19.14	88.00	2.00	0.00	0.68	0.00
19.26	88.67	2.00	0.00	0.67	0.00	19.30	87.79	2.00	0.00	0.67	0.00
19.35	86.55	2.00	0.00	0.67	0.00	19.46	85.95	2.00	0.00	0.67	0.00
19.52	85.91	2.00	0.00	0.67	0.00	19.62	90.67	2.00	0.00	0.67	0.00
19.67	95.97	2.00	0.00	0.67	0.00	19.72	102.70	2.00	0.00	0.67	0.00
19.78	104.50	2.00	0.00	0.66	0.00	19.84	105.96	2.00	0.00	0.66	0.00
19.89	105.38	2.00	0.00	0.66	0.00	19.98	103.44	2.00	0.00	0.66	0.00
20.02	99.20	2.00	0.00	0.66	0.00	20.12	95.81	2.00	0.00	0.66	0.00
20.16	91.57	2.00	0.00	0.66	0.00	20.25	87.93	2.00	0.00	0.66	0.00
20.30	84.43	2.00	0.00	0.66	0.00	20.41	82.69	2.00	0.00	0.65	0.00
20.46	81.59	2.00	0.00	0.65	0.00	20.51	80.83	2.00	0.00	0.65	0.00
20.56	80.76	2.00	0.00	0.65	0.00	20.64	81.60	2.00	0.00	0.65	0.00
20.68	84.80	2.00	0.00	0.65	0.00	20.78	88.51	2.00	0.00	0.65	0.00
20.83	92.25	2.00	0.00	0.65	0.00	20.89	93.91	2.00	0.00	0.65	0.00
21.00	94.83	2.00	0.00	0.64	0.00	21.07	95.66	2.00	0.00	0.64	0.00
21.13	96.81	2.00	0.00	0.64	0.00	21.18	97.61	2.00	0.00	0.64	0.00
21.24	97.47	2.00	0.00	0.64	0.00	21.30	96.46	2.00	0.00	0.64	0.00
21.35	93.63	2.00	0.00	0.64	0.00	21.46	90.93	2.00	0.00	0.64	0.00
21.52	87.91	2.00	0.00	0.64	0.00	21.57	86.90	2.00	0.00	0.63	0.00
21.63	85.58	2.00	0.00	0.63	0.00	21.70	84.92	2.00	0.00	0.63	0.00
21.75	84.91	2.00	0.00	0.63	0.00	21.80	86.38	2.00	0.00	0.63	0.00
21.86	88.74	2.00	0.00	0.63	0.00	21.92	91.61	2.00	0.00	0.63	0.00
22.00	95.92	2.00	0.00	0.63	0.00	22.09	101.49	2.00	0.00	0.63	0.00
22.16	106.64	2.00	0.00	0.62	0.00	22.22	109.92	2.00	0.00	0.62	0.00
22.26	111.98	2.00	0.00	0.62	0.00	22.32	114.68	2.00	0.00	0.62	0.00
22.38	118.89	2.00	0.00	0.62	0.00	22.53	122.34	2.00	0.00	0.62	0.00
22.59	124.40	2.00	0.00	0.62	0.00	22.65	124.84	2.00	0.00	0.62	0.00
22.71	125.09	2.00	0.00	0.62	0.00	22.75	125.25	2.00	0.00	0.61	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
22.80	124.95	2.00	0.00	0.61	0.00	22.93	124.50	2.00	0.00	0.61	0.00
22.97	124.08	2.00	0.00	0.61	0.00	23.02	118.96	2.00	0.00	0.61	0.00
23.08	117.25	2.00	0.00	0.61	0.00	23.14	115.32	2.00	0.00	0.61	0.00
23.19	117.50	2.00	0.00	0.61	0.00	23.25	114.46	2.00	0.00	0.61	0.00
23.31	109.99	2.00	0.00	0.60	0.00	23.37	105.31	2.00	0.00	0.60	0.00
23.43	101.60	2.00	0.00	0.60	0.00	23.50	100.09	2.00	0.00	0.60	0.00
23.58	99.95	2.00	0.00	0.60	0.00	23.63	100.95	2.00	0.00	0.60	0.00
23.72	101.52	2.00	0.00	0.60	0.00	23.78	102.29	2.00	0.00	0.60	0.00
23.85	103.20	2.00	0.00	0.60	0.00	23.90	104.93	2.00	0.00	0.59	0.00
23.96	106.43	2.00	0.00	0.59	0.00	24.08	107.27	2.00	0.00	0.59	0.00
24.12	107.16	2.00	0.00	0.59	0.00	24.17	107.44	2.00	0.00	0.59	0.00
24.23	108.70	2.00	0.00	0.59	0.00	24.30	107.07	2.00	0.00	0.59	0.00
24.35	104.51	2.00	0.00	0.59	0.00	24.47	101.05	2.00	0.00	0.59	0.00
24.52	102.84	2.00	0.00	0.58	0.00	24.59	107.31	2.00	0.00	0.58	0.00
24.70	111.81	2.00	0.00	0.58	0.00	24.70	115.30	2.00	0.00	0.58	0.00
24.77	117.73	2.00	0.00	0.58	0.00	24.83	120.74	2.00	0.00	0.58	0.00
24.88	124.50	2.00	0.00	0.58	0.00	24.98	128.52	2.00	0.00	0.58	0.00
25.05	131.40	2.00	0.00	0.58	0.00	25.09	132.96	2.00	0.00	0.57	0.00
25.14	132.81	2.00	0.00	0.57	0.00	25.23	132.54	2.00	0.00	0.57	0.00
25.30	132.35	2.00	0.00	0.57	0.00	25.35	132.31	2.00	0.00	0.57	0.00
25.41	132.23	2.00	0.00	0.57	0.00	25.50	132.14	2.00	0.00	0.57	0.00
25.57	132.40	2.00	0.00	0.57	0.00	25.63	133.00	2.00	0.00	0.57	0.00
25.67	134.83	2.00	0.00	0.56	0.00	25.79	137.05	2.00	0.00	0.56	0.00
25.85	139.70	2.00	0.00	0.56	0.00	25.91	141.54	2.00	0.00	0.56	0.00
25.98	142.84	2.00	0.00	0.56	0.00	26.03	143.35	2.00	0.00	0.56	0.00
26.07	143.32	2.00	0.00	0.56	0.00	26.12	142.59	2.00	0.00	0.56	0.00
26.23	141.26	2.00	0.00	0.56	0.00	26.29	138.82	2.00	0.00	0.55	0.00
26.39	136.17	2.00	0.00	0.55	0.00	26.43	133.75	2.00	0.00	0.55	0.00
26.51	131.87	2.00	0.00	0.55	0.00	26.61	130.08	2.00	0.00	0.55	0.00
26.66	128.27	2.00	0.00	0.55	0.00	26.73	126.37	2.00	0.00	0.55	0.00
26.78	124.10	2.00	0.00	0.55	0.00	26.95	122.32	2.00	0.00	0.54	0.00
27.00	121.54	2.00	0.00	0.54	0.00	27.06	121.48	2.00	0.00	0.54	0.00
27.18	121.09	2.00	0.00	0.54	0.00	27.22	121.34	2.00	0.00	0.54	0.00
27.26	122.62	2.00	0.00	0.54	0.00	27.32	124.17	2.00	0.00	0.54	0.00
27.38	125.20	2.00	0.00	0.54	0.00	27.43	125.63	2.00	0.00	0.54	0.00
27.53	126.16	2.00	0.00	0.53	0.00	27.59	126.80	2.00	0.00	0.53	0.00
27.65	127.44	2.00	0.00	0.53	0.00	27.70	128.88	2.00	0.00	0.53	0.00
27.79	130.90	2.00	0.00	0.53	0.00	27.84	134.14	2.00	0.00	0.53	0.00
27.94	136.29	2.00	0.00	0.53	0.00	27.98	137.36	2.00	0.00	0.53	0.00
28.04	136.60	2.00	0.00	0.52	0.00	28.10	134.78	2.00	0.00	0.52	0.00
28.19	132.39	2.00	0.00	0.52	0.00	28.24	128.09	2.00	0.00	0.52	0.00
28.32	123.20	2.00	0.00	0.52	0.00	28.37	117.79	2.00	0.00	0.52	0.00
28.41	112.91	2.00	0.00	0.52	0.00	28.51	108.01	2.00	0.00	0.52	0.00
28.58	103.33	2.00	0.00	0.52	0.00	28.63	99.37	2.00	0.00	0.51	0.00
28.68	95.21	2.00	0.00	0.51	0.00	28.77	90.87	2.00	0.00	0.51	0.00
28.83	87.01	2.00	0.00	0.51	0.00	28.90	84.21	2.00	0.00	0.51	0.00
28.94	81.14	2.00	0.00	0.51	0.00	29.05	77.93	2.00	0.00	0.51	0.00
29.11	74.96	2.00	0.00	0.51	0.00	29.16	73.42	2.00	0.00	0.51	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
29.21	72.74	2.00	0.00	0.50	0.00	29.33	72.41	2.00	0.00	0.50	0.00
29.39	72.49	2.00	0.00	0.50	0.00	29.43	72.82	2.00	0.00	0.50	0.00
29.48	73.71	2.00	0.00	0.50	0.00	29.55	75.51	2.00	0.00	0.50	0.00
29.61	79.37	2.00	0.00	0.50	0.00	29.75	83.77	2.00	0.00	0.50	0.00
29.81	87.33	2.00	0.00	0.49	0.00	29.87	88.53	2.00	0.00	0.49	0.00
29.92	88.25	2.00	0.00	0.49	0.00	29.96	87.15	2.00	0.00	0.49	0.00
30.03	84.08	2.00	0.00	0.49	0.00	30.14	82.92	2.00	0.00	0.49	0.00
30.18	83.67	2.00	0.00	0.49	0.00	30.31	88.09	2.00	0.00	0.49	0.00
30.36	92.14	2.00	0.00	0.49	0.00	30.49	94.49	2.00	0.00	0.48	0.00
30.51	91.66	2.00	0.00	0.48	0.00	30.59	86.58	0.19	1.27	0.48	0.01
30.65	83.09	0.18	1.31	0.48	0.01	30.76	84.45	0.18	1.28	0.48	0.02
30.86	89.07	2.00	0.00	0.48	0.00	30.92	95.27	2.00	0.00	0.48	0.00
30.98	102.03	2.00	0.00	0.47	0.00	31.02	109.73	2.00	0.00	0.47	0.00
31.07	117.04	2.00	0.00	0.47	0.00	31.12	125.13	2.00	0.00	0.47	0.00
31.20	130.55	2.00	0.00	0.47	0.00	31.24	135.53	2.00	0.00	0.47	0.00
31.34	133.56	2.00	0.00	0.47	0.00	31.50	131.28	2.00	0.00	0.47	0.00
31.56	126.40	2.00	0.00	0.47	0.00	31.61	124.79	2.00	0.00	0.46	0.00
31.66	122.40	2.00	0.00	0.46	0.00	31.73	120.17	2.00	0.00	0.46	0.00
31.77	117.01	2.00	0.00	0.46	0.00	31.86	112.74	2.00	0.00	0.46	0.00
31.92	106.77	2.00	0.00	0.46	0.00	31.99	101.62	2.00	0.00	0.46	0.00
32.04	97.27	2.00	0.00	0.46	0.00	32.09	92.92	2.00	0.00	0.46	0.00
32.21	88.48	2.00	0.00	0.45	0.00	32.26	84.27	2.00	0.00	0.45	0.00
32.31	82.39	2.00	0.00	0.45	0.00	32.36	81.21	2.00	0.00	0.45	0.00
32.43	81.53	2.00	0.00	0.45	0.00	32.57	83.04	2.00	0.00	0.45	0.00
32.65	85.22	2.00	0.00	0.45	0.00	32.70	86.89	2.00	0.00	0.45	0.00
32.75	89.29	2.00	0.00	0.45	0.00	32.87	92.18	2.00	0.00	0.44	0.00
32.92	96.84	2.00	0.00	0.44	0.00	32.97	101.31	2.00	0.00	0.44	0.00
33.03	105.61	2.00	0.00	0.44	0.00	33.14	107.62	2.00	0.00	0.44	0.00
33.21	108.63	2.00	0.00	0.44	0.00	33.27	110.48	2.00	0.00	0.44	0.00
33.36	112.42	2.00	0.00	0.43	0.00	33.45	113.86	2.00	0.00	0.43	0.00
33.50	113.86	2.00	0.00	0.43	0.00	33.54	114.03	2.00	0.00	0.43	0.00
33.61	114.75	2.00	0.00	0.43	0.00	33.72	115.42	2.00	0.00	0.43	0.00
33.77	116.41	2.00	0.00	0.43	0.00	33.83	117.97	2.00	0.00	0.43	0.00
33.88	120.63	2.00	0.00	0.43	0.00	34.00	123.36	2.00	0.00	0.42	0.00
34.05	125.28	2.00	0.00	0.42	0.00	34.10	125.34	2.00	0.00	0.42	0.00
34.17	124.77	2.00	0.00	0.42	0.00	34.23	123.94	2.00	0.00	0.42	0.00
34.27	123.40	2.00	0.00	0.42	0.00	34.32	122.47	2.00	0.00	0.42	0.00
34.43	121.71	2.00	0.00	0.42	0.00	34.49	121.38	2.00	0.00	0.42	0.00
34.53	121.82	2.00	0.00	0.41	0.00	34.59	121.42	2.00	0.00	0.41	0.00
34.76	119.51	2.00	0.00	0.41	0.00	34.80	115.36	2.00	0.00	0.41	0.00
34.86	109.10	2.00	0.00	0.41	0.00	34.92	101.10	2.00	0.00	0.41	0.00
34.98	92.55	2.00	0.00	0.41	0.00	35.02	83.93	2.00	0.00	0.41	0.00
35.08	75.98	2.00	0.00	0.41	0.00	35.13	67.98	2.00	0.00	0.40	0.00
35.20	61.23	2.00	0.00	0.40	0.00	35.24	56.72	2.00	0.00	0.40	0.00
35.36	54.83	2.00	0.00	0.40	0.00	35.40	54.35	2.00	0.00	0.40	0.00
35.51	53.64	2.00	0.00	0.40	0.00	35.56	52.81	2.00	0.00	0.40	0.00
35.59	52.74	2.00	0.00	0.40	0.00	35.64	52.67	2.00	0.00	0.40	0.00
35.71	52.83	2.00	0.00	0.39	0.00	35.77	52.58	2.00	0.00	0.39	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
35.87	52.40	2.00	0.00	0.39	0.00	35.92	52.13	2.00	0.00	0.39	0.00
35.99	51.99	2.00	0.00	0.39	0.00	36.04	51.79	2.00	0.00	0.39	0.00
36.10	51.76	2.00	0.00	0.39	0.00	36.17	51.44	2.00	0.00	0.39	0.00
36.26	51.30	2.00	0.00	0.39	0.00	36.34	51.26	2.00	0.00	0.38	0.00
36.39	51.56	2.00	0.00	0.38	0.00	36.44	51.88	2.00	0.00	0.38	0.00
36.50	52.19	2.00	0.00	0.38	0.00	36.57	52.90	2.00	0.00	0.38	0.00
36.65	53.59	2.00	0.00	0.38	0.00	36.69	54.33	2.00	0.00	0.38	0.00
36.77	54.69	2.00	0.00	0.38	0.00	36.86	54.87	2.00	0.00	0.38	0.00
36.89	54.98	2.00	0.00	0.37	0.00	36.98	54.95	2.00	0.00	0.37	0.00
37.02	54.99	2.00	0.00	0.37	0.00	37.11	55.10	2.00	0.00	0.37	0.00
37.17	55.42	2.00	0.00	0.37	0.00	37.21	56.06	2.00	0.00	0.37	0.00
37.32	56.76	2.00	0.00	0.37	0.00	37.37	57.79	2.00	0.00	0.37	0.00
37.43	58.91	2.00	0.00	0.37	0.00	37.48	59.20	2.00	0.00	0.36	0.00
37.58	59.94	2.00	0.00	0.36	0.00	37.63	61.09	2.00	0.00	0.36	0.00
37.70	63.15	2.00	0.00	0.36	0.00	37.73	64.97	2.00	0.00	0.36	0.00
37.83	66.35	2.00	0.00	0.36	0.00	37.88	67.13	2.00	0.00	0.36	0.00
37.93	68.66	2.00	0.00	0.36	0.00	38.01	70.35	2.00	0.00	0.36	0.00
38.10	72.35	2.00	0.00	0.35	0.00	38.14	73.31	2.00	0.00	0.35	0.00
38.24	73.34	2.00	0.00	0.35	0.00	38.28	73.13	2.00	0.00	0.35	0.00
38.35	72.72	2.00	0.00	0.35	0.00	38.41	72.88	2.00	0.00	0.35	0.00
38.51	73.09	2.00	0.00	0.35	0.00	38.58	73.31	2.00	0.00	0.35	0.00
38.63	73.44	2.00	0.00	0.35	0.00	38.67	73.97	2.00	0.00	0.34	0.00
38.73	74.49	2.00	0.00	0.34	0.00	38.80	74.66	2.00	0.00	0.34	0.00
38.85	74.46	2.00	0.00	0.34	0.00	39.01	74.07	2.00	0.00	0.34	0.00
39.07	73.54	2.00	0.00	0.34	0.00	39.16	72.80	2.00	0.00	0.34	0.00
39.21	72.15	2.00	0.00	0.34	0.00	39.28	71.84	2.00	0.00	0.33	0.00
39.33	71.73	2.00	0.00	0.33	0.00	39.38	70.37	2.00	0.00	0.33	0.00
39.50	70.32	2.00	0.00	0.33	0.00	39.56	71.82	2.00	0.00	0.33	0.00
39.60	76.25	2.00	0.00	0.33	0.00	39.65	80.69	2.00	0.00	0.33	0.00
39.71	86.20	2.00	0.00	0.33	0.00	39.78	94.45	2.00	0.00	0.33	0.00
39.87	101.16	2.00	0.00	0.32	0.00	39.96	103.47	2.00	0.00	0.32	0.00
39.99	100.37	0.22	0.75	0.32	0.00	40.07	97.14	2.00	0.00	0.32	0.00
40.13	94.05	2.00	0.00	0.32	0.00	40.18	93.62	2.00	0.00	0.32	0.00
40.24	93.74	2.00	0.00	0.32	0.00	40.29	93.89	2.00	0.00	0.32	0.00
40.37	93.30	2.00	0.00	0.32	0.00	40.43	92.48	2.00	0.00	0.31	0.00
40.52	91.87	2.00	0.00	0.31	0.00	40.56	90.53	2.00	0.00	0.31	0.00
40.65	88.23	2.00	0.00	0.31	0.00	40.69	85.62	2.00	0.00	0.31	0.00
40.78	84.46	2.00	0.00	0.31	0.00	40.83	85.08	2.00	0.00	0.31	0.00
40.91	86.32	2.00	0.00	0.31	0.00	40.96	88.15	2.00	0.00	0.31	0.00
41.05	89.67	2.00	0.00	0.30	0.00	41.09	92.25	2.00	0.00	0.30	0.00
41.18	94.68	2.00	0.00	0.30	0.00	41.22	97.51	2.00	0.00	0.30	0.00
41.31	99.40	2.00	0.00	0.30	0.00	41.36	100.81	2.00	0.00	0.30	0.00
41.41	101.20	2.00	0.00	0.30	0.00	41.51	100.99	2.00	0.00	0.30	0.00
41.57	100.38	2.00	0.00	0.30	0.00	41.62	99.19	2.00	0.00	0.29	0.00
41.71	97.64	2.00	0.00	0.29	0.00	41.75	95.73	2.00	0.00	0.29	0.00
41.80	93.74	2.00	0.00	0.29	0.00	41.90	92.07	2.00	0.00	0.29	0.00
41.94	90.79	2.00	0.00	0.29	0.00	42.01	90.21	2.00	0.00	0.29	0.00
42.06	89.77	2.00	0.00	0.29	0.00	42.15	89.60	2.00	0.00	0.29	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
42.19	90.10	2.00	0.00	0.28	0.00	42.32	90.88	2.00	0.00	0.28	0.00
42.37	91.91	2.00	0.00	0.28	0.00	42.42	92.32	2.00	0.00	0.28	0.00
42.46	92.37	2.00	0.00	0.28	0.00	42.52	91.46	2.00	0.00	0.28	0.00
42.59	88.68	2.00	0.00	0.28	0.00	42.73	85.66	2.00	0.00	0.28	0.00
42.78	82.97	2.00	0.00	0.27	0.00	42.85	81.95	2.00	0.00	0.27	0.00
42.90	80.76	2.00	0.00	0.27	0.00	42.95	79.51	2.00	0.00	0.27	0.00
42.98	77.61	2.00	0.00	0.27	0.00	43.08	75.79	2.00	0.00	0.27	0.00
43.12	73.55	2.00	0.00	0.27	0.00	43.23	71.79	2.00	0.00	0.27	0.00
43.29	69.85	2.00	0.00	0.27	0.00	43.34	68.44	2.00	0.00	0.27	0.00
43.39	66.75	2.00	0.00	0.26	0.00	43.50	64.80	2.00	0.00	0.26	0.00
43.56	62.66	2.00	0.00	0.26	0.00	43.60	60.83	2.00	0.00	0.26	0.00
43.66	59.66	2.00	0.00	0.26	0.00	43.71	59.15	2.00	0.00	0.26	0.00
43.78	59.29	2.00	0.00	0.26	0.00	43.87	59.82	2.00	0.00	0.26	0.00
43.99	60.33	2.00	0.00	0.25	0.00	44.04	60.79	2.00	0.00	0.25	0.00
44.09	60.93	2.00	0.00	0.25	0.00	44.14	61.17	2.00	0.00	0.25	0.00
44.20	62.07	2.00	0.00	0.25	0.00	44.27	64.06	2.00	0.00	0.25	0.00
44.36	66.41	2.00	0.00	0.25	0.00	44.40	69.29	2.00	0.00	0.25	0.00
44.45	72.13	2.00	0.00	0.25	0.00	44.53	74.27	2.00	0.00	0.25	0.00
44.58	74.85	2.00	0.00	0.24	0.00	44.62	73.92	2.00	0.00	0.24	0.00
44.75	72.32	2.00	0.00	0.24	0.00	44.84	72.67	2.00	0.00	0.24	0.00
44.89	75.93	2.00	0.00	0.24	0.00	44.96	82.01	2.00	0.00	0.24	0.00
45.02	88.33	2.00	0.00	0.24	0.00	45.12	92.52	2.00	0.00	0.24	0.00
45.16	95.14	2.00	0.00	0.23	0.00	45.23	96.09	2.00	0.00	0.23	0.00
45.33	96.17	2.00	0.00	0.23	0.00	45.38	94.81	2.00	0.00	0.23	0.00
45.43	91.78	2.00	0.00	0.23	0.00	45.50	88.50	2.00	0.00	0.23	0.00
45.55	86.29	2.00	0.00	0.23	0.00	45.65	85.67	2.00	0.00	0.23	0.00
45.71	85.01	2.00	0.00	0.23	0.00	45.76	83.82	2.00	0.00	0.22	0.00
45.82	81.91	2.00	0.00	0.22	0.00	45.90	80.11	2.00	0.00	0.22	0.00
45.94	77.94	2.00	0.00	0.22	0.00	46.02	75.47	2.00	0.00	0.22	0.00
46.08	71.85	2.00	0.00	0.22	0.00	46.17	69.19	2.00	0.00	0.22	0.00
46.22	67.64	2.00	0.00	0.22	0.00	46.32	67.96	2.00	0.00	0.21	0.00
46.37	68.55	2.00	0.00	0.21	0.00	46.42	70.74	2.00	0.00	0.21	0.00
46.52	73.22	2.00	0.00	0.21	0.00	46.56	76.27	2.00	0.00	0.21	0.00
46.61	78.69	2.00	0.00	0.21	0.00	46.66	81.18	2.00	0.00	0.21	0.00
46.72	83.50	2.00	0.00	0.21	0.00	46.79	85.66	2.00	0.00	0.21	0.00
46.88	88.10	2.00	0.00	0.21	0.00	46.95	91.43	2.00	0.00	0.20	0.00
47.00	95.47	2.00	0.00	0.20	0.00	47.05	100.09	2.00	0.00	0.20	0.00
47.15	103.64	2.00	0.00	0.20	0.00	47.19	108.85	2.00	0.00	0.20	0.00
47.27	113.54	2.00	0.00	0.20	0.00	47.32	119.22	2.00	0.00	0.20	0.00
47.42	122.26	2.00	0.00	0.20	0.00	47.49	124.13	2.00	0.00	0.20	0.00
47.54	123.99	2.00	0.00	0.19	0.00	47.59	122.78	2.00	0.00	0.19	0.00
47.69	121.28	2.00	0.00	0.19	0.00	47.75	120.00	2.00	0.00	0.19	0.00
47.80	118.28	2.00	0.00	0.19	0.00	47.88	116.02	2.00	0.00	0.19	0.00
47.93	113.31	2.00	0.00	0.19	0.00	47.98	110.78	2.00	0.00	0.19	0.00
48.04	107.40	2.00	0.00	0.19	0.00	48.16	103.95	2.00	0.00	0.18	0.00
48.38	101.82	2.00	0.00	0.18	0.00	48.47	103.03	2.00	0.00	0.18	0.00
48.54	106.13	2.00	0.00	0.18	0.00	48.60	109.09	2.00	0.00	0.18	0.00
48.64	110.85	2.00	0.00	0.18	0.00	48.69	111.24	2.00	0.00	0.17	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
48.81	110.84	2.00	0.00	0.17	0.00	48.86	109.68	2.00	0.00	0.17	0.00
48.91	108.15	2.00	0.00	0.17	0.00	48.96	104.73	2.00	0.00	0.17	0.00
49.07	100.97	2.00	0.00	0.17	0.00	49.11	97.00	2.00	0.00	0.17	0.00
49.17	94.78	2.00	0.00	0.17	0.00	49.22	92.27	2.00	0.00	0.17	0.00
49.35	90.33	2.00	0.00	0.16	0.00	49.39	89.22	2.00	0.00	0.16	0.00
49.44	88.86	2.00	0.00	0.16	0.00	49.50	87.73	2.00	0.00	0.16	0.00
49.56	85.80	2.00	0.00	0.16	0.00	49.66	84.17	2.00	0.00	0.16	0.00
49.71	84.46	2.00	0.00	0.16	0.00	49.78	86.76	2.00	0.00	0.16	0.00
49.83	89.74	2.00	0.00	0.16	0.00	49.88	91.49	2.00	0.00	0.15	0.00
49.98	91.97	2.00	0.00	0.15	0.00	50.05	91.66	2.00	0.00	0.15	0.00

Total estimated settlement: 0.04

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

LIQUEFACTION ANALYSIS REPORT

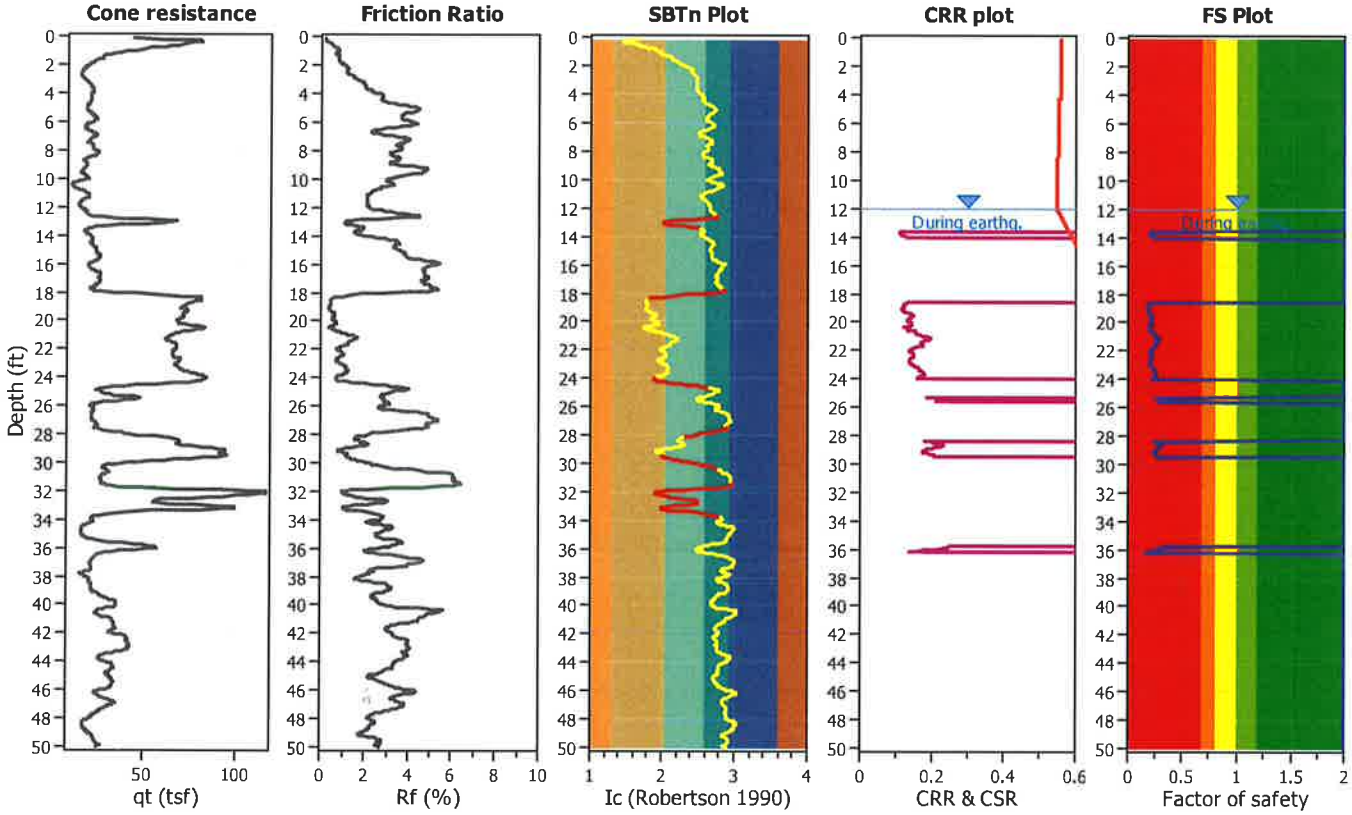
Project title : S-Line Upgrades

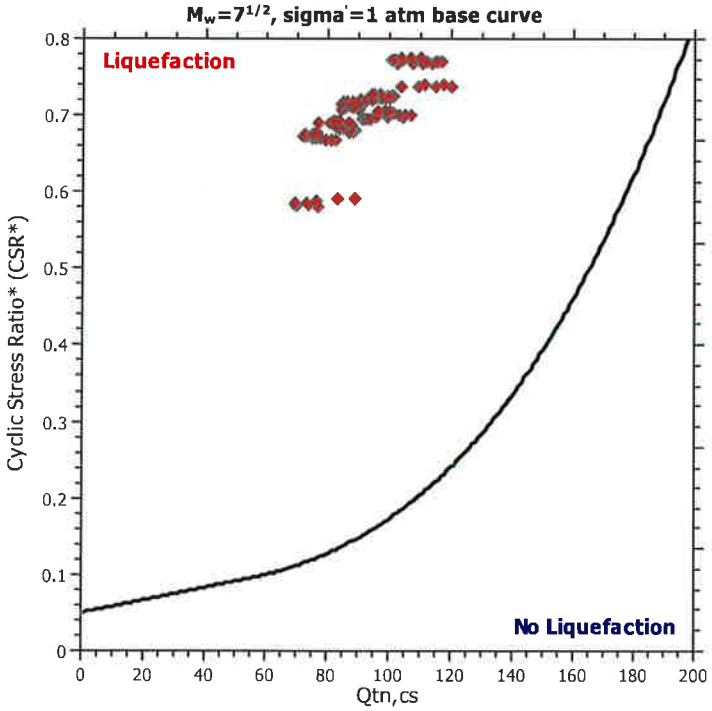
Location : Imperial County, CA

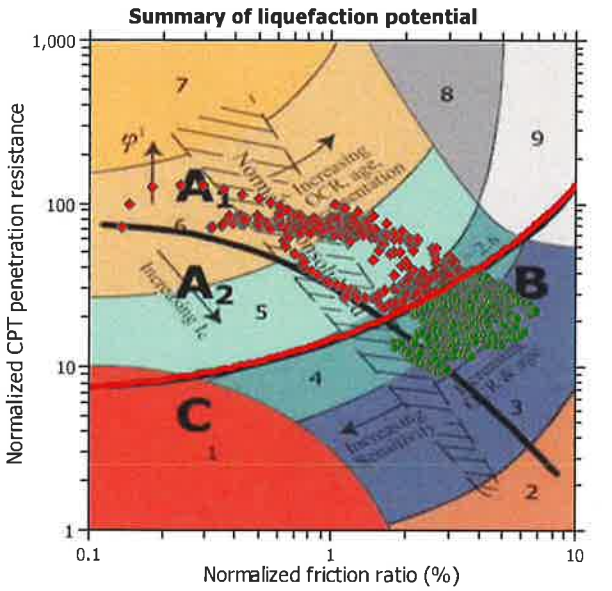
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.79	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

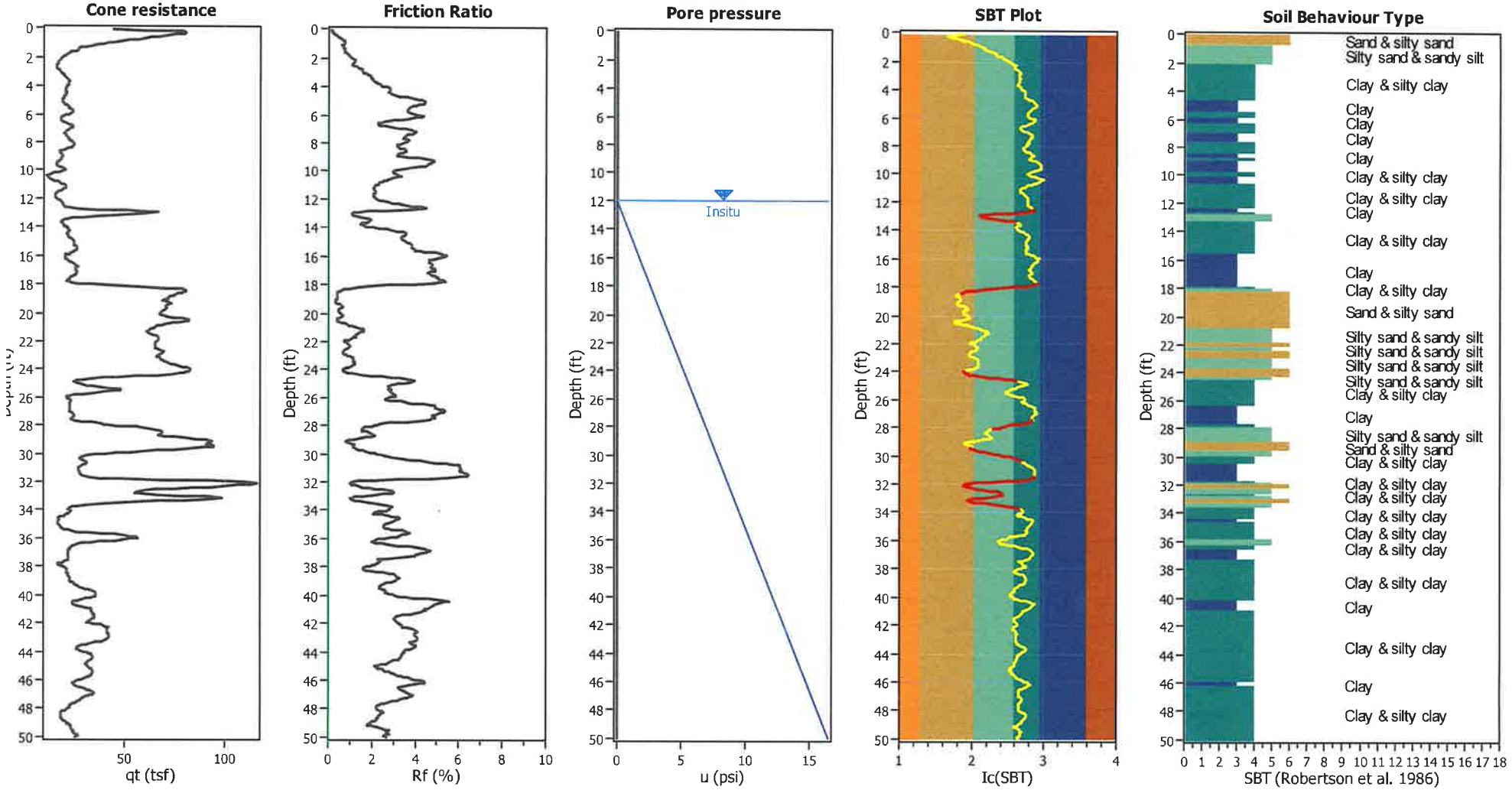






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



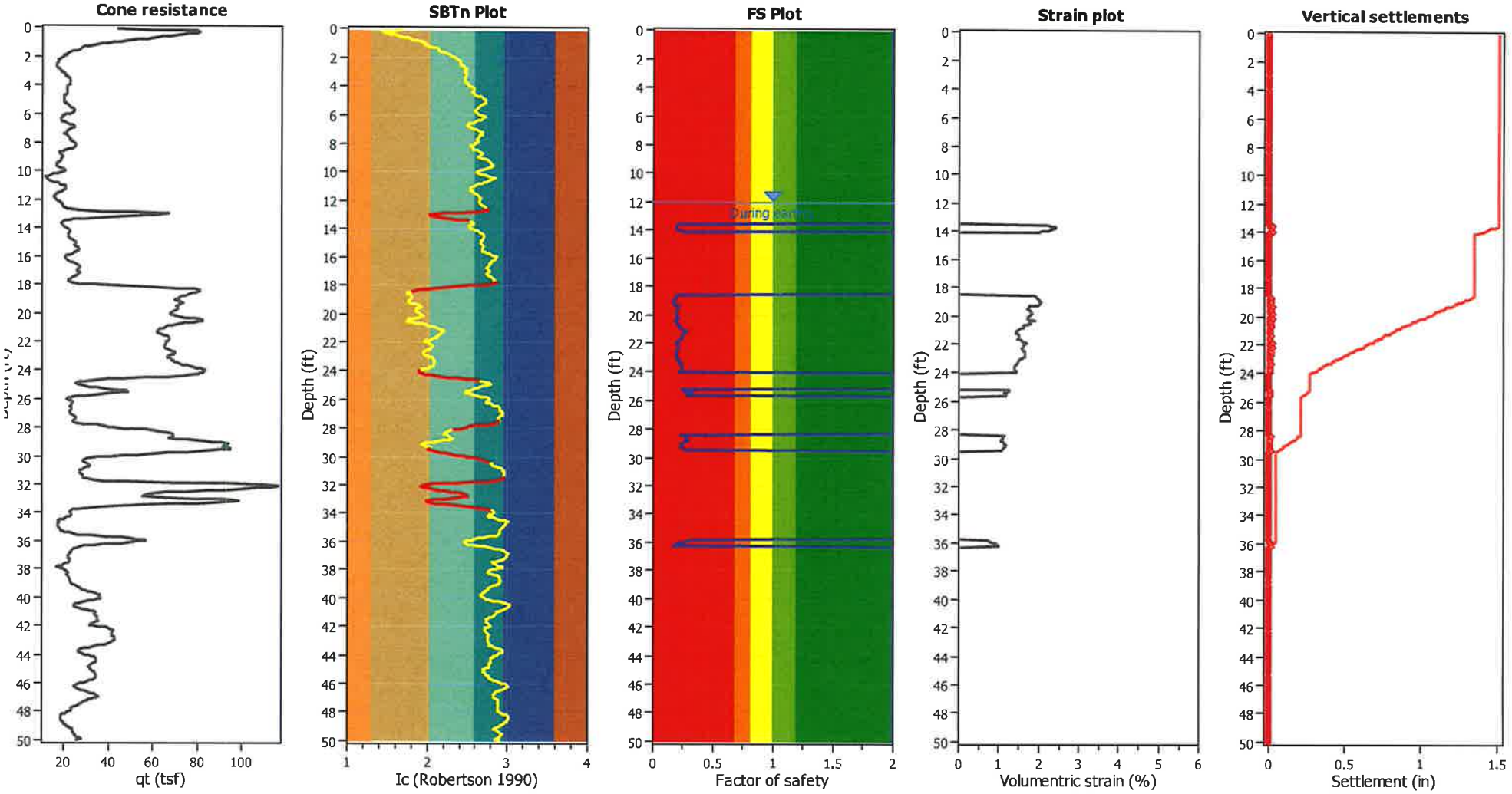
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.79	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
12.04	81.04	2.00	0.00	0.80	0.00	12.10	84.70	2.00	0.00	0.79	0.00
12.16	88.27	2.00	0.00	0.79	0.00	12.22	93.23	2.00	0.00	0.79	0.00
12.29	97.99	2.00	0.00	0.79	0.00	12.35	103.30	2.00	0.00	0.79	0.00
12.42	108.02	2.00	0.00	0.79	0.00	12.48	113.73	2.00	0.00	0.79	0.00
12.55	120.95	2.00	0.00	0.79	0.00	12.62	127.31	2.00	0.00	0.79	0.00
12.66	130.45	2.00	0.00	0.79	0.00	12.74	125.97	2.00	0.00	0.78	0.00
12.79	116.97	2.00	0.00	0.78	0.00	12.85	112.03	2.00	0.00	0.78	0.00
12.92	111.12	2.00	0.00	0.78	0.00	12.98	108.13	2.00	0.00	0.78	0.00
13.05	99.67	2.00	0.00	0.78	0.00	13.17	90.95	2.00	0.00	0.78	0.00
13.24	86.13	2.00	0.00	0.78	0.00	13.32	85.89	2.00	0.00	0.77	0.00
13.33	84.21	2.00	0.00	0.77	0.00	13.44	82.34	2.00	0.00	0.77	0.00
13.48	78.80	2.00	0.00	0.77	0.00	13.58	76.62	0.21	2.24	0.77	0.03
13.63	73.45	0.20	2.31	0.77	0.01	13.67	70.02	0.19	2.40	0.77	0.01
13.72	69.62	0.19	2.41	0.77	0.01	13.78	69.40	0.19	2.42	0.77	0.02
13.85	73.08	0.20	2.31	0.77	0.02	13.94	76.14	0.21	2.23	0.76	0.02
13.98	83.08	0.23	2.08	0.76	0.01	14.07	88.76	0.25	1.96	0.76	0.02
14.12	95.71	2.00	0.00	0.76	0.00	14.20	100.90	2.00	0.00	0.76	0.00
14.25	106.14	2.00	0.00	0.76	0.00	14.31	109.47	2.00	0.00	0.76	0.00
14.38	111.07	2.00	0.00	0.76	0.00	14.51	110.82	2.00	0.00	0.75	0.00
14.56	109.91	2.00	0.00	0.75	0.00	14.63	109.26	2.00	0.00	0.75	0.00
14.69	108.78	2.00	0.00	0.75	0.00	14.76	109.03	2.00	0.00	0.75	0.00
14.82	110.32	2.00	0.00	0.75	0.00	14.88	112.67	2.00	0.00	0.75	0.00
14.95	114.74	2.00	0.00	0.75	0.00	15.00	116.56	2.00	0.00	0.75	0.00
15.08	117.87	2.00	0.00	0.74	0.00	15.14	119.11	2.00	0.00	0.74	0.00
15.20	120.01	2.00	0.00	0.74	0.00	15.27	120.52	2.00	0.00	0.74	0.00
15.33	121.42	2.00	0.00	0.74	0.00	15.39	123.10	2.00	0.00	0.74	0.00
15.52	125.51	2.00	0.00	0.74	0.00	15.58	124.43	2.00	0.00	0.74	0.00
15.65	127.53	2.00	0.00	0.73	0.00	15.71	130.70	2.00	0.00	0.73	0.00
15.75	137.21	2.00	0.00	0.73	0.00	15.84	138.31	2.00	0.00	0.73	0.00
15.89	137.99	2.00	0.00	0.73	0.00	15.94	136.61	2.00	0.00	0.73	0.00
15.98	134.81	2.00	0.00	0.73	0.00	16.05	132.11	2.00	0.00	0.73	0.00
16.11	128.23	2.00	0.00	0.73	0.00	16.20	125.03	2.00	0.00	0.73	0.00
16.28	123.64	2.00	0.00	0.72	0.00	16.34	125.01	2.00	0.00	0.72	0.00
16.41	127.52	2.00	0.00	0.72	0.00	16.47	130.96	2.00	0.00	0.72	0.00
16.55	133.79	2.00	0.00	0.72	0.00	16.60	135.86	2.00	0.00	0.72	0.00
16.73	136.41	2.00	0.00	0.72	0.00	16.79	136.62	2.00	0.00	0.72	0.00
16.86	136.77	2.00	0.00	0.71	0.00	16.91	137.27	2.00	0.00	0.71	0.00
16.99	137.30	2.00	0.00	0.71	0.00	17.04	136.68	2.00	0.00	0.71	0.00
17.10	134.87	2.00	0.00	0.71	0.00	17.17	133.84	2.00	0.00	0.71	0.00
17.21	133.56	2.00	0.00	0.71	0.00	17.34	134.34	2.00	0.00	0.71	0.00
17.40	134.48	2.00	0.00	0.71	0.00	17.47	133.71	2.00	0.00	0.70	0.00
17.52	132.37	2.00	0.00	0.70	0.00	17.59	131.51	2.00	0.00	0.70	0.00
17.66	131.47	2.00	0.00	0.70	0.00	17.71	131.83	2.00	0.00	0.70	0.00
17.79	131.92	2.00	0.00	0.70	0.00	17.84	131.49	2.00	0.00	0.70	0.00
17.90	128.71	2.00	0.00	0.70	0.00	17.97	121.93	2.00	0.00	0.70	0.00
18.03	110.60	2.00	0.00	0.69	0.00	18.10	101.44	2.00	0.00	0.69	0.00
18.15	97.90	2.00	0.00	0.69	0.00	18.28	99.05	2.00	0.00	0.69	0.00
18.34	99.17	2.00	0.00	0.69	0.00	18.40	97.13	2.00	0.00	0.69	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
18.45	85.44	2.00	0.00	0.69	0.00	18.54	84.29	2.00	0.00	0.69	0.00
18.59	82.71	0.20	1.87	0.68	0.01	18.65	81.18	0.19	1.90	0.68	0.01
18.72	79.43	0.19	1.93	0.68	0.02	18.78	77.53	0.18	1.96	0.68	0.01
18.85	76.06	0.18	1.99	0.68	0.02	18.90	75.24	0.18	2.01	0.68	0.01
18.98	74.97	0.18	2.01	0.68	0.02	19.04	73.20	0.17	2.04	0.68	0.01
19.08	72.13	0.17	2.07	0.68	0.01	19.12	72.62	0.17	2.05	0.68	0.01
19.18	74.93	0.18	2.00	0.68	0.01	19.30	76.26	0.18	1.96	0.67	0.03
19.36	86.97	0.21	1.76	0.67	0.01	19.43	88.04	0.21	1.74	0.67	0.01
19.49	88.63	0.21	1.73	0.67	0.01	19.56	88.40	0.21	1.73	0.67	0.01
19.62	87.26	0.21	1.74	0.67	0.01	19.69	85.24	0.20	1.77	0.67	0.02
19.75	83.88	0.20	1.80	0.67	0.01	19.87	82.61	0.19	1.81	0.66	0.03
19.95	83.39	0.20	1.80	0.66	0.02	20.00	84.75	0.20	1.77	0.66	0.01
20.14	86.72	0.20	1.73	0.66	0.03	20.20	87.21	0.21	1.72	0.66	0.01
20.27	86.75	0.20	1.72	0.66	0.01	20.34	76.77	0.18	1.90	0.66	0.02
20.40	80.57	0.19	1.83	0.65	0.01	20.46	83.27	0.19	1.77	0.65	0.01
20.53	83.67	0.19	1.76	0.65	0.02	20.59	81.97	0.19	1.79	0.65	0.01
20.67	91.27	0.22	1.64	0.65	0.02	20.72	91.99	0.22	1.62	0.65	0.01
20.80	92.40	0.22	1.61	0.65	0.02	20.85	93.46	0.22	1.60	0.65	0.01
20.92	95.61	0.23	1.56	0.65	0.01	20.98	99.50	0.25	1.51	0.64	0.01
21.04	104.18	0.27	1.45	0.64	0.01	21.11	107.08	0.28	1.42	0.64	0.01
21.16	107.15	0.28	1.42	0.64	0.01	21.24	105.25	0.27	1.43	0.64	0.01
21.29	103.02	0.26	1.46	0.64	0.01	21.34	101.38	0.25	1.48	0.64	0.01
21.42	99.90	0.25	1.49	0.64	0.02	21.48	98.50	0.24	1.50	0.64	0.01
21.55	97.99	0.24	1.51	0.63	0.01	21.60	98.53	0.24	1.50	0.63	0.01
21.67	99.89	0.24	1.48	0.63	0.01	21.73	96.17	0.23	1.52	0.63	0.01
21.86	90.05	0.21	1.60	0.63	0.02	21.91	84.56	0.19	1.69	0.63	0.01
21.99	84.12	0.19	1.69	0.63	0.02	22.04	85.87	0.20	1.66	0.63	0.01
22.09	87.99	0.20	1.62	0.63	0.01	22.26	89.54	0.21	1.59	0.62	0.03
22.30	90.65	0.21	1.58	0.62	0.01	22.36	89.95	0.21	1.58	0.62	0.01
22.44	88.85	0.20	1.60	0.62	0.01	22.49	87.15	0.20	1.62	0.62	0.01
22.56	85.67	0.19	1.64	0.62	0.02	22.62	84.70	0.19	1.65	0.62	0.01
22.69	84.57	0.19	1.65	0.62	0.01	22.75	84.59	0.19	1.65	0.61	0.01
22.82	84.70	0.19	1.64	0.61	0.01	22.88	85.10	0.19	1.63	0.61	0.01
22.94	86.50	0.20	1.61	0.61	0.01	23.01	88.30	0.20	1.58	0.61	0.01
23.06	90.43	0.21	1.55	0.61	0.01	23.12	92.28	0.21	1.52	0.61	0.01
23.19	94.26	0.22	1.49	0.61	0.01	23.32	95.55	0.22	1.47	0.60	0.02
23.37	96.64	0.23	1.45	0.60	0.01	23.43	97.58	0.23	1.44	0.60	0.01
23.50	98.79	0.23	1.42	0.60	0.01	23.56	99.97	0.24	1.40	0.60	0.01
23.63	100.78	0.24	1.39	0.60	0.01	23.68	101.31	0.24	1.38	0.60	0.01
23.75	100.93	0.24	1.39	0.60	0.01	23.81	99.42	0.24	1.40	0.60	0.01
23.87	96.98	0.23	1.43	0.60	0.01	23.94	95.03	0.22	1.45	0.59	0.01
23.99	94.32	0.22	1.45	0.59	0.01	24.07	94.44	2.00	0.00	0.59	0.00
24.12	94.75	2.00	0.00	0.59	0.00	24.18	95.32	2.00	0.00	0.59	0.00
24.25	96.87	2.00	0.00	0.59	0.00	24.30	102.05	2.00	0.00	0.59	0.00
24.38	107.95	2.00	0.00	0.59	0.00	24.43	115.38	2.00	0.00	0.59	0.00
24.51	119.39	2.00	0.00	0.58	0.00	24.56	121.27	2.00	0.00	0.58	0.00
24.63	119.81	2.00	0.00	0.58	0.00	24.70	118.31	2.00	0.00	0.58	0.00
24.75	116.09	2.00	0.00	0.58	0.00	24.82	112.05	2.00	0.00	0.58	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
24.87	108.12	2.00	0.00	0.58	0.00	24.95	104.63	2.00	0.00	0.58	0.00
25.01	102.13	2.00	0.00	0.58	0.00	25.14	99.22	2.00	0.00	0.57	0.00
25.18	99.95	2.00	0.00	0.57	0.00	25.25	103.71	0.25	1.30	0.57	0.01
25.31	109.58	0.27	1.24	0.57	0.01	25.36	114.89	0.30	1.19	0.57	0.01
25.42	119.89	0.33	1.15	0.57	0.01	25.46	120.22	0.33	1.14	0.57	0.01
25.55	117.76	0.31	1.16	0.57	0.01	25.59	111.49	0.28	1.21	0.57	0.01
25.70	106.41	2.00	0.00	0.56	0.00	25.77	101.97	2.00	0.00	0.56	0.00
25.82	96.41	2.00	0.00	0.56	0.00	25.90	91.73	2.00	0.00	0.56	0.00
25.95	87.64	2.00	0.00	0.56	0.00	26.02	85.44	2.00	0.00	0.56	0.00
26.08	84.51	2.00	0.00	0.56	0.00	26.14	86.31	2.00	0.00	0.56	0.00
26.21	90.93	2.00	0.00	0.56	0.00	26.26	97.93	2.00	0.00	0.55	0.00
26.39	103.43	2.00	0.00	0.55	0.00	26.45	109.92	2.00	0.00	0.55	0.00
26.52	113.58	2.00	0.00	0.55	0.00	26.57	115.81	2.00	0.00	0.55	0.00
26.63	115.85	2.00	0.00	0.55	0.00	26.70	115.81	2.00	0.00	0.55	0.00
26.75	116.54	2.00	0.00	0.55	0.00	26.83	117.78	2.00	0.00	0.55	0.00
26.88	119.40	2.00	0.00	0.54	0.00	26.96	120.05	2.00	0.00	0.54	0.00
27.01	120.04	2.00	0.00	0.54	0.00	27.07	119.43	2.00	0.00	0.54	0.00
27.15	119.00	2.00	0.00	0.54	0.00	27.21	118.76	2.00	0.00	0.54	0.00
27.27	118.81	2.00	0.00	0.54	0.00	27.33	119.28	2.00	0.00	0.54	0.00
27.39	119.19	2.00	0.00	0.54	0.00	27.46	118.38	2.00	0.00	0.53	0.00
27.51	116.39	2.00	0.00	0.53	0.00	27.59	114.00	2.00	0.00	0.53	0.00
27.64	110.86	2.00	0.00	0.53	0.00	27.77	106.45	2.00	0.00	0.53	0.00
27.82	100.92	2.00	0.00	0.53	0.00	27.89	97.06	2.00	0.00	0.53	0.00
27.95	95.38	2.00	0.00	0.53	0.00	28.00	96.20	2.00	0.00	0.53	0.00
28.08	96.36	2.00	0.00	0.52	0.00	28.12	96.49	2.00	0.00	0.52	0.00
28.25	98.88	2.00	0.00	0.52	0.00	28.38	102.56	0.24	1.19	0.52	0.02
28.43	107.22	0.25	1.14	0.52	0.01	28.50	110.36	0.27	1.11	0.52	0.01
28.55	113.68	0.28	1.09	0.52	0.01	28.65	115.68	0.29	1.07	0.51	0.01
28.70	117.17	0.30	1.05	0.51	0.01	28.76	115.29	0.29	1.07	0.51	0.01
28.84	111.91	0.27	1.09	0.51	0.01	28.91	107.57	0.25	1.12	0.51	0.01
28.98	104.25	0.24	1.15	0.51	0.01	29.03	101.62	0.23	1.17	0.51	0.01
29.10	100.69	0.23	1.18	0.51	0.01	29.16	100.99	0.23	1.17	0.51	0.01
29.20	103.62	0.24	1.15	0.51	0.01	29.28	107.14	0.25	1.11	0.50	0.01
29.34	109.72	0.26	1.09	0.50	0.01	29.46	110.30	0.26	1.08	0.50	0.02
29.51	109.25	2.00	0.00	0.50	0.00	29.56	107.00	2.00	0.00	0.50	0.00
29.64	104.15	2.00	0.00	0.50	0.00	29.70	101.64	2.00	0.00	0.50	0.00
29.77	99.92	2.00	0.00	0.50	0.00	29.82	98.81	2.00	0.00	0.49	0.00
29.90	98.18	2.00	0.00	0.49	0.00	29.95	97.31	2.00	0.00	0.49	0.00
30.02	95.59	2.00	0.00	0.49	0.00	30.08	93.27	2.00	0.00	0.49	0.00
30.15	91.76	2.00	0.00	0.49	0.00	30.22	95.36	2.00	0.00	0.49	0.00
30.35	101.75	2.00	0.00	0.49	0.00	30.41	109.68	2.00	0.00	0.48	0.00
30.48	115.38	2.00	0.00	0.48	0.00	30.53	122.52	2.00	0.00	0.48	0.00
30.62	128.83	2.00	0.00	0.48	0.00	30.66	135.28	2.00	0.00	0.48	0.00
30.74	138.05	2.00	0.00	0.48	0.00	30.79	138.53	2.00	0.00	0.48	0.00
30.86	136.36	2.00	0.00	0.48	0.00	30.92	134.04	2.00	0.00	0.48	0.00
30.98	132.81	2.00	0.00	0.47	0.00	31.06	132.33	2.00	0.00	0.47	0.00
31.10	132.34	2.00	0.00	0.47	0.00	31.17	132.55	2.00	0.00	0.47	0.00
31.24	133.60	2.00	0.00	0.47	0.00	31.30	134.88	2.00	0.00	0.47	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
31.33	136.37	2.00	0.00	0.47	0.00	31.43	137.47	2.00	0.00	0.47	0.00
31.49	138.55	2.00	0.00	0.47	0.00	31.54	139.19	2.00	0.00	0.47	0.00
31.62	139.04	2.00	0.00	0.46	0.00	31.67	136.72	2.00	0.00	0.46	0.00
31.74	131.11	2.00	0.00	0.46	0.00	31.80	121.25	2.00	0.00	0.46	0.00
31.86	112.23	2.00	0.00	0.46	0.00	31.93	111.82	2.00	0.00	0.46	0.00
31.99	116.87	2.00	0.00	0.46	0.00	32.07	119.33	2.00	0.00	0.46	0.00
32.12	119.41	2.00	0.00	0.46	0.00	32.19	118.43	2.00	0.00	0.45	0.00
32.24	118.07	2.00	0.00	0.45	0.00	32.30	117.96	2.00	0.00	0.45	0.00
32.38	117.70	2.00	0.00	0.45	0.00	32.43	117.81	2.00	0.00	0.45	0.00
32.50	118.88	2.00	0.00	0.45	0.00	32.55	121.78	2.00	0.00	0.45	0.00
32.63	124.95	2.00	0.00	0.45	0.00	32.69	124.50	2.00	0.00	0.45	0.00
32.81	120.69	2.00	0.00	0.44	0.00	32.86	114.77	2.00	0.00	0.44	0.00
32.91	109.54	2.00	0.00	0.44	0.00	32.98	105.63	2.00	0.00	0.44	0.00
33.04	105.15	2.00	0.00	0.44	0.00	33.11	105.88	2.00	0.00	0.44	0.00
33.17	104.95	2.00	0.00	0.44	0.00	33.23	101.51	2.00	0.00	0.44	0.00
33.30	97.13	2.00	0.00	0.44	0.00	33.35	93.92	2.00	0.00	0.43	0.00
33.43	93.35	2.00	0.00	0.43	0.00	33.49	92.75	2.00	0.00	0.43	0.00
33.66	91.43	2.00	0.00	0.43	0.00	33.73	88.26	2.00	0.00	0.43	0.00
33.79	85.26	2.00	0.00	0.43	0.00	33.84	83.06	2.00	0.00	0.43	0.00
33.92	81.89	2.00	0.00	0.43	0.00	33.97	81.49	2.00	0.00	0.42	0.00
34.06	81.59	2.00	0.00	0.42	0.00	34.10	76.80	2.00	0.00	0.42	0.00
34.18	72.94	2.00	0.00	0.42	0.00	34.24	71.08	2.00	0.00	0.42	0.00
34.29	75.41	2.00	0.00	0.42	0.00	34.37	78.26	2.00	0.00	0.42	0.00
34.42	79.22	2.00	0.00	0.42	0.00	34.50	79.38	2.00	0.00	0.42	0.00
34.54	79.04	2.00	0.00	0.41	0.00	34.62	78.27	2.00	0.00	0.41	0.00
34.68	77.32	2.00	0.00	0.41	0.00	34.73	75.56	2.00	0.00	0.41	0.00
34.86	72.98	2.00	0.00	0.41	0.00	34.93	71.18	2.00	0.00	0.41	0.00
35.04	70.39	2.00	0.00	0.41	0.00	35.12	70.98	2.00	0.00	0.40	0.00
35.17	71.49	2.00	0.00	0.40	0.00	35.25	72.92	2.00	0.00	0.40	0.00
35.30	75.53	2.00	0.00	0.40	0.00	35.37	79.20	2.00	0.00	0.40	0.00
35.43	88.76	2.00	0.00	0.40	0.00	35.57	98.46	2.00	0.00	0.40	0.00
35.61	108.44	2.00	0.00	0.40	0.00	35.67	114.21	2.00	0.00	0.40	0.00
35.75	118.53	2.00	0.00	0.39	0.00	35.79	121.39	0.30	0.78	0.39	0.00
35.86	120.92	0.30	0.78	0.39	0.01	35.92	117.62	0.28	0.80	0.39	0.01
35.99	111.43	0.26	0.83	0.39	0.01	36.05	101.10	0.22	0.90	0.39	0.01
36.18	91.80	0.19	0.97	0.39	0.01	36.23	84.26	0.17	1.04	0.39	0.01
36.29	83.52	2.00	0.00	0.38	0.00	36.36	84.06	2.00	0.00	0.38	0.00
36.43	86.56	2.00	0.00	0.38	0.00	36.49	89.79	2.00	0.00	0.38	0.00
36.54	94.56	2.00	0.00	0.38	0.00	36.67	97.92	2.00	0.00	0.38	0.00
36.72	100.74	2.00	0.00	0.38	0.00	36.80	101.67	2.00	0.00	0.38	0.00
36.85	101.32	2.00	0.00	0.38	0.00	36.98	98.89	2.00	0.00	0.37	0.00
37.06	95.27	2.00	0.00	0.37	0.00	37.13	92.74	2.00	0.00	0.37	0.00
37.21	91.99	2.00	0.00	0.37	0.00	37.26	91.26	2.00	0.00	0.37	0.00
37.34	84.03	2.00	0.00	0.37	0.00	37.40	77.73	2.00	0.00	0.37	0.00
37.47	72.36	2.00	0.00	0.36	0.00	37.52	74.12	2.00	0.00	0.36	0.00
37.60	73.14	2.00	0.00	0.36	0.00	37.65	70.38	2.00	0.00	0.36	0.00
37.71	67.45	2.00	0.00	0.36	0.00	37.74	65.24	2.00	0.00	0.36	0.00
37.74	64.00	2.00	0.00	0.36	0.00	37.84	63.52	2.00	0.00	0.36	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
37.90	63.14	2.00	0.00	0.36	0.00	37.96	63.00	2.00	0.00	0.36	0.00
38.01	61.78	2.00	0.00	0.36	0.00	38.11	60.86	2.00	0.00	0.35	0.00
38.18	61.32	2.00	0.00	0.35	0.00	38.23	63.56	2.00	0.00	0.35	0.00
38.27	66.62	2.00	0.00	0.35	0.00	38.33	70.59	2.00	0.00	0.35	0.00
38.41	74.54	2.00	0.00	0.35	0.00	38.46	77.97	2.00	0.00	0.35	0.00
38.53	81.15	2.00	0.00	0.35	0.00	38.70	83.39	2.00	0.00	0.34	0.00
38.76	84.82	2.00	0.00	0.34	0.00	38.81	84.04	2.00	0.00	0.34	0.00
38.94	83.18	2.00	0.00	0.34	0.00	39.01	82.34	2.00	0.00	0.34	0.00
39.07	81.65	2.00	0.00	0.34	0.00	39.14	80.29	2.00	0.00	0.34	0.00
39.20	79.10	2.00	0.00	0.34	0.00	39.26	78.48	2.00	0.00	0.33	0.00
39.33	78.43	2.00	0.00	0.33	0.00	39.39	78.86	2.00	0.00	0.33	0.00
39.47	79.80	2.00	0.00	0.33	0.00	39.52	81.68	2.00	0.00	0.33	0.00
39.58	84.67	2.00	0.00	0.33	0.00	39.65	87.49	2.00	0.00	0.33	0.00
39.69	89.72	2.00	0.00	0.33	0.00	39.77	90.75	2.00	0.00	0.33	0.00
39.83	92.14	2.00	0.00	0.32	0.00	39.89	94.12	2.00	0.00	0.32	0.00
39.95	96.44	2.00	0.00	0.32	0.00	40.01	99.19	2.00	0.00	0.32	0.00
40.09	101.86	2.00	0.00	0.32	0.00	40.15	104.73	2.00	0.00	0.32	0.00
40.22	108.09	2.00	0.00	0.32	0.00	40.27	112.36	2.00	0.00	0.32	0.00
40.35	114.62	2.00	0.00	0.32	0.00	40.41	114.20	2.00	0.00	0.32	0.00
40.48	110.03	2.00	0.00	0.31	0.00	40.59	106.23	2.00	0.00	0.31	0.00
40.66	103.85	2.00	0.00	0.31	0.00	40.71	106.23	2.00	0.00	0.31	0.00
40.84	109.61	2.00	0.00	0.31	0.00	40.92	113.11	2.00	0.00	0.31	0.00
40.96	114.44	2.00	0.00	0.31	0.00	41.05	114.95	2.00	0.00	0.30	0.00
41.09	114.30	2.00	0.00	0.30	0.00	41.18	112.60	2.00	0.00	0.30	0.00
41.22	109.24	2.00	0.00	0.30	0.00	41.32	105.88	2.00	0.00	0.30	0.00
41.38	101.80	2.00	0.00	0.30	0.00	41.44	99.34	2.00	0.00	0.30	0.00
41.49	97.51	2.00	0.00	0.30	0.00	41.56	96.58	2.00	0.00	0.30	0.00
41.62	95.85	2.00	0.00	0.29	0.00	41.68	95.34	2.00	0.00	0.29	0.00
41.81	94.78	2.00	0.00	0.29	0.00	41.89	94.39	2.00	0.00	0.29	0.00
41.94	95.12	2.00	0.00	0.29	0.00	42.01	97.19	2.00	0.00	0.29	0.00
42.07	100.19	2.00	0.00	0.29	0.00	42.12	104.32	2.00	0.00	0.29	0.00
42.24	108.48	2.00	0.00	0.28	0.00	42.30	113.26	2.00	0.00	0.28	0.00
42.37	116.44	2.00	0.00	0.28	0.00	42.51	118.14	2.00	0.00	0.28	0.00
42.56	118.26	2.00	0.00	0.28	0.00	42.62	117.84	2.00	0.00	0.28	0.00
42.68	117.66	2.00	0.00	0.28	0.00	42.74	117.55	2.00	0.00	0.28	0.00
42.82	118.07	2.00	0.00	0.27	0.00	42.93	118.72	2.00	0.00	0.27	0.00
43.00	119.41	2.00	0.00	0.27	0.00	43.04	119.15	2.00	0.00	0.27	0.00
43.11	118.30	2.00	0.00	0.27	0.00	43.18	115.53	2.00	0.00	0.27	0.00
43.30	110.87	2.00	0.00	0.27	0.00	43.35	106.51	2.00	0.00	0.27	0.00
43.40	103.53	2.00	0.00	0.26	0.00	43.48	101.96	2.00	0.00	0.26	0.00
43.54	99.73	2.00	0.00	0.26	0.00	43.61	96.75	2.00	0.00	0.26	0.00
43.71	94.27	2.00	0.00	0.26	0.00	43.80	92.42	2.00	0.00	0.26	0.00
43.85	91.75	2.00	0.00	0.26	0.00	43.91	92.38	2.00	0.00	0.26	0.00
44.02	93.72	2.00	0.00	0.25	0.00	44.07	95.88	2.00	0.00	0.25	0.00
44.11	97.12	2.00	0.00	0.25	0.00	44.16	97.73	2.00	0.00	0.25	0.00
44.27	97.71	2.00	0.00	0.25	0.00	44.33	97.63	2.00	0.00	0.25	0.00
44.38	97.62	2.00	0.00	0.25	0.00	44.47	96.91	2.00	0.00	0.25	0.00
44.52	95.43	2.00	0.00	0.25	0.00	44.56	92.24	2.00	0.00	0.24	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
44.66	88.80	2.00	0.00	0.24	0.00	44.73	86.35	2.00	0.00	0.24	0.00
44.82	84.86	2.00	0.00	0.24	0.00	44.86	83.57	2.00	0.00	0.24	0.00
44.91	81.19	2.00	0.00	0.24	0.00	44.96	78.80	2.00	0.00	0.24	0.00
45.02	77.38	2.00	0.00	0.24	0.00	45.08	78.15	2.00	0.00	0.24	0.00
45.17	80.61	2.00	0.00	0.23	0.00	45.22	84.19	2.00	0.00	0.23	0.00
45.36	86.72	2.00	0.00	0.23	0.00	45.41	89.09	2.00	0.00	0.23	0.00
45.49	90.37	2.00	0.00	0.23	0.00	45.53	91.72	2.00	0.00	0.23	0.00
45.59	92.95	2.00	0.00	0.23	0.00	45.66	94.29	2.00	0.00	0.23	0.00
45.71	95.74	2.00	0.00	0.23	0.00	45.79	96.82	2.00	0.00	0.22	0.00
45.84	97.48	2.00	0.00	0.22	0.00	45.92	97.70	2.00	0.00	0.22	0.00
45.97	97.81	2.00	0.00	0.22	0.00	46.03	97.77	2.00	0.00	0.22	0.00
46.10	97.12	2.00	0.00	0.22	0.00	46.16	95.19	2.00	0.00	0.22	0.00
46.23	92.47	2.00	0.00	0.22	0.00	46.28	89.28	2.00	0.00	0.22	0.00
46.41	87.10	2.00	0.00	0.21	0.00	46.46	86.41	2.00	0.00	0.21	0.00
46.55	87.96	2.00	0.00	0.21	0.00	46.61	90.91	2.00	0.00	0.21	0.00
46.69	94.00	2.00	0.00	0.21	0.00	46.73	96.70	2.00	0.00	0.21	0.00
46.79	99.23	2.00	0.00	0.21	0.00	46.88	101.73	2.00	0.00	0.21	0.00
46.98	102.43	2.00	0.00	0.20	0.00	47.06	101.40	2.00	0.00	0.20	0.00
47.11	99.28	2.00	0.00	0.20	0.00	47.15	97.31	2.00	0.00	0.20	0.00
47.21	94.54	2.00	0.00	0.20	0.00	47.28	91.25	2.00	0.00	0.20	0.00
47.33	87.97	2.00	0.00	0.20	0.00	47.39	84.86	2.00	0.00	0.20	0.00
47.48	81.80	2.00	0.00	0.20	0.00	47.54	78.59	2.00	0.00	0.19	0.00
47.59	75.05	2.00	0.00	0.19	0.00	47.68	71.94	2.00	0.00	0.19	0.00
47.74	69.47	2.00	0.00	0.19	0.00	47.80	68.43	2.00	0.00	0.19	0.00
47.85	67.71	2.00	0.00	0.19	0.00	47.91	67.21	2.00	0.00	0.19	0.00
48.00	66.83	2.00	0.00	0.19	0.00	48.04	66.42	2.00	0.00	0.19	0.00
48.12	66.12	2.00	0.00	0.18	0.00	48.18	65.91	2.00	0.00	0.18	0.00
48.25	65.46	2.00	0.00	0.18	0.00	48.30	64.77	2.00	0.00	0.18	0.00
48.36	63.85	2.00	0.00	0.18	0.00	48.43	63.12	2.00	0.00	0.18	0.00
48.54	62.60	2.00	0.00	0.18	0.00	48.61	62.45	2.00	0.00	0.18	0.00
48.66	62.50	2.00	0.00	0.18	0.00	48.71	62.54	2.00	0.00	0.17	0.00
48.79	62.51	2.00	0.00	0.17	0.00	48.84	62.36	2.00	0.00	0.17	0.00
48.92	62.13	2.00	0.00	0.17	0.00	48.97	61.75	2.00	0.00	0.17	0.00
49.04	61.36	2.00	0.00	0.17	0.00	49.10	61.22	2.00	0.00	0.17	0.00
49.15	62.20	2.00	0.00	0.17	0.00	49.23	65.09	2.00	0.00	0.17	0.00
49.33	68.55	2.00	0.00	0.16	0.00	49.40	71.54	2.00	0.00	0.16	0.00
49.45	73.45	2.00	0.00	0.16	0.00	49.51	75.46	2.00	0.00	0.16	0.00
49.59	74.21	2.00	0.00	0.16	0.00	49.64	75.10	2.00	0.00	0.16	0.00
49.72	74.92	2.00	0.00	0.16	0.00	49.76	77.31	2.00	0.00	0.16	0.00
49.82	76.83	2.00	0.00	0.16	0.00	49.89	76.37	2.00	0.00	0.15	0.00
49.94	75.98	2.00	0.00	0.15	0.00	50.01	75.73	2.00	0.00	0.15	0.00

Total estimated settlement: 1.51

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

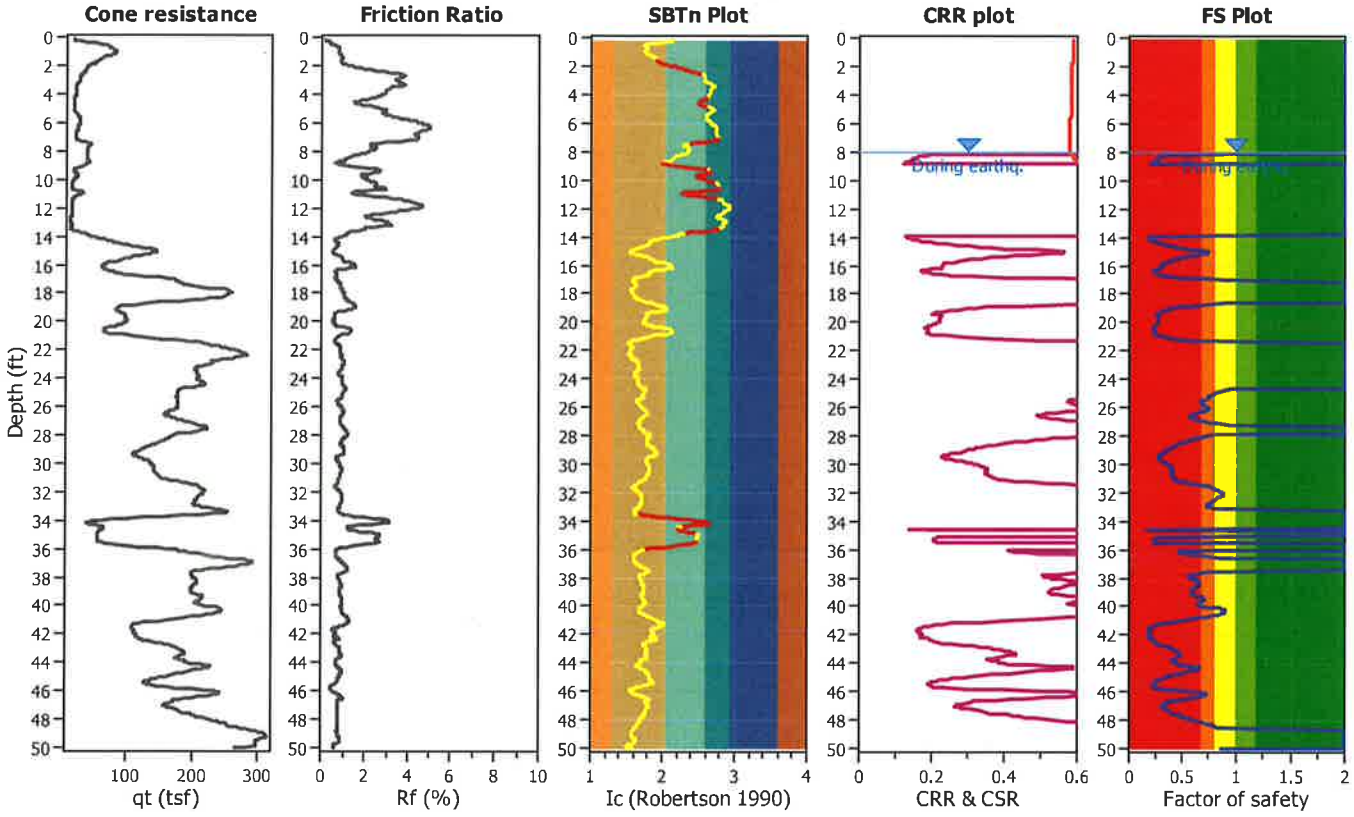
LIQUEFACTION ANALYSIS REPORT

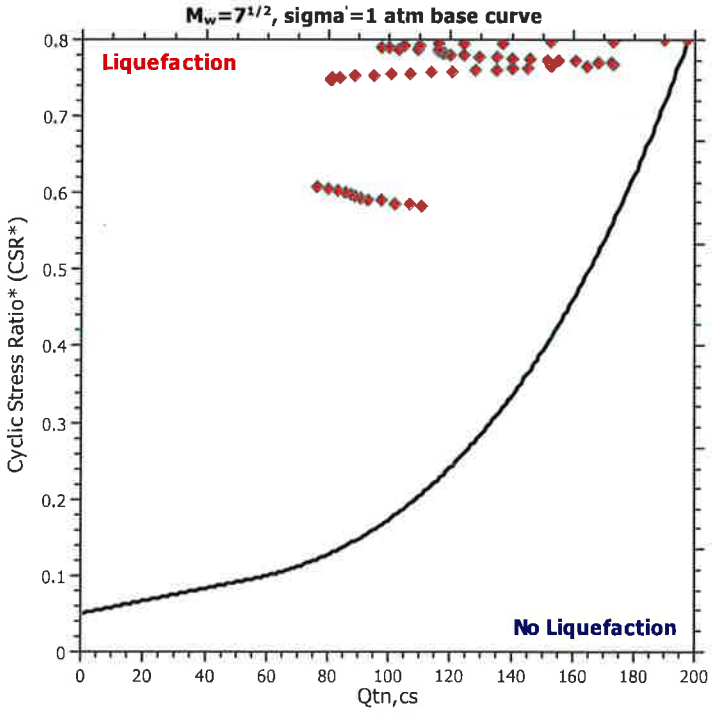
Project title : S-Line Upgrades **Location : Imperial County, CA**

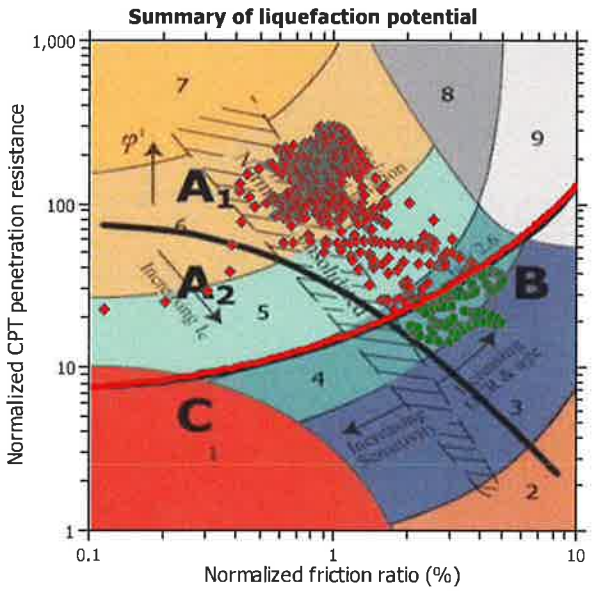
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.83	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

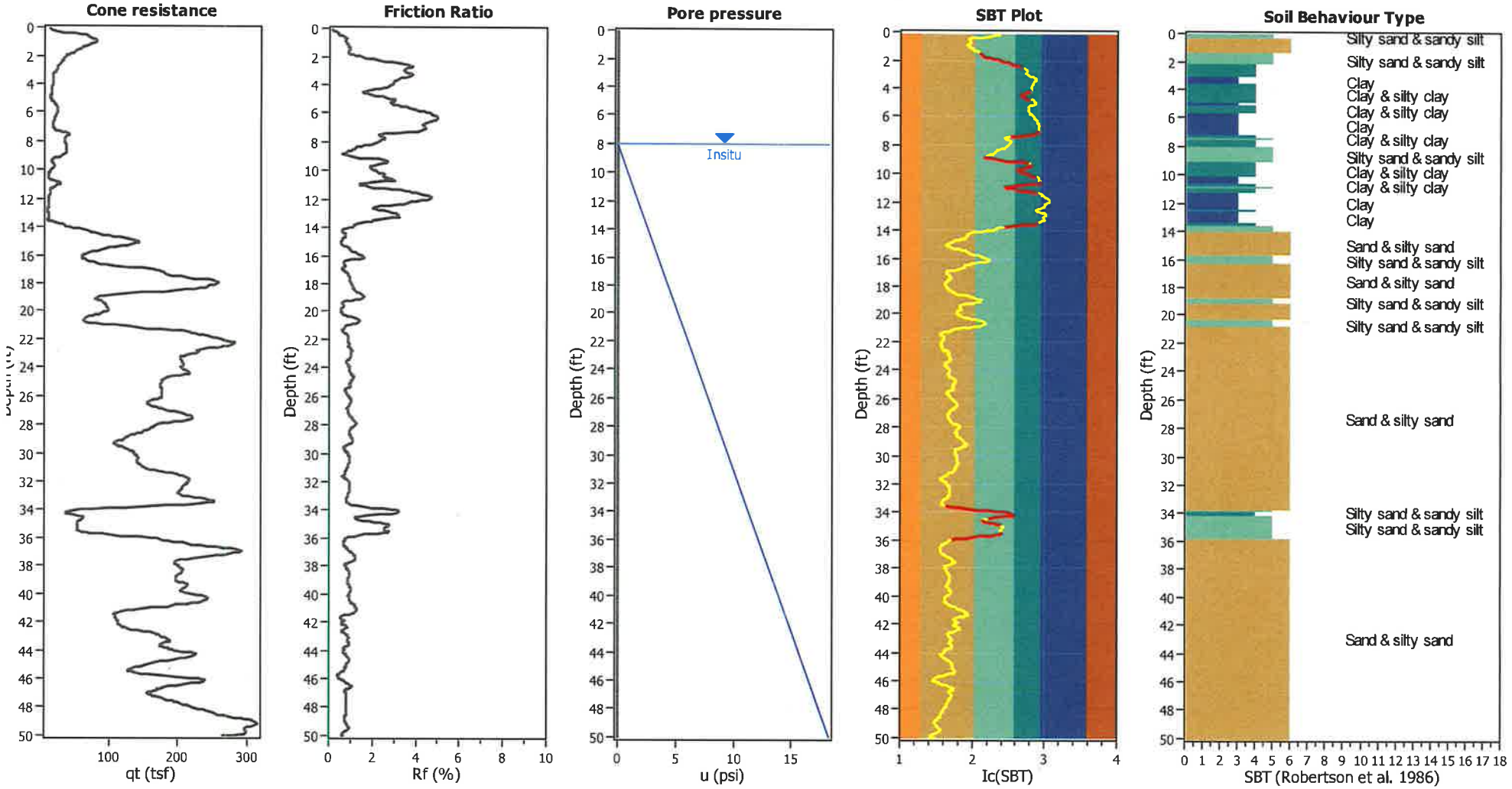






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



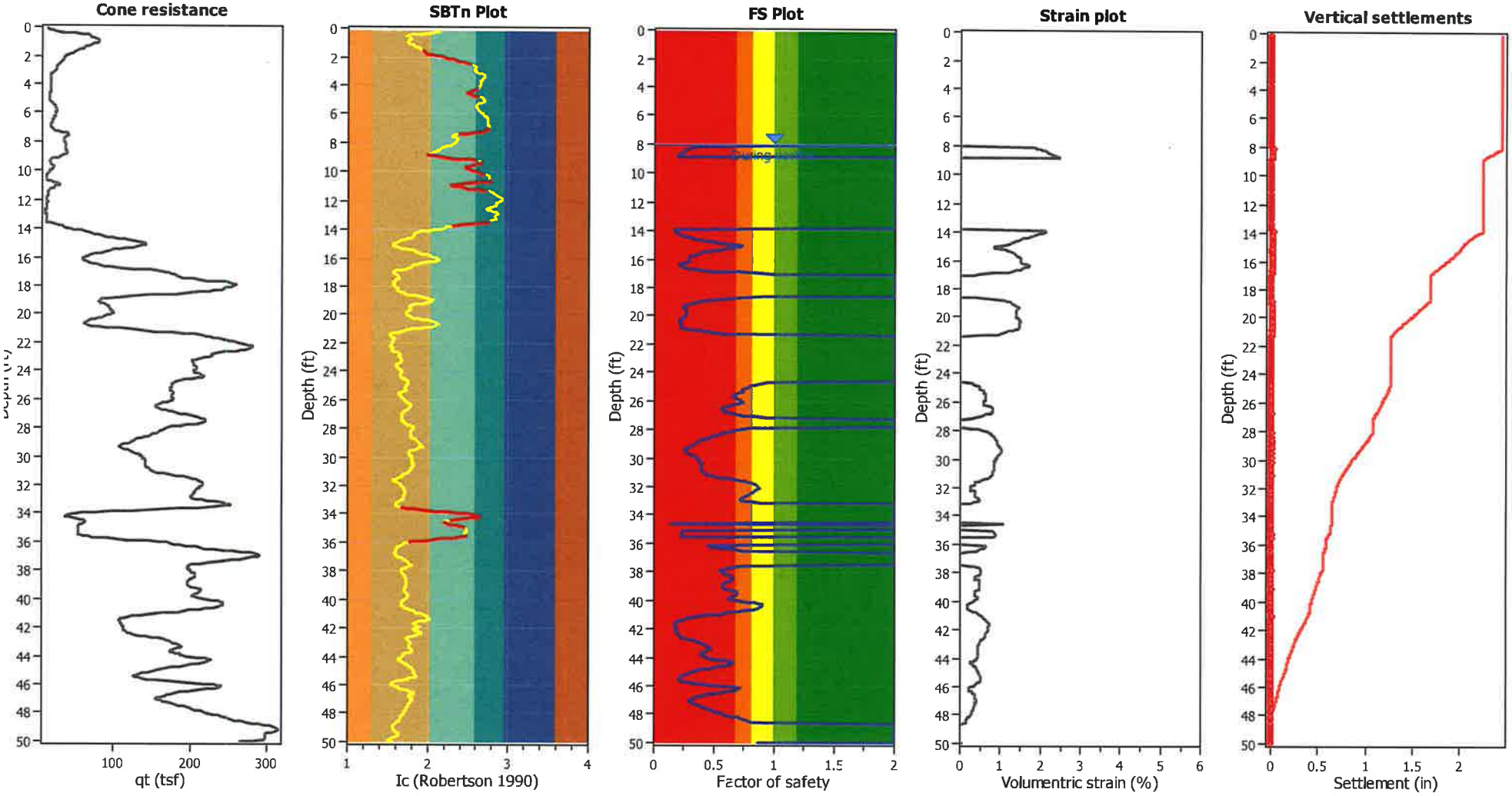
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.83	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

:	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.12	110.92	0.36	1.95	0.86	0.03	8.17	106.91	0.33	1.91	0.86	0.01
8.23	101.79	0.30	1.98	0.86	0.01	8.31	97.21	0.28	2.05	0.86	0.02
8.35	93.11	0.26	2.13	0.86	0.01	8.43	90.86	0.25	2.17	0.86	0.02
8.48	88.95	0.24	2.20	0.86	0.01	8.54	87.24	0.24	2.24	0.86	0.01
8.62	85.45	0.23	2.27	0.85	0.02	8.67	83.09	0.22	2.32	0.85	0.01
8.74	79.94	0.21	2.39	0.85	0.02	8.79	76.25	0.20	2.48	0.85	0.02
8.86	73.92	2.00	0.00	0.85	0.00	8.93	76.42	2.00	0.00	0.85	0.00
9.10	81.66	2.00	0.00	0.85	0.00	9.18	90.65	2.00	0.00	0.84	0.00
9.24	92.06	2.00	0.00	0.84	0.00	9.32	92.41	2.00	0.00	0.84	0.00
9.37	92.59	2.00	0.00	0.84	0.00	9.44	92.31	2.00	0.00	0.84	0.00
9.50	90.80	2.00	0.00	0.84	0.00	9.56	87.71	2.00	0.00	0.84	0.00
9.63	85.43	2.00	0.00	0.84	0.00	9.69	85.04	2.00	0.00	0.84	0.00
9.77	85.38	2.00	0.00	0.83	0.00	9.81	84.65	2.00	0.00	0.83	0.00
9.89	83.35	2.00	0.00	0.83	0.00	9.94	82.52	2.00	0.00	0.83	0.00
10.00	81.75	2.00	0.00	0.83	0.00	10.08	80.94	2.00	0.00	0.83	0.00
10.14	80.66	2.00	0.00	0.83	0.00	10.20	80.86	2.00	0.00	0.83	0.00
10.26	80.60	2.00	0.00	0.83	0.00	10.34	79.89	2.00	0.00	0.82	0.00
10.39	79.40	2.00	0.00	0.82	0.00	10.47	80.22	2.00	0.00	0.82	0.00
10.52	82.56	2.00	0.00	0.82	0.00	10.58	86.13	2.00	0.00	0.82	0.00
10.65	89.34	2.00	0.00	0.82	0.00	10.70	89.83	2.00	0.00	0.82	0.00
10.78	88.32	2.00	0.00	0.82	0.00	10.85	87.17	2.00	0.00	0.82	0.00
10.90	85.29	2.00	0.00	0.82	0.00	10.98	83.41	2.00	0.00	0.81	0.00
11.03	83.86	2.00	0.00	0.81	0.00	11.16	86.51	2.00	0.00	0.81	0.00
11.21	91.41	2.00	0.00	0.81	0.00	11.27	95.28	2.00	0.00	0.81	0.00
11.34	98.33	2.00	0.00	0.81	0.00	11.39	100.54	2.00	0.00	0.81	0.00
11.43	102.26	2.00	0.00	0.81	0.00	11.49	104.49	2.00	0.00	0.81	0.00
11.56	106.70	2.00	0.00	0.80	0.00	11.67	108.67	2.00	0.00	0.80	0.00
11.74	109.73	2.00	0.00	0.80	0.00	11.81	109.51	2.00	0.00	0.80	0.00
11.92	108.14	2.00	0.00	0.80	0.00	12.00	106.07	2.00	0.00	0.80	0.00
12.05	103.71	2.00	0.00	0.80	0.00	12.11	101.05	2.00	0.00	0.79	0.00
12.18	98.53	2.00	0.00	0.79	0.00	12.23	95.87	2.00	0.00	0.79	0.00
12.31	92.79	2.00	0.00	0.79	0.00	12.36	88.45	2.00	0.00	0.79	0.00
12.42	82.65	2.00	0.00	0.79	0.00	12.49	76.90	2.00	0.00	0.79	0.00
12.54	72.31	2.00	0.00	0.79	0.00	12.62	70.60	2.00	0.00	0.79	0.00
12.67	70.28	2.00	0.00	0.79	0.00	12.73	71.48	2.00	0.00	0.78	0.00
12.80	73.55	2.00	0.00	0.78	0.00	12.86	77.27	2.00	0.00	0.78	0.00
12.93	81.15	2.00	0.00	0.78	0.00	12.98	84.88	2.00	0.00	0.78	0.00
13.06	87.17	2.00	0.00	0.78	0.00	13.11	88.43	2.00	0.00	0.78	0.00
13.24	88.42	2.00	0.00	0.78	0.00	13.29	83.24	2.00	0.00	0.77	0.00
13.37	76.40	2.00	0.00	0.77	0.00	13.43	69.81	2.00	0.00	0.77	0.00
13.49	69.19	2.00	0.00	0.77	0.00	13.56	70.80	2.00	0.00	0.77	0.00
13.62	71.71	2.00	0.00	0.77	0.00	13.68	73.10	2.00	0.00	0.77	0.00
13.74	75.89	2.00	0.00	0.77	0.00	13.78	79.20	2.00	0.00	0.77	0.00
13.90	80.72	0.17	2.13	0.76	0.03	13.94	81.19	0.17	2.12	0.76	0.01
14.01	81.45	0.17	2.11	0.76	0.02	14.07	83.75	0.18	2.06	0.76	0.01
14.14	88.84	0.19	1.96	0.76	0.02	14.24	94.85	0.21	1.85	0.76	0.02
14.32	100.77	0.23	1.76	0.76	0.02	14.36	106.87	0.26	1.67	0.76	0.01
14.43	113.50	0.29	1.59	0.76	0.01	14.49	120.92	0.32	1.51	0.75	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
14.55	128.17	0.36	1.44	0.75	0.01	14.62	134.72	0.40	1.38	0.75	0.01
14.68	140.16	0.44	1.33	0.75	0.01	14.74	144.87	0.48	1.29	0.75	0.01
14.80	152.58	0.54	1.24	0.75	0.01	14.89	164.42	0.64	1.10	0.75	0.01
14.98	173.12	0.73	0.84	0.75	0.01	15.10	172.56	0.73	0.84	0.74	0.01
15.16	168.12	0.68	0.87	0.74	0.01	15.22	160.34	0.60	1.14	0.74	0.01
15.30	155.18	0.55	1.19	0.74	0.01	15.34	151.03	0.52	1.23	0.74	0.01
15.41	145.36	0.47	1.27	0.74	0.01	15.47	139.78	0.43	1.31	0.74	0.01
15.53	134.71	0.40	1.35	0.74	0.01	15.61	129.33	0.36	1.39	0.74	0.01
15.73	124.16	0.33	1.44	0.73	0.02	15.78	120.04	0.31	1.47	0.73	0.01
15.83	118.18	0.30	1.49	0.73	0.01	15.91	117.30	0.29	1.50	0.73	0.01
15.97	117.39	0.29	1.49	0.73	0.01	16.05	116.65	0.29	1.50	0.73	0.01
16.09	116.32	0.29	1.50	0.73	0.01	16.18	116.30	0.29	1.50	0.73	0.02
16.23	109.39	0.26	1.57	0.72	0.01	16.28	102.82	0.23	1.65	0.72	0.01
16.36	97.47	0.21	1.72	0.72	0.02	16.41	100.20	0.22	1.68	0.72	0.01
16.48	104.84	0.24	1.62	0.72	0.01	16.58	109.91	0.26	1.55	0.72	0.02
16.63	116.05	0.28	1.49	0.72	0.01	16.67	124.56	0.33	1.40	0.72	0.01
16.76	136.72	0.40	1.29	0.72	0.01	16.83	152.68	0.52	1.18	0.71	0.01
16.91	173.40	0.71	0.80	0.71	0.01	17.00	190.10	0.90	0.43	0.71	0.00
17.06	197.78	1.00	0.33	0.71	0.00	17.11	201.31	2.00	0.00	0.71	0.00
17.15	204.60	2.00	0.00	0.71	0.00	17.20	207.85	2.00	0.00	0.71	0.00
17.29	210.36	2.00	0.00	0.71	0.00	17.34	213.97	2.00	0.00	0.71	0.00
17.44	220.92	2.00	0.00	0.70	0.00	17.53	237.06	2.00	0.00	0.70	0.00
17.64	255.74	2.00	0.00	0.70	0.00	17.69	273.21	2.00	0.00	0.70	0.00
17.73	283.12	2.00	0.00	0.70	0.00	17.79	290.42	2.00	0.00	0.70	0.00
17.91	294.32	2.00	0.00	0.70	0.00	17.95	296.31	2.00	0.00	0.70	0.00
17.99	293.40	2.00	0.00	0.70	0.00	18.10	288.19	2.00	0.00	0.69	0.00
18.14	280.53	2.00	0.00	0.69	0.00	18.31	272.25	2.00	0.00	0.69	0.00
18.35	263.26	2.00	0.00	0.69	0.00	18.40	256.30	2.00	0.00	0.69	0.00
18.45	246.68	2.00	0.00	0.69	0.00	18.52	234.62	2.00	0.00	0.69	0.00
18.57	220.64	2.00	0.00	0.69	0.00	18.62	205.76	2.00	0.00	0.68	0.00
18.66	192.08	0.90	0.41	0.68	0.00	18.71	172.90	0.68	0.77	0.68	0.00
18.87	156.19	0.53	1.10	0.68	0.02	18.92	142.33	0.42	1.19	0.68	0.01
18.98	136.54	0.39	1.23	0.68	0.01	19.03	131.65	0.36	1.26	0.68	0.01
19.10	126.40	0.33	1.30	0.68	0.01	19.16	121.90	0.30	1.34	0.68	0.01
19.23	115.99	0.27	1.39	0.67	0.01	19.29	112.26	0.26	1.43	0.67	0.01
19.37	109.56	0.24	1.46	0.67	0.01	19.42	110.81	0.25	1.44	0.67	0.01
19.47	113.29	0.26	1.41	0.67	0.01	19.55	115.04	0.27	1.39	0.67	0.01
19.60	115.81	0.27	1.38	0.67	0.01	19.64	115.30	0.27	1.39	0.67	0.01
19.73	115.02	0.27	1.39	0.67	0.01	19.78	115.05	0.27	1.38	0.66	0.01
19.86	115.44	0.27	1.38	0.66	0.01	19.91	115.20	0.27	1.38	0.66	0.01
19.97	114.07	0.26	1.39	0.66	0.01	20.04	112.03	0.25	1.41	0.66	0.01
20.09	109.90	0.24	1.43	0.66	0.01	20.17	107.75	0.24	1.45	0.66	0.01
20.22	105.59	0.23	1.47	0.66	0.01	20.30	103.16	0.22	1.49	0.66	0.02
20.35	101.87	0.21	1.51	0.66	0.01	20.41	102.95	0.22	1.49	0.65	0.01
20.49	105.03	0.22	1.47	0.65	0.01	20.54	105.98	0.23	1.45	0.65	0.01
20.66	105.13	0.22	1.46	0.65	0.02	20.72	104.40	0.22	1.46	0.65	0.01
20.77	105.63	0.23	1.45	0.65	0.01	20.84	108.45	0.24	1.41	0.65	0.01
20.88	113.35	0.26	1.36	0.65	0.01	20.95	119.47	0.28	1.30	0.64	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
21.01	130.34	0.34	1.21	0.64	0.01	21.14	146.53	0.44	1.10	0.64	0.02
21.26	166.10	0.60	0.93	0.64	0.01	21.33	189.09	0.84	0.51	0.64	0.00
21.37	206.77	2.00	0.00	0.64	0.00	21.42	221.02	2.00	0.00	0.64	0.00
21.50	230.36	2.00	0.00	0.64	0.00	21.55	235.72	2.00	0.00	0.63	0.00
21.63	239.77	2.00	0.00	0.63	0.00	21.68	245.08	2.00	0.00	0.63	0.00
21.75	252.07	2.00	0.00	0.63	0.00	21.81	259.51	2.00	0.00	0.63	0.00
21.87	266.16	2.00	0.00	0.63	0.00	21.94	271.18	2.00	0.00	0.63	0.00
21.99	277.56	2.00	0.00	0.63	0.00	22.12	284.02	2.00	0.00	0.63	0.00
22.17	291.21	2.00	0.00	0.62	0.00	22.25	294.99	2.00	0.00	0.62	0.00
22.30	295.97	2.00	0.00	0.62	0.00	22.37	293.78	2.00	0.00	0.62	0.00
22.43	289.75	2.00	0.00	0.62	0.00	22.48	284.24	2.00	0.00	0.62	0.00
22.56	277.55	2.00	0.00	0.62	0.00	22.61	270.54	2.00	0.00	0.62	0.00
22.67	254.22	2.00	0.00	0.62	0.00	22.74	243.60	2.00	0.00	0.61	0.00
22.80	239.03	2.00	0.00	0.61	0.00	22.85	239.33	2.00	0.00	0.61	0.00
22.95	237.11	2.00	0.00	0.61	0.00	22.99	233.57	2.00	0.00	0.61	0.00
23.04	229.30	2.00	0.00	0.61	0.00	23.11	222.67	2.00	0.00	0.61	0.00
23.21	217.07	2.00	0.00	0.61	0.00	23.28	213.32	2.00	0.00	0.61	0.00
23.34	212.05	2.00	0.00	0.60	0.00	23.41	209.57	2.00	0.00	0.60	0.00
23.48	209.41	2.00	0.00	0.60	0.00	23.53	209.96	2.00	0.00	0.60	0.00
23.66	209.52	2.00	0.00	0.60	0.00	23.70	210.24	2.00	0.00	0.60	0.00
23.78	211.45	2.00	0.00	0.60	0.00	23.83	212.17	2.00	0.00	0.60	0.00
23.90	212.12	2.00	0.00	0.60	0.00	23.96	211.98	2.00	0.00	0.59	0.00
24.01	211.52	2.00	0.00	0.59	0.00	24.08	211.51	2.00	0.00	0.59	0.00
24.14	212.42	2.00	0.00	0.59	0.00	24.20	214.61	2.00	0.00	0.59	0.00
24.28	217.39	2.00	0.00	0.59	0.00	24.33	220.18	2.00	0.00	0.59	0.00
24.40	221.61	2.00	0.00	0.59	0.00	24.45	221.07	2.00	0.00	0.59	0.00
24.52	217.76	2.00	0.00	0.58	0.00	24.59	212.17	2.00	0.00	0.58	0.00
24.64	205.76	2.00	0.00	0.58	0.00	24.70	199.10	0.94	0.33	0.58	0.00
24.82	193.74	0.87	0.34	0.58	0.01	24.89	189.91	0.83	0.46	0.58	0.00
24.94	188.16	0.81	0.47	0.58	0.00	24.99	186.62	0.79	0.47	0.58	0.00
25.07	185.15	0.77	0.48	0.58	0.00	25.13	183.78	0.76	0.48	0.57	0.00
25.21	182.67	0.75	0.60	0.57	0.01	25.25	181.56	0.73	0.60	0.57	0.00
25.33	182.41	0.74	0.60	0.57	0.01	25.38	181.65	0.73	0.60	0.57	0.00
25.44	179.29	0.71	0.61	0.57	0.00	25.51	174.93	0.66	0.63	0.57	0.01
25.56	174.49	0.66	0.63	0.57	0.00	25.65	174.79	0.66	0.63	0.57	0.01
25.70	175.55	0.67	0.62	0.56	0.00	25.74	176.28	0.68	0.62	0.56	0.00
25.83	177.41	0.69	0.61	0.56	0.01	25.92	178.87	0.70	0.60	0.56	0.01
25.96	180.69	0.72	0.59	0.56	0.00	26.05	181.76	0.73	0.59	0.56	0.01
26.10	182.26	0.74	0.58	0.56	0.00	26.16	180.99	0.72	0.59	0.56	0.00
26.23	178.11	0.69	0.60	0.56	0.00	26.28	174.08	0.65	0.62	0.55	0.00
26.36	170.24	0.62	0.78	0.55	0.01	26.40	167.24	0.59	0.80	0.55	0.00
26.46	165.15	0.57	0.81	0.55	0.01	26.54	164.18	0.56	0.81	0.55	0.01
26.60	164.97	0.57	0.81	0.55	0.01	26.71	166.96	0.59	0.79	0.55	0.01
26.78	169.33	0.61	0.77	0.55	0.01	26.85	171.58	0.63	0.76	0.54	0.01
26.89	175.09	0.66	0.60	0.54	0.00	26.97	178.95	0.70	0.58	0.54	0.01
27.02	184.56	0.76	0.45	0.54	0.00	27.07	190.74	0.83	0.43	0.54	0.00
27.15	198.37	0.92	0.31	0.54	0.00	27.27	204.57	2.00	0.00	0.54	0.00
27.33	209.67	2.00	0.00	0.54	0.00	27.38	212.97	2.00	0.00	0.54	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
27.44	215.92	2.00	0.00	0.53	0.00	27.51	217.88	2.00	0.00	0.53	0.00
27.56	218.84	2.00	0.00	0.53	0.00	27.63	216.19	2.00	0.00	0.53	0.00
27.74	210.66	2.00	0.00	0.53	0.00	27.82	202.72	2.00	0.00	0.53	0.00
27.87	195.11	0.88	0.31	0.53	0.00	27.93	187.53	0.79	0.43	0.53	0.00
28.00	180.02	0.71	0.56	0.53	0.00	28.12	173.83	0.65	0.71	0.52	0.01
28.17	169.10	0.60	0.74	0.52	0.01	28.24	165.84	0.57	0.76	0.52	0.01
28.31	163.03	0.55	0.78	0.52	0.01	28.35	159.80	0.52	0.83	0.52	0.00
28.44	154.97	0.49	0.85	0.52	0.01	28.55	149.89	0.45	0.87	0.52	0.01
28.62	145.68	0.42	0.88	0.52	0.01	28.67	142.74	0.40	0.90	0.51	0.01
28.75	139.67	0.38	0.91	0.51	0.01	28.84	137.26	0.36	0.92	0.51	0.01
28.87	135.88	0.36	0.93	0.51	0.00	28.96	134.98	0.35	0.93	0.51	0.01
29.01	133.26	0.34	0.94	0.51	0.01	29.10	130.87	0.33	0.95	0.51	0.01
29.16	127.14	0.31	0.97	0.51	0.01	29.24	123.36	0.29	0.99	0.50	0.01
29.29	119.86	0.27	1.01	0.50	0.01	29.35	117.50	0.26	1.03	0.50	0.01
29.41	116.62	0.26	1.03	0.50	0.01	29.51	117.20	0.26	1.03	0.50	0.01
29.56	119.44	0.27	1.01	0.50	0.01	29.63	122.35	0.28	0.99	0.50	0.01
29.69	126.52	0.30	0.96	0.50	0.01	29.79	130.46	0.32	0.93	0.50	0.01
29.86	133.69	0.34	0.91	0.49	0.01	29.92	135.33	0.35	0.90	0.49	0.01
29.99	136.71	0.36	0.89	0.49	0.01	30.05	138.41	0.37	0.88	0.49	0.01
30.13	140.15	0.38	0.87	0.49	0.01	30.18	141.64	0.39	0.86	0.49	0.01
30.23	142.63	0.39	0.85	0.49	0.01	30.31	143.16	0.40	0.85	0.49	0.01
30.36	143.27	0.40	0.84	0.49	0.01	30.42	142.96	0.40	0.84	0.48	0.01
30.48	142.53	0.39	0.84	0.48	0.01	30.54	142.21	0.39	0.84	0.48	0.01
30.62	142.16	0.39	0.84	0.48	0.01	30.67	142.53	0.39	0.84	0.48	0.00
30.73	143.22	0.40	0.83	0.48	0.01	30.79	144.13	0.40	0.83	0.48	0.01
30.84	145.02	0.41	0.82	0.48	0.00	30.92	145.65	0.41	0.82	0.48	0.01
30.97	146.58	0.42	0.81	0.48	0.01	31.10	148.14	0.43	0.80	0.47	0.01
31.15	151.35	0.45	0.79	0.47	0.00	31.22	156.12	0.48	0.76	0.47	0.01
31.28	161.92	0.53	0.74	0.47	0.01	31.34	168.39	0.58	0.67	0.47	0.00
31.42	173.94	0.64	0.64	0.47	0.01	31.46	179.15	0.69	0.50	0.47	0.00
31.54	183.76	0.73	0.48	0.47	0.01	31.59	186.77	0.76	0.38	0.46	0.00
31.64	188.65	0.78	0.37	0.46	0.00	31.72	190.43	0.80	0.37	0.46	0.00
31.77	192.61	0.83	0.36	0.46	0.00	31.83	193.54	0.84	0.36	0.46	0.00
31.91	195.01	0.86	0.27	0.46	0.00	32.00	196.08	0.87	0.26	0.46	0.00
32.10	196.52	0.87	0.26	0.46	0.00	32.15	196.18	0.87	0.26	0.46	0.00
32.20	195.29	0.86	0.26	0.45	0.00	32.24	194.09	0.84	0.35	0.45	0.00
32.30	192.57	0.83	0.35	0.45	0.00	32.37	191.26	0.81	0.36	0.45	0.00
32.43	190.46	0.80	0.36	0.45	0.00	32.51	190.06	0.80	0.36	0.45	0.00
32.55	189.42	0.79	0.36	0.45	0.00	32.62	187.78	0.77	0.36	0.45	0.00
32.68	185.75	0.75	0.46	0.45	0.00	32.81	183.26	0.72	0.46	0.44	0.01
32.86	182.51	0.71	0.46	0.44	0.00	32.94	183.47	0.72	0.46	0.44	0.00
33.00	186.72	0.76	0.36	0.44	0.00	33.04	191.34	0.81	0.35	0.44	0.00
33.13	197.78	0.88	0.25	0.44	0.00	33.18	206.12	2.00	0.00	0.44	0.00
33.24	213.38	2.00	0.00	0.44	0.00	33.30	218.81	2.00	0.00	0.44	0.00
33.37	221.94	2.00	0.00	0.43	0.00	33.44	220.77	2.00	0.00	0.43	0.00
33.48	213.94	2.00	0.00	0.43	0.00	33.55	204.57	2.00	0.00	0.43	0.00
33.61	193.29	2.00	0.00	0.43	0.00	33.68	178.33	2.00	0.00	0.43	0.00
33.74	163.05	2.00	0.00	0.43	0.00	33.80	152.05	2.00	0.00	0.43	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
33.88	145.87	2.00	0.00	0.43	0.00	33.93	139.66	2.00	0.00	0.42	0.00
34.00	130.14	2.00	0.00	0.42	0.00	34.06	117.65	2.00	0.00	0.42	0.00
34.19	107.88	2.00	0.00	0.42	0.00	34.24	101.27	2.00	0.00	0.42	0.00
34.31	95.48	2.00	0.00	0.42	0.00	34.37	89.54	2.00	0.00	0.42	0.00
34.42	85.42	2.00	0.00	0.42	0.00	34.50	85.02	2.00	0.00	0.42	0.00
34.55	85.41	0.15	1.10	0.41	0.01	34.68	87.39	2.00	0.00	0.41	0.00
34.73	91.88	2.00	0.00	0.41	0.00	34.81	96.52	2.00	0.00	0.41	0.00
34.86	102.52	2.00	0.00	0.41	0.00	34.90	107.51	2.00	0.00	0.41	0.00
34.95	112.70	2.00	0.00	0.41	0.00	35.00	115.16	2.00	0.00	0.41	0.00
35.05	114.76	0.24	0.85	0.41	0.01	35.16	113.91	0.24	0.85	0.40	0.01
35.21	112.44	0.23	0.86	0.40	0.00	35.30	110.76	0.23	0.86	0.40	0.01
35.35	110.96	0.23	0.86	0.40	0.01	35.48	113.05	0.24	0.84	0.40	0.01
35.52	116.74	2.00	0.00	0.40	0.00	35.57	119.41	2.00	0.00	0.40	0.00
35.63	119.70	2.00	0.00	0.40	0.00	35.70	117.92	2.00	0.00	0.39	0.00
35.74	115.47	2.00	0.00	0.39	0.00	35.87	122.12	2.00	0.00	0.39	0.00
35.93	135.64	2.00	0.00	0.39	0.00	35.99	144.74	2.00	0.00	0.39	0.00
36.05	149.55	2.00	0.00	0.39	0.00	36.12	152.74	0.45	0.64	0.39	0.00
36.19	155.77	0.47	0.63	0.39	0.01	36.23	159.56	0.50	0.61	0.39	0.00
36.31	165.14	0.55	0.60	0.38	0.01	36.36	175.35	0.64	0.52	0.38	0.00
36.48	185.93	0.74	0.39	0.38	0.01	36.54	196.65	0.86	0.22	0.38	0.00
36.60	205.73	2.00	0.00	0.38	0.00	36.67	215.38	2.00	0.00	0.38	0.00
36.72	225.54	2.00	0.00	0.38	0.00	36.77	234.66	2.00	0.00	0.38	0.00
36.85	241.51	2.00	0.00	0.38	0.00	36.90	245.05	2.00	0.00	0.37	0.00
36.95	245.10	2.00	0.00	0.37	0.00	37.03	241.50	2.00	0.00	0.37	0.00
37.08	239.43	2.00	0.00	0.37	0.00	37.15	235.44	2.00	0.00	0.37	0.00
37.21	230.28	2.00	0.00	0.37	0.00	37.27	223.83	2.00	0.00	0.37	0.00
37.34	213.79	2.00	0.00	0.37	0.00	37.46	202.60	2.00	0.00	0.37	0.00
37.52	191.37	0.80	0.29	0.36	0.00	37.59	184.63	0.73	0.37	0.36	0.00
37.65	176.35	0.65	0.48	0.36	0.00	37.78	170.60	0.59	0.50	0.36	0.01
37.83	165.72	0.55	0.52	0.36	0.00	37.89	166.89	0.56	0.52	0.36	0.00
37.96	167.99	0.57	0.51	0.36	0.00	38.00	169.06	0.58	0.50	0.36	0.00
38.10	170.07	0.59	0.50	0.35	0.01	38.13	172.54	0.61	0.49	0.35	0.00
38.22	174.87	0.63	0.48	0.35	0.01	38.27	177.02	0.65	0.38	0.35	0.00
38.41	177.33	0.65	0.38	0.35	0.01	38.44	177.40	0.66	0.38	0.35	0.00
38.49	176.60	0.65	0.46	0.35	0.00	38.53	175.22	0.63	0.47	0.35	0.00
38.60	173.27	0.62	0.47	0.35	0.00	38.70	171.45	0.60	0.48	0.34	0.01
38.76	170.40	0.59	0.48	0.34	0.00	38.80	169.78	0.59	0.48	0.34	0.00
38.87	169.01	0.58	0.48	0.34	0.00	38.93	168.49	0.57	0.48	0.34	0.00
38.98	168.21	0.57	0.48	0.34	0.00	39.11	169.11	0.58	0.48	0.34	0.01
39.16	171.45	0.60	0.47	0.34	0.00	39.24	174.84	0.63	0.45	0.33	0.00
39.29	177.96	0.66	0.36	0.33	0.00	39.34	180.05	0.68	0.36	0.33	0.00
39.38	181.12	0.69	0.35	0.33	0.00	39.49	181.22	0.69	0.35	0.33	0.00
39.53	180.84	0.69	0.35	0.33	0.00	39.60	179.94	0.68	0.35	0.33	0.00
39.64	178.17	0.66	0.36	0.33	0.00	39.73	176.13	0.64	0.44	0.33	0.00
39.77	174.48	0.63	0.44	0.33	0.00	39.85	174.38	0.63	0.44	0.32	0.00
39.91	178.20	0.66	0.35	0.32	0.00	40.04	183.66	0.72	0.33	0.32	0.01
40.09	190.00	0.79	0.26	0.32	0.00	40.14	194.30	0.84	0.25	0.32	0.00
40.22	197.68	0.88	0.18	0.32	0.00	40.26	199.72	0.90	0.18	0.32	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
40.35	199.88	0.90	0.18	0.32	0.00	40.40	199.21	0.89	0.18	0.32	0.00
40.48	197.98	0.88	0.18	0.31	0.00	40.53	196.52	0.86	0.18	0.31	0.00
40.60	193.15	0.82	0.24	0.31	0.00	40.66	187.89	0.76	0.25	0.31	0.00
40.72	182.96	0.71	0.32	0.31	0.00	40.76	174.21	0.63	0.42	0.31	0.00
40.92	165.01	0.55	0.47	0.31	0.01	40.96	150.42	0.44	0.51	0.31	0.00
41.09	139.06	0.36	0.54	0.30	0.01	41.14	128.56	0.30	0.58	0.30	0.00
41.19	122.51	0.28	0.60	0.30	0.00	41.23	116.66	0.25	0.62	0.30	0.00
41.32	111.32	0.23	0.64	0.30	0.01	41.36	105.76	0.21	0.67	0.30	0.00
41.45	101.77	0.20	0.69	0.30	0.01	41.50	97.87	0.18	0.71	0.30	0.00
41.58	95.53	0.18	0.72	0.30	0.01	41.64	94.12	0.17	0.72	0.29	0.00
41.72	94.68	0.17	0.72	0.29	0.01	41.78	96.64	0.18	0.70	0.29	0.00
41.84	98.69	0.19	0.69	0.29	0.01	41.89	99.81	0.19	0.68	0.29	0.00
41.97	99.24	0.19	0.68	0.29	0.01	42.03	98.01	0.18	0.68	0.29	0.00
42.11	97.46	0.18	0.68	0.29	0.01	42.16	98.52	0.19	0.68	0.29	0.00
42.22	101.40	0.19	0.66	0.28	0.00	42.29	105.03	0.21	0.64	0.28	0.01
42.35	107.97	0.22	0.62	0.28	0.00	42.42	109.24	0.22	0.61	0.28	0.01
42.49	110.03	0.22	0.60	0.28	0.00	42.56	112.42	0.23	0.59	0.28	0.00
42.60	117.46	0.25	0.57	0.28	0.00	42.68	124.05	0.28	0.54	0.28	0.00
42.74	130.73	0.32	0.52	0.28	0.00	42.80	136.36	0.35	0.50	0.27	0.00
42.87	140.63	0.37	0.48	0.27	0.00	42.96	143.80	0.39	0.47	0.27	0.00
43.00	146.62	0.41	0.46	0.27	0.00	43.08	149.20	0.43	0.45	0.27	0.00
43.14	151.72	0.45	0.45	0.27	0.00	43.20	153.72	0.46	0.44	0.27	0.00
43.27	155.20	0.47	0.43	0.27	0.00	43.31	155.87	0.48	0.43	0.27	0.00
43.39	155.40	0.47	0.43	0.26	0.00	43.44	152.69	0.45	0.44	0.26	0.00
43.57	149.36	0.43	0.44	0.26	0.01	43.65	145.31	0.40	0.45	0.26	0.00
43.71	143.66	0.39	0.45	0.26	0.00	43.76	143.42	0.39	0.45	0.26	0.00
43.83	145.60	0.41	0.44	0.26	0.00	43.88	148.79	0.43	0.43	0.26	0.00
43.96	148.13	0.42	0.43	0.25	0.00	43.97	150.32	0.44	0.43	0.25	0.00
44.05	153.69	0.46	0.42	0.25	0.00	44.10	162.18	0.53	0.40	0.25	0.00
44.17	169.46	0.59	0.35	0.25	0.00	44.24	173.56	0.63	0.34	0.25	0.00
44.29	176.26	0.65	0.27	0.25	0.00	44.37	176.33	0.66	0.27	0.25	0.00
44.44	173.83	0.63	0.34	0.25	0.00	44.50	169.55	0.59	0.35	0.25	0.00
44.56	164.61	0.55	0.36	0.24	0.00	44.64	158.96	0.50	0.39	0.24	0.00
44.72	152.76	0.46	0.40	0.24	0.00	44.77	144.75	0.40	0.42	0.24	0.00
44.90	137.09	0.36	0.43	0.24	0.01	44.99	130.06	0.32	0.45	0.24	0.00
45.07	124.73	0.29	0.46	0.24	0.00	45.13	119.84	0.27	0.47	0.24	0.00
45.21	115.21	0.25	0.49	0.23	0.00	45.26	111.43	0.23	0.50	0.23	0.00
45.35	108.52	0.22	0.51	0.23	0.01	45.39	106.41	0.21	0.51	0.23	0.00
45.47	105.73	0.21	0.51	0.23	0.01	45.52	106.43	0.21	0.51	0.23	0.00
45.60	108.58	0.22	0.50	0.23	0.00	45.66	109.69	0.23	0.49	0.23	0.00
45.72	118.84	0.26	0.46	0.23	0.00	45.79	134.14	0.34	0.41	0.22	0.00
45.90	150.78	0.45	0.37	0.22	0.00	45.97	166.60	0.57	0.32	0.22	0.00
46.01	175.32	0.65	0.24	0.22	0.00	46.10	180.25	0.70	0.23	0.22	0.00
46.15	181.98	0.72	0.23	0.22	0.00	46.23	179.82	0.70	0.23	0.22	0.00
46.28	178.32	0.68	0.23	0.22	0.00	46.35	173.30	0.63	0.29	0.21	0.00
46.41	166.46	0.57	0.31	0.21	0.00	46.47	159.03	0.51	0.34	0.21	0.00
46.54	153.24	0.47	0.35	0.21	0.00	46.60	146.52	0.42	0.36	0.21	0.00
46.67	141.21	0.38	0.37	0.21	0.00	46.72	136.21	0.35	0.38	0.21	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
46.80	134.42	0.34	0.38	0.21	0.00	46.85	133.03	0.34	0.38	0.21	0.00
46.92	128.66	0.31	0.39	0.20	0.00	46.94	126.72	0.30	0.39	0.20	0.00
46.99	125.59	0.30	0.39	0.20	0.00	47.08	128.08	0.31	0.39	0.20	0.00
47.13	129.52	0.32	0.38	0.20	0.00	47.21	131.11	0.33	0.37	0.20	0.00
47.25	133.74	0.34	0.37	0.20	0.00	47.31	139.29	0.37	0.35	0.20	0.00
47.53	145.02	0.41	0.34	0.19	0.01	47.57	150.49	0.45	0.32	0.19	0.00
47.64	152.75	0.47	0.32	0.19	0.00	47.69	155.05	0.48	0.31	0.19	0.00
47.78	157.19	0.50	0.31	0.19	0.00	47.84	159.52	0.52	0.30	0.19	0.00
47.88	163.94	0.55	0.28	0.19	0.00	48.02	169.17	0.60	0.26	0.19	0.00
48.10	174.90	0.66	0.21	0.18	0.00	48.19	178.36	0.69	0.20	0.18	0.00
48.24	180.89	0.72	0.19	0.18	0.00	48.31	184.99	0.76	0.15	0.18	0.00
48.52	190.60	0.82	0.14	0.18	0.00	48.59	197.42	0.90	0.10	0.18	0.00
48.66	202.40	2.00	0.00	0.18	0.00	48.72	208.66	2.00	0.00	0.17	0.00
48.80	215.21	2.00	0.00	0.17	0.00	48.86	220.80	2.00	0.00	0.17	0.00
48.93	224.87	2.00	0.00	0.17	0.00	48.99	228.13	2.00	0.00	0.17	0.00
49.07	230.84	2.00	0.00	0.17	0.00	49.14	232.52	2.00	0.00	0.17	0.00
49.21	232.20	2.00	0.00	0.17	0.00	49.28	229.28	2.00	0.00	0.16	0.00
49.34	224.38	2.00	0.00	0.16	0.00	49.41	220.44	2.00	0.00	0.16	0.00
49.48	218.31	2.00	0.00	0.16	0.00	49.60	217.98	2.00	0.00	0.16	0.00
49.70	218.43	2.00	0.00	0.16	0.00	49.78	218.25	2.00	0.00	0.16	0.00
49.92	216.48	2.00	0.00	0.15	0.00	49.98	204.63	2.00	0.00	0.15	0.00
50.01	193.53	0.87	0.09	0.15	0.00						

Total estimated settlement: 2.44

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

LIQUEFACTION ANALYSIS REPORT

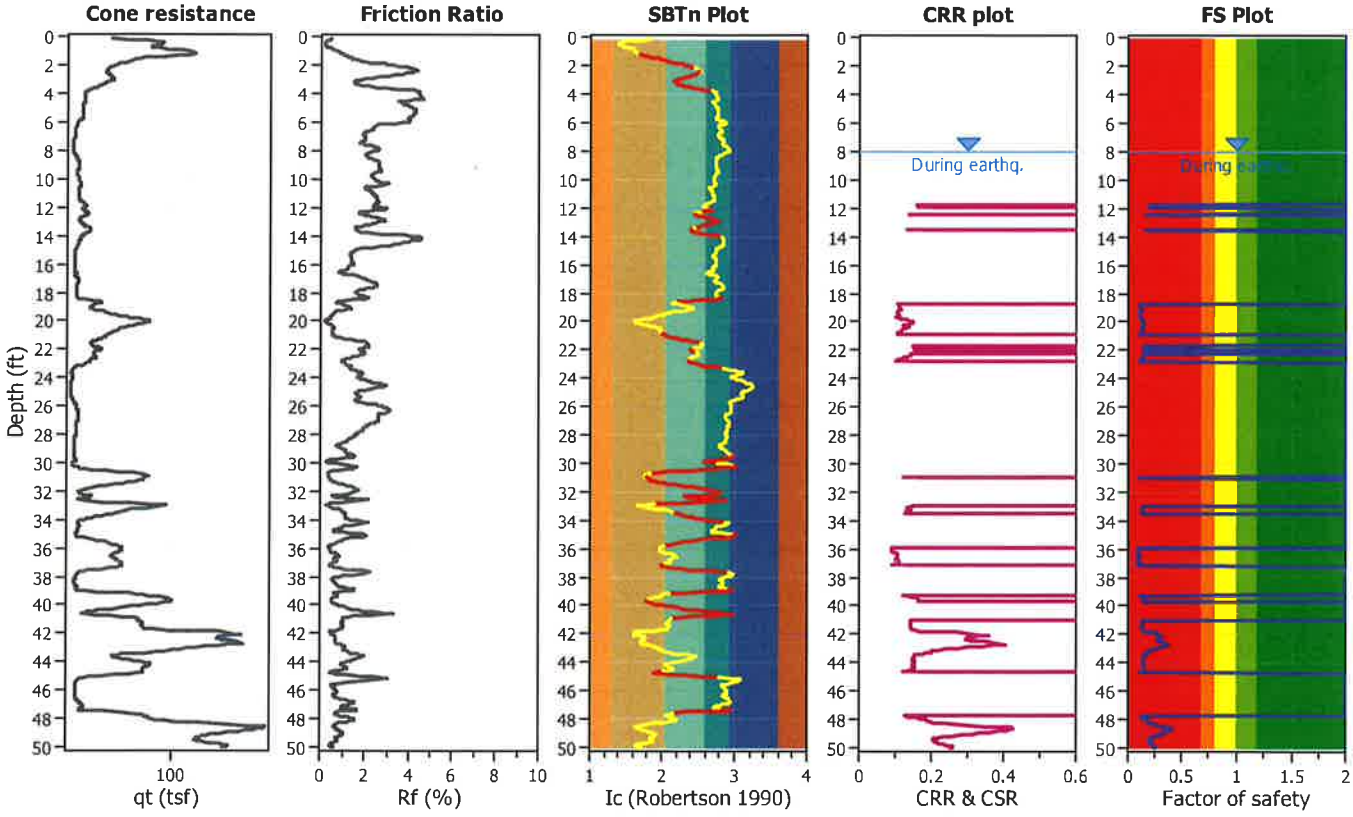
Project title : S-Line Upgrades

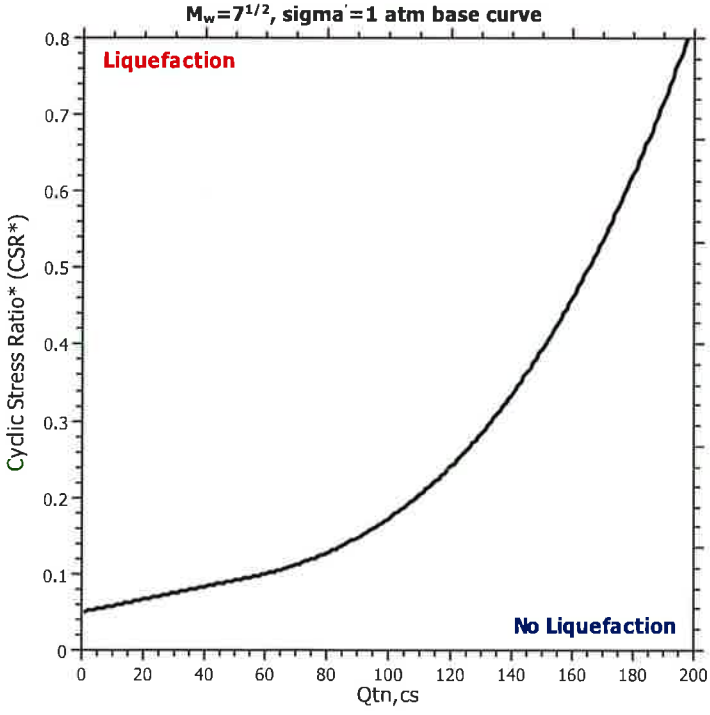
Location : Imperial County, CA

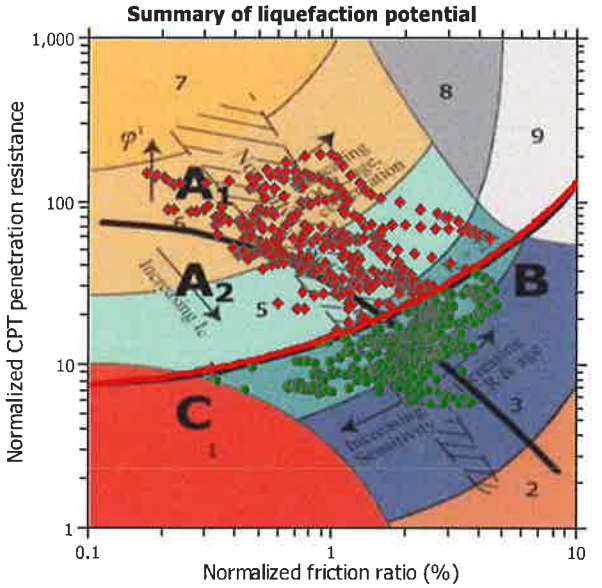
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.97	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

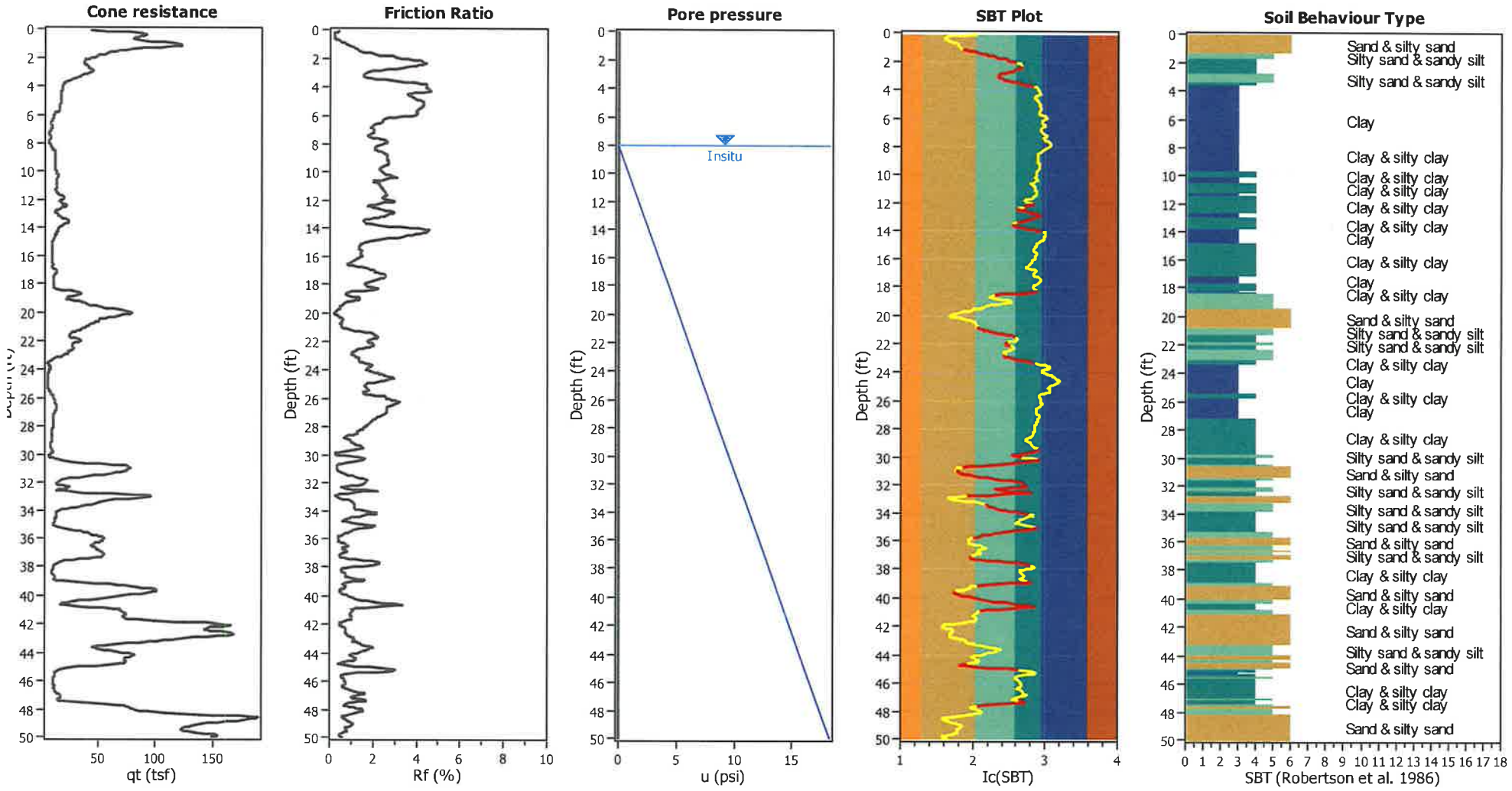






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



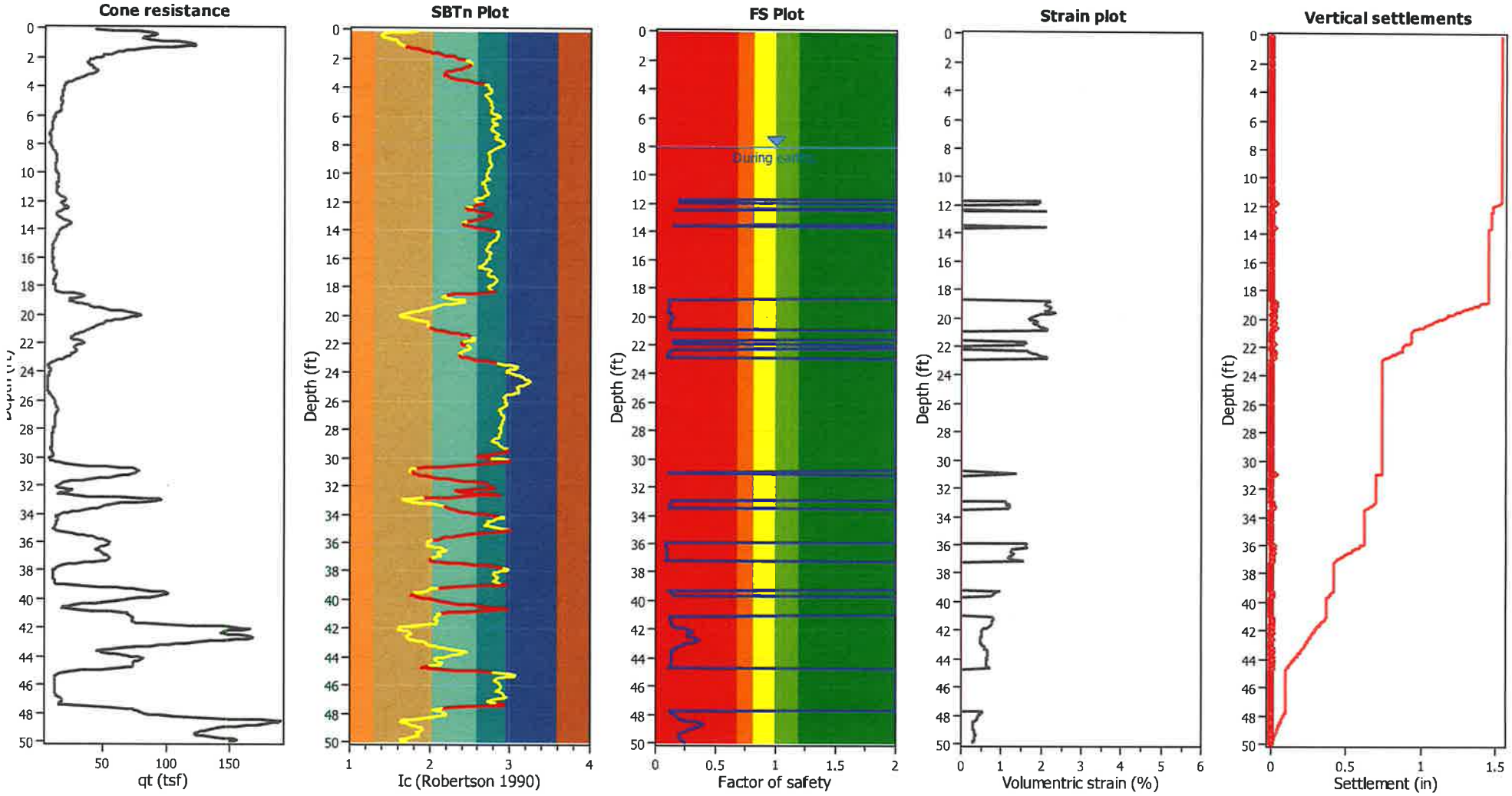
nput parameters and analysis data

alysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.97	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.01	67.20	2.00	0.00	0.86	0.00	8.12	66.08	2.00	0.00	0.86	0.00
8.25	65.83	2.00	0.00	0.86	0.00	8.31	67.41	2.00	0.00	0.86	0.00
8.38	69.46	2.00	0.00	0.86	0.00	8.44	71.78	2.00	0.00	0.86	0.00
8.51	74.47	2.00	0.00	0.86	0.00	8.56	77.24	2.00	0.00	0.85	0.00
8.61	80.26	2.00	0.00	0.85	0.00	8.69	82.49	2.00	0.00	0.85	0.00
8.74	83.96	2.00	0.00	0.85	0.00	8.80	84.25	2.00	0.00	0.85	0.00
8.87	84.26	2.00	0.00	0.85	0.00	8.92	84.21	2.00	0.00	0.85	0.00
9.05	84.24	2.00	0.00	0.85	0.00	9.11	84.01	2.00	0.00	0.85	0.00
9.18	83.84	2.00	0.00	0.84	0.00	9.22	83.72	2.00	0.00	0.84	0.00
9.29	83.87	2.00	0.00	0.84	0.00	9.36	83.84	2.00	0.00	0.84	0.00
9.42	83.40	2.00	0.00	0.84	0.00	9.48	82.24	2.00	0.00	0.84	0.00
9.53	80.59	2.00	0.00	0.84	0.00	9.59	78.76	2.00	0.00	0.84	0.00
9.71	77.70	2.00	0.00	0.84	0.00	9.78	77.65	2.00	0.00	0.83	0.00
9.85	78.34	2.00	0.00	0.83	0.00	9.90	79.68	2.00	0.00	0.83	0.00
9.98	81.59	2.00	0.00	0.83	0.00	10.09	83.88	2.00	0.00	0.83	0.00
10.15	86.34	2.00	0.00	0.83	0.00	10.21	89.58	2.00	0.00	0.83	0.00
10.29	92.61	2.00	0.00	0.83	0.00	10.33	95.12	2.00	0.00	0.82	0.00
10.40	90.41	2.00	0.00	0.82	0.00	10.54	83.04	2.00	0.00	0.82	0.00
10.60	75.78	2.00	0.00	0.82	0.00	10.65	75.20	2.00	0.00	0.82	0.00
10.69	77.58	2.00	0.00	0.82	0.00	10.78	78.64	2.00	0.00	0.82	0.00
10.82	79.38	2.00	0.00	0.82	0.00	10.88	79.36	2.00	0.00	0.82	0.00
10.90	80.09	2.00	0.00	0.82	0.00	11.00	80.96	2.00	0.00	0.81	0.00
11.05	81.70	2.00	0.00	0.81	0.00	11.10	81.88	2.00	0.00	0.81	0.00
11.23	81.86	2.00	0.00	0.81	0.00	11.28	82.57	2.00	0.00	0.81	0.00
11.35	83.43	2.00	0.00	0.81	0.00	11.41	84.36	2.00	0.00	0.81	0.00
11.46	85.21	2.00	0.00	0.81	0.00	11.54	86.55	2.00	0.00	0.80	0.00
11.60	89.54	2.00	0.00	0.80	0.00	11.67	92.55	2.00	0.00	0.80	0.00
11.72	94.68	0.20	1.96	0.80	0.01	11.85	95.63	0.20	1.94	0.80	0.03
11.90	96.81	0.20	1.92	0.80	0.01	11.97	98.75	2.00	0.00	0.80	0.00
12.03	99.75	2.00	0.00	0.80	0.00	12.09	98.07	2.00	0.00	0.80	0.00
12.16	92.25	2.00	0.00	0.79	0.00	12.28	86.65	2.00	0.00	0.79	0.00
12.34	83.43	2.00	0.00	0.79	0.00	12.40	84.52	0.16	2.12	0.79	0.01
12.47	86.32	2.00	0.00	0.79	0.00	12.52	88.01	2.00	0.00	0.79	0.00
12.57	88.73	2.00	0.00	0.79	0.00	12.65	89.03	2.00	0.00	0.79	0.00
12.70	89.12	2.00	0.00	0.78	0.00	12.78	89.22	2.00	0.00	0.78	0.00
12.83	88.90	2.00	0.00	0.78	0.00	12.89	88.25	2.00	0.00	0.78	0.00
12.96	87.34	2.00	0.00	0.78	0.00	13.02	87.32	2.00	0.00	0.78	0.00
13.10	87.55	2.00	0.00	0.78	0.00	13.15	87.48	2.00	0.00	0.78	0.00
13.22	86.29	2.00	0.00	0.78	0.00	13.27	83.56	2.00	0.00	0.78	0.00
13.35	80.71	2.00	0.00	0.77	0.00	13.40	78.94	2.00	0.00	0.77	0.00
13.46	80.19	2.00	0.00	0.77	0.00	13.53	81.66	0.15	2.13	0.77	0.02
13.66	83.12	2.00	0.00	0.77	0.00	13.71	85.58	2.00	0.00	0.77	0.00
13.77	91.03	2.00	0.00	0.77	0.00	13.84	98.66	2.00	0.00	0.77	0.00
13.89	105.61	2.00	0.00	0.76	0.00	13.94	111.32	2.00	0.00	0.76	0.00
13.99	115.34	2.00	0.00	0.76	0.00	14.05	117.57	2.00	0.00	0.76	0.00
14.12	116.93	2.00	0.00	0.76	0.00	14.23	114.67	2.00	0.00	0.76	0.00
14.30	111.51	2.00	0.00	0.76	0.00	14.34	108.21	2.00	0.00	0.76	0.00
14.42	104.59	2.00	0.00	0.76	0.00	14.48	100.83	2.00	0.00	0.75	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
14.53	97.04	2.00	0.00	0.75	0.00	14.60	92.90	2.00	0.00	0.75	0.00
14.65	88.34	2.00	0.00	0.75	0.00	14.71	82.35	2.00	0.00	0.75	0.00
14.78	74.62	2.00	0.00	0.75	0.00	14.90	66.95	2.00	0.00	0.75	0.00
14.96	61.31	2.00	0.00	0.75	0.00	15.08	59.10	2.00	0.00	0.74	0.00
15.14	57.80	2.00	0.00	0.74	0.00	15.19	57.29	2.00	0.00	0.74	0.00
15.26	56.50	2.00	0.00	0.74	0.00	15.32	56.47	2.00	0.00	0.74	0.00
15.37	56.41	2.00	0.00	0.74	0.00	15.44	56.28	2.00	0.00	0.74	0.00
15.49	56.40	2.00	0.00	0.74	0.00	15.55	56.71	2.00	0.00	0.74	0.00
15.67	57.21	2.00	0.00	0.73	0.00	15.73	57.11	2.00	0.00	0.73	0.00
15.80	57.04	2.00	0.00	0.73	0.00	15.84	57.39	2.00	0.00	0.73	0.00
15.91	57.87	2.00	0.00	0.73	0.00	15.98	58.30	2.00	0.00	0.73	0.00
16.02	57.54	2.00	0.00	0.73	0.00	16.10	56.10	2.00	0.00	0.73	0.00
16.16	54.87	2.00	0.00	0.73	0.00	16.21	54.31	2.00	0.00	0.73	0.00
16.28	53.54	2.00	0.00	0.72	0.00	16.38	51.17	2.00	0.00	0.72	0.00
16.51	47.71	2.00	0.00	0.72	0.00	16.56	46.38	2.00	0.00	0.72	0.00
16.63	47.87	2.00	0.00	0.72	0.00	16.69	51.63	2.00	0.00	0.72	0.00
16.75	55.03	2.00	0.00	0.72	0.00	16.78	58.35	2.00	0.00	0.72	0.00
16.82	63.21	2.00	0.00	0.71	0.00	16.93	67.83	2.00	0.00	0.71	0.00
17.00	71.62	2.00	0.00	0.71	0.00	17.06	73.44	2.00	0.00	0.71	0.00
17.12	74.72	2.00	0.00	0.71	0.00	17.17	76.14	2.00	0.00	0.71	0.00
17.23	77.74	2.00	0.00	0.71	0.00	17.30	78.62	2.00	0.00	0.71	0.00
17.35	78.53	2.00	0.00	0.71	0.00	17.43	77.44	2.00	0.00	0.70	0.00
17.48	76.38	2.00	0.00	0.70	0.00	17.53	74.99	2.00	0.00	0.70	0.00
17.61	72.76	2.00	0.00	0.70	0.00	17.66	69.36	2.00	0.00	0.70	0.00
17.79	66.29	2.00	0.00	0.70	0.00	17.84	63.72	2.00	0.00	0.70	0.00
17.92	62.85	2.00	0.00	0.70	0.00	17.97	62.12	2.00	0.00	0.70	0.00
18.02	62.41	2.00	0.00	0.69	0.00	18.10	62.97	2.00	0.00	0.69	0.00
18.15	64.90	2.00	0.00	0.69	0.00	18.22	67.25	2.00	0.00	0.69	0.00
18.28	69.74	2.00	0.00	0.69	0.00	18.33	71.57	2.00	0.00	0.69	0.00
18.41	71.40	2.00	0.00	0.69	0.00	18.46	68.80	2.00	0.00	0.69	0.00
18.53	65.86	2.00	0.00	0.69	0.00	18.64	66.42	2.00	0.00	0.68	0.00
18.70	66.17	2.00	0.00	0.68	0.00	18.77	66.67	0.11	2.22	0.68	0.02
18.89	67.60	0.11	2.19	0.68	0.03	18.94	70.82	0.12	2.11	0.68	0.01
19.07	71.17	0.12	2.09	0.68	0.03	19.13	69.43	0.11	2.13	0.68	0.01
19.21	66.77	0.11	2.19	0.67	0.02	19.26	65.55	0.11	2.23	0.67	0.01
19.31	65.35	0.11	2.23	0.67	0.01	19.37	65.60	0.11	2.22	0.67	0.02
19.44	66.26	0.11	2.20	0.67	0.02	19.51	67.25	0.11	2.17	0.67	0.02
19.57	69.56	0.11	2.10	0.67	0.02	19.61	61.52	0.10	2.32	0.67	0.01
19.69	66.34	0.11	2.18	0.67	0.02	19.74	71.32	0.11	2.05	0.67	0.01
19.75	74.99	0.12	1.97	0.67	0.00	19.83	80.75	0.13	1.85	0.66	0.02
19.94	85.58	0.14	1.76	0.66	0.02	20.00	89.60	0.15	1.69	0.66	0.01
20.06	89.41	0.15	1.69	0.66	0.01	20.13	86.34	0.14	1.74	0.66	0.01
20.19	82.31	0.13	1.80	0.66	0.01	20.26	77.63	0.12	1.89	0.66	0.01
20.31	83.58	0.13	1.78	0.66	0.01	20.38	81.43	0.13	1.81	0.65	0.02
20.44	79.30	0.13	1.85	0.65	0.01	20.49	76.07	0.12	1.91	0.65	0.01
20.62	72.91	0.12	1.97	0.65	0.03	20.68	69.88	0.11	2.04	0.65	0.01
20.74	68.18	0.11	2.07	0.65	0.02	20.80	66.56	0.11	2.11	0.65	0.01
20.84	65.09	0.10	2.15	0.65	0.01	20.93	63.93	2.00	0.00	0.65	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
20.98	63.39	2.00	0.00	0.64	0.00	21.05	64.09	2.00	0.00	0.64	0.00
21.11	65.86	2.00	0.00	0.64	0.00	21.16	69.64	2.00	0.00	0.64	0.00
21.24	74.26	2.00	0.00	0.64	0.00	21.28	79.36	2.00	0.00	0.64	0.00
21.35	83.20	2.00	0.00	0.64	0.00	21.42	85.91	2.00	0.00	0.64	0.00
21.47	87.25	2.00	0.00	0.64	0.00	21.54	87.79	2.00	0.00	0.63	0.00
21.60	88.33	2.00	0.00	0.63	0.00	21.65	89.70	0.14	1.62	0.63	0.01
21.77	91.08	0.15	1.59	0.63	0.02	21.83	91.91	0.15	1.58	0.63	0.01
21.89	91.37	0.15	1.58	0.63	0.01	21.90	90.37	2.00	0.00	0.63	0.00
22.08	89.74	2.00	0.00	0.63	0.00	22.12	89.95	2.00	0.00	0.63	0.00
22.18	89.49	2.00	0.00	0.62	0.00	22.26	88.28	0.14	1.61	0.62	0.01
22.31	86.41	0.14	1.64	0.62	0.01	22.38	84.09	0.13	1.67	0.62	0.01
22.43	81.21	0.13	1.72	0.62	0.01	22.49	77.38	0.12	1.78	0.62	0.01
22.56	73.56	0.11	1.85	0.62	0.02	22.62	69.14	0.11	1.95	0.62	0.01
22.68	64.96	0.10	2.05	0.62	0.02	22.75	62.14	0.10	2.12	0.61	0.02
22.79	60.65	0.10	2.16	0.61	0.01	22.88	60.90	2.00	0.00	0.61	0.00
22.92	60.92	2.00	0.00	0.61	0.00	23.10	60.81	2.00	0.00	0.61	0.00
23.14	58.95	2.00	0.00	0.61	0.00	23.22	55.16	2.00	0.00	0.61	0.00
23.32	51.48	2.00	0.00	0.60	0.00	23.40	49.45	2.00	0.00	0.60	0.00
23.45	49.29	2.00	0.00	0.60	0.00	23.52	49.53	2.00	0.00	0.60	0.00
23.59	50.71	2.00	0.00	0.60	0.00	23.64	52.33	2.00	0.00	0.60	0.00
23.70	53.97	2.00	0.00	0.60	0.00	23.76	54.96	2.00	0.00	0.60	0.00
23.82	54.73	2.00	0.00	0.60	0.00	23.94	54.22	2.00	0.00	0.59	0.00
23.98	53.63	2.00	0.00	0.59	0.00	24.07	53.77	2.00	0.00	0.59	0.00
24.13	54.18	2.00	0.00	0.59	0.00	24.20	54.75	2.00	0.00	0.59	0.00
24.25	55.28	2.00	0.00	0.59	0.00	24.31	55.82	2.00	0.00	0.59	0.00
24.37	56.51	2.00	0.00	0.59	0.00	24.43	57.51	2.00	0.00	0.59	0.00
24.49	58.21	2.00	0.00	0.58	0.00	24.56	58.06	2.00	0.00	0.58	0.00
24.61	56.74	2.00	0.00	0.58	0.00	24.70	54.86	2.00	0.00	0.58	0.00
24.74	52.28	2.00	0.00	0.58	0.00	24.88	50.35	2.00	0.00	0.58	0.00
24.93	48.70	2.00	0.00	0.58	0.00	25.00	48.18	2.00	0.00	0.58	0.00
25.05	47.78	2.00	0.00	0.58	0.00	25.12	47.77	2.00	0.00	0.57	0.00
25.23	48.00	2.00	0.00	0.57	0.00	25.30	48.84	2.00	0.00	0.57	0.00
25.36	50.33	2.00	0.00	0.57	0.00	25.42	51.39	2.00	0.00	0.57	0.00
25.50	51.97	2.00	0.00	0.57	0.00	25.54	51.84	2.00	0.00	0.57	0.00
25.63	52.34	2.00	0.00	0.57	0.00	25.67	54.89	2.00	0.00	0.56	0.00
25.74	58.87	2.00	0.00	0.56	0.00	25.80	63.48	2.00	0.00	0.56	0.00
25.85	66.25	2.00	0.00	0.56	0.00	25.86	69.19	2.00	0.00	0.56	0.00
25.97	71.32	2.00	0.00	0.56	0.00	26.02	73.88	2.00	0.00	0.56	0.00
26.07	75.76	2.00	0.00	0.56	0.00	26.14	77.67	2.00	0.00	0.56	0.00
26.19	79.29	2.00	0.00	0.56	0.00	26.26	80.03	2.00	0.00	0.55	0.00
26.32	79.51	2.00	0.00	0.55	0.00	26.45	78.42	2.00	0.00	0.55	0.00
26.50	77.38	2.00	0.00	0.55	0.00	26.57	76.84	2.00	0.00	0.55	0.00
26.64	76.34	2.00	0.00	0.55	0.00	26.69	75.64	2.00	0.00	0.55	0.00
26.81	74.91	2.00	0.00	0.55	0.00	26.86	74.25	2.00	0.00	0.54	0.00
26.93	73.60	2.00	0.00	0.54	0.00	26.99	72.82	2.00	0.00	0.54	0.00
27.04	71.03	2.00	0.00	0.54	0.00	27.16	68.96	2.00	0.00	0.54	0.00
27.22	66.71	2.00	0.00	0.54	0.00	27.29	65.51	2.00	0.00	0.54	0.00
27.35	64.55	2.00	0.00	0.54	0.00	27.42	63.80	2.00	0.00	0.54	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
27.47	62.77	2.00	0.00	0.53	0.00	27.61	61.86	2.00	0.00	0.53	0.00
27.65	61.26	2.00	0.00	0.53	0.00	27.70	60.84	2.00	0.00	0.53	0.00
27.78	60.02	2.00	0.00	0.53	0.00	27.83	59.08	2.00	0.00	0.53	0.00
27.89	58.13	2.00	0.00	0.53	0.00	27.96	57.08	2.00	0.00	0.53	0.00
28.01	55.97	2.00	0.00	0.53	0.00	28.09	54.99	2.00	0.00	0.52	0.00
28.14	54.07	2.00	0.00	0.52	0.00	28.19	52.59	2.00	0.00	0.52	0.00
28.27	51.15	2.00	0.00	0.52	0.00	28.32	50.09	2.00	0.00	0.52	0.00
28.38	49.67	2.00	0.00	0.52	0.00	28.45	49.30	2.00	0.00	0.52	0.00
28.51	48.26	2.00	0.00	0.52	0.00	28.57	46.34	2.00	0.00	0.52	0.00
28.63	43.47	2.00	0.00	0.51	0.00	28.68	40.88	2.00	0.00	0.51	0.00
28.76	39.95	2.00	0.00	0.51	0.00	28.82	40.73	2.00	0.00	0.51	0.00
28.89	42.35	2.00	0.00	0.51	0.00	28.95	44.09	2.00	0.00	0.51	0.00
29.07	45.20	2.00	0.00	0.51	0.00	29.12	46.10	2.00	0.00	0.51	0.00
29.17	46.77	2.00	0.00	0.51	0.00	29.27	47.79	2.00	0.00	0.50	0.00
29.33	49.28	2.00	0.00	0.50	0.00	29.43	50.43	2.00	0.00	0.50	0.00
29.48	51.26	2.00	0.00	0.50	0.00	29.53	50.49	2.00	0.00	0.50	0.00
29.60	46.95	2.00	0.00	0.50	0.00	29.71	40.96	2.00	0.00	0.50	0.00
29.78	34.70	2.00	0.00	0.50	0.00	29.83	31.41	2.00	0.00	0.49	0.00
29.88	30.74	2.00	0.00	0.49	0.00	29.93	30.41	2.00	0.00	0.49	0.00
29.99	31.43	2.00	0.00	0.49	0.00	30.05	37.35	2.00	0.00	0.49	0.00
30.15	45.27	2.00	0.00	0.49	0.00	30.23	51.76	2.00	0.00	0.49	0.00
30.27	55.69	2.00	0.00	0.49	0.00	30.33	58.42	2.00	0.00	0.49	0.00
30.39	60.67	2.00	0.00	0.48	0.00	30.45	59.20	2.00	0.00	0.48	0.00
30.55	55.78	2.00	0.00	0.48	0.00	30.61	56.51	2.00	0.00	0.48	0.00
30.66	51.96	2.00	0.00	0.48	0.00	30.72	63.25	2.00	0.00	0.48	0.00
30.77	72.29	2.00	0.00	0.48	0.00	30.94	76.99	0.11	1.38	0.48	0.03
30.98	76.54	0.11	1.38	0.47	0.01	30.99	75.24	0.11	1.40	0.47	0.00
31.12	72.83	2.00	0.00	0.47	0.00	31.19	71.82	2.00	0.00	0.47	0.00
31.25	79.79	2.00	0.00	0.47	0.00	31.31	78.38	2.00	0.00	0.47	0.00
31.38	77.57	2.00	0.00	0.47	0.00	31.43	77.45	2.00	0.00	0.47	0.00
31.50	76.48	2.00	0.00	0.47	0.00	31.56	75.07	2.00	0.00	0.47	0.00
31.63	73.78	2.00	0.00	0.46	0.00	31.69	71.21	2.00	0.00	0.46	0.00
31.83	67.00	2.00	0.00	0.46	0.00	31.97	60.93	2.00	0.00	0.46	0.00
32.04	57.56	2.00	0.00	0.46	0.00	32.16	56.03	2.00	0.00	0.45	0.00
32.23	52.11	2.00	0.00	0.45	0.00	32.28	49.16	2.00	0.00	0.45	0.00
32.34	47.97	2.00	0.00	0.45	0.00	32.41	50.56	2.00	0.00	0.45	0.00
32.46	55.96	2.00	0.00	0.45	0.00	32.51	63.52	2.00	0.00	0.45	0.00
32.59	67.96	2.00	0.00	0.45	0.00	32.64	65.78	2.00	0.00	0.45	0.00
32.77	63.13	2.00	0.00	0.44	0.00	32.82	60.22	2.00	0.00	0.44	0.00
32.89	79.46	2.00	0.00	0.44	0.00	32.95	90.10	0.13	1.12	0.44	0.01
33.01	91.41	0.14	1.11	0.44	0.01	33.08	82.92	0.12	1.20	0.44	0.01
33.19	86.52	0.13	1.15	0.44	0.01	33.26	82.42	0.12	1.19	0.44	0.01
33.37	80.82	0.12	1.21	0.43	0.02	33.43	79.64	0.12	1.22	0.43	0.01
33.55	78.34	2.00	0.00	0.43	0.00	33.61	76.64	2.00	0.00	0.43	0.00
33.66	72.99	2.00	0.00	0.43	0.00	33.74	68.62	2.00	0.00	0.43	0.00
33.79	64.20	2.00	0.00	0.43	0.00	33.85	61.52	2.00	0.00	0.43	0.00
33.92	60.44	2.00	0.00	0.43	0.00	33.98	61.43	2.00	0.00	0.42	0.00
34.05	63.35	2.00	0.00	0.42	0.00	34.10	64.46	2.00	0.00	0.42	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
34.16	64.70	2.00	0.00	0.42	0.00	34.23	64.17	2.00	0.00	0.42	0.00
34.29	60.60	2.00	0.00	0.42	0.00	34.41	54.74	2.00	0.00	0.42	0.00
34.47	49.39	2.00	0.00	0.42	0.00	34.54	46.51	2.00	0.00	0.41	0.00
34.59	44.38	2.00	0.00	0.41	0.00	34.67	41.27	2.00	0.00	0.41	0.00
34.72	39.76	2.00	0.00	0.41	0.00	34.78	40.36	2.00	0.00	0.41	0.00
34.82	42.09	2.00	0.00	0.41	0.00	34.87	46.65	2.00	0.00	0.41	0.00
34.98	51.55	2.00	0.00	0.41	0.00	35.03	57.12	2.00	0.00	0.41	0.00
35.09	59.99	2.00	0.00	0.41	0.00	35.21	61.53	2.00	0.00	0.40	0.00
35.27	59.99	2.00	0.00	0.40	0.00	35.38	59.58	2.00	0.00	0.40	0.00
35.44	61.40	2.00	0.00	0.40	0.00	35.52	63.55	2.00	0.00	0.40	0.00
35.57	63.82	2.00	0.00	0.40	0.00	35.64	61.52	2.00	0.00	0.40	0.00
35.75	59.55	2.00	0.00	0.39	0.00	35.82	44.48	2.00	0.00	0.39	0.00
35.87	46.77	2.00	0.00	0.39	0.00	35.92	48.41	0.08	1.66	0.39	0.01
36.00	49.27	0.08	1.63	0.39	0.02	36.05	49.53	0.08	1.62	0.39	0.01
36.10	49.33	0.08	1.62	0.39	0.01	36.18	48.68	0.08	1.63	0.39	0.02
36.24	47.56	0.08	1.66	0.39	0.01	36.30	63.28	0.09	1.31	0.38	0.01
36.36	65.15	0.10	1.27	0.38	0.01	36.49	66.30	0.10	1.25	0.38	0.02
36.54	65.84	0.10	1.25	0.38	0.01	36.61	63.55	0.09	1.29	0.38	0.01
36.67	61.91	0.09	1.31	0.38	0.01	36.72	62.56	0.09	1.30	0.38	0.01
36.80	64.98	0.10	1.25	0.38	0.01	36.84	67.89	0.10	1.21	0.38	0.01
36.91	69.08	0.10	1.18	0.37	0.01	36.98	68.33	0.10	1.19	0.37	0.01
37.03	65.48	0.10	1.23	0.37	0.01	37.11	48.77	0.08	1.56	0.37	0.01
37.21	48.46	2.00	0.00	0.37	0.00	37.29	63.62	2.00	0.00	0.37	0.00
37.33	64.28	2.00	0.00	0.37	0.00	37.40	66.07	2.00	0.00	0.37	0.00
37.47	68.93	2.00	0.00	0.36	0.00	37.52	71.94	2.00	0.00	0.36	0.00
37.58	72.80	2.00	0.00	0.36	0.00	37.64	71.76	2.00	0.00	0.36	0.00
37.72	66.74	2.00	0.00	0.36	0.00	37.82	59.40	2.00	0.00	0.36	0.00
37.91	51.03	2.00	0.00	0.36	0.00	37.95	44.76	2.00	0.00	0.36	0.00
38.02	40.26	2.00	0.00	0.36	0.00	38.09	37.07	2.00	0.00	0.35	0.00
38.16	36.01	2.00	0.00	0.35	0.00	38.22	36.16	2.00	0.00	0.35	0.00
38.28	36.31	2.00	0.00	0.35	0.00	38.35	36.93	2.00	0.00	0.35	0.00
38.40	38.06	2.00	0.00	0.35	0.00	38.46	39.16	2.00	0.00	0.35	0.00
38.53	40.32	2.00	0.00	0.35	0.00	38.64	40.92	2.00	0.00	0.35	0.00
38.71	43.00	2.00	0.00	0.34	0.00	38.76	46.29	2.00	0.00	0.34	0.00
38.83	49.88	2.00	0.00	0.34	0.00	38.89	52.51	2.00	0.00	0.34	0.00
38.96	54.12	2.00	0.00	0.34	0.00	39.02	53.97	2.00	0.00	0.34	0.00
39.07	54.85	2.00	0.00	0.34	0.00	39.15	61.11	2.00	0.00	0.34	0.00
39.20	69.39	2.00	0.00	0.34	0.00	39.26	76.87	0.11	0.97	0.33	0.01
39.33	83.22	0.12	0.91	0.33	0.01	39.38	89.27	0.13	0.85	0.33	0.01
39.46	93.52	0.14	0.82	0.33	0.01	39.51	96.20	0.15	0.80	0.33	0.00
39.64	97.20	0.15	0.79	0.33	0.01	39.69	88.66	2.00	0.00	0.33	0.00
39.75	95.51	2.00	0.00	0.33	0.00	39.82	92.76	2.00	0.00	0.33	0.00
39.87	90.23	2.00	0.00	0.32	0.00	39.94	86.60	2.00	0.00	0.32	0.00
40.05	83.99	2.00	0.00	0.32	0.00	40.13	82.22	2.00	0.00	0.32	0.00
40.18	81.00	2.00	0.00	0.32	0.00	40.31	79.53	2.00	0.00	0.32	0.00
40.35	78.92	2.00	0.00	0.32	0.00	40.44	78.62	2.00	0.00	0.31	0.00
40.48	79.65	2.00	0.00	0.31	0.00	40.57	80.77	2.00	0.00	0.31	0.00
40.62	82.53	2.00	0.00	0.31	0.00	40.67	84.81	2.00	0.00	0.31	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
40.74	84.83	2.00	0.00	0.31	0.00	40.79	82.46	2.00	0.00	0.31	0.00
40.84	82.13	2.00	0.00	0.31	0.00	40.90	84.26	2.00	0.00	0.31	0.00
40.96	85.92	2.00	0.00	0.31	0.00	41.03	86.48	0.13	0.80	0.30	0.01
41.08	86.61	0.13	0.80	0.30	0.01	41.15	86.48	0.13	0.80	0.30	0.01
41.27	87.02	0.13	0.79	0.30	0.01	41.33	87.66	0.13	0.78	0.30	0.01
41.39	88.02	0.13	0.77	0.30	0.00	41.45	87.90	0.13	0.77	0.30	0.01
41.52	87.76	0.13	0.77	0.30	0.01	41.57	88.40	0.13	0.76	0.30	0.00
41.64	90.04	0.13	0.75	0.29	0.01	41.70	92.46	0.14	0.73	0.29	0.00
41.76	98.76	0.15	0.69	0.29	0.00	41.82	109.92	0.18	0.63	0.29	0.00
41.88	126.03	0.24	0.56	0.29	0.00	42.04	139.95	0.30	0.51	0.29	0.01
42.10	143.87	0.32	0.50	0.29	0.00	42.15	139.76	0.30	0.51	0.29	0.00
42.23	135.38	0.28	0.52	0.28	0.01	42.28	133.75	0.27	0.52	0.28	0.00
42.34	132.26	0.27	0.52	0.28	0.00	42.41	133.45	0.27	0.52	0.28	0.00
42.45	135.25	0.28	0.51	0.28	0.00	42.51	141.97	0.31	0.49	0.28	0.00
42.63	147.94	0.35	0.47	0.28	0.01	42.69	151.49	0.37	0.46	0.28	0.00
42.76	150.06	0.36	0.46	0.28	0.00	42.82	145.85	0.33	0.47	0.27	0.00
42.88	139.99	0.30	0.48	0.27	0.00	42.94	133.56	0.27	0.50	0.27	0.00
43.00	126.34	0.24	0.52	0.27	0.00	43.07	119.10	0.22	0.55	0.27	0.00
43.12	112.78	0.19	0.57	0.27	0.00	43.18	108.95	0.18	0.58	0.27	0.00
43.25	108.47	0.18	0.58	0.27	0.01	43.30	104.04	0.17	0.60	0.27	0.00
43.36	99.38	0.16	0.62	0.27	0.00	43.43	92.46	0.14	0.66	0.26	0.01
43.48	92.85	0.14	0.65	0.26	0.00	43.56	92.37	0.14	0.65	0.26	0.01
43.61	91.63	0.14	0.65	0.26	0.00	43.65	89.78	0.13	0.66	0.26	0.00
43.70	89.21	0.13	0.67	0.26	0.00	43.78	89.61	0.13	0.66	0.26	0.01
43.86	91.10	0.14	0.65	0.26	0.01	43.91	92.06	0.14	0.64	0.26	0.00
44.00	91.94	0.14	0.64	0.25	0.01	44.04	90.44	0.14	0.64	0.25	0.00
44.13	90.89	0.14	0.64	0.25	0.01	44.17	90.59	0.14	0.64	0.25	0.00
44.26	92.00	0.14	0.62	0.25	0.01	44.31	91.58	0.14	0.63	0.25	0.00
44.37	92.41	0.14	0.62	0.25	0.00	44.48	91.18	0.14	0.62	0.25	0.01
44.53	88.43	0.13	0.63	0.25	0.00	44.57	81.68	0.12	0.67	0.24	0.00
44.67	75.26	0.11	0.72	0.24	0.01	44.72	58.86	2.00	0.00	0.24	0.00
44.77	69.48	2.00	0.00	0.24	0.00	44.84	69.92	2.00	0.00	0.24	0.00
44.93	74.03	2.00	0.00	0.24	0.00	44.97	78.64	2.00	0.00	0.24	0.00
45.08	79.20	2.00	0.00	0.24	0.00	45.15	75.84	2.00	0.00	0.23	0.00
45.22	68.48	2.00	0.00	0.23	0.00	45.33	58.95	2.00	0.00	0.23	0.00
45.40	46.90	2.00	0.00	0.23	0.00	45.51	38.75	2.00	0.00	0.23	0.00
45.58	35.26	2.00	0.00	0.23	0.00	45.64	35.31	2.00	0.00	0.23	0.00
45.71	35.94	2.00	0.00	0.23	0.00	45.77	36.52	2.00	0.00	0.22	0.00
45.81	37.11	2.00	0.00	0.22	0.00	45.91	37.55	2.00	0.00	0.22	0.00
45.95	38.04	2.00	0.00	0.22	0.00	46.01	38.72	2.00	0.00	0.22	0.00
46.08	38.74	2.00	0.00	0.22	0.00	46.21	38.66	2.00	0.00	0.22	0.00
46.26	37.48	2.00	0.00	0.22	0.00	46.31	36.52	2.00	0.00	0.22	0.00
46.39	36.01	2.00	0.00	0.21	0.00	46.43	36.75	2.00	0.00	0.21	0.00
46.49	37.91	2.00	0.00	0.21	0.00	46.52	39.20	2.00	0.00	0.21	0.00
46.60	41.82	2.00	0.00	0.21	0.00	46.71	45.78	2.00	0.00	0.21	0.00
46.76	50.15	2.00	0.00	0.21	0.00	46.83	53.69	2.00	0.00	0.21	0.00
46.89	55.45	2.00	0.00	0.21	0.00	46.95	54.73	2.00	0.00	0.20	0.00
47.02	52.28	2.00	0.00	0.20	0.00	47.07	49.47	2.00	0.00	0.20	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
47.12	48.62	2.00	0.00	0.20	0.00
47.25	52.45	2.00	0.00	0.20	0.00
47.39	56.61	2.00	0.00	0.20	0.00
47.51	58.28	2.00	0.00	0.19	0.00
47.69	73.64	2.00	0.00	0.19	0.00
47.81	83.92	0.13	0.51	0.19	0.00
47.92	94.88	0.15	0.46	0.19	0.00
48.04	103.34	0.17	0.42	0.19	0.00
48.18	107.90	0.18	0.40	0.18	0.00
48.31	118.89	0.22	0.37	0.18	0.00
48.48	143.03	0.33	0.31	0.18	0.00
48.58	153.98	0.39	0.29	0.18	0.00
48.71	153.99	0.39	0.29	0.17	0.00
48.84	148.31	0.36	0.29	0.17	0.00
48.97	139.69	0.31	0.30	0.17	0.00
49.09	129.72	0.26	0.32	0.17	0.00
49.25	117.45	0.22	0.34	0.17	0.00
49.38	110.56	0.19	0.35	0.16	0.00
49.52	110.35	0.19	0.35	0.16	0.00
49.61	113.23	0.20	0.34	0.16	0.00
49.78	118.19	0.22	0.32	0.16	0.00
49.89	123.60	0.24	0.30	0.15	0.00
50.00	123.40	0.24	0.30	0.15	0.00

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
47.20	49.73	2.00	0.00	0.20	0.00
47.34	55.12	2.00	0.00	0.20	0.00
47.46	57.30	2.00	0.00	0.20	0.00
47.61	64.91	2.00	0.00	0.19	0.00
47.74	78.64	0.12	0.54	0.19	0.00
47.87	89.30	0.14	0.48	0.19	0.00
47.99	99.43	0.16	0.44	0.19	0.00
48.11	106.00	0.18	0.41	0.18	0.00
48.23	110.81	0.19	0.39	0.18	0.00
48.41	131.10	0.27	0.34	0.18	0.00
48.53	151.28	0.37	0.30	0.18	0.00
48.66	154.96	0.40	0.29	0.18	0.00
48.78	151.50	0.38	0.29	0.17	0.00
48.90	144.20	0.34	0.30	0.17	0.00
49.02	135.06	0.29	0.31	0.17	0.00
49.15	123.45	0.24	0.33	0.17	0.00
49.33	113.37	0.20	0.35	0.16	0.00
49.42	110.30	0.19	0.35	0.16	0.00
49.56	112.17	0.20	0.34	0.16	0.00
49.73	115.60	0.21	0.33	0.16	0.00
49.83	121.14	0.23	0.31	0.16	0.00
49.95	124.17	0.24	0.30	0.15	0.00

Total estimated settlement: 1.53

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

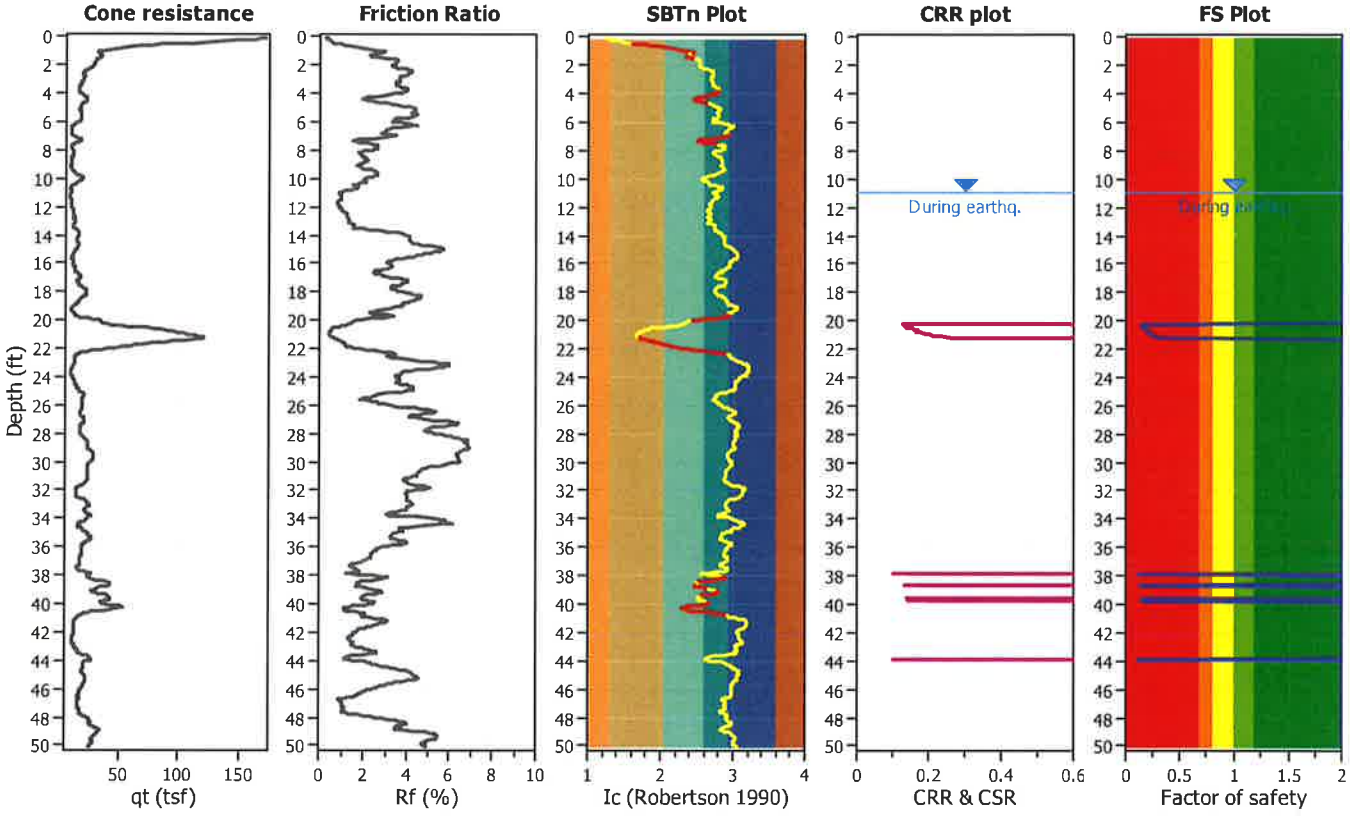
LIQUEFACTION ANALYSIS REPORT

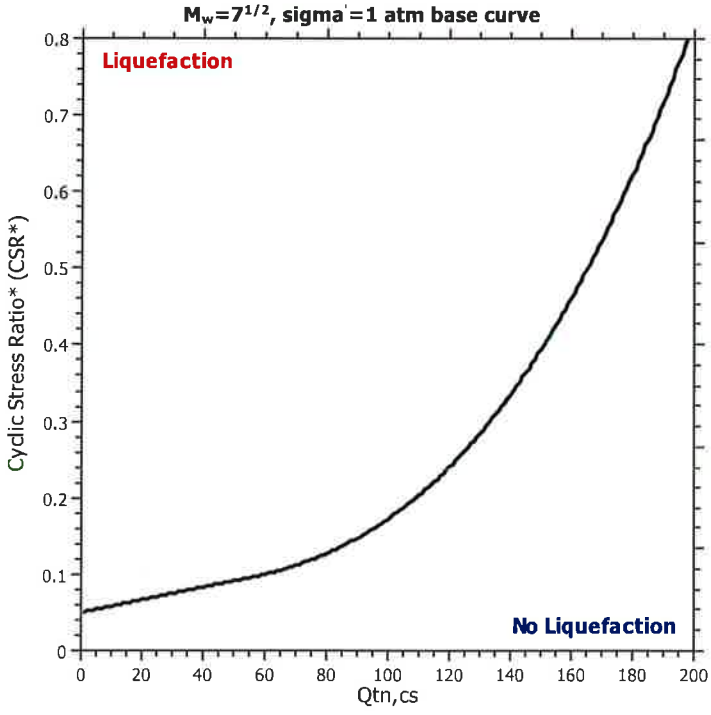
Project title : S-Line Upgrades **Location : Imperial County, CA**

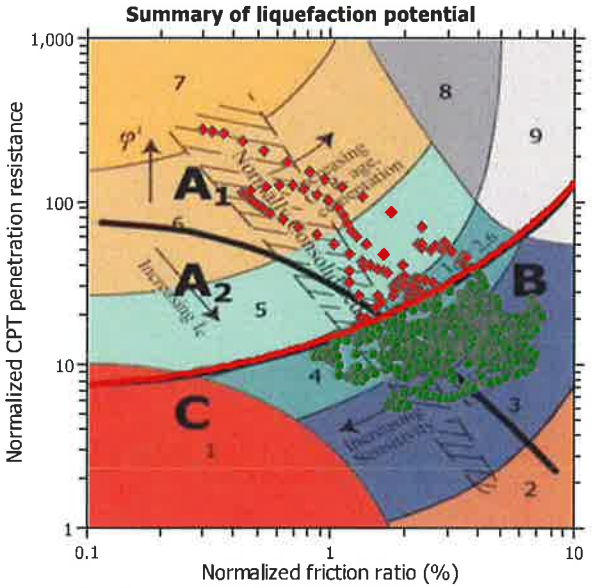
CPT file : CPT-5

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	11.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.95	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

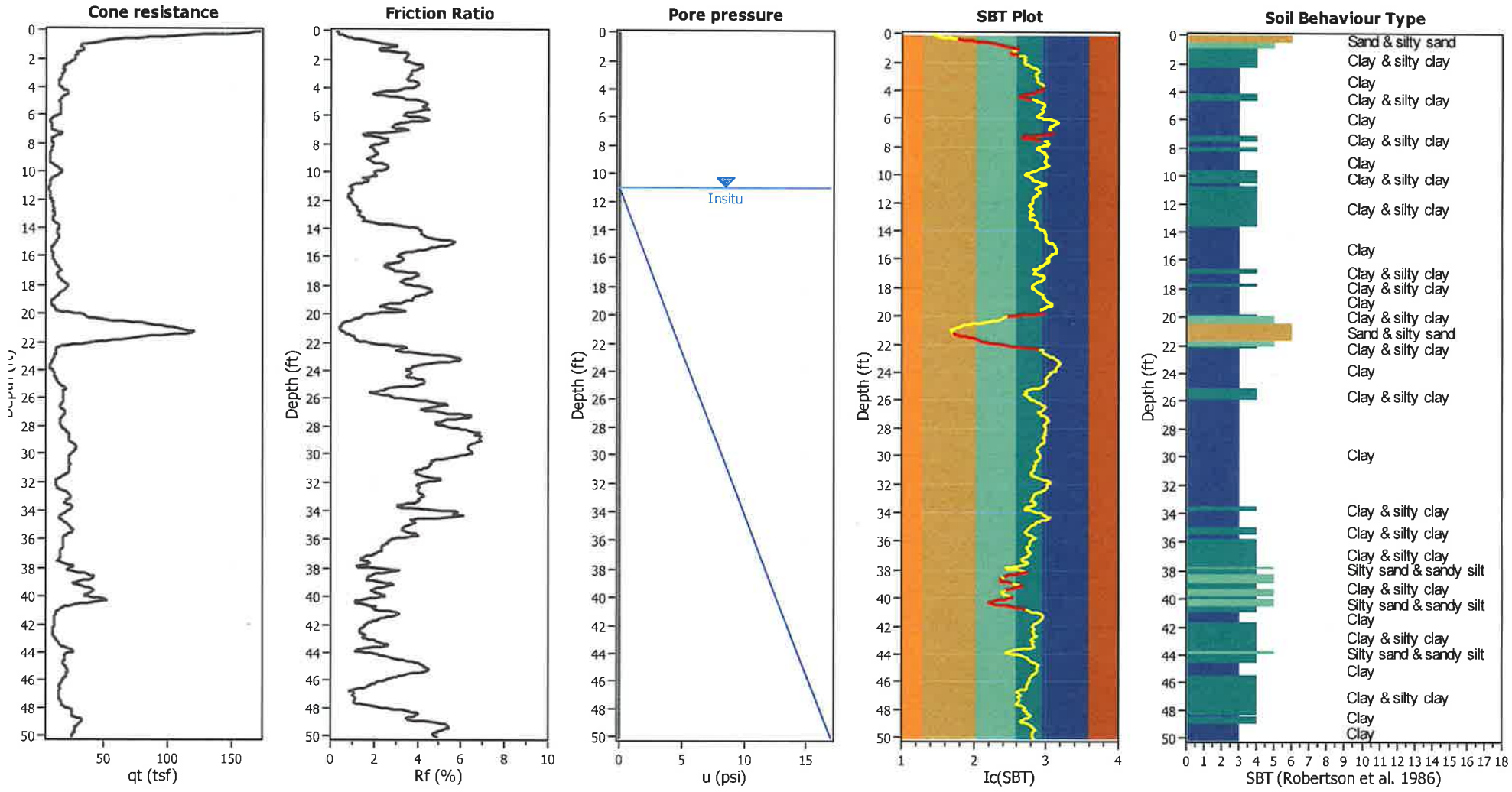






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



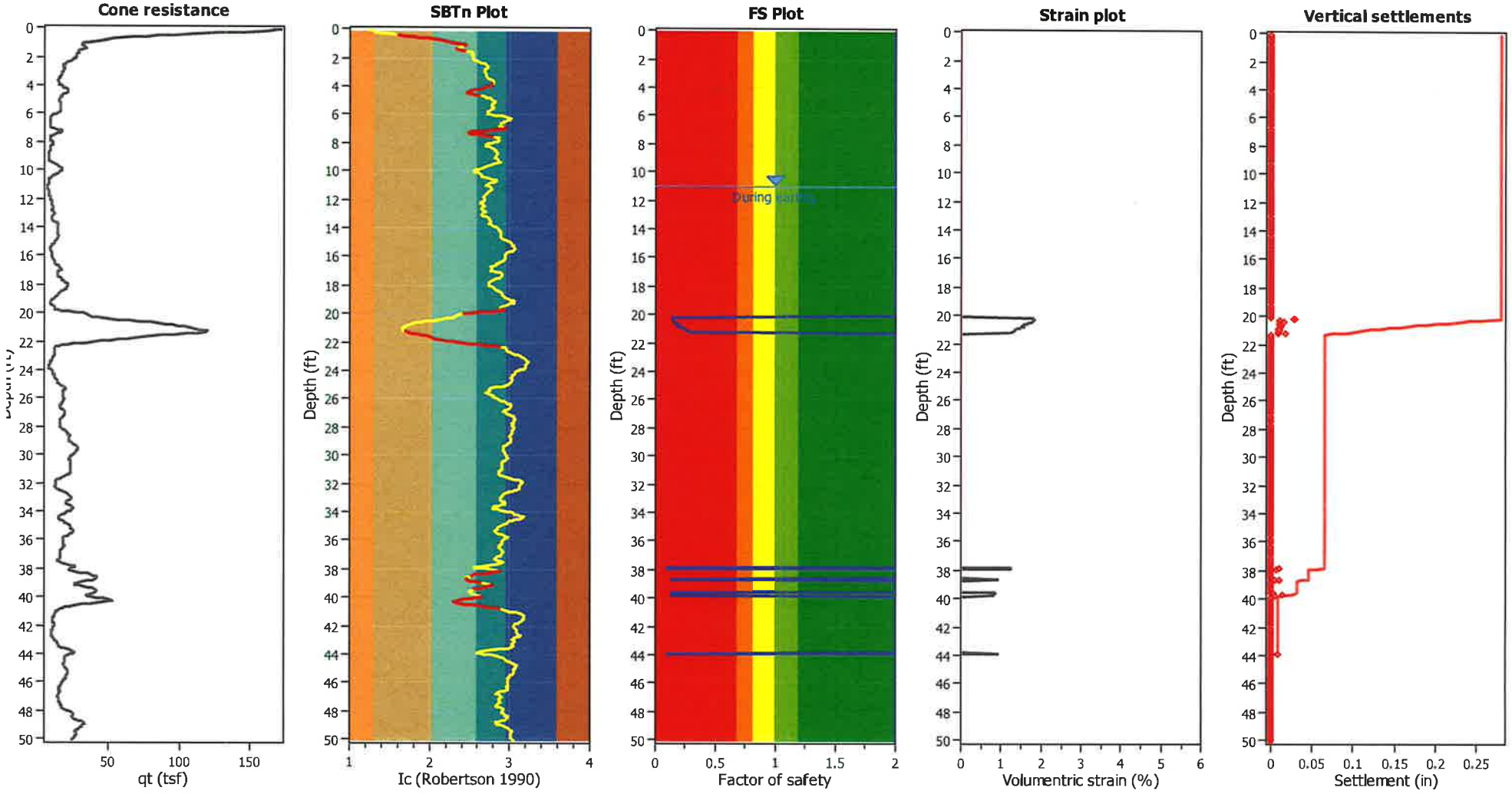
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.95	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.04	44.87	2.00	0.00	0.81	0.00	11.11	45.09	2.00	0.00	0.81	0.00
11.19	45.26	2.00	0.00	0.81	0.00	11.26	45.26	2.00	0.00	0.81	0.00
11.31	45.18	2.00	0.00	0.81	0.00	11.36	45.30	2.00	0.00	0.81	0.00
11.44	45.53	2.00	0.00	0.81	0.00	11.50	45.53	2.00	0.00	0.81	0.00
11.57	45.03	2.00	0.00	0.80	0.00	11.62	43.96	2.00	0.00	0.80	0.00
11.75	43.59	2.00	0.00	0.80	0.00	11.80	44.13	2.00	0.00	0.80	0.00
11.87	45.08	2.00	0.00	0.80	0.00	11.93	45.75	2.00	0.00	0.80	0.00
11.99	46.60	2.00	0.00	0.80	0.00	12.06	47.48	2.00	0.00	0.80	0.00
12.11	48.49	2.00	0.00	0.79	0.00	12.19	49.13	2.00	0.00	0.79	0.00
12.24	49.78	2.00	0.00	0.79	0.00	12.30	50.49	2.00	0.00	0.79	0.00
12.37	51.62	2.00	0.00	0.79	0.00	12.42	53.37	2.00	0.00	0.79	0.00
12.49	54.54	2.00	0.00	0.79	0.00	12.59	54.87	2.00	0.00	0.79	0.00
12.68	55.03	2.00	0.00	0.79	0.00	12.73	55.60	2.00	0.00	0.78	0.00
12.81	56.37	2.00	0.00	0.78	0.00	12.86	56.65	2.00	0.00	0.78	0.00
12.91	56.95	2.00	0.00	0.78	0.00	13.04	57.35	2.00	0.00	0.78	0.00
13.10	58.31	2.00	0.00	0.78	0.00	13.17	59.08	2.00	0.00	0.78	0.00
13.21	59.56	2.00	0.00	0.78	0.00	13.29	59.90	2.00	0.00	0.77	0.00
13.35	59.78	2.00	0.00	0.77	0.00	13.39	58.79	2.00	0.00	0.77	0.00
13.47	58.02	2.00	0.00	0.77	0.00	13.52	60.99	2.00	0.00	0.77	0.00
13.59	68.77	2.00	0.00	0.77	0.00	13.66	76.76	2.00	0.00	0.77	0.00
13.70	85.73	2.00	0.00	0.77	0.00	13.79	92.71	2.00	0.00	0.77	0.00
13.86	99.43	2.00	0.00	0.77	0.00	13.94	102.94	2.00	0.00	0.76	0.00
14.01	105.00	2.00	0.00	0.76	0.00	14.06	105.46	2.00	0.00	0.76	0.00
14.13	105.18	2.00	0.00	0.76	0.00	14.19	104.05	2.00	0.00	0.76	0.00
14.25	103.49	2.00	0.00	0.76	0.00	14.40	103.41	2.00	0.00	0.76	0.00
14.44	105.13	2.00	0.00	0.76	0.00	14.56	107.14	2.00	0.00	0.75	0.00
14.62	109.82	2.00	0.00	0.75	0.00	14.68	113.44	2.00	0.00	0.75	0.00
14.80	116.46	2.00	0.00	0.75	0.00	14.85	118.66	2.00	0.00	0.75	0.00
14.92	118.73	2.00	0.00	0.75	0.00	14.97	117.69	2.00	0.00	0.75	0.00
15.04	114.30	2.00	0.00	0.75	0.00	15.15	109.73	2.00	0.00	0.74	0.00
15.21	104.50	2.00	0.00	0.74	0.00	15.27	100.11	2.00	0.00	0.74	0.00
15.33	96.13	2.00	0.00	0.74	0.00	15.38	92.58	2.00	0.00	0.74	0.00
15.46	89.71	2.00	0.00	0.74	0.00	15.51	86.70	2.00	0.00	0.74	0.00
15.59	84.23	2.00	0.00	0.74	0.00	15.64	82.18	2.00	0.00	0.74	0.00
15.69	80.64	2.00	0.00	0.73	0.00	15.77	79.23	2.00	0.00	0.73	0.00
15.87	78.31	2.00	0.00	0.73	0.00	15.94	78.20	2.00	0.00	0.73	0.00
15.99	79.13	2.00	0.00	0.73	0.00	16.07	80.75	2.00	0.00	0.73	0.00
16.17	82.49	2.00	0.00	0.73	0.00	16.25	84.06	2.00	0.00	0.72	0.00
16.35	83.30	2.00	0.00	0.72	0.00	16.43	78.65	2.00	0.00	0.72	0.00
16.48	76.68	2.00	0.00	0.72	0.00	16.54	75.39	2.00	0.00	0.72	0.00
16.61	78.46	2.00	0.00	0.72	0.00	16.66	78.26	2.00	0.00	0.72	0.00
16.73	80.59	2.00	0.00	0.72	0.00	16.79	83.01	2.00	0.00	0.72	0.00
16.81	85.46	2.00	0.00	0.72	0.00	16.87	88.26	2.00	0.00	0.71	0.00
16.96	91.38	2.00	0.00	0.71	0.00	17.01	95.39	2.00	0.00	0.71	0.00
17.08	97.75	2.00	0.00	0.71	0.00	17.14	98.84	2.00	0.00	0.71	0.00
17.22	99.10	2.00	0.00	0.71	0.00	17.30	98.92	2.00	0.00	0.71	0.00
17.34	98.38	2.00	0.00	0.71	0.00	17.41	97.46	2.00	0.00	0.70	0.00
17.49	96.95	2.00	0.00	0.70	0.00	17.54	96.43	2.00	0.00	0.70	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
17.62	96.45	2.00	0.00	0.70	0.00	17.67	96.68	2.00	0.00	0.70	0.00
17.72	99.26	2.00	0.00	0.70	0.00	17.83	102.57	2.00	0.00	0.70	0.00
17.89	106.39	2.00	0.00	0.70	0.00	17.93	109.58	2.00	0.00	0.70	0.00
17.99	113.16	2.00	0.00	0.70	0.00	18.06	117.30	2.00	0.00	0.69	0.00
18.18	120.43	2.00	0.00	0.69	0.00	18.24	121.83	2.00	0.00	0.69	0.00
18.29	120.96	2.00	0.00	0.69	0.00	18.37	118.39	2.00	0.00	0.69	0.00
18.42	115.27	2.00	0.00	0.69	0.00	18.48	111.16	2.00	0.00	0.69	0.00
18.55	107.71	2.00	0.00	0.69	0.00	18.59	104.25	2.00	0.00	0.68	0.00
18.65	101.18	2.00	0.00	0.68	0.00	18.73	98.12	2.00	0.00	0.68	0.00
18.78	94.92	2.00	0.00	0.68	0.00	18.85	92.02	2.00	0.00	0.68	0.00
18.91	87.82	2.00	0.00	0.68	0.00	19.04	83.31	2.00	0.00	0.68	0.00
19.08	77.25	2.00	0.00	0.68	0.00	19.21	72.77	2.00	0.00	0.67	0.00
19.26	67.44	2.00	0.00	0.67	0.00	19.39	66.16	2.00	0.00	0.67	0.00
19.45	65.96	2.00	0.00	0.67	0.00	19.52	69.94	2.00	0.00	0.67	0.00
19.57	74.33	2.00	0.00	0.67	0.00	19.64	80.46	2.00	0.00	0.67	0.00
19.74	84.88	2.00	0.00	0.67	0.00	19.77	87.86	2.00	0.00	0.66	0.00
19.85	87.85	2.00	0.00	0.66	0.00	19.90	86.47	2.00	0.00	0.66	0.00
19.96	84.69	2.00	0.00	0.66	0.00	20.02	83.41	2.00	0.00	0.66	0.00
20.10	82.30	2.00	0.00	0.66	0.00	20.22	81.33	0.15	1.82	0.66	0.03
20.27	80.70	0.15	1.83	0.66	0.01	20.32	80.87	0.15	1.82	0.66	0.01
20.40	82.07	0.15	1.80	0.65	0.02	20.45	84.45	0.16	1.75	0.65	0.01
20.52	87.64	0.16	1.70	0.65	0.01	20.58	91.36	0.17	1.64	0.65	0.01
20.64	95.29	0.18	1.58	0.65	0.01	20.70	99.27	0.20	1.53	0.65	0.01
20.76	96.32	0.19	1.55	0.65	0.01	20.82	100.96	0.20	1.50	0.65	0.01
20.89	105.24	0.21	1.45	0.65	0.01	20.94	109.08	0.23	1.40	0.65	0.01
21.01	112.68	0.24	1.36	0.64	0.01	21.07	117.60	0.26	1.32	0.64	0.01
21.13	125.10	0.30	1.25	0.64	0.02	21.25	130.58	0.32	1.20	0.64	0.01
21.30	132.40	2.00	0.00	0.64	0.00	21.38	130.40	2.00	0.00	0.64	0.00
21.43	125.97	2.00	0.00	0.64	0.00	21.49	120.22	2.00	0.00	0.64	0.00
21.56	114.84	2.00	0.00	0.63	0.00	21.61	108.15	2.00	0.00	0.63	0.00
21.74	102.02	2.00	0.00	0.63	0.00	21.79	96.43	2.00	0.00	0.63	0.00
21.86	93.47	2.00	0.00	0.63	0.00	21.91	92.00	2.00	0.00	0.63	0.00
21.99	92.57	2.00	0.00	0.63	0.00	22.04	93.92	2.00	0.00	0.63	0.00
22.10	94.63	2.00	0.00	0.63	0.00	22.17	94.55	2.00	0.00	0.62	0.00
22.22	93.71	2.00	0.00	0.62	0.00	22.28	91.59	2.00	0.00	0.62	0.00
22.35	88.66	2.00	0.00	0.62	0.00	22.40	84.42	2.00	0.00	0.62	0.00
22.47	80.15	2.00	0.00	0.62	0.00	22.53	77.09	2.00	0.00	0.62	0.00
22.58	77.19	2.00	0.00	0.62	0.00	22.66	79.89	2.00	0.00	0.62	0.00
22.70	84.05	2.00	0.00	0.62	0.00	22.78	88.91	2.00	0.00	0.61	0.00
22.88	93.26	2.00	0.00	0.61	0.00	22.91	96.47	2.00	0.00	0.61	0.00
23.02	97.88	2.00	0.00	0.61	0.00	23.05	98.67	2.00	0.00	0.61	0.00
23.11	98.10	2.00	0.00	0.61	0.00	23.19	96.51	2.00	0.00	0.61	0.00
23.26	93.88	2.00	0.00	0.61	0.00	23.32	90.68	2.00	0.00	0.60	0.00
23.37	86.75	2.00	0.00	0.60	0.00	23.43	82.38	2.00	0.00	0.60	0.00
23.50	77.55	2.00	0.00	0.60	0.00	23.58	73.58	2.00	0.00	0.60	0.00
23.65	70.84	2.00	0.00	0.60	0.00	23.69	70.11	2.00	0.00	0.60	0.00
23.77	69.57	2.00	0.00	0.60	0.00	23.85	69.36	2.00	0.00	0.60	0.00
23.90	70.65	2.00	0.00	0.59	0.00	23.98	73.21	2.00	0.00	0.59	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
24.05	76.43	2.00	0.00	0.59	0.00	24.12	77.98	2.00	0.00	0.59	0.00
24.24	78.87	2.00	0.00	0.59	0.00	24.29	78.86	2.00	0.00	0.59	0.00
24.34	78.99	2.00	0.00	0.59	0.00	24.43	79.46	2.00	0.00	0.59	0.00
24.47	80.86	2.00	0.00	0.59	0.00	24.54	83.51	2.00	0.00	0.58	0.00
24.60	86.44	2.00	0.00	0.58	0.00	24.65	89.64	2.00	0.00	0.58	0.00
24.73	91.72	2.00	0.00	0.58	0.00	24.78	93.08	2.00	0.00	0.58	0.00
24.83	93.74	2.00	0.00	0.58	0.00	24.91	93.97	2.00	0.00	0.58	0.00
24.96	94.31	2.00	0.00	0.58	0.00	25.02	94.51	2.00	0.00	0.58	0.00
25.09	93.99	2.00	0.00	0.57	0.00	25.14	90.01	2.00	0.00	0.57	0.00
25.27	85.41	2.00	0.00	0.57	0.00	25.33	81.97	2.00	0.00	0.57	0.00
25.40	81.54	2.00	0.00	0.57	0.00	25.45	77.23	2.00	0.00	0.57	0.00
25.52	71.77	2.00	0.00	0.57	0.00	25.58	68.66	2.00	0.00	0.57	0.00
25.65	72.88	2.00	0.00	0.57	0.00	25.71	78.31	2.00	0.00	0.56	0.00
25.76	82.03	2.00	0.00	0.56	0.00	25.85	83.41	2.00	0.00	0.56	0.00
25.89	84.18	2.00	0.00	0.56	0.00	25.93	86.19	2.00	0.00	0.56	0.00
25.99	91.24	2.00	0.00	0.56	0.00	26.10	96.93	2.00	0.00	0.56	0.00
26.16	101.66	2.00	0.00	0.56	0.00	26.22	104.11	2.00	0.00	0.56	0.00
26.28	106.29	2.00	0.00	0.55	0.00	26.34	108.64	2.00	0.00	0.55	0.00
26.39	110.13	2.00	0.00	0.55	0.00	26.47	109.41	2.00	0.00	0.55	0.00
26.52	106.56	2.00	0.00	0.55	0.00	26.58	102.62	2.00	0.00	0.55	0.00
26.65	99.07	2.00	0.00	0.55	0.00	26.75	97.73	2.00	0.00	0.55	0.00
26.82	99.55	2.00	0.00	0.55	0.00	26.87	104.05	2.00	0.00	0.54	0.00
26.93	111.19	2.00	0.00	0.54	0.00	27.05	117.31	2.00	0.00	0.54	0.00
27.11	122.49	2.00	0.00	0.54	0.00	27.18	124.12	2.00	0.00	0.54	0.00
27.23	124.43	2.00	0.00	0.54	0.00	27.30	122.40	2.00	0.00	0.54	0.00
27.36	118.97	2.00	0.00	0.54	0.00	27.41	113.80	2.00	0.00	0.54	0.00
27.49	108.82	2.00	0.00	0.53	0.00	27.53	104.15	2.00	0.00	0.53	0.00
27.67	101.40	2.00	0.00	0.53	0.00	27.71	99.91	2.00	0.00	0.53	0.00
27.78	100.29	2.00	0.00	0.53	0.00	27.89	101.83	2.00	0.00	0.53	0.00
27.96	104.28	2.00	0.00	0.53	0.00	28.02	107.11	2.00	0.00	0.53	0.00
28.08	110.37	2.00	0.00	0.52	0.00	28.15	114.28	2.00	0.00	0.52	0.00
28.20	118.46	2.00	0.00	0.52	0.00	28.26	122.80	2.00	0.00	0.52	0.00
28.33	127.12	2.00	0.00	0.52	0.00	28.39	131.28	2.00	0.00	0.52	0.00
28.45	134.74	2.00	0.00	0.52	0.00	28.51	134.67	2.00	0.00	0.52	0.00
28.56	135.46	2.00	0.00	0.52	0.00	28.64	136.11	2.00	0.00	0.51	0.00
28.69	138.54	2.00	0.00	0.51	0.00	28.74	138.58	2.00	0.00	0.51	0.00
28.86	137.34	2.00	0.00	0.51	0.00	28.91	136.53	2.00	0.00	0.51	0.00
28.94	136.63	2.00	0.00	0.51	0.00	29.02	137.31	2.00	0.00	0.51	0.00
29.09	138.35	2.00	0.00	0.51	0.00	29.14	140.00	2.00	0.00	0.51	0.00
29.25	141.81	2.00	0.00	0.50	0.00	29.33	143.48	2.00	0.00	0.50	0.00
29.38	144.57	2.00	0.00	0.50	0.00	29.45	144.99	2.00	0.00	0.50	0.00
29.51	145.33	2.00	0.00	0.50	0.00	29.57	145.42	2.00	0.00	0.50	0.00
29.64	145.23	2.00	0.00	0.50	0.00	29.69	144.68	2.00	0.00	0.50	0.00
29.74	143.79	2.00	0.00	0.50	0.00	29.86	142.36	2.00	0.00	0.49	0.00
29.94	140.02	2.00	0.00	0.49	0.00	30.00	137.14	2.00	0.00	0.49	0.00
30.05	133.38	2.00	0.00	0.49	0.00	30.12	130.13	2.00	0.00	0.49	0.00
30.17	125.47	2.00	0.00	0.49	0.00	30.30	120.89	2.00	0.00	0.49	0.00
30.35	116.35	2.00	0.00	0.49	0.00	30.42	113.98	2.00	0.00	0.48	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
30.48	112.82	2.00	0.00	0.48	0.00	30.54	112.39	2.00	0.00	0.48	0.00
30.59	112.23	2.00	0.00	0.48	0.00	30.66	112.12	2.00	0.00	0.48	0.00
30.72	112.02	2.00	0.00	0.48	0.00	30.79	111.54	2.00	0.00	0.48	0.00
30.90	110.56	2.00	0.00	0.48	0.00	30.97	109.07	2.00	0.00	0.48	0.00
31.02	107.34	2.00	0.00	0.47	0.00	31.09	105.48	2.00	0.00	0.47	0.00
31.15	103.97	2.00	0.00	0.47	0.00	31.20	102.80	2.00	0.00	0.47	0.00
31.27	102.22	2.00	0.00	0.47	0.00	31.33	102.02	2.00	0.00	0.47	0.00
31.38	100.73	2.00	0.00	0.47	0.00	31.45	99.22	2.00	0.00	0.47	0.00
31.50	97.52	2.00	0.00	0.47	0.00	31.63	96.67	2.00	0.00	0.46	0.00
31.69	94.99	2.00	0.00	0.46	0.00	31.76	92.58	2.00	0.00	0.46	0.00
31.81	90.00	2.00	0.00	0.46	0.00	31.86	88.11	2.00	0.00	0.46	0.00
31.90	86.17	2.00	0.00	0.46	0.00	31.97	83.91	2.00	0.00	0.46	0.00
32.03	80.90	2.00	0.00	0.46	0.00	32.14	78.95	2.00	0.00	0.46	0.00
32.21	78.07	2.00	0.00	0.45	0.00	32.26	79.13	2.00	0.00	0.45	0.00
32.39	80.40	2.00	0.00	0.45	0.00	32.43	82.26	2.00	0.00	0.45	0.00
32.48	84.72	2.00	0.00	0.45	0.00	32.55	87.96	2.00	0.00	0.45	0.00
32.61	91.45	2.00	0.00	0.45	0.00	32.66	94.68	2.00	0.00	0.45	0.00
32.71	97.84	2.00	0.00	0.45	0.00	32.79	100.99	2.00	0.00	0.44	0.00
32.85	104.08	2.00	0.00	0.44	0.00	32.96	105.97	2.00	0.00	0.44	0.00
33.01	106.71	2.00	0.00	0.44	0.00	33.07	105.76	2.00	0.00	0.44	0.00
33.14	104.28	2.00	0.00	0.44	0.00	33.19	102.39	2.00	0.00	0.44	0.00
33.26	100.28	2.00	0.00	0.44	0.00	33.32	97.97	2.00	0.00	0.44	0.00
33.38	95.21	2.00	0.00	0.43	0.00	33.45	92.93	2.00	0.00	0.43	0.00
33.50	91.19	2.00	0.00	0.43	0.00	33.57	90.47	2.00	0.00	0.43	0.00
33.63	90.39	2.00	0.00	0.43	0.00	33.67	92.03	2.00	0.00	0.43	0.00
33.76	95.56	2.00	0.00	0.43	0.00	33.80	101.19	2.00	0.00	0.43	0.00
33.87	108.09	2.00	0.00	0.43	0.00	33.98	113.51	2.00	0.00	0.42	0.00
34.03	116.30	2.00	0.00	0.42	0.00	34.11	113.96	2.00	0.00	0.42	0.00
34.16	108.74	2.00	0.00	0.42	0.00	34.21	104.86	2.00	0.00	0.42	0.00
34.28	102.91	2.00	0.00	0.42	0.00	34.33	102.24	2.00	0.00	0.42	0.00
34.39	97.22	2.00	0.00	0.42	0.00	34.47	90.32	2.00	0.00	0.42	0.00
34.56	84.59	2.00	0.00	0.41	0.00	34.60	83.22	2.00	0.00	0.41	0.00
34.65	85.85	2.00	0.00	0.41	0.00	34.73	88.96	2.00	0.00	0.41	0.00
34.83	91.89	2.00	0.00	0.41	0.00	34.87	93.70	2.00	0.00	0.41	0.00
34.93	94.20	2.00	0.00	0.41	0.00	34.99	93.99	2.00	0.00	0.41	0.00
35.09	92.74	2.00	0.00	0.41	0.00	35.17	92.23	2.00	0.00	0.40	0.00
35.22	92.28	2.00	0.00	0.40	0.00	35.27	93.21	2.00	0.00	0.40	0.00
35.32	94.28	2.00	0.00	0.40	0.00	35.37	96.04	2.00	0.00	0.40	0.00
35.49	97.65	2.00	0.00	0.40	0.00	35.53	98.90	2.00	0.00	0.40	0.00
35.57	98.08	2.00	0.00	0.40	0.00	35.71	95.92	2.00	0.00	0.39	0.00
35.75	92.37	2.00	0.00	0.39	0.00	35.80	88.26	2.00	0.00	0.39	0.00
35.86	83.94	2.00	0.00	0.39	0.00	35.90	79.79	2.00	0.00	0.39	0.00
35.97	76.97	2.00	0.00	0.39	0.00	36.06	75.26	2.00	0.00	0.39	0.00
36.11	74.74	2.00	0.00	0.39	0.00	36.23	74.33	2.00	0.00	0.39	0.00
36.28	73.80	2.00	0.00	0.39	0.00	36.33	73.06	2.00	0.00	0.38	0.00
36.38	72.36	2.00	0.00	0.38	0.00	36.46	71.74	2.00	0.00	0.38	0.00
36.51	71.04	2.00	0.00	0.38	0.00	36.58	70.29	2.00	0.00	0.38	0.00
36.64	69.36	2.00	0.00	0.38	0.00	36.70	68.54	2.00	0.00	0.38	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
36.77	67.51	2.00	0.00	0.38	0.00	36.83	66.19	2.00	0.00	0.38	0.00
36.89	64.35	2.00	0.00	0.37	0.00	37.08	61.54	2.00	0.00	0.37	0.00
37.13	58.93	2.00	0.00	0.37	0.00	37.19	56.45	2.00	0.00	0.37	0.00
37.26	55.09	2.00	0.00	0.37	0.00	37.30	54.02	2.00	0.00	0.37	0.00
37.36	53.52	2.00	0.00	0.37	0.00	37.43	53.66	2.00	0.00	0.37	0.00
37.49	54.45	2.00	0.00	0.36	0.00	37.55	57.26	2.00	0.00	0.36	0.00
37.66	60.84	2.00	0.00	0.36	0.00	37.73	63.66	2.00	0.00	0.36	0.00
37.78	62.17	2.00	0.00	0.36	0.00	37.86	60.40	0.10	1.27	0.36	0.01
37.91	61.58	0.10	1.24	0.36	0.01	37.96	69.42	2.00	0.00	0.36	0.00
38.04	77.43	2.00	0.00	0.36	0.00	38.10	83.48	2.00	0.00	0.35	0.00
38.16	86.07	2.00	0.00	0.35	0.00	38.23	86.54	2.00	0.00	0.35	0.00
38.34	85.71	2.00	0.00	0.35	0.00	38.37	84.48	2.00	0.00	0.35	0.00
38.40	83.94	2.00	0.00	0.35	0.00	38.49	83.46	2.00	0.00	0.35	0.00
38.53	83.07	2.00	0.00	0.35	0.00	38.62	82.65	0.13	0.94	0.35	0.01
38.66	81.65	0.13	0.95	0.34	0.00	38.75	80.27	2.00	0.00	0.34	0.00
38.80	79.14	2.00	0.00	0.34	0.00	38.86	80.17	2.00	0.00	0.34	0.00
38.96	82.29	2.00	0.00	0.34	0.00	39.00	85.37	2.00	0.00	0.34	0.00
39.10	87.03	2.00	0.00	0.34	0.00	39.15	88.55	2.00	0.00	0.34	0.00
39.19	89.36	2.00	0.00	0.34	0.00	39.28	89.52	2.00	0.00	0.33	0.00
39.33	89.24	2.00	0.00	0.33	0.00	39.38	88.26	2.00	0.00	0.33	0.00
39.48	86.88	2.00	0.00	0.33	0.00	39.54	85.44	2.00	0.00	0.33	0.00
39.58	85.63	0.14	0.87	0.33	0.00	39.72	86.69	0.14	0.86	0.33	0.01
39.77	88.67	0.14	0.84	0.33	0.00	39.84	89.83	2.00	0.00	0.32	0.00
39.90	90.80	2.00	0.00	0.32	0.00	39.94	90.86	2.00	0.00	0.32	0.00
40.00	90.09	2.00	0.00	0.32	0.00	40.08	88.62	2.00	0.00	0.32	0.00
40.12	86.81	2.00	0.00	0.32	0.00	40.17	83.28	2.00	0.00	0.32	0.00
40.27	78.92	2.00	0.00	0.32	0.00	40.31	72.68	2.00	0.00	0.32	0.00
40.43	68.41	2.00	0.00	0.31	0.00	40.47	66.10	2.00	0.00	0.31	0.00
40.52	66.99	2.00	0.00	0.31	0.00	40.56	67.95	2.00	0.00	0.31	0.00
40.65	68.20	2.00	0.00	0.31	0.00	40.70	66.82	2.00	0.00	0.31	0.00
40.77	64.09	2.00	0.00	0.31	0.00	40.83	61.38	2.00	0.00	0.31	0.00
40.89	60.44	2.00	0.00	0.31	0.00	40.96	61.43	2.00	0.00	0.31	0.00
41.02	63.11	2.00	0.00	0.30	0.00	41.08	64.28	2.00	0.00	0.30	0.00
41.19	64.67	2.00	0.00	0.30	0.00	41.25	64.30	2.00	0.00	0.30	0.00
41.31	62.68	2.00	0.00	0.30	0.00	41.39	60.47	2.00	0.00	0.30	0.00
41.44	58.03	2.00	0.00	0.30	0.00	41.51	56.33	2.00	0.00	0.30	0.00
41.56	54.91	2.00	0.00	0.30	0.00	41.63	53.83	2.00	0.00	0.29	0.00
41.70	52.90	2.00	0.00	0.29	0.00	41.74	52.09	2.00	0.00	0.29	0.00
41.81	51.50	2.00	0.00	0.29	0.00	41.87	50.65	2.00	0.00	0.29	0.00
41.99	49.82	2.00	0.00	0.29	0.00	42.05	48.71	2.00	0.00	0.29	0.00
42.15	47.66	2.00	0.00	0.29	0.00	42.22	46.48	2.00	0.00	0.28	0.00
42.28	45.43	2.00	0.00	0.28	0.00	42.34	44.48	2.00	0.00	0.28	0.00
42.40	43.92	2.00	0.00	0.28	0.00	42.45	43.75	2.00	0.00	0.28	0.00
42.52	43.98	2.00	0.00	0.28	0.00	42.58	44.12	2.00	0.00	0.28	0.00
42.63	44.58	2.00	0.00	0.28	0.00	42.70	45.33	2.00	0.00	0.28	0.00
42.76	46.15	2.00	0.00	0.28	0.00	42.81	46.53	2.00	0.00	0.27	0.00
42.88	46.78	2.00	0.00	0.27	0.00	42.93	47.42	2.00	0.00	0.27	0.00
42.98	49.47	2.00	0.00	0.27	0.00	43.06	51.83	2.00	0.00	0.27	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
43.11	54.68	2.00	0.00	0.27	0.00	43.18	57.23	2.00	0.00	0.27	0.00
43.24	60.62	2.00	0.00	0.27	0.00	43.37	63.57	2.00	0.00	0.26	0.00
43.42	65.55	2.00	0.00	0.26	0.00	43.49	65.68	2.00	0.00	0.26	0.00
43.54	64.78	2.00	0.00	0.26	0.00	43.60	63.36	2.00	0.00	0.26	0.00
43.66	59.70	2.00	0.00	0.26	0.00	43.78	57.04	2.00	0.00	0.26	0.00
43.85	57.35	0.10	0.95	0.26	0.01	43.91	61.02	2.00	0.00	0.26	0.00
43.97	64.82	2.00	0.00	0.25	0.00	44.04	66.94	2.00	0.00	0.25	0.00
44.09	67.99	2.00	0.00	0.25	0.00	44.16	68.20	2.00	0.00	0.25	0.00
44.18	68.66	2.00	0.00	0.25	0.00	44.24	69.62	2.00	0.00	0.25	0.00
44.29	72.38	2.00	0.00	0.25	0.00	44.41	75.08	2.00	0.00	0.25	0.00
44.47	77.83	2.00	0.00	0.25	0.00	44.52	79.40	2.00	0.00	0.25	0.00
44.57	80.77	2.00	0.00	0.24	0.00	44.65	81.95	2.00	0.00	0.24	0.00
44.70	82.99	2.00	0.00	0.24	0.00	44.75	84.07	2.00	0.00	0.24	0.00
44.83	85.88	2.00	0.00	0.24	0.00	44.93	87.80	2.00	0.00	0.24	0.00
45.01	89.78	2.00	0.00	0.24	0.00	45.07	91.13	2.00	0.00	0.24	0.00
45.14	92.17	2.00	0.00	0.24	0.00	45.18	93.10	2.00	0.00	0.23	0.00
45.24	93.68	2.00	0.00	0.23	0.00	45.31	92.24	2.00	0.00	0.23	0.00
45.44	89.36	2.00	0.00	0.23	0.00	45.49	85.42	2.00	0.00	0.23	0.00
45.55	82.53	2.00	0.00	0.23	0.00	45.62	80.15	2.00	0.00	0.23	0.00
45.67	78.19	2.00	0.00	0.23	0.00	45.73	75.98	2.00	0.00	0.23	0.00
45.79	73.83	2.00	0.00	0.22	0.00	45.85	71.73	2.00	0.00	0.22	0.00
45.90	69.74	2.00	0.00	0.22	0.00	45.98	67.65	2.00	0.00	0.22	0.00
46.03	65.08	2.00	0.00	0.22	0.00	46.11	62.85	2.00	0.00	0.22	0.00
46.15	60.76	2.00	0.00	0.22	0.00	46.22	59.15	2.00	0.00	0.22	0.00
46.29	57.60	2.00	0.00	0.22	0.00	46.33	56.23	2.00	0.00	0.21	0.00
46.40	55.16	2.00	0.00	0.21	0.00	46.46	54.11	2.00	0.00	0.21	0.00
46.53	52.80	2.00	0.00	0.21	0.00	46.60	49.44	2.00	0.00	0.21	0.00
46.71	46.05	2.00	0.00	0.21	0.00	46.77	43.40	2.00	0.00	0.21	0.00
46.83	44.05	2.00	0.00	0.21	0.00	46.90	44.84	2.00	0.00	0.21	0.00
46.95	45.13	2.00	0.00	0.20	0.00	47.00	44.76	2.00	0.00	0.20	0.00
47.08	44.71	2.00	0.00	0.20	0.00	47.13	45.09	2.00	0.00	0.20	0.00
47.19	45.72	2.00	0.00	0.20	0.00	47.26	46.64	2.00	0.00	0.20	0.00
47.37	47.00	2.00	0.00	0.20	0.00	47.44	47.19	2.00	0.00	0.20	0.00
47.49	46.70	2.00	0.00	0.20	0.00	47.56	46.81	2.00	0.00	0.19	0.00
47.61	47.52	2.00	0.00	0.19	0.00	47.66	49.69	2.00	0.00	0.19	0.00
47.74	52.40	2.00	0.00	0.19	0.00	47.79	57.89	2.00	0.00	0.19	0.00
47.92	63.65	2.00	0.00	0.19	0.00	47.97	69.61	2.00	0.00	0.19	0.00
48.04	74.67	2.00	0.00	0.19	0.00	48.10	79.91	2.00	0.00	0.18	0.00
48.16	85.02	2.00	0.00	0.18	0.00	48.23	88.80	2.00	0.00	0.18	0.00
48.28	91.44	2.00	0.00	0.18	0.00	48.34	92.76	2.00	0.00	0.18	0.00
48.41	93.08	2.00	0.00	0.18	0.00	48.46	92.66	2.00	0.00	0.18	0.00
48.51	92.54	2.00	0.00	0.18	0.00	48.59	92.81	2.00	0.00	0.18	0.00
48.65	93.27	2.00	0.00	0.18	0.00	48.70	94.26	2.00	0.00	0.17	0.00
48.77	96.83	2.00	0.00	0.17	0.00	48.84	99.33	2.00	0.00	0.17	0.00
48.90	104.07	2.00	0.00	0.17	0.00	48.97	109.08	2.00	0.00	0.17	0.00
49.06	113.70	2.00	0.00	0.17	0.00	49.11	115.55	2.00	0.00	0.17	0.00
49.20	115.41	2.00	0.00	0.17	0.00	49.26	114.52	2.00	0.00	0.17	0.00
49.32	113.05	2.00	0.00	0.16	0.00	49.37	111.29	2.00	0.00	0.16	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
49.42	110.05	2.00	0.00	0.16	0.00	49.48	108.66	2.00	0.00	0.16	0.00
49.55	107.25	2.00	0.00	0.16	0.00	49.64	105.77	2.00	0.00	0.16	0.00
49.69	105.07	2.00	0.00	0.16	0.00	49.75	104.82	2.00	0.00	0.16	0.00
49.81	103.03	2.00	0.00	0.16	0.00	49.91	101.57	2.00	0.00	0.15	0.00
49.96	100.15	2.00	0.00	0.15	0.00	50.08	100.48	2.00	0.00	0.15	0.00

Total estimated settlement: 0.28

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

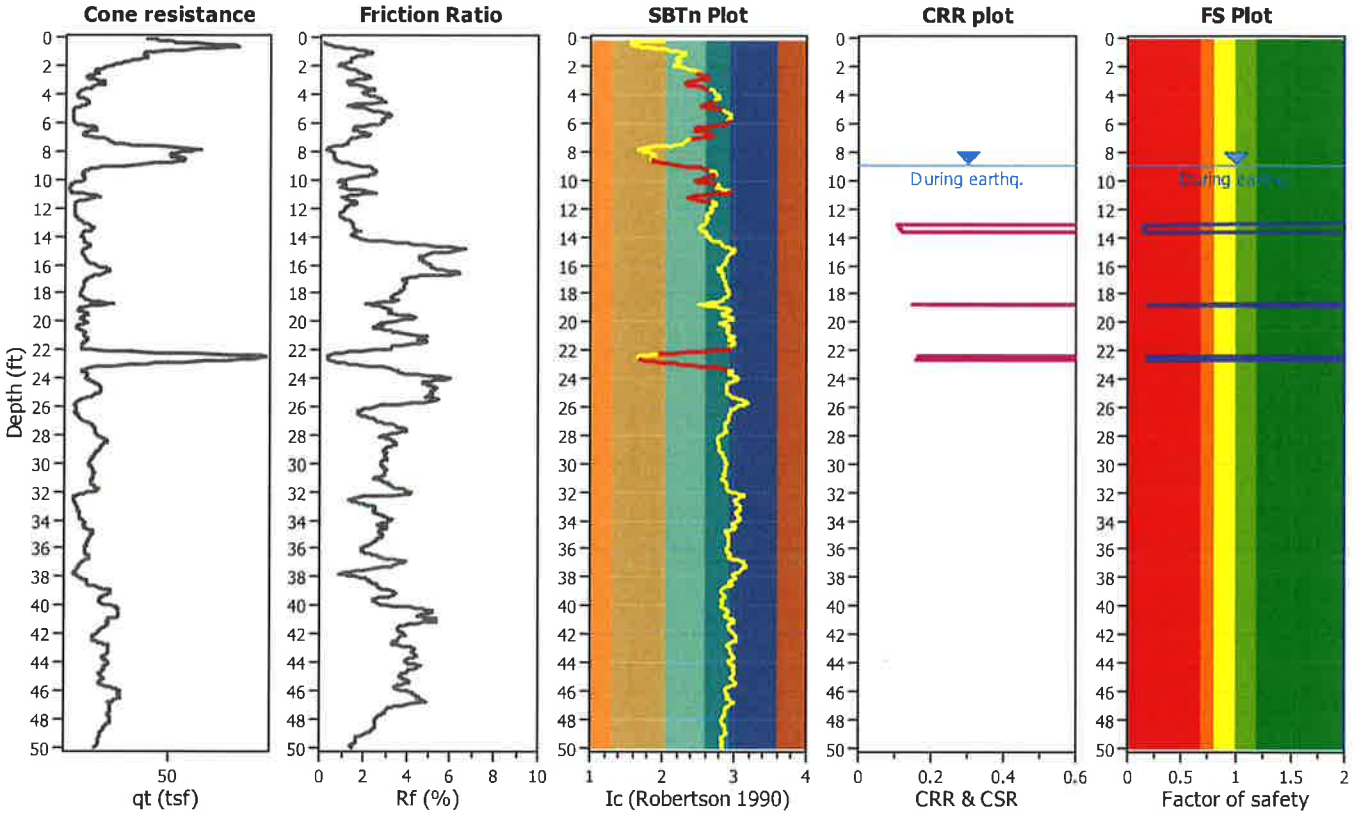
LIQUEFACTION ANALYSIS REPORT

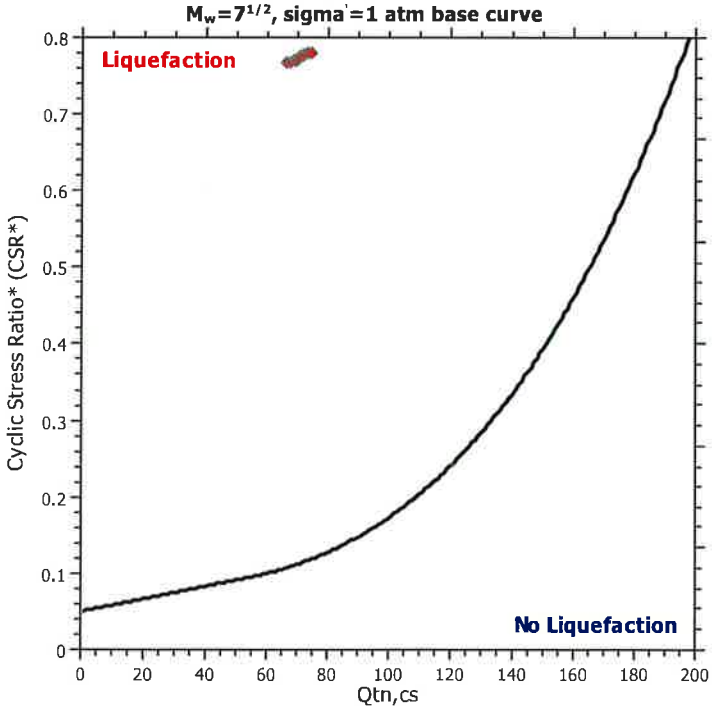
Project title : S-Line Upgrades **Location : Imperial County, CA**

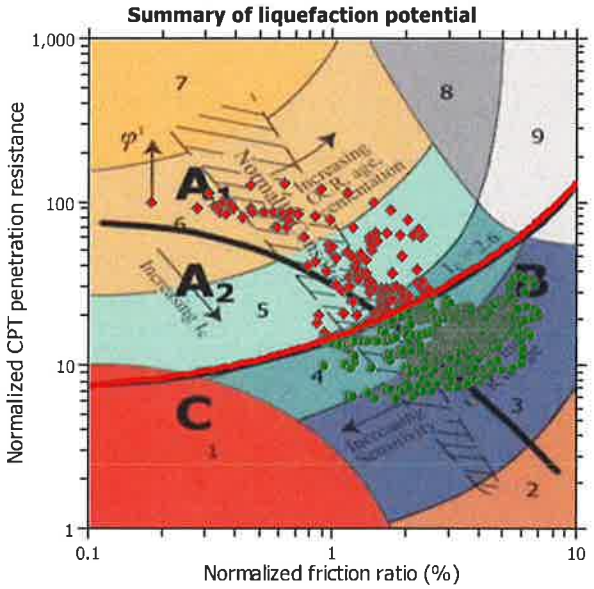
CPT file : CPT-6

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	9.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.91	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

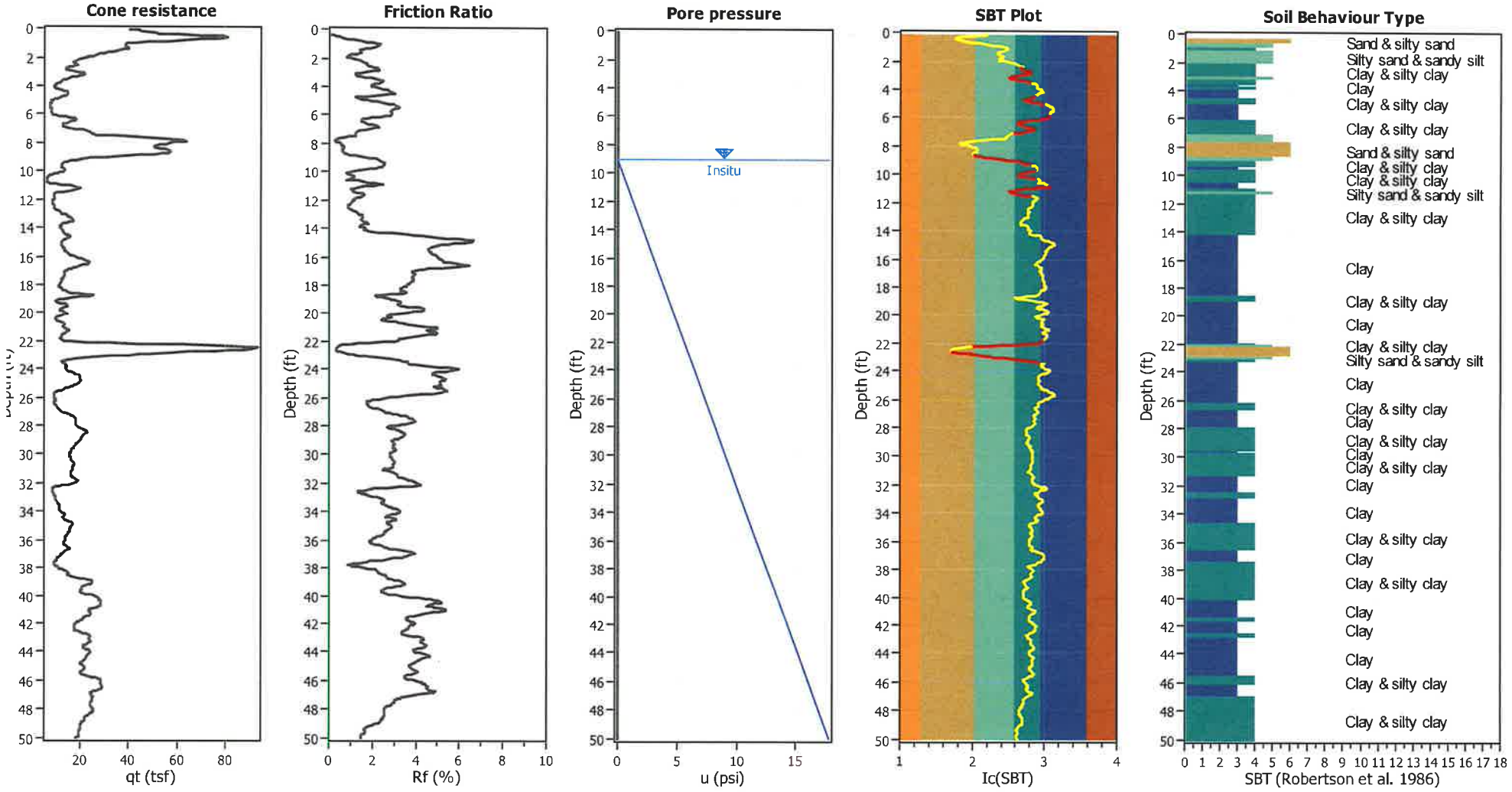






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



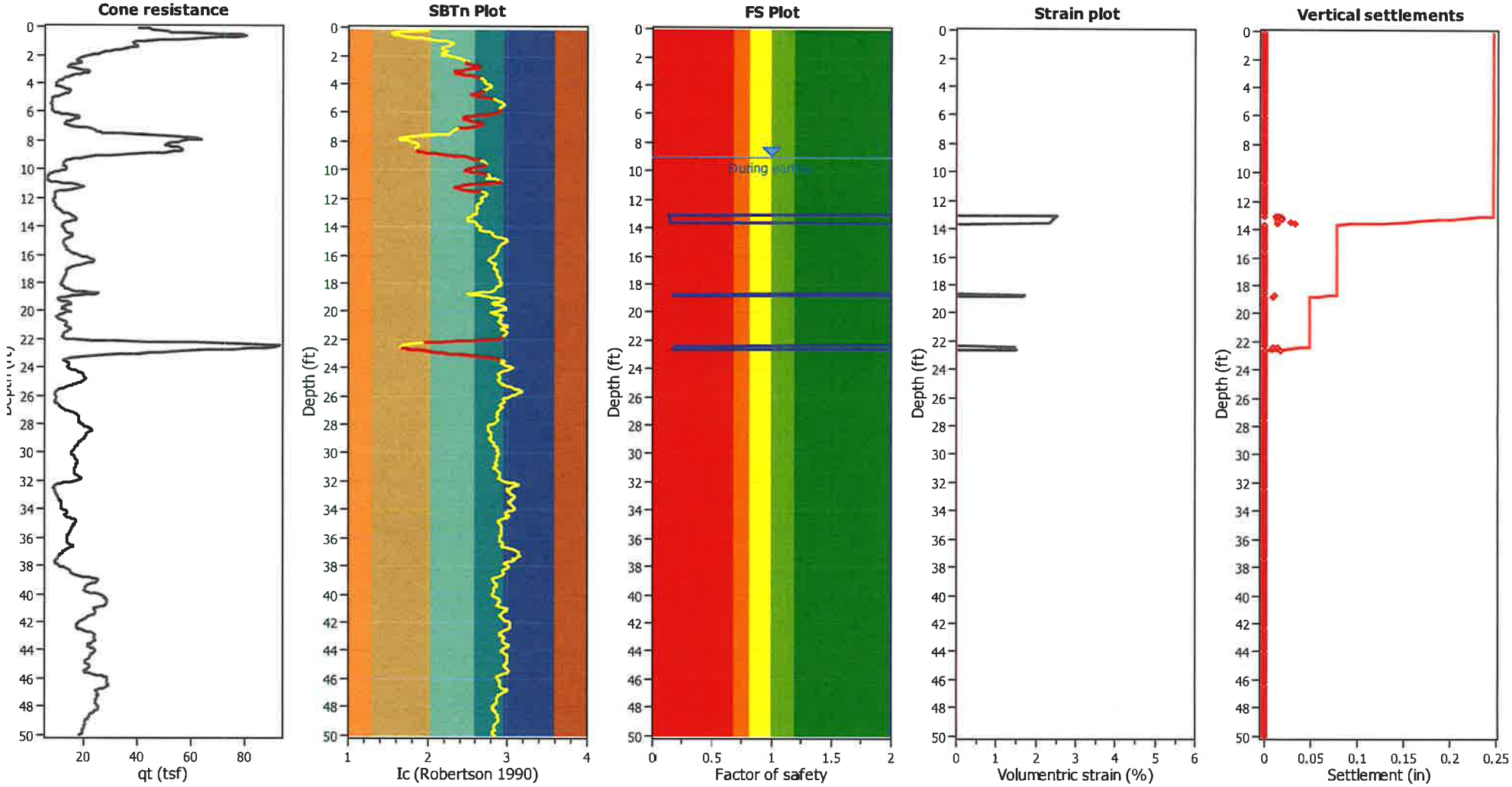
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	9.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.91	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

:	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
9.05	98.15	2.00	0.00	0.85	0.00	9.09	97.39	2.00	0.00	0.85	0.00
9.14	94.00	2.00	0.00	0.85	0.00	9.23	90.80	2.00	0.00	0.84	0.00
9.27	87.80	2.00	0.00	0.84	0.00	9.36	85.90	2.00	0.00	0.84	0.00
9.40	84.28	2.00	0.00	0.84	0.00	9.49	83.21	2.00	0.00	0.84	0.00
9.53	81.39	2.00	0.00	0.84	0.00	9.63	79.73	2.00	0.00	0.84	0.00
9.68	77.81	2.00	0.00	0.84	0.00	9.73	75.77	2.00	0.00	0.84	0.00
9.79	71.73	2.00	0.00	0.83	0.00	9.89	64.64	2.00	0.00	0.83	0.00
10.00	57.27	2.00	0.00	0.83	0.00	10.06	51.61	2.00	0.00	0.83	0.00
10.11	49.87	2.00	0.00	0.83	0.00	10.16	49.30	2.00	0.00	0.83	0.00
10.23	49.28	2.00	0.00	0.83	0.00	10.26	49.30	2.00	0.00	0.83	0.00
10.33	49.14	2.00	0.00	0.82	0.00	10.37	47.99	2.00	0.00	0.82	0.00
10.48	45.90	2.00	0.00	0.82	0.00	10.55	42.56	2.00	0.00	0.82	0.00
10.60	46.23	2.00	0.00	0.82	0.00	10.64	49.82	2.00	0.00	0.82	0.00
10.76	56.23	2.00	0.00	0.82	0.00	10.81	61.74	2.00	0.00	0.82	0.00
10.91	68.20	2.00	0.00	0.82	0.00	10.95	72.39	2.00	0.00	0.81	0.00
10.99	73.51	2.00	0.00	0.81	0.00	11.03	72.60	2.00	0.00	0.81	0.00
11.12	69.66	2.00	0.00	0.81	0.00	11.21	66.35	2.00	0.00	0.81	0.00
11.24	63.56	2.00	0.00	0.81	0.00	11.30	63.11	2.00	0.00	0.81	0.00
11.40	62.43	2.00	0.00	0.81	0.00	11.47	62.23	2.00	0.00	0.81	0.00
11.57	62.02	2.00	0.00	0.80	0.00	11.61	61.18	2.00	0.00	0.80	0.00
11.73	59.46	2.00	0.00	0.80	0.00	11.79	57.42	2.00	0.00	0.80	0.00
11.83	55.55	2.00	0.00	0.80	0.00	11.88	54.11	2.00	0.00	0.80	0.00
11.93	52.88	2.00	0.00	0.80	0.00	12.00	52.15	2.00	0.00	0.80	0.00
12.05	51.68	2.00	0.00	0.80	0.00	12.10	51.19	2.00	0.00	0.79	0.00
12.15	50.32	2.00	0.00	0.79	0.00	12.25	49.03	2.00	0.00	0.79	0.00
12.32	47.94	2.00	0.00	0.79	0.00	12.36	47.44	2.00	0.00	0.79	0.00
12.41	47.38	2.00	0.00	0.79	0.00	12.53	47.53	2.00	0.00	0.79	0.00
12.58	47.88	2.00	0.00	0.79	0.00	12.63	48.76	2.00	0.00	0.79	0.00
12.68	50.47	2.00	0.00	0.79	0.00	12.76	52.19	2.00	0.00	0.78	0.00
12.80	55.11	2.00	0.00	0.78	0.00	12.90	59.09	2.00	0.00	0.78	0.00
13.02	63.28	2.00	0.00	0.78	0.00	13.07	66.22	0.14	2.55	0.78	0.02
13.11	67.68	0.14	2.50	0.78	0.01	13.17	68.53	0.14	2.47	0.78	0.02
13.22	69.50	0.14	2.44	0.78	0.01	13.29	70.22	0.15	2.42	0.77	0.02
13.33	70.57	0.15	2.41	0.77	0.01	13.43	71.70	0.15	2.37	0.77	0.03
13.55	72.97	0.15	2.33	0.77	0.03	13.60	74.55	0.15	2.29	0.77	0.01
13.65	73.22	2.00	0.00	0.77	0.00	13.71	68.03	2.00	0.00	0.77	0.00
13.77	63.90	2.00	0.00	0.77	0.00	13.87	62.35	2.00	0.00	0.76	0.00
13.94	64.73	2.00	0.00	0.76	0.00	13.99	65.87	2.00	0.00	0.76	0.00
14.04	66.28	2.00	0.00	0.76	0.00	14.11	67.36	2.00	0.00	0.76	0.00
14.20	71.00	2.00	0.00	0.76	0.00	14.26	78.55	2.00	0.00	0.76	0.00
14.32	89.50	2.00	0.00	0.76	0.00	14.41	99.32	2.00	0.00	0.76	0.00
14.48	108.75	2.00	0.00	0.75	0.00	14.54	116.12	2.00	0.00	0.75	0.00
14.59	124.33	2.00	0.00	0.75	0.00	14.68	130.43	2.00	0.00	0.75	0.00
14.74	135.33	2.00	0.00	0.75	0.00	14.80	137.16	2.00	0.00	0.75	0.00
14.85	137.17	2.00	0.00	0.75	0.00	14.90	133.20	2.00	0.00	0.75	0.00
14.99	127.35	2.00	0.00	0.75	0.00	15.07	121.40	2.00	0.00	0.74	0.00
15.12	118.03	2.00	0.00	0.74	0.00	15.16	115.90	2.00	0.00	0.74	0.00
15.23	113.67	2.00	0.00	0.74	0.00	15.33	111.92	2.00	0.00	0.74	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
15.39	110.37	2.00	0.00	0.74	0.00	15.44	111.55	2.00	0.00	0.74	0.00
15.60	112.65	2.00	0.00	0.74	0.00	15.65	115.52	2.00	0.00	0.73	0.00
15.75	117.48	2.00	0.00	0.73	0.00	15.81	120.10	2.00	0.00	0.73	0.00
15.87	122.45	2.00	0.00	0.73	0.00	15.92	124.38	2.00	0.00	0.73	0.00
15.97	128.08	2.00	0.00	0.73	0.00	16.08	132.32	2.00	0.00	0.73	0.00
16.14	136.82	2.00	0.00	0.73	0.00	16.18	140.76	2.00	0.00	0.73	0.00
16.25	145.38	2.00	0.00	0.72	0.00	16.31	150.33	2.00	0.00	0.72	0.00
16.36	156.02	2.00	0.00	0.72	0.00	16.46	160.86	2.00	0.00	0.72	0.00
16.52	164.42	2.00	0.00	0.72	0.00	16.58	160.58	2.00	0.00	0.72	0.00
16.68	147.26	2.00	0.00	0.72	0.00	16.74	132.42	2.00	0.00	0.72	0.00
16.80	121.31	2.00	0.00	0.72	0.00	16.84	115.59	2.00	0.00	0.71	0.00
16.91	109.75	2.00	0.00	0.71	0.00	16.96	104.12	2.00	0.00	0.71	0.00
17.02	101.79	2.00	0.00	0.71	0.00	17.07	100.47	2.00	0.00	0.71	0.00
17.13	100.26	2.00	0.00	0.71	0.00	17.19	100.71	2.00	0.00	0.71	0.00
17.26	100.29	2.00	0.00	0.71	0.00	17.35	99.55	2.00	0.00	0.71	0.00
17.42	98.73	2.00	0.00	0.70	0.00	17.46	98.43	2.00	0.00	0.70	0.00
17.55	98.14	2.00	0.00	0.70	0.00	17.63	97.50	2.00	0.00	0.70	0.00
17.68	96.77	2.00	0.00	0.70	0.00	17.73	95.60	2.00	0.00	0.70	0.00
17.81	94.30	2.00	0.00	0.70	0.00	17.86	92.72	2.00	0.00	0.70	0.00
17.94	91.38	2.00	0.00	0.70	0.00	17.99	89.97	2.00	0.00	0.70	0.00
18.07	88.91	2.00	0.00	0.69	0.00	18.12	87.78	2.00	0.00	0.69	0.00
18.21	87.11	2.00	0.00	0.69	0.00	18.25	87.65	2.00	0.00	0.69	0.00
18.40	89.25	2.00	0.00	0.69	0.00	18.44	94.25	2.00	0.00	0.69	0.00
18.54	97.93	2.00	0.00	0.69	0.00	18.60	99.39	2.00	0.00	0.68	0.00
18.64	96.20	2.00	0.00	0.68	0.00	18.69	92.71	0.17	1.70	0.68	0.01
18.74	90.76	0.17	1.73	0.68	0.01	18.79	90.28	0.17	1.73	0.68	0.01
18.88	89.75	2.00	0.00	0.68	0.00	18.94	87.34	2.00	0.00	0.68	0.00
19.05	83.96	2.00	0.00	0.68	0.00	19.07	81.00	2.00	0.00	0.68	0.00
19.14	80.70	2.00	0.00	0.68	0.00	19.18	81.00	2.00	0.00	0.67	0.00
19.26	82.63	2.00	0.00	0.67	0.00	19.32	84.77	2.00	0.00	0.67	0.00
19.36	89.23	2.00	0.00	0.67	0.00	19.45	93.44	2.00	0.00	0.67	0.00
19.50	98.55	2.00	0.00	0.67	0.00	19.58	101.91	2.00	0.00	0.67	0.00
19.63	100.33	2.00	0.00	0.67	0.00	19.73	97.96	2.00	0.00	0.67	0.00
19.82	95.21	2.00	0.00	0.66	0.00	19.89	94.92	2.00	0.00	0.66	0.00
19.98	92.30	2.00	0.00	0.66	0.00	20.03	87.40	2.00	0.00	0.66	0.00
20.08	83.60	2.00	0.00	0.66	0.00	20.22	78.53	2.00	0.00	0.66	0.00
20.28	76.23	2.00	0.00	0.66	0.00	20.34	71.37	2.00	0.00	0.66	0.00
20.40	69.75	2.00	0.00	0.65	0.00	20.44	69.53	2.00	0.00	0.65	0.00
20.54	74.23	2.00	0.00	0.65	0.00	20.58	79.98	2.00	0.00	0.65	0.00
20.65	84.55	2.00	0.00	0.65	0.00	20.71	88.23	2.00	0.00	0.65	0.00
20.75	93.08	2.00	0.00	0.65	0.00	20.91	97.91	2.00	0.00	0.65	0.00
20.97	102.92	2.00	0.00	0.64	0.00	21.01	105.33	2.00	0.00	0.64	0.00
21.06	106.52	2.00	0.00	0.64	0.00	21.13	106.97	2.00	0.00	0.64	0.00
21.18	107.12	2.00	0.00	0.64	0.00	21.24	107.61	2.00	0.00	0.64	0.00
21.28	108.60	2.00	0.00	0.64	0.00	21.33	109.27	2.00	0.00	0.64	0.00
21.40	108.02	2.00	0.00	0.64	0.00	21.50	105.15	2.00	0.00	0.64	0.00
21.55	100.48	2.00	0.00	0.63	0.00	21.62	95.40	2.00	0.00	0.63	0.00
21.68	89.22	2.00	0.00	0.63	0.00	21.77	84.92	2.00	0.00	0.63	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
21.81	82.72	2.00	0.00	0.63	0.00	21.93	83.35	2.00	0.00	0.63	0.00
21.99	83.26	2.00	0.00	0.63	0.00	22.03	81.85	2.00	0.00	0.63	0.00
22.09	78.74	2.00	0.00	0.63	0.00	22.13	76.66	2.00	0.00	0.62	0.00
22.20	77.55	2.00	0.00	0.62	0.00	22.25	84.34	2.00	0.00	0.62	0.00
22.35	85.69	2.00	0.00	0.62	0.00	22.40	97.31	0.18	1.48	0.62	0.01
22.48	99.92	0.19	1.45	0.62	0.01	22.52	98.12	0.18	1.47	0.62	0.01
22.62	93.44	0.17	1.52	0.62	0.02	22.68	86.80	2.00	0.00	0.62	0.00
22.74	80.68	2.00	0.00	0.61	0.00	22.78	83.75	2.00	0.00	0.61	0.00
22.87	80.56	2.00	0.00	0.61	0.00	22.92	79.75	2.00	0.00	0.61	0.00
22.98	80.63	2.00	0.00	0.61	0.00	23.04	82.33	2.00	0.00	0.61	0.00
23.10	85.49	2.00	0.00	0.61	0.00	23.18	89.03	2.00	0.00	0.61	0.00
23.23	90.04	2.00	0.00	0.61	0.00	23.31	88.65	2.00	0.00	0.60	0.00
23.43	86.26	2.00	0.00	0.60	0.00	23.49	86.84	2.00	0.00	0.60	0.00
23.54	87.40	2.00	0.00	0.60	0.00	23.58	89.24	2.00	0.00	0.60	0.00
23.64	91.63	2.00	0.00	0.60	0.00	23.69	96.01	2.00	0.00	0.60	0.00
23.76	102.75	2.00	0.00	0.60	0.00	23.85	108.29	2.00	0.00	0.60	0.00
23.90	111.97	2.00	0.00	0.59	0.00	23.97	113.15	2.00	0.00	0.59	0.00
24.02	113.76	2.00	0.00	0.59	0.00	24.12	113.67	2.00	0.00	0.59	0.00
24.17	113.06	2.00	0.00	0.59	0.00	24.22	112.58	2.00	0.00	0.59	0.00
24.29	113.06	2.00	0.00	0.59	0.00	24.39	115.00	2.00	0.00	0.59	0.00
24.44	118.53	2.00	0.00	0.59	0.00	24.50	121.94	2.00	0.00	0.58	0.00
24.56	124.89	2.00	0.00	0.58	0.00	24.66	126.49	2.00	0.00	0.58	0.00
24.70	127.35	2.00	0.00	0.58	0.00	24.77	126.90	2.00	0.00	0.58	0.00
24.83	125.80	2.00	0.00	0.58	0.00	24.87	123.53	2.00	0.00	0.58	0.00
25.04	121.20	2.00	0.00	0.58	0.00	25.09	119.12	2.00	0.00	0.57	0.00
25.13	116.20	2.00	0.00	0.57	0.00	25.19	112.63	2.00	0.00	0.57	0.00
25.26	108.95	2.00	0.00	0.57	0.00	25.31	107.51	2.00	0.00	0.57	0.00
25.36	106.41	2.00	0.00	0.57	0.00	25.41	103.81	2.00	0.00	0.57	0.00
25.48	100.29	2.00	0.00	0.57	0.00	25.53	94.74	2.00	0.00	0.57	0.00
25.65	89.78	2.00	0.00	0.57	0.00	25.69	84.42	2.00	0.00	0.56	0.00
25.74	79.48	2.00	0.00	0.56	0.00	25.83	74.25	2.00	0.00	0.56	0.00
25.89	69.68	2.00	0.00	0.56	0.00	25.92	66.79	2.00	0.00	0.56	0.00
26.00	64.55	2.00	0.00	0.56	0.00	26.09	62.33	2.00	0.00	0.56	0.00
26.14	60.11	2.00	0.00	0.56	0.00	26.23	58.15	2.00	0.00	0.56	0.00
26.28	55.99	2.00	0.00	0.55	0.00	26.37	55.16	2.00	0.00	0.55	0.00
26.42	55.15	2.00	0.00	0.55	0.00	26.47	56.18	2.00	0.00	0.55	0.00
26.55	57.03	2.00	0.00	0.55	0.00	26.58	58.38	2.00	0.00	0.55	0.00
26.67	59.95	2.00	0.00	0.55	0.00	26.71	62.81	2.00	0.00	0.55	0.00
26.80	65.57	2.00	0.00	0.55	0.00	26.84	68.78	2.00	0.00	0.55	0.00
26.93	71.87	2.00	0.00	0.54	0.00	27.05	74.96	2.00	0.00	0.54	0.00
27.09	78.96	2.00	0.00	0.54	0.00	27.18	82.22	2.00	0.00	0.54	0.00
27.21	86.28	2.00	0.00	0.54	0.00	27.27	89.31	2.00	0.00	0.54	0.00
27.32	93.22	2.00	0.00	0.54	0.00	27.41	95.70	2.00	0.00	0.54	0.00
27.44	98.16	2.00	0.00	0.53	0.00	27.51	100.01	2.00	0.00	0.53	0.00
27.64	101.13	2.00	0.00	0.53	0.00	27.69	101.00	2.00	0.00	0.53	0.00
27.74	98.29	2.00	0.00	0.53	0.00	27.86	95.46	2.00	0.00	0.53	0.00
27.90	93.46	2.00	0.00	0.53	0.00	27.95	89.62	2.00	0.00	0.53	0.00
28.01	87.40	2.00	0.00	0.53	0.00	28.12	86.15	2.00	0.00	0.52	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
28.17	89.83	2.00	0.00	0.52	0.00	28.22	93.72	2.00	0.00	0.52	0.00
28.29	96.55	2.00	0.00	0.52	0.00	28.30	99.12	2.00	0.00	0.52	0.00
28.38	100.32	2.00	0.00	0.52	0.00	28.41	101.85	2.00	0.00	0.52	0.00
28.50	102.33	2.00	0.00	0.52	0.00	28.55	101.94	2.00	0.00	0.52	0.00
28.65	100.49	2.00	0.00	0.51	0.00	28.70	98.03	2.00	0.00	0.51	0.00
28.83	95.63	2.00	0.00	0.51	0.00	28.87	93.25	2.00	0.00	0.51	0.00
28.92	91.44	2.00	0.00	0.51	0.00	28.98	89.70	2.00	0.00	0.51	0.00
29.03	88.31	2.00	0.00	0.51	0.00	29.09	87.70	2.00	0.00	0.51	0.00
29.19	87.62	2.00	0.00	0.51	0.00	29.24	87.37	2.00	0.00	0.50	0.00
29.31	86.60	2.00	0.00	0.50	0.00	29.36	85.77	2.00	0.00	0.50	0.00
29.40	85.07	2.00	0.00	0.50	0.00	29.50	84.96	2.00	0.00	0.50	0.00
29.57	84.82	2.00	0.00	0.50	0.00	29.62	84.63	2.00	0.00	0.50	0.00
29.71	83.72	2.00	0.00	0.50	0.00	29.77	82.38	2.00	0.00	0.50	0.00
29.82	81.06	2.00	0.00	0.49	0.00	29.89	79.99	2.00	0.00	0.49	0.00
29.93	79.52	2.00	0.00	0.49	0.00	30.04	79.10	2.00	0.00	0.49	0.00
30.11	79.23	2.00	0.00	0.49	0.00	30.15	79.56	2.00	0.00	0.49	0.00
30.20	80.41	2.00	0.00	0.49	0.00	30.25	81.41	2.00	0.00	0.49	0.00
30.35	82.53	2.00	0.00	0.49	0.00	30.42	83.68	2.00	0.00	0.48	0.00
30.47	84.71	2.00	0.00	0.48	0.00	30.52	85.05	2.00	0.00	0.48	0.00
30.64	84.80	2.00	0.00	0.48	0.00	30.69	84.21	2.00	0.00	0.48	0.00
30.73	83.76	2.00	0.00	0.48	0.00	30.78	83.48	2.00	0.00	0.48	0.00
30.85	83.28	2.00	0.00	0.48	0.00	30.95	80.21	2.00	0.00	0.48	0.00
31.00	77.22	2.00	0.00	0.47	0.00	31.07	75.83	2.00	0.00	0.47	0.00
31.12	78.25	2.00	0.00	0.47	0.00	31.17	81.14	2.00	0.00	0.47	0.00
31.32	82.37	2.00	0.00	0.47	0.00	31.35	83.21	2.00	0.00	0.47	0.00
31.37	83.61	2.00	0.00	0.47	0.00	31.46	84.04	2.00	0.00	0.47	0.00
31.50	84.64	2.00	0.00	0.47	0.00	31.56	85.81	2.00	0.00	0.47	0.00
31.64	88.50	2.00	0.00	0.46	0.00	31.73	92.07	2.00	0.00	0.46	0.00
31.78	95.48	2.00	0.00	0.46	0.00	31.83	97.82	2.00	0.00	0.46	0.00
31.95	97.90	2.00	0.00	0.46	0.00	31.99	95.51	2.00	0.00	0.46	0.00
32.09	91.14	2.00	0.00	0.46	0.00	32.14	84.27	2.00	0.00	0.46	0.00
32.22	76.59	2.00	0.00	0.45	0.00	32.26	68.01	2.00	0.00	0.45	0.00
32.31	60.88	2.00	0.00	0.45	0.00	32.36	54.34	2.00	0.00	0.45	0.00
32.48	49.17	2.00	0.00	0.45	0.00	32.52	46.38	2.00	0.00	0.45	0.00
32.58	46.51	2.00	0.00	0.45	0.00	32.62	47.52	2.00	0.00	0.45	0.00
32.69	48.96	2.00	0.00	0.45	0.00	32.75	51.35	2.00	0.00	0.44	0.00
32.85	53.56	2.00	0.00	0.44	0.00	32.90	56.01	2.00	0.00	0.44	0.00
32.96	57.86	2.00	0.00	0.44	0.00	33.01	60.21	2.00	0.00	0.44	0.00
33.17	61.77	2.00	0.00	0.44	0.00	33.22	62.90	2.00	0.00	0.44	0.00
33.27	62.85	2.00	0.00	0.44	0.00	33.32	62.70	2.00	0.00	0.44	0.00
33.38	62.98	2.00	0.00	0.43	0.00	33.43	63.92	2.00	0.00	0.43	0.00
33.49	65.26	2.00	0.00	0.43	0.00	33.54	66.69	2.00	0.00	0.43	0.00
33.64	67.85	2.00	0.00	0.43	0.00	33.71	68.80	2.00	0.00	0.43	0.00
33.76	69.41	2.00	0.00	0.43	0.00	33.81	70.33	2.00	0.00	0.43	0.00
33.91	71.58	2.00	0.00	0.43	0.00	33.97	73.14	2.00	0.00	0.42	0.00
34.02	74.37	2.00	0.00	0.42	0.00	34.07	75.35	2.00	0.00	0.42	0.00
34.12	76.18	2.00	0.00	0.42	0.00	34.19	74.18	2.00	0.00	0.42	0.00
34.29	70.54	2.00	0.00	0.42	0.00	34.35	68.72	2.00	0.00	0.42	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
34.41	70.44	2.00	0.00	0.42	0.00	34.47	73.88	2.00	0.00	0.42	0.00
34.56	75.17	2.00	0.00	0.41	0.00	34.61	75.75	2.00	0.00	0.41	0.00
34.68	75.98	2.00	0.00	0.41	0.00	34.73	76.46	2.00	0.00	0.41	0.00
34.79	77.14	2.00	0.00	0.41	0.00	34.89	77.74	2.00	0.00	0.41	0.00
34.94	78.30	2.00	0.00	0.41	0.00	35.00	78.47	2.00	0.00	0.41	0.00
35.06	78.31	2.00	0.00	0.41	0.00	35.11	76.95	2.00	0.00	0.40	0.00
35.23	75.41	2.00	0.00	0.40	0.00	35.28	73.97	2.00	0.00	0.40	0.00
35.33	73.34	2.00	0.00	0.40	0.00	35.38	72.87	2.00	0.00	0.40	0.00
35.45	72.13	2.00	0.00	0.40	0.00	35.55	71.30	2.00	0.00	0.40	0.00
35.59	69.53	2.00	0.00	0.40	0.00	35.72	67.80	2.00	0.00	0.39	0.00
35.77	65.88	2.00	0.00	0.39	0.00	35.81	64.65	2.00	0.00	0.39	0.00
35.86	63.56	2.00	0.00	0.39	0.00	35.92	62.41	2.00	0.00	0.39	0.00
35.99	61.57	2.00	0.00	0.39	0.00	36.03	60.94	2.00	0.00	0.39	0.00
36.15	60.80	2.00	0.00	0.39	0.00	36.19	61.07	2.00	0.00	0.39	0.00
36.25	61.83	2.00	0.00	0.39	0.00	36.30	63.35	2.00	0.00	0.38	0.00
36.35	66.14	2.00	0.00	0.38	0.00	36.47	69.01	2.00	0.00	0.38	0.00
36.52	71.72	2.00	0.00	0.38	0.00	36.57	73.49	2.00	0.00	0.38	0.00
36.62	75.04	2.00	0.00	0.38	0.00	36.69	76.91	2.00	0.00	0.38	0.00
36.79	78.47	2.00	0.00	0.38	0.00	36.84	79.36	2.00	0.00	0.38	0.00
36.91	78.92	2.00	0.00	0.37	0.00	36.96	77.06	2.00	0.00	0.37	0.00
37.07	74.82	2.00	0.00	0.37	0.00	37.12	72.42	2.00	0.00	0.37	0.00
37.18	70.70	2.00	0.00	0.37	0.00	37.23	68.96	2.00	0.00	0.37	0.00
37.28	64.35	2.00	0.00	0.37	0.00	37.45	59.09	2.00	0.00	0.37	0.00
37.49	53.08	2.00	0.00	0.36	0.00	37.55	50.80	2.00	0.00	0.36	0.00
37.59	49.30	2.00	0.00	0.36	0.00	37.66	46.33	2.00	0.00	0.36	0.00
37.71	43.07	2.00	0.00	0.36	0.00	37.76	39.94	2.00	0.00	0.36	0.00
37.81	40.55	2.00	0.00	0.36	0.00	37.87	43.22	2.00	0.00	0.36	0.00
37.93	47.08	2.00	0.00	0.36	0.00	38.01	51.71	2.00	0.00	0.36	0.00
38.08	55.79	2.00	0.00	0.35	0.00	38.13	59.90	2.00	0.00	0.35	0.00
38.22	62.77	2.00	0.00	0.35	0.00	38.26	65.29	2.00	0.00	0.35	0.00
38.35	66.37	2.00	0.00	0.35	0.00	38.40	67.55	2.00	0.00	0.35	0.00
38.49	68.50	2.00	0.00	0.35	0.00	38.53	69.94	2.00	0.00	0.35	0.00
38.59	71.82	2.00	0.00	0.35	0.00	38.68	75.25	2.00	0.00	0.34	0.00
38.77	79.69	2.00	0.00	0.34	0.00	38.83	84.63	2.00	0.00	0.34	0.00
38.88	89.07	2.00	0.00	0.34	0.00	38.93	93.07	2.00	0.00	0.34	0.00
38.98	96.20	2.00	0.00	0.34	0.00	39.09	97.23	2.00	0.00	0.34	0.00
39.19	96.25	2.00	0.00	0.34	0.00	39.25	93.37	2.00	0.00	0.33	0.00
39.31	89.99	2.00	0.00	0.33	0.00	39.37	86.45	2.00	0.00	0.33	0.00
39.41	83.04	2.00	0.00	0.33	0.00	39.46	80.07	2.00	0.00	0.33	0.00
39.52	77.83	2.00	0.00	0.33	0.00	39.59	76.23	2.00	0.00	0.33	0.00
39.68	75.25	2.00	0.00	0.33	0.00	39.75	75.07	2.00	0.00	0.33	0.00
39.79	78.75	2.00	0.00	0.33	0.00	39.90	83.47	2.00	0.00	0.32	0.00
39.94	90.69	2.00	0.00	0.32	0.00	40.05	97.14	2.00	0.00	0.32	0.00
40.12	103.79	2.00	0.00	0.32	0.00	40.16	109.06	2.00	0.00	0.32	0.00
40.21	113.47	2.00	0.00	0.32	0.00	40.26	116.99	2.00	0.00	0.32	0.00
40.31	119.78	2.00	0.00	0.32	0.00	40.38	121.57	2.00	0.00	0.32	0.00
40.43	123.24	2.00	0.00	0.31	0.00	40.53	123.39	2.00	0.00	0.31	0.00
40.59	118.77	2.00	0.00	0.31	0.00	40.65	116.51	2.00	0.00	0.31	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
40.75	114.55	2.00	0.00	0.31	0.00	40.81	116.79	2.00	0.00	0.31	0.00
40.87	116.35	2.00	0.00	0.31	0.00	40.91	116.19	2.00	0.00	0.31	0.00
40.96	116.47	2.00	0.00	0.31	0.00	41.01	115.55	2.00	0.00	0.30	0.00
41.11	114.13	2.00	0.00	0.30	0.00	41.14	111.54	2.00	0.00	0.30	0.00
41.22	108.84	2.00	0.00	0.30	0.00	41.28	105.45	2.00	0.00	0.30	0.00
41.34	101.72	2.00	0.00	0.30	0.00	41.44	97.92	2.00	0.00	0.30	0.00
41.50	94.41	2.00	0.00	0.30	0.00	41.55	92.29	2.00	0.00	0.30	0.00
41.61	90.71	2.00	0.00	0.29	0.00	41.71	89.69	2.00	0.00	0.29	0.00
41.76	88.82	2.00	0.00	0.29	0.00	41.83	88.40	2.00	0.00	0.29	0.00
41.89	88.34	2.00	0.00	0.29	0.00	41.93	88.38	2.00	0.00	0.29	0.00
42.05	87.64	2.00	0.00	0.29	0.00	42.10	86.20	2.00	0.00	0.29	0.00
42.15	84.58	2.00	0.00	0.29	0.00	42.20	83.33	2.00	0.00	0.28	0.00
42.36	82.63	2.00	0.00	0.28	0.00	42.41	82.28	2.00	0.00	0.28	0.00
42.46	82.22	2.00	0.00	0.28	0.00	42.51	82.18	2.00	0.00	0.28	0.00
42.56	82.85	2.00	0.00	0.28	0.00	42.63	84.40	2.00	0.00	0.28	0.00
42.68	86.72	2.00	0.00	0.28	0.00	42.73	89.13	2.00	0.00	0.28	0.00
42.78	93.35	2.00	0.00	0.27	0.00	42.90	97.33	2.00	0.00	0.27	0.00
42.95	101.06	2.00	0.00	0.27	0.00	43.05	102.15	2.00	0.00	0.27	0.00
43.11	102.48	2.00	0.00	0.27	0.00	43.17	101.99	2.00	0.00	0.27	0.00
43.21	101.48	2.00	0.00	0.27	0.00	43.26	101.18	2.00	0.00	0.27	0.00
43.32	101.09	2.00	0.00	0.27	0.00	43.37	101.02	2.00	0.00	0.26	0.00
43.48	100.72	2.00	0.00	0.26	0.00	43.53	100.12	2.00	0.00	0.26	0.00
43.58	98.98	2.00	0.00	0.26	0.00	43.65	97.54	2.00	0.00	0.26	0.00
43.70	96.04	2.00	0.00	0.26	0.00	43.78	95.16	2.00	0.00	0.26	0.00
43.84	94.70	2.00	0.00	0.26	0.00	43.90	95.85	2.00	0.00	0.26	0.00
44.04	97.57	2.00	0.00	0.25	0.00	44.08	100.09	2.00	0.00	0.25	0.00
44.13	101.77	2.00	0.00	0.25	0.00	44.22	102.60	2.00	0.00	0.25	0.00
44.26	102.34	2.00	0.00	0.25	0.00	44.32	101.28	2.00	0.00	0.25	0.00
44.36	99.48	2.00	0.00	0.25	0.00	44.48	97.34	2.00	0.00	0.25	0.00
44.56	94.78	2.00	0.00	0.24	0.00	44.64	92.22	2.00	0.00	0.24	0.00
44.74	90.02	2.00	0.00	0.24	0.00	44.78	88.72	2.00	0.00	0.24	0.00
44.83	88.23	2.00	0.00	0.24	0.00	44.93	88.01	2.00	0.00	0.24	0.00
44.99	88.19	2.00	0.00	0.24	0.00	45.03	89.01	2.00	0.00	0.24	0.00
45.10	90.18	2.00	0.00	0.24	0.00	45.15	91.49	2.00	0.00	0.23	0.00
45.24	92.12	2.00	0.00	0.23	0.00	45.36	92.18	2.00	0.00	0.23	0.00
45.41	90.94	2.00	0.00	0.23	0.00	45.51	89.18	2.00	0.00	0.23	0.00
45.56	87.70	2.00	0.00	0.23	0.00	45.63	87.37	2.00	0.00	0.23	0.00
45.67	89.02	2.00	0.00	0.23	0.00	45.79	91.69	2.00	0.00	0.22	0.00
45.85	94.80	2.00	0.00	0.22	0.00	45.90	97.39	2.00	0.00	0.22	0.00
45.94	100.91	2.00	0.00	0.22	0.00	46.05	104.15	2.00	0.00	0.22	0.00
46.12	106.53	2.00	0.00	0.22	0.00	46.16	106.92	2.00	0.00	0.22	0.00
46.21	106.89	2.00	0.00	0.22	0.00	46.26	108.15	2.00	0.00	0.22	0.00
46.38	109.46	2.00	0.00	0.21	0.00	46.43	110.76	2.00	0.00	0.21	0.00
46.48	110.51	2.00	0.00	0.21	0.00	46.53	109.68	2.00	0.00	0.21	0.00
46.60	109.04	2.00	0.00	0.21	0.00	46.69	108.56	2.00	0.00	0.21	0.00
46.75	107.88	2.00	0.00	0.21	0.00	46.81	105.62	2.00	0.00	0.21	0.00
46.87	102.31	2.00	0.00	0.21	0.00	46.92	97.66	2.00	0.00	0.20	0.00
47.07	93.83	2.00	0.00	0.20	0.00	47.11	90.83	2.00	0.00	0.20	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
47.16	89.64	2.00	0.00	0.20	0.00	47.20	88.38	2.00	0.00	0.20	0.00
47.25	86.82	2.00	0.00	0.20	0.00	47.33	85.44	2.00	0.00	0.20	0.00
47.38	84.64	2.00	0.00	0.20	0.00	47.48	84.31	2.00	0.00	0.20	0.00
47.54	83.95	2.00	0.00	0.19	0.00	47.60	83.19	2.00	0.00	0.19	0.00
47.65	82.12	2.00	0.00	0.19	0.00	47.73	80.92	2.00	0.00	0.19	0.00
47.78	79.88	2.00	0.00	0.19	0.00	47.84	79.31	2.00	0.00	0.19	0.00
47.95	78.91	2.00	0.00	0.19	0.00	48.00	78.56	2.00	0.00	0.19	0.00
48.04	78.50	2.00	0.00	0.19	0.00	48.15	78.56	2.00	0.00	0.18	0.00
48.19	78.75	2.00	0.00	0.18	0.00	48.26	78.62	2.00	0.00	0.18	0.00
48.31	77.87	2.00	0.00	0.18	0.00	48.40	76.93	2.00	0.00	0.18	0.00
48.44	75.79	2.00	0.00	0.18	0.00	48.51	74.92	2.00	0.00	0.18	0.00
48.57	74.00	2.00	0.00	0.18	0.00	48.67	73.19	2.00	0.00	0.18	0.00
48.71	72.64	2.00	0.00	0.17	0.00	48.76	72.04	2.00	0.00	0.17	0.00
48.88	71.14	2.00	0.00	0.17	0.00	48.93	70.03	2.00	0.00	0.17	0.00
48.97	68.78	2.00	0.00	0.17	0.00	49.02	67.27	2.00	0.00	0.17	0.00
49.09	65.00	2.00	0.00	0.17	0.00	49.24	62.69	2.00	0.00	0.17	0.00
49.28	60.70	2.00	0.00	0.16	0.00	49.34	59.79	2.00	0.00	0.16	0.00
49.39	59.32	2.00	0.00	0.16	0.00	49.43	59.30	2.00	0.00	0.16	0.00
49.50	59.40	2.00	0.00	0.16	0.00	49.59	59.39	2.00	0.00	0.16	0.00
49.65	59.04	2.00	0.00	0.16	0.00	49.71	58.23	2.00	0.00	0.16	0.00
49.77	57.20	2.00	0.00	0.16	0.00	49.81	56.40	2.00	0.00	0.16	0.00
49.90	55.70	2.00	0.00	0.15	0.00	49.96	55.38	2.00	0.00	0.15	0.00
50.03	55.14	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.25

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

LIQUEFACTION ANALYSIS REPORT

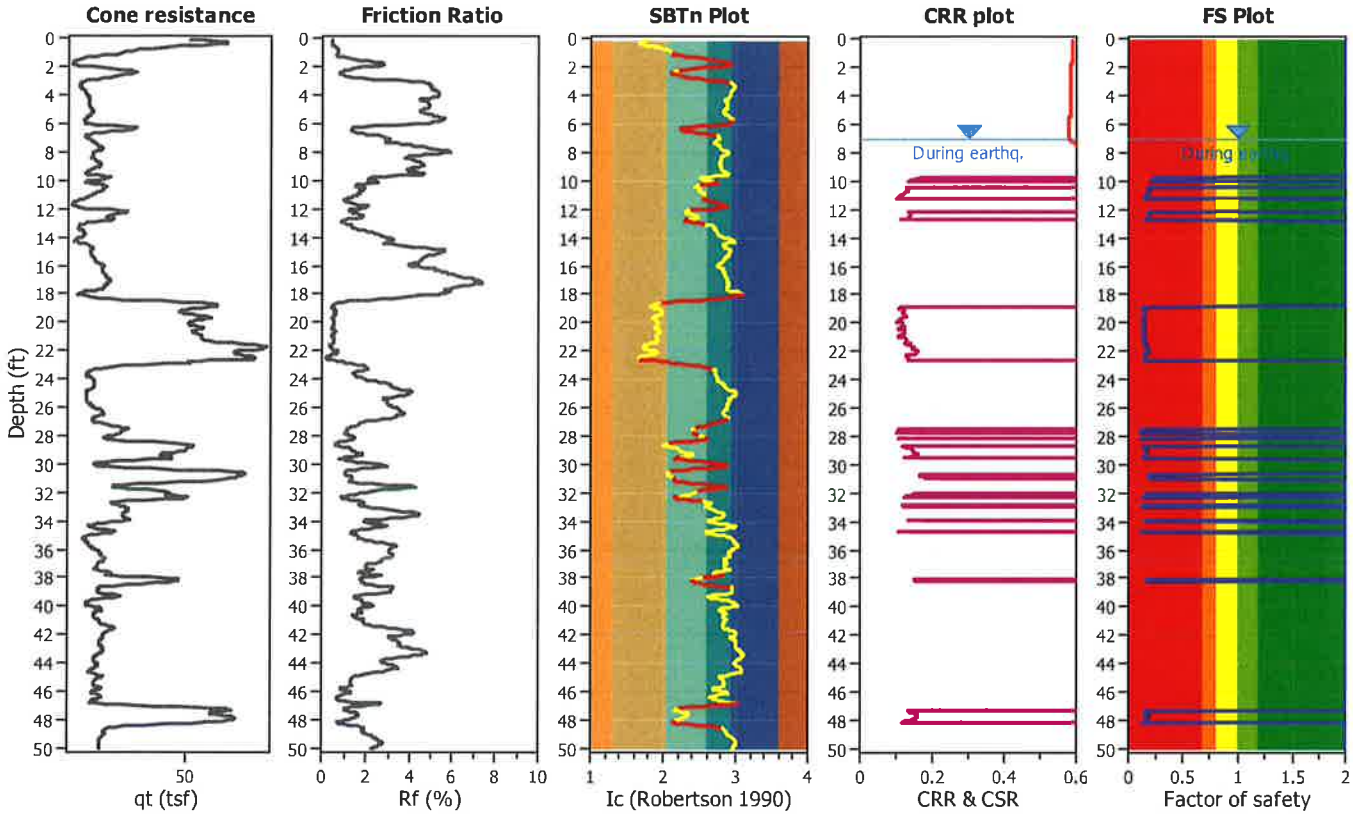
Project title : S-Line Upgrades

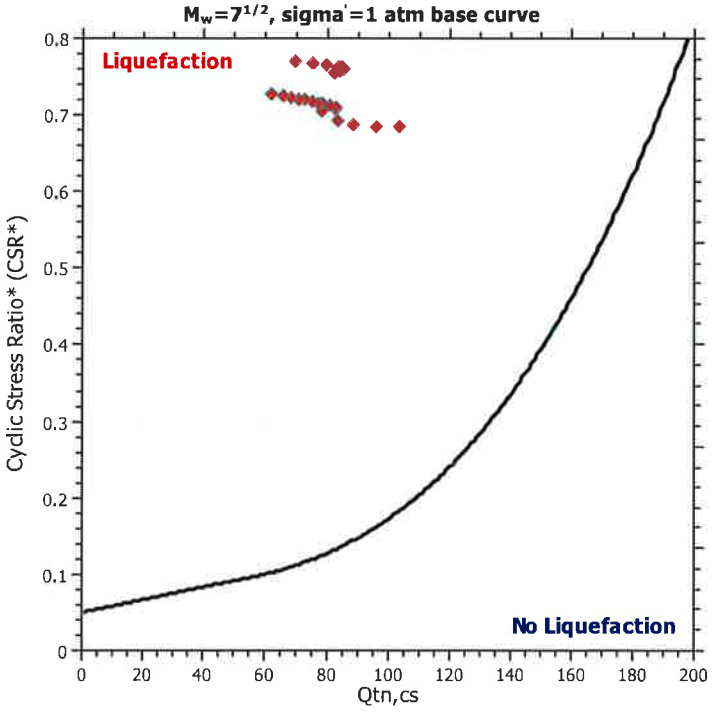
Location : Imperial County, CA

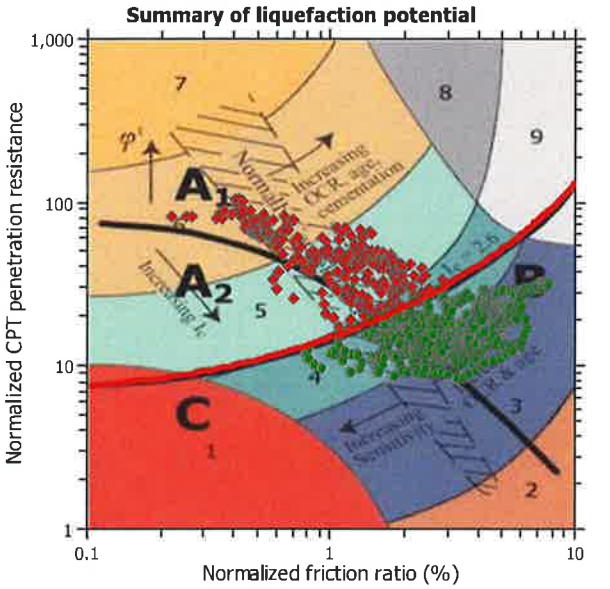
CPT file : CPT-7

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	7.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.83	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

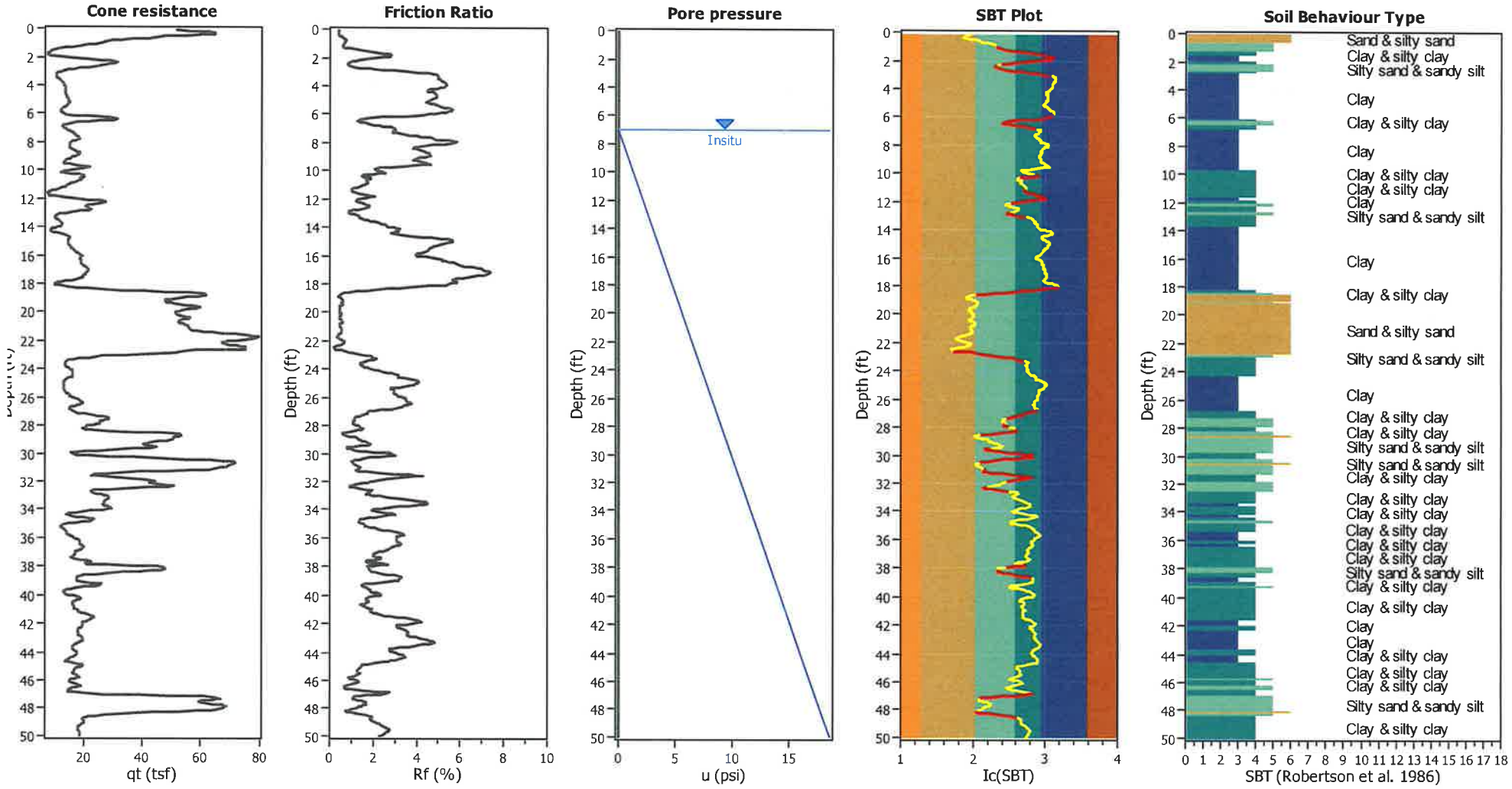






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



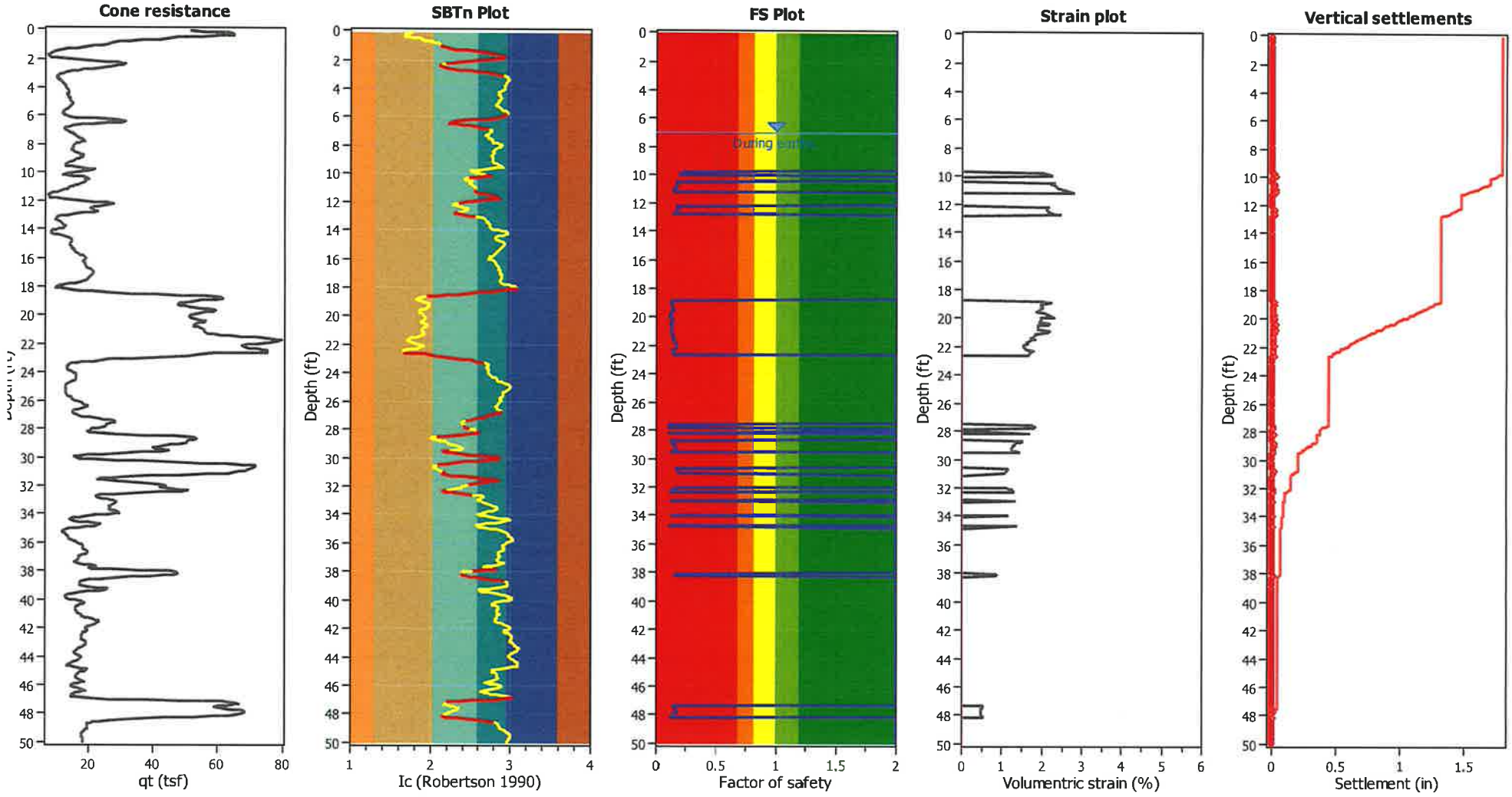
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.83	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	7.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

:	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
7.03	88.72	2.00	0.00	0.88	0.00	7.08	92.23	2.00	0.00	0.88	0.00
7.16	92.37	2.00	0.00	0.88	0.00	7.21	92.96	2.00	0.00	0.88	0.00
7.29	93.96	2.00	0.00	0.88	0.00	7.34	98.38	2.00	0.00	0.88	0.00
7.40	104.02	2.00	0.00	0.87	0.00	7.47	109.58	2.00	0.00	0.87	0.00
7.52	115.32	2.00	0.00	0.87	0.00	7.56	120.44	2.00	0.00	0.87	0.00
7.62	127.86	2.00	0.00	0.87	0.00	7.76	133.99	2.00	0.00	0.87	0.00
7.82	138.85	2.00	0.00	0.87	0.00	7.92	139.47	2.00	0.00	0.87	0.00
7.95	136.93	2.00	0.00	0.87	0.00	8.05	132.01	2.00	0.00	0.86	0.00
8.10	125.87	2.00	0.00	0.86	0.00	8.14	119.45	2.00	0.00	0.86	0.00
8.23	114.06	2.00	0.00	0.86	0.00	8.28	109.19	2.00	0.00	0.86	0.00
8.37	107.26	2.00	0.00	0.86	0.00	8.43	106.69	2.00	0.00	0.86	0.00
8.47	109.91	2.00	0.00	0.86	0.00	8.58	114.08	2.00	0.00	0.85	0.00
8.62	120.13	2.00	0.00	0.85	0.00	8.71	124.07	2.00	0.00	0.85	0.00
8.76	127.14	2.00	0.00	0.85	0.00	8.80	127.80	2.00	0.00	0.85	0.00
8.89	127.51	2.00	0.00	0.85	0.00	8.94	124.95	2.00	0.00	0.85	0.00
9.03	121.12	2.00	0.00	0.85	0.00	9.09	114.96	2.00	0.00	0.85	0.00
9.18	110.06	2.00	0.00	0.84	0.00	9.23	106.48	2.00	0.00	0.84	0.00
9.28	105.99	2.00	0.00	0.84	0.00	9.33	106.93	2.00	0.00	0.84	0.00
9.42	108.41	2.00	0.00	0.84	0.00	9.51	110.02	2.00	0.00	0.84	0.00
9.56	111.06	2.00	0.00	0.84	0.00	9.60	111.40	2.00	0.00	0.84	0.00
9.66	108.98	2.00	0.00	0.84	0.00	9.74	103.35	0.27	1.90	0.83	0.02
9.80	95.50	0.23	2.02	0.83	0.01	9.86	87.86	0.21	2.16	0.83	0.01
10.00	83.14	0.19	2.26	0.83	0.04	10.07	81.28	2.00	0.00	0.83	0.00
10.13	80.55	2.00	0.00	0.83	0.00	10.18	79.14	2.00	0.00	0.83	0.00
10.27	76.54	2.00	0.00	0.83	0.00	10.32	74.47	2.00	0.00	0.83	0.00
10.39	75.09	2.00	0.00	0.82	0.00	10.44	78.10	0.18	2.36	0.82	0.01
10.51	82.24	0.19	2.25	0.82	0.02	10.57	82.55	0.19	2.24	0.82	0.02
10.64	80.87	0.18	2.28	0.82	0.02	10.72	78.34	0.17	2.34	0.82	0.02
10.77	76.63	0.17	2.38	0.82	0.01	10.87	75.06	0.17	2.41	0.82	0.03
10.92	72.74	0.16	2.47	0.81	0.01	10.97	70.61	0.16	2.53	0.81	0.01
11.03	68.27	0.15	2.60	0.81	0.02	11.12	65.48	0.15	2.68	0.81	0.03
11.18	61.89	0.14	2.81	0.81	0.02	11.25	57.47	2.00	0.00	0.81	0.00
11.30	53.52	2.00	0.00	0.81	0.00	11.37	50.96	2.00	0.00	0.81	0.00
11.43	49.58	2.00	0.00	0.81	0.00	11.49	48.87	2.00	0.00	0.81	0.00
11.55	49.39	2.00	0.00	0.80	0.00	11.66	52.84	2.00	0.00	0.80	0.00
11.74	57.70	2.00	0.00	0.80	0.00	11.79	63.76	2.00	0.00	0.80	0.00
11.86	67.13	2.00	0.00	0.80	0.00	11.97	67.78	2.00	0.00	0.80	0.00
12.05	67.77	2.00	0.00	0.80	0.00	12.10	71.28	2.00	0.00	0.79	0.00
12.18	76.43	2.00	0.00	0.79	0.00	12.23	81.63	0.17	2.19	0.79	0.01
12.29	84.06	0.18	2.13	0.79	0.02	12.36	85.13	0.18	2.11	0.79	0.02
12.41	84.87	0.18	2.11	0.79	0.01	12.48	84.19	0.18	2.12	0.79	0.02
12.54	82.83	0.17	2.15	0.79	0.02	12.64	79.39	0.17	2.22	0.79	0.03
12.71	74.76	0.15	2.33	0.78	0.02	12.77	69.39	0.14	2.47	0.78	0.02
12.84	64.15	2.00	0.00	0.78	0.00	12.90	59.14	2.00	0.00	0.78	0.00
12.96	55.68	2.00	0.00	0.78	0.00	13.02	54.84	2.00	0.00	0.78	0.00
13.08	55.84	2.00	0.00	0.78	0.00	13.15	57.35	2.00	0.00	0.78	0.00
13.26	57.51	2.00	0.00	0.78	0.00	13.34	58.24	2.00	0.00	0.77	0.00
13.38	59.73	2.00	0.00	0.77	0.00	13.45	63.14	2.00	0.00	0.77	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
13.51	66.43	2.00	0.00	0.77	0.00	13.57	69.31	2.00	0.00	0.77	0.00
13.60	72.84	2.00	0.00	0.77	0.00	13.67	76.73	2.00	0.00	0.77	0.00
13.76	80.18	2.00	0.00	0.77	0.00	13.80	82.00	2.00	0.00	0.77	0.00
13.95	82.92	2.00	0.00	0.76	0.00	14.00	83.46	2.00	0.00	0.76	0.00
14.08	82.67	2.00	0.00	0.76	0.00	14.13	80.50	2.00	0.00	0.76	0.00
14.19	77.31	2.00	0.00	0.76	0.00	14.26	77.15	2.00	0.00	0.76	0.00
14.31	77.06	2.00	0.00	0.76	0.00	14.37	78.72	2.00	0.00	0.76	0.00
14.44	80.37	2.00	0.00	0.76	0.00	14.49	90.37	2.00	0.00	0.75	0.00
14.62	101.02	2.00	0.00	0.75	0.00	14.66	112.61	2.00	0.00	0.75	0.00
14.75	118.90	2.00	0.00	0.75	0.00	14.79	124.29	2.00	0.00	0.75	0.00
14.85	126.90	2.00	0.00	0.75	0.00	14.92	128.51	2.00	0.00	0.75	0.00
14.97	128.53	2.00	0.00	0.75	0.00	15.04	127.24	2.00	0.00	0.75	0.00
15.10	124.46	2.00	0.00	0.74	0.00	15.21	121.84	2.00	0.00	0.74	0.00
15.28	120.20	2.00	0.00	0.74	0.00	15.33	119.97	2.00	0.00	0.74	0.00
15.39	119.92	2.00	0.00	0.74	0.00	15.45	119.89	2.00	0.00	0.74	0.00
15.51	119.77	2.00	0.00	0.74	0.00	15.58	120.04	2.00	0.00	0.74	0.00
15.64	120.42	2.00	0.00	0.73	0.00	15.75	120.38	2.00	0.00	0.73	0.00
15.82	120.04	2.00	0.00	0.73	0.00	15.87	119.15	2.00	0.00	0.73	0.00
15.94	119.60	2.00	0.00	0.73	0.00	16.00	121.36	2.00	0.00	0.73	0.00
16.05	127.26	2.00	0.00	0.73	0.00	16.17	132.25	2.00	0.00	0.73	0.00
16.21	136.89	2.00	0.00	0.73	0.00	16.31	138.29	2.00	0.00	0.72	0.00
16.36	140.72	2.00	0.00	0.72	0.00	16.43	143.42	2.00	0.00	0.72	0.00
16.49	146.11	2.00	0.00	0.72	0.00	16.54	147.93	2.00	0.00	0.72	0.00
16.62	150.88	2.00	0.00	0.72	0.00	16.72	156.07	2.00	0.00	0.72	0.00
16.80	162.42	2.00	0.00	0.72	0.00	16.85	167.33	2.00	0.00	0.71	0.00
16.90	170.10	2.00	0.00	0.71	0.00	16.97	171.92	2.00	0.00	0.71	0.00
17.03	173.76	2.00	0.00	0.71	0.00	17.10	174.79	2.00	0.00	0.71	0.00
17.15	175.06	2.00	0.00	0.71	0.00	17.21	173.59	2.00	0.00	0.71	0.00
17.28	170.80	2.00	0.00	0.71	0.00	17.33	166.77	2.00	0.00	0.71	0.00
17.39	161.67	2.00	0.00	0.71	0.00	17.46	155.95	2.00	0.00	0.70	0.00
17.57	149.63	2.00	0.00	0.70	0.00	17.64	143.61	2.00	0.00	0.70	0.00
17.70	137.14	2.00	0.00	0.70	0.00	17.77	131.29	2.00	0.00	0.70	0.00
17.82	125.31	2.00	0.00	0.70	0.00	17.87	117.95	2.00	0.00	0.70	0.00
17.95	110.63	2.00	0.00	0.70	0.00	17.99	104.78	2.00	0.00	0.70	0.00
18.07	102.09	2.00	0.00	0.69	0.00	18.13	102.30	2.00	0.00	0.69	0.00
18.26	101.09	2.00	0.00	0.69	0.00	18.30	99.90	2.00	0.00	0.69	0.00
18.36	97.41	2.00	0.00	0.69	0.00	18.44	93.86	2.00	0.00	0.69	0.00
18.48	89.88	2.00	0.00	0.69	0.00	18.54	86.17	2.00	0.00	0.69	0.00
18.62	84.56	2.00	0.00	0.68	0.00	18.67	84.63	2.00	0.00	0.68	0.00
18.74	85.22	2.00	0.00	0.68	0.00	18.86	74.05	0.13	2.03	0.68	0.03
18.92	70.76	0.13	2.11	0.68	0.02	18.97	66.38	0.12	2.22	0.68	0.01
19.05	76.90	0.14	1.96	0.68	0.02	19.10	76.40	0.14	1.97	0.68	0.01
19.17	74.57	0.14	2.01	0.68	0.02	19.23	73.51	0.13	2.03	0.67	0.02
19.29	73.66	0.13	2.02	0.67	0.01	19.36	75.78	0.14	1.97	0.67	0.02
19.41	77.63	0.14	1.93	0.67	0.01	19.47	77.64	0.14	1.93	0.67	0.01
19.51	78.80	0.14	1.90	0.67	0.01	19.58	79.58	0.14	1.88	0.67	0.02
19.63	70.54	0.13	2.08	0.67	0.01	19.71	63.02	0.12	2.11	0.67	0.02
19.77	66.49	0.12	2.17	0.66	0.01	19.82	64.05	0.12	2.24	0.66	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
19.92	62.04	0.12	2.29	0.66	0.03	19.98	73.82	0.13	1.98	0.66	0.01
20.02	73.76	0.13	1.98	0.66	0.01	20.10	73.96	0.13	1.97	0.66	0.02
20.16	74.29	0.13	1.96	0.66	0.01	20.22	75.32	0.13	1.94	0.66	0.01
20.33	64.64	0.12	2.19	0.66	0.03	20.41	65.80	0.12	2.15	0.65	0.02
20.46	65.19	0.12	2.17	0.65	0.01	20.51	76.82	0.14	1.89	0.65	0.01
20.60	76.67	0.14	1.89	0.65	0.02	20.64	76.21	0.14	1.90	0.65	0.01
20.77	75.57	0.13	1.90	0.65	0.03	20.82	75.25	0.13	1.91	0.65	0.01
20.88	63.70	0.12	2.19	0.65	0.02	20.95	64.39	0.12	2.16	0.64	0.02
21.00	64.69	0.12	2.15	0.64	0.01	21.06	77.07	0.14	1.86	0.64	0.02
21.13	77.80	0.14	1.84	0.64	0.01	21.19	78.49	0.14	1.83	0.64	0.01
21.26	79.31	0.14	1.81	0.64	0.02	21.31	80.53	0.14	1.78	0.64	0.01
21.36	82.36	0.15	1.75	0.64	0.01	21.44	84.47	0.15	1.71	0.64	0.02
21.48	77.15	0.14	1.84	0.64	0.01	21.55	81.35	0.14	1.76	0.63	0.01
21.62	85.16	0.15	1.69	0.63	0.01	21.66	87.79	0.16	1.65	0.63	0.01
21.74	89.18	0.16	1.62	0.63	0.02	21.79	88.13	0.16	1.63	0.63	0.01
21.91	94.72	0.18	1.54	0.63	0.02	21.97	94.44	0.17	1.54	0.63	0.01
22.03	93.51	0.17	1.55	0.63	0.01	22.10	92.32	0.17	1.56	0.63	0.01
22.15	91.09	0.17	1.58	0.62	0.01	22.20	89.12	0.16	1.60	0.62	0.01
22.28	78.24	0.14	1.78	0.62	0.02	22.33	79.86	0.14	1.75	0.62	0.01
22.41	81.24	0.14	1.72	0.62	0.02	22.46	82.46	0.14	1.70	0.62	0.01
22.59	82.32	0.14	1.69	0.62	0.03	22.64	78.92	2.00	0.00	0.62	0.00
22.68	78.23	2.00	0.00	0.62	0.00	22.71	79.82	2.00	0.00	0.62	0.00
22.79	83.04	2.00	0.00	0.61	0.00	22.85	87.48	2.00	0.00	0.61	0.00
22.97	86.84	2.00	0.00	0.61	0.00	23.03	86.16	2.00	0.00	0.61	0.00
23.09	84.15	2.00	0.00	0.61	0.00	23.20	81.52	2.00	0.00	0.61	0.00
23.27	77.90	2.00	0.00	0.61	0.00	23.34	73.32	2.00	0.00	0.60	0.00
23.39	68.39	2.00	0.00	0.60	0.00	23.44	63.49	2.00	0.00	0.60	0.00
23.51	60.55	2.00	0.00	0.60	0.00	23.56	59.14	2.00	0.00	0.60	0.00
23.64	59.45	2.00	0.00	0.60	0.00	23.69	59.82	2.00	0.00	0.60	0.00
23.74	60.51	2.00	0.00	0.60	0.00	23.82	61.66	2.00	0.00	0.60	0.00
23.87	63.32	2.00	0.00	0.60	0.00	23.91	66.12	2.00	0.00	0.59	0.00
23.99	69.30	2.00	0.00	0.59	0.00	24.05	73.12	2.00	0.00	0.59	0.00
24.13	76.27	2.00	0.00	0.59	0.00	24.18	79.68	2.00	0.00	0.59	0.00
24.24	83.31	2.00	0.00	0.59	0.00	24.31	86.67	2.00	0.00	0.59	0.00
24.36	89.06	2.00	0.00	0.59	0.00	24.42	89.73	2.00	0.00	0.59	0.00
24.49	89.64	2.00	0.00	0.58	0.00	24.54	89.49	2.00	0.00	0.58	0.00
24.61	90.59	2.00	0.00	0.58	0.00	24.74	92.01	2.00	0.00	0.58	0.00
24.85	92.80	2.00	0.00	0.58	0.00	24.91	92.67	2.00	0.00	0.58	0.00
24.97	91.87	2.00	0.00	0.58	0.00	25.03	91.11	2.00	0.00	0.58	0.00
25.10	90.16	2.00	0.00	0.57	0.00	25.15	88.92	2.00	0.00	0.57	0.00
25.22	85.97	2.00	0.00	0.57	0.00	25.28	81.59	2.00	0.00	0.57	0.00
25.34	78.21	2.00	0.00	0.57	0.00	25.40	77.67	2.00	0.00	0.57	0.00
25.46	79.05	2.00	0.00	0.57	0.00	25.59	80.56	2.00	0.00	0.57	0.00
25.68	81.79	2.00	0.00	0.56	0.00	25.73	83.52	2.00	0.00	0.56	0.00
25.81	84.94	2.00	0.00	0.56	0.00	25.88	86.34	2.00	0.00	0.56	0.00
25.94	88.40	2.00	0.00	0.56	0.00	26.00	91.13	2.00	0.00	0.56	0.00
26.07	93.75	2.00	0.00	0.56	0.00	26.12	96.87	2.00	0.00	0.56	0.00
26.30	99.86	2.00	0.00	0.55	0.00	26.36	102.53	2.00	0.00	0.55	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
26.43	103.24	2.00	0.00	0.55	0.00	26.48	101.56	2.00	0.00	0.55	0.00
26.52	98.75	2.00	0.00	0.55	0.00	26.57	95.30	2.00	0.00	0.55	0.00
26.65	92.18	2.00	0.00	0.55	0.00	26.70	89.31	2.00	0.00	0.55	0.00
26.74	85.17	2.00	0.00	0.55	0.00	26.83	80.72	2.00	0.00	0.55	0.00
26.87	75.36	2.00	0.00	0.54	0.00	26.94	71.10	2.00	0.00	0.54	0.00
27.01	68.33	2.00	0.00	0.54	0.00	27.05	68.01	2.00	0.00	0.54	0.00
27.13	69.43	2.00	0.00	0.54	0.00	27.18	70.64	2.00	0.00	0.54	0.00
27.30	69.59	2.00	0.00	0.54	0.00	27.36	67.99	2.00	0.00	0.54	0.00
27.41	66.34	2.00	0.00	0.54	0.00	27.49	66.65	2.00	0.00	0.53	0.00
27.54	66.83	0.11	1.73	0.53	0.01	27.60	66.10	0.11	1.75	0.53	0.01
27.67	64.69	0.11	1.77	0.53	0.02	27.72	62.85	0.11	1.81	0.53	0.01
27.79	62.02	0.11	1.83	0.53	0.02	27.85	61.94	2.00	0.00	0.53	0.00
27.90	62.75	2.00	0.00	0.53	0.00	27.96	63.74	2.00	0.00	0.53	0.00
28.03	64.75	2.00	0.00	0.53	0.00	28.15	65.39	0.11	1.73	0.52	0.03
28.20	66.10	2.00	0.00	0.52	0.00	28.27	65.61	2.00	0.00	0.52	0.00
28.33	64.45	2.00	0.00	0.52	0.00	28.39	62.60	2.00	0.00	0.52	0.00
28.45	63.10	2.00	0.00	0.52	0.00	28.49	65.98	2.00	0.00	0.52	0.00
28.61	69.86	2.00	0.00	0.52	0.00	28.67	74.46	0.12	1.53	0.51	0.01
28.79	79.31	0.13	1.45	0.51	0.02	28.84	85.24	0.14	1.36	0.51	0.01
28.97	88.09	0.15	1.32	0.51	0.02	29.02	89.89	0.16	1.30	0.51	0.01
29.09	89.98	0.16	1.29	0.51	0.01	29.15	90.78	0.16	1.28	0.51	0.01
29.21	92.56	0.16	1.26	0.50	0.01	29.28	93.68	0.16	1.24	0.50	0.01
29.33	93.38	0.16	1.24	0.50	0.01	29.39	89.99	0.16	1.28	0.50	0.01
29.46	83.30	0.14	1.36	0.50	0.01	29.50	75.55	0.13	1.47	0.50	0.01
29.57	69.82	2.00	0.00	0.50	0.00	29.63	66.88	2.00	0.00	0.50	0.00
29.68	65.78	2.00	0.00	0.50	0.00	29.75	65.55	2.00	0.00	0.50	0.00
29.82	66.53	2.00	0.00	0.49	0.00	29.86	68.45	2.00	0.00	0.49	0.00
29.94	71.14	2.00	0.00	0.49	0.00	29.99	78.55	2.00	0.00	0.49	0.00
30.12	85.03	2.00	0.00	0.49	0.00	30.18	89.42	2.00	0.00	0.49	0.00
30.25	88.81	2.00	0.00	0.49	0.00	30.30	88.21	2.00	0.00	0.49	0.00
30.37	88.95	2.00	0.00	0.49	0.00	30.43	90.77	2.00	0.00	0.48	0.00
30.48	92.91	2.00	0.00	0.48	0.00	30.54	94.51	2.00	0.00	0.48	0.00
30.61	95.38	2.00	0.00	0.48	0.00	30.65	96.17	0.17	1.16	0.48	0.01
30.79	97.22	0.17	1.14	0.48	0.02	30.83	100.57	0.18	1.11	0.48	0.01
30.96	103.28	0.19	1.08	0.48	0.02	31.01	102.44	0.19	1.09	0.47	0.01
31.13	95.49	2.00	0.00	0.47	0.00	31.19	87.90	2.00	0.00	0.47	0.00
31.26	84.20	2.00	0.00	0.47	0.00	31.32	86.94	2.00	0.00	0.47	0.00
31.38	93.61	2.00	0.00	0.47	0.00	31.45	99.61	2.00	0.00	0.47	0.00
31.50	105.04	2.00	0.00	0.47	0.00	31.55	108.48	2.00	0.00	0.47	0.00
31.63	111.18	2.00	0.00	0.46	0.00	31.64	111.68	2.00	0.00	0.46	0.00
31.71	109.27	2.00	0.00	0.46	0.00	31.80	105.47	2.00	0.00	0.46	0.00
31.85	101.41	2.00	0.00	0.46	0.00	31.97	98.13	2.00	0.00	0.46	0.00
32.03	94.38	0.17	1.12	0.46	0.01	32.10	90.08	0.16	1.16	0.46	0.01
32.15	84.02	0.14	1.23	0.46	0.01	32.21	78.75	0.13	1.29	0.45	0.01
32.29	75.59	0.13	1.33	0.45	0.01	32.34	74.80	2.00	0.00	0.45	0.00
32.40	74.26	2.00	0.00	0.45	0.00	32.46	73.94	2.00	0.00	0.45	0.00
32.52	75.07	2.00	0.00	0.45	0.00	32.59	76.43	2.00	0.00	0.45	0.00
32.64	75.99	2.00	0.00	0.45	0.00	32.76	73.69	2.00	0.00	0.44	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
32.82	71.09	2.00	0.00	0.44	0.00	32.89	71.64	0.12	1.36	0.44	0.01
32.95	75.58	0.13	1.30	0.44	0.01	33.00	80.97	2.00	0.00	0.44	0.00
33.08	87.66	2.00	0.00	0.44	0.00	33.18	95.43	2.00	0.00	0.44	0.00
33.26	104.36	2.00	0.00	0.44	0.00	33.36	111.56	2.00	0.00	0.43	0.00
33.43	116.69	2.00	0.00	0.43	0.00	33.49	119.19	2.00	0.00	0.43	0.00
33.55	119.56	2.00	0.00	0.43	0.00	33.61	117.99	2.00	0.00	0.43	0.00
33.67	113.87	2.00	0.00	0.43	0.00	33.74	107.93	2.00	0.00	0.43	0.00
33.80	101.33	2.00	0.00	0.43	0.00	33.86	94.89	2.00	0.00	0.43	0.00
33.92	89.29	2.00	0.00	0.43	0.00	33.98	82.30	0.14	1.16	0.42	0.01
34.05	77.63	2.00	0.00	0.42	0.00	34.10	75.07	2.00	0.00	0.42	0.00
34.15	76.01	2.00	0.00	0.42	0.00	34.23	76.82	2.00	0.00	0.42	0.00
34.28	76.48	2.00	0.00	0.42	0.00	34.36	75.19	2.00	0.00	0.42	0.00
34.41	72.81	2.00	0.00	0.42	0.00	34.48	70.93	2.00	0.00	0.42	0.00
34.54	69.47	2.00	0.00	0.41	0.00	34.60	68.46	2.00	0.00	0.41	0.00
34.66	67.13	2.00	0.00	0.41	0.00	34.72	64.46	0.11	1.38	0.41	0.01
34.85	62.10	2.00	0.00	0.41	0.00	34.91	59.62	2.00	0.00	0.41	0.00
34.99	58.78	2.00	0.00	0.41	0.00	35.03	57.58	2.00	0.00	0.41	0.00
35.11	56.40	2.00	0.00	0.40	0.00	35.16	55.20	2.00	0.00	0.40	0.00
35.23	55.58	2.00	0.00	0.40	0.00	35.29	57.66	2.00	0.00	0.40	0.00
35.34	60.65	2.00	0.00	0.40	0.00	35.40	63.74	2.00	0.00	0.40	0.00
35.47	67.09	2.00	0.00	0.40	0.00	35.53	70.66	2.00	0.00	0.40	0.00
35.60	74.50	2.00	0.00	0.40	0.00	35.70	77.23	2.00	0.00	0.39	0.00
35.78	78.77	2.00	0.00	0.39	0.00	35.83	78.95	2.00	0.00	0.39	0.00
35.87	79.15	2.00	0.00	0.39	0.00	35.96	79.59	2.00	0.00	0.39	0.00
36.01	80.50	2.00	0.00	0.39	0.00	36.09	81.36	2.00	0.00	0.39	0.00
36.14	82.26	2.00	0.00	0.39	0.00	36.19	83.03	2.00	0.00	0.39	0.00
36.27	83.68	2.00	0.00	0.39	0.00	36.31	84.25	2.00	0.00	0.38	0.00
36.37	84.91	2.00	0.00	0.38	0.00	36.44	85.50	2.00	0.00	0.38	0.00
36.49	85.72	2.00	0.00	0.38	0.00	36.55	84.93	2.00	0.00	0.38	0.00
36.62	82.92	2.00	0.00	0.38	0.00	36.74	80.92	2.00	0.00	0.38	0.00
36.80	79.19	2.00	0.00	0.38	0.00	36.86	77.16	2.00	0.00	0.38	0.00
36.94	74.11	2.00	0.00	0.37	0.00	36.99	70.49	2.00	0.00	0.37	0.00
37.05	68.26	2.00	0.00	0.37	0.00	37.11	67.06	2.00	0.00	0.37	0.00
37.17	66.66	2.00	0.00	0.37	0.00	37.22	66.15	2.00	0.00	0.37	0.00
37.35	66.84	2.00	0.00	0.37	0.00	37.40	68.91	2.00	0.00	0.37	0.00
37.46	70.31	2.00	0.00	0.37	0.00	37.53	69.85	2.00	0.00	0.36	0.00
37.60	67.95	2.00	0.00	0.36	0.00	37.65	67.09	2.00	0.00	0.36	0.00
37.72	69.69	2.00	0.00	0.36	0.00	37.78	75.26	2.00	0.00	0.36	0.00
37.83	81.78	2.00	0.00	0.36	0.00	37.91	85.06	2.00	0.00	0.36	0.00
37.97	86.41	2.00	0.00	0.36	0.00	38.02	88.16	2.00	0.00	0.36	0.00
38.09	90.84	0.16	0.90	0.35	0.01	38.19	92.04	0.16	0.88	0.35	0.01
38.26	91.45	2.00	0.00	0.35	0.00	38.32	88.89	2.00	0.00	0.35	0.00
38.37	86.29	2.00	0.00	0.35	0.00	38.44	84.36	2.00	0.00	0.35	0.00
38.49	83.88	2.00	0.00	0.35	0.00	38.55	83.98	2.00	0.00	0.35	0.00
38.62	83.79	2.00	0.00	0.35	0.00	38.68	83.14	2.00	0.00	0.34	0.00
38.72	82.55	2.00	0.00	0.34	0.00	38.80	82.32	2.00	0.00	0.34	0.00
38.85	81.30	2.00	0.00	0.34	0.00	38.98	79.89	2.00	0.00	0.34	0.00
39.03	78.09	2.00	0.00	0.34	0.00	39.09	75.85	2.00	0.00	0.34	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.21	72.68	2.00	0.00	0.34	0.00	39.26	69.09	2.00	0.00	0.33	0.00
39.33	66.59	2.00	0.00	0.33	0.00	39.39	64.73	2.00	0.00	0.33	0.00
39.45	63.19	2.00	0.00	0.33	0.00	39.52	61.84	2.00	0.00	0.33	0.00
39.58	60.09	2.00	0.00	0.33	0.00	39.65	58.72	2.00	0.00	0.33	0.00
39.70	57.65	2.00	0.00	0.33	0.00	39.74	57.53	2.00	0.00	0.33	0.00
39.82	58.18	2.00	0.00	0.33	0.00	39.87	60.52	2.00	0.00	0.32	0.00
39.95	63.39	2.00	0.00	0.32	0.00	40.01	65.47	2.00	0.00	0.32	0.00
40.06	65.46	2.00	0.00	0.32	0.00	40.14	63.94	2.00	0.00	0.32	0.00
40.25	62.72	2.00	0.00	0.32	0.00	40.32	62.38	2.00	0.00	0.32	0.00
40.36	62.39	2.00	0.00	0.32	0.00	40.42	62.03	2.00	0.00	0.31	0.00
40.49	61.55	2.00	0.00	0.31	0.00	40.54	59.70	2.00	0.00	0.31	0.00
40.62	57.63	2.00	0.00	0.31	0.00	40.68	55.41	2.00	0.00	0.31	0.00
40.73	57.23	2.00	0.00	0.31	0.00	40.85	59.91	2.00	0.00	0.31	0.00
40.92	62.74	2.00	0.00	0.31	0.00	40.94	63.35	2.00	0.00	0.31	0.00
40.95	63.90	2.00	0.00	0.31	0.00	41.08	64.21	2.00	0.00	0.30	0.00
41.13	64.68	2.00	0.00	0.30	0.00	41.17	65.62	2.00	0.00	0.30	0.00
41.26	67.64	2.00	0.00	0.30	0.00	41.30	71.00	2.00	0.00	0.30	0.00
41.38	75.06	2.00	0.00	0.30	0.00	41.44	79.69	2.00	0.00	0.30	0.00
41.50	84.20	2.00	0.00	0.30	0.00	41.57	88.52	2.00	0.00	0.30	0.00
41.62	92.14	2.00	0.00	0.29	0.00	41.68	95.31	2.00	0.00	0.29	0.00
41.75	96.41	2.00	0.00	0.29	0.00	41.84	95.42	2.00	0.00	0.29	0.00
41.92	92.54	2.00	0.00	0.29	0.00	41.97	88.95	2.00	0.00	0.29	0.00
42.05	85.49	2.00	0.00	0.29	0.00	42.10	82.91	2.00	0.00	0.29	0.00
42.14	81.74	2.00	0.00	0.29	0.00	42.23	81.24	2.00	0.00	0.28	0.00
42.28	81.00	2.00	0.00	0.28	0.00	42.33	81.28	2.00	0.00	0.28	0.00
42.41	82.16	2.00	0.00	0.28	0.00	42.46	83.41	2.00	0.00	0.28	0.00
42.59	84.01	2.00	0.00	0.28	0.00	42.64	83.83	2.00	0.00	0.28	0.00
42.71	83.30	2.00	0.00	0.28	0.00	42.77	83.13	2.00	0.00	0.28	0.00
42.82	84.39	2.00	0.00	0.27	0.00	42.89	86.34	2.00	0.00	0.27	0.00
42.94	89.32	2.00	0.00	0.27	0.00	43.01	92.26	2.00	0.00	0.27	0.00
43.07	94.84	2.00	0.00	0.27	0.00	43.19	96.15	2.00	0.00	0.27	0.00
43.24	96.44	2.00	0.00	0.27	0.00	43.30	95.61	2.00	0.00	0.27	0.00
43.36	93.37	2.00	0.00	0.27	0.00	43.43	90.22	2.00	0.00	0.26	0.00
43.48	86.39	2.00	0.00	0.26	0.00	43.53	82.78	2.00	0.00	0.26	0.00
43.61	79.05	2.00	0.00	0.26	0.00	43.67	74.64	2.00	0.00	0.26	0.00
43.74	71.47	2.00	0.00	0.26	0.00	43.78	69.80	2.00	0.00	0.26	0.00
43.86	70.74	2.00	0.00	0.26	0.00	43.92	72.25	2.00	0.00	0.26	0.00
43.98	74.58	2.00	0.00	0.25	0.00	44.09	76.54	2.00	0.00	0.25	0.00
44.14	78.02	2.00	0.00	0.25	0.00	44.18	78.60	2.00	0.00	0.25	0.00
44.23	78.47	2.00	0.00	0.25	0.00	44.34	77.57	2.00	0.00	0.25	0.00
44.37	75.61	2.00	0.00	0.25	0.00	44.43	72.64	2.00	0.00	0.25	0.00
44.52	68.93	2.00	0.00	0.25	0.00	44.60	66.02	2.00	0.00	0.24	0.00
44.65	64.65	2.00	0.00	0.24	0.00	44.70	63.82	2.00	0.00	0.24	0.00
44.78	62.37	2.00	0.00	0.24	0.00	44.87	60.43	2.00	0.00	0.24	0.00
44.91	59.05	2.00	0.00	0.24	0.00	44.96	57.93	2.00	0.00	0.24	0.00
45.06	56.39	2.00	0.00	0.24	0.00	45.12	54.86	2.00	0.00	0.24	0.00
45.18	53.70	2.00	0.00	0.23	0.00	45.24	52.50	2.00	0.00	0.23	0.00
45.35	52.18	2.00	0.00	0.23	0.00	45.42	51.80	2.00	0.00	0.23	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
45.47	52.51	2.00	0.00	0.23	0.00	45.54	53.03	2.00	0.00	0.23	0.00
45.60	52.63	2.00	0.00	0.23	0.00	45.70	50.65	2.00	0.00	0.23	0.00
45.78	47.64	2.00	0.00	0.22	0.00	45.82	46.25	2.00	0.00	0.22	0.00
45.90	46.83	2.00	0.00	0.22	0.00	45.95	48.22	2.00	0.00	0.22	0.00
46.00	50.03	2.00	0.00	0.22	0.00	46.13	50.55	2.00	0.00	0.22	0.00
46.19	49.29	2.00	0.00	0.22	0.00	46.31	46.61	2.00	0.00	0.22	0.00
46.37	43.90	2.00	0.00	0.21	0.00	46.44	42.80	2.00	0.00	0.21	0.00
46.49	42.07	2.00	0.00	0.21	0.00	46.55	42.13	2.00	0.00	0.21	0.00
46.62	42.35	2.00	0.00	0.21	0.00	46.67	45.67	2.00	0.00	0.21	0.00
46.75	52.29	2.00	0.00	0.21	0.00	46.80	61.05	2.00	0.00	0.21	0.00
46.86	69.46	2.00	0.00	0.21	0.00	46.93	75.49	2.00	0.00	0.20	0.00
46.99	78.39	2.00	0.00	0.20	0.00	47.02	77.51	2.00	0.00	0.20	0.00
47.10	77.25	2.00	0.00	0.20	0.00	47.15	78.45	2.00	0.00	0.20	0.00
47.27	79.07	2.00	0.00	0.20	0.00	47.31	80.29	2.00	0.00	0.20	0.00
47.35	82.31	0.14	0.54	0.20	0.00	47.42	85.07	0.15	0.52	0.20	0.00
47.47	87.95	0.15	0.51	0.20	0.00	47.54	89.77	0.16	0.50	0.19	0.00
47.57	92.13	0.16	0.48	0.19	0.00	47.65	93.79	0.17	0.47	0.19	0.00
47.74	94.98	0.17	0.47	0.19	0.00	47.79	94.11	0.17	0.47	0.19	0.00
47.88	92.78	0.17	0.47	0.19	0.01	47.91	89.43	0.16	0.48	0.19	0.00
48.01	85.78	0.15	0.49	0.19	0.01	48.03	78.71	0.14	0.53	0.19	0.00
48.14	72.47	0.12	0.56	0.18	0.01	48.19	66.38	2.00	0.00	0.18	0.00
48.24	63.83	2.00	0.00	0.18	0.00	48.31	63.64	2.00	0.00	0.18	0.00
48.41	65.48	2.00	0.00	0.18	0.00	48.48	67.59	2.00	0.00	0.18	0.00
48.55	67.41	2.00	0.00	0.18	0.00	48.59	66.36	2.00	0.00	0.18	0.00
48.65	65.05	2.00	0.00	0.18	0.00	48.72	63.79	2.00	0.00	0.17	0.00
48.77	63.03	2.00	0.00	0.17	0.00	48.83	63.19	2.00	0.00	0.17	0.00
48.90	64.16	2.00	0.00	0.17	0.00	49.00	65.70	2.00	0.00	0.17	0.00
49.08	67.24	2.00	0.00	0.17	0.00	49.13	68.05	2.00	0.00	0.17	0.00
49.20	68.25	2.00	0.00	0.17	0.00	49.25	68.15	2.00	0.00	0.17	0.00
49.32	68.42	2.00	0.00	0.16	0.00	49.39	68.79	2.00	0.00	0.16	0.00
49.44	69.43	2.00	0.00	0.16	0.00	49.51	69.96	2.00	0.00	0.16	0.00
49.56	70.41	2.00	0.00	0.16	0.00	49.61	71.00	2.00	0.00	0.16	0.00
49.71	70.57	2.00	0.00	0.16	0.00	49.75	70.08	2.00	0.00	0.16	0.00
49.83	68.98	2.00	0.00	0.16	0.00	49.88	68.04	2.00	0.00	0.15	0.00
49.97	66.81	2.00	0.00	0.15	0.00	50.02	65.81	2.00	0.00	0.15	0.00

Total estimated settlement: 1.79

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

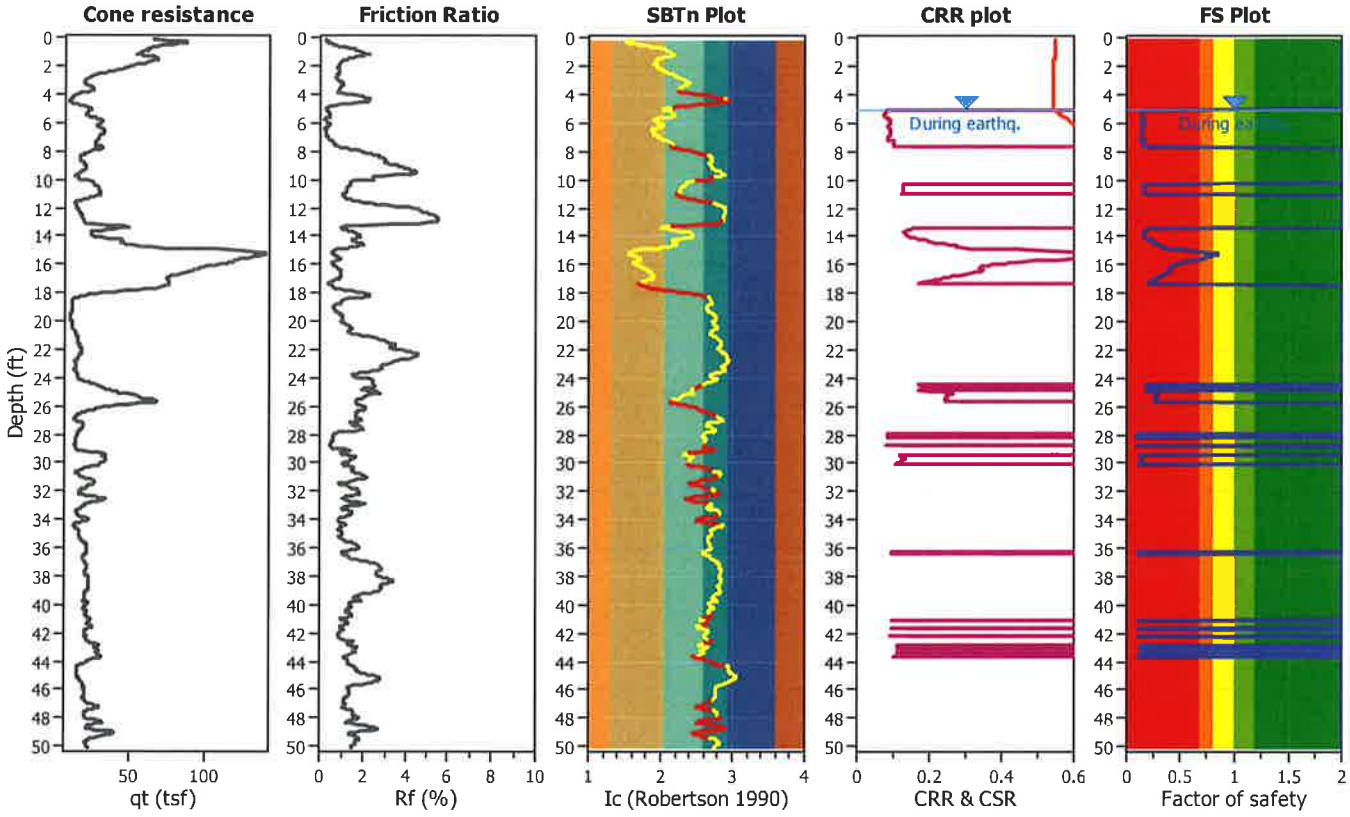
LIQUEFACTION ANALYSIS REPORT

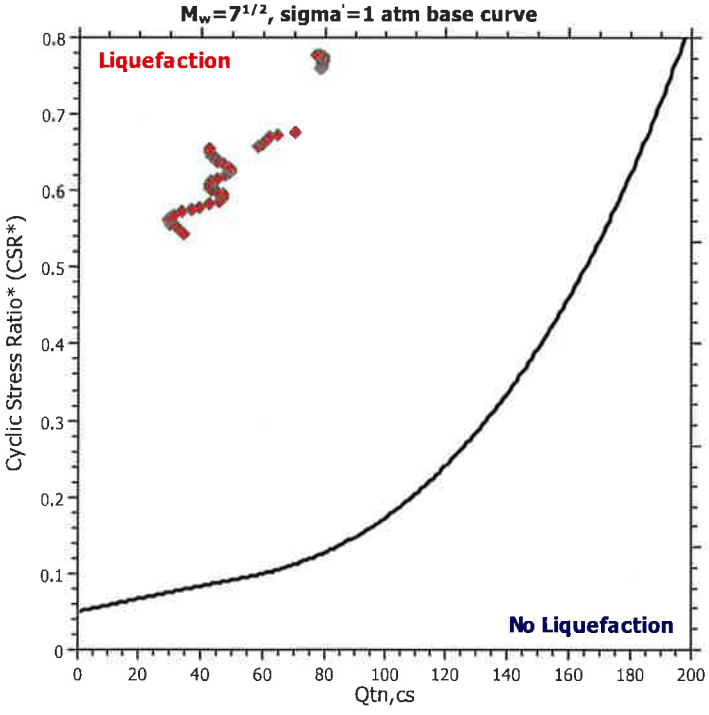
Project title : S-Line Upgrades **Location : Imperial County, CA**

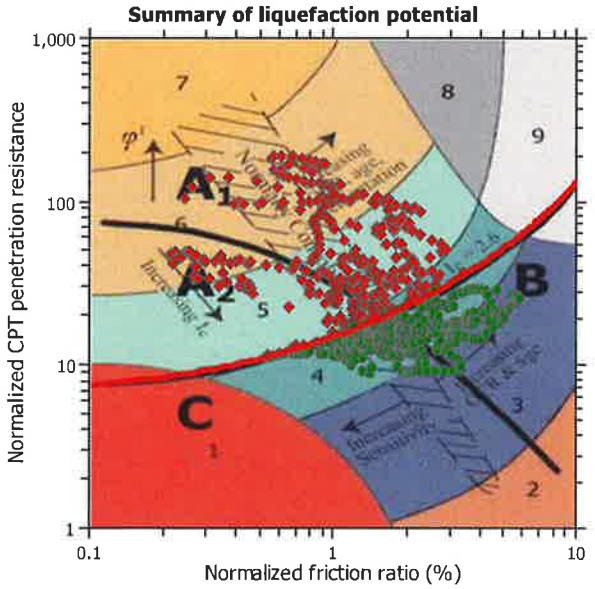
CPT file : CPT-8

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.77	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

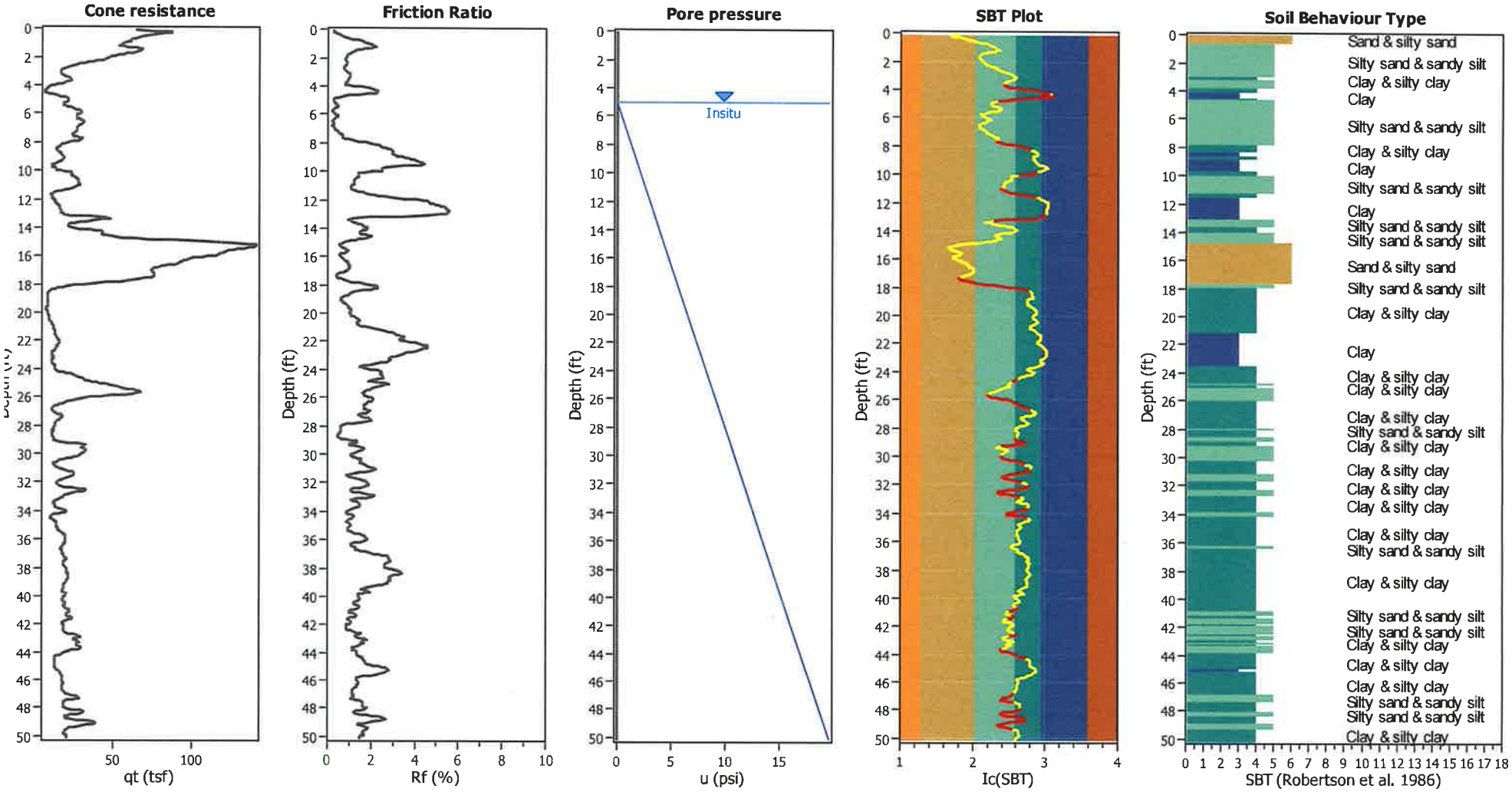






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



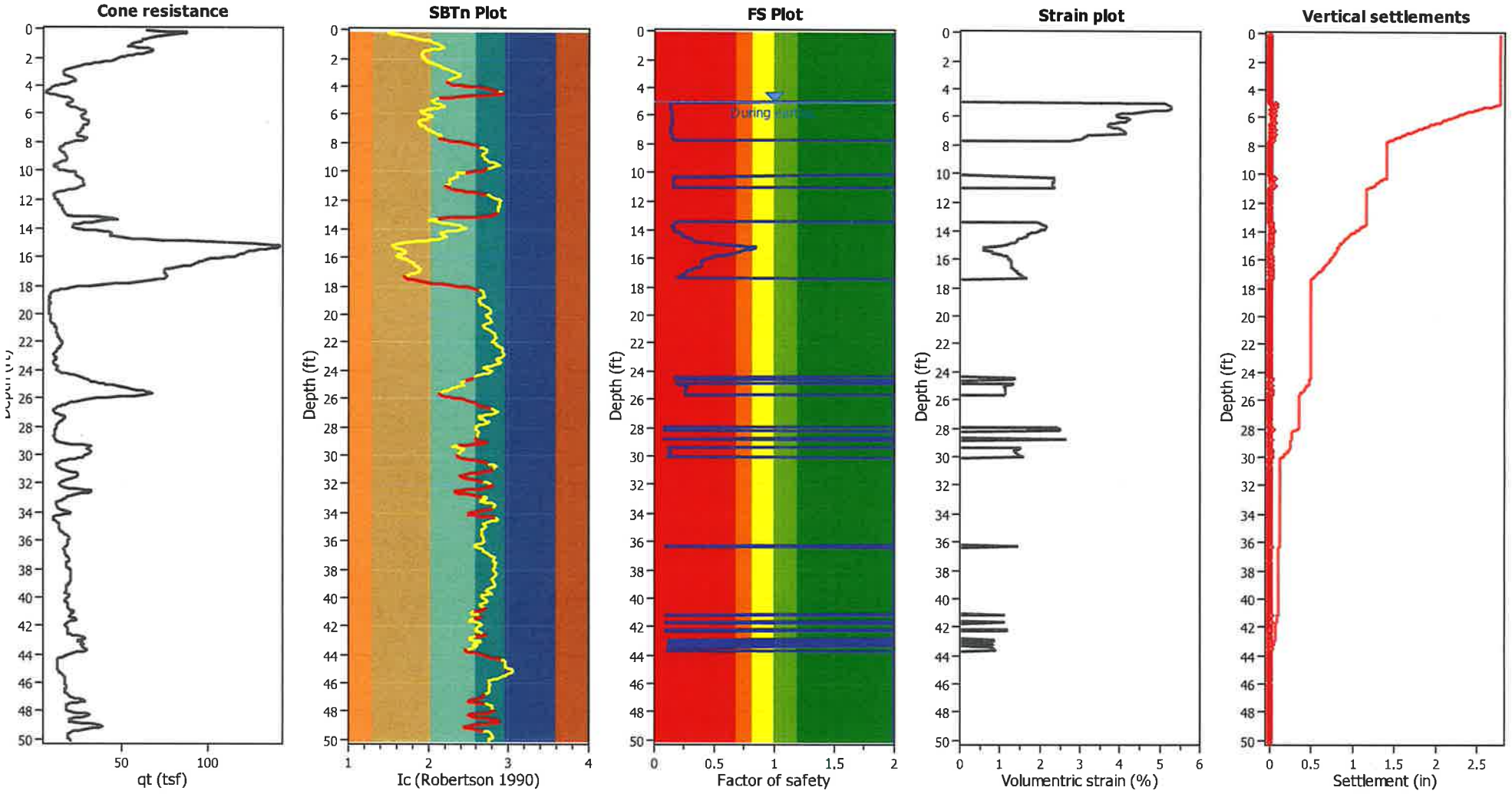
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.77	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
5.05	34.56	0.15	5.11	0.91	0.08	5.10	33.77	0.14	5.20	0.91	0.03
5.23	31.64	0.14	5.29	0.91	0.08	5.28	30.06	0.13	5.28	0.91	0.03
5.33	29.45	0.13	5.28	0.91	0.03	5.37	29.54	0.13	5.27	0.91	0.03
5.42	29.86	0.13	5.27	0.91	0.03	5.46	31.43	0.13	5.26	0.91	0.03
5.55	33.69	0.14	5.17	0.91	0.06	5.60	36.59	0.14	4.82	0.91	0.03
5.65	39.36	0.14	4.54	0.90	0.03	5.73	42.37	0.15	4.27	0.90	0.04
5.78	45.42	0.15	4.03	0.90	0.02	5.90	46.98	0.15	3.91	0.90	0.06
5.96	46.70	0.15	3.92	0.90	0.03	6.03	44.71	0.15	4.06	0.90	0.03
6.08	43.15	0.14	4.18	0.90	0.03	6.15	42.38	0.14	4.23	0.90	0.04
6.21	42.42	0.14	4.22	0.89	0.03	6.32	43.36	0.14	4.14	0.89	0.06
6.39	45.14	0.14	4.00	0.89	0.03	6.45	47.44	0.14	3.84	0.89	0.03
6.51	48.92	0.15	3.74	0.89	0.03	6.57	49.56	0.15	3.69	0.89	0.02
6.64	49.47	0.15	3.69	0.89	0.03	6.70	48.63	0.14	3.74	0.89	0.03
6.77	47.18	0.14	3.83	0.89	0.03	6.81	45.24	0.14	3.96	0.88	0.02
6.93	44.08	0.13	4.04	0.88	0.06	6.97	43.06	0.13	4.11	0.88	0.02
7.05	43.32	0.13	4.09	0.88	0.04	7.09	42.81	0.13	4.12	0.88	0.02
7.21	42.34	0.13	4.15	0.88	0.06	7.27	58.15	0.15	3.20	0.88	0.02
7.36	59.08	0.15	3.15	0.88	0.03	7.42	60.20	0.15	3.10	0.87	0.02
7.47	60.86	0.15	3.07	0.87	0.02	7.58	62.15	0.15	3.01	0.87	0.04
7.62	64.46	0.16	2.92	0.87	0.02	7.68	70.17	0.17	2.72	0.87	0.02
7.75	75.69	2.00	0.00	0.87	0.00	7.80	80.99	2.00	0.00	0.87	0.00
7.91	83.68	2.00	0.00	0.87	0.00	7.94	85.90	2.00	0.00	0.87	0.00
8.06	87.35	2.00	0.00	0.86	0.00	8.11	88.21	2.00	0.00	0.86	0.00
8.18	88.76	2.00	0.00	0.86	0.00	8.24	88.80	2.00	0.00	0.86	0.00
8.29	89.39	2.00	0.00	0.86	0.00	8.35	89.88	2.00	0.00	0.86	0.00
8.42	90.37	2.00	0.00	0.86	0.00	8.47	91.45	2.00	0.00	0.86	0.00
8.53	93.07	2.00	0.00	0.86	0.00	8.65	94.67	2.00	0.00	0.85	0.00
8.73	96.15	2.00	0.00	0.85	0.00	8.78	98.27	2.00	0.00	0.85	0.00
8.84	101.56	2.00	0.00	0.85	0.00	8.91	105.30	2.00	0.00	0.85	0.00
8.95	108.89	2.00	0.00	0.85	0.00	9.01	112.16	2.00	0.00	0.85	0.00
9.08	115.14	2.00	0.00	0.85	0.00	9.14	117.63	2.00	0.00	0.85	0.00
9.20	119.27	2.00	0.00	0.84	0.00	9.27	120.03	2.00	0.00	0.84	0.00
9.32	119.12	2.00	0.00	0.84	0.00	9.39	116.31	2.00	0.00	0.84	0.00
9.50	111.99	2.00	0.00	0.84	0.00	9.57	102.84	2.00	0.00	0.84	0.00
9.62	91.16	2.00	0.00	0.84	0.00	9.70	81.12	2.00	0.00	0.84	0.00
9.75	78.62	2.00	0.00	0.83	0.00	9.82	81.55	2.00	0.00	0.83	0.00
9.93	83.54	2.00	0.00	0.83	0.00	9.97	84.23	2.00	0.00	0.83	0.00
10.00	81.52	2.00	0.00	0.83	0.00	10.07	78.51	2.00	0.00	0.83	0.00
10.11	77.56	2.00	0.00	0.83	0.00	10.27	78.07	0.16	2.36	0.83	0.05
10.32	78.93	0.17	2.34	0.83	0.01	10.36	78.95	0.16	2.34	0.82	0.01
10.41	78.73	0.16	2.34	0.82	0.01	10.46	78.60	0.16	2.34	0.82	0.01
10.51	78.61	0.16	2.34	0.82	0.02	10.58	78.67	0.16	2.33	0.82	0.02
10.64	79.19	0.16	2.32	0.82	0.01	10.80	79.26	0.16	2.31	0.82	0.05
10.87	78.97	0.16	2.31	0.82	0.02	10.94	78.05	0.16	2.33	0.81	0.02
10.99	76.74	0.16	2.36	0.81	0.01	11.06	75.24	2.00	0.00	0.81	0.00
11.11	72.97	2.00	0.00	0.81	0.00	11.24	71.08	2.00	0.00	0.81	0.00
11.29	69.89	2.00	0.00	0.81	0.00	11.35	69.42	2.00	0.00	0.81	0.00
11.42	69.09	2.00	0.00	0.81	0.00	11.47	69.56	2.00	0.00	0.81	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.53	69.28	2.00	0.00	0.80	0.00	11.60	70.35	2.00	0.00	0.80	0.00
11.65	71.65	2.00	0.00	0.80	0.00	11.71	75.42	2.00	0.00	0.80	0.00
11.78	79.95	2.00	0.00	0.80	0.00	11.83	86.65	2.00	0.00	0.80	0.00
11.91	93.84	2.00	0.00	0.80	0.00	11.96	101.22	2.00	0.00	0.80	0.00
12.03	106.20	2.00	0.00	0.80	0.00	12.09	110.27	2.00	0.00	0.80	0.00
12.22	113.51	2.00	0.00	0.79	0.00	12.26	116.68	2.00	0.00	0.79	0.00
12.32	119.67	2.00	0.00	0.79	0.00	12.40	122.33	2.00	0.00	0.79	0.00
12.44	125.62	2.00	0.00	0.79	0.00	12.51	128.76	2.00	0.00	0.79	0.00
12.57	131.98	2.00	0.00	0.79	0.00	12.63	133.03	2.00	0.00	0.79	0.00
12.69	133.93	2.00	0.00	0.78	0.00	12.75	134.16	2.00	0.00	0.78	0.00
12.82	135.92	2.00	0.00	0.78	0.00	12.88	136.69	2.00	0.00	0.78	0.00
13.00	136.69	2.00	0.00	0.78	0.00	13.02	133.90	2.00	0.00	0.78	0.00
13.07	128.57	2.00	0.00	0.78	0.00	13.13	118.53	2.00	0.00	0.78	0.00
13.20	105.47	2.00	0.00	0.78	0.00	13.31	100.63	2.00	0.00	0.77	0.00
13.37	98.00	2.00	0.00	0.77	0.00	13.43	92.16	0.18	1.93	0.77	0.01
13.50	87.54	0.17	2.01	0.77	0.02	13.55	84.12	0.16	2.07	0.77	0.01
13.62	81.66	0.16	2.12	0.77	0.02	13.68	79.56	0.15	2.16	0.77	0.02
13.73	79.85	0.15	2.16	0.77	0.01	13.86	81.44	0.16	2.12	0.77	0.03
13.91	85.56	0.16	2.03	0.76	0.01	14.04	88.97	0.17	1.96	0.76	0.03
14.08	93.90	0.19	1.87	0.76	0.01	14.15	98.71	0.20	1.80	0.76	0.02
14.22	102.89	0.22	1.73	0.76	0.01	14.26	105.89	0.23	1.69	0.76	0.01
14.34	107.40	0.23	1.67	0.76	0.02	14.40	109.06	0.24	1.65	0.76	0.01
14.46	113.07	0.25	1.60	0.75	0.01	14.52	119.25	0.28	1.52	0.75	0.01
14.57	124.69	0.31	1.47	0.75	0.01	14.65	127.25	0.32	1.44	0.75	0.01
14.70	127.92	0.32	1.43	0.75	0.01	14.76	130.39	0.34	1.41	0.75	0.01
14.83	136.21	0.37	1.36	0.75	0.01	14.88	145.94	0.43	1.28	0.75	0.01
14.94	158.09	0.52	1.20	0.75	0.01	15.06	170.10	0.63	1.05	0.74	0.02
15.12	185.72	0.79	0.61	0.74	0.00	15.18	190.02	0.84	0.59	0.74	0.00
15.24	190.14	0.84	0.59	0.74	0.00	15.30	187.33	0.81	0.60	0.74	0.00
15.37	182.87	0.76	0.62	0.74	0.01	15.42	180.22	0.73	0.79	0.74	0.00
15.49	179.19	0.72	0.79	0.74	0.01	15.54	178.04	0.70	0.80	0.74	0.00
15.61	177.01	0.69	0.80	0.74	0.01	15.68	172.00	0.64	1.02	0.73	0.01
15.73	163.73	0.57	1.09	0.73	0.01	15.80	156.83	0.51	1.18	0.73	0.01
15.85	154.55	0.49	1.20	0.73	0.01	15.93	151.57	0.47	1.21	0.73	0.01
15.98	146.89	0.43	1.24	0.73	0.01	16.03	144.15	0.41	1.26	0.73	0.01
16.12	141.49	0.40	1.28	0.73	0.01	16.16	140.48	0.39	1.28	0.73	0.01
16.25	140.27	0.39	1.28	0.72	0.01	16.29	140.89	0.39	1.28	0.72	0.01
16.36	141.70	0.40	1.27	0.72	0.01	16.42	141.81	0.40	1.27	0.72	0.01
16.47	140.59	0.39	1.27	0.72	0.01	16.55	138.31	0.37	1.29	0.72	0.01
16.60	134.23	0.35	1.32	0.72	0.01	16.70	129.36	0.32	1.36	0.72	0.02
16.79	124.89	0.30	1.39	0.72	0.01	16.83	121.53	0.28	1.42	0.71	0.01
16.93	119.02	0.27	1.44	0.71	0.02	16.99	116.83	0.26	1.46	0.71	0.01
17.03	115.00	0.25	1.48	0.71	0.01	17.09	112.88	0.24	1.50	0.71	0.01
17.14	109.20	0.23	1.54	0.71	0.01	17.22	105.20	0.21	1.59	0.71	0.02
17.27	97.95	0.19	1.68	0.71	0.01	17.33	97.68	0.19	1.68	0.71	0.01
17.39	97.49	2.00	0.00	0.71	0.00	17.49	96.39	2.00	0.00	0.70	0.00
17.53	103.26	2.00	0.00	0.70	0.00	17.64	102.28	2.00	0.00	0.70	0.00
17.68	101.68	2.00	0.00	0.70	0.00	17.79	101.58	2.00	0.00	0.70	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
17.84	102.33	2.00	0.00	0.70	0.00	17.94	101.73	2.00	0.00	0.70	0.00
18.01	100.69	2.00	0.00	0.69	0.00	18.07	96.99	2.00	0.00	0.69	0.00
18.12	92.45	2.00	0.00	0.69	0.00	18.19	87.25	2.00	0.00	0.69	0.00
18.24	80.27	2.00	0.00	0.69	0.00	18.32	73.15	2.00	0.00	0.69	0.00
18.37	64.66	2.00	0.00	0.69	0.00	18.43	56.86	2.00	0.00	0.69	0.00
18.55	51.06	2.00	0.00	0.69	0.00	18.60	48.92	2.00	0.00	0.68	0.00
18.72	47.32	2.00	0.00	0.68	0.00	18.78	44.80	2.00	0.00	0.68	0.00
18.90	41.46	2.00	0.00	0.68	0.00	18.97	40.68	2.00	0.00	0.68	0.00
19.03	41.15	2.00	0.00	0.68	0.00	19.08	41.63	2.00	0.00	0.68	0.00
19.13	42.06	2.00	0.00	0.68	0.00	19.16	42.26	2.00	0.00	0.68	0.00
19.26	42.91	2.00	0.00	0.67	0.00	19.30	44.43	2.00	0.00	0.67	0.00
19.39	45.84	2.00	0.00	0.67	0.00	19.43	46.83	2.00	0.00	0.67	0.00
19.54	46.90	2.00	0.00	0.67	0.00	19.59	47.01	2.00	0.00	0.67	0.00
19.64	47.45	2.00	0.00	0.67	0.00	19.73	47.96	2.00	0.00	0.67	0.00
19.80	48.40	2.00	0.00	0.66	0.00	19.86	48.40	2.00	0.00	0.66	0.00
19.92	48.22	2.00	0.00	0.66	0.00	19.98	48.08	2.00	0.00	0.66	0.00
20.04	48.43	2.00	0.00	0.66	0.00	20.12	49.36	2.00	0.00	0.66	0.00
20.16	50.70	2.00	0.00	0.66	0.00	20.21	52.34	2.00	0.00	0.66	0.00
20.29	54.19	2.00	0.00	0.66	0.00	20.39	55.82	2.00	0.00	0.65	0.00
20.46	57.02	2.00	0.00	0.65	0.00	20.52	57.42	2.00	0.00	0.65	0.00
20.57	57.41	2.00	0.00	0.65	0.00	20.63	57.12	2.00	0.00	0.65	0.00
20.70	57.03	2.00	0.00	0.65	0.00	20.76	58.06	2.00	0.00	0.65	0.00
20.83	59.76	2.00	0.00	0.65	0.00	20.88	62.52	2.00	0.00	0.65	0.00
20.93	66.13	2.00	0.00	0.65	0.00	21.01	71.20	2.00	0.00	0.64	0.00
21.13	76.78	2.00	0.00	0.64	0.00	21.24	81.49	2.00	0.00	0.64	0.00
21.31	84.90	2.00	0.00	0.64	0.00	21.36	87.01	2.00	0.00	0.64	0.00
21.41	88.75	2.00	0.00	0.64	0.00	21.50	90.18	2.00	0.00	0.64	0.00
21.54	92.08	2.00	0.00	0.63	0.00	21.61	94.28	2.00	0.00	0.63	0.00
21.67	96.68	2.00	0.00	0.63	0.00	21.72	97.46	2.00	0.00	0.63	0.00
21.78	96.69	2.00	0.00	0.63	0.00	21.85	95.51	2.00	0.00	0.63	0.00
21.91	96.96	2.00	0.00	0.63	0.00	21.98	100.72	2.00	0.00	0.63	0.00
22.03	105.31	2.00	0.00	0.63	0.00	22.09	108.37	2.00	0.00	0.63	0.00
22.12	110.73	2.00	0.00	0.63	0.00	22.24	112.02	2.00	0.00	0.62	0.00
22.28	112.86	2.00	0.00	0.62	0.00	22.33	112.41	2.00	0.00	0.62	0.00
22.38	111.15	2.00	0.00	0.62	0.00	22.45	109.71	2.00	0.00	0.62	0.00
22.51	106.19	2.00	0.00	0.62	0.00	22.64	100.16	2.00	0.00	0.62	0.00
22.75	93.50	2.00	0.00	0.61	0.00	22.82	89.16	2.00	0.00	0.61	0.00
22.86	87.05	2.00	0.00	0.61	0.00	23.00	85.27	2.00	0.00	0.61	0.00
23.04	83.64	2.00	0.00	0.61	0.00	23.10	82.72	2.00	0.00	0.61	0.00
23.17	82.06	2.00	0.00	0.61	0.00	23.22	81.33	2.00	0.00	0.61	0.00
23.30	80.55	2.00	0.00	0.61	0.00	23.34	79.64	2.00	0.00	0.60	0.00
23.40	78.28	2.00	0.00	0.60	0.00	23.48	76.24	2.00	0.00	0.60	0.00
23.53	73.38	2.00	0.00	0.60	0.00	23.59	70.36	2.00	0.00	0.60	0.00
23.66	67.40	2.00	0.00	0.60	0.00	23.71	64.63	2.00	0.00	0.60	0.00
23.79	62.45	2.00	0.00	0.60	0.00	23.83	62.82	2.00	0.00	0.60	0.00
23.96	65.83	2.00	0.00	0.59	0.00	24.01	70.35	2.00	0.00	0.59	0.00
24.07	75.25	2.00	0.00	0.59	0.00	24.14	79.60	2.00	0.00	0.59	0.00
24.19	83.54	2.00	0.00	0.59	0.00	24.24	87.13	2.00	0.00	0.59	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
24.32	90.25	2.00	0.00	0.59	0.00	24.37	94.08	2.00	0.00	0.59	0.00
24.45	97.50	0.18	1.40	0.59	0.01	24.55	101.32	0.19	1.35	0.58	0.02
24.63	104.46	2.00	0.00	0.58	0.00	24.68	102.66	2.00	0.00	0.58	0.00
24.74	96.60	2.00	0.00	0.58	0.00	24.81	92.90	2.00	0.00	0.58	0.00
24.86	98.97	0.18	1.36	0.58	0.01	24.93	110.31	0.22	1.24	0.58	0.01
24.99	119.54	0.25	1.16	0.58	0.01	25.04	125.00	0.28	1.12	0.58	0.01
25.08	125.84	0.28	1.11	0.57	0.01	25.14	124.26	0.27	1.12	0.57	0.01
25.21	121.45	0.26	1.14	0.57	0.01	25.32	120.17	0.26	1.15	0.57	0.02
25.44	120.62	0.26	1.14	0.57	0.02	25.49	121.22	0.26	1.13	0.57	0.01
25.56	120.92	0.26	1.13	0.57	0.01	25.61	120.16	0.26	1.14	0.57	0.01
25.65	119.89	0.25	1.14	0.57	0.01	25.72	118.61	2.00	0.00	0.56	0.00
25.78	115.58	2.00	0.00	0.56	0.00	25.83	110.66	2.00	0.00	0.56	0.00
25.87	104.78	2.00	0.00	0.56	0.00	25.96	100.43	2.00	0.00	0.56	0.00
26.01	97.17	2.00	0.00	0.56	0.00	26.06	94.12	2.00	0.00	0.56	0.00
26.16	89.19	2.00	0.00	0.56	0.00	26.27	83.46	2.00	0.00	0.55	0.00
26.32	78.53	2.00	0.00	0.55	0.00	26.36	74.36	2.00	0.00	0.55	0.00
26.45	70.94	2.00	0.00	0.55	0.00	26.50	68.27	2.00	0.00	0.55	0.00
26.55	66.65	2.00	0.00	0.55	0.00	26.60	64.31	2.00	0.00	0.55	0.00
26.73	62.21	2.00	0.00	0.55	0.00	26.78	60.62	2.00	0.00	0.55	0.00
26.84	61.02	2.00	0.00	0.55	0.00	26.89	62.00	2.00	0.00	0.54	0.00
26.94	63.38	2.00	0.00	0.54	0.00	26.98	63.84	2.00	0.00	0.54	0.00
27.07	63.57	2.00	0.00	0.54	0.00	27.12	62.63	2.00	0.00	0.54	0.00
27.18	62.14	2.00	0.00	0.54	0.00	27.24	63.87	2.00	0.00	0.54	0.00
27.34	66.70	2.00	0.00	0.54	0.00	27.38	69.71	2.00	0.00	0.54	0.00
27.43	71.72	2.00	0.00	0.54	0.00	27.60	72.61	2.00	0.00	0.53	0.00
27.64	69.87	2.00	0.00	0.53	0.00	27.73	62.54	2.00	0.00	0.53	0.00
27.79	53.72	2.00	0.00	0.53	0.00	27.84	47.73	2.00	0.00	0.53	0.00
27.91	45.57	2.00	0.00	0.53	0.00	27.96	43.42	0.09	2.44	0.53	0.01
28.05	42.19	0.09	2.49	0.52	0.03	28.12	41.49	0.09	2.52	0.52	0.02
28.18	41.57	0.09	2.51	0.52	0.02	28.23	41.72	2.00	0.00	0.52	0.00
28.33	41.66	2.00	0.00	0.52	0.00	28.39	41.37	2.00	0.00	0.52	0.00
28.44	40.97	2.00	0.00	0.52	0.00	28.48	40.25	2.00	0.00	0.52	0.00
28.58	39.06	2.00	0.00	0.52	0.00	28.63	37.93	2.00	0.00	0.51	0.00
28.69	37.06	2.00	0.00	0.51	0.00	28.76	37.54	0.08	2.67	0.51	0.02
28.88	39.23	2.00	0.00	0.51	0.00	28.93	42.34	2.00	0.00	0.51	0.00
28.99	47.13	2.00	0.00	0.51	0.00	29.06	52.26	2.00	0.00	0.51	0.00
29.11	57.17	2.00	0.00	0.51	0.00	29.18	60.11	2.00	0.00	0.51	0.00
29.24	61.50	2.00	0.00	0.50	0.00	29.29	63.84	2.00	0.00	0.50	0.00
29.38	67.16	2.00	0.00	0.50	0.00	29.42	71.70	0.12	1.54	0.50	0.01
29.49	76.87	0.13	1.45	0.50	0.01	29.55	81.42	0.14	1.38	0.50	0.01
29.60	82.68	0.14	1.36	0.50	0.01	29.73	81.34	0.14	1.37	0.50	0.02
29.78	77.26	0.13	1.43	0.50	0.01	29.91	73.08	0.12	1.49	0.49	0.02
29.96	68.16	0.11	1.57	0.49	0.01	30.03	66.57	0.11	1.60	0.49	0.01
30.09	66.05	2.00	0.00	0.49	0.00	30.16	66.88	2.00	0.00	0.49	0.00
30.21	67.30	2.00	0.00	0.49	0.00	30.27	68.14	2.00	0.00	0.49	0.00
30.33	68.29	2.00	0.00	0.49	0.00	30.39	65.58	2.00	0.00	0.48	0.00
30.45	61.88	2.00	0.00	0.48	0.00	30.57	59.05	2.00	0.00	0.48	0.00
30.63	59.14	2.00	0.00	0.48	0.00	30.70	59.90	2.00	0.00	0.48	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
30.76	61.36	2.00	0.00	0.48	0.00	30.79	64.16	2.00	0.00	0.48	0.00
30.89	67.74	2.00	0.00	0.48	0.00	30.97	71.10	2.00	0.00	0.48	0.00
31.01	73.82	2.00	0.00	0.47	0.00	31.06	75.83	2.00	0.00	0.47	0.00
31.13	76.20	2.00	0.00	0.47	0.00	31.19	74.90	2.00	0.00	0.47	0.00
31.23	70.46	2.00	0.00	0.47	0.00	31.36	65.26	2.00	0.00	0.47	0.00
31.41	59.21	2.00	0.00	0.47	0.00	31.46	57.47	2.00	0.00	0.47	0.00
31.51	57.91	2.00	0.00	0.47	0.00	31.61	61.36	2.00	0.00	0.46	0.00
31.76	64.25	2.00	0.00	0.46	0.00	31.81	66.54	2.00	0.00	0.46	0.00
31.85	66.91	2.00	0.00	0.46	0.00	31.90	66.47	2.00	0.00	0.46	0.00
31.95	65.87	2.00	0.00	0.46	0.00	32.01	65.41	2.00	0.00	0.46	0.00
32.05	65.37	2.00	0.00	0.46	0.00	32.11	65.57	2.00	0.00	0.46	0.00
32.16	66.15	2.00	0.00	0.45	0.00	32.25	65.62	2.00	0.00	0.45	0.00
32.35	65.29	2.00	0.00	0.45	0.00	32.40	64.82	2.00	0.00	0.45	0.00
32.45	65.43	2.00	0.00	0.45	0.00	32.52	66.48	2.00	0.00	0.45	0.00
32.56	68.01	2.00	0.00	0.45	0.00	32.65	69.96	2.00	0.00	0.45	0.00
32.70	72.36	2.00	0.00	0.45	0.00	32.79	74.30	2.00	0.00	0.44	0.00
32.85	75.93	2.00	0.00	0.44	0.00	32.91	76.33	2.00	0.00	0.44	0.00
32.96	73.57	2.00	0.00	0.44	0.00	33.05	67.96	2.00	0.00	0.44	0.00
33.09	59.22	2.00	0.00	0.44	0.00	33.21	53.60	2.00	0.00	0.44	0.00
33.24	51.61	2.00	0.00	0.44	0.00	33.30	53.43	2.00	0.00	0.44	0.00
33.35	54.74	2.00	0.00	0.43	0.00	33.40	55.59	2.00	0.00	0.43	0.00
33.50	56.26	2.00	0.00	0.43	0.00	33.54	56.71	2.00	0.00	0.43	0.00
33.63	56.42	2.00	0.00	0.43	0.00	33.68	55.51	2.00	0.00	0.43	0.00
33.73	54.82	2.00	0.00	0.43	0.00	33.80	54.41	2.00	0.00	0.43	0.00
33.91	53.93	2.00	0.00	0.43	0.00	33.99	52.94	2.00	0.00	0.42	0.00
34.10	51.52	2.00	0.00	0.42	0.00	34.16	50.44	2.00	0.00	0.42	0.00
34.21	50.29	2.00	0.00	0.42	0.00	34.27	50.32	2.00	0.00	0.42	0.00
34.35	49.53	2.00	0.00	0.42	0.00	34.39	48.18	2.00	0.00	0.42	0.00
34.52	47.25	2.00	0.00	0.41	0.00	34.57	46.72	2.00	0.00	0.41	0.00
34.62	46.84	2.00	0.00	0.41	0.00	34.70	46.89	2.00	0.00	0.41	0.00
34.74	47.94	2.00	0.00	0.41	0.00	34.83	49.18	2.00	0.00	0.41	0.00
34.93	50.43	2.00	0.00	0.41	0.00	35.00	50.84	2.00	0.00	0.41	0.00
35.05	50.35	2.00	0.00	0.41	0.00	35.14	49.32	2.00	0.00	0.40	0.00
35.18	48.50	2.00	0.00	0.40	0.00	35.24	48.55	2.00	0.00	0.40	0.00
35.31	49.36	2.00	0.00	0.40	0.00	35.36	50.91	2.00	0.00	0.40	0.00
35.43	54.01	2.00	0.00	0.40	0.00	35.54	57.67	2.00	0.00	0.40	0.00
35.60	62.12	2.00	0.00	0.40	0.00	35.67	65.15	2.00	0.00	0.40	0.00
35.72	67.62	2.00	0.00	0.39	0.00	35.80	68.64	2.00	0.00	0.39	0.00
35.85	69.33	2.00	0.00	0.39	0.00	35.91	69.77	2.00	0.00	0.39	0.00
35.98	69.86	2.00	0.00	0.39	0.00	36.03	69.63	2.00	0.00	0.39	0.00
36.10	67.34	2.00	0.00	0.39	0.00	36.16	62.91	2.00	0.00	0.39	0.00
36.22	58.10	2.00	0.00	0.39	0.00	36.29	55.01	0.10	1.47	0.38	0.01
36.34	54.77	0.10	1.47	0.38	0.01	36.40	55.36	2.00	0.00	0.38	0.00
36.47	56.36	2.00	0.00	0.38	0.00	36.51	57.18	2.00	0.00	0.38	0.00
36.59	57.51	2.00	0.00	0.38	0.00	36.66	58.00	2.00	0.00	0.38	0.00
36.71	59.47	2.00	0.00	0.38	0.00	36.78	62.09	2.00	0.00	0.38	0.00
36.85	65.81	2.00	0.00	0.38	0.00	36.93	69.39	2.00	0.00	0.37	0.00
36.98	73.06	2.00	0.00	0.37	0.00	37.04	75.96	2.00	0.00	0.37	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
37.08	79.74	2.00	0.00	0.37	0.00	37.15	83.26	2.00	0.00	0.37	0.00
37.31	85.61	2.00	0.00	0.37	0.00	37.36	86.24	2.00	0.00	0.37	0.00
37.42	85.92	2.00	0.00	0.37	0.00	37.47	85.71	2.00	0.00	0.36	0.00
37.51	85.07	2.00	0.00	0.36	0.00	37.56	83.64	2.00	0.00	0.36	0.00
37.64	81.91	2.00	0.00	0.36	0.00	37.69	80.55	2.00	0.00	0.36	0.00
37.73	80.18	2.00	0.00	0.36	0.00	37.85	80.15	2.00	0.00	0.36	0.00
37.91	81.31	2.00	0.00	0.36	0.00	37.95	83.26	2.00	0.00	0.36	0.00
38.02	85.90	2.00	0.00	0.36	0.00	38.08	88.45	2.00	0.00	0.35	0.00
38.13	91.00	2.00	0.00	0.35	0.00	38.26	93.14	2.00	0.00	0.35	0.00
38.31	94.36	2.00	0.00	0.35	0.00	38.36	94.46	2.00	0.00	0.35	0.00
38.44	93.05	2.00	0.00	0.35	0.00	38.49	90.87	2.00	0.00	0.35	0.00
38.55	87.88	2.00	0.00	0.35	0.00	38.62	86.17	2.00	0.00	0.35	0.00
38.66	86.34	2.00	0.00	0.34	0.00	38.79	87.00	2.00	0.00	0.34	0.00
38.85	86.63	2.00	0.00	0.34	0.00	38.92	85.15	2.00	0.00	0.34	0.00
38.97	83.84	2.00	0.00	0.34	0.00	39.04	82.75	2.00	0.00	0.34	0.00
39.10	81.00	2.00	0.00	0.34	0.00	39.15	78.25	2.00	0.00	0.34	0.00
39.23	75.28	2.00	0.00	0.34	0.00	39.28	70.00	2.00	0.00	0.33	0.00
39.40	65.61	2.00	0.00	0.33	0.00	39.46	62.72	2.00	0.00	0.33	0.00
39.51	63.71	2.00	0.00	0.33	0.00	39.59	65.55	2.00	0.00	0.33	0.00
39.65	66.68	2.00	0.00	0.33	0.00	39.71	67.39	2.00	0.00	0.33	0.00
39.72	66.15	2.00	0.00	0.33	0.00	39.79	64.35	2.00	0.00	0.33	0.00
39.84	61.87	2.00	0.00	0.32	0.00	39.94	60.65	2.00	0.00	0.32	0.00
39.99	60.14	2.00	0.00	0.32	0.00	40.05	60.54	2.00	0.00	0.32	0.00
40.11	60.88	2.00	0.00	0.32	0.00	40.19	60.36	2.00	0.00	0.32	0.00
40.29	59.37	2.00	0.00	0.32	0.00	40.33	58.13	2.00	0.00	0.32	0.00
40.37	57.14	2.00	0.00	0.32	0.00	40.47	56.75	2.00	0.00	0.31	0.00
40.53	57.28	2.00	0.00	0.31	0.00	40.59	58.92	2.00	0.00	0.31	0.00
40.63	60.88	2.00	0.00	0.31	0.00	40.72	61.81	2.00	0.00	0.31	0.00
40.77	61.95	2.00	0.00	0.31	0.00	40.82	60.76	2.00	0.00	0.31	0.00
40.91	59.02	2.00	0.00	0.31	0.00	40.98	56.75	2.00	0.00	0.31	0.00
41.03	54.94	2.00	0.00	0.30	0.00	41.13	55.24	0.10	1.15	0.30	0.01
41.17	57.42	2.00	0.00	0.30	0.00	41.22	59.22	2.00	0.00	0.30	0.00
41.34	60.14	2.00	0.00	0.30	0.00	41.38	59.60	2.00	0.00	0.30	0.00
41.42	59.23	2.00	0.00	0.30	0.00	41.48	57.42	2.00	0.00	0.30	0.00
41.57	55.42	2.00	0.00	0.30	0.00	41.63	53.94	0.10	1.14	0.29	0.01
41.70	53.75	0.10	1.14	0.29	0.01	41.74	54.20	2.00	0.00	0.29	0.00
41.83	52.90	2.00	0.00	0.29	0.00	41.92	51.03	2.00	0.00	0.29	0.00
41.98	49.22	2.00	0.00	0.29	0.00	42.07	49.02	2.00	0.00	0.29	0.00
42.13	49.16	2.00	0.00	0.29	0.00	42.18	49.15	0.10	1.19	0.29	0.01
42.23	49.19	0.10	1.19	0.28	0.01	42.27	49.73	2.00	0.00	0.28	0.00
42.36	50.18	2.00	0.00	0.28	0.00	42.43	53.92	2.00	0.00	0.28	0.00
42.54	58.76	2.00	0.00	0.28	0.00	42.59	62.90	2.00	0.00	0.28	0.00
42.63	63.80	2.00	0.00	0.28	0.00	42.67	63.26	2.00	0.00	0.28	0.00
42.72	63.53	2.00	0.00	0.28	0.00	42.82	64.77	2.00	0.00	0.27	0.00
42.87	67.38	0.12	0.83	0.27	0.01	42.95	69.70	0.12	0.85	0.27	0.01
42.99	71.58	2.00	0.00	0.27	0.00	43.05	71.65	2.00	0.00	0.27	0.00
43.13	70.96	2.00	0.00	0.27	0.00	43.23	70.57	0.12	0.83	0.27	0.01
43.20	70.56	0.12	0.83	0.27	0.01	43.35	71.22	2.00	0.00	0.27	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
43.43	69.96	0.12	0.83	0.26	0.01	43.54	67.12	0.12	0.85	0.26	0.01
43.61	63.83	0.11	0.88	0.26	0.01	43.66	62.16	0.11	0.90	0.26	0.01
43.71	62.39	2.00	0.00	0.26	0.00	43.79	62.07	2.00	0.00	0.26	0.00
43.84	61.45	2.00	0.00	0.26	0.00	43.97	59.79	2.00	0.00	0.25	0.00
44.03	57.98	2.00	0.00	0.25	0.00	44.15	56.25	2.00	0.00	0.25	0.00
44.20	54.94	2.00	0.00	0.25	0.00	44.27	54.58	2.00	0.00	0.25	0.00
44.32	54.33	2.00	0.00	0.25	0.00	44.39	54.25	2.00	0.00	0.25	0.00
44.45	54.69	2.00	0.00	0.25	0.00	44.56	55.27	2.00	0.00	0.24	0.00
44.62	56.00	2.00	0.00	0.24	0.00	44.73	56.77	2.00	0.00	0.24	0.00
44.80	57.83	2.00	0.00	0.24	0.00	44.85	59.16	2.00	0.00	0.24	0.00
44.91	60.82	2.00	0.00	0.24	0.00	44.98	62.86	2.00	0.00	0.24	0.00
45.03	65.06	2.00	0.00	0.24	0.00	45.10	67.07	2.00	0.00	0.24	0.00
45.16	68.64	2.00	0.00	0.23	0.00	45.22	69.82	2.00	0.00	0.23	0.00
45.29	70.66	2.00	0.00	0.23	0.00	45.40	71.17	2.00	0.00	0.23	0.00
45.47	71.20	2.00	0.00	0.23	0.00	45.52	70.65	2.00	0.00	0.23	0.00
45.59	68.49	2.00	0.00	0.23	0.00	45.65	64.53	2.00	0.00	0.23	0.00
45.71	59.91	2.00	0.00	0.23	0.00	45.78	56.77	2.00	0.00	0.22	0.00
45.83	55.91	2.00	0.00	0.22	0.00	45.95	55.84	2.00	0.00	0.22	0.00
46.00	56.18	2.00	0.00	0.22	0.00	46.08	56.70	2.00	0.00	0.22	0.00
46.17	57.03	2.00	0.00	0.22	0.00	46.29	57.01	2.00	0.00	0.22	0.00
46.34	56.73	2.00	0.00	0.21	0.00	46.40	56.60	2.00	0.00	0.21	0.00
46.44	56.28	2.00	0.00	0.21	0.00	46.48	55.67	2.00	0.00	0.21	0.00
46.53	54.55	2.00	0.00	0.21	0.00	46.65	53.40	2.00	0.00	0.21	0.00
46.69	52.57	2.00	0.00	0.21	0.00	46.74	52.46	2.00	0.00	0.21	0.00
46.79	52.93	2.00	0.00	0.21	0.00	46.93	53.73	2.00	0.00	0.20	0.00
46.98	55.07	2.00	0.00	0.20	0.00	47.02	56.67	2.00	0.00	0.20	0.00
47.08	58.49	2.00	0.00	0.20	0.00	47.14	59.40	2.00	0.00	0.20	0.00
47.19	59.87	2.00	0.00	0.20	0.00	47.28	59.81	2.00	0.00	0.20	0.00
47.32	60.36	2.00	0.00	0.20	0.00	47.43	60.79	2.00	0.00	0.20	0.00
47.48	61.10	2.00	0.00	0.20	0.00	47.52	61.09	2.00	0.00	0.19	0.00
47.58	60.76	2.00	0.00	0.19	0.00	47.68	60.69	2.00	0.00	0.19	0.00
47.73	60.73	2.00	0.00	0.19	0.00	47.78	60.68	2.00	0.00	0.19	0.00
47.89	60.86	2.00	0.00	0.19	0.00	47.94	61.63	2.00	0.00	0.19	0.00
47.99	63.50	2.00	0.00	0.19	0.00	48.04	65.30	2.00	0.00	0.19	0.00
48.14	65.56	2.00	0.00	0.18	0.00	48.18	64.94	2.00	0.00	0.18	0.00
48.30	64.33	2.00	0.00	0.18	0.00	48.36	64.98	2.00	0.00	0.18	0.00
48.43	66.40	2.00	0.00	0.18	0.00	48.49	68.53	2.00	0.00	0.18	0.00
48.56	70.51	2.00	0.00	0.18	0.00	48.61	72.54	2.00	0.00	0.18	0.00
48.68	74.50	2.00	0.00	0.17	0.00	48.74	76.74	2.00	0.00	0.17	0.00
48.78	79.69	2.00	0.00	0.17	0.00	48.85	82.89	2.00	0.00	0.17	0.00
48.92	85.42	2.00	0.00	0.17	0.00	48.96	83.57	2.00	0.00	0.17	0.00
49.05	79.40	2.00	0.00	0.17	0.00	49.10	73.81	2.00	0.00	0.17	0.00
49.20	71.46	2.00	0.00	0.17	0.00	49.23	70.88	2.00	0.00	0.17	0.00
49.31	70.90	2.00	0.00	0.16	0.00	49.38	70.56	2.00	0.00	0.16	0.00
49.42	68.45	2.00	0.00	0.16	0.00	49.52	65.69	2.00	0.00	0.16	0.00
49.57	62.74	2.00	0.00	0.16	0.00	49.64	61.36	2.00	0.00	0.16	0.00
49.71	60.82	2.00	0.00	0.16	0.00	49.76	61.36	2.00	0.00	0.16	0.00
49.84	61.64	2.00	0.00	0.16	0.00	49.88	61.39	2.00	0.00	0.15	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
49.95	60.36	2.00	0.00	0.15	0.00	50.12	59.57	2.00	0.00	0.15	0.00

Total estimated settlement: 2.77

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

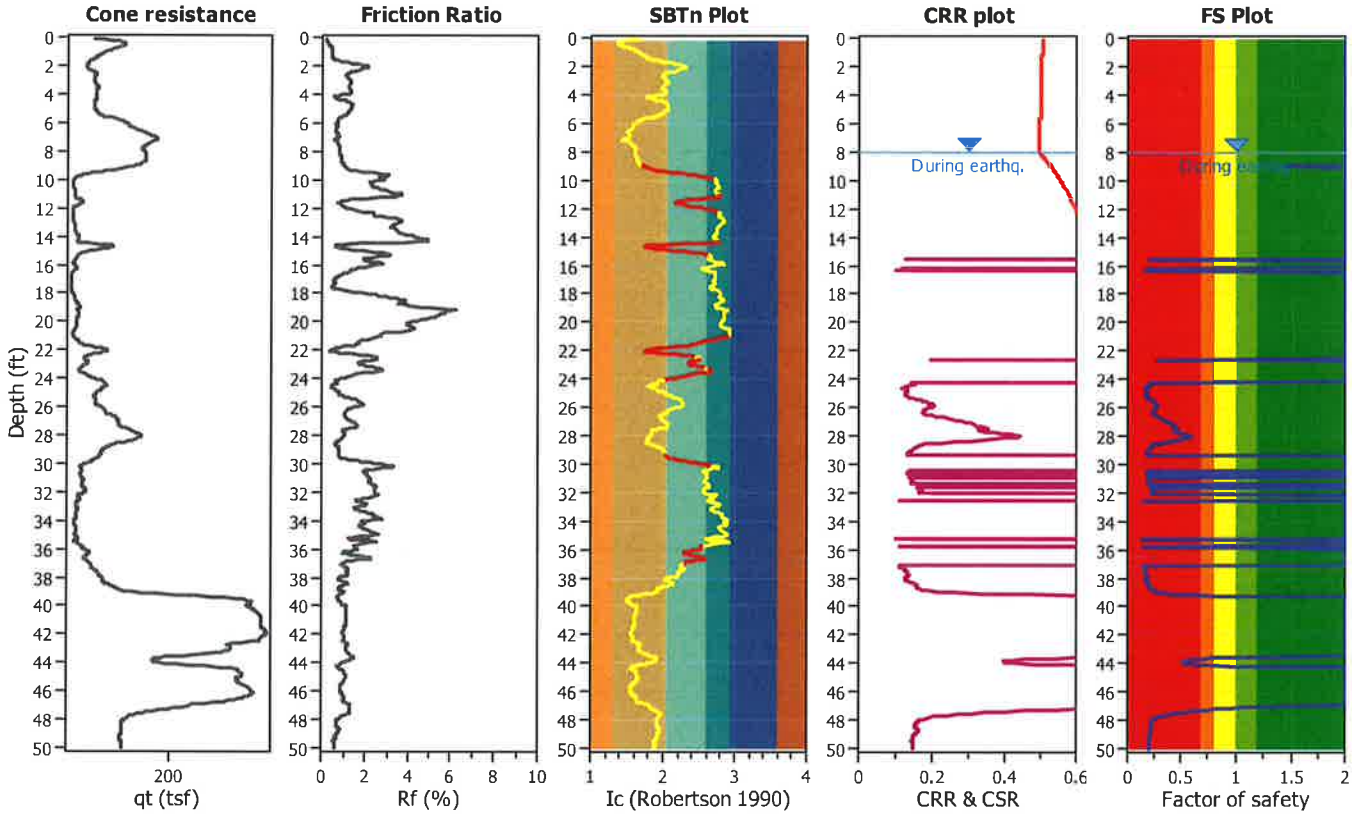
LIQUEFACTION ANALYSIS REPORT

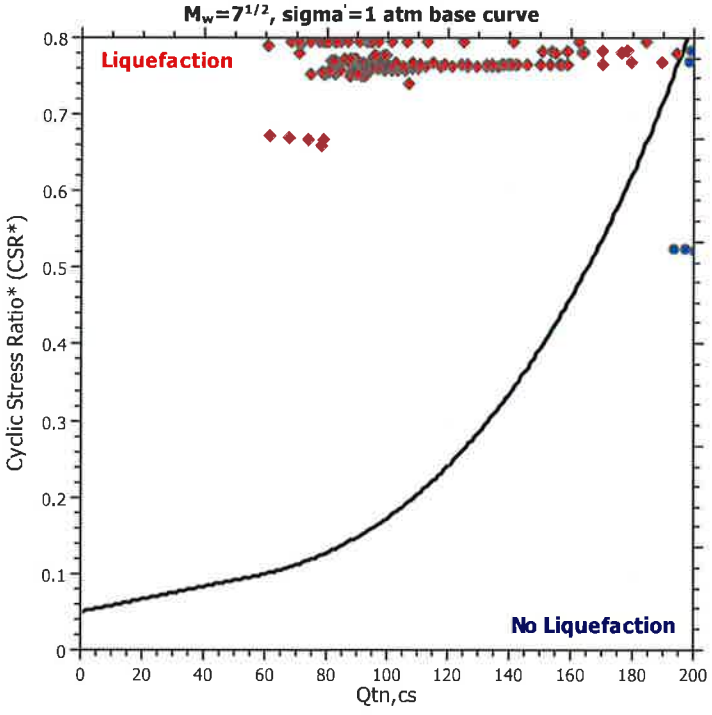
Project title : S-Line Upgrades **Location : Imperial County, CA**

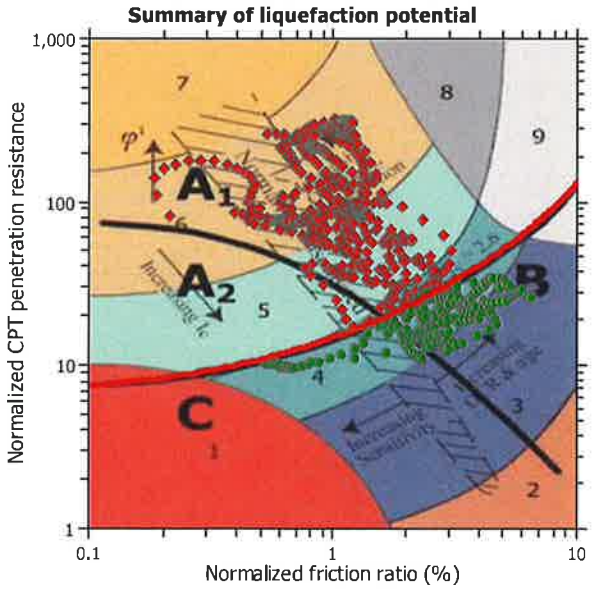
CPT file : CPT-9

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.71	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

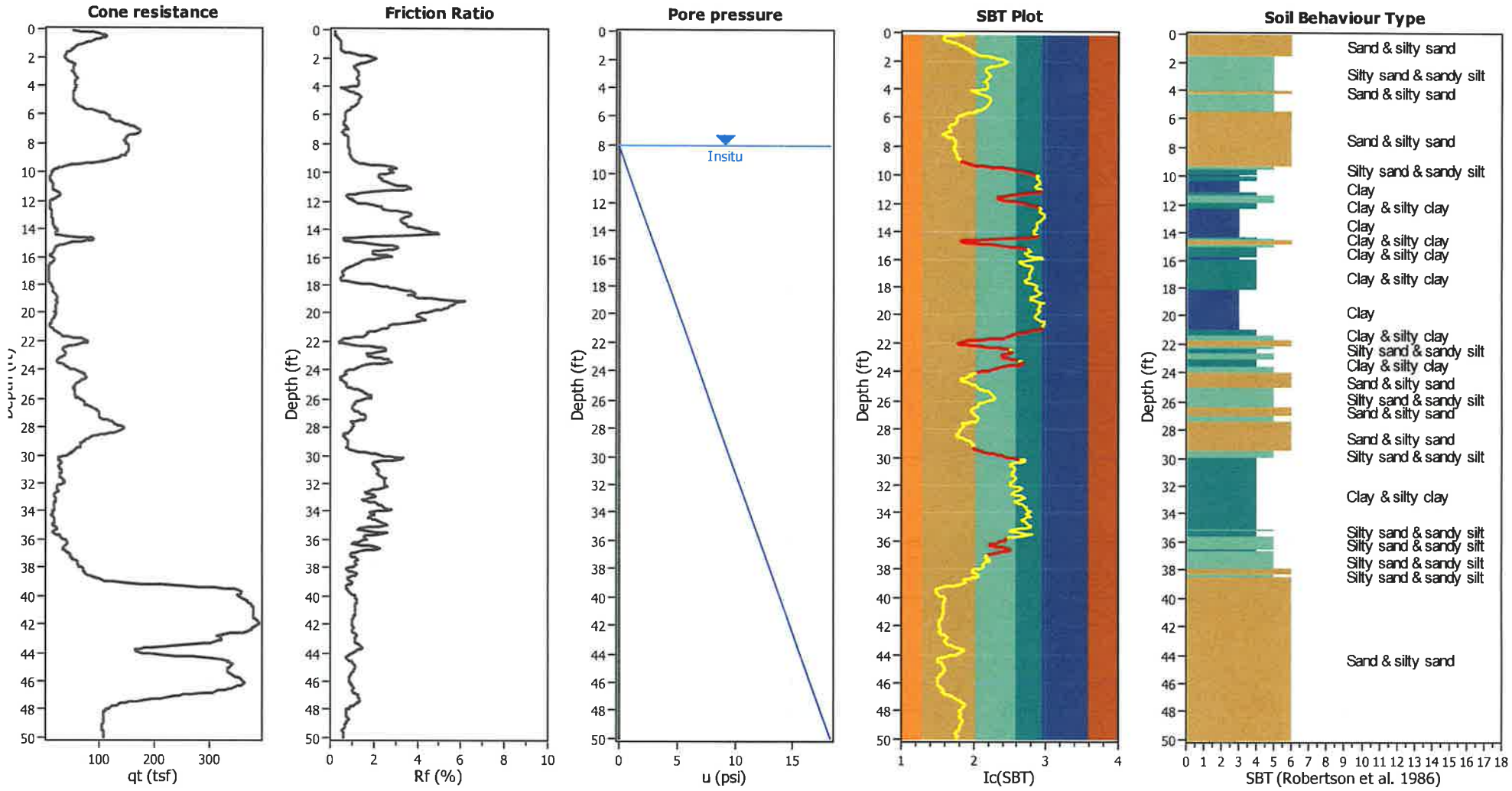






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



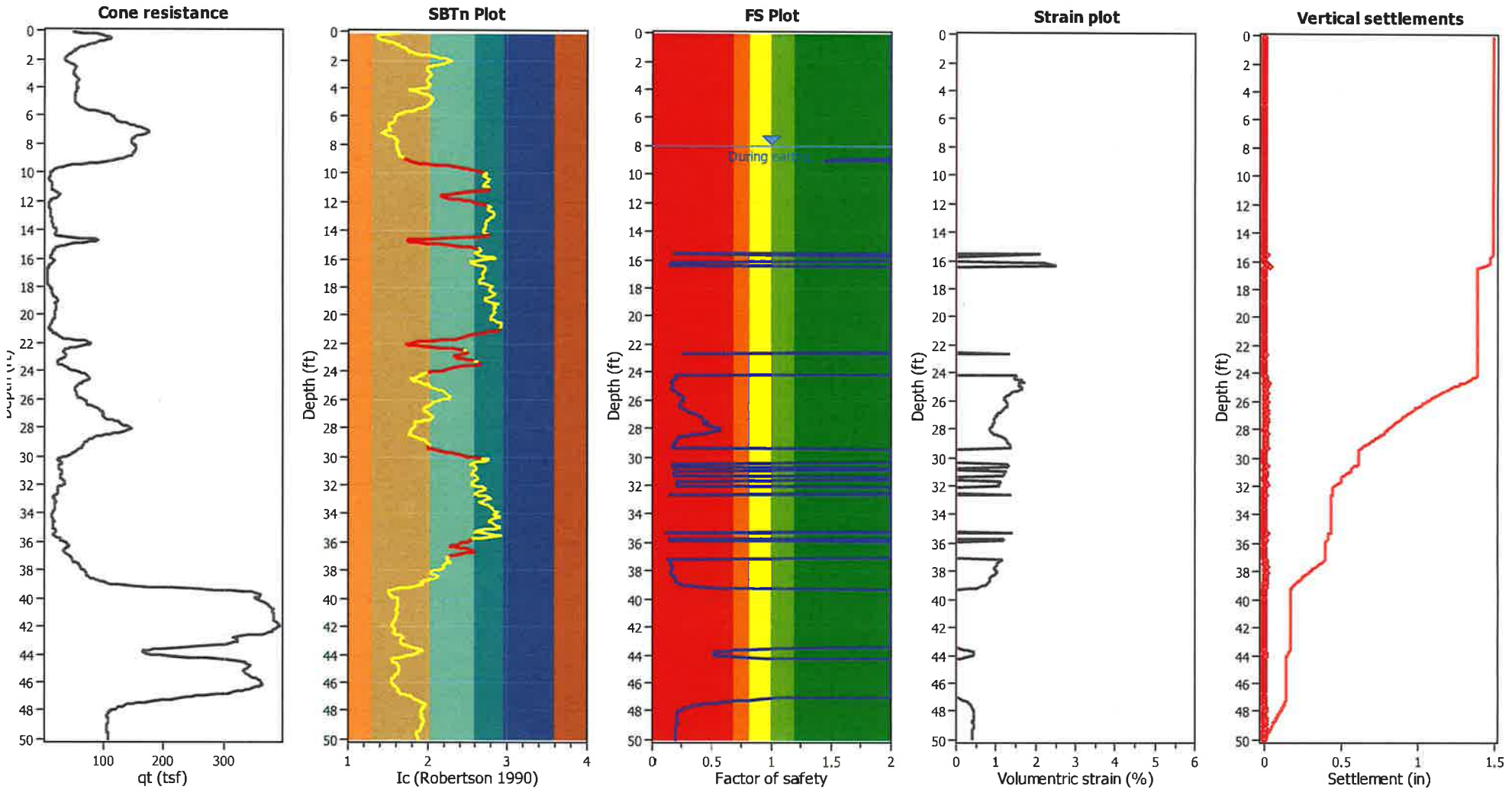
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.71	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

:	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.03	212.80	2.00	0.00	0.86	0.00	8.12	214.19	2.00	0.00	0.86	0.00
8.16	215.41	2.00	0.00	0.86	0.00	8.21	215.43	2.00	0.00	0.86	0.00
8.31	214.69	2.00	0.00	0.86	0.00	8.38	213.86	2.00	0.00	0.86	0.00
8.47	212.57	2.00	0.00	0.86	0.00	8.51	211.03	2.00	0.00	0.86	0.00
8.61	209.21	2.00	0.00	0.85	0.00	8.65	207.44	2.00	0.00	0.85	0.00
8.70	206.45	2.00	0.00	0.85	0.00	8.79	204.77	2.00	0.00	0.85	0.00
8.84	202.69	2.00	0.00	0.85	0.00	8.88	200.43	2.00	0.00	0.85	0.00
8.95	197.36	1.52	0.00	0.85	0.00	9.01	193.65	1.44	0.00	0.85	0.00
9.08	189.07	2.00	0.00	0.85	0.00	9.13	180.69	2.00	0.00	0.85	0.00
9.25	170.05	2.00	0.00	0.84	0.00	9.31	157.87	2.00	0.00	0.84	0.00
9.37	148.33	2.00	0.00	0.84	0.00	9.44	141.42	2.00	0.00	0.84	0.00
9.49	138.26	2.00	0.00	0.84	0.00	9.57	136.25	2.00	0.00	0.84	0.00
9.62	129.53	2.00	0.00	0.84	0.00	9.68	118.60	2.00	0.00	0.84	0.00
9.75	106.74	2.00	0.00	0.83	0.00	9.81	99.87	2.00	0.00	0.83	0.00
9.89	96.95	2.00	0.00	0.83	0.00	9.93	92.14	2.00	0.00	0.83	0.00
10.00	87.56	2.00	0.00	0.83	0.00	10.06	83.02	2.00	0.00	0.83	0.00
10.11	79.12	2.00	0.00	0.83	0.00	10.20	76.67	2.00	0.00	0.83	0.00
10.32	75.37	2.00	0.00	0.83	0.00	10.37	75.63	2.00	0.00	0.82	0.00
10.42	75.76	2.00	0.00	0.82	0.00	10.49	76.53	2.00	0.00	0.82	0.00
10.53	78.53	2.00	0.00	0.82	0.00	10.58	82.52	2.00	0.00	0.82	0.00
10.67	87.72	2.00	0.00	0.82	0.00	10.75	93.22	2.00	0.00	0.82	0.00
10.84	97.50	2.00	0.00	0.82	0.00	10.90	100.70	2.00	0.00	0.82	0.00
10.94	103.21	2.00	0.00	0.81	0.00	11.02	104.91	2.00	0.00	0.81	0.00
11.07	105.22	2.00	0.00	0.81	0.00	11.13	103.30	2.00	0.00	0.81	0.00
11.19	100.15	2.00	0.00	0.81	0.00	11.24	93.35	2.00	0.00	0.81	0.00
11.34	85.00	2.00	0.00	0.81	0.00	11.41	77.06	2.00	0.00	0.81	0.00
11.46	72.98	2.00	0.00	0.81	0.00	11.51	69.74	2.00	0.00	0.80	0.00
11.56	66.44	2.00	0.00	0.80	0.00	11.63	63.57	2.00	0.00	0.80	0.00
11.68	61.60	2.00	0.00	0.80	0.00	11.78	60.31	2.00	0.00	0.80	0.00
11.85	59.29	2.00	0.00	0.80	0.00	11.90	57.72	2.00	0.00	0.80	0.00
11.95	56.38	2.00	0.00	0.80	0.00	12.02	55.87	2.00	0.00	0.80	0.00
12.08	57.81	2.00	0.00	0.80	0.00	12.17	62.15	2.00	0.00	0.79	0.00
12.24	67.49	2.00	0.00	0.79	0.00	12.29	72.07	2.00	0.00	0.79	0.00
12.34	74.38	2.00	0.00	0.79	0.00	12.47	75.73	2.00	0.00	0.79	0.00
12.56	78.63	2.00	0.00	0.79	0.00	12.62	84.17	2.00	0.00	0.79	0.00
12.68	89.57	2.00	0.00	0.79	0.00	12.74	93.98	2.00	0.00	0.78	0.00
12.80	96.88	2.00	0.00	0.78	0.00	12.86	99.42	2.00	0.00	0.78	0.00
12.95	99.98	2.00	0.00	0.78	0.00	13.02	99.44	2.00	0.00	0.78	0.00
13.08	98.41	2.00	0.00	0.78	0.00	13.13	97.96	2.00	0.00	0.78	0.00
13.25	97.76	2.00	0.00	0.78	0.00	13.30	98.17	2.00	0.00	0.77	0.00
13.36	99.82	2.00	0.00	0.77	0.00	13.44	102.35	2.00	0.00	0.77	0.00
13.54	104.80	2.00	0.00	0.77	0.00	13.61	106.00	2.00	0.00	0.77	0.00
13.66	106.65	2.00	0.00	0.77	0.00	13.74	108.96	2.00	0.00	0.77	0.00
13.79	113.76	2.00	0.00	0.77	0.00	13.85	120.55	2.00	0.00	0.77	0.00
13.92	126.51	2.00	0.00	0.76	0.00	13.97	130.84	2.00	0.00	0.76	0.00
14.03	133.62	2.00	0.00	0.76	0.00	14.10	136.25	2.00	0.00	0.76	0.00
14.16	139.99	2.00	0.00	0.76	0.00	14.23	141.32	2.00	0.00	0.76	0.00
14.28	139.51	2.00	0.00	0.76	0.00	14.34	132.11	2.00	0.00	0.76	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
14.41	120.24	2.00	0.00	0.76	0.00	14.46	99.49	2.00	0.00	0.75	0.00
14.58	102.95	2.00	0.00	0.75	0.00	14.63	115.48	2.00	0.00	0.75	0.00
14.70	118.86	2.00	0.00	0.75	0.00	14.76	116.40	2.00	0.00	0.75	0.00
14.82	112.97	2.00	0.00	0.75	0.00	14.89	109.47	2.00	0.00	0.75	0.00
14.94	108.49	2.00	0.00	0.75	0.00	15.02	109.76	2.00	0.00	0.75	0.00
15.07	112.51	2.00	0.00	0.74	0.00	15.12	112.54	2.00	0.00	0.74	0.00
15.20	111.10	2.00	0.00	0.74	0.00	15.25	107.57	2.00	0.00	0.74	0.00
15.32	103.48	2.00	0.00	0.74	0.00	15.38	98.13	2.00	0.00	0.74	0.00
15.43	92.00	2.00	0.00	0.74	0.00	15.49	83.99	2.00	0.00	0.74	0.00
15.56	77.93	0.19	2.11	0.74	0.02	15.68	74.59	2.00	0.00	0.73	0.00
15.79	75.89	2.00	0.00	0.73	0.00	15.82	78.42	2.00	0.00	0.73	0.00
15.91	80.80	2.00	0.00	0.73	0.00	15.95	82.76	2.00	0.00	0.73	0.00
16.09	81.72	2.00	0.00	0.73	0.00	16.15	79.02	0.19	2.06	0.73	0.01
16.19	73.69	0.18	2.18	0.73	0.01	16.26	67.55	0.16	2.33	0.72	0.02
16.39	61.48	0.15	2.51	0.72	0.04	16.44	57.21	2.00	0.00	0.72	0.00
16.50	53.86	2.00	0.00	0.72	0.00	16.57	50.59	2.00	0.00	0.72	0.00
16.62	47.42	2.00	0.00	0.72	0.00	16.68	44.82	2.00	0.00	0.72	0.00
16.75	42.67	2.00	0.00	0.72	0.00	16.81	41.05	2.00	0.00	0.72	0.00
16.87	39.82	2.00	0.00	0.71	0.00	16.93	38.55	2.00	0.00	0.71	0.00
16.98	37.70	2.00	0.00	0.71	0.00	17.06	37.22	2.00	0.00	0.71	0.00
17.11	37.80	2.00	0.00	0.71	0.00	17.23	38.28	2.00	0.00	0.71	0.00
17.28	38.63	2.00	0.00	0.71	0.00	17.34	38.12	2.00	0.00	0.71	0.00
17.41	37.48	2.00	0.00	0.70	0.00	17.46	36.76	2.00	0.00	0.70	0.00
17.53	36.27	2.00	0.00	0.70	0.00	17.59	36.27	2.00	0.00	0.70	0.00
17.64	37.19	2.00	0.00	0.70	0.00	17.72	41.52	2.00	0.00	0.70	0.00
17.84	48.61	2.00	0.00	0.70	0.00	17.89	56.62	2.00	0.00	0.70	0.00
17.94	64.19	2.00	0.00	0.70	0.00	18.01	71.19	2.00	0.00	0.69	0.00
18.07	77.52	2.00	0.00	0.69	0.00	18.14	82.59	2.00	0.00	0.69	0.00
18.20	86.26	2.00	0.00	0.69	0.00	18.25	89.26	2.00	0.00	0.69	0.00
18.31	92.59	2.00	0.00	0.69	0.00	18.38	96.24	2.00	0.00	0.69	0.00
18.44	100.19	2.00	0.00	0.69	0.00	18.51	104.39	2.00	0.00	0.69	0.00
18.62	108.95	2.00	0.00	0.68	0.00	18.69	108.14	2.00	0.00	0.68	0.00
18.74	116.03	2.00	0.00	0.68	0.00	18.91	123.42	2.00	0.00	0.68	0.00
18.96	135.92	2.00	0.00	0.68	0.00	19.04	140.57	2.00	0.00	0.68	0.00
19.09	144.99	2.00	0.00	0.68	0.00	19.10	146.65	2.00	0.00	0.68	0.00
19.17	147.38	2.00	0.00	0.68	0.00	19.24	145.99	2.00	0.00	0.67	0.00
19.37	144.64	2.00	0.00	0.67	0.00	19.41	142.73	2.00	0.00	0.67	0.00
19.46	141.30	2.00	0.00	0.67	0.00	19.50	139.98	2.00	0.00	0.67	0.00
19.59	138.68	2.00	0.00	0.67	0.00	19.63	135.22	2.00	0.00	0.67	0.00
19.74	131.50	2.00	0.00	0.67	0.00	19.77	125.98	2.00	0.00	0.66	0.00
19.88	122.04	2.00	0.00	0.66	0.00	19.93	117.98	2.00	0.00	0.66	0.00
19.98	115.65	2.00	0.00	0.66	0.00	20.03	113.79	2.00	0.00	0.66	0.00
20.12	112.71	2.00	0.00	0.66	0.00	20.16	112.00	2.00	0.00	0.66	0.00
20.25	111.58	2.00	0.00	0.66	0.00	20.30	111.01	2.00	0.00	0.66	0.00
20.35	109.39	2.00	0.00	0.66	0.00	20.45	107.52	2.00	0.00	0.65	0.00
20.50	104.64	2.00	0.00	0.65	0.00	20.55	97.72	2.00	0.00	0.65	0.00
20.69	89.46	2.00	0.00	0.65	0.00	20.74	80.81	2.00	0.00	0.65	0.00
20.78	77.50	2.00	0.00	0.65	0.00	20.84	74.76	2.00	0.00	0.65	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
20.90	73.84	2.00	0.00	0.65	0.00	20.96	73.71	2.00	0.00	0.64	0.00
21.01	74.75	2.00	0.00	0.64	0.00	21.08	76.37	2.00	0.00	0.64	0.00
21.13	78.47	2.00	0.00	0.64	0.00	21.26	78.47	2.00	0.00	0.64	0.00
21.32	77.48	2.00	0.00	0.64	0.00	21.39	75.94	2.00	0.00	0.64	0.00
21.44	77.94	2.00	0.00	0.64	0.00	21.50	80.84	2.00	0.00	0.64	0.00
21.62	82.69	2.00	0.00	0.63	0.00	21.66	82.78	2.00	0.00	0.63	0.00
21.67	80.49	2.00	0.00	0.63	0.00	21.79	82.38	2.00	0.00	0.63	0.00
21.84	88.39	2.00	0.00	0.63	0.00	21.91	91.02	2.00	0.00	0.63	0.00
21.97	84.92	2.00	0.00	0.63	0.00	22.03	85.97	2.00	0.00	0.63	0.00
22.09	83.60	2.00	0.00	0.63	0.00	22.15	89.95	2.00	0.00	0.62	0.00
22.22	91.20	2.00	0.00	0.62	0.00	22.28	95.91	2.00	0.00	0.62	0.00
22.33	101.10	2.00	0.00	0.62	0.00	22.41	105.37	2.00	0.00	0.62	0.00
22.46	107.23	2.00	0.00	0.62	0.00	22.54	107.50	2.00	0.00	0.62	0.00
22.59	106.70	0.26	1.37	0.62	0.01	22.66	106.32	2.00	0.00	0.62	0.00
22.71	101.88	2.00	0.00	0.62	0.00	22.83	96.61	2.00	0.00	0.61	0.00
22.88	90.72	2.00	0.00	0.61	0.00	23.00	89.09	2.00	0.00	0.61	0.00
23.06	89.89	2.00	0.00	0.61	0.00	23.12	92.12	2.00	0.00	0.61	0.00
23.18	94.56	2.00	0.00	0.61	0.00	23.24	95.83	2.00	0.00	0.61	0.00
23.30	96.68	2.00	0.00	0.61	0.00	23.36	96.06	2.00	0.00	0.60	0.00
23.42	96.36	2.00	0.00	0.60	0.00	23.48	94.96	2.00	0.00	0.60	0.00
23.55	92.16	2.00	0.00	0.60	0.00	23.60	87.21	2.00	0.00	0.60	0.00
23.66	83.42	2.00	0.00	0.60	0.00	23.77	81.98	2.00	0.00	0.60	0.00
23.82	81.66	2.00	0.00	0.60	0.00	23.95	81.21	2.00	0.00	0.59	0.00
24.00	80.53	2.00	0.00	0.59	0.00	24.08	81.33	2.00	0.00	0.59	0.00
24.13	84.05	2.00	0.00	0.59	0.00	24.20	87.65	0.19	1.54	0.59	0.01
24.26	91.00	0.20	1.49	0.59	0.01	24.31	92.29	0.20	1.47	0.59	0.01
24.39	91.17	0.20	1.48	0.59	0.01	24.44	89.43	0.19	1.50	0.59	0.01
24.49	79.61	0.17	1.65	0.58	0.01	24.57	78.65	0.17	1.66	0.58	0.02
24.69	74.08	0.16	1.74	0.58	0.03	24.70	82.63	0.18	1.59	0.58	0.00
24.78	81.69	0.17	1.60	0.58	0.02	24.88	82.55	0.18	1.58	0.58	0.02
24.93	81.81	0.17	1.59	0.58	0.01	24.97	80.61	0.17	1.61	0.58	0.01
25.03	78.86	0.17	1.63	0.58	0.01	25.11	77.86	0.16	1.65	0.57	0.01
25.15	78.41	0.17	1.64	0.57	0.01	25.22	80.88	0.17	1.59	0.57	0.01
25.28	84.40	0.18	1.53	0.57	0.01	25.33	89.78	0.19	1.46	0.57	0.01
25.45	94.30	0.21	1.39	0.57	0.02	25.50	98.79	0.22	1.34	0.57	0.01
25.58	101.11	0.23	1.31	0.57	0.01	25.63	103.36	0.24	1.29	0.57	0.01
25.68	105.86	0.25	1.26	0.56	0.01	25.76	108.33	0.26	1.23	0.56	0.01
25.81	110.12	0.27	1.21	0.56	0.01	25.89	110.21	0.27	1.21	0.56	0.01
25.94	108.40	0.26	1.23	0.56	0.01	26.05	105.84	0.25	1.25	0.56	0.02
26.12	103.61	0.24	1.27	0.56	0.01	26.16	102.32	0.24	1.28	0.56	0.01
26.24	101.88	0.23	1.28	0.56	0.01	26.29	100.79	0.23	1.29	0.55	0.01
26.35	100.36	0.23	1.29	0.55	0.01	26.42	100.90	0.23	1.28	0.55	0.01
26.47	103.76	0.24	1.25	0.55	0.01	26.53	108.30	0.26	1.20	0.55	0.01
26.65	112.61	0.28	1.16	0.55	0.02	26.70	117.64	0.30	1.12	0.55	0.01
26.83	121.41	0.32	1.09	0.55	0.02	26.89	126.04	0.35	1.05	0.54	0.01
26.96	129.30	0.37	1.03	0.54	0.01	27.01	132.32	0.39	1.01	0.54	0.01
27.09	134.48	0.40	0.99	0.54	0.01	27.14	136.42	0.41	0.98	0.54	0.01
27.26	137.79	0.42	0.97	0.54	0.01	27.31	140.17	0.44	0.95	0.54	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
27.44	142.76	0.46	0.93	0.53	0.01	27.49	141.76	0.45	0.94	0.53	0.01
27.55	139.50	0.43	0.95	0.53	0.01	27.62	138.29	0.43	0.95	0.53	0.01
27.68	142.06	0.45	0.93	0.53	0.01	27.75	145.87	0.48	0.91	0.53	0.01
27.84	150.28	0.52	0.88	0.53	0.01	27.92	153.28	0.54	0.87	0.53	0.01
27.97	156.77	0.57	0.83	0.53	0.00	28.06	157.14	0.58	0.83	0.52	0.01
28.10	156.09	0.57	0.83	0.52	0.00	28.16	150.06	0.51	0.88	0.52	0.01
28.32	142.41	0.46	0.91	0.52	0.02	28.37	132.72	0.39	0.96	0.52	0.01
28.41	124.26	0.34	1.01	0.52	0.01	28.48	115.27	0.29	1.08	0.52	0.01
28.54	107.93	0.26	1.13	0.52	0.01	28.59	102.60	0.24	1.18	0.52	0.01
28.65	98.68	0.22	1.22	0.51	0.01	28.72	95.62	0.21	1.24	0.51	0.01
28.76	93.45	0.20	1.27	0.51	0.01	28.83	91.89	0.20	1.28	0.51	0.01
28.89	90.72	0.19	1.29	0.51	0.01	28.97	88.98	0.19	1.31	0.51	0.01
29.02	86.66	0.18	1.34	0.51	0.01	29.08	84.66	0.18	1.36	0.51	0.01
29.14	83.82	0.18	1.37	0.51	0.01	29.20	83.42	0.17	1.37	0.51	0.01
29.32	82.29	0.17	1.38	0.50	0.02	29.37	80.77	2.00	0.00	0.50	0.00
29.43	79.14	2.00	0.00	0.50	0.00	29.55	79.48	2.00	0.00	0.50	0.00
29.63	81.88	2.00	0.00	0.50	0.00	29.69	86.50	2.00	0.00	0.50	0.00
29.75	92.48	2.00	0.00	0.50	0.00	29.81	98.19	2.00	0.00	0.49	0.00
29.87	102.12	2.00	0.00	0.49	0.00	29.94	103.07	2.00	0.00	0.49	0.00
30.00	102.83	2.00	0.00	0.49	0.00	30.05	102.56	2.00	0.00	0.49	0.00
30.13	102.62	2.00	0.00	0.49	0.00	30.18	102.03	2.00	0.00	0.49	0.00
30.24	99.74	2.00	0.00	0.49	0.00	30.30	95.19	2.00	0.00	0.49	0.00
30.36	89.89	2.00	0.00	0.49	0.00	30.43	85.04	0.18	1.29	0.48	0.01
30.53	82.38	0.17	1.32	0.48	0.02	30.60	81.50	0.17	1.33	0.48	0.01
30.66	81.85	0.17	1.32	0.48	0.01	30.72	82.19	2.00	0.00	0.48	0.00
30.79	82.41	2.00	0.00	0.48	0.00	30.84	83.63	2.00	0.00	0.48	0.00
30.92	85.66	0.18	1.26	0.48	0.01	30.97	87.55	0.18	1.24	0.48	0.01
31.04	88.99	0.19	1.22	0.47	0.01	31.11	89.41	0.19	1.21	0.47	0.01
31.18	89.17	0.19	1.21	0.47	0.01	31.24	88.29	0.19	1.22	0.47	0.01
31.30	87.51	0.18	1.22	0.47	0.01	31.37	86.96	2.00	0.00	0.47	0.00
31.44	88.14	2.00	0.00	0.47	0.00	31.55	90.18	2.00	0.00	0.47	0.00
31.61	93.25	2.00	0.00	0.46	0.00	31.67	95.11	0.21	1.13	0.46	0.01
31.74	96.95	0.21	1.11	0.46	0.01	31.79	98.47	0.22	1.09	0.46	0.01
31.92	99.50	0.22	1.08	0.46	0.02	31.96	98.97	0.22	1.08	0.46	0.01
32.02	95.93	0.21	1.11	0.46	0.01	32.09	92.39	2.00	0.00	0.46	0.00
32.14	89.32	2.00	0.00	0.46	0.00	32.22	86.72	2.00	0.00	0.45	0.00
32.32	82.96	2.00	0.00	0.45	0.00	32.40	78.70	2.00	0.00	0.45	0.00
32.45	75.85	2.00	0.00	0.45	0.00	32.51	73.46	2.00	0.00	0.45	0.00
32.58	70.78	0.14	1.39	0.45	0.01	32.63	68.54	2.00	0.00	0.45	0.00
32.70	67.80	2.00	0.00	0.45	0.00	32.76	68.47	2.00	0.00	0.44	0.00
32.80	69.36	2.00	0.00	0.44	0.00	32.89	70.16	2.00	0.00	0.44	0.00
32.93	70.52	2.00	0.00	0.44	0.00	32.98	68.12	2.00	0.00	0.44	0.00
33.11	65.14	2.00	0.00	0.44	0.00	33.16	63.38	2.00	0.00	0.44	0.00
33.21	64.72	2.00	0.00	0.44	0.00	33.27	66.81	2.00	0.00	0.44	0.00
33.33	68.41	2.00	0.00	0.44	0.00	33.37	71.14	2.00	0.00	0.43	0.00
33.51	73.51	2.00	0.00	0.43	0.00	33.55	75.57	2.00	0.00	0.43	0.00
33.62	75.95	2.00	0.00	0.43	0.00	33.68	76.01	2.00	0.00	0.43	0.00
33.75	76.22	2.00	0.00	0.43	0.00	33.80	77.37	2.00	0.00	0.43	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
33.86	78.30	2.00	0.00	0.43	0.00	33.91	73.21	2.00	0.00	0.43	0.00
33.99	67.59	2.00	0.00	0.42	0.00	34.04	62.03	2.00	0.00	0.42	0.00
34.11	62.99	2.00	0.00	0.42	0.00	34.17	63.07	2.00	0.00	0.42	0.00
34.21	62.69	2.00	0.00	0.42	0.00	34.30	62.36	2.00	0.00	0.42	0.00
34.34	62.67	2.00	0.00	0.42	0.00	34.43	63.86	2.00	0.00	0.42	0.00
34.48	66.01	2.00	0.00	0.42	0.00	34.52	67.79	2.00	0.00	0.41	0.00
34.58	69.16	2.00	0.00	0.41	0.00	34.69	70.59	2.00	0.00	0.41	0.00
34.79	71.95	2.00	0.00	0.41	0.00	34.85	72.98	2.00	0.00	0.41	0.00
34.91	73.39	2.00	0.00	0.41	0.00	34.96	73.36	2.00	0.00	0.41	0.00
35.01	73.19	2.00	0.00	0.41	0.00	35.05	70.74	2.00	0.00	0.41	0.00
35.13	66.44	2.00	0.00	0.40	0.00	35.18	62.07	2.00	0.00	0.40	0.00
35.28	60.44	0.13	1.42	0.40	0.02	35.32	61.83	2.00	0.00	0.40	0.00
35.40	64.96	2.00	0.00	0.40	0.00	35.45	68.81	2.00	0.00	0.40	0.00
35.51	72.27	2.00	0.00	0.40	0.00	35.57	73.42	2.00	0.00	0.40	0.00
35.69	72.69	2.00	0.00	0.40	0.00	35.75	71.10	0.14	1.22	0.39	0.01
35.80	70.82	0.14	1.22	0.39	0.01	35.89	72.21	2.00	0.00	0.39	0.00
35.93	74.77	2.00	0.00	0.39	0.00	35.99	78.29	2.00	0.00	0.39	0.00
36.06	77.90	2.00	0.00	0.39	0.00	36.18	74.28	2.00	0.00	0.39	0.00
36.24	69.28	2.00	0.00	0.39	0.00	36.29	67.64	2.00	0.00	0.38	0.00
36.35	71.00	2.00	0.00	0.38	0.00	36.42	76.33	2.00	0.00	0.38	0.00
36.46	82.73	2.00	0.00	0.38	0.00	36.54	86.74	2.00	0.00	0.38	0.00
36.59	89.24	2.00	0.00	0.38	0.00	36.67	88.62	2.00	0.00	0.38	0.00
36.73	85.92	2.00	0.00	0.38	0.00	36.78	80.18	2.00	0.00	0.38	0.00
36.86	74.31	2.00	0.00	0.38	0.00	36.90	69.84	2.00	0.00	0.37	0.00
36.96	68.71	2.00	0.00	0.37	0.00	37.03	68.12	2.00	0.00	0.37	0.00
37.09	67.53	2.00	0.00	0.37	0.00	37.16	68.34	0.14	1.18	0.37	0.01
37.21	70.78	0.14	1.15	0.37	0.01	37.27	74.51	0.15	1.10	0.37	0.01
37.34	77.54	0.16	1.06	0.37	0.01	37.43	79.47	0.16	1.03	0.37	0.01
37.47	79.89	0.16	1.03	0.36	0.00	37.55	80.89	0.16	1.01	0.36	0.01
37.70	82.56	0.17	0.99	0.36	0.02	37.76	84.50	0.17	0.97	0.36	0.01
37.81	84.64	0.17	0.96	0.36	0.00	37.87	82.82	0.17	0.98	0.36	0.01
37.94	80.28	0.16	1.00	0.36	0.01	37.99	78.79	0.16	1.01	0.36	0.01
38.12	78.46	0.16	1.01	0.35	0.02	38.16	80.21	0.16	0.99	0.35	0.01
38.25	82.86	0.17	0.96	0.35	0.01	38.29	87.06	0.18	0.92	0.35	0.01
38.36	90.35	0.19	0.89	0.35	0.01	38.41	92.87	0.19	0.87	0.35	0.01
38.47	93.94	0.20	0.86	0.35	0.01	38.53	94.50	0.20	0.85	0.35	0.01
38.60	94.10	0.20	0.85	0.35	0.01	38.65	94.14	0.20	0.85	0.34	0.01
38.71	94.71	0.20	0.84	0.34	0.01	38.78	96.91	0.21	0.82	0.34	0.01
38.83	100.98	0.22	0.79	0.34	0.00	38.90	106.32	0.24	0.76	0.34	0.01
38.95	113.28	0.27	0.72	0.34	0.00	39.01	125.22	0.33	0.66	0.34	0.00
39.13	141.04	0.43	0.59	0.34	0.01	39.19	162.50	0.60	0.50	0.34	0.00
39.23	184.50	0.84	0.28	0.34	0.00	39.31	215.68	2.00	0.00	0.33	0.00
39.37	243.50	2.00	0.00	0.33	0.00	39.43	265.18	2.00	0.00	0.33	0.00
39.48	280.85	2.00	0.00	0.33	0.00	39.55	292.95	2.00	0.00	0.33	0.00
39.66	299.73	2.00	0.00	0.33	0.00	39.71	305.05	2.00	0.00	0.33	0.00
39.88	302.45	2.00	0.00	0.32	0.00	39.93	298.61	2.00	0.00	0.32	0.00
39.97	295.57	2.00	0.00	0.32	0.00	40.06	297.44	2.00	0.00	0.32	0.00
40.10	301.84	2.00	0.00	0.32	0.00	40.19	304.04	2.00	0.00	0.32	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
40.23	306.55	2.00	0.00	0.32	0.00	40.33	308.08	2.00	0.00	0.32	0.00
40.36	309.81	2.00	0.00	0.32	0.00	40.46	310.88	2.00	0.00	0.31	0.00
40.50	312.87	2.00	0.00	0.31	0.00	40.59	314.17	2.00	0.00	0.31	0.00
40.63	315.69	2.00	0.00	0.31	0.00	40.70	316.82	2.00	0.00	0.31	0.00
40.79	317.44	2.00	0.00	0.31	0.00	40.82	317.20	2.00	0.00	0.31	0.00
40.89	316.61	2.00	0.00	0.31	0.00	40.98	316.33	2.00	0.00	0.31	0.00
41.07	316.55	2.00	0.00	0.30	0.00	41.09	316.71	2.00	0.00	0.30	0.00
41.16	316.64	2.00	0.00	0.30	0.00	41.25	316.46	2.00	0.00	0.30	0.00
41.28	316.26	2.00	0.00	0.30	0.00	41.34	315.58	2.00	0.00	0.30	0.00
41.41	315.19	2.00	0.00	0.30	0.00	41.47	314.49	2.00	0.00	0.30	0.00
41.56	314.60	2.00	0.00	0.30	0.00	41.61	315.72	2.00	0.00	0.29	0.00
41.69	317.93	2.00	0.00	0.29	0.00	41.76	319.90	2.00	0.00	0.29	0.00
41.83	320.83	2.00	0.00	0.29	0.00	41.87	321.37	2.00	0.00	0.29	0.00
41.95	321.29	2.00	0.00	0.29	0.00	42.00	320.20	2.00	0.00	0.29	0.00
42.08	317.45	2.00	0.00	0.29	0.00	42.15	313.92	2.00	0.00	0.29	0.00
42.22	311.36	2.00	0.00	0.28	0.00	42.28	309.83	2.00	0.00	0.28	0.00
42.39	308.65	2.00	0.00	0.28	0.00	42.44	306.20	2.00	0.00	0.28	0.00
42.49	302.00	2.00	0.00	0.28	0.00	42.55	294.24	2.00	0.00	0.28	0.00
42.62	275.12	2.00	0.00	0.28	0.00	42.66	268.08	2.00	0.00	0.28	0.00
42.75	261.94	2.00	0.00	0.28	0.00	42.80	264.48	2.00	0.00	0.27	0.00
42.88	262.42	2.00	0.00	0.27	0.00	42.95	261.34	2.00	0.00	0.27	0.00
42.98	261.38	2.00	0.00	0.27	0.00	43.07	261.08	2.00	0.00	0.27	0.00
43.15	259.20	2.00	0.00	0.27	0.00	43.22	255.43	2.00	0.00	0.27	0.00
43.27	249.98	2.00	0.00	0.27	0.00	43.31	242.83	2.00	0.00	0.27	0.00
43.37	221.86	2.00	0.00	0.26	0.00	43.55	199.26	1.04	0.12	0.26	0.00
43.59	178.37	0.78	0.23	0.26	0.00	43.64	170.30	0.69	0.30	0.26	0.00
43.69	163.81	0.62	0.39	0.26	0.00	43.73	158.55	0.58	0.40	0.26	0.00
43.77	153.65	0.53	0.42	0.26	0.00	43.87	150.50	0.51	0.43	0.26	0.01
43.91	150.63	0.51	0.43	0.26	0.00	44.03	154.95	0.55	0.41	0.25	0.01
44.08	164.04	0.63	0.37	0.25	0.00	44.14	176.46	0.76	0.22	0.25	0.00
44.20	194.08	0.97	0.12	0.25	0.00	44.27	217.29	2.00	0.00	0.25	0.00
44.33	240.40	2.00	0.00	0.25	0.00	44.44	256.70	2.00	0.00	0.25	0.00
44.51	266.57	2.00	0.00	0.25	0.00	44.52	264.90	2.00	0.00	0.25	0.00
44.57	265.46	2.00	0.00	0.24	0.00	44.64	266.65	2.00	0.00	0.24	0.00
44.74	271.41	2.00	0.00	0.24	0.00	44.81	271.92	2.00	0.00	0.24	0.00
44.85	270.05	2.00	0.00	0.24	0.00	44.98	267.03	2.00	0.00	0.24	0.00
45.03	264.87	2.00	0.00	0.24	0.00	45.10	263.09	2.00	0.00	0.24	0.00
45.16	261.50	2.00	0.00	0.23	0.00	45.21	261.97	2.00	0.00	0.23	0.00
45.28	262.48	2.00	0.00	0.23	0.00	45.34	263.55	2.00	0.00	0.23	0.00
45.40	264.78	2.00	0.00	0.23	0.00	45.47	267.00	2.00	0.00	0.23	0.00
45.56	269.47	2.00	0.00	0.23	0.00	45.64	272.69	2.00	0.00	0.23	0.00
45.70	276.02	2.00	0.00	0.23	0.00	45.82	278.62	2.00	0.00	0.22	0.00
45.88	280.94	2.00	0.00	0.22	0.00	46.00	281.98	2.00	0.00	0.22	0.00
46.05	283.07	2.00	0.00	0.22	0.00	46.12	283.44	2.00	0.00	0.22	0.00
46.18	283.00	2.00	0.00	0.22	0.00	46.24	281.24	2.00	0.00	0.22	0.00
46.30	278.17	2.00	0.00	0.22	0.00	46.35	273.95	2.00	0.00	0.21	0.00
46.41	269.30	2.00	0.00	0.21	0.00	46.48	264.63	2.00	0.00	0.21	0.00
46.53	260.13	2.00	0.00	0.21	0.00	46.60	255.07	2.00	0.00	0.21	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
46.66	246.51	2.00	0.00	0.21	0.00	46.79	238.28	2.00	0.00	0.21	0.00
46.83	228.95	2.00	0.00	0.21	0.00	46.88	217.35	2.00	0.00	0.21	0.00
46.92	209.94	2.00	0.00	0.20	0.00	46.99	203.93	2.00	0.00	0.20	0.00
47.07	198.76	1.06	0.07	0.20	0.00	47.15	189.52	0.93	0.12	0.20	0.00
47.19	179.19	0.80	0.17	0.20	0.00	47.28	170.30	0.70	0.23	0.20	0.00
47.32	158.90	0.59	0.31	0.20	0.00	47.41	150.19	0.52	0.33	0.20	0.00
47.46	140.93	0.44	0.35	0.20	0.00	47.55	134.56	0.40	0.36	0.19	0.00
47.59	126.04	0.35	0.37	0.19	0.00	47.72	118.97	0.31	0.39	0.19	0.01
47.77	110.44	0.27	0.41	0.19	0.00	47.91	105.15	0.25	0.42	0.19	0.01
47.94	100.69	0.23	0.44	0.19	0.00	47.99	98.74	0.22	0.44	0.19	0.00
48.03	97.26	0.22	0.44	0.19	0.00	48.09	96.23	0.21	0.45	0.18	0.00
48.13	95.46	0.21	0.45	0.18	0.00	48.18	94.75	0.21	0.45	0.18	0.00
48.25	93.96	0.21	0.45	0.18	0.00	48.30	93.05	0.20	0.45	0.18	0.00
48.38	92.49	0.20	0.45	0.18	0.00	48.47	92.50	0.20	0.44	0.18	0.00
48.51	93.26	0.20	0.44	0.18	0.00	48.56	94.78	0.21	0.43	0.18	0.00
48.67	96.04	0.21	0.42	0.18	0.01	48.72	96.80	0.22	0.42	0.17	0.00
48.77	96.23	0.21	0.42	0.17	0.00	48.82	94.96	0.21	0.42	0.17	0.00
48.93	93.66	0.21	0.42	0.17	0.01	48.99	92.58	0.20	0.42	0.17	0.00
49.04	91.66	0.20	0.42	0.17	0.00	49.10	90.42	0.20	0.43	0.17	0.00
49.22	89.65	0.19	0.42	0.17	0.01	49.29	89.67	0.19	0.42	0.16	0.00
49.36	89.22	0.19	0.42	0.16	0.00	49.41	88.75	0.19	0.42	0.16	0.00
49.49	88.21	0.19	0.42	0.16	0.00	49.53	89.12	0.19	0.41	0.16	0.00
49.59	90.13	0.20	0.41	0.16	0.00	49.66	90.27	0.20	0.40	0.16	0.00
49.70	89.99	0.20	0.40	0.16	0.00	49.76	89.57	0.19	0.40	0.16	0.00
49.81	89.63	0.19	0.40	0.16	0.00	49.89	89.74	0.20	0.39	0.15	0.00
49.94	89.81	0.20	0.39	0.15	0.00	50.01	90.04	0.20	0.39	0.15	0.00

Total estimated settlement: 1.49

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

LIQUEFACTION ANALYSIS REPORT

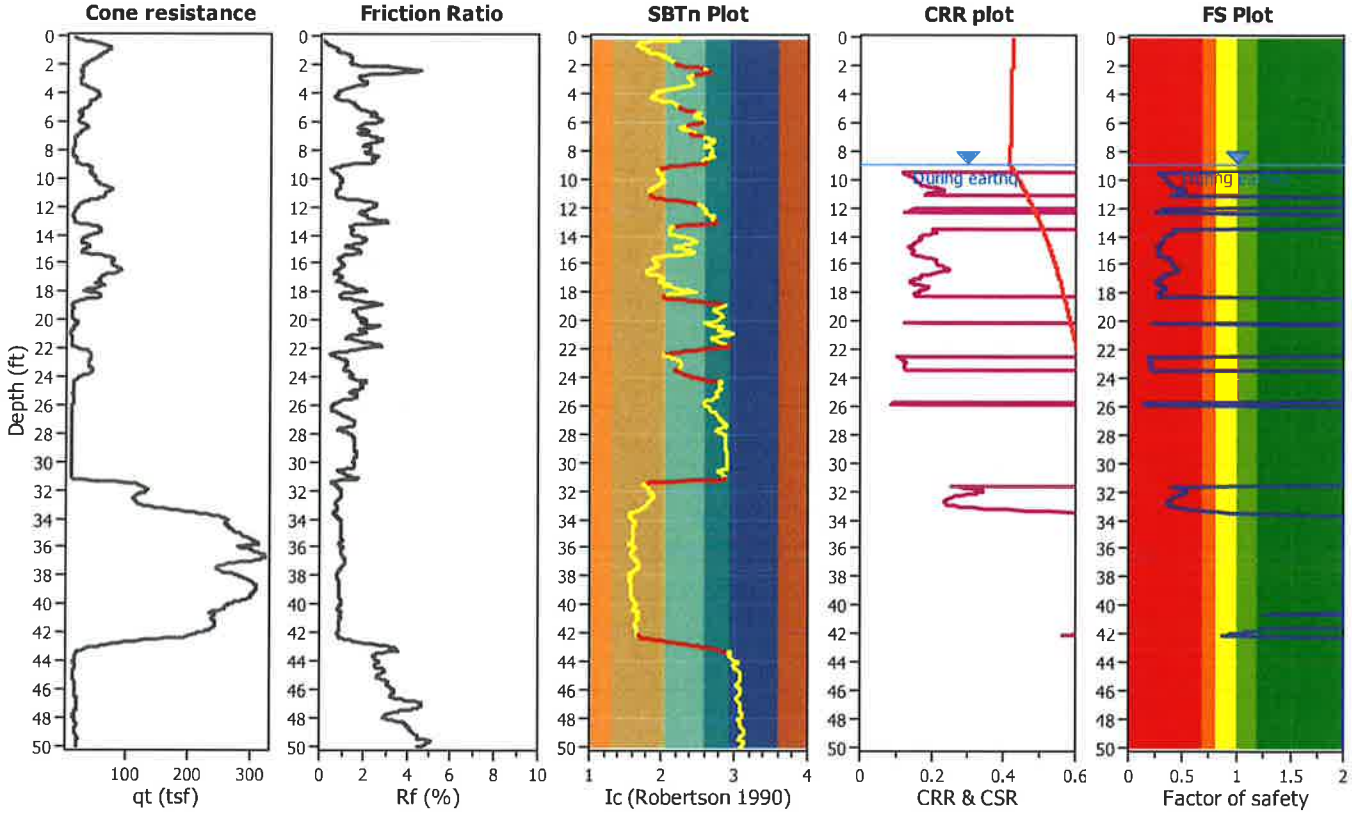
Project title : S-Line Upgrades

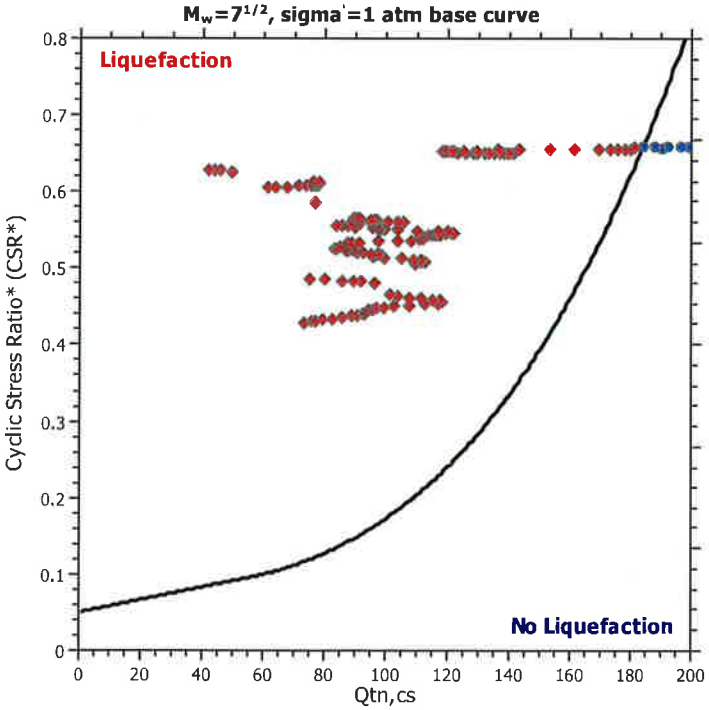
Location : Imperial County, CA

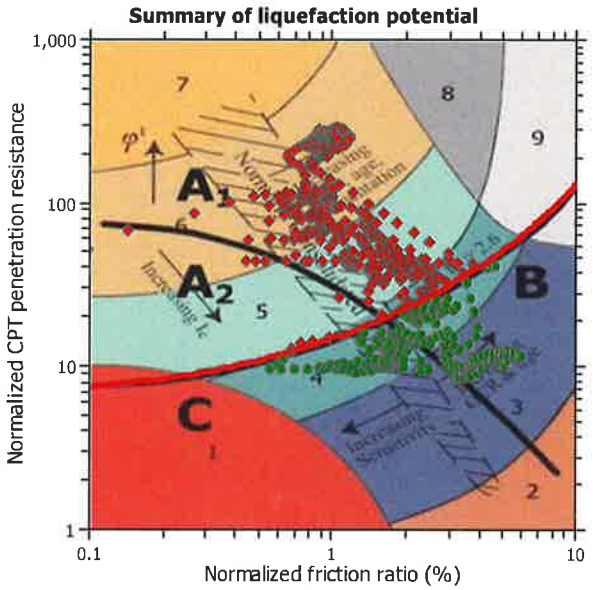
CPT file : CPT-10

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	9.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.60	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

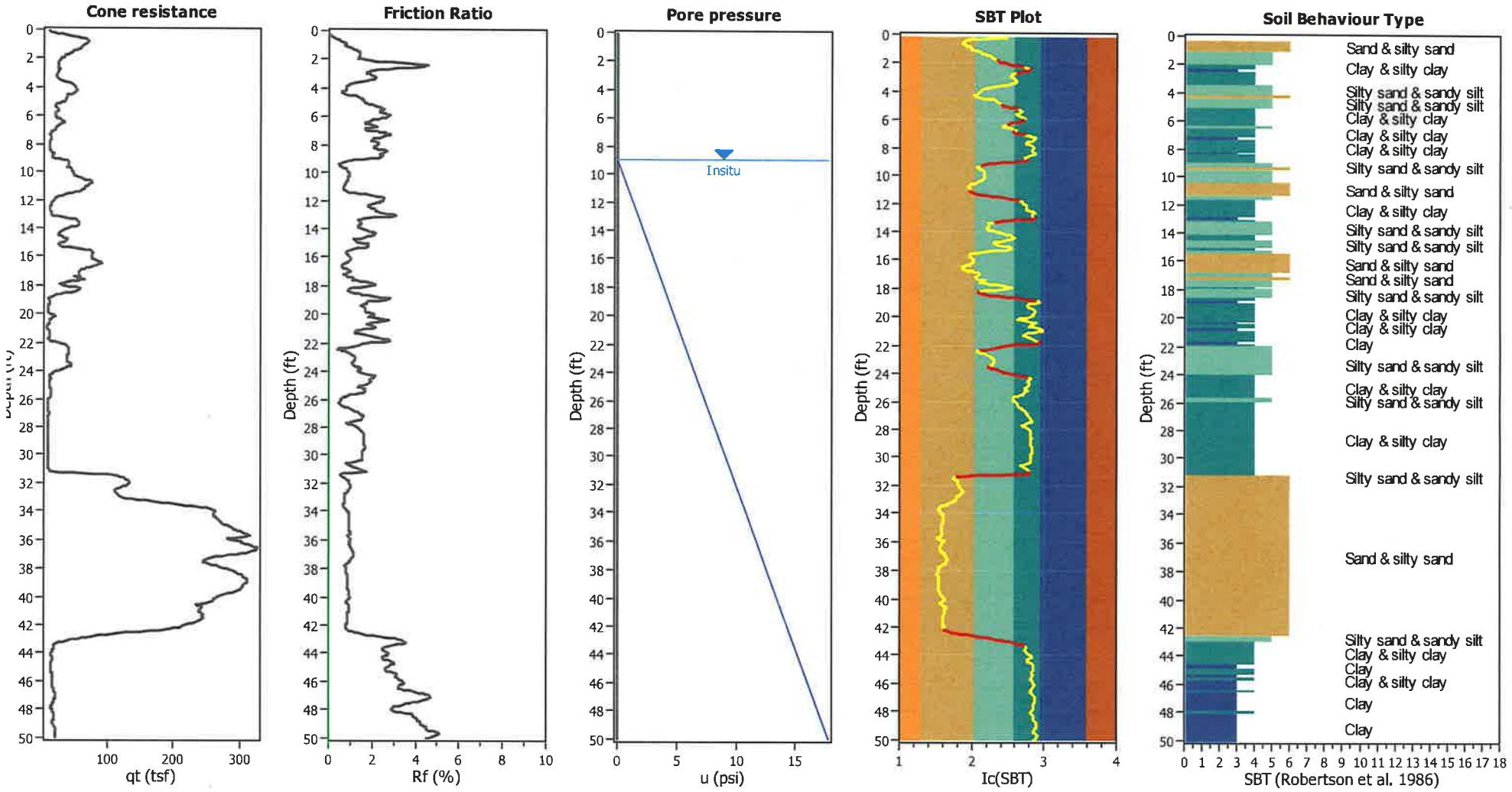






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



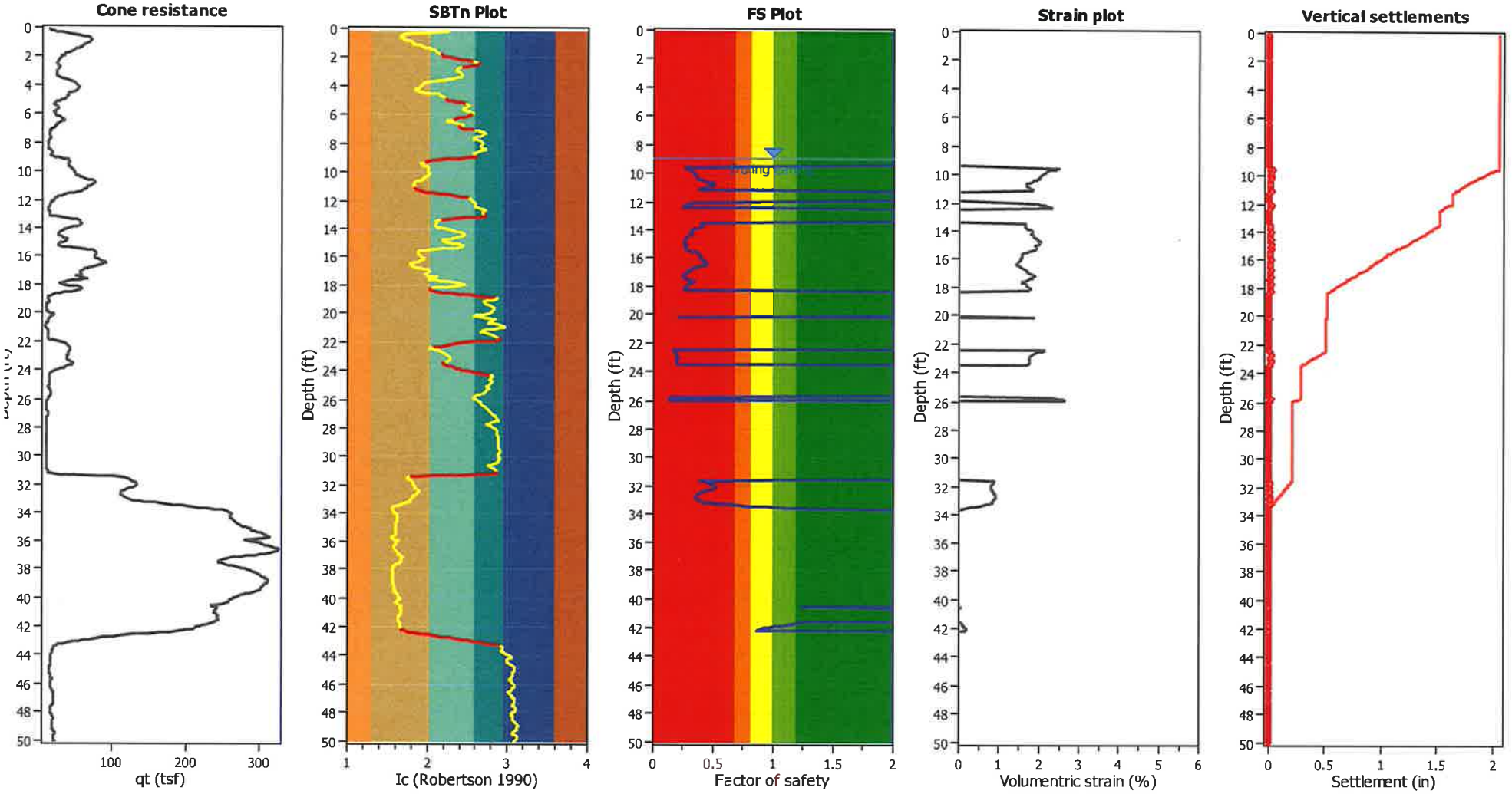
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	9.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
9.01	79.00	2.00	0.00	0.85	0.00	9.09	78.52	2.00	0.00	0.85	0.00
9.15	80.15	2.00	0.00	0.85	0.00	9.21	82.52	2.00	0.00	0.84	0.00
9.27	78.74	2.00	0.00	0.84	0.00	9.34	74.60	2.00	0.00	0.84	0.00
9.40	59.18	2.00	0.00	0.84	0.00	9.52	73.22	0.27	2.53	0.84	0.04
9.58	75.52	0.28	2.46	0.84	0.02	9.62	77.15	0.28	2.42	0.84	0.01
9.66	79.55	0.29	2.36	0.84	0.01	9.72	82.47	0.30	2.29	0.84	0.02
9.80	85.80	0.32	2.21	0.83	0.02	9.85	88.74	0.33	2.15	0.83	0.01
9.94	90.86	0.34	2.10	0.83	0.02	9.98	92.46	0.35	2.07	0.83	0.01
10.07	93.15	0.35	2.05	0.83	0.02	10.11	93.89	0.35	2.04	0.83	0.01
10.21	94.30	0.35	2.03	0.83	0.02	10.25	95.36	0.36	2.01	0.83	0.01
10.32	96.90	0.37	1.98	0.83	0.02	10.39	99.13	0.38	1.94	0.82	0.02
10.43	102.61	0.40	1.88	0.82	0.01	10.51	107.30	0.43	1.81	0.82	0.02
10.60	112.46	0.47	1.74	0.82	0.02	10.65	116.76	0.50	1.69	0.82	0.01
10.74	118.33	0.51	1.67	0.82	0.02	10.78	117.57	0.51	1.67	0.82	0.01
10.85	115.06	0.48	1.70	0.82	0.02	10.90	111.25	0.45	1.75	0.82	0.01
11.00	107.51	0.42	1.79	0.81	0.02	11.04	103.70	0.40	1.84	0.81	0.01
11.15	101.37	0.38	1.87	0.81	0.03	11.22	100.13	2.00	0.00	0.81	0.00
11.27	100.04	2.00	0.00	0.81	0.00	11.34	100.25	2.00	0.00	0.81	0.00
11.40	100.56	2.00	0.00	0.81	0.00	11.45	101.91	2.00	0.00	0.81	0.00
11.53	103.23	2.00	0.00	0.80	0.00	11.57	105.32	2.00	0.00	0.80	0.00
11.63	106.77	2.00	0.00	0.80	0.00	11.71	107.30	2.00	0.00	0.80	0.00
11.75	105.86	2.00	0.00	0.80	0.00	11.83	103.15	2.00	0.00	0.80	0.00
11.88	99.48	2.00	0.00	0.80	0.00	12.02	95.95	0.34	1.92	0.80	0.03
12.06	91.84	0.32	1.99	0.80	0.01	12.11	89.64	0.30	2.03	0.79	0.01
12.19	85.33	0.28	2.11	0.79	0.02	12.26	80.02	0.26	2.22	0.79	0.02
12.33	74.93	0.24	2.34	0.79	0.02	12.40	73.21	2.00	0.00	0.79	0.00
12.46	73.65	2.00	0.00	0.79	0.00	12.54	73.61	2.00	0.00	0.79	0.00
12.59	73.87	2.00	0.00	0.79	0.00	12.63	74.36	2.00	0.00	0.79	0.00
12.68	75.35	2.00	0.00	0.79	0.00	12.77	76.10	2.00	0.00	0.78	0.00
12.81	78.95	2.00	0.00	0.78	0.00	12.90	82.80	2.00	0.00	0.78	0.00
12.94	88.34	2.00	0.00	0.78	0.00	12.99	93.37	2.00	0.00	0.78	0.00
13.09	96.64	2.00	0.00	0.78	0.00	13.15	96.70	2.00	0.00	0.78	0.00
13.20	93.68	2.00	0.00	0.78	0.00	13.30	93.96	2.00	0.00	0.77	0.00
13.35	99.44	2.00	0.00	0.77	0.00	13.43	104.63	2.00	0.00	0.77	0.00
13.48	109.28	0.40	1.68	0.77	0.01	13.57	111.49	0.41	1.65	0.77	0.02
13.61	112.44	0.42	1.63	0.77	0.01	13.67	112.24	0.41	1.63	0.77	0.01
13.74	111.27	0.41	1.64	0.77	0.01	13.79	108.84	0.39	1.67	0.77	0.01
13.87	104.84	0.37	1.72	0.77	0.02	13.92	99.56	0.33	1.79	0.76	0.01
14.04	96.28	0.32	1.84	0.76	0.03	14.09	95.66	0.31	1.84	0.76	0.01
14.18	97.04	0.32	1.82	0.76	0.02	14.22	98.03	0.32	1.80	0.76	0.01
14.26	97.34	0.32	1.81	0.76	0.01	14.34	94.78	0.31	1.85	0.76	0.02
14.42	92.77	0.30	1.88	0.76	0.02	14.47	90.70	0.29	1.91	0.75	0.01
14.56	89.41	0.28	1.93	0.75	0.02	14.63	87.66	0.27	1.96	0.75	0.01
14.67	86.83	0.27	1.97	0.75	0.01	14.72	82.92	0.25	2.05	0.75	0.01
14.81	83.76	0.26	2.02	0.75	0.02	14.92	84.83	0.26	2.00	0.75	0.03
14.98	89.68	0.28	1.91	0.75	0.01	15.04	89.28	0.28	1.91	0.75	0.01
15.13	87.18	0.27	1.94	0.74	0.02	15.17	86.92	0.27	1.95	0.74	0.01
15.26	87.49	0.27	1.93	0.74	0.02	15.30	88.65	0.27	1.91	0.74	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
15.36	91.13	0.28	1.87	0.74	0.01	15.44	97.26	0.31	1.77	0.74	0.02
15.53	103.82	0.34	1.67	0.74	0.02	15.58	108.05	0.37	1.61	0.74	0.01
15.63	110.43	0.38	1.58	0.74	0.01	15.70	111.80	0.39	1.56	0.73	0.01
15.79	112.06	0.39	1.56	0.73	0.02	15.84	112.23	0.39	1.55	0.73	0.01
15.96	112.64	0.39	1.55	0.73	0.02	16.01	113.62	0.40	1.53	0.73	0.01
16.06	114.74	0.41	1.52	0.73	0.01	16.12	116.10	0.42	1.50	0.73	0.01
16.19	117.72	0.43	1.48	0.73	0.01	16.24	119.57	0.44	1.46	0.72	0.01
16.32	121.04	0.45	1.45	0.72	0.01	16.37	121.60	0.45	1.44	0.72	0.01
16.44	120.25	0.44	1.45	0.72	0.01	16.50	116.70	0.42	1.48	0.72	0.01
16.56	110.16	0.37	1.55	0.72	0.01	16.68	103.83	0.33	1.63	0.72	0.02
16.73	99.44	0.31	1.68	0.72	0.01	16.81	98.30	0.31	1.69	0.72	0.02
16.86	97.81	0.30	1.70	0.71	0.01	16.91	97.03	0.30	1.71	0.71	0.01
16.99	95.57	0.29	1.73	0.71	0.02	17.04	89.99	0.27	1.81	0.71	0.01
17.16	85.52	0.25	1.88	0.71	0.03	17.22	83.84	0.24	1.91	0.71	0.01
17.29	87.77	0.26	1.84	0.71	0.02	17.34	90.91	0.27	1.78	0.71	0.01
17.39	88.98	0.26	1.81	0.71	0.01	17.41	91.45	0.27	1.77	0.70	0.00
17.48	95.50	0.29	1.71	0.70	0.01	17.56	103.60	0.33	1.59	0.70	0.02
17.60	105.78	0.34	1.57	0.70	0.01	17.65	103.90	0.33	1.59	0.70	0.01
17.75	100.33	0.31	1.63	0.70	0.02	17.85	97.09	0.29	1.67	0.70	0.02
17.89	96.02	0.29	1.68	0.70	0.01	17.94	94.81	0.28	1.70	0.70	0.01
17.99	91.70	0.27	1.74	0.70	0.01	18.07	89.48	0.26	1.78	0.69	0.02
18.12	90.05	0.26	1.76	0.69	0.01	18.25	91.26	0.27	1.74	0.69	0.03
18.30	89.53	2.00	0.00	0.69	0.00	18.43	86.54	2.00	0.00	0.69	0.00
18.48	83.41	2.00	0.00	0.69	0.00	18.55	81.43	2.00	0.00	0.69	0.00
18.61	79.70	2.00	0.00	0.68	0.00	18.68	78.95	2.00	0.00	0.68	0.00
18.74	79.41	2.00	0.00	0.68	0.00	18.80	80.52	2.00	0.00	0.68	0.00
18.87	80.65	2.00	0.00	0.68	0.00	18.91	76.45	2.00	0.00	0.68	0.00
19.05	71.74	2.00	0.00	0.68	0.00	19.09	67.16	2.00	0.00	0.68	0.00
19.17	66.17	2.00	0.00	0.68	0.00	19.22	65.65	2.00	0.00	0.67	0.00
19.28	62.49	2.00	0.00	0.67	0.00	19.35	59.68	2.00	0.00	0.67	0.00
19.40	57.37	2.00	0.00	0.67	0.00	19.47	58.12	2.00	0.00	0.67	0.00
19.53	58.81	2.00	0.00	0.67	0.00	19.66	58.79	2.00	0.00	0.67	0.00
19.67	59.24	2.00	0.00	0.67	0.00	19.71	59.48	2.00	0.00	0.67	0.00
19.75	60.21	2.00	0.00	0.67	0.00	19.85	61.85	2.00	0.00	0.66	0.00
19.89	64.78	2.00	0.00	0.66	0.00	19.95	70.85	2.00	0.00	0.66	0.00
20.06	74.93	2.00	0.00	0.66	0.00	20.11	77.16	2.00	0.00	0.66	0.00
20.16	76.61	0.21	1.91	0.66	0.01	20.21	77.56	2.00	0.00	0.66	0.00
20.32	79.32	2.00	0.00	0.66	0.00	20.37	81.19	2.00	0.00	0.65	0.00
20.42	79.81	2.00	0.00	0.65	0.00	20.53	74.83	2.00	0.00	0.65	0.00
20.59	68.30	2.00	0.00	0.65	0.00	20.65	63.61	2.00	0.00	0.65	0.00
20.72	62.29	2.00	0.00	0.65	0.00	20.83	61.86	2.00	0.00	0.65	0.00
20.90	60.77	2.00	0.00	0.65	0.00	20.95	58.62	2.00	0.00	0.64	0.00
21.01	55.14	2.00	0.00	0.64	0.00	21.08	53.73	2.00	0.00	0.64	0.00
21.14	53.51	2.00	0.00	0.64	0.00	21.21	54.20	2.00	0.00	0.64	0.00
21.26	54.19	2.00	0.00	0.64	0.00	21.32	57.82	2.00	0.00	0.64	0.00
21.44	62.40	2.00	0.00	0.64	0.00	21.51	67.21	2.00	0.00	0.64	0.00
21.64	70.00	2.00	0.00	0.63	0.00	21.70	72.91	2.00	0.00	0.63	0.00
21.74	75.24	2.00	0.00	0.63	0.00	21.81	76.78	2.00	0.00	0.63	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
21.88	77.68	2.00	0.00	0.63	0.00	21.93	77.66	2.00	0.00	0.63	0.00
22.05	78.18	2.00	0.00	0.63	0.00	22.10	80.56	2.00	0.00	0.63	0.00
22.23	75.44	2.00	0.00	0.62	0.00	22.29	67.67	2.00	0.00	0.62	0.00
22.36	43.92	2.00	0.00	0.62	0.00	22.41	44.24	2.00	0.00	0.62	0.00
22.48	61.10	0.17	2.17	0.62	0.02	22.54	63.94	0.17	2.08	0.62	0.01
22.59	67.42	0.18	1.99	0.62	0.01	22.67	71.03	0.19	1.90	0.62	0.02
22.77	73.98	0.19	1.84	0.61	0.02	22.81	75.76	0.20	1.80	0.61	0.01
22.85	76.70	0.20	1.78	0.61	0.01	22.93	77.44	0.20	1.76	0.61	0.02
22.98	77.83	0.20	1.75	0.61	0.01	23.07	77.71	0.20	1.75	0.61	0.02
23.10	77.18	0.20	1.76	0.61	0.01	23.20	76.55	0.20	1.77	0.61	0.02
23.25	76.03	0.20	1.77	0.61	0.01	23.34	76.05	0.20	1.77	0.60	0.02
23.38	76.53	0.20	1.76	0.60	0.01	23.43	78.10	0.20	1.73	0.60	0.01
23.52	79.97	2.00	0.00	0.60	0.00	23.56	82.46	2.00	0.00	0.60	0.00
23.65	84.15	2.00	0.00	0.60	0.00	23.69	84.41	2.00	0.00	0.60	0.00
23.79	82.36	2.00	0.00	0.60	0.00	23.85	78.26	2.00	0.00	0.60	0.00
23.91	73.94	2.00	0.00	0.59	0.00	23.96	69.92	2.00	0.00	0.59	0.00
24.02	67.00	2.00	0.00	0.59	0.00	24.09	66.15	2.00	0.00	0.59	0.00
24.21	66.94	2.00	0.00	0.59	0.00	24.27	68.78	2.00	0.00	0.59	0.00
24.33	69.16	2.00	0.00	0.59	0.00	24.39	68.93	2.00	0.00	0.59	0.00
24.45	67.71	2.00	0.00	0.59	0.00	24.51	66.40	2.00	0.00	0.58	0.00
24.58	65.51	2.00	0.00	0.58	0.00	24.64	65.62	2.00	0.00	0.58	0.00
24.71	66.16	2.00	0.00	0.58	0.00	24.75	66.22	2.00	0.00	0.58	0.00
24.81	64.64	2.00	0.00	0.58	0.00	24.91	62.97	2.00	0.00	0.58	0.00
24.98	59.56	2.00	0.00	0.58	0.00	25.02	56.91	2.00	0.00	0.58	0.00
25.09	56.00	2.00	0.00	0.57	0.00	25.15	57.99	2.00	0.00	0.57	0.00
25.20	60.88	2.00	0.00	0.57	0.00	25.27	62.40	2.00	0.00	0.57	0.00
25.35	63.17	2.00	0.00	0.57	0.00	25.40	64.01	2.00	0.00	0.57	0.00
25.50	63.26	2.00	0.00	0.57	0.00	25.54	60.73	2.00	0.00	0.57	0.00
25.60	57.02	2.00	0.00	0.57	0.00	25.66	52.77	2.00	0.00	0.57	0.00
25.75	49.44	0.15	2.35	0.56	0.03	25.81	45.87	0.14	2.49	0.56	0.02
25.88	43.70	0.14	2.59	0.56	0.02	25.92	41.73	0.14	2.68	0.56	0.01
25.99	40.86	2.00	0.00	0.56	0.00	26.06	39.02	2.00	0.00	0.56	0.00
26.18	37.69	2.00	0.00	0.56	0.00	26.24	36.31	2.00	0.00	0.56	0.00
26.36	37.24	2.00	0.00	0.55	0.00	26.41	38.62	2.00	0.00	0.55	0.00
26.46	40.44	2.00	0.00	0.55	0.00	26.54	42.25	2.00	0.00	0.55	0.00
26.60	44.22	2.00	0.00	0.55	0.00	26.67	46.65	2.00	0.00	0.55	0.00
26.78	49.12	2.00	0.00	0.55	0.00	26.85	51.30	2.00	0.00	0.54	0.00
26.90	52.77	2.00	0.00	0.54	0.00	26.98	54.24	2.00	0.00	0.54	0.00
27.03	55.59	2.00	0.00	0.54	0.00	27.08	56.70	2.00	0.00	0.54	0.00
27.16	56.76	2.00	0.00	0.54	0.00	27.21	56.24	2.00	0.00	0.54	0.00
27.27	55.28	2.00	0.00	0.54	0.00	27.33	54.75	2.00	0.00	0.54	0.00
27.39	54.66	2.00	0.00	0.54	0.00	27.46	53.85	2.00	0.00	0.53	0.00
27.52	51.33	2.00	0.00	0.53	0.00	27.58	46.97	2.00	0.00	0.53	0.00
27.65	43.86	2.00	0.00	0.53	0.00	27.70	43.27	2.00	0.00	0.53	0.00
27.76	45.28	2.00	0.00	0.53	0.00	27.83	47.37	2.00	0.00	0.53	0.00
27.90	49.51	2.00	0.00	0.53	0.00	27.98	51.27	2.00	0.00	0.53	0.00
28.06	52.40	2.00	0.00	0.52	0.00	28.08	53.14	2.00	0.00	0.52	0.00
28.21	53.83	2.00	0.00	0.52	0.00	28.26	54.52	2.00	0.00	0.52	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
28.30	55.02	2.00	0.00	0.52	0.00	28.35	55.25	2.00	0.00	0.52	0.00
28.44	55.44	2.00	0.00	0.52	0.00	28.48	55.73	2.00	0.00	0.52	0.00
28.57	55.88	2.00	0.00	0.52	0.00	28.61	56.03	2.00	0.00	0.52	0.00
28.68	55.99	2.00	0.00	0.51	0.00	28.75	56.04	2.00	0.00	0.51	0.00
28.87	56.05	2.00	0.00	0.51	0.00	28.92	56.04	2.00	0.00	0.51	0.00
28.99	55.88	2.00	0.00	0.51	0.00	29.05	55.72	2.00	0.00	0.51	0.00
29.10	55.61	2.00	0.00	0.51	0.00	29.16	55.72	2.00	0.00	0.51	0.00
29.28	55.89	2.00	0.00	0.50	0.00	29.36	56.09	2.00	0.00	0.50	0.00
29.41	56.16	2.00	0.00	0.50	0.00	29.47	56.03	2.00	0.00	0.50	0.00
29.55	55.78	2.00	0.00	0.50	0.00	29.59	55.47	2.00	0.00	0.50	0.00
29.66	55.12	2.00	0.00	0.50	0.00	29.72	54.69	2.00	0.00	0.50	0.00
29.79	54.23	2.00	0.00	0.50	0.00	29.86	53.95	2.00	0.00	0.49	0.00
29.91	53.91	2.00	0.00	0.49	0.00	29.98	53.89	2.00	0.00	0.49	0.00
30.03	53.93	2.00	0.00	0.49	0.00	30.11	53.97	2.00	0.00	0.49	0.00
30.17	54.15	2.00	0.00	0.49	0.00	30.21	54.26	2.00	0.00	0.49	0.00
30.34	54.28	2.00	0.00	0.49	0.00	30.39	53.76	2.00	0.00	0.48	0.00
30.46	49.29	2.00	0.00	0.48	0.00	30.52	45.45	2.00	0.00	0.48	0.00
30.57	42.23	2.00	0.00	0.48	0.00	30.65	44.11	2.00	0.00	0.48	0.00
30.70	45.02	2.00	0.00	0.48	0.00	30.75	45.91	2.00	0.00	0.48	0.00
30.83	46.59	2.00	0.00	0.48	0.00	30.84	47.90	2.00	0.00	0.48	0.00
30.93	49.51	2.00	0.00	0.48	0.00	30.98	52.37	2.00	0.00	0.47	0.00
31.06	55.50	2.00	0.00	0.47	0.00	31.15	58.73	2.00	0.00	0.47	0.00
31.20	60.99	2.00	0.00	0.47	0.00	31.24	60.93	2.00	0.00	0.47	0.00
31.31	67.98	2.00	0.00	0.47	0.00	31.37	88.25	2.00	0.00	0.47	0.00
31.44	104.80	2.00	0.00	0.47	0.00	31.50	117.62	2.00	0.00	0.47	0.00
31.58	123.15	0.39	0.92	0.46	0.01	31.63	128.09	0.42	0.88	0.46	0.00
31.73	131.75	0.45	0.86	0.46	0.01	31.80	135.24	0.48	0.84	0.46	0.01
31.84	137.91	0.50	0.83	0.46	0.00	31.89	139.86	0.51	0.82	0.46	0.00
31.97	141.06	0.52	0.81	0.46	0.01	32.05	141.06	0.52	0.80	0.46	0.01
32.09	139.63	0.51	0.81	0.46	0.00	32.18	137.10	0.49	0.82	0.45	0.01
32.23	133.26	0.46	0.84	0.45	0.01	32.33	129.36	0.43	0.86	0.45	0.01
32.38	125.77	0.41	0.87	0.45	0.00	32.42	123.41	0.39	0.89	0.45	0.00
32.48	121.82	0.38	0.89	0.45	0.01	32.56	120.33	0.37	0.90	0.45	0.01
32.62	119.31	0.36	0.90	0.45	0.01	32.70	118.46	0.36	0.91	0.45	0.01
32.75	118.32	0.36	0.91	0.44	0.01	32.84	118.39	0.36	0.90	0.44	0.01
32.88	119.19	0.36	0.90	0.44	0.00	32.95	120.99	0.37	0.88	0.44	0.01
33.01	124.84	0.40	0.86	0.44	0.01	33.10	129.34	0.43	0.83	0.44	0.01
33.15	136.35	0.48	0.79	0.44	0.00	33.24	143.29	0.54	0.76	0.44	0.01
33.28	153.22	0.63	0.71	0.44	0.00	33.37	161.29	0.72	0.54	0.43	0.01
33.41	169.63	0.82	0.41	0.43	0.00	33.50	179.77	0.95	0.28	0.43	0.00
33.56	190.89	1.11	0.16	0.43	0.00	33.63	200.70	2.00	0.00	0.43	0.00
33.68	210.95	2.00	0.00	0.43	0.00	33.74	221.31	2.00	0.00	0.43	0.00
33.81	229.66	2.00	0.00	0.43	0.00	33.87	234.83	2.00	0.00	0.43	0.00
33.94	237.68	2.00	0.00	0.42	0.00	34.01	239.43	2.00	0.00	0.42	0.00
34.07	240.50	2.00	0.00	0.42	0.00	34.12	239.43	2.00	0.00	0.42	0.00
34.21	237.84	2.00	0.00	0.42	0.00	34.28	236.65	2.00	0.00	0.42	0.00
34.34	237.79	2.00	0.00	0.42	0.00	34.42	239.05	2.00	0.00	0.42	0.00
34.48	240.72	2.00	0.00	0.42	0.00	34.55	241.38	2.00	0.00	0.41	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
34.61	242.38	2.00	0.00	0.41	0.00	34.71	243.29	2.00	0.00	0.41	0.00
34.78	244.58	2.00	0.00	0.41	0.00	34.84	246.06	2.00	0.00	0.41	0.00
34.91	247.98	2.00	0.00	0.41	0.00	34.96	250.68	2.00	0.00	0.41	0.00
35.01	253.88	2.00	0.00	0.41	0.00	35.09	256.69	2.00	0.00	0.41	0.00
35.15	258.68	2.00	0.00	0.40	0.00	35.22	259.90	2.00	0.00	0.40	0.00
35.27	261.36	2.00	0.00	0.40	0.00	35.33	263.84	2.00	0.00	0.40	0.00
35.40	267.20	2.00	0.00	0.40	0.00	35.45	270.64	2.00	0.00	0.40	0.00
35.53	273.27	2.00	0.00	0.40	0.00	35.58	275.21	2.00	0.00	0.40	0.00
35.64	276.95	2.00	0.00	0.40	0.00	35.71	278.85	2.00	0.00	0.39	0.00
35.76	280.88	2.00	0.00	0.39	0.00	35.83	272.50	2.00	0.00	0.39	0.00
35.94	254.63	2.00	0.00	0.39	0.00	35.97	249.61	2.00	0.00	0.39	0.00
36.06	254.21	2.00	0.00	0.39	0.00	36.10	267.78	2.00	0.00	0.39	0.00
36.18	268.47	2.00	0.00	0.39	0.00	36.23	269.86	2.00	0.00	0.39	0.00
36.30	272.77	2.00	0.00	0.38	0.00	36.37	276.52	2.00	0.00	0.38	0.00
36.45	280.74	2.00	0.00	0.38	0.00	36.50	284.54	2.00	0.00	0.38	0.00
36.59	286.81	2.00	0.00	0.38	0.00	36.65	287.17	2.00	0.00	0.38	0.00
36.72	285.59	2.00	0.00	0.38	0.00	36.76	282.48	2.00	0.00	0.38	0.00
36.83	277.22	2.00	0.00	0.38	0.00	36.93	271.38	2.00	0.00	0.37	0.00
36.97	265.87	2.00	0.00	0.37	0.00	37.03	260.85	2.00	0.00	0.37	0.00
37.07	252.49	2.00	0.00	0.37	0.00	37.16	244.67	2.00	0.00	0.37	0.00
37.21	235.35	2.00	0.00	0.37	0.00	37.28	228.50	2.00	0.00	0.37	0.00
37.35	221.88	2.00	0.00	0.37	0.00	37.43	217.81	2.00	0.00	0.37	0.00
37.47	215.43	2.00	0.00	0.36	0.00	37.54	215.03	2.00	0.00	0.36	0.00
37.61	214.23	2.00	0.00	0.36	0.00	37.70	218.85	2.00	0.00	0.36	0.00
37.76	223.22	2.00	0.00	0.36	0.00	37.80	228.73	2.00	0.00	0.36	0.00
37.88	233.02	2.00	0.00	0.36	0.00	37.94	238.44	2.00	0.00	0.36	0.00
38.01	241.83	2.00	0.00	0.36	0.00	38.06	244.59	2.00	0.00	0.35	0.00
38.13	247.13	2.00	0.00	0.35	0.00	38.19	250.38	2.00	0.00	0.35	0.00
38.28	254.14	2.00	0.00	0.35	0.00	38.37	256.20	2.00	0.00	0.35	0.00
38.41	258.37	2.00	0.00	0.35	0.00	38.49	260.02	2.00	0.00	0.35	0.00
38.55	261.55	2.00	0.00	0.35	0.00	38.59	263.18	2.00	0.00	0.35	0.00
38.68	264.54	2.00	0.00	0.34	0.00	38.73	265.97	2.00	0.00	0.34	0.00
38.81	266.22	2.00	0.00	0.34	0.00	38.91	265.64	2.00	0.00	0.34	0.00
38.97	264.61	2.00	0.00	0.34	0.00	39.02	262.90	2.00	0.00	0.34	0.00
39.12	260.83	2.00	0.00	0.34	0.00	39.18	258.99	2.00	0.00	0.34	0.00
39.23	257.85	2.00	0.00	0.34	0.00	39.30	257.14	2.00	0.00	0.33	0.00
39.35	256.66	2.00	0.00	0.33	0.00	39.39	256.14	2.00	0.00	0.33	0.00
39.44	255.33	2.00	0.00	0.33	0.00	39.51	254.09	2.00	0.00	0.33	0.00
39.57	251.29	2.00	0.00	0.33	0.00	39.66	247.26	2.00	0.00	0.33	0.00
39.72	242.12	2.00	0.00	0.33	0.00	39.78	237.35	2.00	0.00	0.33	0.00
39.83	231.57	2.00	0.00	0.32	0.00	39.93	226.39	2.00	0.00	0.32	0.00
40.00	223.78	2.00	0.00	0.32	0.00	40.05	222.26	2.00	0.00	0.32	0.00
40.10	220.96	2.00	0.00	0.32	0.00	40.16	218.60	2.00	0.00	0.32	0.00
40.22	217.18	2.00	0.00	0.32	0.00	40.33	215.88	2.00	0.00	0.32	0.00
40.40	214.27	2.00	0.00	0.32	0.00	40.50	208.51	2.00	0.00	0.31	0.00
40.54	201.64	2.00	0.00	0.31	0.00	40.58	199.48	1.24	0.08	0.31	0.00
40.62	200.27	2.00	0.00	0.31	0.00	40.71	203.68	2.00	0.00	0.31	0.00
40.76	203.11	2.00	0.00	0.31	0.00	40.90	201.96	2.00	0.00	0.31	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
40.96	200.92	2.00	0.00	0.31	0.00	41.01	200.32	2.00	0.00	0.30	0.00
41.06	200.33	2.00	0.00	0.30	0.00	41.11	200.84	2.00	0.00	0.30	0.00
41.17	201.27	2.00	0.00	0.30	0.00	41.24	201.17	2.00	0.00	0.30	0.00
41.28	200.92	2.00	0.00	0.30	0.00	41.38	200.44	2.00	0.00	0.30	0.00
41.46	200.45	2.00	0.00	0.30	0.00	41.51	200.57	2.00	0.00	0.30	0.00
41.57	200.44	2.00	0.00	0.30	0.00	41.63	199.38	1.24	0.07	0.29	0.00
41.68	196.57	1.20	0.07	0.29	0.00	41.81	192.71	1.13	0.10	0.29	0.00
41.86	188.36	1.07	0.11	0.29	0.00	41.92	184.56	1.01	0.14	0.29	0.00
41.99	181.09	0.96	0.15	0.29	0.00	42.03	178.09	0.92	0.19	0.29	0.00
42.08	175.66	0.89	0.20	0.29	0.00	42.17	173.44	0.86	0.20	0.29	0.00
42.21	168.69	2.00	0.00	0.28	0.00	42.33	162.77	2.00	0.00	0.28	0.00
42.37	155.48	2.00	0.00	0.28	0.00	42.39	147.67	2.00	0.00	0.28	0.00
42.48	139.12	2.00	0.00	0.28	0.00	42.52	129.76	2.00	0.00	0.28	0.00
42.61	123.96	2.00	0.00	0.28	0.00	42.70	121.01	2.00	0.00	0.28	0.00
42.73	120.87	2.00	0.00	0.28	0.00	42.84	122.28	2.00	0.00	0.27	0.00
42.88	124.73	2.00	0.00	0.27	0.00	42.93	124.37	2.00	0.00	0.27	0.00
43.01	121.14	2.00	0.00	0.27	0.00	43.06	115.36	2.00	0.00	0.27	0.00
43.11	108.42	2.00	0.00	0.27	0.00	43.21	101.55	2.00	0.00	0.27	0.00
43.26	94.66	2.00	0.00	0.27	0.00	43.32	88.55	2.00	0.00	0.27	0.00
43.37	81.84	2.00	0.00	0.26	0.00	43.46	76.30	2.00	0.00	0.26	0.00
43.51	71.95	2.00	0.00	0.26	0.00	43.60	70.50	2.00	0.00	0.26	0.00
43.65	69.82	2.00	0.00	0.26	0.00	43.70	69.41	2.00	0.00	0.26	0.00
43.78	68.91	2.00	0.00	0.26	0.00	43.84	68.59	2.00	0.00	0.26	0.00
43.94	68.37	2.00	0.00	0.26	0.00	43.99	67.99	2.00	0.00	0.25	0.00
44.03	67.17	2.00	0.00	0.25	0.00	44.12	66.40	2.00	0.00	0.25	0.00
44.17	66.06	2.00	0.00	0.25	0.00	44.27	66.18	2.00	0.00	0.25	0.00
44.31	67.00	2.00	0.00	0.25	0.00	44.43	67.59	2.00	0.00	0.25	0.00
44.46	68.48	2.00	0.00	0.25	0.00	44.51	69.13	2.00	0.00	0.25	0.00
44.56	70.07	2.00	0.00	0.24	0.00	44.65	69.98	2.00	0.00	0.24	0.00
44.76	68.84	2.00	0.00	0.24	0.00	44.83	67.00	2.00	0.00	0.24	0.00
44.88	65.45	2.00	0.00	0.24	0.00	44.95	64.37	2.00	0.00	0.24	0.00
45.01	63.87	2.00	0.00	0.24	0.00	45.08	63.72	2.00	0.00	0.24	0.00
45.19	64.29	2.00	0.00	0.23	0.00	45.26	65.61	2.00	0.00	0.23	0.00
45.32	67.65	2.00	0.00	0.23	0.00	45.38	69.92	2.00	0.00	0.23	0.00
45.44	71.67	2.00	0.00	0.23	0.00	45.49	72.71	2.00	0.00	0.23	0.00
45.56	72.90	2.00	0.00	0.23	0.00	45.62	73.03	2.00	0.00	0.23	0.00
45.68	73.11	2.00	0.00	0.23	0.00	45.75	73.47	2.00	0.00	0.22	0.00
45.80	73.66	2.00	0.00	0.22	0.00	45.88	74.05	2.00	0.00	0.22	0.00
45.96	74.48	2.00	0.00	0.22	0.00	46.04	74.84	2.00	0.00	0.22	0.00
46.09	75.14	2.00	0.00	0.22	0.00	46.13	75.10	2.00	0.00	0.22	0.00
46.22	74.74	2.00	0.00	0.22	0.00	46.27	74.25	2.00	0.00	0.22	0.00
46.38	74.60	2.00	0.00	0.21	0.00	46.49	76.06	2.00	0.00	0.21	0.00
46.57	78.42	2.00	0.00	0.21	0.00	46.62	80.90	2.00	0.00	0.21	0.00
46.68	83.48	2.00	0.00	0.21	0.00	46.75	86.07	2.00	0.00	0.21	0.00
46.80	88.52	2.00	0.00	0.21	0.00	46.85	90.60	2.00	0.00	0.21	0.00
46.93	92.22	2.00	0.00	0.20	0.00	46.98	93.10	2.00	0.00	0.20	0.00
47.11	93.18	2.00	0.00	0.20	0.00	47.15	92.78	2.00	0.00	0.20	0.00
47.22	91.85	2.00	0.00	0.20	0.00	47.28	90.45	2.00	0.00	0.20	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
47.33	88.10	2.00	0.00	0.20	0.00	47.41	85.46	2.00	0.00	0.20	0.00
47.46	82.38	2.00	0.00	0.20	0.00	47.53	79.55	2.00	0.00	0.19	0.00
47.58	76.73	2.00	0.00	0.19	0.00	47.64	73.78	2.00	0.00	0.19	0.00
47.71	70.71	2.00	0.00	0.19	0.00	47.77	68.45	2.00	0.00	0.19	0.00
47.82	67.35	2.00	0.00	0.19	0.00	47.89	67.26	2.00	0.00	0.19	0.00
47.95	67.64	2.00	0.00	0.19	0.00	48.01	68.65	2.00	0.00	0.19	0.00
48.07	70.27	2.00	0.00	0.19	0.00	48.13	72.71	2.00	0.00	0.18	0.00
48.20	75.69	2.00	0.00	0.18	0.00	48.26	78.91	2.00	0.00	0.18	0.00
48.30	81.50	2.00	0.00	0.18	0.00	48.39	82.87	2.00	0.00	0.18	0.00
48.44	83.34	2.00	0.00	0.18	0.00	48.51	83.14	2.00	0.00	0.18	0.00
48.56	83.01	2.00	0.00	0.18	0.00	48.68	82.42	2.00	0.00	0.17	0.00
48.75	81.90	2.00	0.00	0.17	0.00	48.76	81.42	2.00	0.00	0.17	0.00
48.84	81.61	2.00	0.00	0.17	0.00	48.90	81.87	2.00	0.00	0.17	0.00
48.97	82.11	2.00	0.00	0.17	0.00	49.02	82.75	2.00	0.00	0.17	0.00
49.10	84.17	2.00	0.00	0.17	0.00	49.16	86.31	2.00	0.00	0.17	0.00
49.21	88.33	2.00	0.00	0.17	0.00	49.28	89.99	2.00	0.00	0.16	0.00
49.37	91.46	2.00	0.00	0.16	0.00	49.44	92.75	2.00	0.00	0.16	0.00
49.48	94.00	2.00	0.00	0.16	0.00	49.56	94.88	2.00	0.00	0.16	0.00
49.65	95.20	2.00	0.00	0.16	0.00	49.68	94.84	2.00	0.00	0.16	0.00
49.74	93.78	2.00	0.00	0.16	0.00	49.83	92.71	2.00	0.00	0.16	0.00
49.88	91.94	2.00	0.00	0.15	0.00	49.99	91.42	2.00	0.00	0.15	0.00
50.03	91.05	2.00	0.00	0.15	0.00						

Total estimated settlement: 2.05

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

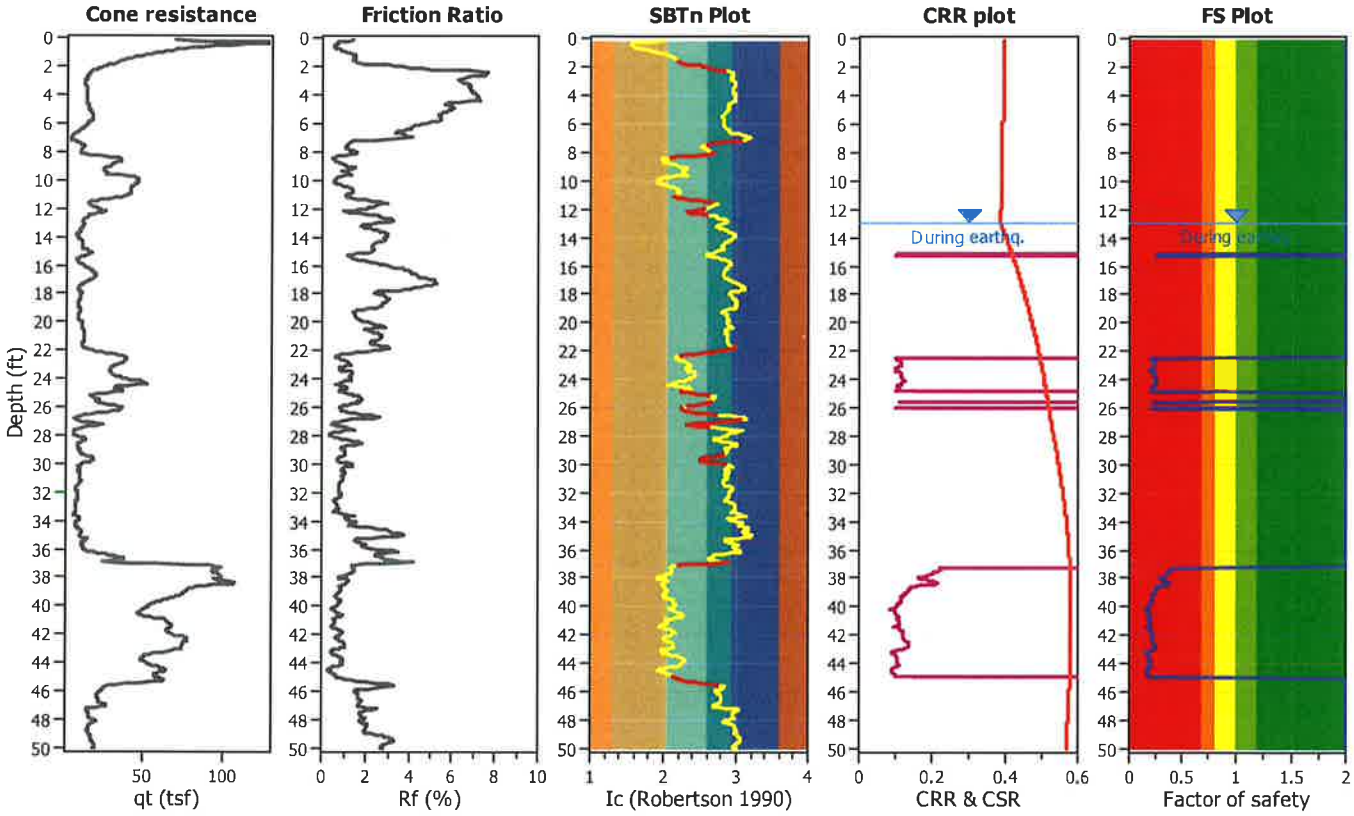
LIQUEFACTION ANALYSIS REPORT

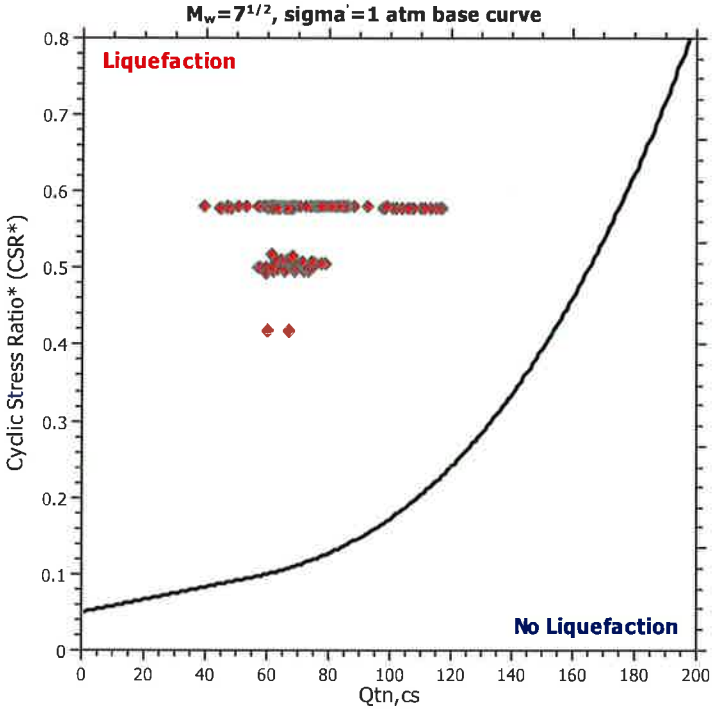
Project title : S-Line Upgrades **Location : Imperial County, CA**

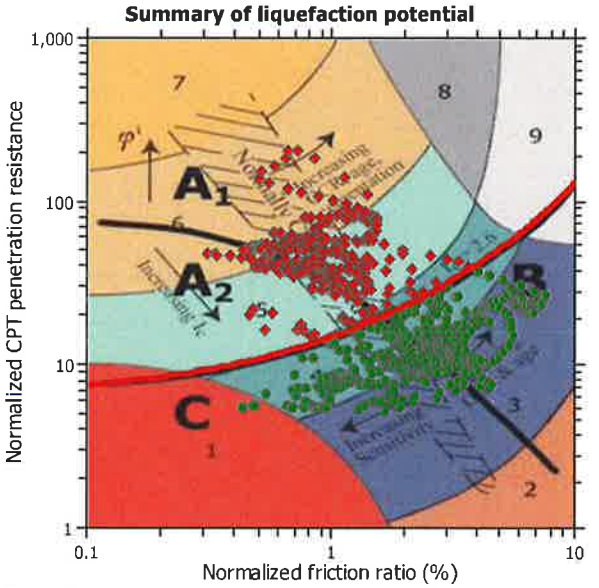
CPT file : CPT-11

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	13.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	13.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.56	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

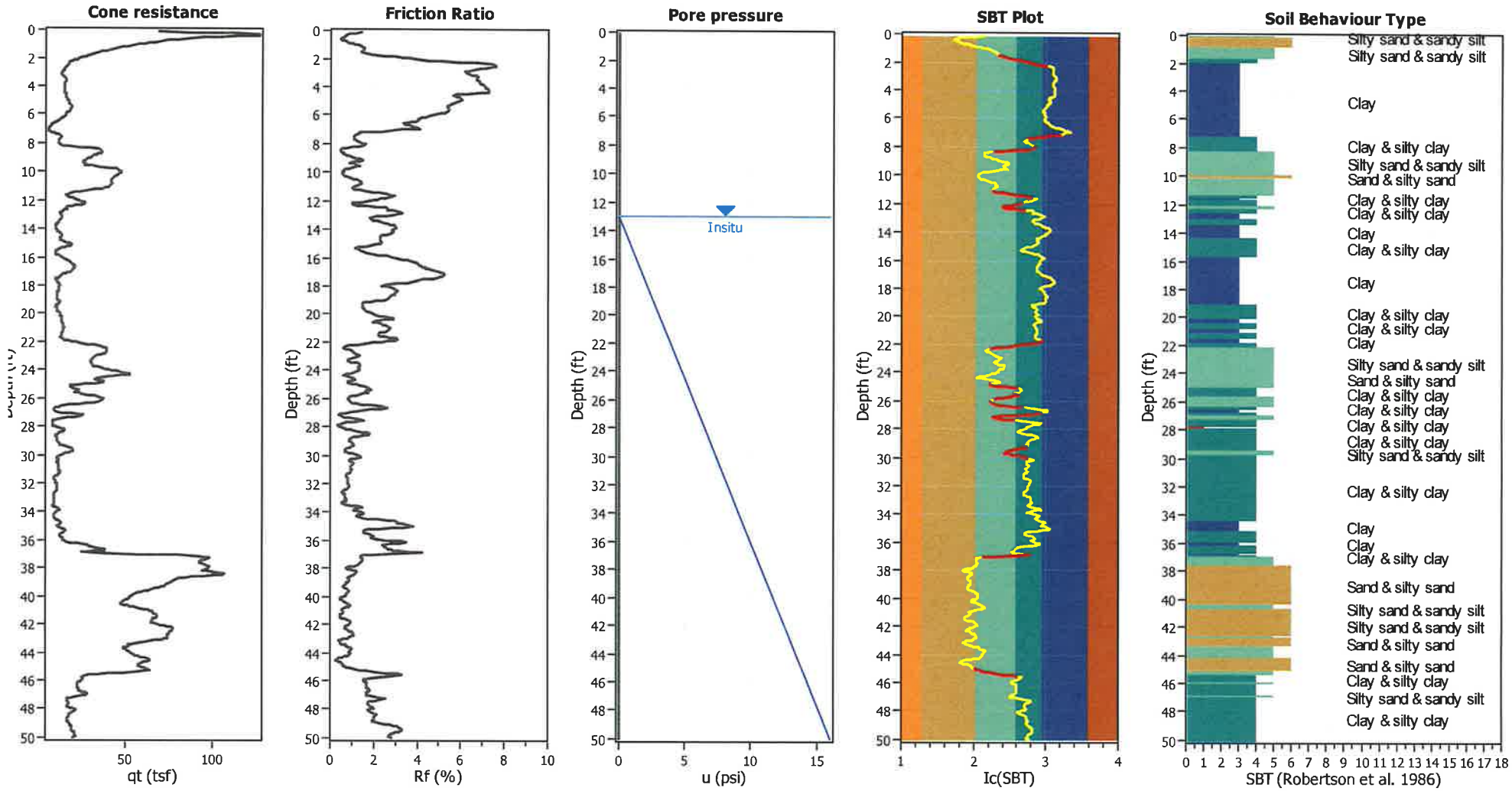






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



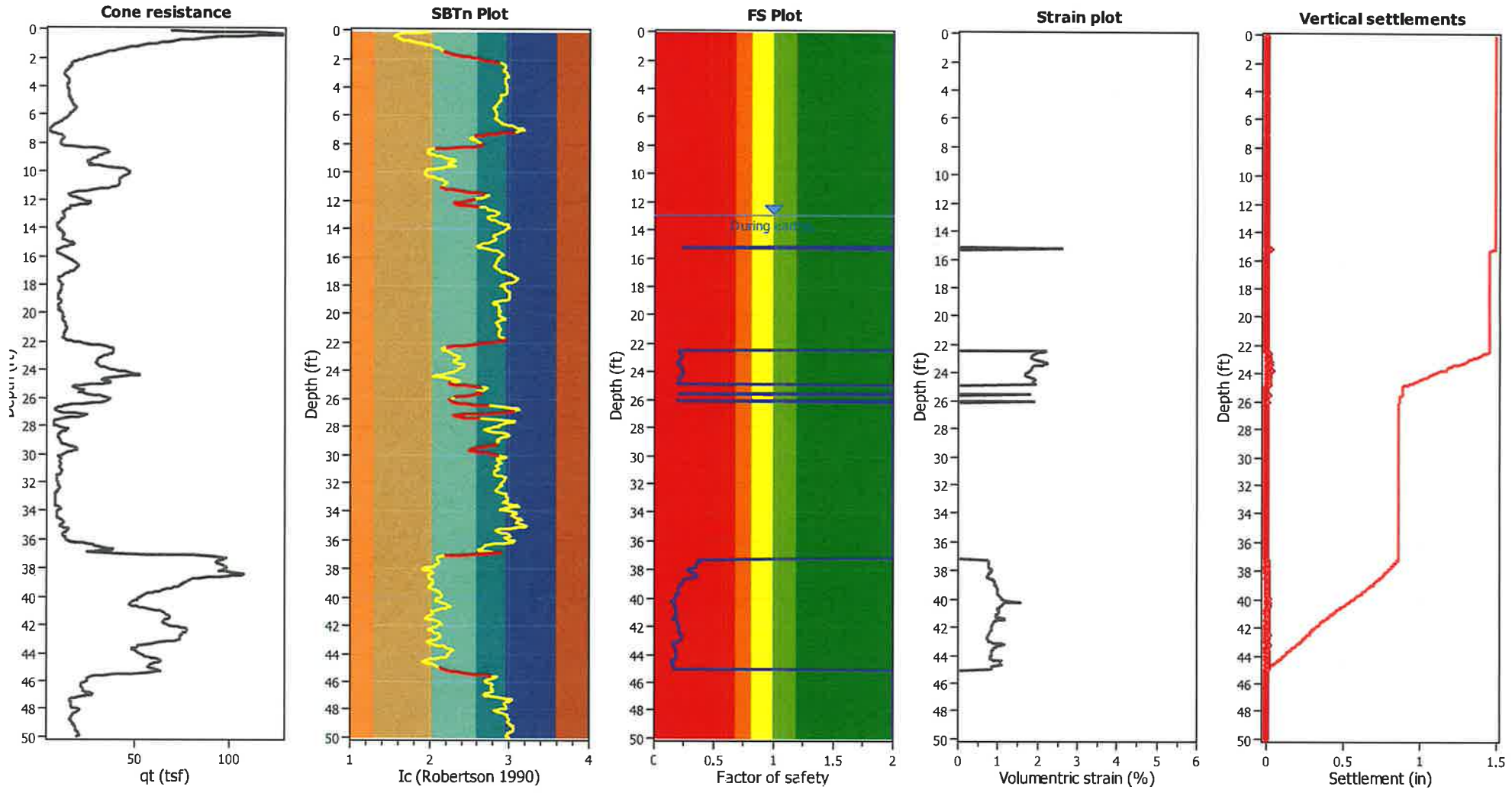
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	13.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.56	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	13.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
13.02	76.93	2.00	0.00	0.78	0.00	13.06	71.03	2.00	0.00	0.78	0.00
13.15	67.43	2.00	0.00	0.78	0.00	13.21	65.80	2.00	0.00	0.78	0.00
13.30	66.23	2.00	0.00	0.77	0.00	13.36	66.87	2.00	0.00	0.77	0.00
13.39	68.85	2.00	0.00	0.77	0.00	13.48	70.78	2.00	0.00	0.77	0.00
13.54	72.34	2.00	0.00	0.77	0.00	13.62	72.82	2.00	0.00	0.77	0.00
13.67	73.05	2.00	0.00	0.77	0.00	13.71	72.99	2.00	0.00	0.77	0.00
13.80	72.55	2.00	0.00	0.77	0.00	13.90	72.21	2.00	0.00	0.76	0.00
13.98	71.96	2.00	0.00	0.76	0.00	14.02	72.34	2.00	0.00	0.76	0.00
14.08	73.17	2.00	0.00	0.76	0.00	14.14	74.44	2.00	0.00	0.76	0.00
14.19	75.56	2.00	0.00	0.76	0.00	14.24	76.36	2.00	0.00	0.76	0.00
14.33	76.44	2.00	0.00	0.76	0.00	14.38	75.41	2.00	0.00	0.76	0.00
14.45	73.45	2.00	0.00	0.76	0.00	14.55	71.86	2.00	0.00	0.75	0.00
14.60	71.28	2.00	0.00	0.75	0.00	14.64	70.97	2.00	0.00	0.75	0.00
14.75	70.61	2.00	0.00	0.75	0.00	14.81	70.95	2.00	0.00	0.75	0.00
14.86	72.74	2.00	0.00	0.75	0.00	14.91	75.65	2.00	0.00	0.75	0.00
15.00	78.13	2.00	0.00	0.75	0.00	15.06	77.89	2.00	0.00	0.74	0.00
15.13	74.80	2.00	0.00	0.74	0.00	15.17	66.80	0.26	2.42	0.74	0.01
15.26	60.28	0.24	2.62	0.74	0.03	15.32	55.28	2.00	0.00	0.74	0.00
15.37	55.27	2.00	0.00	0.74	0.00	15.43	54.34	2.00	0.00	0.74	0.00
15.53	53.20	2.00	0.00	0.74	0.00	15.55	53.00	2.00	0.00	0.74	0.00
15.62	55.25	2.00	0.00	0.74	0.00	15.72	59.53	2.00	0.00	0.73	0.00
15.80	63.73	2.00	0.00	0.73	0.00	15.84	67.52	2.00	0.00	0.73	0.00
15.89	71.05	2.00	0.00	0.73	0.00	15.95	76.66	2.00	0.00	0.73	0.00
16.05	83.48	2.00	0.00	0.73	0.00	16.14	89.54	2.00	0.00	0.73	0.00
16.19	93.87	2.00	0.00	0.73	0.00	16.24	96.58	2.00	0.00	0.72	0.00
16.28	100.17	2.00	0.00	0.72	0.00	16.37	104.05	2.00	0.00	0.72	0.00
16.43	107.78	2.00	0.00	0.72	0.00	16.51	110.28	2.00	0.00	0.72	0.00
16.57	112.37	2.00	0.00	0.72	0.00	16.63	113.97	2.00	0.00	0.72	0.00
16.67	115.05	2.00	0.00	0.72	0.00	16.77	115.39	2.00	0.00	0.72	0.00
16.82	116.00	2.00	0.00	0.72	0.00	16.88	117.48	2.00	0.00	0.71	0.00
16.98	118.23	2.00	0.00	0.71	0.00	17.03	117.77	2.00	0.00	0.71	0.00
17.07	114.47	2.00	0.00	0.71	0.00	17.17	110.48	2.00	0.00	0.71	0.00
17.22	106.06	2.00	0.00	0.71	0.00	17.29	102.20	2.00	0.00	0.71	0.00
17.34	96.47	2.00	0.00	0.71	0.00	17.44	90.79	2.00	0.00	0.70	0.00
17.48	85.72	2.00	0.00	0.70	0.00	17.52	82.50	2.00	0.00	0.70	0.00
17.62	80.09	2.00	0.00	0.70	0.00	17.66	78.61	2.00	0.00	0.70	0.00
17.76	77.53	2.00	0.00	0.70	0.00	17.80	74.30	2.00	0.00	0.70	0.00
17.85	70.44	2.00	0.00	0.70	0.00	17.95	68.32	2.00	0.00	0.70	0.00
18.01	69.61	2.00	0.00	0.69	0.00	18.05	71.84	2.00	0.00	0.69	0.00
18.14	73.25	2.00	0.00	0.69	0.00	18.18	74.60	2.00	0.00	0.69	0.00
18.28	75.50	2.00	0.00	0.69	0.00	18.32	75.54	2.00	0.00	0.69	0.00
18.41	74.61	2.00	0.00	0.69	0.00	18.44	73.09	2.00	0.00	0.69	0.00
18.51	71.90	2.00	0.00	0.69	0.00	18.59	70.84	2.00	0.00	0.68	0.00
18.67	69.73	2.00	0.00	0.68	0.00	18.74	68.51	2.00	0.00	0.68	0.00
18.78	67.74	2.00	0.00	0.68	0.00	18.85	67.43	2.00	0.00	0.68	0.00
18.94	66.74	2.00	0.00	0.68	0.00	18.99	65.25	2.00	0.00	0.68	0.00
19.06	62.83	2.00	0.00	0.68	0.00	19.13	60.16	2.00	0.00	0.68	0.00
19.18	57.14	2.00	0.00	0.67	0.00	19.25	55.05	2.00	0.00	0.67	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
19.29	54.01	2.00	0.00	0.67	0.00	19.39	53.19	2.00	0.00	0.67	0.00
19.43	52.55	2.00	0.00	0.67	0.00	19.52	52.14	2.00	0.00	0.67	0.00
19.57	53.45	2.00	0.00	0.67	0.00	19.65	54.18	2.00	0.00	0.67	0.00
19.70	54.73	2.00	0.00	0.67	0.00	19.79	55.08	2.00	0.00	0.66	0.00
19.84	56.45	2.00	0.00	0.66	0.00	19.89	59.35	2.00	0.00	0.66	0.00
19.97	62.24	2.00	0.00	0.66	0.00	20.02	65.46	2.00	0.00	0.66	0.00
20.12	68.01	2.00	0.00	0.66	0.00	20.16	71.29	2.00	0.00	0.66	0.00
20.26	73.59	2.00	0.00	0.66	0.00	20.30	75.39	2.00	0.00	0.66	0.00
20.35	75.38	2.00	0.00	0.66	0.00	20.41	70.51	2.00	0.00	0.65	0.00
20.48	66.15	2.00	0.00	0.65	0.00	20.54	63.35	2.00	0.00	0.65	0.00
20.61	67.43	2.00	0.00	0.65	0.00	20.72	70.62	2.00	0.00	0.65	0.00
20.79	72.62	2.00	0.00	0.65	0.00	20.81	73.97	2.00	0.00	0.65	0.00
20.90	75.21	2.00	0.00	0.65	0.00	20.95	76.43	2.00	0.00	0.64	0.00
21.00	76.65	2.00	0.00	0.64	0.00	21.07	75.77	2.00	0.00	0.64	0.00
21.16	74.04	2.00	0.00	0.64	0.00	21.25	72.21	2.00	0.00	0.64	0.00
21.29	70.71	2.00	0.00	0.64	0.00	21.34	69.30	2.00	0.00	0.64	0.00
21.42	67.99	2.00	0.00	0.64	0.00	21.46	67.38	2.00	0.00	0.64	0.00
21.55	67.74	2.00	0.00	0.63	0.00	21.60	69.50	2.00	0.00	0.63	0.00
21.69	72.17	2.00	0.00	0.63	0.00	21.73	75.54	2.00	0.00	0.63	0.00
21.81	78.26	2.00	0.00	0.63	0.00	21.88	79.95	2.00	0.00	0.63	0.00
21.93	79.68	2.00	0.00	0.63	0.00	22.02	78.50	2.00	0.00	0.63	0.00
22.06	75.13	2.00	0.00	0.63	0.00	22.14	71.53	2.00	0.00	0.62	0.00
22.18	65.80	2.00	0.00	0.62	0.00	22.27	61.30	2.00	0.00	0.62	0.00
22.31	58.21	2.00	0.00	0.62	0.00	22.40	57.64	2.00	0.00	0.62	0.00
22.44	59.39	0.20	2.22	0.62	0.01	22.53	61.93	0.21	2.14	0.62	0.02
22.58	65.92	0.22	2.03	0.62	0.01	22.66	69.06	0.22	1.95	0.62	0.02
22.71	71.90	0.23	1.88	0.62	0.01	22.79	72.84	0.23	1.86	0.61	0.02
22.84	73.34	0.23	1.85	0.61	0.01	22.92	73.49	0.23	1.84	0.61	0.02
22.98	73.87	0.24	1.83	0.61	0.01	23.04	68.76	0.22	1.94	0.61	0.01
23.15	63.00	0.21	2.07	0.61	0.03	23.22	57.16	0.19	2.24	0.61	0.02
23.34	57.58	0.20	2.22	0.60	0.03	23.38	59.12	0.20	2.17	0.60	0.01
23.42	61.11	0.20	2.11	0.60	0.01	23.44	64.78	0.21	2.01	0.60	0.00
23.51	68.89	0.22	1.91	0.60	0.02	23.57	71.20	0.23	1.85	0.60	0.01
23.74	71.81	0.23	1.83	0.60	0.04	23.80	71.93	0.23	1.83	0.60	0.01
23.88	73.62	0.23	1.79	0.60	0.02	23.92	75.86	0.24	1.74	0.59	0.01
23.97	77.70	0.24	1.71	0.59	0.01	24.05	78.80	0.25	1.68	0.59	0.02
24.10	78.77	0.25	1.68	0.59	0.01	24.18	77.47	0.24	1.70	0.59	0.02
24.23	74.37	0.23	1.76	0.59	0.01	24.33	71.44	0.22	1.81	0.59	0.02
24.37	68.63	0.22	1.87	0.59	0.01	24.41	66.41	0.21	1.92	0.59	0.01
24.51	65.24	0.21	1.94	0.58	0.02	24.56	66.40	0.21	1.91	0.58	0.01
24.66	67.29	0.21	1.88	0.58	0.02	24.70	66.33	0.21	1.90	0.58	0.01
24.79	64.16	0.20	1.95	0.58	0.02	24.83	62.42	0.20	1.99	0.58	0.01
24.88	62.17	2.00	0.00	0.58	0.00	24.99	62.89	2.00	0.00	0.58	0.00
25.03	63.91	2.00	0.00	0.58	0.00	25.08	63.09	2.00	0.00	0.57	0.00
25.13	60.91	2.00	0.00	0.57	0.00	25.20	64.64	2.00	0.00	0.57	0.00
25.35	68.82	2.00	0.00	0.57	0.00	25.41	72.61	2.00	0.00	0.57	0.00
25.43	70.57	2.00	0.00	0.57	0.00	25.47	69.78	2.00	0.00	0.57	0.00
25.55	68.29	0.21	1.81	0.57	0.02	25.59	68.56	2.00	0.00	0.57	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
25.67	67.14	2.00	0.00	0.56	0.00	25.74	65.34	2.00	0.00	0.56	0.00
25.83	63.03	2.00	0.00	0.56	0.00	25.88	61.61	2.00	0.00	0.56	0.00
25.96	61.05	2.00	0.00	0.56	0.00	26.01	61.03	2.00	0.00	0.56	0.00
26.05	61.50	0.20	1.94	0.56	0.01	26.15	61.99	2.00	0.00	0.56	0.00
26.26	62.48	2.00	0.00	0.55	0.00	26.30	63.01	2.00	0.00	0.55	0.00
26.35	64.02	2.00	0.00	0.55	0.00	26.40	65.36	2.00	0.00	0.55	0.00
26.49	66.42	2.00	0.00	0.55	0.00	26.54	66.04	2.00	0.00	0.55	0.00
26.61	64.25	2.00	0.00	0.55	0.00	26.66	60.53	2.00	0.00	0.55	0.00
26.75	55.76	2.00	0.00	0.55	0.00	26.80	50.02	2.00	0.00	0.55	0.00
26.85	45.48	2.00	0.00	0.54	0.00	26.95	42.38	2.00	0.00	0.54	0.00
27.05	41.22	2.00	0.00	0.54	0.00	27.11	40.87	2.00	0.00	0.54	0.00
27.15	20.54	2.00	0.00	0.54	0.00	27.21	22.28	2.00	0.00	0.54	0.00
27.26	45.19	2.00	0.00	0.54	0.00	27.32	46.88	2.00	0.00	0.54	0.00
27.37	48.81	2.00	0.00	0.54	0.00	27.47	49.71	2.00	0.00	0.53	0.00
27.54	47.98	2.00	0.00	0.53	0.00	27.60	44.47	2.00	0.00	0.53	0.00
27.66	40.33	2.00	0.00	0.53	0.00	27.72	36.21	2.00	0.00	0.53	0.00
27.78	32.59	2.00	0.00	0.53	0.00	27.85	30.09	2.00	0.00	0.53	0.00
27.90	29.32	2.00	0.00	0.53	0.00	27.99	30.05	2.00	0.00	0.53	0.00
28.04	32.42	2.00	0.00	0.52	0.00	28.11	37.70	2.00	0.00	0.52	0.00
28.18	42.65	2.00	0.00	0.52	0.00	28.22	48.10	2.00	0.00	0.52	0.00
28.30	51.58	2.00	0.00	0.52	0.00	28.35	54.48	2.00	0.00	0.52	0.00
28.43	55.47	2.00	0.00	0.52	0.00	28.48	54.89	2.00	0.00	0.52	0.00
28.57	52.49	2.00	0.00	0.52	0.00	28.65	49.38	2.00	0.00	0.51	0.00
28.69	46.44	2.00	0.00	0.51	0.00	28.74	44.19	2.00	0.00	0.51	0.00
28.83	42.12	2.00	0.00	0.51	0.00	28.88	41.25	2.00	0.00	0.51	0.00
28.97	41.74	2.00	0.00	0.51	0.00	29.01	43.42	2.00	0.00	0.51	0.00
29.14	44.87	2.00	0.00	0.51	0.00	29.19	46.02	2.00	0.00	0.51	0.00
29.24	46.49	2.00	0.00	0.50	0.00	29.28	47.00	2.00	0.00	0.50	0.00
29.34	47.60	2.00	0.00	0.50	0.00	29.45	48.02	2.00	0.00	0.50	0.00
29.50	47.10	2.00	0.00	0.50	0.00	29.58	46.04	2.00	0.00	0.50	0.00
29.69	45.18	2.00	0.00	0.50	0.00	29.73	46.05	2.00	0.00	0.50	0.00
29.85	47.75	2.00	0.00	0.49	0.00	29.89	49.35	2.00	0.00	0.49	0.00
29.94	50.47	2.00	0.00	0.49	0.00	30.00	50.51	2.00	0.00	0.49	0.00
30.10	49.17	2.00	0.00	0.49	0.00	30.16	46.99	2.00	0.00	0.49	0.00
30.21	44.83	2.00	0.00	0.49	0.00	30.25	43.28	2.00	0.00	0.49	0.00
30.36	42.36	2.00	0.00	0.49	0.00	30.42	42.33	2.00	0.00	0.48	0.00
30.47	43.17	2.00	0.00	0.48	0.00	30.52	44.58	2.00	0.00	0.48	0.00
30.58	44.99	2.00	0.00	0.48	0.00	30.67	44.34	2.00	0.00	0.48	0.00
30.74	43.24	2.00	0.00	0.48	0.00	30.78	42.65	2.00	0.00	0.48	0.00
30.89	42.81	2.00	0.00	0.48	0.00	30.93	43.12	2.00	0.00	0.48	0.00
30.98	43.53	2.00	0.00	0.47	0.00	31.07	43.74	2.00	0.00	0.47	0.00
31.11	43.74	2.00	0.00	0.47	0.00	31.20	43.54	2.00	0.00	0.47	0.00
31.24	42.62	2.00	0.00	0.47	0.00	31.33	41.46	2.00	0.00	0.47	0.00
31.38	39.95	2.00	0.00	0.47	0.00	31.47	38.93	2.00	0.00	0.47	0.00
31.53	37.84	2.00	0.00	0.47	0.00	31.60	37.47	2.00	0.00	0.46	0.00
31.64	37.47	2.00	0.00	0.46	0.00	31.72	37.78	2.00	0.00	0.46	0.00
31.77	37.95	2.00	0.00	0.46	0.00	31.90	38.32	2.00	0.00	0.46	0.00
31.95	38.85	2.00	0.00	0.46	0.00	32.00	39.66	2.00	0.00	0.46	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
32.07	40.25	2.00	0.00	0.46	0.00	32.13	40.68	2.00	0.00	0.46	0.00
32.18	40.74	2.00	0.00	0.45	0.00	32.26	40.35	2.00	0.00	0.45	0.00
32.31	39.55	2.00	0.00	0.45	0.00	32.39	38.38	2.00	0.00	0.45	0.00
32.44	37.11	2.00	0.00	0.45	0.00	32.50	35.99	2.00	0.00	0.45	0.00
32.57	35.19	2.00	0.00	0.45	0.00	32.62	34.88	2.00	0.00	0.45	0.00
32.69	34.79	2.00	0.00	0.45	0.00	32.75	34.77	2.00	0.00	0.44	0.00
32.82	34.72	2.00	0.00	0.44	0.00	32.88	34.68	2.00	0.00	0.44	0.00
33.01	34.90	2.00	0.00	0.44	0.00	33.06	35.57	2.00	0.00	0.44	0.00
33.13	36.02	2.00	0.00	0.44	0.00	33.19	35.88	2.00	0.00	0.44	0.00
33.24	33.89	2.00	0.00	0.44	0.00	33.32	32.72	2.00	0.00	0.44	0.00
33.37	32.90	2.00	0.00	0.43	0.00	33.43	35.33	2.00	0.00	0.43	0.00
33.50	38.99	2.00	0.00	0.43	0.00	33.59	41.84	2.00	0.00	0.43	0.00
33.61	44.37	2.00	0.00	0.43	0.00	33.67	44.93	2.00	0.00	0.43	0.00
33.73	45.06	2.00	0.00	0.43	0.00	33.82	44.94	2.00	0.00	0.43	0.00
33.87	45.88	2.00	0.00	0.43	0.00	34.00	46.91	2.00	0.00	0.42	0.00
34.05	46.88	2.00	0.00	0.42	0.00	34.13	45.43	2.00	0.00	0.42	0.00
34.18	43.48	2.00	0.00	0.42	0.00	34.26	42.43	2.00	0.00	0.42	0.00
34.31	42.85	2.00	0.00	0.42	0.00	34.37	44.71	2.00	0.00	0.42	0.00
34.44	48.11	2.00	0.00	0.42	0.00	34.49	53.42	2.00	0.00	0.42	0.00
34.55	59.33	2.00	0.00	0.41	0.00	34.62	64.45	2.00	0.00	0.41	0.00
34.68	67.70	2.00	0.00	0.41	0.00	34.75	69.10	2.00	0.00	0.41	0.00
34.79	70.16	2.00	0.00	0.41	0.00	34.90	70.63	2.00	0.00	0.41	0.00
34.95	70.15	2.00	0.00	0.41	0.00	35.01	68.54	2.00	0.00	0.41	0.00
35.06	66.21	2.00	0.00	0.41	0.00	35.13	63.82	2.00	0.00	0.40	0.00
35.19	61.29	2.00	0.00	0.40	0.00	35.24	58.56	2.00	0.00	0.40	0.00
35.31	56.52	2.00	0.00	0.40	0.00	35.42	55.14	2.00	0.00	0.40	0.00
35.49	54.88	2.00	0.00	0.40	0.00	35.55	54.98	2.00	0.00	0.40	0.00
35.61	55.62	2.00	0.00	0.40	0.00	35.68	56.36	2.00	0.00	0.40	0.00
35.72	57.06	2.00	0.00	0.39	0.00	35.81	57.40	2.00	0.00	0.39	0.00
35.85	57.95	2.00	0.00	0.39	0.00	35.90	61.41	2.00	0.00	0.39	0.00
36.00	66.54	2.00	0.00	0.39	0.00	36.04	73.58	2.00	0.00	0.39	0.00
36.13	78.48	2.00	0.00	0.39	0.00	36.17	82.23	2.00	0.00	0.39	0.00
36.27	82.97	2.00	0.00	0.39	0.00	36.31	82.88	2.00	0.00	0.38	0.00
36.35	83.97	2.00	0.00	0.38	0.00	36.45	86.24	2.00	0.00	0.38	0.00
36.50	92.86	2.00	0.00	0.38	0.00	36.60	98.11	2.00	0.00	0.38	0.00
36.65	102.61	2.00	0.00	0.38	0.00	36.70	102.76	2.00	0.00	0.38	0.00
36.75	103.10	2.00	0.00	0.38	0.00	36.84	103.86	2.00	0.00	0.38	0.00
36.89	104.11	2.00	0.00	0.37	0.00	36.97	102.06	2.00	0.00	0.37	0.00
37.05	100.11	2.00	0.00	0.37	0.00	37.10	105.10	2.00	0.00	0.37	0.00
37.15	111.03	2.00	0.00	0.37	0.00	37.24	114.86	0.33	0.77	0.37	0.01
37.30	116.97	0.40	0.76	0.37	0.01	37.35	116.30	0.39	0.76	0.37	0.00
37.45	114.98	0.38	0.76	0.37	0.01	37.50	112.94	0.37	0.77	0.36	0.00
37.59	111.18	0.36	0.78	0.36	0.01	37.63	110.20	0.35	0.78	0.36	0.00
37.69	110.09	0.35	0.78	0.36	0.01	37.73	110.00	0.35	0.78	0.36	0.00
37.84	105.94	0.33	0.80	0.36	0.01	37.89	100.64	0.30	0.83	0.36	0.00
37.94	97.27	0.29	0.85	0.36	0.01	38.03	98.07	0.29	0.84	0.36	0.01
38.07	101.61	0.31	0.82	0.35	0.00	38.13	103.67	0.32	0.80	0.35	0.01
38.21	107.61	0.34	0.78	0.35	0.01	38.26	110.94	0.36	0.75	0.35	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
38.37	113.16	0.37	0.74	0.35	0.01	38.44	110.96	0.36	0.75	0.35	0.01
38.48	105.53	0.33	0.78	0.35	0.00	38.54	98.50	0.29	0.82	0.35	0.01
38.62	92.36	0.26	0.86	0.35	0.01	38.66	88.27	0.25	0.89	0.34	0.00
38.73	86.54	0.24	0.90	0.34	0.01	38.79	85.67	0.24	0.91	0.34	0.01
38.85	84.04	0.23	0.92	0.34	0.01	38.97	82.32	0.23	0.93	0.34	0.01
39.03	80.51	0.22	0.94	0.34	0.01	39.10	79.53	0.22	0.95	0.34	0.01
39.15	78.25	0.21	0.96	0.34	0.01	39.21	76.38	0.21	0.98	0.34	0.01
39.27	74.67	0.20	0.99	0.33	0.01	39.33	73.74	0.20	1.00	0.33	0.01
39.41	73.69	0.20	1.00	0.33	0.01	39.46	73.94	0.20	0.99	0.33	0.01
39.52	74.09	0.20	0.99	0.33	0.01	39.59	73.85	0.20	0.99	0.33	0.01
39.64	72.60	0.20	1.00	0.33	0.01	39.72	70.48	0.19	1.02	0.33	0.01
39.77	68.36	0.19	1.04	0.33	0.01	39.83	66.59	0.19	1.06	0.32	0.01
39.94	64.55	0.18	1.08	0.32	0.01	40.02	61.92	0.18	1.11	0.32	0.01
40.07	59.29	0.17	1.15	0.32	0.01	40.13	57.23	0.17	1.18	0.32	0.01
40.20	39.59	0.14	1.59	0.32	0.01	40.26	56.73	0.17	1.18	0.32	0.01
40.33	58.59	0.17	1.15	0.32	0.01	40.45	60.46	0.17	1.11	0.31	0.02
40.52	62.38	0.18	1.08	0.31	0.01	40.56	64.41	0.18	1.05	0.31	0.01
40.64	66.85	0.19	1.01	0.31	0.01	40.69	67.86	0.19	1.00	0.31	0.01
40.76	67.07	0.19	1.00	0.31	0.01	40.79	65.38	0.18	1.02	0.31	0.00
40.83	64.12	0.18	1.04	0.31	0.01	40.94	64.30	0.18	1.03	0.31	0.01
40.95	65.73	0.18	1.01	0.31	0.00	41.05	67.66	0.19	0.98	0.30	0.01
41.10	69.21	0.19	0.96	0.30	0.01	41.20	69.10	0.19	0.95	0.30	0.01
41.25	68.12	0.19	0.96	0.30	0.01	41.29	67.13	0.19	0.97	0.30	0.00
41.39	53.01	0.16	1.17	0.30	0.01	41.44	53.27	0.16	1.17	0.30	0.01
41.48	67.12	0.19	0.96	0.30	0.00	41.57	68.56	0.19	0.94	0.30	0.01
41.62	70.59	0.19	0.92	0.29	0.01	41.67	73.47	0.20	0.88	0.29	0.01
41.75	75.48	0.21	0.86	0.29	0.01	41.85	76.80	0.21	0.84	0.29	0.01
41.89	76.22	0.21	0.85	0.29	0.00	41.98	75.61	0.21	0.85	0.29	0.01
42.05	75.40	0.21	0.85	0.29	0.01	42.09	75.93	0.21	0.84	0.29	0.00
42.15	76.35	0.21	0.83	0.29	0.01	42.23	76.72	0.21	0.83	0.28	0.01
42.28	77.21	0.21	0.82	0.28	0.00	42.33	79.52	0.22	0.80	0.28	0.00
42.50	81.73	0.23	0.77	0.28	0.02	42.54	84.24	0.23	0.75	0.28	0.00
42.67	84.90	0.24	0.74	0.28	0.01	42.72	85.42	0.24	0.73	0.28	0.00
42.78	84.75	0.24	0.74	0.27	0.01	42.85	83.23	0.23	0.74	0.27	0.01
42.90	80.46	0.22	0.76	0.27	0.00	42.98	77.26	0.21	0.78	0.27	0.01
43.03	72.31	0.20	0.83	0.27	0.00	43.10	67.98	0.19	0.86	0.27	0.01
43.16	50.57	0.16	1.10	0.27	0.01	43.27	46.66	0.15	1.16	0.27	0.01
43.34	59.23	0.17	0.95	0.27	0.01	43.40	58.59	0.17	0.96	0.26	0.01
43.43	59.74	0.17	0.94	0.26	0.00	43.47	61.29	0.17	0.92	0.26	0.00
43.51	63.16	0.18	0.89	0.26	0.00	43.60	64.59	0.18	0.87	0.26	0.01
43.68	65.76	0.18	0.86	0.26	0.01	43.73	66.73	0.19	0.84	0.26	0.00
43.78	66.62	0.19	0.84	0.26	0.00	43.87	66.16	0.18	0.84	0.26	0.01
43.97	65.84	0.18	0.84	0.25	0.01	44.01	66.82	0.19	0.83	0.25	0.00
44.08	67.82	0.19	0.81	0.25	0.01	44.13	67.73	0.19	0.81	0.25	0.00
44.22	66.17	0.18	0.82	0.25	0.01	44.26	63.83	0.18	0.84	0.25	0.00
44.31	61.11	0.17	0.87	0.25	0.01	44.39	45.17	0.15	1.11	0.25	0.01
44.43	47.04	0.15	1.07	0.25	0.01	44.52	48.05	0.16	1.05	0.25	0.01
44.57	47.87	0.16	1.05	0.24	0.01	44.66	46.62	0.15	1.06	0.24	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
44.69	44.67	0.15	1.10	0.24	0.00	44.78	60.12	0.17	0.85	0.24	0.01
44.83	61.04	0.18	0.84	0.24	0.01	44.93	61.93	0.18	0.83	0.24	0.01
44.97	63.39	0.18	0.81	0.24	0.00	45.03	65.79	2.00	0.00	0.24	0.00
45.09	69.58	2.00	0.00	0.24	0.00	45.15	77.55	2.00	0.00	0.23	0.00
45.25	84.31	2.00	0.00	0.23	0.00	45.32	90.83	2.00	0.00	0.23	0.00
45.37	95.75	2.00	0.00	0.23	0.00	45.44	99.99	2.00	0.00	0.23	0.00
45.50	101.60	2.00	0.00	0.23	0.00	45.54	97.95	2.00	0.00	0.23	0.00
45.61	91.93	2.00	0.00	0.23	0.00	45.68	80.74	2.00	0.00	0.23	0.00
45.81	70.56	2.00	0.00	0.22	0.00	45.86	63.05	2.00	0.00	0.22	0.00
45.98	62.69	2.00	0.00	0.22	0.00	46.03	61.69	2.00	0.00	0.22	0.00
46.07	61.81	2.00	0.00	0.22	0.00	46.15	62.19	2.00	0.00	0.22	0.00
46.20	62.39	2.00	0.00	0.22	0.00	46.29	61.62	2.00	0.00	0.22	0.00
46.35	61.31	2.00	0.00	0.21	0.00	46.42	61.71	2.00	0.00	0.21	0.00
46.47	62.53	2.00	0.00	0.21	0.00	46.53	63.61	2.00	0.00	0.21	0.00
46.60	64.34	2.00	0.00	0.21	0.00	46.69	64.29	2.00	0.00	0.21	0.00
46.73	64.08	2.00	0.00	0.21	0.00	46.80	64.72	2.00	0.00	0.21	0.00
46.87	65.90	2.00	0.00	0.21	0.00	46.95	66.60	2.00	0.00	0.20	0.00
47.02	66.63	2.00	0.00	0.20	0.00	47.08	66.33	2.00	0.00	0.20	0.00
47.13	66.18	2.00	0.00	0.20	0.00	47.23	65.54	2.00	0.00	0.20	0.00
47.26	64.08	2.00	0.00	0.20	0.00	47.31	61.42	2.00	0.00	0.20	0.00
47.39	58.48	2.00	0.00	0.20	0.00	47.48	56.43	2.00	0.00	0.20	0.00
47.52	55.92	2.00	0.00	0.19	0.00	47.60	55.87	2.00	0.00	0.19	0.00
47.64	55.84	2.00	0.00	0.19	0.00	47.71	56.30	2.00	0.00	0.19	0.00
47.81	57.01	2.00	0.00	0.19	0.00	47.85	58.52	2.00	0.00	0.19	0.00
47.93	59.96	2.00	0.00	0.19	0.00	47.97	61.14	2.00	0.00	0.19	0.00
48.06	61.44	2.00	0.00	0.19	0.00	48.10	61.20	2.00	0.00	0.18	0.00
48.18	61.25	2.00	0.00	0.18	0.00	48.23	61.12	2.00	0.00	0.18	0.00
48.32	61.01	2.00	0.00	0.18	0.00	48.36	60.69	2.00	0.00	0.18	0.00
48.44	60.00	2.00	0.00	0.18	0.00	48.53	59.21	2.00	0.00	0.18	0.00
48.57	58.47	2.00	0.00	0.18	0.00	48.64	58.21	2.00	0.00	0.18	0.00
48.73	57.67	2.00	0.00	0.17	0.00	48.78	57.29	2.00	0.00	0.17	0.00
48.86	57.41	2.00	0.00	0.17	0.00	48.90	59.22	2.00	0.00	0.17	0.00
48.98	62.51	2.00	0.00	0.17	0.00	49.07	65.69	2.00	0.00	0.17	0.00
49.11	68.47	2.00	0.00	0.17	0.00	49.17	70.35	2.00	0.00	0.17	0.00
49.22	72.25	2.00	0.00	0.17	0.00	49.31	73.46	2.00	0.00	0.16	0.00
49.35	74.29	2.00	0.00	0.16	0.00	49.42	74.72	2.00	0.00	0.16	0.00
49.49	75.21	2.00	0.00	0.16	0.00	49.56	74.88	2.00	0.00	0.16	0.00
49.64	74.20	2.00	0.00	0.16	0.00	49.71	73.29	2.00	0.00	0.16	0.00
49.75	72.82	2.00	0.00	0.16	0.00	49.84	72.42	2.00	0.00	0.16	0.00
49.88	71.64	2.00	0.00	0.15	0.00	49.96	71.27	2.00	0.00	0.15	0.00
50.02	70.99	2.00	0.00	0.15	0.00						

Total estimated settlement: 1.49

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

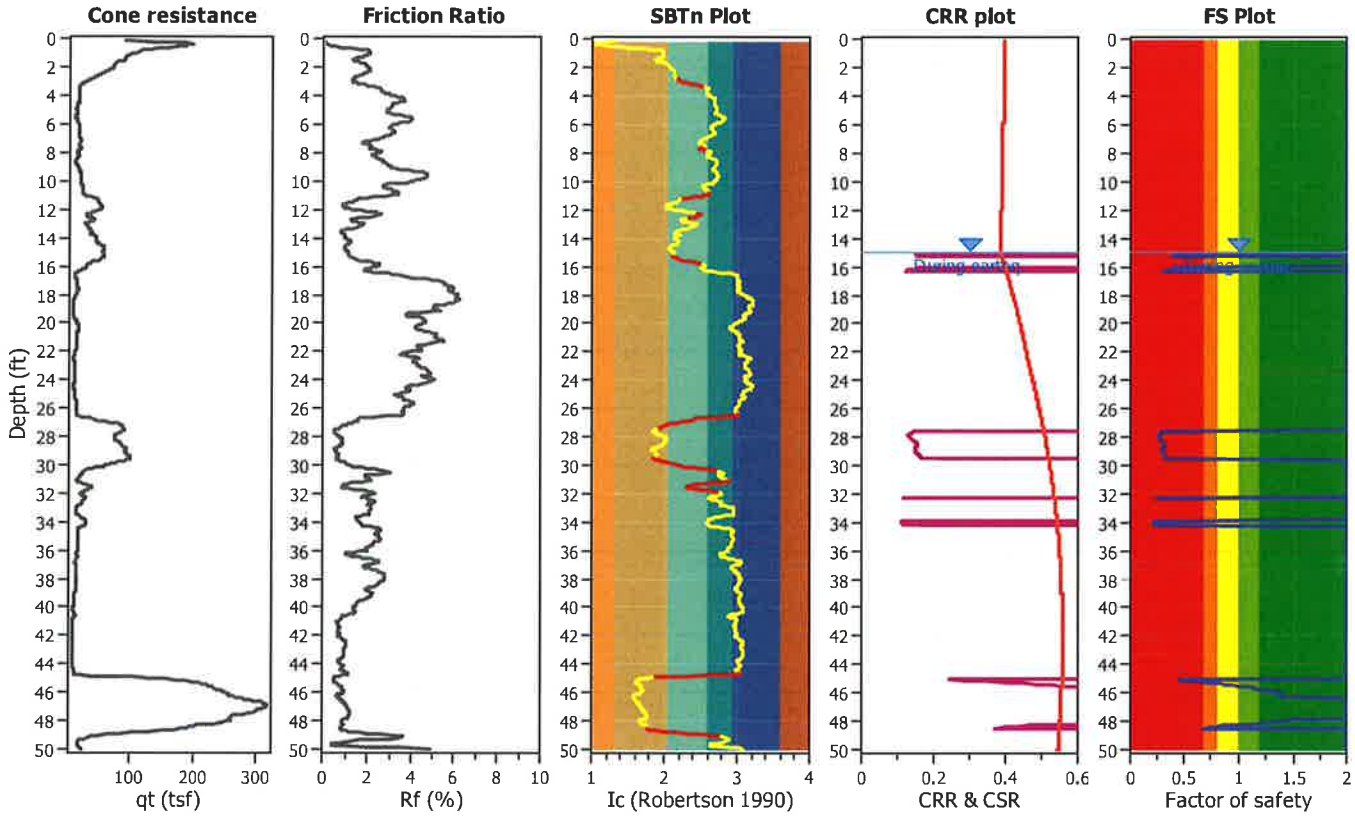
LIQUEFACTION ANALYSIS REPORT

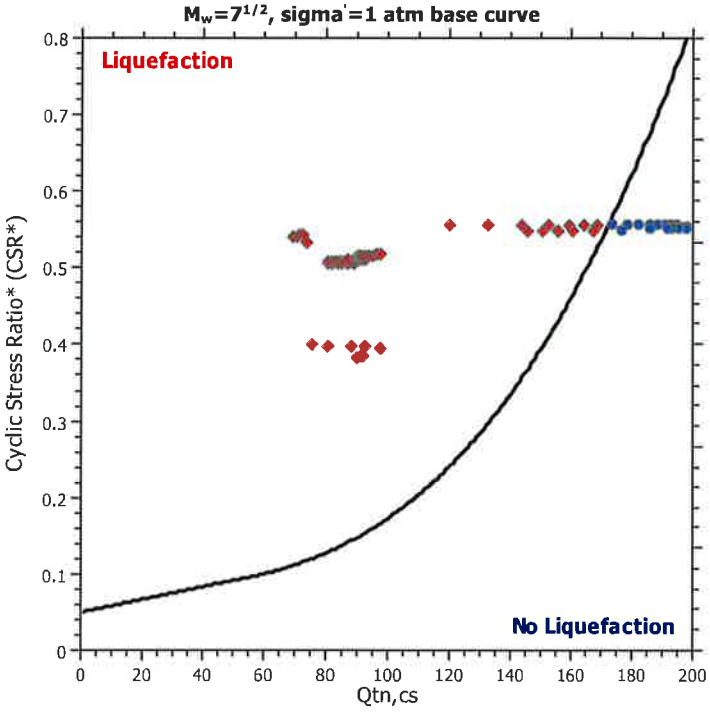
Project title : S-Line Upgrades **Location : Imperial County, CA**

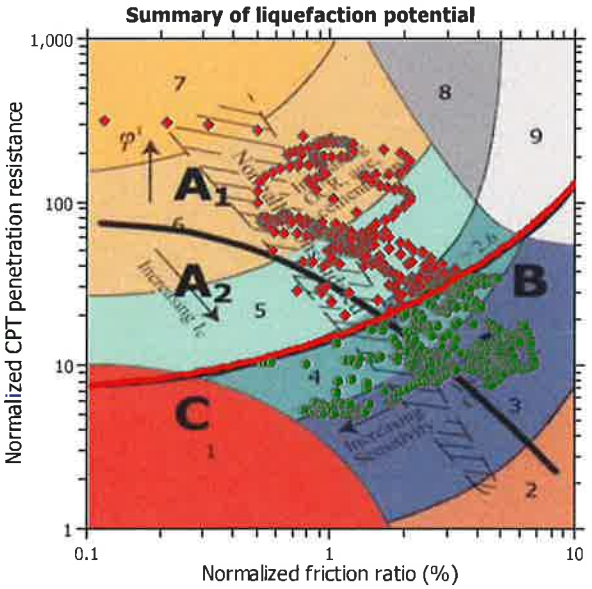
CPT file : CPT-12

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	15.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	15.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.56	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

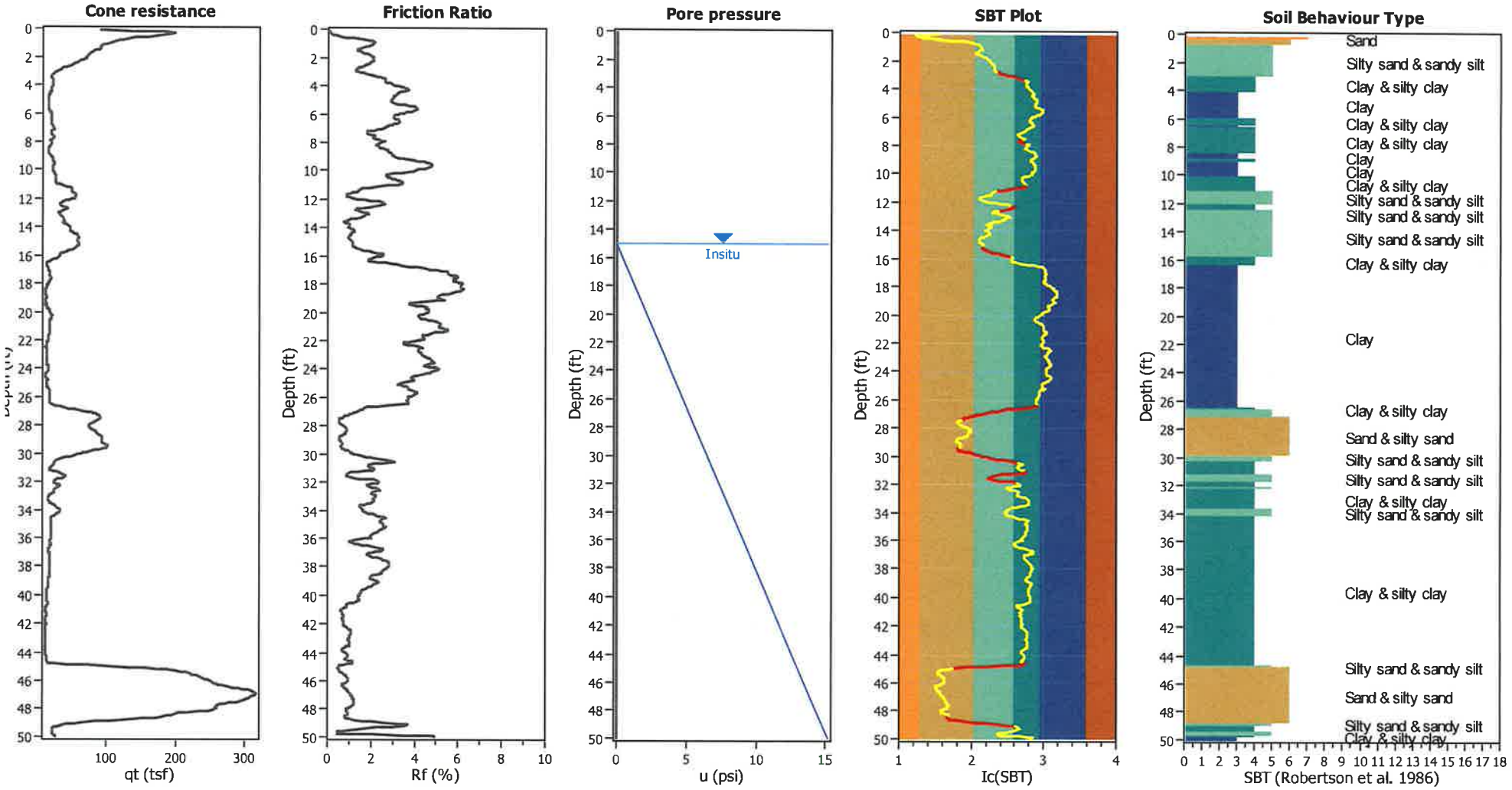






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



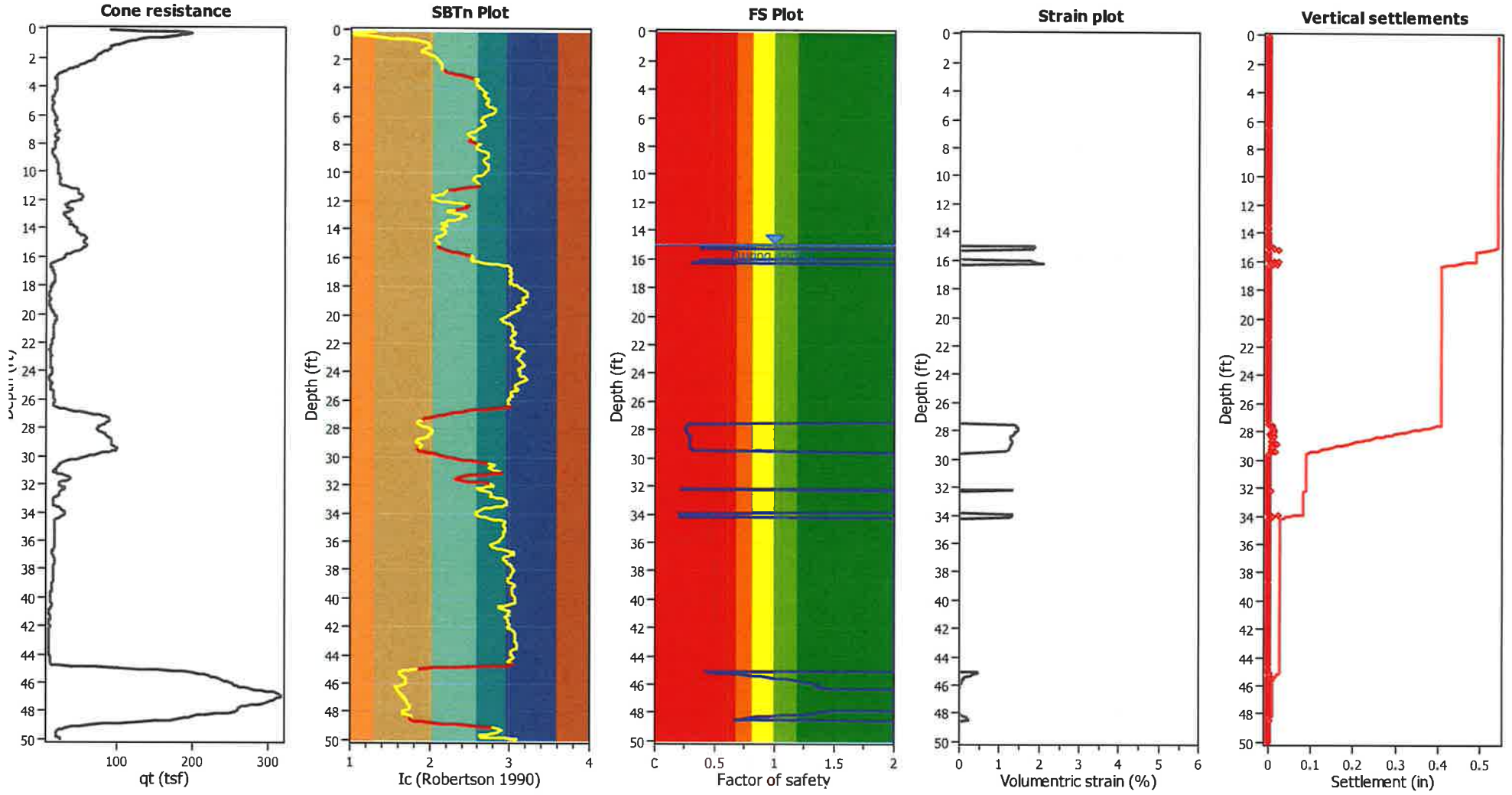
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.56	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	15.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
15.04	89.96	0.38	1.90	0.75	0.01	15.10	91.32	0.39	1.87	0.74	0.01
15.21	91.87	0.39	1.86	0.74	0.02	15.28	91.91	2.00	0.00	0.74	0.00
15.34	91.70	2.00	0.00	0.74	0.00	15.40	92.58	2.00	0.00	0.74	0.00
15.47	94.98	2.00	0.00	0.74	0.00	15.58	97.48	2.00	0.00	0.74	0.00
15.65	99.44	2.00	0.00	0.73	0.00	15.70	100.50	2.00	0.00	0.73	0.00
15.78	101.73	2.00	0.00	0.73	0.00	15.83	102.19	2.00	0.00	0.73	0.00
15.89	100.63	2.00	0.00	0.73	0.00	16.01	97.40	0.42	1.74	0.73	0.02
16.07	92.64	0.39	1.81	0.73	0.01	16.14	88.42	0.36	1.88	0.73	0.02
16.19	80.72	0.32	2.02	0.73	0.01	16.27	75.87	0.30	2.12	0.72	0.02
16.33	72.66	2.00	0.00	0.72	0.00	16.40	75.38	2.00	0.00	0.72	0.00
16.45	76.85	2.00	0.00	0.72	0.00	16.52	76.82	2.00	0.00	0.72	0.00
16.58	75.91	2.00	0.00	0.72	0.00	16.63	77.87	2.00	0.00	0.72	0.00
16.71	83.07	2.00	0.00	0.72	0.00	16.80	89.36	2.00	0.00	0.72	0.00
16.84	94.99	2.00	0.00	0.71	0.00	16.92	98.73	2.00	0.00	0.71	0.00
16.96	103.13	2.00	0.00	0.71	0.00	17.04	106.15	2.00	0.00	0.71	0.00
17.07	109.86	2.00	0.00	0.71	0.00	17.18	111.99	2.00	0.00	0.71	0.00
17.22	113.77	2.00	0.00	0.71	0.00	17.27	114.65	2.00	0.00	0.71	0.00
17.35	115.74	2.00	0.00	0.71	0.00	17.40	117.24	2.00	0.00	0.71	0.00
17.46	118.36	2.00	0.00	0.70	0.00	17.53	119.03	2.00	0.00	0.70	0.00
17.62	119.06	2.00	0.00	0.70	0.00	17.67	118.17	2.00	0.00	0.70	0.00
17.76	116.98	2.00	0.00	0.70	0.00	17.80	115.43	2.00	0.00	0.70	0.00
17.89	113.90	2.00	0.00	0.70	0.00	17.93	110.96	2.00	0.00	0.70	0.00
18.02	107.97	2.00	0.00	0.69	0.00	18.05	104.49	2.00	0.00	0.69	0.00
18.13	102.39	2.00	0.00	0.69	0.00	18.18	100.64	2.00	0.00	0.69	0.00
18.26	99.33	2.00	0.00	0.69	0.00	18.33	97.73	2.00	0.00	0.69	0.00
18.37	95.61	2.00	0.00	0.69	0.00	18.46	93.34	2.00	0.00	0.69	0.00
18.55	91.23	2.00	0.00	0.69	0.00	18.60	89.22	2.00	0.00	0.68	0.00
18.68	87.67	2.00	0.00	0.68	0.00	18.73	86.38	2.00	0.00	0.68	0.00
18.77	86.53	2.00	0.00	0.68	0.00	18.95	87.03	2.00	0.00	0.68	0.00
18.99	88.05	2.00	0.00	0.68	0.00	19.12	88.09	2.00	0.00	0.68	0.00
19.17	84.68	2.00	0.00	0.68	0.00	19.23	79.96	2.00	0.00	0.67	0.00
19.30	75.64	2.00	0.00	0.67	0.00	19.36	75.35	2.00	0.00	0.67	0.00
19.43	76.43	2.00	0.00	0.67	0.00	19.48	77.74	2.00	0.00	0.67	0.00
19.53	79.46	2.00	0.00	0.67	0.00	19.57	82.38	2.00	0.00	0.67	0.00
19.64	85.66	2.00	0.00	0.67	0.00	19.70	89.52	2.00	0.00	0.67	0.00
19.77	92.77	2.00	0.00	0.66	0.00	19.85	95.21	2.00	0.00	0.66	0.00
19.89	97.74	2.00	0.00	0.66	0.00	19.99	99.33	2.00	0.00	0.66	0.00
20.03	100.86	2.00	0.00	0.66	0.00	20.11	101.22	2.00	0.00	0.66	0.00
20.17	101.77	2.00	0.00	0.66	0.00	20.26	102.12	2.00	0.00	0.66	0.00
20.28	102.50	2.00	0.00	0.66	0.00	20.35	102.70	2.00	0.00	0.66	0.00
20.43	102.83	2.00	0.00	0.65	0.00	20.49	102.94	2.00	0.00	0.65	0.00
20.56	102.85	2.00	0.00	0.65	0.00	20.61	103.46	2.00	0.00	0.65	0.00
20.70	104.03	2.00	0.00	0.65	0.00	20.74	104.54	2.00	0.00	0.65	0.00
20.87	104.20	2.00	0.00	0.65	0.00	20.91	103.90	2.00	0.00	0.65	0.00
20.96	103.71	2.00	0.00	0.64	0.00	21.05	103.74	2.00	0.00	0.64	0.00
21.09	104.03	2.00	0.00	0.64	0.00	21.14	104.52	2.00	0.00	0.64	0.00
21.23	104.46	2.00	0.00	0.64	0.00	21.29	103.78	2.00	0.00	0.64	0.00
21.34	102.26	2.00	0.00	0.64	0.00	21.40	98.99	2.00	0.00	0.64	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
21.56	95.43	2.00	0.00	0.63	0.00	21.61	92.32	2.00	0.00	0.63	0.00
21.71	91.37	2.00	0.00	0.63	0.00	21.76	91.02	2.00	0.00	0.63	0.00
21.84	90.73	2.00	0.00	0.63	0.00	21.89	90.24	2.00	0.00	0.63	0.00
21.93	89.17	2.00	0.00	0.63	0.00	21.99	85.83	2.00	0.00	0.63	0.00
22.06	81.36	2.00	0.00	0.63	0.00	22.16	77.75	2.00	0.00	0.62	0.00
22.22	76.80	2.00	0.00	0.62	0.00	22.28	77.08	2.00	0.00	0.62	0.00
22.33	77.23	2.00	0.00	0.62	0.00	22.42	77.60	2.00	0.00	0.62	0.00
22.48	77.95	2.00	0.00	0.62	0.00	22.51	78.11	2.00	0.00	0.62	0.00
22.59	78.07	2.00	0.00	0.62	0.00	22.66	78.25	2.00	0.00	0.62	0.00
22.71	79.39	2.00	0.00	0.62	0.00	22.80	80.90	2.00	0.00	0.61	0.00
22.84	82.53	2.00	0.00	0.61	0.00	22.92	83.40	2.00	0.00	0.61	0.00
22.97	83.75	2.00	0.00	0.61	0.00	23.06	83.97	2.00	0.00	0.61	0.00
23.10	84.56	2.00	0.00	0.61	0.00	23.19	84.62	2.00	0.00	0.61	0.00
23.28	84.46	2.00	0.00	0.61	0.00	23.31	84.15	2.00	0.00	0.60	0.00
23.40	84.21	2.00	0.00	0.60	0.00	23.44	84.31	2.00	0.00	0.60	0.00
23.51	84.11	2.00	0.00	0.60	0.00	23.60	83.82	2.00	0.00	0.60	0.00
23.64	83.63	2.00	0.00	0.60	0.00	23.72	83.70	2.00	0.00	0.60	0.00
23.77	85.31	2.00	0.00	0.60	0.00	23.85	87.59	2.00	0.00	0.60	0.00
23.89	90.60	2.00	0.00	0.60	0.00	23.99	92.23	2.00	0.00	0.59	0.00
24.03	92.34	2.00	0.00	0.59	0.00	24.11	90.86	2.00	0.00	0.59	0.00
24.16	87.84	2.00	0.00	0.59	0.00	24.25	84.66	2.00	0.00	0.59	0.00
24.30	79.60	2.00	0.00	0.59	0.00	24.38	74.70	2.00	0.00	0.59	0.00
24.43	70.59	2.00	0.00	0.59	0.00	24.56	69.85	2.00	0.00	0.58	0.00
24.59	71.30	2.00	0.00	0.58	0.00	24.64	73.58	2.00	0.00	0.58	0.00
24.69	76.59	2.00	0.00	0.58	0.00	24.77	79.37	2.00	0.00	0.58	0.00
24.82	80.11	2.00	0.00	0.58	0.00	24.91	76.94	2.00	0.00	0.58	0.00
25.00	73.20	2.00	0.00	0.58	0.00	25.04	70.92	2.00	0.00	0.58	0.00
25.08	71.70	2.00	0.00	0.57	0.00	25.17	72.57	2.00	0.00	0.57	0.00
25.22	73.91	2.00	0.00	0.57	0.00	25.26	76.16	2.00	0.00	0.57	0.00
25.34	79.16	2.00	0.00	0.57	0.00	25.42	82.27	2.00	0.00	0.57	0.00
25.48	85.05	2.00	0.00	0.57	0.00	25.57	86.70	2.00	0.00	0.57	0.00
25.61	87.67	2.00	0.00	0.57	0.00	25.70	87.86	2.00	0.00	0.56	0.00
25.75	87.90	2.00	0.00	0.56	0.00	25.79	87.18	2.00	0.00	0.56	0.00
25.88	86.24	2.00	0.00	0.56	0.00	25.93	85.44	2.00	0.00	0.56	0.00
25.99	85.84	2.00	0.00	0.56	0.00	26.13	86.17	2.00	0.00	0.56	0.00
26.18	86.13	2.00	0.00	0.56	0.00	26.23	85.24	2.00	0.00	0.56	0.00
26.27	84.46	2.00	0.00	0.55	0.00	26.32	83.84	2.00	0.00	0.55	0.00
26.42	83.14	2.00	0.00	0.55	0.00	26.46	82.39	2.00	0.00	0.55	0.00
26.52	80.78	2.00	0.00	0.55	0.00	26.63	78.66	2.00	0.00	0.55	0.00
26.67	77.54	2.00	0.00	0.55	0.00	26.72	80.08	2.00	0.00	0.55	0.00
26.81	84.06	2.00	0.00	0.55	0.00	26.85	88.37	2.00	0.00	0.54	0.00
26.94	91.51	2.00	0.00	0.54	0.00	27.00	94.43	2.00	0.00	0.54	0.00
27.04	96.48	2.00	0.00	0.54	0.00	27.11	97.29	2.00	0.00	0.54	0.00
27.20	97.46	2.00	0.00	0.54	0.00	27.25	96.63	2.00	0.00	0.54	0.00
27.31	94.62	2.00	0.00	0.54	0.00	27.42	92.35	2.00	0.00	0.54	0.00
27.49	90.24	2.00	0.00	0.53	0.00	27.54	88.63	0.29	1.38	0.53	0.01
27.60	86.90	0.28	1.40	0.53	0.01	27.66	85.16	0.27	1.42	0.53	0.01
27.73	83.59	0.27	1.43	0.53	0.01	27.78	82.08	0.26	1.45	0.53	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
27.86	80.88	0.25	1.47	0.53	0.01	27.91	80.72	0.25	1.47	0.53	0.01
27.98	81.71	0.26	1.45	0.53	0.01	28.04	83.28	0.26	1.42	0.52	0.01
28.13	84.36	0.27	1.41	0.52	0.02	28.15	85.59	0.27	1.39	0.52	0.00
28.24	86.85	0.28	1.37	0.52	0.01	28.29	89.12	0.29	1.34	0.52	0.01
28.38	90.81	0.29	1.31	0.52	0.01	28.43	92.09	0.30	1.30	0.52	0.01
28.50	92.29	0.30	1.29	0.52	0.01	28.56	91.99	0.30	1.29	0.52	0.01
28.63	91.55	0.30	1.29	0.51	0.01	28.68	90.88	0.29	1.30	0.51	0.01
28.74	90.34	0.29	1.30	0.51	0.01	28.81	90.06	0.29	1.30	0.51	0.01
28.93	89.92	0.29	1.30	0.51	0.02	28.99	90.21	0.29	1.29	0.51	0.01
29.04	90.73	0.29	1.29	0.51	0.01	29.11	91.44	0.29	1.27	0.51	0.01
29.16	92.47	0.30	1.26	0.51	0.01	29.23	93.44	0.30	1.25	0.50	0.01
29.29	95.14	0.31	1.23	0.50	0.01	29.40	96.40	0.32	1.21	0.50	0.02
29.47	97.24	0.32	1.20	0.50	0.01	29.60	96.82	2.00	0.00	0.50	0.00
29.65	95.76	2.00	0.00	0.50	0.00	29.70	93.89	2.00	0.00	0.50	0.00
29.78	91.12	2.00	0.00	0.50	0.00	29.82	88.76	2.00	0.00	0.49	0.00
29.91	86.00	2.00	0.00	0.49	0.00	29.96	84.55	2.00	0.00	0.49	0.00
30.02	83.82	2.00	0.00	0.49	0.00	30.09	85.05	2.00	0.00	0.49	0.00
30.13	86.87	2.00	0.00	0.49	0.00	30.21	87.34	2.00	0.00	0.49	0.00
30.26	86.97	2.00	0.00	0.49	0.00	30.32	87.18	2.00	0.00	0.49	0.00
30.44	89.12	2.00	0.00	0.48	0.00	30.51	89.64	2.00	0.00	0.48	0.00
30.57	86.85	2.00	0.00	0.48	0.00	30.63	79.95	2.00	0.00	0.48	0.00
30.70	73.22	2.00	0.00	0.48	0.00	30.75	68.08	2.00	0.00	0.48	0.00
30.88	66.74	2.00	0.00	0.48	0.00	30.93	66.24	2.00	0.00	0.48	0.00
31.00	65.72	2.00	0.00	0.47	0.00	31.06	64.83	2.00	0.00	0.47	0.00
31.12	63.69	2.00	0.00	0.47	0.00	31.18	61.68	2.00	0.00	0.47	0.00
31.27	59.21	2.00	0.00	0.47	0.00	31.31	57.40	2.00	0.00	0.47	0.00
31.40	57.78	2.00	0.00	0.47	0.00	31.48	58.70	2.00	0.00	0.47	0.00
31.53	59.61	2.00	0.00	0.47	0.00	31.57	61.47	2.00	0.00	0.46	0.00
31.66	65.27	2.00	0.00	0.46	0.00	31.75	70.36	2.00	0.00	0.46	0.00
31.80	74.62	2.00	0.00	0.46	0.00	31.83	76.13	2.00	0.00	0.46	0.00
31.92	76.13	2.00	0.00	0.46	0.00	31.97	75.10	2.00	0.00	0.46	0.00
32.05	74.51	2.00	0.00	0.46	0.00	32.10	73.27	2.00	0.00	0.46	0.00
32.19	72.52	2.00	0.00	0.45	0.00	32.23	73.70	0.22	1.36	0.45	0.01
32.32	75.94	2.00	0.00	0.45	0.00	32.36	78.01	2.00	0.00	0.45	0.00
32.45	78.07	2.00	0.00	0.45	0.00	32.50	77.82	2.00	0.00	0.45	0.00
32.58	76.80	2.00	0.00	0.45	0.00	32.63	75.01	2.00	0.00	0.45	0.00
32.68	72.14	2.00	0.00	0.45	0.00	32.79	69.63	2.00	0.00	0.44	0.00
32.85	67.75	2.00	0.00	0.44	0.00	32.90	66.72	2.00	0.00	0.44	0.00
32.96	65.37	2.00	0.00	0.44	0.00	33.02	63.37	2.00	0.00	0.44	0.00
33.12	61.78	2.00	0.00	0.44	0.00	33.20	60.69	2.00	0.00	0.44	0.00
33.25	60.55	2.00	0.00	0.44	0.00	33.29	60.84	2.00	0.00	0.44	0.00
33.41	61.10	2.00	0.00	0.43	0.00	33.47	61.53	2.00	0.00	0.43	0.00
33.51	61.60	2.00	0.00	0.43	0.00	33.57	62.13	2.00	0.00	0.43	0.00
33.64	62.58	2.00	0.00	0.43	0.00	33.68	62.15	2.00	0.00	0.43	0.00
33.73	63.54	2.00	0.00	0.43	0.00	33.80	66.03	2.00	0.00	0.43	0.00
33.95	69.20	0.20	1.34	0.42	0.03	34.00	70.77	0.21	1.31	0.42	0.01
34.06	71.11	0.21	1.31	0.42	0.01	34.09	71.23	0.21	1.30	0.42	0.00
34.13	72.47	0.21	1.28	0.42	0.01	34.26	73.78	2.00	0.00	0.42	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
34.30	75.22	2.00	0.00	0.42	0.00	34.33	74.62	2.00	0.00	0.42	0.00
34.42	73.79	2.00	0.00	0.42	0.00	34.49	72.70	2.00	0.00	0.42	0.00
34.53	71.41	2.00	0.00	0.41	0.00	34.62	70.10	2.00	0.00	0.41	0.00
34.67	69.01	2.00	0.00	0.41	0.00	34.72	68.37	2.00	0.00	0.41	0.00
34.78	68.26	2.00	0.00	0.41	0.00	34.88	68.37	2.00	0.00	0.41	0.00
34.93	69.00	2.00	0.00	0.41	0.00	35.02	69.53	2.00	0.00	0.41	0.00
35.07	70.17	2.00	0.00	0.41	0.00	35.19	70.57	2.00	0.00	0.40	0.00
35.23	70.82	2.00	0.00	0.40	0.00	35.28	70.59	2.00	0.00	0.40	0.00
35.33	70.05	2.00	0.00	0.40	0.00	35.37	69.26	2.00	0.00	0.40	0.00
35.44	67.93	2.00	0.00	0.40	0.00	35.54	66.59	2.00	0.00	0.40	0.00
35.59	65.46	2.00	0.00	0.40	0.00	35.63	64.60	2.00	0.00	0.40	0.00
35.72	63.63	2.00	0.00	0.39	0.00	35.77	62.97	2.00	0.00	0.39	0.00
35.89	62.79	2.00	0.00	0.39	0.00	35.94	62.91	2.00	0.00	0.39	0.00
35.99	63.19	2.00	0.00	0.39	0.00	36.03	58.42	2.00	0.00	0.39	0.00
36.16	53.34	2.00	0.00	0.39	0.00	36.21	47.40	2.00	0.00	0.39	0.00
36.28	48.50	2.00	0.00	0.39	0.00	36.34	49.98	2.00	0.00	0.38	0.00
36.39	52.45	2.00	0.00	0.38	0.00	36.47	54.54	2.00	0.00	0.38	0.00
36.49	57.08	2.00	0.00	0.38	0.00	36.56	59.43	2.00	0.00	0.38	0.00
36.64	61.87	2.00	0.00	0.38	0.00	36.73	63.23	2.00	0.00	0.38	0.00
36.78	63.55	2.00	0.00	0.38	0.00	36.82	62.56	2.00	0.00	0.38	0.00
36.90	61.28	2.00	0.00	0.37	0.00	36.95	59.67	2.00	0.00	0.37	0.00
37.04	58.71	2.00	0.00	0.37	0.00	37.08	58.12	2.00	0.00	0.37	0.00
37.17	58.40	2.00	0.00	0.37	0.00	37.21	60.03	2.00	0.00	0.37	0.00
37.31	62.22	2.00	0.00	0.37	0.00	37.36	64.55	2.00	0.00	0.37	0.00
37.41	66.35	2.00	0.00	0.37	0.00	37.52	67.65	2.00	0.00	0.36	0.00
37.57	68.51	2.00	0.00	0.36	0.00	37.61	68.79	2.00	0.00	0.36	0.00
37.71	68.81	2.00	0.00	0.36	0.00	37.75	68.63	2.00	0.00	0.36	0.00
37.80	68.20	2.00	0.00	0.36	0.00	37.91	67.76	2.00	0.00	0.36	0.00
37.97	67.41	2.00	0.00	0.36	0.00	38.01	67.10	2.00	0.00	0.36	0.00
38.10	66.52	2.00	0.00	0.35	0.00	38.16	65.74	2.00	0.00	0.35	0.00
38.22	65.04	2.00	0.00	0.35	0.00	38.27	64.56	2.00	0.00	0.35	0.00
38.37	64.18	2.00	0.00	0.35	0.00	38.43	63.79	2.00	0.00	0.35	0.00
38.49	63.40	2.00	0.00	0.35	0.00	38.55	61.26	2.00	0.00	0.35	0.00
38.63	59.18	2.00	0.00	0.35	0.00	38.74	57.08	2.00	0.00	0.34	0.00
38.80	57.16	2.00	0.00	0.34	0.00	38.84	57.45	2.00	0.00	0.34	0.00
38.90	57.95	2.00	0.00	0.34	0.00	38.97	58.25	2.00	0.00	0.34	0.00
38.98	58.60	2.00	0.00	0.34	0.00	39.06	58.74	2.00	0.00	0.34	0.00
39.16	58.67	2.00	0.00	0.34	0.00	39.23	57.92	2.00	0.00	0.34	0.00
39.33	56.80	2.00	0.00	0.33	0.00	39.39	55.50	2.00	0.00	0.33	0.00
39.45	54.11	2.00	0.00	0.33	0.00	39.51	52.50	2.00	0.00	0.33	0.00
39.56	50.87	2.00	0.00	0.33	0.00	39.63	49.32	2.00	0.00	0.33	0.00
39.74	48.14	2.00	0.00	0.33	0.00	39.81	47.21	2.00	0.00	0.33	0.00
39.90	46.55	2.00	0.00	0.32	0.00	39.95	45.91	2.00	0.00	0.32	0.00
39.99	45.35	2.00	0.00	0.32	0.00	40.03	44.94	2.00	0.00	0.32	0.00
40.10	44.70	2.00	0.00	0.32	0.00	40.21	44.62	2.00	0.00	0.32	0.00
40.26	44.98	2.00	0.00	0.32	0.00	40.33	45.56	2.00	0.00	0.32	0.00
40.38	46.41	2.00	0.00	0.32	0.00	40.45	46.65	2.00	0.00	0.31	0.00
40.52	46.10	2.00	0.00	0.31	0.00	40.56	44.45	2.00	0.00	0.31	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
40.62	42.13	2.00	0.00	0.31	0.00	40.70	39.85	2.00	0.00	0.31	0.00
40.81	38.32	2.00	0.00	0.31	0.00	40.87	36.13	2.00	0.00	0.31	0.00
40.99	34.68	2.00	0.00	0.31	0.00	41.05	33.56	2.00	0.00	0.30	0.00
41.14	34.36	2.00	0.00	0.30	0.00	41.16	34.69	2.00	0.00	0.30	0.00
41.23	35.16	2.00	0.00	0.30	0.00	41.28	35.81	2.00	0.00	0.30	0.00
41.35	36.41	2.00	0.00	0.30	0.00	41.47	36.35	2.00	0.00	0.30	0.00
41.53	35.76	2.00	0.00	0.30	0.00	41.58	35.26	2.00	0.00	0.30	0.00
41.65	34.89	2.00	0.00	0.29	0.00	41.71	35.06	2.00	0.00	0.29	0.00
41.76	35.43	2.00	0.00	0.29	0.00	41.84	35.73	2.00	0.00	0.29	0.00
41.89	35.75	2.00	0.00	0.29	0.00	41.96	35.53	2.00	0.00	0.29	0.00
42.02	35.51	2.00	0.00	0.29	0.00	42.07	35.77	2.00	0.00	0.29	0.00
42.13	36.26	2.00	0.00	0.29	0.00	42.20	37.32	2.00	0.00	0.28	0.00
42.32	38.24	2.00	0.00	0.28	0.00	42.38	38.93	2.00	0.00	0.28	0.00
42.43	39.05	2.00	0.00	0.28	0.00	42.51	39.18	2.00	0.00	0.28	0.00
42.56	39.45	2.00	0.00	0.28	0.00	42.63	39.53	2.00	0.00	0.28	0.00
42.68	39.41	2.00	0.00	0.28	0.00	42.81	38.99	2.00	0.00	0.27	0.00
42.91	38.47	2.00	0.00	0.27	0.00	42.99	38.04	2.00	0.00	0.27	0.00
43.03	37.76	2.00	0.00	0.27	0.00	43.10	37.72	2.00	0.00	0.27	0.00
43.17	37.69	2.00	0.00	0.27	0.00	43.22	37.68	2.00	0.00	0.27	0.00
43.29	37.73	2.00	0.00	0.27	0.00	43.34	37.88	2.00	0.00	0.27	0.00
43.42	38.03	2.00	0.00	0.26	0.00	43.48	38.12	2.00	0.00	0.26	0.00
43.53	36.98	2.00	0.00	0.26	0.00	43.65	35.77	2.00	0.00	0.26	0.00
43.71	34.50	2.00	0.00	0.26	0.00	43.78	34.50	2.00	0.00	0.26	0.00
43.83	34.55	2.00	0.00	0.26	0.00	43.89	34.81	2.00	0.00	0.26	0.00
43.92	35.92	2.00	0.00	0.26	0.00	44.05	37.07	2.00	0.00	0.25	0.00
44.11	38.04	2.00	0.00	0.25	0.00	44.23	38.09	2.00	0.00	0.25	0.00
44.36	37.76	2.00	0.00	0.25	0.00	44.41	37.48	2.00	0.00	0.25	0.00
44.46	38.23	2.00	0.00	0.25	0.00	44.53	39.10	2.00	0.00	0.25	0.00
44.59	41.55	2.00	0.00	0.24	0.00	44.71	44.58	2.00	0.00	0.24	0.00
44.77	49.44	2.00	0.00	0.24	0.00	44.85	54.45	2.00	0.00	0.24	0.00
44.89	67.56	2.00	0.00	0.24	0.00	44.95	86.72	2.00	0.00	0.24	0.00
45.02	98.76	2.00	0.00	0.24	0.00	45.08	120.00	0.43	0.47	0.24	0.00
45.15	132.60	0.53	0.44	0.23	0.00	45.20	143.56	0.64	0.41	0.23	0.00
45.25	152.37	0.74	0.32	0.23	0.00	45.33	159.08	0.82	0.24	0.23	0.00
45.39	164.23	0.89	0.17	0.23	0.00	45.43	169.03	0.95	0.12	0.23	0.00
45.56	173.44	1.02	0.12	0.23	0.00	45.62	178.54	1.10	0.09	0.23	0.00
45.73	182.39	1.16	0.06	0.22	0.00	45.79	186.37	1.23	0.06	0.22	0.00
45.86	189.06	1.28	0.04	0.22	0.00	45.91	191.49	1.32	0.04	0.22	0.00
45.97	193.32	1.36	0.00	0.22	0.00	46.04	194.79	1.38	0.00	0.22	0.00
46.09	192.97	1.35	0.04	0.22	0.00	46.17	194.00	1.37	0.00	0.22	0.00
46.22	195.78	1.40	0.00	0.22	0.00	46.28	198.29	1.45	0.00	0.22	0.00
46.35	202.65	2.00	0.00	0.21	0.00	46.40	209.44	2.00	0.00	0.21	0.00
46.48	213.50	2.00	0.00	0.21	0.00	46.53	219.74	2.00	0.00	0.21	0.00
46.61	224.35	2.00	0.00	0.21	0.00	46.66	231.37	2.00	0.00	0.21	0.00
46.73	234.48	2.00	0.00	0.21	0.00	46.79	237.17	2.00	0.00	0.21	0.00
46.90	239.69	2.00	0.00	0.21	0.00	46.93	241.23	2.00	0.00	0.20	0.00
47.01	240.55	2.00	0.00	0.20	0.00	47.06	239.21	2.00	0.00	0.20	0.00
47.14	237.56	2.00	0.00	0.20	0.00	47.18	236.11	2.00	0.00	0.20	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
47.25	234.75	2.00	0.00	0.20	0.00	47.32	232.82	2.00	0.00	0.20	0.00
47.40	228.83	2.00	0.00	0.20	0.00	47.50	224.08	2.00	0.00	0.19	0.00
47.54	217.96	2.00	0.00	0.19	0.00	47.63	213.20	2.00	0.00	0.19	0.00
47.66	207.98	2.00	0.00	0.19	0.00	47.73	204.22	2.00	0.00	0.19	0.00
47.81	201.41	2.00	0.00	0.19	0.00	47.85	198.28	1.46	0.00	0.19	0.00
47.94	195.69	1.41	0.00	0.19	0.00	47.98	193.14	1.36	0.00	0.19	0.00
48.04	191.60	1.34	0.03	0.19	0.00	48.12	185.99	1.23	0.05	0.18	0.00
48.20	177.05	1.09	0.07	0.18	0.00	48.24	167.39	0.94	0.13	0.18	0.00
48.31	160.64	0.85	0.18	0.18	0.00	48.37	155.52	0.78	0.19	0.18	0.00
48.47	150.53	0.72	0.25	0.18	0.00	48.50	145.49	0.67	0.26	0.18	0.00
48.59	139.77	2.00	0.00	0.18	0.00	48.64	133.56	2.00	0.00	0.18	0.00
48.70	123.86	2.00	0.00	0.17	0.00	48.81	114.68	2.00	0.00	0.17	0.00
48.86	109.17	2.00	0.00	0.17	0.00	48.91	108.38	2.00	0.00	0.17	0.00
48.99	109.58	2.00	0.00	0.17	0.00	49.04	109.69	2.00	0.00	0.17	0.00
49.09	105.43	2.00	0.00	0.17	0.00	49.16	94.55	2.00	0.00	0.17	0.00
49.29	80.66	2.00	0.00	0.16	0.00	49.34	66.53	2.00	0.00	0.16	0.00
49.39	57.35	2.00	0.00	0.16	0.00	49.46	48.72	2.00	0.00	0.16	0.00
49.58	41.17	2.00	0.00	0.16	0.00	49.65	36.84	2.00	0.00	0.16	0.00
49.69	36.56	2.00	0.00	0.16	0.00	49.77	37.41	2.00	0.00	0.16	0.00
49.83	62.96	2.00	0.00	0.16	0.00	49.88	81.14	2.00	0.00	0.15	0.00
49.95	95.59	2.00	0.00	0.15	0.00	50.01	96.93	2.00	0.00	0.15	0.00

Total estimated settlement: 0.54

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

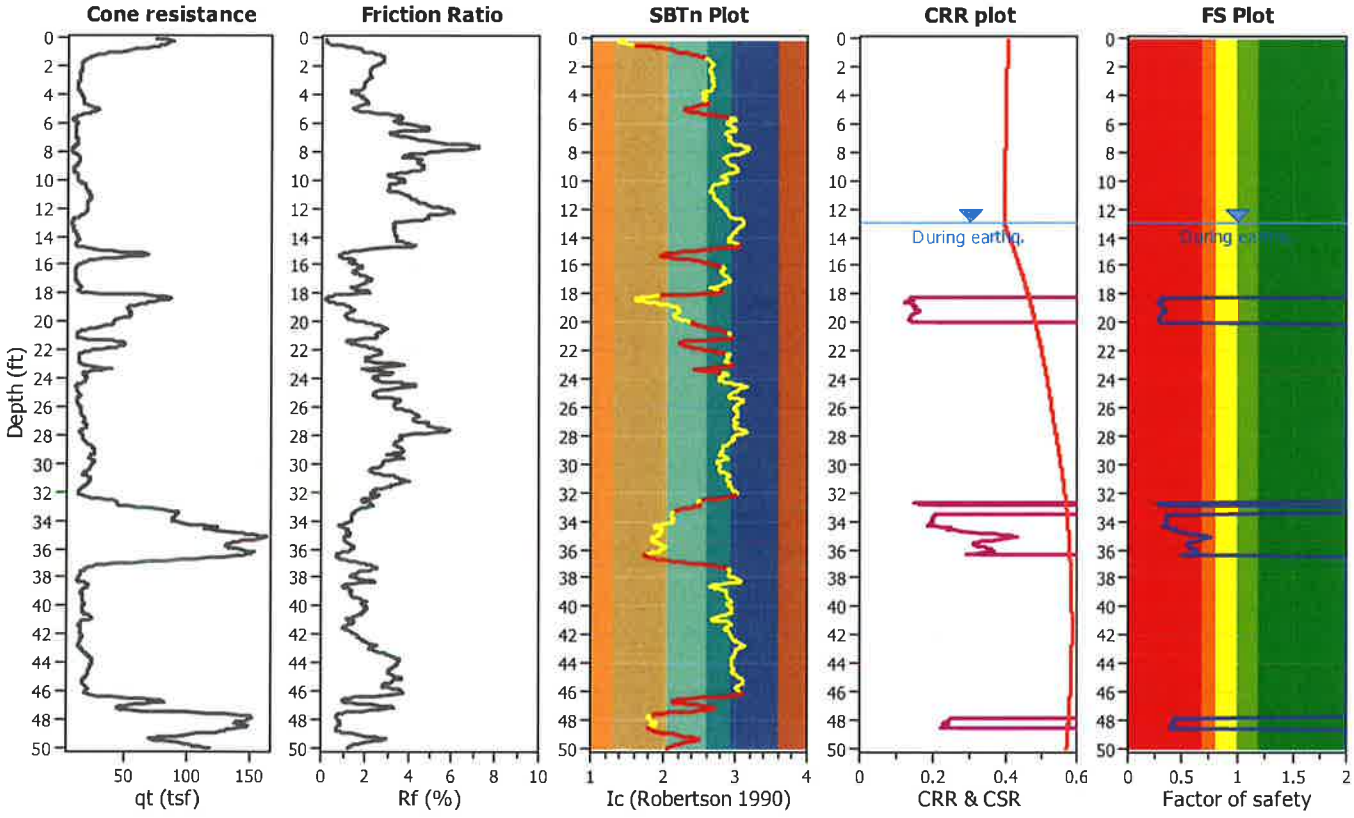
LIQUEFACTION ANALYSIS REPORT

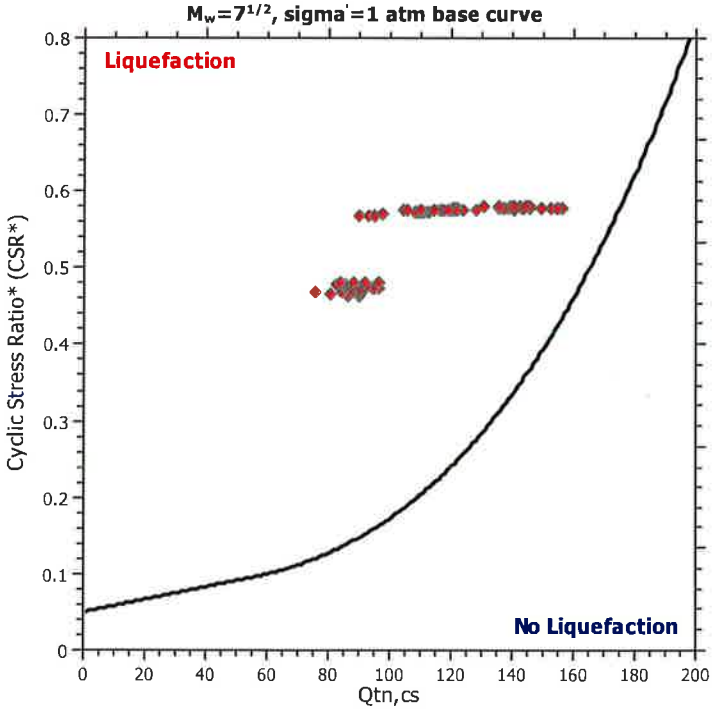
Project title : S-Line Upgrades **Location : Imperial County, CA**

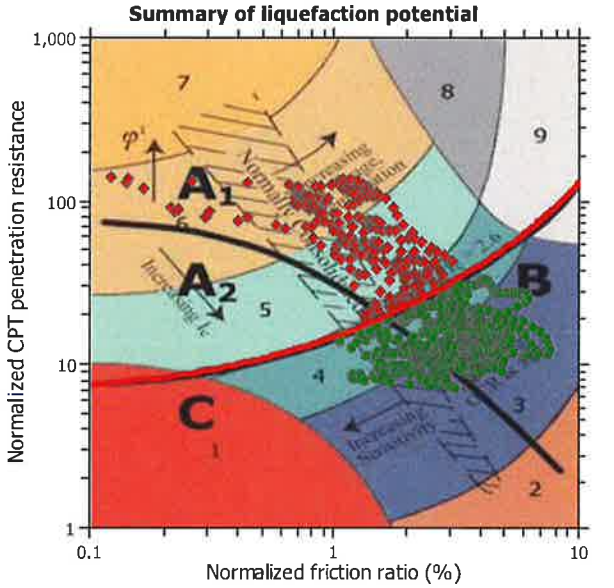
CPT file : CPT-13

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	13.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	13.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.57	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

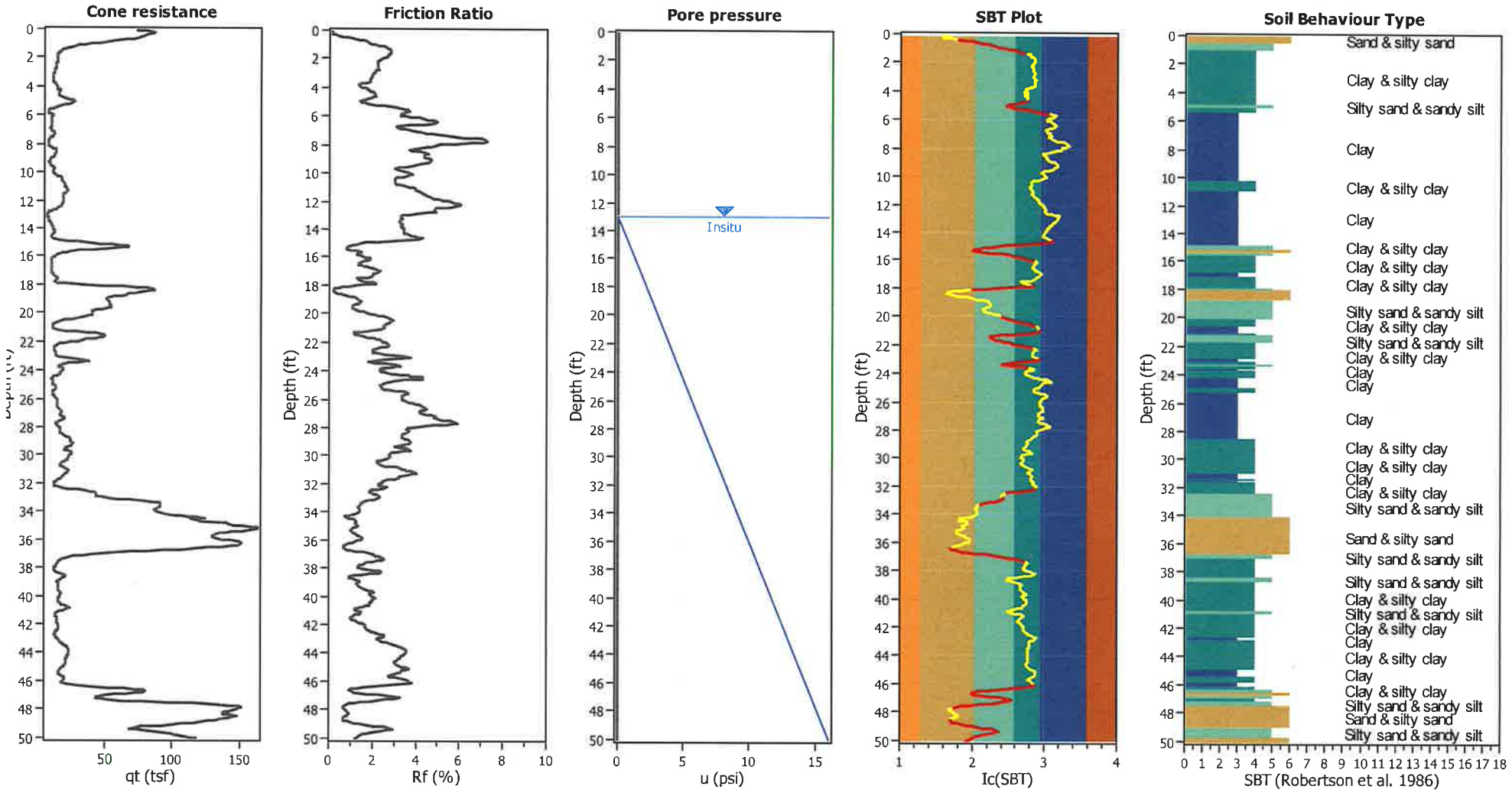






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



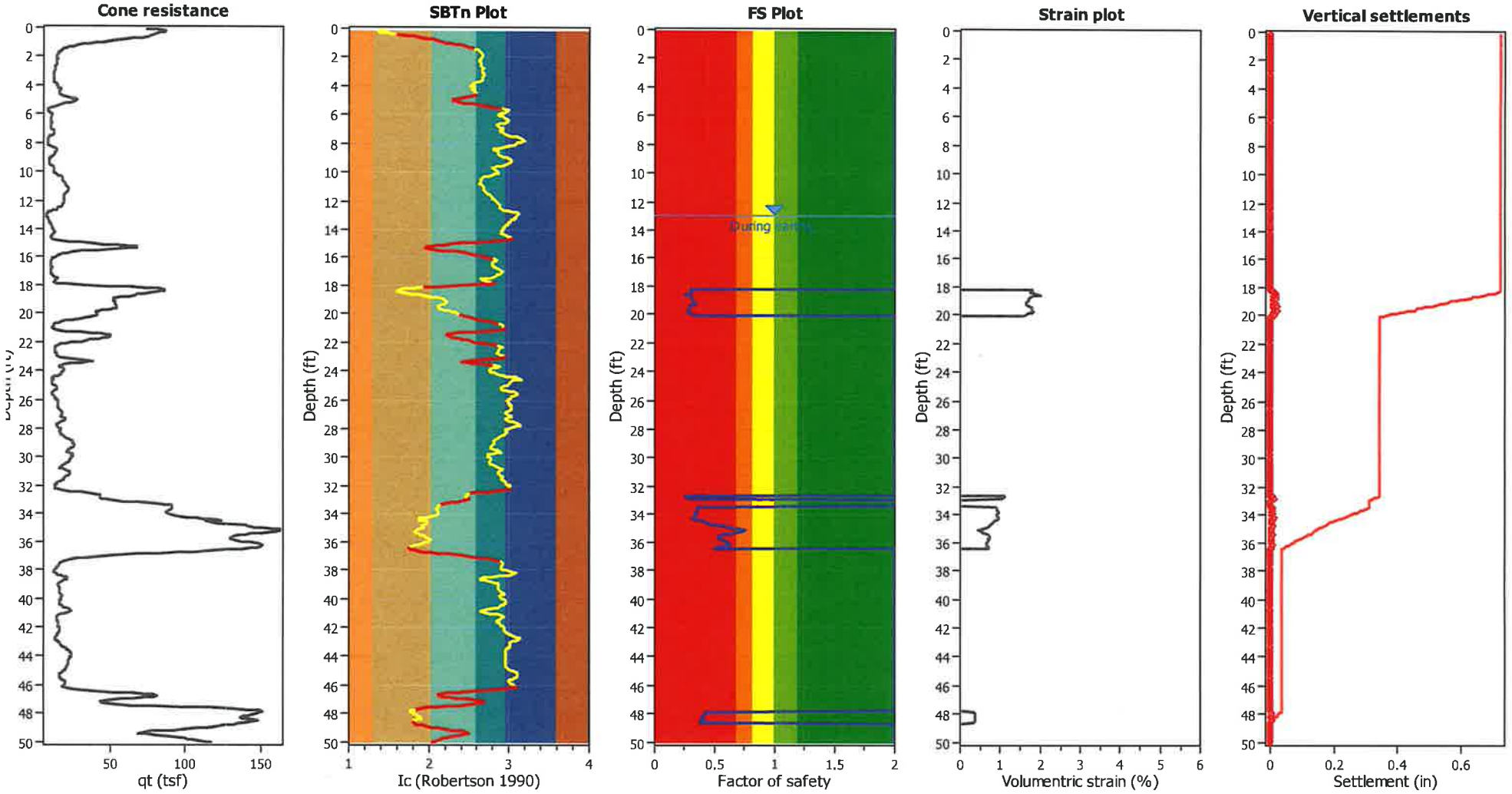
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	13.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.57	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	13.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
13.02	69.31	2.00	0.00	0.78	0.00	13.06	68.57	2.00	0.00	0.78	0.00
13.15	69.68	2.00	0.00	0.78	0.00	13.20	71.52	2.00	0.00	0.78	0.00
13.29	72.60	2.00	0.00	0.77	0.00	13.32	73.32	2.00	0.00	0.77	0.00
13.43	73.60	2.00	0.00	0.77	0.00	13.48	75.07	2.00	0.00	0.77	0.00
13.59	76.62	2.00	0.00	0.77	0.00	13.63	78.31	2.00	0.00	0.77	0.00
13.68	79.18	2.00	0.00	0.77	0.00	13.72	79.96	2.00	0.00	0.77	0.00
13.82	81.00	2.00	0.00	0.77	0.00	13.88	82.29	2.00	0.00	0.76	0.00
13.92	84.28	2.00	0.00	0.76	0.00	14.07	85.66	2.00	0.00	0.76	0.00
14.12	86.69	2.00	0.00	0.76	0.00	14.16	86.79	2.00	0.00	0.76	0.00
14.22	86.85	2.00	0.00	0.76	0.00	14.27	87.00	2.00	0.00	0.76	0.00
14.32	87.15	2.00	0.00	0.76	0.00	14.37	86.64	2.00	0.00	0.76	0.00
14.47	86.08	2.00	0.00	0.75	0.00	14.52	85.37	2.00	0.00	0.75	0.00
14.58	85.56	2.00	0.00	0.75	0.00	14.65	87.25	2.00	0.00	0.75	0.00
14.74	89.71	2.00	0.00	0.75	0.00	14.79	90.04	2.00	0.00	0.75	0.00
14.91	86.61	2.00	0.00	0.75	0.00	14.96	84.06	2.00	0.00	0.75	0.00
15.02	83.98	2.00	0.00	0.75	0.00	15.09	86.18	2.00	0.00	0.74	0.00
15.14	90.20	2.00	0.00	0.74	0.00	15.19	94.49	2.00	0.00	0.74	0.00
15.25	97.04	2.00	0.00	0.74	0.00	15.32	95.43	2.00	0.00	0.74	0.00
15.36	88.89	2.00	0.00	0.74	0.00	15.43	80.54	2.00	0.00	0.74	0.00
15.49	74.84	2.00	0.00	0.74	0.00	15.59	74.64	2.00	0.00	0.74	0.00
15.66	73.02	2.00	0.00	0.73	0.00	15.71	67.08	2.00	0.00	0.73	0.00
15.77	60.89	2.00	0.00	0.73	0.00	15.83	59.44	2.00	0.00	0.73	0.00
15.89	61.01	2.00	0.00	0.73	0.00	15.96	61.62	2.00	0.00	0.73	0.00
16.02	62.08	2.00	0.00	0.73	0.00	16.10	62.02	2.00	0.00	0.73	0.00
16.16	61.01	2.00	0.00	0.73	0.00	16.23	59.28	2.00	0.00	0.72	0.00
16.27	56.96	2.00	0.00	0.72	0.00	16.36	54.76	2.00	0.00	0.72	0.00
16.45	53.10	2.00	0.00	0.72	0.00	16.52	53.07	2.00	0.00	0.72	0.00
16.57	55.09	2.00	0.00	0.72	0.00	16.66	57.49	2.00	0.00	0.72	0.00
16.70	59.69	2.00	0.00	0.72	0.00	16.74	61.00	2.00	0.00	0.72	0.00
16.80	62.16	2.00	0.00	0.72	0.00	16.88	63.74	2.00	0.00	0.71	0.00
16.97	64.94	2.00	0.00	0.71	0.00	17.01	65.41	2.00	0.00	0.71	0.00
17.12	64.53	2.00	0.00	0.71	0.00	17.16	63.19	2.00	0.00	0.71	0.00
17.20	63.02	2.00	0.00	0.71	0.00	17.29	64.26	2.00	0.00	0.71	0.00
17.34	64.62	2.00	0.00	0.71	0.00	17.44	63.17	2.00	0.00	0.70	0.00
17.49	60.20	2.00	0.00	0.70	0.00	17.53	58.19	2.00	0.00	0.70	0.00
17.60	57.59	2.00	0.00	0.70	0.00	17.72	58.60	2.00	0.00	0.70	0.00
17.78	61.47	2.00	0.00	0.70	0.00	17.83	66.51	2.00	0.00	0.70	0.00
17.91	71.58	2.00	0.00	0.70	0.00	17.96	73.49	2.00	0.00	0.70	0.00
18.03	72.78	2.00	0.00	0.69	0.00	18.09	76.52	2.00	0.00	0.69	0.00
18.14	82.76	2.00	0.00	0.69	0.00	18.22	79.15	2.00	0.00	0.69	0.00
18.26	86.05	0.30	1.82	0.69	0.01	18.31	89.89	0.32	1.75	0.69	0.01
18.39	90.21	0.32	1.75	0.69	0.02	18.45	86.94	0.30	1.80	0.69	0.01
18.53	80.53	0.28	1.91	0.69	0.02	18.60	75.67	0.26	2.01	0.69	0.02
18.64	84.59	0.29	1.83	0.68	0.01	18.73	88.05	0.31	1.77	0.68	0.02
18.78	90.43	0.32	1.73	0.68	0.01	18.87	91.10	0.32	1.72	0.68	0.02
18.93	90.62	0.32	1.72	0.68	0.01	18.98	90.60	0.32	1.72	0.68	0.01
19.05	91.67	0.32	1.70	0.68	0.01	19.10	94.16	0.33	1.66	0.68	0.01
19.19	96.12	0.34	1.63	0.67	0.02	19.33	95.18	0.34	1.64	0.67	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
19.35	92.23	0.32	1.68	0.67	0.02	19.39	88.32	0.30	1.74	0.67	0.01
19.45	86.22	0.29	1.77	0.67	0.01	19.50	85.16	0.29	1.78	0.67	0.01
19.61	85.37	0.29	1.78	0.67	0.02	19.67	85.07	0.29	1.78	0.67	0.01
19.72	83.80	0.28	1.80	0.67	0.01	19.78	82.59	0.28	1.82	0.66	0.01
19.85	83.90	0.28	1.79	0.66	0.01	19.90	87.87	0.30	1.72	0.66	0.01
19.98	92.04	0.32	1.65	0.66	0.01	20.03	96.27	0.34	1.59	0.66	0.01
20.10	100.34	2.00	0.00	0.66	0.00	20.16	104.32	2.00	0.00	0.66	0.00
20.22	107.00	2.00	0.00	0.66	0.00	20.29	106.43	2.00	0.00	0.66	0.00
20.40	103.02	2.00	0.00	0.65	0.00	20.47	97.38	2.00	0.00	0.65	0.00
20.52	90.52	2.00	0.00	0.65	0.00	20.59	84.02	2.00	0.00	0.65	0.00
20.65	78.36	2.00	0.00	0.65	0.00	20.71	74.47	2.00	0.00	0.65	0.00
20.77	71.67	2.00	0.00	0.65	0.00	20.82	69.59	2.00	0.00	0.65	0.00
20.88	68.82	2.00	0.00	0.65	0.00	20.95	68.20	2.00	0.00	0.64	0.00
21.00	68.35	2.00	0.00	0.64	0.00	21.13	68.11	2.00	0.00	0.64	0.00
21.18	67.30	2.00	0.00	0.64	0.00	21.26	66.02	2.00	0.00	0.64	0.00
21.31	67.45	2.00	0.00	0.64	0.00	21.37	72.74	2.00	0.00	0.64	0.00
21.44	77.56	2.00	0.00	0.64	0.00	21.46	83.13	2.00	0.00	0.64	0.00
21.55	88.40	2.00	0.00	0.63	0.00	21.63	94.47	2.00	0.00	0.63	0.00
21.67	99.18	2.00	0.00	0.63	0.00	21.76	102.17	2.00	0.00	0.63	0.00
21.81	103.14	2.00	0.00	0.63	0.00	21.86	100.30	2.00	0.00	0.63	0.00
21.98	96.04	2.00	0.00	0.63	0.00	22.03	90.11	2.00	0.00	0.63	0.00
22.11	85.37	2.00	0.00	0.63	0.00	22.16	80.70	2.00	0.00	0.62	0.00
22.22	76.64	2.00	0.00	0.62	0.00	22.30	73.08	2.00	0.00	0.62	0.00
22.34	68.76	2.00	0.00	0.62	0.00	22.48	65.81	2.00	0.00	0.62	0.00
22.53	63.81	2.00	0.00	0.62	0.00	22.60	63.66	2.00	0.00	0.62	0.00
22.65	63.68	2.00	0.00	0.62	0.00	22.72	64.59	2.00	0.00	0.61	0.00
22.78	67.67	2.00	0.00	0.61	0.00	22.89	72.47	2.00	0.00	0.61	0.00
22.95	80.96	2.00	0.00	0.61	0.00	23.07	90.02	2.00	0.00	0.61	0.00
23.14	93.58	2.00	0.00	0.61	0.00	23.27	92.11	2.00	0.00	0.61	0.00
23.32	89.22	2.00	0.00	0.60	0.00	23.37	88.11	2.00	0.00	0.60	0.00
23.44	88.10	2.00	0.00	0.60	0.00	23.49	89.07	2.00	0.00	0.60	0.00
23.57	89.13	2.00	0.00	0.60	0.00	23.63	86.73	2.00	0.00	0.60	0.00
23.69	82.13	2.00	0.00	0.60	0.00	23.76	78.90	2.00	0.00	0.60	0.00
23.81	77.15	2.00	0.00	0.60	0.00	23.89	77.48	2.00	0.00	0.60	0.00
23.93	78.22	2.00	0.00	0.59	0.00	24.00	80.39	2.00	0.00	0.59	0.00
24.06	77.79	2.00	0.00	0.59	0.00	24.12	78.93	2.00	0.00	0.59	0.00
24.20	81.18	2.00	0.00	0.59	0.00	24.25	87.44	2.00	0.00	0.59	0.00
24.31	88.93	2.00	0.00	0.59	0.00	24.38	87.53	2.00	0.00	0.59	0.00
24.43	85.19	2.00	0.00	0.59	0.00	24.49	82.07	2.00	0.00	0.58	0.00
24.57	78.67	2.00	0.00	0.58	0.00	24.62	74.80	2.00	0.00	0.58	0.00
24.74	70.34	2.00	0.00	0.58	0.00	24.81	66.89	2.00	0.00	0.58	0.00
24.91	65.15	2.00	0.00	0.58	0.00	24.97	65.30	2.00	0.00	0.58	0.00
25.04	66.43	2.00	0.00	0.58	0.00	25.15	68.36	2.00	0.00	0.57	0.00
25.22	69.86	2.00	0.00	0.57	0.00	25.27	70.75	2.00	0.00	0.57	0.00
25.35	71.85	2.00	0.00	0.57	0.00	25.39	73.37	2.00	0.00	0.57	0.00
25.47	74.28	2.00	0.00	0.57	0.00	25.53	74.62	2.00	0.00	0.57	0.00
25.58	74.41	2.00	0.00	0.57	0.00	25.66	74.37	2.00	0.00	0.57	0.00
25.71	74.73	2.00	0.00	0.56	0.00	25.77	75.56	2.00	0.00	0.56	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
25.84	76.72	2.00	0.00	0.56	0.00	25.89	78.08	2.00	0.00	0.56	0.00
25.97	79.11	2.00	0.00	0.56	0.00	26.02	80.24	2.00	0.00	0.56	0.00
26.07	81.44	2.00	0.00	0.56	0.00	26.15	82.76	2.00	0.00	0.56	0.00
26.19	84.12	2.00	0.00	0.56	0.00	26.25	85.48	2.00	0.00	0.56	0.00
26.33	87.15	2.00	0.00	0.55	0.00	26.38	89.55	2.00	0.00	0.55	0.00
26.56	91.84	2.00	0.00	0.55	0.00	26.62	94.13	2.00	0.00	0.55	0.00
26.68	95.22	2.00	0.00	0.55	0.00	26.73	95.65	2.00	0.00	0.55	0.00
26.81	95.39	2.00	0.00	0.55	0.00	26.86	95.71	2.00	0.00	0.54	0.00
26.99	96.14	2.00	0.00	0.54	0.00	27.04	97.08	2.00	0.00	0.54	0.00
27.08	98.36	2.00	0.00	0.54	0.00	27.14	100.64	2.00	0.00	0.54	0.00
27.22	103.33	2.00	0.00	0.54	0.00	27.26	105.91	2.00	0.00	0.54	0.00
27.31	107.98	2.00	0.00	0.54	0.00	27.39	109.53	2.00	0.00	0.54	0.00
27.44	109.80	2.00	0.00	0.53	0.00	27.52	108.68	2.00	0.00	0.53	0.00
27.57	105.56	2.00	0.00	0.53	0.00	27.66	102.16	2.00	0.00	0.53	0.00
27.70	98.12	2.00	0.00	0.53	0.00	27.79	95.05	2.00	0.00	0.53	0.00
27.83	91.84	2.00	0.00	0.53	0.00	27.93	89.41	2.00	0.00	0.53	0.00
27.98	87.15	2.00	0.00	0.53	0.00	28.03	86.09	2.00	0.00	0.52	0.00
28.09	85.70	2.00	0.00	0.52	0.00	28.19	85.90	2.00	0.00	0.52	0.00
28.23	86.29	2.00	0.00	0.52	0.00	28.29	86.47	2.00	0.00	0.52	0.00
28.39	86.50	2.00	0.00	0.52	0.00	28.45	86.52	2.00	0.00	0.52	0.00
28.50	87.64	2.00	0.00	0.52	0.00	28.63	89.89	2.00	0.00	0.51	0.00
28.68	92.81	2.00	0.00	0.51	0.00	28.73	96.01	2.00	0.00	0.51	0.00
28.80	98.36	2.00	0.00	0.51	0.00	28.85	100.28	2.00	0.00	0.51	0.00
28.91	101.76	2.00	0.00	0.51	0.00	28.98	103.02	2.00	0.00	0.51	0.00
29.03	104.24	2.00	0.00	0.51	0.00	29.11	104.46	2.00	0.00	0.51	0.00
29.16	104.33	2.00	0.00	0.51	0.00	29.21	99.14	2.00	0.00	0.50	0.00
29.29	94.20	2.00	0.00	0.50	0.00	29.34	90.74	2.00	0.00	0.50	0.00
29.41	92.95	2.00	0.00	0.50	0.00	29.47	94.60	2.00	0.00	0.50	0.00
29.60	94.78	2.00	0.00	0.50	0.00	29.64	94.36	2.00	0.00	0.50	0.00
29.66	93.49	2.00	0.00	0.50	0.00	29.75	92.08	2.00	0.00	0.50	0.00
29.79	90.19	2.00	0.00	0.50	0.00	29.91	88.75	2.00	0.00	0.49	0.00
29.97	87.83	2.00	0.00	0.49	0.00	30.07	87.01	2.00	0.00	0.49	0.00
30.15	84.80	2.00	0.00	0.49	0.00	30.27	81.18	2.00	0.00	0.49	0.00
30.33	77.46	2.00	0.00	0.49	0.00	30.39	74.93	2.00	0.00	0.48	0.00
30.46	73.67	2.00	0.00	0.48	0.00	30.50	73.10	2.00	0.00	0.48	0.00
30.56	72.01	2.00	0.00	0.48	0.00	30.68	71.71	2.00	0.00	0.48	0.00
30.73	72.53	2.00	0.00	0.48	0.00	30.77	76.22	2.00	0.00	0.48	0.00
30.82	80.63	2.00	0.00	0.48	0.00	30.87	86.38	2.00	0.00	0.48	0.00
30.94	90.69	2.00	0.00	0.48	0.00	30.99	93.95	2.00	0.00	0.47	0.00
31.05	95.62	2.00	0.00	0.47	0.00	31.12	97.67	2.00	0.00	0.47	0.00
31.18	99.25	2.00	0.00	0.47	0.00	31.26	99.36	2.00	0.00	0.47	0.00
31.30	95.27	2.00	0.00	0.47	0.00	31.43	90.03	2.00	0.00	0.47	0.00
31.49	84.73	2.00	0.00	0.47	0.00	31.56	82.70	2.00	0.00	0.47	0.00
31.61	80.67	2.00	0.00	0.46	0.00	31.68	76.85	2.00	0.00	0.46	0.00
31.74	71.50	2.00	0.00	0.46	0.00	31.79	66.79	2.00	0.00	0.46	0.00
31.87	64.54	2.00	0.00	0.46	0.00	31.92	63.85	2.00	0.00	0.46	0.00
31.98	62.60	2.00	0.00	0.46	0.00	32.05	61.69	2.00	0.00	0.46	0.00
32.13	61.75	2.00	0.00	0.46	0.00	32.18	63.91	2.00	0.00	0.45	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
32.22	68.83	2.00	0.00	0.45	0.00	32.34	73.54	2.00	0.00	0.45	0.00
32.41	76.93	2.00	0.00	0.45	0.00	32.45	79.34	2.00	0.00	0.45	0.00
32.55	82.32	2.00	0.00	0.45	0.00	32.59	86.32	2.00	0.00	0.45	0.00
32.65	89.73	0.26	1.14	0.45	0.01	32.70	92.89	0.27	1.11	0.45	0.01
32.76	95.19	0.28	1.08	0.44	0.01	32.85	97.24	0.29	1.06	0.44	0.01
32.92	99.28	2.00	0.00	0.44	0.00	32.98	101.73	2.00	0.00	0.44	0.00
33.03	103.91	2.00	0.00	0.44	0.00	33.11	105.54	2.00	0.00	0.44	0.00
33.15	107.20	2.00	0.00	0.44	0.00	33.23	109.30	2.00	0.00	0.44	0.00
33.33	111.69	2.00	0.00	0.44	0.00	33.39	112.97	2.00	0.00	0.43	0.00
33.45	112.52	0.37	0.92	0.43	0.01	33.51	111.55	0.37	0.92	0.43	0.01
33.55	110.55	0.36	0.93	0.43	0.01	33.62	109.99	0.36	0.93	0.43	0.01
33.68	109.36	0.35	0.93	0.43	0.01	33.73	108.76	0.35	0.93	0.43	0.01
33.82	108.26	0.35	0.93	0.43	0.01	33.88	108.06	0.34	0.93	0.43	0.01
33.93	108.24	0.34	0.93	0.42	0.01	33.99	109.11	0.35	0.92	0.42	0.01
34.09	108.31	0.34	0.92	0.42	0.01	34.21	105.66	0.33	0.94	0.42	0.01
34.26	104.22	0.32	0.95	0.42	0.01	34.31	105.49	0.33	0.94	0.42	0.01
34.36	110.14	0.35	0.90	0.42	0.01	34.42	115.95	0.39	0.86	0.42	0.01
34.48	122.08	0.43	0.82	0.42	0.01	34.53	118.68	0.41	0.84	0.41	0.00
34.59	123.60	0.44	0.81	0.41	0.01	34.68	128.26	0.48	0.79	0.41	0.01
34.81	140.42	0.59	0.73	0.41	0.01	34.85	143.28	0.61	0.71	0.41	0.00
34.90	145.78	0.64	0.70	0.41	0.00	34.97	149.08	0.67	0.57	0.41	0.00
35.01	152.60	0.71	0.55	0.41	0.00	35.07	155.30	0.74	0.53	0.41	0.00
35.13	156.15	0.75	0.43	0.40	0.00	35.19	154.31	0.73	0.54	0.40	0.00
35.25	149.08	0.67	0.56	0.40	0.00	35.37	143.75	0.62	0.70	0.40	0.01
35.43	138.94	0.57	0.71	0.40	0.01	35.50	137.04	0.55	0.72	0.40	0.01
35.55	135.51	0.54	0.72	0.40	0.00	35.63	135.41	0.54	0.72	0.40	0.01
35.68	135.94	0.54	0.72	0.40	0.00	35.73	137.32	0.55	0.71	0.39	0.00
35.80	139.25	0.57	0.70	0.39	0.01	35.86	140.93	0.59	0.69	0.39	0.00
35.90	142.46	0.60	0.68	0.39	0.00	35.98	144.07	0.62	0.68	0.39	0.01
36.03	145.11	0.63	0.67	0.39	0.00	36.16	145.75	0.63	0.66	0.39	0.01
36.21	144.54	0.62	0.67	0.39	0.00	36.26	140.73	0.58	0.68	0.39	0.00
36.34	135.69	0.54	0.70	0.38	0.01	36.39	130.70	0.50	0.72	0.38	0.00
36.47	126.90	2.00	0.00	0.38	0.00	36.52	122.11	2.00	0.00	0.38	0.00
36.58	115.91	2.00	0.00	0.38	0.00	36.65	108.76	2.00	0.00	0.38	0.00
36.69	102.55	2.00	0.00	0.38	0.00	36.76	98.79	2.00	0.00	0.38	0.00
36.83	97.21	2.00	0.00	0.38	0.00	36.89	96.82	2.00	0.00	0.37	0.00
36.96	93.08	2.00	0.00	0.37	0.00	37.06	88.05	2.00	0.00	0.37	0.00
37.13	82.15	2.00	0.00	0.37	0.00	37.18	78.79	2.00	0.00	0.37	0.00
37.26	76.30	2.00	0.00	0.37	0.00	37.31	73.85	2.00	0.00	0.37	0.00
37.36	71.42	2.00	0.00	0.37	0.00	37.42	68.23	2.00	0.00	0.37	0.00
37.51	64.71	2.00	0.00	0.36	0.00	37.56	61.25	2.00	0.00	0.36	0.00
37.60	57.17	2.00	0.00	0.36	0.00	37.75	53.61	2.00	0.00	0.36	0.00
37.82	50.34	2.00	0.00	0.36	0.00	37.88	49.37	2.00	0.00	0.36	0.00
37.93	48.74	2.00	0.00	0.36	0.00	37.99	49.23	2.00	0.00	0.36	0.00
38.11	51.66	2.00	0.00	0.35	0.00	38.18	55.24	2.00	0.00	0.35	0.00
38.23	58.97	2.00	0.00	0.35	0.00	38.29	61.52	2.00	0.00	0.35	0.00
38.36	62.27	2.00	0.00	0.35	0.00	38.41	60.63	2.00	0.00	0.35	0.00
38.48	56.72	2.00	0.00	0.35	0.00	38.54	52.49	2.00	0.00	0.35	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
38.61	49.87	2.00	0.00	0.35	0.00	38.68	49.34	2.00	0.00	0.34	0.00
38.73	50.09	2.00	0.00	0.34	0.00	38.80	51.20	2.00	0.00	0.34	0.00
38.87	52.19	2.00	0.00	0.34	0.00	38.94	52.28	2.00	0.00	0.34	0.00
38.99	51.55	2.00	0.00	0.34	0.00	39.04	50.56	2.00	0.00	0.34	0.00
39.12	50.23	2.00	0.00	0.34	0.00	39.22	50.81	2.00	0.00	0.34	0.00
39.29	52.40	2.00	0.00	0.33	0.00	39.39	54.14	2.00	0.00	0.33	0.00
39.47	55.85	2.00	0.00	0.33	0.00	39.59	58.35	2.00	0.00	0.33	0.00
39.65	60.09	2.00	0.00	0.33	0.00	39.70	61.38	2.00	0.00	0.33	0.00
39.77	61.11	2.00	0.00	0.33	0.00	39.82	61.04	2.00	0.00	0.33	0.00
39.87	61.03	2.00	0.00	0.32	0.00	39.92	61.17	2.00	0.00	0.32	0.00
40.00	61.78	2.00	0.00	0.32	0.00	40.05	62.33	2.00	0.00	0.32	0.00
40.12	62.29	2.00	0.00	0.32	0.00	40.18	61.40	2.00	0.00	0.32	0.00
40.25	60.28	2.00	0.00	0.32	0.00	40.32	59.56	2.00	0.00	0.32	0.00
40.36	59.31	2.00	0.00	0.32	0.00	40.43	59.32	2.00	0.00	0.31	0.00
40.50	59.91	2.00	0.00	0.31	0.00	40.61	61.29	2.00	0.00	0.31	0.00
40.67	61.78	2.00	0.00	0.31	0.00	40.78	60.60	2.00	0.00	0.31	0.00
40.85	57.78	2.00	0.00	0.31	0.00	40.90	55.54	2.00	0.00	0.31	0.00
40.98	54.52	2.00	0.00	0.31	0.00	41.02	54.31	2.00	0.00	0.30	0.00
41.09	53.71	2.00	0.00	0.30	0.00	41.20	52.02	2.00	0.00	0.30	0.00
41.25	49.71	2.00	0.00	0.30	0.00	41.30	47.29	2.00	0.00	0.30	0.00
41.38	45.64	2.00	0.00	0.30	0.00	41.43	44.62	2.00	0.00	0.30	0.00
41.51	44.24	2.00	0.00	0.30	0.00	41.56	44.22	2.00	0.00	0.30	0.00
41.61	44.77	2.00	0.00	0.29	0.00	41.69	46.15	2.00	0.00	0.29	0.00
41.74	48.35	2.00	0.00	0.29	0.00	41.86	50.37	2.00	0.00	0.29	0.00
41.91	52.33	2.00	0.00	0.29	0.00	41.97	53.55	2.00	0.00	0.29	0.00
42.04	54.40	2.00	0.00	0.29	0.00	42.14	54.73	2.00	0.00	0.29	0.00
42.21	54.75	2.00	0.00	0.28	0.00	42.26	55.23	2.00	0.00	0.28	0.00
42.37	55.79	2.00	0.00	0.28	0.00	42.44	56.10	2.00	0.00	0.28	0.00
42.49	55.75	2.00	0.00	0.28	0.00	42.54	56.08	2.00	0.00	0.28	0.00
42.61	57.15	2.00	0.00	0.28	0.00	42.73	58.33	2.00	0.00	0.28	0.00
42.75	58.98	2.00	0.00	0.28	0.00	42.79	59.39	2.00	0.00	0.27	0.00
42.88	59.48	2.00	0.00	0.27	0.00	42.94	59.43	2.00	0.00	0.27	0.00
42.99	59.79	2.00	0.00	0.27	0.00	43.05	61.86	2.00	0.00	0.27	0.00
43.19	64.96	2.00	0.00	0.27	0.00	43.25	68.08	2.00	0.00	0.27	0.00
43.30	70.45	2.00	0.00	0.27	0.00	43.36	72.38	2.00	0.00	0.27	0.00
43.40	74.78	2.00	0.00	0.26	0.00	43.47	77.40	2.00	0.00	0.26	0.00
43.53	79.99	2.00	0.00	0.26	0.00	43.58	82.14	2.00	0.00	0.26	0.00
43.65	84.28	2.00	0.00	0.26	0.00	43.71	85.99	2.00	0.00	0.26	0.00
43.78	87.06	2.00	0.00	0.26	0.00	43.83	87.06	2.00	0.00	0.26	0.00
43.94	86.65	2.00	0.00	0.26	0.00	44.02	86.13	2.00	0.00	0.25	0.00
44.07	85.43	2.00	0.00	0.25	0.00	44.13	84.45	2.00	0.00	0.25	0.00
44.20	83.40	2.00	0.00	0.25	0.00	44.24	82.22	2.00	0.00	0.25	0.00
44.34	81.04	2.00	0.00	0.25	0.00	44.41	79.75	2.00	0.00	0.25	0.00
44.46	78.71	2.00	0.00	0.25	0.00	44.52	77.89	2.00	0.00	0.25	0.00
44.58	77.45	2.00	0.00	0.24	0.00	44.64	77.30	2.00	0.00	0.24	0.00
44.73	77.24	2.00	0.00	0.24	0.00	44.79	77.17	2.00	0.00	0.24	0.00
44.85	77.39	2.00	0.00	0.24	0.00	44.95	77.79	2.00	0.00	0.24	0.00
45.01	78.46	2.00	0.00	0.24	0.00	45.08	78.22	2.00	0.00	0.24	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
45.13	76.51	2.00	0.00	0.24	0.00	45.18	73.79	2.00	0.00	0.23	0.00
45.22	71.67	2.00	0.00	0.23	0.00	45.35	70.43	2.00	0.00	0.23	0.00
45.39	69.70	2.00	0.00	0.23	0.00	45.45	68.66	2.00	0.00	0.23	0.00
45.52	67.97	2.00	0.00	0.23	0.00	45.56	67.82	2.00	0.00	0.23	0.00
45.61	69.30	2.00	0.00	0.23	0.00	45.69	71.62	2.00	0.00	0.23	0.00
45.74	75.40	2.00	0.00	0.22	0.00	45.84	78.29	2.00	0.00	0.22	0.00
45.88	80.38	2.00	0.00	0.22	0.00	45.94	80.43	2.00	0.00	0.22	0.00
46.00	79.51	2.00	0.00	0.22	0.00	46.09	78.34	2.00	0.00	0.22	0.00
46.13	78.60	2.00	0.00	0.22	0.00	46.26	78.27	2.00	0.00	0.22	0.00
46.36	77.64	2.00	0.00	0.21	0.00	46.44	73.67	2.00	0.00	0.21	0.00
46.49	72.81	2.00	0.00	0.21	0.00	46.54	74.90	2.00	0.00	0.21	0.00
46.62	78.51	2.00	0.00	0.21	0.00	46.66	82.12	2.00	0.00	0.21	0.00
46.75	84.82	2.00	0.00	0.21	0.00	46.80	86.90	2.00	0.00	0.21	0.00
46.85	89.73	2.00	0.00	0.21	0.00	46.92	93.53	2.00	0.00	0.20	0.00
46.97	99.09	2.00	0.00	0.20	0.00	47.05	104.33	2.00	0.00	0.20	0.00
47.11	107.49	2.00	0.00	0.20	0.00	47.16	106.63	2.00	0.00	0.20	0.00
47.24	103.02	2.00	0.00	0.20	0.00	47.29	98.36	2.00	0.00	0.20	0.00
47.35	95.76	2.00	0.00	0.20	0.00	47.42	93.57	2.00	0.00	0.20	0.00
47.47	94.83	2.00	0.00	0.20	0.00	47.53	98.74	2.00	0.00	0.19	0.00
47.59	105.46	2.00	0.00	0.19	0.00	47.64	111.59	2.00	0.00	0.19	0.00
47.71	117.02	2.00	0.00	0.19	0.00	47.77	120.18	2.00	0.00	0.19	0.00
47.84	121.85	0.43	0.38	0.19	0.00	47.90	121.53	0.43	0.37	0.19	0.00
48.01	120.88	0.42	0.37	0.19	0.00	48.08	119.90	0.42	0.37	0.19	0.00
48.13	118.48	0.41	0.37	0.18	0.00	48.20	117.27	0.40	0.38	0.18	0.00
48.26	116.66	0.39	0.37	0.18	0.00	48.33	117.50	0.40	0.37	0.18	0.00
48.39	119.15	0.41	0.36	0.18	0.00	48.45	120.96	0.42	0.36	0.18	0.00
48.51	118.77	0.41	0.36	0.18	0.00	48.56	114.50	0.38	0.37	0.18	0.00
48.70	109.29	2.00	0.00	0.17	0.00	48.74	107.54	2.00	0.00	0.17	0.00
48.78	107.16	2.00	0.00	0.17	0.00	48.83	107.63	2.00	0.00	0.17	0.00
48.92	107.88	2.00	0.00	0.17	0.00	48.97	108.44	2.00	0.00	0.17	0.00
49.02	109.64	2.00	0.00	0.17	0.00	49.08	112.51	2.00	0.00	0.17	0.00
49.18	115.60	2.00	0.00	0.17	0.00	49.22	118.83	2.00	0.00	0.17	0.00
49.32	119.95	2.00	0.00	0.16	0.00	49.36	121.07	2.00	0.00	0.16	0.00
49.45	120.29	2.00	0.00	0.16	0.00	49.50	117.23	2.00	0.00	0.16	0.00
49.64	113.01	2.00	0.00	0.16	0.00	49.69	109.06	2.00	0.00	0.16	0.00
49.75	106.58	2.00	0.00	0.16	0.00	49.79	105.64	2.00	0.00	0.16	0.00
49.84	105.87	2.00	0.00	0.16	0.00	49.89	107.02	2.00	0.00	0.15	0.00
49.98	108.45	2.00	0.00	0.15	0.00	50.02	109.63	2.00	0.00	0.15	0.00

Total estimated settlement: 0.73

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

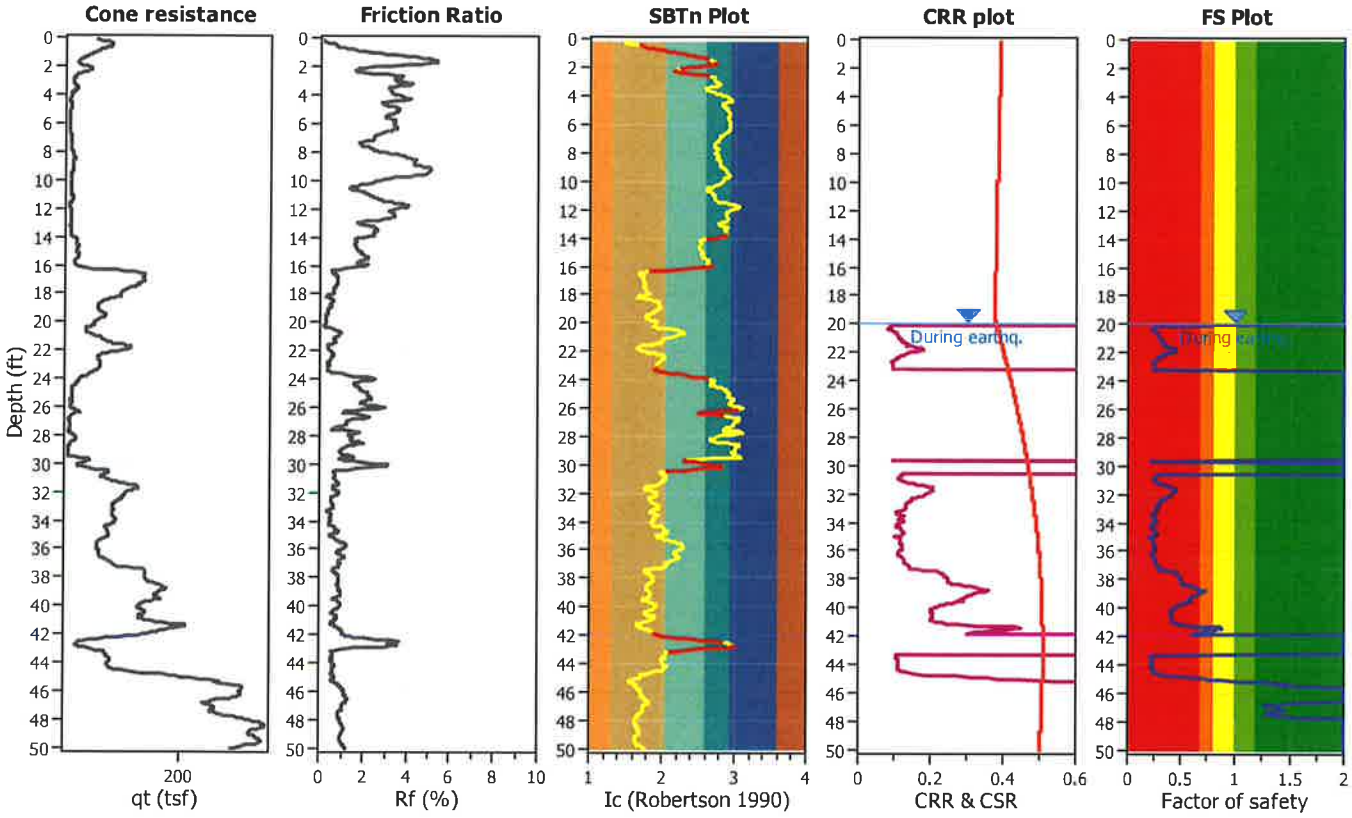
LIQUEFACTION ANALYSIS REPORT

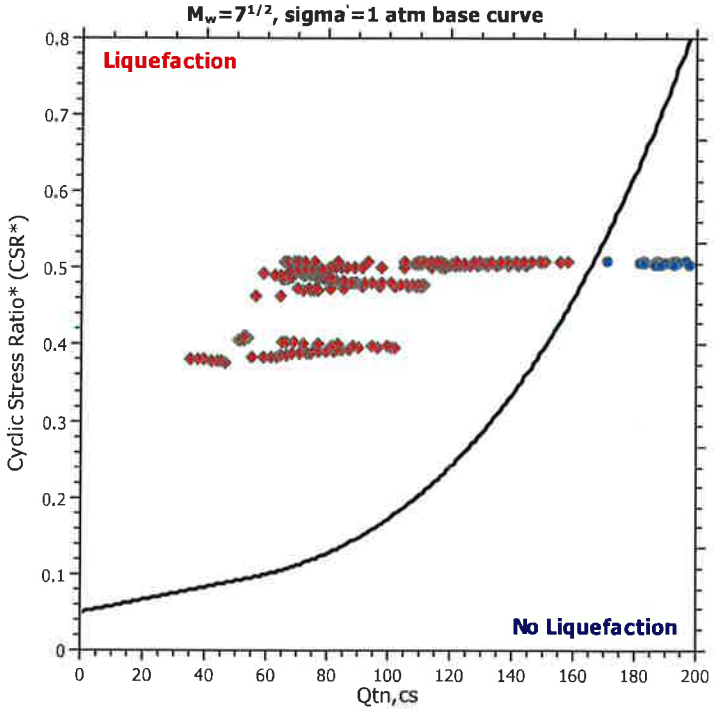
Project title : S-Line Upgrades **Location : Imperial County, CA**

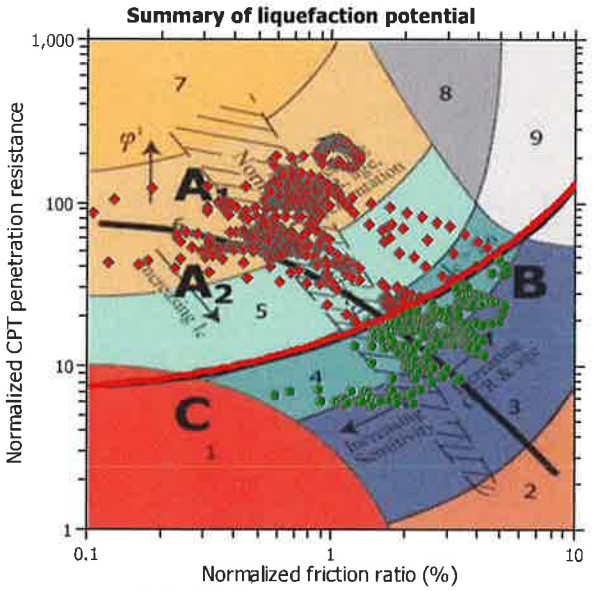
CPT file : CPT-14

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	20.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	20.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

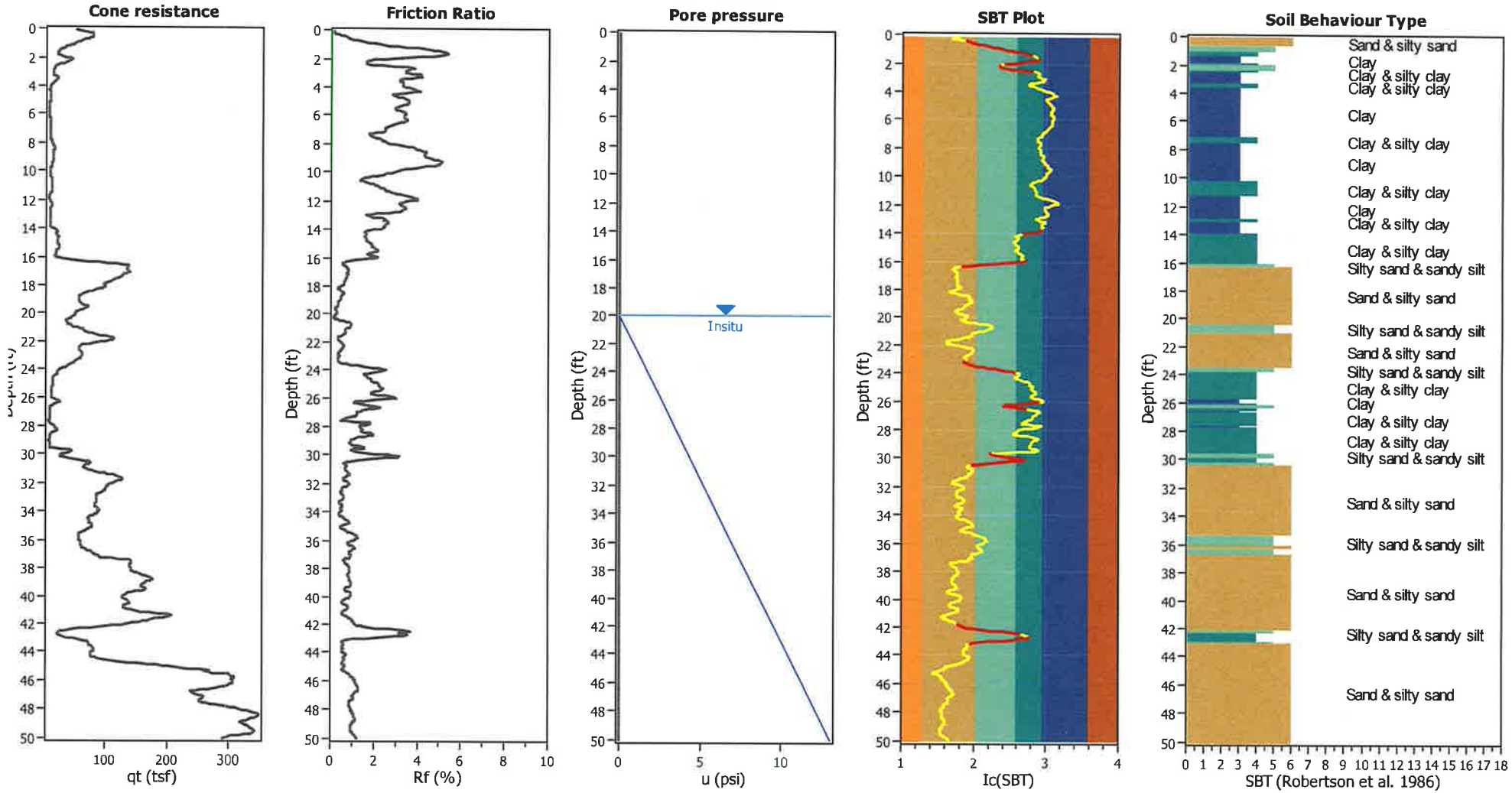






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



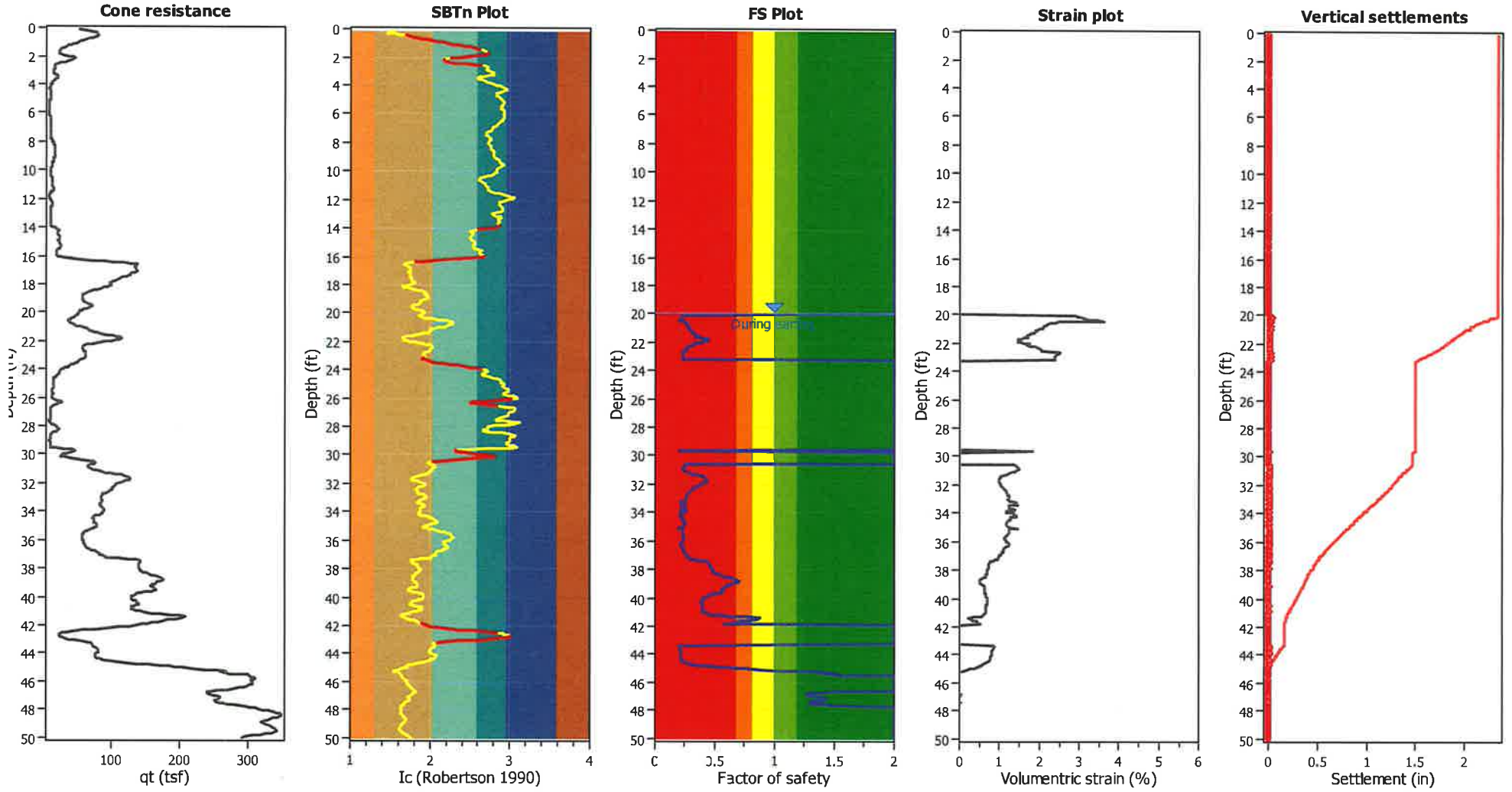
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	20.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	20.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
20.04	45.97	0.23	2.92	0.66	0.03	20.16	44.74	0.23	2.97	0.66	0.04
20.20	43.45	0.23	3.04	0.66	0.01	20.25	41.65	0.22	3.15	0.66	0.02
20.34	39.64	0.22	3.27	0.66	0.04	20.38	37.31	0.21	3.43	0.65	0.02
20.43	34.89	0.21	3.62	0.65	0.02	20.52	54.75	0.25	2.50	0.65	0.03
20.58	58.47	0.26	2.36	0.65	0.02	20.62	61.29	0.26	2.27	0.65	0.01
20.67	63.31	0.27	2.21	0.65	0.01	20.77	64.62	0.27	2.17	0.65	0.03
20.82	66.02	0.28	2.13	0.65	0.01	20.96	67.82	0.28	2.07	0.64	0.03
21.02	70.71	0.29	2.00	0.64	0.02	21.09	72.93	0.30	1.95	0.64	0.02
21.14	74.13	0.30	1.92	0.64	0.01	21.21	75.08	0.31	1.89	0.64	0.02
21.26	76.76	0.31	1.86	0.64	0.01	21.32	79.44	0.32	1.80	0.64	0.01
21.40	82.11	0.33	1.75	0.64	0.02	21.45	84.47	0.35	1.71	0.64	0.01
21.52	86.67	0.36	1.67	0.64	0.01	21.58	82.94	0.34	1.73	0.63	0.01
21.63	90.17	0.38	1.61	0.63	0.01	21.70	96.55	0.41	1.52	0.63	0.01
21.75	100.74	0.44	1.47	0.63	0.01	21.82	101.60	0.45	1.45	0.63	0.01
21.88	99.32	0.43	1.48	0.63	0.01	21.93	94.54	0.40	1.54	0.63	0.01
22.01	88.36	0.36	1.62	0.63	0.02	22.07	81.03	0.32	1.74	0.63	0.01
22.13	83.13	0.33	1.70	0.62	0.01	22.20	77.11	0.31	1.80	0.62	0.02
22.25	71.71	0.28	1.91	0.62	0.01	22.34	68.52	0.27	1.98	0.62	0.02
22.41	65.97	0.26	2.04	0.62	0.02	22.45	65.01	0.26	2.06	0.62	0.01
22.53	64.90	0.26	2.06	0.62	0.02	22.58	64.86	0.26	2.06	0.62	0.01
22.66	50.68	0.23	2.51	0.62	0.02	22.71	51.40	0.23	2.48	0.62	0.02
22.77	52.27	0.23	2.44	0.61	0.02	22.87	53.22	0.23	2.40	0.61	0.03
22.91	53.83	0.23	2.38	0.61	0.01	23.00	53.72	0.23	2.37	0.61	0.02
23.05	53.40	0.23	2.38	0.61	0.01	23.10	52.96	0.23	2.39	0.61	0.01
23.20	52.21	0.23	2.42	0.61	0.03	23.26	50.87	2.00	0.00	0.61	0.00
23.30	48.49	2.00	0.00	0.61	0.00	23.40	45.57	2.00	0.00	0.60	0.00
23.46	42.51	2.00	0.00	0.60	0.00	23.53	58.64	2.00	0.00	0.60	0.00
23.57	61.74	2.00	0.00	0.60	0.00	23.64	66.02	2.00	0.00	0.60	0.00
23.71	72.16	2.00	0.00	0.60	0.00	23.80	77.78	2.00	0.00	0.60	0.00
23.83	83.04	2.00	0.00	0.60	0.00	23.90	86.00	2.00	0.00	0.59	0.00
23.97	87.99	2.00	0.00	0.59	0.00	24.02	84.93	2.00	0.00	0.59	0.00
24.12	79.16	2.00	0.00	0.59	0.00	24.15	71.26	2.00	0.00	0.59	0.00
24.24	66.82	2.00	0.00	0.59	0.00	24.29	64.71	2.00	0.00	0.59	0.00
24.38	64.05	2.00	0.00	0.59	0.00	24.42	62.75	2.00	0.00	0.59	0.00
24.51	61.29	2.00	0.00	0.58	0.00	24.55	60.05	2.00	0.00	0.58	0.00
24.64	59.48	2.00	0.00	0.58	0.00	24.68	59.14	2.00	0.00	0.58	0.00
24.77	59.01	2.00	0.00	0.58	0.00	24.81	59.86	2.00	0.00	0.58	0.00
24.90	61.08	2.00	0.00	0.58	0.00	24.95	62.74	2.00	0.00	0.58	0.00
25.04	63.59	2.00	0.00	0.58	0.00	25.10	63.90	2.00	0.00	0.57	0.00
25.15	63.85	2.00	0.00	0.57	0.00	25.20	63.80	2.00	0.00	0.57	0.00
25.28	63.82	2.00	0.00	0.57	0.00	25.34	63.55	2.00	0.00	0.57	0.00
25.42	62.50	2.00	0.00	0.57	0.00	25.50	60.69	2.00	0.00	0.57	0.00
25.57	58.77	2.00	0.00	0.57	0.00	25.61	57.73	2.00	0.00	0.57	0.00
25.70	57.68	2.00	0.00	0.56	0.00	25.75	58.68	2.00	0.00	0.56	0.00
25.82	60.17	2.00	0.00	0.56	0.00	25.87	62.28	2.00	0.00	0.56	0.00
25.95	64.22	2.00	0.00	0.56	0.00	26.00	65.44	2.00	0.00	0.56	0.00
26.08	65.60	2.00	0.00	0.56	0.00	26.13	63.96	2.00	0.00	0.56	0.00
26.21	61.20	2.00	0.00	0.56	0.00	26.26	58.59	2.00	0.00	0.55	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
26.34	57.74	2.00	0.00	0.55	0.00	26.39	58.06	2.00	0.00	0.55	0.00
26.46	59.68	2.00	0.00	0.55	0.00	26.56	60.73	2.00	0.00	0.55	0.00
26.61	60.56	2.00	0.00	0.55	0.00	26.65	57.74	2.00	0.00	0.55	0.00
26.75	53.33	2.00	0.00	0.55	0.00	26.79	48.77	2.00	0.00	0.55	0.00
26.84	45.47	2.00	0.00	0.55	0.00	26.93	43.74	2.00	0.00	0.54	0.00
26.98	43.18	2.00	0.00	0.54	0.00	27.09	43.63	2.00	0.00	0.54	0.00
27.14	44.17	2.00	0.00	0.54	0.00	27.19	44.13	2.00	0.00	0.54	0.00
27.23	43.41	2.00	0.00	0.54	0.00	27.32	41.87	2.00	0.00	0.54	0.00
27.38	38.30	2.00	0.00	0.54	0.00	27.51	35.18	2.00	0.00	0.53	0.00
27.58	33.18	2.00	0.00	0.53	0.00	27.62	36.47	2.00	0.00	0.53	0.00
27.67	41.79	2.00	0.00	0.53	0.00	27.72	47.75	2.00	0.00	0.53	0.00
27.76	50.61	2.00	0.00	0.53	0.00	27.88	51.54	2.00	0.00	0.53	0.00
27.91	51.33	2.00	0.00	0.53	0.00	27.98	55.64	2.00	0.00	0.53	0.00
28.16	59.52	2.00	0.00	0.52	0.00	28.19	61.90	2.00	0.00	0.52	0.00
28.22	60.61	2.00	0.00	0.52	0.00	28.29	59.00	2.00	0.00	0.52	0.00
28.38	58.01	2.00	0.00	0.52	0.00	28.42	57.25	2.00	0.00	0.52	0.00
28.52	55.63	2.00	0.00	0.52	0.00	28.57	53.13	2.00	0.00	0.52	0.00
28.61	49.85	2.00	0.00	0.52	0.00	28.69	47.07	2.00	0.00	0.51	0.00
28.74	43.69	2.00	0.00	0.51	0.00	28.86	41.40	2.00	0.00	0.51	0.00
28.92	39.16	2.00	0.00	0.51	0.00	28.99	38.53	2.00	0.00	0.51	0.00
29.03	38.46	2.00	0.00	0.51	0.00	29.08	38.25	2.00	0.00	0.51	0.00
29.13	38.39	2.00	0.00	0.51	0.00	29.24	39.32	2.00	0.00	0.50	0.00
29.31	40.97	2.00	0.00	0.50	0.00	29.35	43.31	2.00	0.00	0.50	0.00
29.44	45.68	2.00	0.00	0.50	0.00	29.50	48.53	2.00	0.00	0.50	0.00
29.54	51.94	2.00	0.00	0.50	0.00	29.60	56.42	0.21	1.86	0.50	0.01
29.66	64.22	0.23	1.67	0.50	0.01	29.75	70.85	2.00	0.00	0.50	0.00
29.81	77.30	2.00	0.00	0.49	0.00	29.92	82.57	2.00	0.00	0.49	0.00
29.97	87.65	2.00	0.00	0.49	0.00	30.01	89.54	2.00	0.00	0.49	0.00
30.08	90.16	2.00	0.00	0.49	0.00	30.14	89.50	2.00	0.00	0.49	0.00
30.19	86.82	2.00	0.00	0.49	0.00	30.31	81.56	2.00	0.00	0.49	0.00
30.37	77.21	2.00	0.00	0.49	0.00	30.42	75.94	2.00	0.00	0.48	0.00
30.49	77.49	2.00	0.00	0.48	0.00	30.54	77.41	2.00	0.00	0.48	0.00
30.60	76.95	0.26	1.39	0.48	0.01	30.68	75.45	0.25	1.41	0.48	0.01
30.72	74.46	0.25	1.43	0.48	0.01	30.80	72.07	0.24	1.46	0.48	0.01
30.85	70.17	0.24	1.49	0.48	0.01	30.91	69.94	0.24	1.49	0.48	0.01
30.98	73.52	0.25	1.43	0.47	0.01	31.09	76.20	0.26	1.38	0.47	0.02
31.12	80.35	0.27	1.32	0.47	0.00	31.19	85.00	0.29	1.26	0.47	0.01
31.27	91.05	0.32	1.19	0.47	0.01	31.31	97.17	0.35	1.12	0.47	0.00
31.39	102.00	0.38	1.08	0.47	0.01	31.45	106.46	0.40	1.04	0.47	0.01
31.53	108.48	0.42	1.02	0.47	0.01	31.57	109.82	0.43	1.01	0.46	0.00
31.67	110.54	0.43	1.00	0.46	0.01	31.75	111.10	0.43	0.99	0.46	0.01
31.80	110.93	0.43	0.99	0.46	0.01	31.84	109.37	0.42	1.00	0.46	0.01
31.93	107.45	0.41	1.01	0.46	0.01	31.98	105.60	0.40	1.02	0.46	0.01
32.02	103.48	0.38	1.04	0.46	0.01	32.12	100.35	0.36	1.06	0.46	0.01
32.22	97.25	0.34	1.09	0.45	0.01	32.25	94.14	0.33	1.11	0.45	0.00
32.35	91.80	0.32	1.13	0.45	0.01	32.38	89.67	0.31	1.15	0.45	0.00
32.42	88.67	0.30	1.16	0.45	0.01	32.50	88.26	0.30	1.16	0.45	0.01
32.55	87.37	0.29	1.17	0.45	0.01	32.61	85.04	0.28	1.19	0.45	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
32.72	82.45	0.27	1.22	0.45	0.02	32.75	80.92	0.27	1.24	0.44	0.00
32.82	80.88	0.27	1.23	0.44	0.01	32.91	80.77	0.27	1.23	0.44	0.01
32.94	80.99	0.27	1.23	0.44	0.01	33.04	80.84	0.27	1.22	0.44	0.01
33.08	80.26	0.26	1.23	0.44	0.01	33.16	78.49	0.26	1.25	0.44	0.01
33.22	66.76	0.22	1.42	0.44	0.01	33.30	66.66	0.22	1.42	0.44	0.01
33.34	65.77	0.22	1.43	0.43	0.01	33.41	64.84	0.22	1.45	0.43	0.01
33.48	77.10	0.25	1.25	0.43	0.01	33.59	77.77	0.25	1.24	0.43	0.02
33.61	77.44	0.25	1.24	0.43	0.00	33.70	77.23	0.25	1.24	0.43	0.01
33.73	66.99	0.22	1.39	0.43	0.01	33.84	68.00	0.22	1.37	0.43	0.02
33.88	80.69	0.26	1.19	0.43	0.01	33.96	80.31	0.26	1.19	0.42	0.01
34.02	68.17	0.22	1.35	0.42	0.01	34.06	67.32	0.22	1.37	0.42	0.01
34.15	66.06	0.22	1.38	0.42	0.01	34.20	64.29	0.21	1.41	0.42	0.01
34.28	62.56	0.21	1.44	0.42	0.01	34.32	72.21	0.23	1.28	0.42	0.01
34.39	72.18	0.23	1.27	0.42	0.01	34.46	72.52	0.24	1.26	0.42	0.01
34.53	74.58	0.24	1.23	0.41	0.01	34.58	76.20	0.25	1.21	0.41	0.01
34.70	77.95	0.25	1.18	0.41	0.02	34.75	78.90	0.26	1.17	0.41	0.01
34.83	77.71	0.25	1.18	0.41	0.01	34.88	74.72	0.24	1.21	0.41	0.01
35.00	72.21	0.23	1.24	0.41	0.02	35.05	58.77	0.20	1.47	0.41	0.01
35.11	71.15	0.23	1.25	0.40	0.01	35.19	71.56	0.23	1.24	0.40	0.01
35.24	71.67	0.23	1.24	0.40	0.01	35.31	71.20	0.23	1.24	0.40	0.01
35.37	71.11	0.23	1.24	0.40	0.01	35.44	71.54	0.23	1.23	0.40	0.01
35.50	72.58	0.23	1.21	0.40	0.01	35.54	73.76	0.24	1.19	0.40	0.01
35.58	75.17	0.24	1.17	0.40	0.01	35.64	76.30	0.24	1.16	0.40	0.01
35.73	76.96	0.25	1.14	0.39	0.01	35.78	77.11	0.25	1.14	0.39	0.01
35.84	76.54	0.25	1.14	0.39	0.01	35.93	74.98	0.24	1.16	0.39	0.01
35.98	72.60	0.23	1.19	0.39	0.01	36.03	70.21	0.23	1.22	0.39	0.01
36.11	68.54	0.22	1.24	0.39	0.01	36.16	67.91	0.22	1.24	0.39	0.01
36.25	68.22	0.22	1.23	0.39	0.01	36.29	70.28	0.23	1.20	0.38	0.01
36.39	72.67	0.23	1.16	0.38	0.01	36.44	75.28	0.24	1.13	0.38	0.01
36.53	76.75	0.24	1.11	0.38	0.01	36.57	77.75	0.25	1.09	0.38	0.00
36.63	77.81	0.25	1.09	0.38	0.01	36.72	77.91	0.25	1.08	0.38	0.01
36.76	78.30	0.25	1.08	0.38	0.00	36.82	80.60	0.26	1.05	0.38	0.01
36.91	82.58	0.26	1.02	0.37	0.01	36.95	84.40	0.27	1.00	0.37	0.00
37.04	84.52	0.27	1.00	0.37	0.01	37.09	86.25	0.28	0.98	0.37	0.01
37.23	88.55	0.29	0.95	0.37	0.02	37.27	91.13	0.30	0.93	0.37	0.00
37.28	97.23	0.33	0.88	0.37	0.00	37.37	104.72	0.37	0.83	0.37	0.01
37.41	113.71	0.43	0.77	0.37	0.00	37.50	116.58	0.45	0.75	0.36	0.01
37.58	117.74	0.46	0.74	0.36	0.01	37.63	118.15	0.46	0.74	0.36	0.00
37.70	118.64	0.47	0.73	0.36	0.01	37.76	119.43	0.47	0.73	0.36	0.01
37.86	120.29	0.48	0.72	0.36	0.01	37.94	121.06	0.49	0.71	0.36	0.01
37.98	121.56	0.49	0.71	0.36	0.00	38.05	121.59	0.49	0.71	0.36	0.01
38.12	121.80	0.49	0.70	0.35	0.01	38.17	122.16	0.50	0.70	0.35	0.00
38.25	122.99	0.50	0.69	0.35	0.01	38.29	124.27	0.51	0.69	0.35	0.00
38.34	126.36	0.53	0.68	0.35	0.00	38.41	129.00	0.55	0.66	0.35	0.01
38.47	131.91	0.58	0.65	0.35	0.00	38.53	135.13	0.61	0.63	0.35	0.00
38.60	138.95	0.65	0.53	0.35	0.00	38.72	142.17	0.69	0.51	0.34	0.01
38.78	144.17	0.71	0.50	0.34	0.00	38.82	143.91	0.71	0.50	0.34	0.00
38.89	142.43	0.69	0.51	0.34	0.00	38.96	139.51	0.66	0.52	0.34	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.08	136.55	0.63	0.61	0.34	0.01	39.14	134.00	0.60	0.62	0.34	0.00
39.19	132.75	0.59	0.62	0.34	0.00	39.27	132.13	0.58	0.62	0.33	0.01
39.31	130.66	0.57	0.63	0.33	0.00	39.37	129.75	0.56	0.63	0.33	0.00
39.44	129.38	0.56	0.63	0.33	0.01	39.50	130.78	0.57	0.62	0.33	0.00
39.57	131.21	0.57	0.62	0.33	0.01	39.62	128.15	0.54	0.63	0.33	0.00
39.67	124.09	0.51	0.64	0.33	0.00	39.73	120.40	0.48	0.66	0.33	0.01
39.78	118.37	0.46	0.66	0.33	0.00	39.87	116.51	0.45	0.67	0.32	0.01
39.91	114.09	0.43	0.68	0.32	0.00	39.99	112.22	0.42	0.68	0.32	0.01
40.04	110.33	0.40	0.69	0.32	0.00	40.12	109.33	0.40	0.69	0.32	0.01
40.17	108.57	0.39	0.70	0.32	0.00	40.26	108.26	0.39	0.70	0.32	0.01
40.31	108.99	0.40	0.69	0.32	0.00	40.43	109.77	0.40	0.68	0.31	0.01
40.47	110.49	0.41	0.68	0.31	0.00	40.53	110.40	0.40	0.67	0.31	0.01
40.58	110.34	0.40	0.67	0.31	0.00	40.66	110.09	0.40	0.67	0.31	0.01
40.71	109.70	0.40	0.67	0.31	0.00	40.84	109.30	0.40	0.67	0.31	0.01
40.88	109.56	0.40	0.67	0.31	0.00	40.95	111.00	0.41	0.66	0.31	0.01
41.02	113.57	0.43	0.64	0.30	0.01	41.06	117.03	0.45	0.62	0.30	0.00
41.14	121.92	0.49	0.60	0.30	0.01	41.20	129.15	0.55	0.57	0.30	0.00
41.25	138.90	0.65	0.54	0.30	0.00	41.31	148.96	0.76	0.34	0.30	0.00
41.37	155.93	0.85	0.24	0.30	0.00	41.43	157.92	0.88	0.24	0.30	0.00
41.47	155.69	0.85	0.32	0.30	0.00	41.55	150.58	0.78	0.33	0.30	0.00
41.64	145.97	0.73	0.42	0.29	0.00	41.68	141.27	0.67	0.44	0.29	0.00
41.77	137.83	0.64	0.52	0.29	0.01	41.81	133.36	0.59	0.54	0.29	0.00
41.90	129.14	2.00	0.00	0.29	0.00	41.95	123.59	2.00	0.00	0.29	0.00
42.04	119.01	2.00	0.00	0.29	0.00	42.09	114.30	2.00	0.00	0.29	0.00
42.13	109.03	2.00	0.00	0.29	0.00	42.23	105.61	2.00	0.00	0.28	0.00
42.29	105.28	2.00	0.00	0.28	0.00	42.33	106.69	2.00	0.00	0.28	0.00
42.43	105.52	2.00	0.00	0.28	0.00	42.48	97.09	2.00	0.00	0.28	0.00
42.54	87.65	2.00	0.00	0.28	0.00	42.60	80.61	2.00	0.00	0.28	0.00
42.66	80.80	2.00	0.00	0.28	0.00	42.75	81.34	2.00	0.00	0.28	0.00
42.82	81.85	2.00	0.00	0.27	0.00	42.86	81.02	2.00	0.00	0.27	0.00
42.93	77.46	2.00	0.00	0.27	0.00	42.99	70.10	2.00	0.00	0.27	0.00
43.06	62.54	2.00	0.00	0.27	0.00	43.13	59.82	2.00	0.00	0.27	0.00
43.21	61.55	2.00	0.00	0.27	0.00	43.25	64.15	2.00	0.00	0.27	0.00
43.31	65.46	0.21	0.88	0.27	0.01	43.39	66.23	0.21	0.87	0.26	0.01
43.47	66.35	0.21	0.86	0.26	0.01	43.56	66.47	0.21	0.85	0.26	0.01
43.59	67.14	0.21	0.85	0.26	0.00	43.66	68.64	0.22	0.83	0.26	0.01
43.74	70.10	0.22	0.81	0.26	0.01	43.78	70.77	0.22	0.80	0.26	0.00
43.87	70.36	0.22	0.80	0.26	0.01	43.92	69.48	0.22	0.81	0.26	0.00
44.00	68.93	0.22	0.81	0.25	0.01	44.07	68.90	0.22	0.80	0.25	0.01
44.12	69.68	0.22	0.79	0.25	0.00	44.19	70.12	0.22	0.78	0.25	0.01
44.23	69.67	0.22	0.79	0.25	0.00	44.33	69.75	0.22	0.78	0.25	0.01
44.37	70.06	0.22	0.78	0.25	0.00	44.43	72.53	0.23	0.75	0.25	0.00
44.52	75.52	0.24	0.72	0.25	0.01	44.56	83.15	0.26	0.67	0.24	0.00
44.68	92.89	0.30	0.60	0.24	0.01	44.75	105.27	0.37	0.54	0.24	0.00
44.79	115.69	0.44	0.50	0.24	0.00	44.85	127.23	0.53	0.46	0.24	0.00
44.93	136.52	0.62	0.43	0.24	0.00	44.98	143.92	0.70	0.35	0.24	0.00
45.04	149.57	0.77	0.27	0.24	0.00	45.11	157.99	0.88	0.19	0.24	0.00
45.16	171.12	1.08	0.09	0.23	0.00	45.24	183.42	1.29	0.04	0.23	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
45.28	194.00	1.50	0.00	0.23	0.00	45.35	187.49	1.37	0.00	0.23	0.00
45.42	193.15	1.48	0.00	0.23	0.00	45.52	197.08	1.56	0.00	0.23	0.00
45.56	215.60	2.00	0.00	0.23	0.00	45.67	219.45	2.00	0.00	0.23	0.00
45.73	223.81	2.00	0.00	0.22	0.00	45.78	225.99	2.00	0.00	0.22	0.00
45.87	225.36	2.00	0.00	0.22	0.00	45.91	224.86	2.00	0.00	0.22	0.00
45.95	224.61	2.00	0.00	0.22	0.00	46.00	226.15	2.00	0.00	0.22	0.00
46.09	226.89	2.00	0.00	0.22	0.00	46.13	226.95	2.00	0.00	0.22	0.00
46.22	226.52	2.00	0.00	0.22	0.00	46.26	225.27	2.00	0.00	0.22	0.00
46.35	223.52	2.00	0.00	0.21	0.00	46.40	220.09	2.00	0.00	0.21	0.00
46.49	216.46	2.00	0.00	0.21	0.00	46.53	210.66	2.00	0.00	0.21	0.00
46.61	203.58	2.00	0.00	0.21	0.00	46.67	194.55	1.51	0.00	0.21	0.00
46.75	187.32	1.37	0.00	0.21	0.00	46.79	182.68	1.28	0.04	0.21	0.00
46.85	181.87	1.26	0.04	0.21	0.00	46.93	183.77	1.30	0.04	0.20	0.00
47.01	187.16	1.36	0.00	0.20	0.00	47.08	189.95	1.42	0.00	0.20	0.00
47.15	191.14	1.44	0.00	0.20	0.00	47.19	190.87	1.44	0.00	0.20	0.00
47.27	190.13	1.42	0.00	0.20	0.00	47.31	186.87	1.36	0.00	0.20	0.00
47.41	183.96	1.31	0.04	0.20	0.00	47.46	183.00	1.29	0.04	0.20	0.00
47.56	186.75	1.36	0.00	0.19	0.00	47.62	189.03	1.40	0.00	0.19	0.00
47.65	192.91	1.48	0.00	0.19	0.00	47.72	198.17	1.59	0.00	0.19	0.00
47.80	206.71	2.00	0.00	0.19	0.00	47.85	213.50	2.00	0.00	0.19	0.00
47.92	217.86	2.00	0.00	0.19	0.00	47.99	221.88	2.00	0.00	0.19	0.00
48.07	226.04	2.00	0.00	0.19	0.00	48.13	231.02	2.00	0.00	0.18	0.00
48.20	236.10	2.00	0.00	0.18	0.00	48.26	240.66	2.00	0.00	0.18	0.00
48.34	243.64	2.00	0.00	0.18	0.00	48.36	245.59	2.00	0.00	0.18	0.00
48.43	246.12	2.00	0.00	0.18	0.00	48.51	245.45	2.00	0.00	0.18	0.00
48.56	242.94	2.00	0.00	0.18	0.00	48.65	239.72	2.00	0.00	0.18	0.00
48.70	236.48	2.00	0.00	0.17	0.00	48.76	232.95	2.00	0.00	0.17	0.00
48.84	229.11	2.00	0.00	0.17	0.00	48.93	226.07	2.00	0.00	0.17	0.00
48.96	225.45	2.00	0.00	0.17	0.00	49.05	225.98	2.00	0.00	0.17	0.00
49.09	227.27	2.00	0.00	0.17	0.00	49.15	229.59	2.00	0.00	0.17	0.00
49.22	231.64	2.00	0.00	0.17	0.00	49.31	232.92	2.00	0.00	0.16	0.00
49.35	234.66	2.00	0.00	0.16	0.00	49.44	235.83	2.00	0.00	0.16	0.00
49.49	236.89	2.00	0.00	0.16	0.00	49.57	236.91	2.00	0.00	0.16	0.00
49.62	235.51	2.00	0.00	0.16	0.00	49.71	233.52	2.00	0.00	0.16	0.00
49.76	229.86	2.00	0.00	0.16	0.00	49.84	225.19	2.00	0.00	0.16	0.00
49.89	218.82	2.00	0.00	0.15	0.00	49.99	213.52	2.00	0.00	0.15	0.00
50.04	210.25	2.00	0.00	0.15	0.00						

Total estimated settlement: 2.34

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

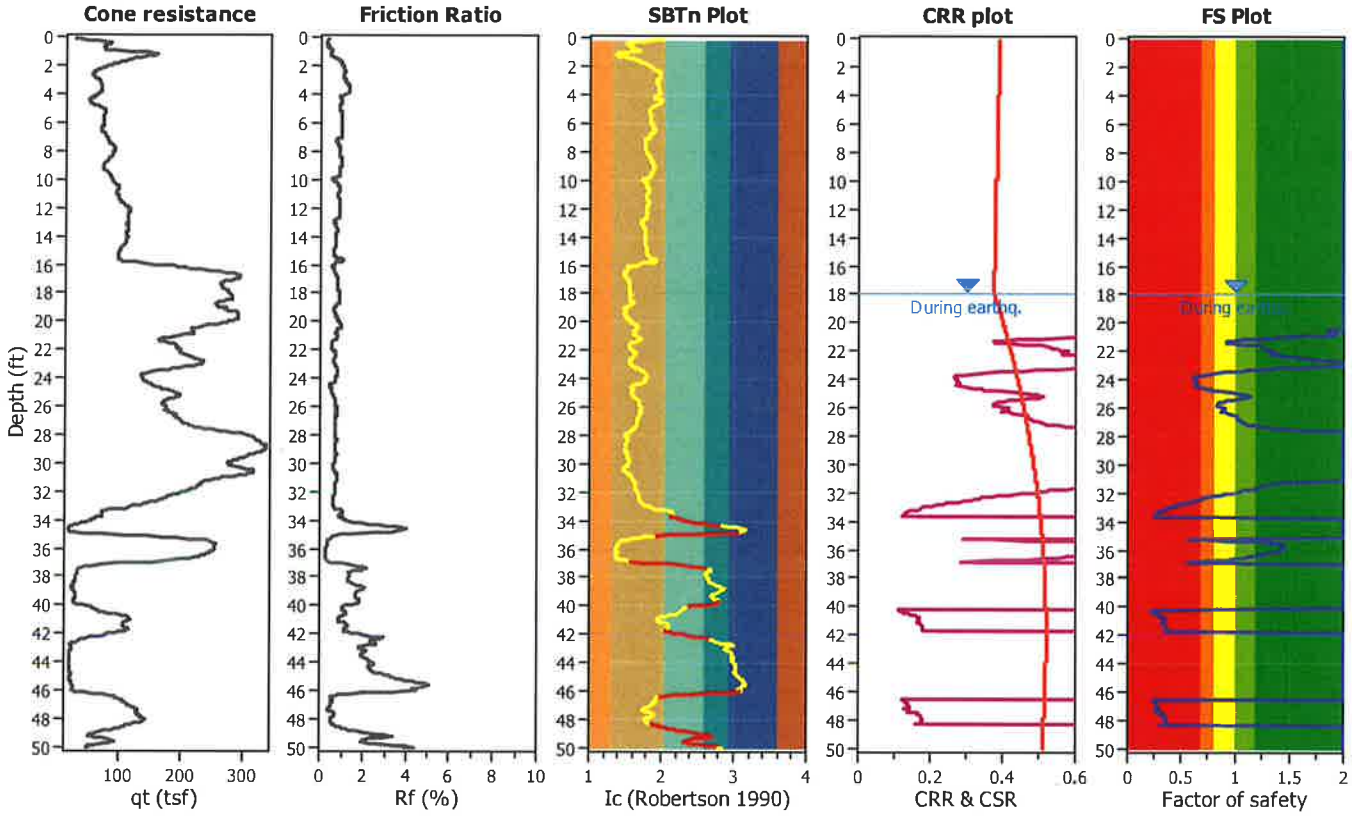
LIQUEFACTION ANALYSIS REPORT

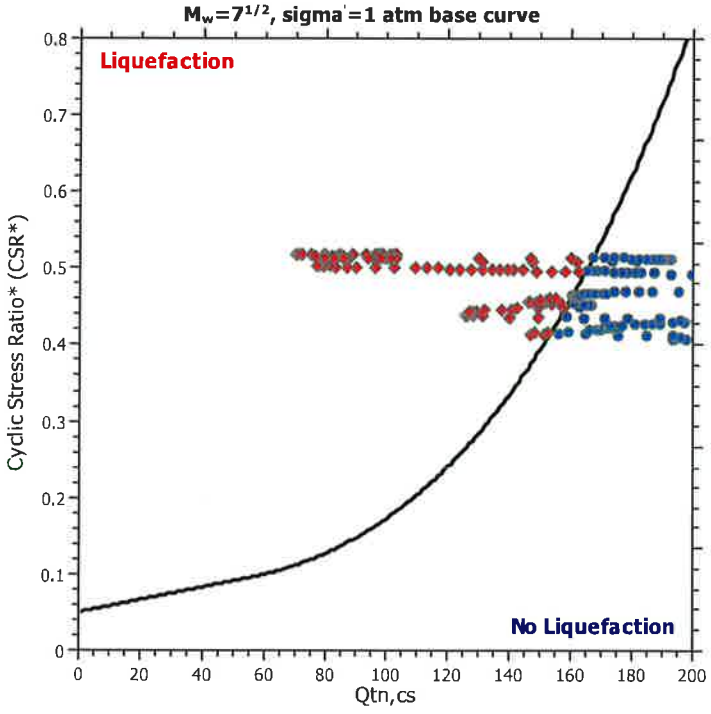
Project title : S-Line Upgrades **Location : Imperial County, CA**

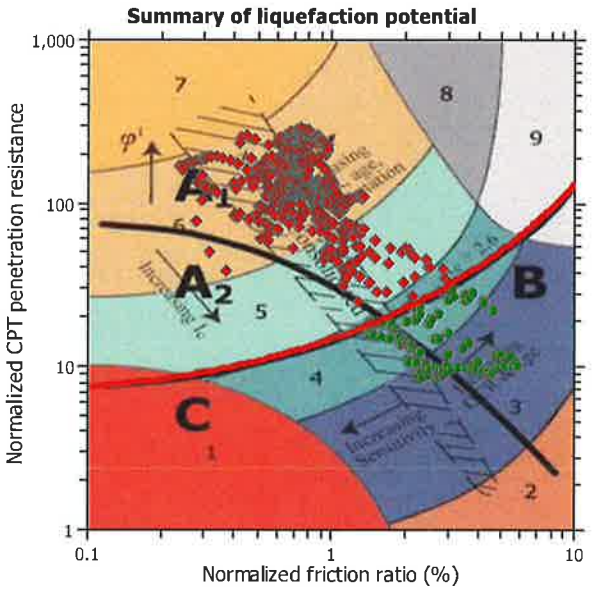
CPT file : CPT-15

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	18.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	18.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

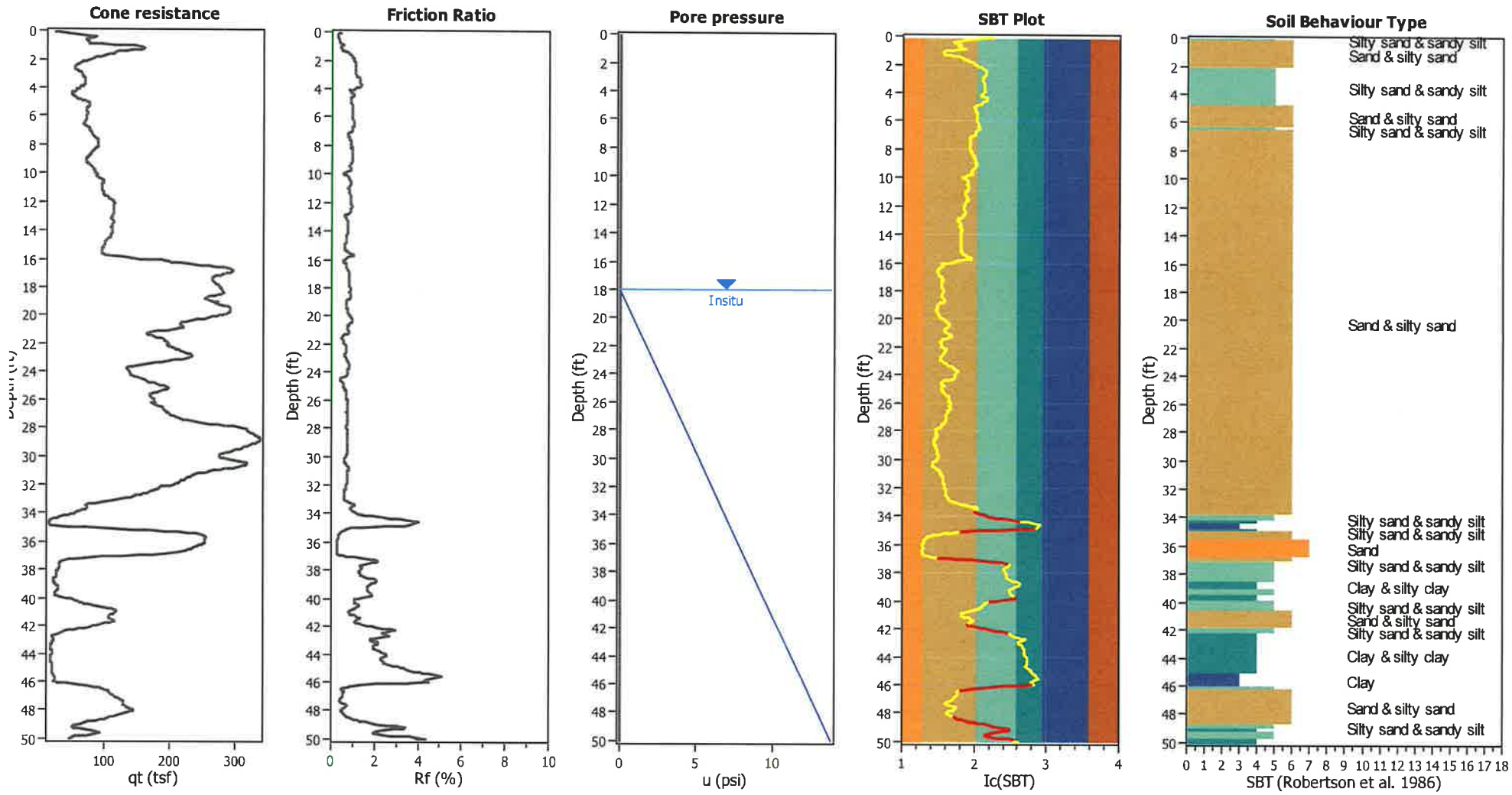






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



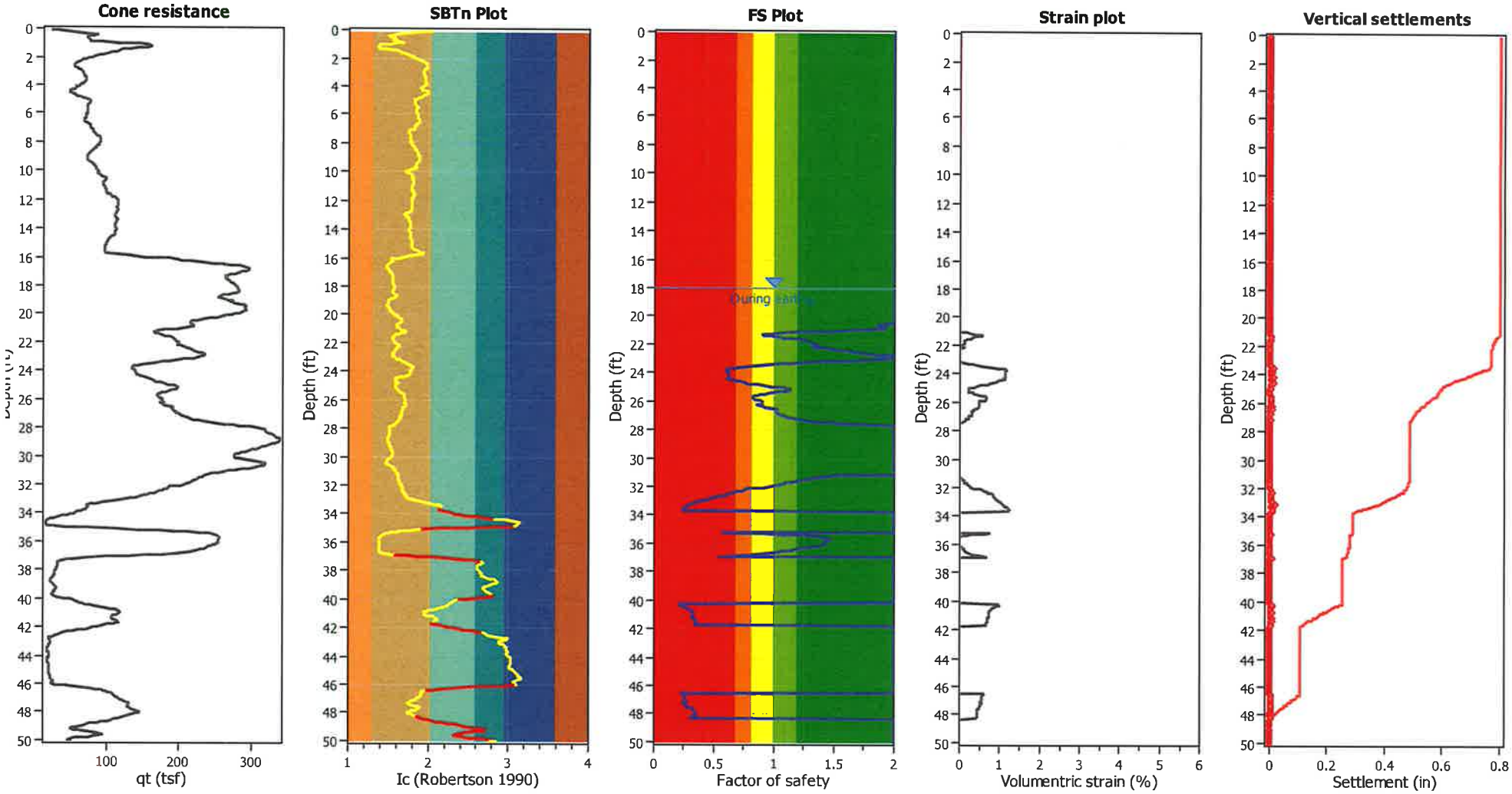
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	18.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
18.03	259.80	2.00	0.00	0.69	0.00	18.08	260.75	2.00	0.00	0.69	0.00
18.25	261.19	2.00	0.00	0.69	0.00	18.30	261.86	2.00	0.00	0.69	0.00
18.36	261.95	2.00	0.00	0.69	0.00	18.43	261.03	2.00	0.00	0.69	0.00
18.47	258.26	2.00	0.00	0.69	0.00	18.52	253.54	2.00	0.00	0.69	0.00
18.58	247.73	2.00	0.00	0.69	0.00	18.63	241.11	2.00	0.00	0.68	0.00
18.74	236.29	2.00	0.00	0.68	0.00	18.80	233.42	2.00	0.00	0.68	0.00
18.86	235.81	2.00	0.00	0.68	0.00	18.96	240.04	2.00	0.00	0.68	0.00
19.03	246.17	2.00	0.00	0.68	0.00	19.08	251.08	2.00	0.00	0.68	0.00
19.13	247.30	2.00	0.00	0.68	0.00	19.17	249.85	2.00	0.00	0.68	0.00
19.25	252.62	2.00	0.00	0.67	0.00	19.32	262.62	2.00	0.00	0.67	0.00
19.36	265.26	2.00	0.00	0.67	0.00	19.45	265.83	2.00	0.00	0.67	0.00
19.49	266.31	2.00	0.00	0.67	0.00	19.59	265.10	2.00	0.00	0.67	0.00
19.63	265.33	2.00	0.00	0.67	0.00	19.71	265.10	2.00	0.00	0.67	0.00
19.76	264.67	2.00	0.00	0.67	0.00	19.84	260.46	2.00	0.00	0.66	0.00
19.95	255.08	2.00	0.00	0.66	0.00	20.00	250.07	2.00	0.00	0.66	0.00
20.04	245.50	2.00	0.00	0.66	0.00	20.11	240.57	2.00	0.00	0.66	0.00
20.16	233.41	2.00	0.00	0.66	0.00	20.24	226.39	2.00	0.00	0.66	0.00
20.29	218.60	2.00	0.00	0.66	0.00	20.35	211.74	2.00	0.00	0.66	0.00
20.43	203.91	2.00	0.00	0.65	0.00	20.51	197.94	1.97	0.00	0.65	0.00
20.55	193.79	1.86	0.00	0.65	0.00	20.64	194.05	1.86	0.00	0.65	0.00
20.68	195.10	1.89	0.00	0.65	0.00	20.75	196.48	1.92	0.00	0.65	0.00
20.85	196.31	1.91	0.00	0.65	0.00	20.91	193.93	1.85	0.00	0.65	0.00
20.96	185.17	1.63	0.00	0.64	0.00	21.08	175.37	1.41	0.00	0.64	0.00
21.13	164.97	1.21	0.18	0.64	0.00	21.20	156.35	1.05	0.26	0.64	0.00
21.26	151.15	0.97	0.38	0.64	0.00	21.31	146.90	0.90	0.57	0.64	0.00
21.38	147.91	0.92	0.56	0.64	0.00	21.44	152.20	0.98	0.38	0.64	0.00
21.56	159.57	1.10	0.26	0.63	0.00	21.62	165.99	1.21	0.18	0.63	0.00
21.67	168.58	1.26	0.13	0.63	0.00	21.79	169.85	1.28	0.13	0.63	0.00
21.85	171.03	1.30	0.12	0.63	0.00	21.91	172.36	1.32	0.12	0.63	0.00
21.97	173.73	1.35	0.12	0.63	0.00	22.02	174.81	1.37	0.00	0.63	0.00
22.09	174.08	1.35	0.00	0.63	0.00	22.15	172.91	1.33	0.12	0.62	0.00
22.22	173.11	1.33	0.12	0.62	0.00	22.27	176.63	1.40	0.00	0.62	0.00
22.35	180.94	1.48	0.00	0.62	0.00	22.41	184.29	1.56	0.00	0.62	0.00
22.46	186.98	1.61	0.00	0.62	0.00	22.55	189.64	1.67	0.00	0.62	0.00
22.60	193.96	1.77	0.00	0.62	0.00	22.70	197.80	1.87	0.00	0.62	0.00
22.76	201.67	2.00	0.00	0.61	0.00	22.80	203.72	2.00	0.00	0.61	0.00
22.84	204.47	2.00	0.00	0.61	0.00	22.94	203.61	2.00	0.00	0.61	0.00
22.99	201.55	2.00	0.00	0.61	0.00	23.03	196.46	1.82	0.00	0.61	0.00
23.12	189.55	1.65	0.00	0.61	0.00	23.18	178.77	1.41	0.00	0.61	0.00
23.30	171.01	1.26	0.12	0.61	0.00	23.31	164.07	1.13	0.24	0.60	0.00
23.38	158.99	1.04	0.35	0.60	0.00	23.43	149.40	0.90	0.52	0.60	0.00
23.61	140.04	0.77	0.75	0.60	0.02	23.65	131.40	0.67	1.00	0.60	0.01
23.70	128.23	0.63	1.14	0.60	0.01	23.76	126.37	0.61	1.15	0.60	0.01
23.80	125.73	0.60	1.16	0.60	0.01	23.87	125.99	0.61	1.15	0.60	0.01
23.92	126.61	0.61	1.14	0.59	0.01	23.96	127.34	0.62	1.14	0.59	0.01
24.05	127.71	0.62	1.13	0.59	0.01	24.10	127.91	0.62	1.13	0.59	0.01
24.20	127.94	0.62	1.13	0.59	0.01	24.25	128.35	0.62	1.12	0.59	0.01
24.32	129.08	0.63	1.11	0.59	0.01	24.37	127.56	0.61	1.12	0.59	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
24.43	127.09	0.61	1.12	0.59	0.01	24.49	132.00	0.66	0.97	0.58	0.01
24.62	137.54	0.72	0.91	0.58	0.01	24.67	141.07	0.76	0.72	0.58	0.00
24.72	140.85	0.76	0.72	0.58	0.00	24.78	142.47	0.78	0.70	0.58	0.00
24.82	149.13	0.87	0.50	0.58	0.00	24.95	157.39	0.99	0.33	0.58	0.01
25.00	162.92	1.07	0.23	0.58	0.00	25.06	164.89	1.10	0.23	0.58	0.00
25.13	166.19	1.13	0.23	0.57	0.00	25.18	166.88	1.14	0.23	0.57	0.00
25.24	166.55	1.13	0.23	0.57	0.00	25.31	164.66	1.10	0.23	0.57	0.00
25.36	161.09	1.04	0.32	0.57	0.00	25.40	156.69	0.97	0.33	0.57	0.00
25.49	153.66	0.92	0.47	0.57	0.00	25.53	150.90	0.88	0.48	0.57	0.00
25.59	148.73	0.85	0.64	0.57	0.00	25.66	147.18	0.83	0.65	0.57	0.01
25.76	146.52	0.82	0.66	0.56	0.01	25.82	147.12	0.82	0.65	0.56	0.01
25.88	148.55	0.84	0.64	0.56	0.00	25.93	151.58	0.88	0.47	0.56	0.00
25.99	152.90	0.90	0.47	0.56	0.00	26.06	153.05	0.90	0.47	0.56	0.00
26.20	151.99	0.89	0.47	0.56	0.01	26.24	152.85	0.90	0.46	0.56	0.00
26.28	149.92	0.86	0.48	0.55	0.00	26.32	153.15	0.90	0.46	0.55	0.00
26.46	155.23	0.93	0.45	0.55	0.01	26.52	161.36	1.02	0.31	0.55	0.00
26.59	161.29	1.02	0.31	0.55	0.00	26.64	160.84	1.01	0.31	0.55	0.00
26.69	160.97	1.01	0.31	0.55	0.00	26.77	160.96	1.01	0.31	0.55	0.00
26.82	161.72	1.02	0.31	0.55	0.00	26.86	162.54	1.03	0.31	0.54	0.00
26.93	163.40	1.05	0.30	0.54	0.00	26.99	164.44	1.06	0.22	0.54	0.00
27.04	166.37	1.09	0.21	0.54	0.00	27.16	168.20	1.12	0.21	0.54	0.00
27.21	170.34	1.16	0.15	0.54	0.00	27.26	172.09	1.19	0.15	0.54	0.00
27.32	174.27	1.22	0.15	0.54	0.00	27.38	178.19	1.29	0.10	0.54	0.00
27.43	182.47	1.38	0.00	0.54	0.00	27.50	187.18	1.47	0.00	0.53	0.00
27.57	195.44	1.65	0.00	0.53	0.00	27.66	205.07	2.00	0.00	0.53	0.00
27.74	216.12	2.00	0.00	0.53	0.00	27.79	225.04	2.00	0.00	0.53	0.00
27.85	233.61	2.00	0.00	0.53	0.00	27.92	243.80	2.00	0.00	0.53	0.00
28.03	252.36	2.00	0.00	0.52	0.00	28.09	258.39	2.00	0.00	0.52	0.00
28.14	259.72	2.00	0.00	0.52	0.00	28.19	259.72	2.00	0.00	0.52	0.00
28.24	260.39	2.00	0.00	0.52	0.00	28.28	261.88	2.00	0.00	0.52	0.00
28.36	264.34	2.00	0.00	0.52	0.00	28.43	266.73	2.00	0.00	0.52	0.00
28.48	268.75	2.00	0.00	0.52	0.00	28.61	269.66	2.00	0.00	0.52	0.00
28.65	270.97	2.00	0.00	0.51	0.00	28.70	272.41	2.00	0.00	0.51	0.00
28.74	274.04	2.00	0.00	0.51	0.00	28.81	274.64	2.00	0.00	0.51	0.00
28.90	273.67	2.00	0.00	0.51	0.00	28.99	272.09	2.00	0.00	0.51	0.00
29.05	270.13	2.00	0.00	0.51	0.00	29.12	267.99	2.00	0.00	0.51	0.00
29.17	264.59	2.00	0.00	0.51	0.00	29.25	260.23	2.00	0.00	0.50	0.00
29.30	256.30	2.00	0.00	0.50	0.00	29.35	253.65	2.00	0.00	0.50	0.00
29.41	250.34	2.00	0.00	0.50	0.00	29.52	246.32	2.00	0.00	0.50	0.00
29.58	241.38	2.00	0.00	0.50	0.00	29.65	237.42	2.00	0.00	0.50	0.00
29.70	233.45	2.00	0.00	0.50	0.00	29.75	229.44	2.00	0.00	0.50	0.00
29.83	225.22	2.00	0.00	0.49	0.00	29.88	222.33	2.00	0.00	0.49	0.00
29.93	220.81	2.00	0.00	0.49	0.00	30.05	220.39	2.00	0.00	0.49	0.00
30.13	221.43	2.00	0.00	0.49	0.00	30.19	224.99	2.00	0.00	0.49	0.00
30.23	234.43	2.00	0.00	0.49	0.00	30.36	243.73	2.00	0.00	0.49	0.00
30.41	251.09	2.00	0.00	0.48	0.00	30.49	252.60	2.00	0.00	0.48	0.00
30.54	252.79	2.00	0.00	0.48	0.00	30.59	252.21	2.00	0.00	0.48	0.00
30.66	250.66	2.00	0.00	0.48	0.00	30.71	247.29	2.00	0.00	0.48	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
30.77	241.80	2.00	0.00	0.48	0.00	30.84	234.14	2.00	0.00	0.48	0.00
30.89	225.75	2.00	0.00	0.48	0.00	30.96	217.95	2.00	0.00	0.48	0.00
31.02	211.50	2.00	0.00	0.47	0.00	31.07	206.18	2.00	0.00	0.47	0.00
31.13	200.14	2.00	0.00	0.47	0.00	31.19	193.24	1.53	0.00	0.47	0.00
31.26	187.51	1.41	0.00	0.47	0.00	31.35	183.27	1.32	0.09	0.47	0.00
31.47	181.07	1.28	0.09	0.47	0.00	31.53	178.93	1.24	0.13	0.47	0.00
31.58	176.64	1.20	0.13	0.46	0.00	31.70	174.07	1.15	0.13	0.46	0.00
31.75	171.40	1.11	0.18	0.46	0.00	31.83	168.96	1.07	0.18	0.46	0.00
31.88	167.35	1.04	0.25	0.46	0.00	31.92	165.41	1.01	0.25	0.46	0.00
31.98	162.35	0.96	0.26	0.46	0.00	32.06	158.25	0.90	0.36	0.46	0.00
32.10	153.71	0.84	0.49	0.46	0.00	32.16	148.68	0.78	0.52	0.45	0.00
32.28	144.59	0.73	0.66	0.45	0.01	32.35	141.37	0.69	0.68	0.45	0.00
32.41	139.47	0.67	0.69	0.45	0.01	32.46	137.11	0.64	0.81	0.45	0.01
32.53	134.23	0.61	0.82	0.45	0.01	32.59	130.97	0.58	0.84	0.45	0.01
32.64	127.50	0.55	0.86	0.45	0.01	32.71	124.02	0.52	0.87	0.45	0.01
32.77	120.57	0.49	0.89	0.44	0.01	32.82	117.03	0.46	0.91	0.44	0.01
32.90	113.32	0.43	0.93	0.44	0.01	32.94	109.32	0.40	0.96	0.44	0.01
33.01	102.62	0.36	1.01	0.44	0.01	33.18	95.96	0.32	1.06	0.44	0.02
33.23	90.07	0.30	1.11	0.44	0.01	33.30	86.68	0.28	1.14	0.44	0.01
33.34	83.40	0.27	1.18	0.43	0.01	33.41	81.15	0.26	1.20	0.43	0.01
33.47	79.38	0.25	1.22	0.43	0.01	33.54	78.67	0.25	1.23	0.43	0.01
33.59	77.54	0.25	1.24	0.43	0.01	33.66	76.73	0.24	1.25	0.43	0.01
33.73	75.68	2.00	0.00	0.43	0.00	33.78	74.77	2.00	0.00	0.43	0.00
33.83	74.13	2.00	0.00	0.43	0.00	33.90	73.80	2.00	0.00	0.43	0.00
33.96	73.80	2.00	0.00	0.42	0.00	34.02	73.84	2.00	0.00	0.42	0.00
34.09	74.11	2.00	0.00	0.42	0.00	34.14	76.01	2.00	0.00	0.42	0.00
34.19	78.65	2.00	0.00	0.42	0.00	34.27	80.70	2.00	0.00	0.42	0.00
34.34	80.42	2.00	0.00	0.42	0.00	34.39	79.04	2.00	0.00	0.42	0.00
34.49	77.72	2.00	0.00	0.42	0.00	34.54	76.22	2.00	0.00	0.41	0.00
34.61	75.15	2.00	0.00	0.41	0.00	34.72	74.63	2.00	0.00	0.41	0.00
34.77	74.48	2.00	0.00	0.41	0.00	34.85	74.37	2.00	0.00	0.41	0.00
34.90	74.29	2.00	0.00	0.41	0.00	34.98	72.50	2.00	0.00	0.41	0.00
35.02	78.83	2.00	0.00	0.41	0.00	35.10	96.90	2.00	0.00	0.41	0.00
35.16	116.48	2.00	0.00	0.40	0.00	35.21	131.21	0.57	0.75	0.40	0.00
35.29	147.23	0.74	0.57	0.40	0.01	35.34	161.83	0.93	0.31	0.40	0.00
35.39	173.72	1.11	0.15	0.40	0.00	35.45	182.12	1.26	0.08	0.40	0.00
35.51	188.29	1.37	0.00	0.40	0.00	35.60	191.70	1.44	0.00	0.40	0.00
35.68	193.13	1.47	0.00	0.40	0.00	35.73	192.36	1.45	0.00	0.39	0.00
35.86	191.11	1.43	0.00	0.39	0.00	35.91	190.60	1.42	0.00	0.39	0.00
35.96	190.65	1.42	0.00	0.39	0.00	36.02	190.79	1.42	0.00	0.39	0.00
36.08	190.30	1.41	0.00	0.39	0.00	36.13	189.05	1.38	0.00	0.39	0.00
36.18	187.16	1.35	0.07	0.39	0.00	36.26	184.69	1.30	0.07	0.39	0.00
36.31	182.28	1.26	0.07	0.38	0.00	36.37	179.79	1.21	0.10	0.38	0.00
36.42	177.45	1.17	0.10	0.38	0.00	36.48	174.50	1.12	0.15	0.38	0.00
36.57	171.28	1.07	0.15	0.38	0.00	36.63	167.39	1.01	0.21	0.38	0.00
36.70	159.94	0.90	0.30	0.38	0.00	36.80	146.71	0.73	0.54	0.38	0.01
36.90	129.85	0.55	0.71	0.37	0.01	36.96	116.36	2.00	0.00	0.37	0.00
37.02	104.67	2.00	0.00	0.37	0.00	37.06	93.01	2.00	0.00	0.37	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
37.17	87.49	2.00	0.00	0.37	0.00	37.24	86.00	2.00	0.00	0.37	0.00
37.28	83.98	2.00	0.00	0.37	0.00	37.34	82.01	2.00	0.00	0.37	0.00
37.40	79.20	2.00	0.00	0.37	0.00	37.46	75.76	2.00	0.00	0.37	0.00
37.50	71.47	2.00	0.00	0.36	0.00	37.55	66.57	2.00	0.00	0.36	0.00
37.64	63.00	2.00	0.00	0.36	0.00	37.70	61.61	2.00	0.00	0.36	0.00
37.76	62.11	2.00	0.00	0.36	0.00	37.82	62.41	2.00	0.00	0.36	0.00
37.86	61.84	2.00	0.00	0.36	0.00	37.96	60.62	2.00	0.00	0.36	0.00
38.03	59.18	2.00	0.00	0.36	0.00	38.08	57.97	2.00	0.00	0.35	0.00
38.15	57.90	2.00	0.00	0.35	0.00	38.21	57.71	2.00	0.00	0.35	0.00
38.26	58.28	2.00	0.00	0.35	0.00	38.34	58.55	2.00	0.00	0.35	0.00
38.39	59.80	2.00	0.00	0.35	0.00	38.50	61.28	2.00	0.00	0.35	0.00
38.57	62.86	2.00	0.00	0.35	0.00	38.62	64.26	2.00	0.00	0.35	0.00
38.68	64.97	2.00	0.00	0.34	0.00	38.75	65.19	2.00	0.00	0.34	0.00
38.80	64.93	2.00	0.00	0.34	0.00	38.85	64.60	2.00	0.00	0.34	0.00
38.92	64.15	2.00	0.00	0.34	0.00	39.03	63.99	2.00	0.00	0.34	0.00
39.10	64.26	2.00	0.00	0.34	0.00	39.16	65.04	2.00	0.00	0.34	0.00
39.22	65.65	2.00	0.00	0.34	0.00	39.27	65.89	2.00	0.00	0.33	0.00
39.33	65.39	2.00	0.00	0.33	0.00	39.42	64.86	2.00	0.00	0.33	0.00
39.49	64.45	2.00	0.00	0.33	0.00	39.54	64.56	2.00	0.00	0.33	0.00
39.59	64.60	2.00	0.00	0.33	0.00	39.66	64.55	2.00	0.00	0.33	0.00
39.72	64.54	2.00	0.00	0.33	0.00	39.78	64.73	2.00	0.00	0.33	0.00
39.84	65.03	2.00	0.00	0.32	0.00	39.90	64.70	2.00	0.00	0.32	0.00
40.01	64.26	2.00	0.00	0.32	0.00	40.08	65.31	2.00	0.00	0.32	0.00
40.12	68.19	2.00	0.00	0.32	0.00	40.20	69.86	0.22	1.00	0.32	0.01
40.26	70.91	0.22	0.98	0.32	0.01	40.30	71.97	0.22	0.97	0.32	0.01
40.38	75.19	0.23	0.93	0.32	0.01	40.43	79.67	0.24	0.89	0.31	0.01
40.49	84.13	0.26	0.84	0.31	0.01	40.56	88.88	0.28	0.80	0.31	0.01
40.63	93.41	0.30	0.77	0.31	0.01	40.72	97.27	0.32	0.74	0.31	0.01
40.76	98.73	0.33	0.73	0.31	0.00	40.83	98.76	0.33	0.73	0.31	0.01
40.89	98.58	0.33	0.73	0.31	0.00	40.97	98.11	0.32	0.73	0.31	0.01
41.02	97.08	0.32	0.73	0.30	0.00	41.12	96.29	0.31	0.73	0.30	0.01
41.16	96.10	0.31	0.73	0.30	0.00	41.21	98.72	0.33	0.71	0.30	0.00
41.36	100.95	0.34	0.69	0.30	0.01	41.42	102.69	0.35	0.68	0.30	0.00
41.47	102.39	0.35	0.68	0.30	0.00	41.51	102.50	0.35	0.68	0.30	0.00
41.56	102.98	0.35	0.67	0.30	0.00	41.64	102.87	0.35	0.67	0.29	0.01
41.68	101.51	0.34	0.68	0.29	0.00	41.78	99.57	2.00	0.00	0.29	0.00
41.80	98.02	2.00	0.00	0.29	0.00	41.91	98.04	2.00	0.00	0.29	0.00
41.96	99.66	2.00	0.00	0.29	0.00	42.01	101.73	2.00	0.00	0.29	0.00
42.08	104.26	2.00	0.00	0.29	0.00	42.18	106.63	2.00	0.00	0.29	0.00
42.22	107.73	2.00	0.00	0.28	0.00	42.29	104.91	2.00	0.00	0.28	0.00
42.34	96.47	2.00	0.00	0.28	0.00	42.40	86.63	2.00	0.00	0.28	0.00
42.51	78.62	2.00	0.00	0.28	0.00	42.57	75.06	2.00	0.00	0.28	0.00
42.67	71.44	2.00	0.00	0.28	0.00	42.75	67.14	2.00	0.00	0.28	0.00
42.82	63.41	2.00	0.00	0.27	0.00	42.88	60.65	2.00	0.00	0.27	0.00
42.93	59.29	2.00	0.00	0.27	0.00	43.04	59.55	2.00	0.00	0.27	0.00
43.10	60.90	2.00	0.00	0.27	0.00	43.15	62.08	2.00	0.00	0.27	0.00
43.21	61.86	2.00	0.00	0.27	0.00	43.28	60.49	2.00	0.00	0.27	0.00
43.33	58.40	2.00	0.00	0.27	0.00	43.39	57.11	2.00	0.00	0.26	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
43.46	56.46	2.00	0.00	0.26	0.00	43.51	56.40	2.00	0.00	0.26	0.00
43.59	56.49	2.00	0.00	0.26	0.00	43.64	57.56	2.00	0.00	0.26	0.00
43.72	59.32	2.00	0.00	0.26	0.00	43.77	61.39	2.00	0.00	0.26	0.00
43.87	62.81	2.00	0.00	0.26	0.00	43.91	63.82	2.00	0.00	0.26	0.00
43.98	64.52	2.00	0.00	0.25	0.00	44.06	64.56	2.00	0.00	0.25	0.00
44.12	63.74	2.00	0.00	0.25	0.00	44.19	62.35	2.00	0.00	0.25	0.00
44.23	60.91	2.00	0.00	0.25	0.00	44.31	60.46	2.00	0.00	0.25	0.00
44.38	60.30	2.00	0.00	0.25	0.00	44.43	60.92	2.00	0.00	0.25	0.00
44.49	61.22	2.00	0.00	0.25	0.00	44.57	61.97	2.00	0.00	0.24	0.00
44.67	62.85	2.00	0.00	0.24	0.00	44.70	64.48	2.00	0.00	0.24	0.00
44.76	66.73	2.00	0.00	0.24	0.00	44.83	69.29	2.00	0.00	0.24	0.00
44.89	71.33	2.00	0.00	0.24	0.00	44.98	72.32	2.00	0.00	0.24	0.00
45.02	72.78	2.00	0.00	0.24	0.00	45.11	73.13	2.00	0.00	0.24	0.00
45.15	74.40	2.00	0.00	0.23	0.00	45.25	76.03	2.00	0.00	0.23	0.00
45.29	78.81	2.00	0.00	0.23	0.00	45.38	81.20	2.00	0.00	0.23	0.00
45.42	83.98	2.00	0.00	0.23	0.00	45.51	86.35	2.00	0.00	0.23	0.00
45.56	89.08	2.00	0.00	0.23	0.00	45.61	90.89	2.00	0.00	0.23	0.00
45.74	90.93	2.00	0.00	0.22	0.00	45.80	89.57	2.00	0.00	0.22	0.00
45.86	88.21	2.00	0.00	0.22	0.00	45.90	87.46	2.00	0.00	0.22	0.00
45.95	86.77	2.00	0.00	0.22	0.00	46.04	86.09	2.00	0.00	0.22	0.00
46.08	83.88	2.00	0.00	0.22	0.00	46.13	79.52	2.00	0.00	0.22	0.00
46.22	74.57	2.00	0.00	0.22	0.00	46.27	72.28	2.00	0.00	0.22	0.00
46.39	72.87	2.00	0.00	0.21	0.00	46.44	73.26	2.00	0.00	0.21	0.00
46.49	74.08	2.00	0.00	0.21	0.00	46.52	76.05	0.23	0.62	0.21	0.00
46.61	79.41	0.25	0.59	0.21	0.01	46.67	82.14	0.26	0.57	0.21	0.00
46.74	83.13	0.26	0.57	0.21	0.00	46.84	83.71	0.26	0.56	0.21	0.01
46.91	84.34	0.26	0.55	0.20	0.00	46.97	85.43	0.27	0.54	0.20	0.00
47.02	86.48	0.27	0.53	0.20	0.00	47.09	87.37	0.28	0.53	0.20	0.00
47.15	79.64	0.25	0.57	0.20	0.00	47.20	82.73	0.26	0.55	0.20	0.00
47.32	85.35	0.27	0.53	0.20	0.01	47.37	86.79	0.27	0.52	0.20	0.00
47.45	85.89	0.27	0.52	0.20	0.00	47.50	95.42	0.31	0.47	0.19	0.00
47.56	96.86	0.32	0.46	0.19	0.00	47.63	98.12	0.33	0.46	0.19	0.00
47.68	99.37	0.33	0.45	0.19	0.00	47.74	99.85	0.34	0.45	0.19	0.00
47.81	100.08	0.34	0.44	0.19	0.00	47.85	100.36	0.34	0.44	0.19	0.00
47.94	101.49	0.35	0.43	0.19	0.00	47.99	102.74	0.35	0.43	0.19	0.00
48.03	102.93	0.35	0.42	0.19	0.00	48.11	101.01	0.34	0.43	0.18	0.00
48.21	97.98	0.33	0.43	0.18	0.01	48.28	93.98	0.31	0.45	0.18	0.00
48.40	90.83	2.00	0.00	0.18	0.00	48.45	88.50	2.00	0.00	0.18	0.00
48.52	88.12	2.00	0.00	0.18	0.00	48.57	88.26	2.00	0.00	0.18	0.00
48.64	88.04	2.00	0.00	0.18	0.00	48.69	87.93	2.00	0.00	0.17	0.00
48.75	88.44	2.00	0.00	0.17	0.00	48.82	89.59	2.00	0.00	0.17	0.00
48.98	93.13	2.00	0.00	0.17	0.00	49.04	97.56	2.00	0.00	0.17	0.00
49.09	101.74	2.00	0.00	0.17	0.00	49.16	104.88	2.00	0.00	0.17	0.00
49.22	107.57	2.00	0.00	0.17	0.00	49.28	107.91	2.00	0.00	0.16	0.00
49.35	106.53	2.00	0.00	0.16	0.00	49.40	105.44	2.00	0.00	0.16	0.00
49.49	105.02	2.00	0.00	0.16	0.00	49.57	105.22	2.00	0.00	0.16	0.00
49.62	106.45	2.00	0.00	0.16	0.00	49.69	109.08	2.00	0.00	0.16	0.00
49.78	112.19	2.00	0.00	0.16	0.00	49.83	113.95	2.00	0.00	0.16	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
49.88	113.87	2.00	0.00	0.15	0.00	49.98	113.59	2.00	0.00	0.15	0.00
50.02	113.06	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.80

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

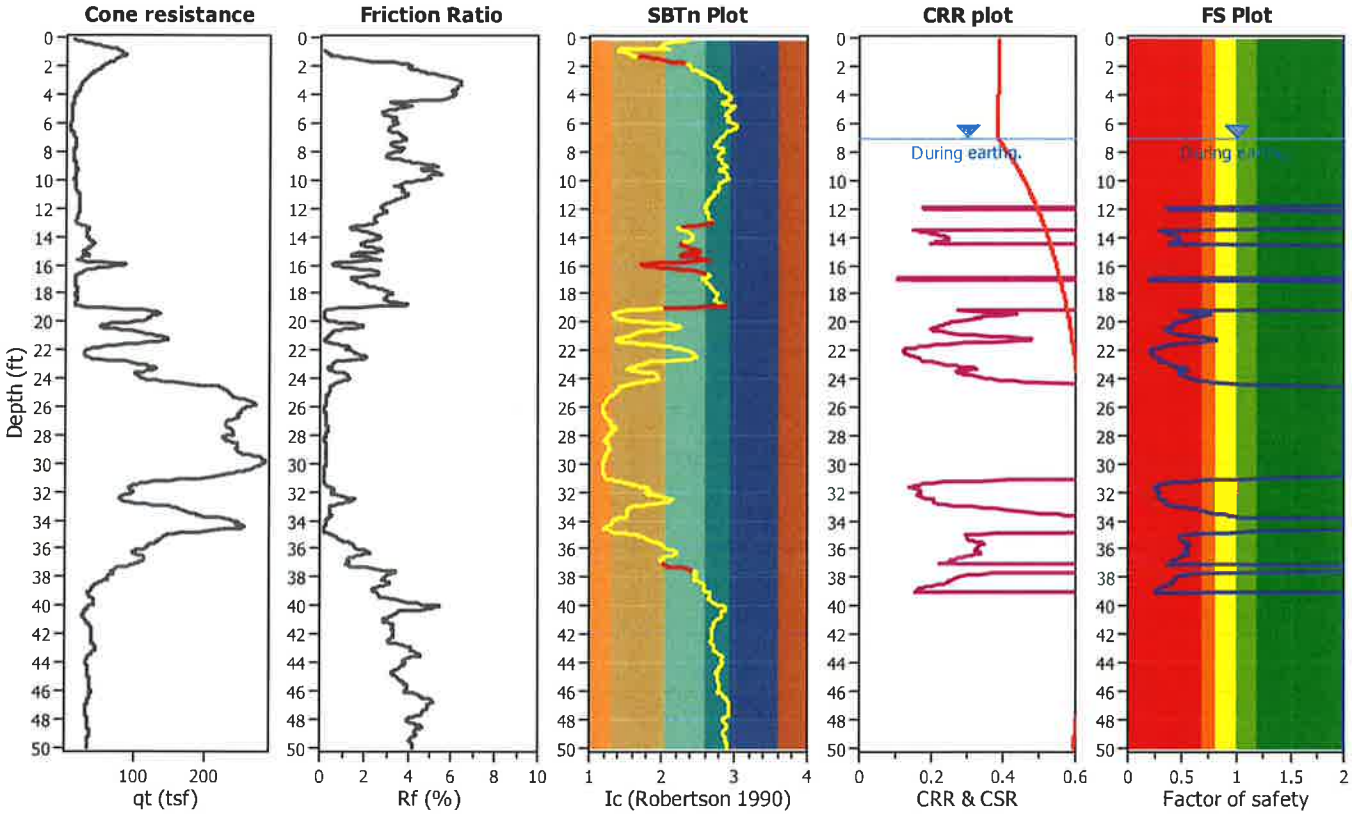
LIQUEFACTION ANALYSIS REPORT

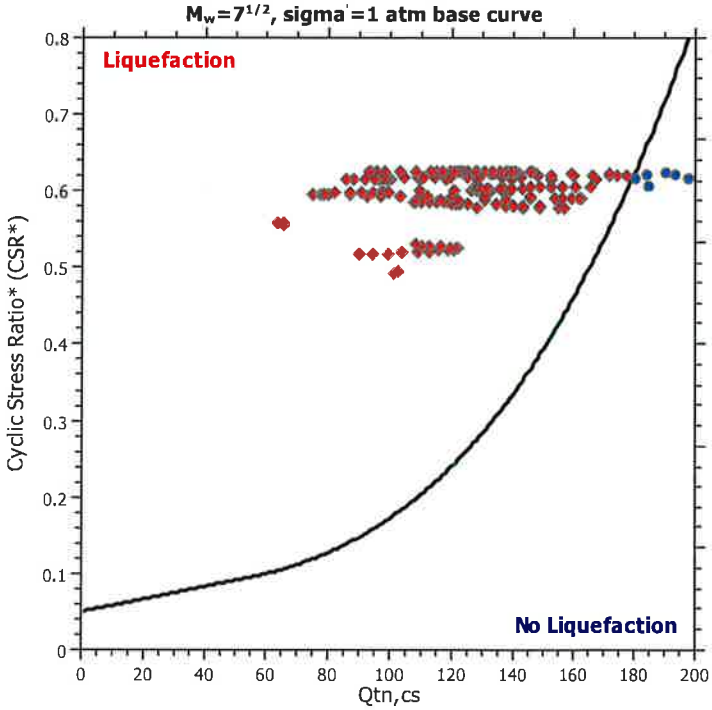
Project title : S-Line Upgrades **Location : Imperial County, CA**

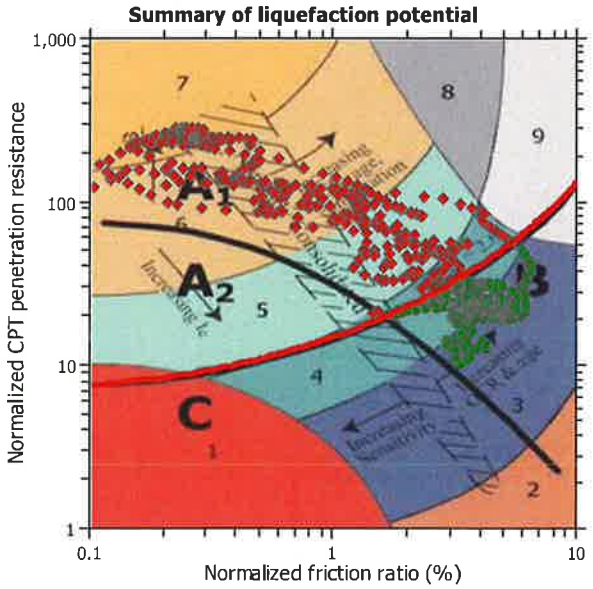
CPT file : CPT-16

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	7.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

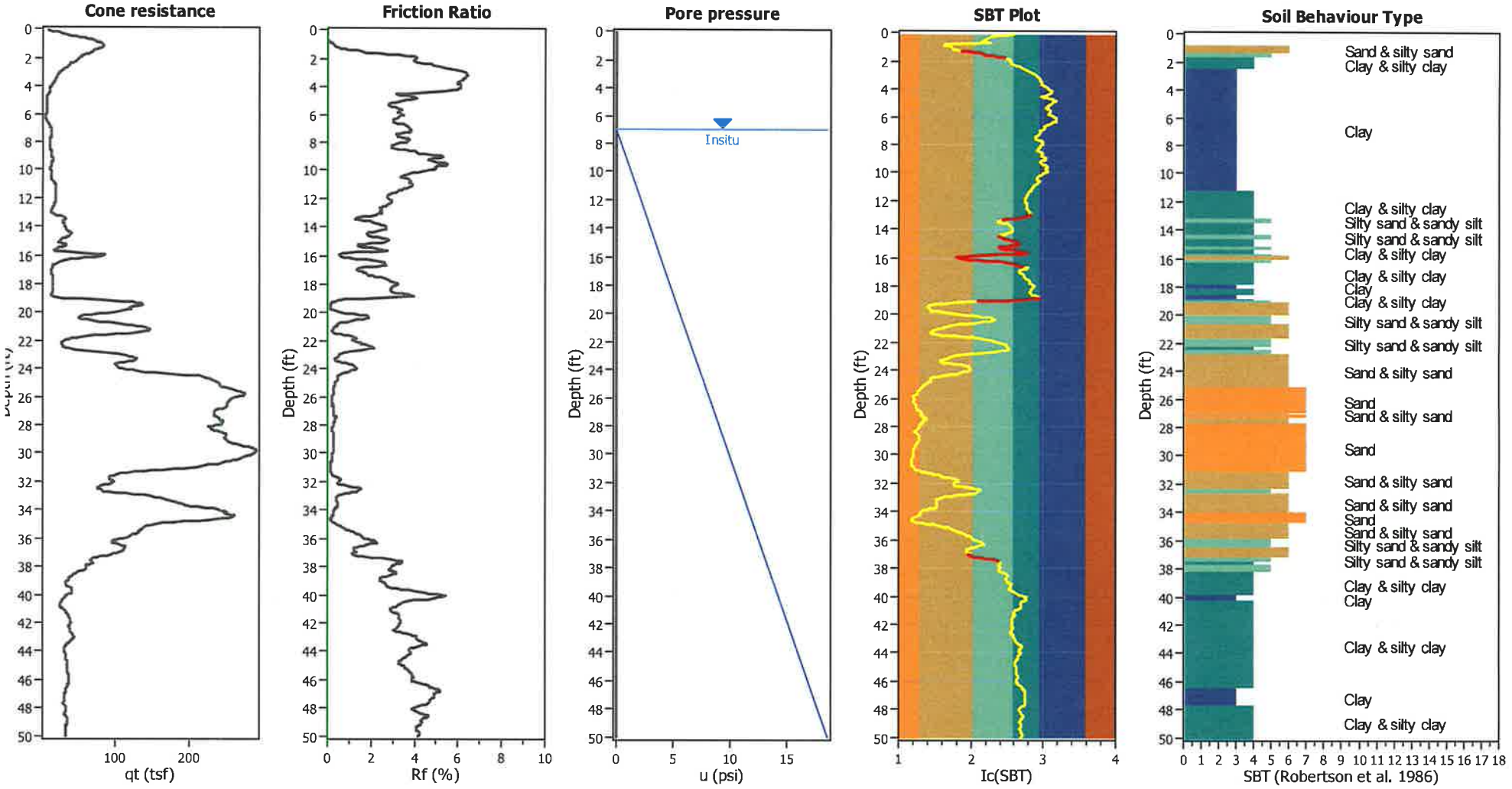






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



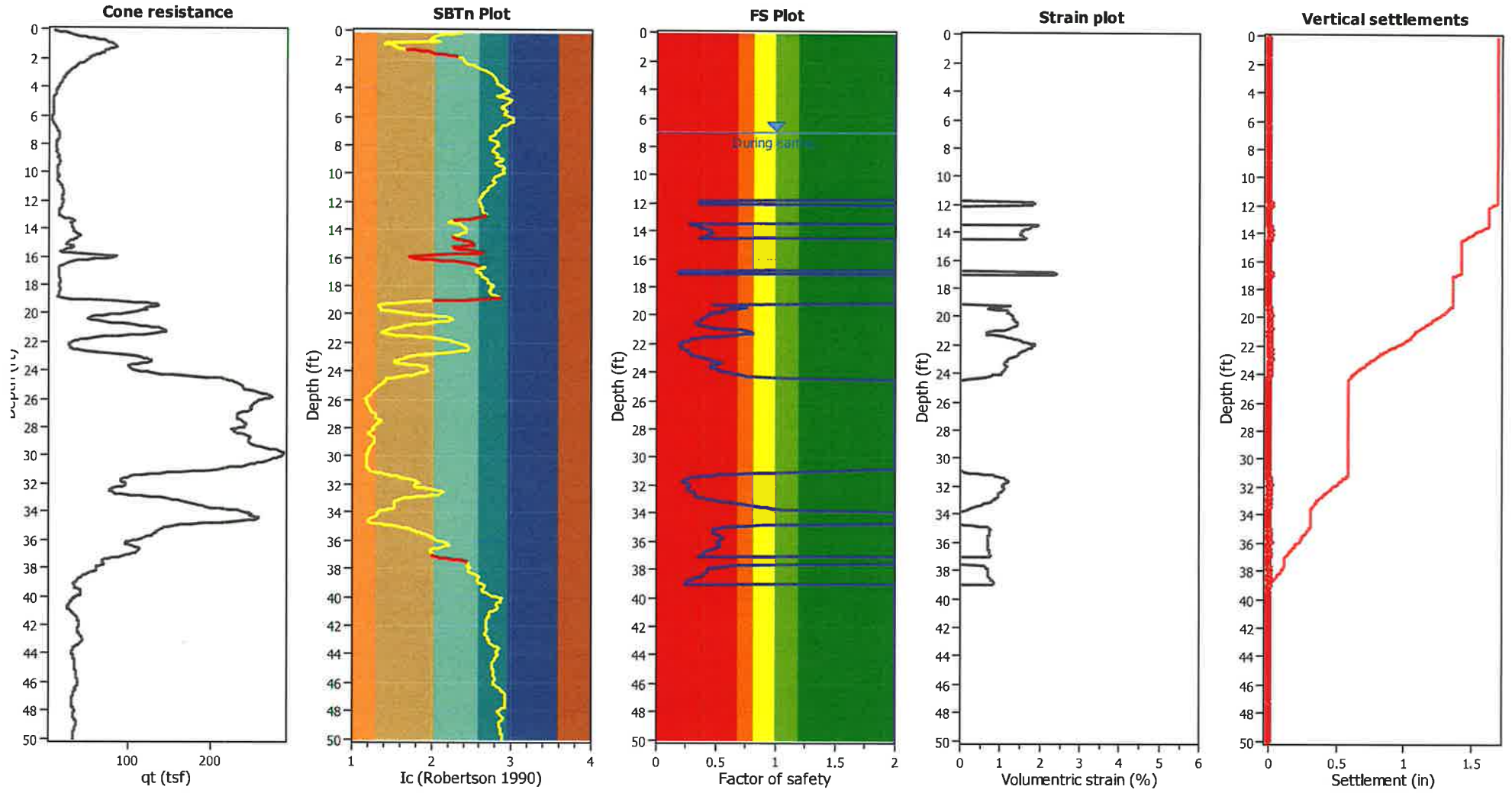
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	7.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

.:	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
7.01	102.29	2.00	0.00	0.88	0.00	7.07	103.79	2.00	0.00	0.88	0.00
7.12	105.71	2.00	0.00	0.88	0.00	7.19	106.28	2.00	0.00	0.88	0.00
7.24	105.85	2.00	0.00	0.88	0.00	7.30	102.10	2.00	0.00	0.88	0.00
7.37	98.28	2.00	0.00	0.88	0.00	7.42	96.25	2.00	0.00	0.87	0.00
7.48	97.74	2.00	0.00	0.87	0.00	7.55	99.10	2.00	0.00	0.87	0.00
7.61	99.27	2.00	0.00	0.87	0.00	7.67	99.54	2.00	0.00	0.87	0.00
7.68	99.11	2.00	0.00	0.87	0.00	7.78	98.83	2.00	0.00	0.87	0.00
7.83	98.33	2.00	0.00	0.87	0.00	7.91	97.94	2.00	0.00	0.87	0.00
7.96	96.19	2.00	0.00	0.87	0.00	8.01	92.98	2.00	0.00	0.86	0.00
8.07	90.01	2.00	0.00	0.86	0.00	8.19	88.51	2.00	0.00	0.86	0.00
8.25	88.28	2.00	0.00	0.86	0.00	8.31	88.66	2.00	0.00	0.86	0.00
8.38	88.97	2.00	0.00	0.86	0.00	8.44	90.15	2.00	0.00	0.86	0.00
8.48	92.54	2.00	0.00	0.86	0.00	8.54	97.01	2.00	0.00	0.86	0.00
8.62	101.76	2.00	0.00	0.85	0.00	8.66	107.11	2.00	0.00	0.85	0.00
8.80	111.02	2.00	0.00	0.85	0.00	8.84	115.73	2.00	0.00	0.85	0.00
8.91	120.19	2.00	0.00	0.85	0.00	8.97	124.13	2.00	0.00	0.85	0.00
9.03	125.99	2.00	0.00	0.85	0.00	9.10	125.46	2.00	0.00	0.85	0.00
9.15	123.82	2.00	0.00	0.84	0.00	9.22	122.77	2.00	0.00	0.84	0.00
9.28	123.21	2.00	0.00	0.84	0.00	9.33	124.92	2.00	0.00	0.84	0.00
9.40	126.49	2.00	0.00	0.84	0.00	9.46	127.09	2.00	0.00	0.84	0.00
9.56	126.33	2.00	0.00	0.84	0.00	9.61	123.95	2.00	0.00	0.84	0.00
9.66	120.82	2.00	0.00	0.84	0.00	9.72	117.81	2.00	0.00	0.84	0.00
9.82	115.83	2.00	0.00	0.83	0.00	9.90	114.72	2.00	0.00	0.83	0.00
9.94	114.07	2.00	0.00	0.83	0.00	9.99	113.10	2.00	0.00	0.83	0.00
10.06	111.37	2.00	0.00	0.83	0.00	10.12	109.96	2.00	0.00	0.83	0.00
10.18	108.10	2.00	0.00	0.83	0.00	10.25	105.11	2.00	0.00	0.83	0.00
10.37	101.23	2.00	0.00	0.82	0.00	10.43	98.66	2.00	0.00	0.82	0.00
10.47	99.22	2.00	0.00	0.82	0.00	10.55	103.00	2.00	0.00	0.82	0.00
10.70	106.53	2.00	0.00	0.82	0.00	10.77	111.02	2.00	0.00	0.82	0.00
10.86	114.05	2.00	0.00	0.82	0.00	10.91	117.80	2.00	0.00	0.82	0.00
10.97	120.00	2.00	0.00	0.81	0.00	11.03	121.20	2.00	0.00	0.81	0.00
11.12	121.68	2.00	0.00	0.81	0.00	11.17	120.49	2.00	0.00	0.81	0.00
11.27	118.60	2.00	0.00	0.81	0.00	11.32	116.30	2.00	0.00	0.81	0.00
11.36	114.73	2.00	0.00	0.81	0.00	11.43	112.84	2.00	0.00	0.81	0.00
11.52	110.71	2.00	0.00	0.80	0.00	11.57	107.84	2.00	0.00	0.80	0.00
11.66	105.41	2.00	0.00	0.80	0.00	11.72	103.28	2.00	0.00	0.80	0.00
11.75	102.15	2.00	0.00	0.80	0.00	11.85	101.48	0.36	1.84	0.80	0.02
11.92	101.12	0.36	1.85	0.80	0.01	11.96	101.53	0.36	1.84	0.80	0.01
12.05	102.66	0.36	1.82	0.80	0.02	12.10	104.43	2.00	0.00	0.80	0.00
12.14	105.19	2.00	0.00	0.79	0.00	12.24	105.09	2.00	0.00	0.79	0.00
12.29	103.56	2.00	0.00	0.79	0.00	12.34	101.79	2.00	0.00	0.79	0.00
12.40	98.97	2.00	0.00	0.79	0.00	12.50	96.22	2.00	0.00	0.79	0.00
12.54	93.08	2.00	0.00	0.79	0.00	12.63	91.04	2.00	0.00	0.79	0.00
12.67	88.69	2.00	0.00	0.79	0.00	12.77	87.36	2.00	0.00	0.78	0.00
12.82	85.80	2.00	0.00	0.78	0.00	12.88	85.69	2.00	0.00	0.78	0.00
12.94	86.36	2.00	0.00	0.78	0.00	13.03	87.60	2.00	0.00	0.78	0.00
13.09	88.05	2.00	0.00	0.78	0.00	13.13	89.79	2.00	0.00	0.78	0.00
13.25	89.43	2.00	0.00	0.78	0.00	13.29	87.97	2.00	0.00	0.77	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
13.33	85.87	2.00	0.00	0.77	0.00	13.42	86.69	2.00	0.00	0.77	0.00
13.47	89.76	0.28	1.97	0.77	0.01	13.53	94.14	0.30	1.89	0.77	0.01
13.59	99.29	0.33	1.81	0.77	0.01	13.66	103.96	0.35	1.74	0.77	0.01
13.75	108.58	0.38	1.68	0.77	0.02	13.82	112.43	0.41	1.63	0.77	0.01
13.86	115.93	0.43	1.58	0.77	0.01	13.92	118.61	0.45	1.55	0.76	0.01
13.98	120.78	0.47	1.53	0.76	0.01	14.10	121.62	0.47	1.51	0.76	0.02
14.17	121.37	0.47	1.51	0.76	0.01	14.21	119.46	0.45	1.53	0.76	0.01
14.28	116.27	0.43	1.57	0.76	0.01	14.34	112.69	0.40	1.60	0.76	0.01
14.39	109.71	0.38	1.64	0.76	0.01	14.45	107.86	0.37	1.66	0.76	0.01
14.52	107.05	2.00	0.00	0.75	0.00	14.59	107.63	2.00	0.00	0.75	0.00
14.65	110.41	2.00	0.00	0.75	0.00	14.73	113.88	2.00	0.00	0.75	0.00
14.79	117.03	2.00	0.00	0.75	0.00	14.83	116.90	2.00	0.00	0.75	0.00
14.93	115.11	2.00	0.00	0.75	0.00	14.97	108.89	2.00	0.00	0.75	0.00
15.07	102.04	2.00	0.00	0.74	0.00	15.13	94.20	2.00	0.00	0.74	0.00
15.18	89.84	2.00	0.00	0.74	0.00	15.22	87.55	2.00	0.00	0.74	0.00
15.32	87.21	2.00	0.00	0.74	0.00	15.41	88.17	2.00	0.00	0.74	0.00
15.45	91.52	2.00	0.00	0.74	0.00	15.50	94.61	2.00	0.00	0.74	0.00
15.60	96.33	2.00	0.00	0.74	0.00	15.63	95.80	2.00	0.00	0.74	0.00
15.69	88.79	2.00	0.00	0.73	0.00	15.78	80.10	2.00	0.00	0.73	0.00
15.83	86.32	2.00	0.00	0.73	0.00	15.89	103.34	2.00	0.00	0.73	0.00
15.99	112.70	2.00	0.00	0.73	0.00	16.06	112.30	2.00	0.00	0.73	0.00
16.11	106.43	2.00	0.00	0.73	0.00	16.17	101.57	2.00	0.00	0.73	0.00
16.24	99.60	2.00	0.00	0.72	0.00	16.29	102.40	2.00	0.00	0.72	0.00
16.35	105.31	2.00	0.00	0.72	0.00	16.42	106.17	2.00	0.00	0.72	0.00
16.53	100.83	2.00	0.00	0.72	0.00	16.65	95.58	2.00	0.00	0.72	0.00
16.69	89.08	2.00	0.00	0.72	0.00	16.74	81.77	2.00	0.00	0.72	0.00
16.81	72.32	2.00	0.00	0.72	0.00	16.91	65.67	0.19	2.35	0.71	0.03
16.94	64.06	0.19	2.40	0.71	0.01	17.04	65.82	0.19	2.34	0.71	0.03
17.08	67.71	2.00	0.00	0.71	0.00	17.15	69.07	2.00	0.00	0.71	0.00
17.21	70.58	2.00	0.00	0.71	0.00	17.26	72.59	2.00	0.00	0.71	0.00
17.33	74.76	2.00	0.00	0.71	0.00	17.40	78.14	2.00	0.00	0.71	0.00
17.48	81.28	2.00	0.00	0.70	0.00	17.52	86.30	2.00	0.00	0.70	0.00
17.61	90.10	2.00	0.00	0.70	0.00	17.65	93.46	2.00	0.00	0.70	0.00
17.74	94.63	2.00	0.00	0.70	0.00	17.79	95.81	2.00	0.00	0.70	0.00
17.87	96.87	2.00	0.00	0.70	0.00	17.92	97.49	2.00	0.00	0.70	0.00
18.01	97.09	2.00	0.00	0.69	0.00	18.05	95.69	2.00	0.00	0.69	0.00
18.14	94.46	2.00	0.00	0.69	0.00	18.19	93.79	2.00	0.00	0.69	0.00
18.28	94.10	2.00	0.00	0.69	0.00	18.36	93.82	2.00	0.00	0.69	0.00
18.41	93.30	2.00	0.00	0.69	0.00	18.45	92.63	2.00	0.00	0.69	0.00
18.51	93.38	2.00	0.00	0.69	0.00	18.58	95.76	2.00	0.00	0.69	0.00
18.64	99.39	2.00	0.00	0.68	0.00	18.71	102.54	2.00	0.00	0.68	0.00
18.79	103.85	2.00	0.00	0.68	0.00	18.85	101.10	2.00	0.00	0.68	0.00
18.91	93.32	2.00	0.00	0.68	0.00	19.02	84.36	2.00	0.00	0.68	0.00
19.04	89.02	2.00	0.00	0.68	0.00	19.11	101.06	2.00	0.00	0.68	0.00
19.20	127.99	0.48	1.29	0.67	0.01	19.25	142.83	0.61	1.18	0.67	0.01
19.30	148.92	0.67	0.94	0.67	0.01	19.38	154.83	0.73	0.89	0.67	0.01
19.43	156.81	0.76	0.71	0.67	0.00	19.51	148.61	0.66	0.94	0.67	0.01
19.56	143.29	0.61	1.16	0.67	0.01	19.66	137.61	0.55	1.20	0.67	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
19.70	139.86	0.58	1.18	0.67	0.01	19.75	134.15	0.52	1.22	0.67	0.01
19.90	125.17	0.45	1.29	0.66	0.02	19.97	122.45	0.43	1.31	0.66	0.01
20.02	121.24	0.42	1.32	0.66	0.01	20.09	119.95	0.41	1.33	0.66	0.01
20.15	118.92	0.40	1.33	0.66	0.01	20.20	117.71	0.40	1.34	0.66	0.01
20.27	115.28	0.38	1.37	0.66	0.01	20.32	112.75	0.36	1.39	0.66	0.01
20.37	110.19	0.35	1.41	0.65	0.01	20.43	108.27	0.34	1.43	0.65	0.01
20.50	107.62	0.33	1.44	0.65	0.01	20.55	108.22	0.34	1.43	0.65	0.01
20.63	110.83	0.35	1.40	0.65	0.01	20.67	116.47	0.39	1.34	0.65	0.01
20.81	121.75	0.42	1.29	0.65	0.02	20.86	130.45	0.49	1.21	0.65	0.01
20.93	137.44	0.55	1.16	0.65	0.01	20.99	145.69	0.62	1.11	0.64	0.01
21.03	153.57	0.71	0.86	0.64	0.00	21.11	159.64	0.78	0.66	0.64	0.01
21.21	162.38	0.81	0.64	0.64	0.01	21.28	161.64	0.80	0.64	0.64	0.01
21.34	156.20	0.73	0.83	0.64	0.01	21.39	145.73	0.62	1.09	0.64	0.01
21.46	130.55	0.48	1.19	0.64	0.01	21.52	119.95	0.41	1.28	0.64	0.01
21.58	111.77	0.35	1.35	0.63	0.01	21.65	103.22	0.31	1.44	0.63	0.01
21.70	96.58	0.28	1.52	0.63	0.01	21.78	92.27	0.26	1.57	0.63	0.02
21.82	86.69	0.24	1.66	0.63	0.01	21.88	79.96	0.21	1.77	0.63	0.01
21.96	75.24	0.20	1.85	0.63	0.02	22.02	75.24	0.20	1.85	0.63	0.01
22.09	77.46	0.21	1.80	0.63	0.01	22.13	77.87	0.21	1.79	0.62	0.01
22.18	78.61	0.21	1.78	0.62	0.01	22.27	81.78	0.22	1.72	0.62	0.02
22.34	86.59	0.23	1.63	0.62	0.01	22.40	90.75	0.25	1.57	0.62	0.01
22.44	94.29	0.26	1.52	0.62	0.01	22.54	96.77	0.27	1.48	0.62	0.02
22.57	98.33	0.28	1.46	0.62	0.01	22.66	97.66	0.28	1.47	0.62	0.01
22.71	99.60	0.29	1.44	0.62	0.01	22.83	109.55	0.34	1.33	0.61	0.02
22.98	120.47	0.40	1.22	0.61	0.02	23.05	125.98	0.44	1.18	0.61	0.01
23.11	128.34	0.46	1.16	0.61	0.01	23.17	132.53	0.49	1.13	0.61	0.01
23.23	136.42	0.53	1.10	0.61	0.01	23.29	138.44	0.54	1.08	0.61	0.01
23.33	136.85	0.53	1.09	0.60	0.01	23.42	132.12	0.49	1.12	0.60	0.01
23.46	126.85	0.45	1.16	0.60	0.01	23.53	127.36	0.45	1.15	0.60	0.01
23.60	127.90	0.46	1.15	0.60	0.01	23.64	129.13	0.46	1.14	0.60	0.01
23.71	131.51	0.48	1.12	0.60	0.01	23.77	135.45	0.52	1.09	0.60	0.01
23.89	139.41	0.55	1.06	0.60	0.01	23.95	143.22	0.58	1.03	0.59	0.01
24.00	145.91	0.61	1.02	0.59	0.01	24.06	148.92	0.64	1.01	0.59	0.01
24.12	152.29	0.68	0.80	0.59	0.01	24.17	155.95	0.72	0.77	0.59	0.00
24.23	160.44	0.77	0.60	0.59	0.00	24.30	165.61	0.83	0.57	0.59	0.00
24.35	184.88	1.10	0.22	0.59	0.00	24.48	205.91	2.00	0.00	0.59	0.00
24.52	223.23	2.00	0.00	0.58	0.00	24.59	230.25	2.00	0.00	0.58	0.00
24.66	234.62	2.00	0.00	0.58	0.00	24.70	237.58	2.00	0.00	0.58	0.00
24.75	239.88	2.00	0.00	0.58	0.00	24.83	242.03	2.00	0.00	0.58	0.00
24.88	245.48	2.00	0.00	0.58	0.00	25.05	248.15	2.00	0.00	0.58	0.00
25.13	249.72	2.00	0.00	0.57	0.00	25.19	249.46	2.00	0.00	0.57	0.00
25.22	248.80	2.00	0.00	0.57	0.00	25.30	250.67	2.00	0.00	0.57	0.00
25.36	254.46	2.00	0.00	0.57	0.00	25.40	262.02	2.00	0.00	0.57	0.00
25.53	267.70	2.00	0.00	0.57	0.00	25.58	273.80	2.00	0.00	0.57	0.00
25.63	276.74	2.00	0.00	0.57	0.00	25.71	279.80	2.00	0.00	0.56	0.00
25.76	281.48	2.00	0.00	0.56	0.00	25.82	282.04	2.00	0.00	0.56	0.00
25.89	279.36	2.00	0.00	0.56	0.00	25.93	273.89	2.00	0.00	0.56	0.00
26.00	268.93	2.00	0.00	0.56	0.00	26.07	265.60	2.00	0.00	0.56	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
26.12	262.59	2.00	0.00	0.56	0.00	26.24	259.87	2.00	0.00	0.56	0.00
26.29	258.24	2.00	0.00	0.55	0.00	26.35	257.58	2.00	0.00	0.55	0.00
26.42	255.57	2.00	0.00	0.55	0.00	26.52	253.64	2.00	0.00	0.55	0.00
26.59	253.02	2.00	0.00	0.55	0.00	26.64	253.11	2.00	0.00	0.55	0.00
26.69	253.20	2.00	0.00	0.55	0.00	26.77	250.76	2.00	0.00	0.55	0.00
26.82	247.28	2.00	0.00	0.55	0.00	26.88	241.37	2.00	0.00	0.54	0.00
26.99	236.97	2.00	0.00	0.54	0.00	27.07	233.94	2.00	0.00	0.54	0.00
27.12	233.16	2.00	0.00	0.54	0.00	27.17	233.03	2.00	0.00	0.54	0.00
27.30	232.59	2.00	0.00	0.54	0.00	27.35	232.93	2.00	0.00	0.54	0.00
27.41	235.37	2.00	0.00	0.54	0.00	27.53	237.71	2.00	0.00	0.53	0.00
27.61	239.89	2.00	0.00	0.53	0.00	27.65	239.99	2.00	0.00	0.53	0.00
27.71	242.52	2.00	0.00	0.53	0.00	27.79	242.47	2.00	0.00	0.53	0.00
27.84	242.28	2.00	0.00	0.53	0.00	27.92	239.84	2.00	0.00	0.53	0.00
27.96	239.96	2.00	0.00	0.53	0.00	28.01	233.31	2.00	0.00	0.53	0.00
28.06	228.08	2.00	0.00	0.52	0.00	28.10	223.45	2.00	0.00	0.52	0.00
28.16	226.22	2.00	0.00	0.52	0.00	28.26	226.64	2.00	0.00	0.52	0.00
28.30	227.30	2.00	0.00	0.52	0.00	28.37	229.22	2.00	0.00	0.52	0.00
28.44	234.01	2.00	0.00	0.52	0.00	28.53	238.75	2.00	0.00	0.52	0.00
28.61	242.55	2.00	0.00	0.52	0.00	28.66	243.47	2.00	0.00	0.51	0.00
28.71	243.43	2.00	0.00	0.51	0.00	28.78	242.62	2.00	0.00	0.51	0.00
28.83	242.26	2.00	0.00	0.51	0.00	28.89	241.58	2.00	0.00	0.51	0.00
28.97	241.14	2.00	0.00	0.51	0.00	29.01	241.77	2.00	0.00	0.51	0.00
29.13	243.23	2.00	0.00	0.51	0.00	29.19	245.25	2.00	0.00	0.51	0.00
29.25	247.21	2.00	0.00	0.50	0.00	29.31	250.08	2.00	0.00	0.50	0.00
29.37	254.28	2.00	0.00	0.50	0.00	29.42	259.77	2.00	0.00	0.50	0.00
29.49	265.42	2.00	0.00	0.50	0.00	29.54	271.25	2.00	0.00	0.50	0.00
29.67	275.37	2.00	0.00	0.50	0.00	29.72	278.43	2.00	0.00	0.50	0.00
29.76	279.53	2.00	0.00	0.50	0.00	29.84	279.27	2.00	0.00	0.49	0.00
29.90	278.28	2.00	0.00	0.49	0.00	29.96	276.73	2.00	0.00	0.49	0.00
30.03	274.94	2.00	0.00	0.49	0.00	30.08	272.70	2.00	0.00	0.49	0.00
30.14	269.70	2.00	0.00	0.49	0.00	30.20	266.22	2.00	0.00	0.49	0.00
30.26	261.49	2.00	0.00	0.49	0.00	30.38	256.33	2.00	0.00	0.49	0.00
30.44	251.20	2.00	0.00	0.48	0.00	30.50	246.83	2.00	0.00	0.48	0.00
30.56	242.22	2.00	0.00	0.48	0.00	30.61	237.10	2.00	0.00	0.48	0.00
30.69	231.64	2.00	0.00	0.48	0.00	30.74	226.23	2.00	0.00	0.48	0.00
30.80	213.58	2.00	0.00	0.48	0.00	30.97	198.08	1.30	0.08	0.48	0.00
31.04	180.32	1.02	0.24	0.47	0.00	31.09	167.78	0.84	0.45	0.47	0.00
31.15	152.72	0.67	0.64	0.47	0.00	31.18	139.60	0.54	0.84	0.47	0.00
31.26	128.40	0.45	0.90	0.47	0.01	31.30	118.34	0.38	0.96	0.47	0.01
31.41	109.31	0.33	1.02	0.47	0.01	31.43	100.23	0.28	1.09	0.47	0.00
31.52	95.98	0.26	1.13	0.47	0.01	31.56	91.59	0.25	1.17	0.47	0.01
31.65	87.97	0.23	1.20	0.46	0.01	31.71	85.82	0.23	1.23	0.46	0.01
31.83	96.19	0.26	1.11	0.46	0.02	31.88	98.47	0.27	1.09	0.46	0.01
31.92	99.12	0.28	1.08	0.46	0.01	31.96	99.22	0.28	1.08	0.46	0.00
32.05	98.82	0.28	1.08	0.46	0.01	32.10	97.30	0.27	1.09	0.46	0.01
32.19	95.14	0.26	1.11	0.45	0.01	32.23	94.96	0.26	1.11	0.45	0.01
32.34	97.93	0.27	1.07	0.45	0.01	32.40	104.28	0.30	1.02	0.45	0.01
32.45	108.64	0.32	0.98	0.45	0.01	32.49	110.93	0.34	0.96	0.45	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
32.58	110.43	0.33	0.96	0.45	0.01	32.69	109.77	0.33	0.97	0.45	0.01
32.76	110.68	0.33	0.96	0.44	0.01	32.80	114.18	0.35	0.93	0.44	0.01
32.85	119.44	0.39	0.90	0.44	0.01	32.93	124.79	0.42	0.86	0.44	0.01
32.98	129.06	0.45	0.84	0.44	0.00	33.02	136.16	0.51	0.80	0.44	0.00
33.10	142.20	0.56	0.77	0.44	0.01	33.16	147.94	0.62	0.75	0.44	0.01
33.27	152.72	0.66	0.59	0.44	0.01	33.32	160.16	0.75	0.55	0.44	0.00
33.48	166.00	0.81	0.42	0.43	0.01	33.56	171.71	0.89	0.30	0.43	0.00
33.61	174.38	0.92	0.30	0.43	0.00	33.68	177.81	0.97	0.22	0.43	0.00
33.73	184.28	1.07	0.16	0.43	0.00	33.77	193.87	1.22	0.11	0.43	0.00
33.83	204.37	2.00	0.00	0.43	0.00	33.91	212.80	2.00	0.00	0.43	0.00
33.97	217.35	2.00	0.00	0.42	0.00	34.04	221.70	2.00	0.00	0.42	0.00
34.08	225.30	2.00	0.00	0.42	0.00	34.14	228.36	2.00	0.00	0.42	0.00
34.17	225.07	2.00	0.00	0.42	0.00	34.21	223.96	2.00	0.00	0.42	0.00
34.26	225.95	2.00	0.00	0.42	0.00	34.35	232.09	2.00	0.00	0.42	0.00
34.41	235.12	2.00	0.00	0.42	0.00	34.45	233.55	2.00	0.00	0.42	0.00
34.54	229.27	2.00	0.00	0.41	0.00	34.60	222.02	2.00	0.00	0.41	0.00
34.65	207.51	2.00	0.00	0.41	0.00	34.76	190.33	1.16	0.11	0.41	0.00
34.83	172.06	0.89	0.29	0.41	0.00	34.88	159.10	0.73	0.52	0.41	0.00
34.93	147.70	0.61	0.70	0.41	0.00	35.01	138.50	0.52	0.73	0.41	0.01
35.06	132.22	0.47	0.75	0.41	0.00	35.11	132.80	0.48	0.75	0.40	0.00
35.19	132.91	0.48	0.75	0.40	0.01	35.30	133.26	0.48	0.74	0.40	0.01
35.36	133.90	0.49	0.74	0.40	0.01	35.41	135.98	0.50	0.73	0.40	0.00
35.49	138.20	0.52	0.71	0.40	0.01	35.54	140.17	0.54	0.70	0.40	0.00
35.58	141.52	0.55	0.70	0.40	0.00	35.67	142.16	0.56	0.69	0.40	0.01
35.72	140.72	0.54	0.70	0.39	0.00	35.94	138.71	0.53	0.70	0.39	0.02
36.01	137.36	0.51	0.70	0.39	0.01	36.07	137.58	0.52	0.70	0.39	0.01
36.12	138.36	0.52	0.69	0.39	0.00	36.17	139.43	0.53	0.69	0.39	0.00
36.23	140.37	0.54	0.68	0.39	0.01	36.29	140.41	0.54	0.68	0.38	0.00
36.33	139.40	0.53	0.68	0.38	0.00	36.39	137.56	0.52	0.69	0.38	0.00
36.46	135.45	0.50	0.70	0.38	0.01	36.51	133.19	0.48	0.70	0.38	0.00
36.56	130.52	0.46	0.71	0.38	0.00	36.64	127.59	0.44	0.73	0.38	0.01
36.69	125.00	0.42	0.74	0.38	0.00	36.80	123.18	0.41	0.74	0.38	0.01
36.87	122.49	0.40	0.74	0.38	0.01	36.92	122.88	0.40	0.74	0.37	0.00
37.00	119.49	0.38	0.75	0.37	0.01	37.04	114.75	0.35	0.78	0.37	0.00
37.10	109.28	2.00	0.00	0.37	0.00	37.17	108.49	2.00	0.00	0.37	0.00
37.22	110.24	2.00	0.00	0.37	0.00	37.28	112.71	2.00	0.00	0.37	0.00
37.35	118.39	2.00	0.00	0.37	0.00	37.41	125.45	2.00	0.00	0.37	0.00
37.49	134.30	2.00	0.00	0.36	0.00	37.58	140.74	2.00	0.00	0.36	0.00
37.61	145.19	2.00	0.00	0.36	0.00	37.70	146.18	0.59	0.62	0.36	0.01
37.75	145.40	0.59	0.62	0.36	0.00	37.80	139.31	0.53	0.64	0.36	0.00
37.88	133.40	0.48	0.66	0.36	0.01	37.93	128.26	0.44	0.68	0.36	0.00
38.02	127.36	0.44	0.68	0.36	0.01	38.15	125.26	0.42	0.69	0.35	0.01
38.24	123.51	0.41	0.69	0.35	0.01	38.28	122.25	0.40	0.70	0.35	0.00
38.33	121.92	0.40	0.70	0.35	0.00	38.40	120.50	0.39	0.70	0.35	0.01
38.46	117.13	0.37	0.71	0.35	0.00	38.55	113.14	0.34	0.73	0.35	0.01
38.59	107.99	0.32	0.76	0.35	0.00	38.66	103.02	0.29	0.79	0.34	0.01
38.72	98.40	0.27	0.81	0.34	0.01	38.78	95.41	0.26	0.83	0.34	0.01
38.86	93.95	0.25	0.84	0.34	0.01	38.97	93.10	0.25	0.84	0.34	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.03	92.77	2.00	0.00	0.34	0.00	39.08	92.52	2.00	0.00	0.34	0.00
39.14	92.62	2.00	0.00	0.34	0.00	39.21	94.21	2.00	0.00	0.34	0.00
39.39	97.17	2.00	0.00	0.33	0.00	39.43	101.92	2.00	0.00	0.33	0.00
39.50	107.06	2.00	0.00	0.33	0.00	39.56	113.44	2.00	0.00	0.33	0.00
39.61	115.67	2.00	0.00	0.33	0.00	39.68	121.81	2.00	0.00	0.33	0.00
39.78	126.15	2.00	0.00	0.33	0.00	39.84	133.59	2.00	0.00	0.32	0.00
39.92	135.82	2.00	0.00	0.32	0.00	39.96	137.56	2.00	0.00	0.32	0.00
40.01	137.30	2.00	0.00	0.32	0.00	40.04	134.96	2.00	0.00	0.32	0.00
40.14	131.84	2.00	0.00	0.32	0.00	40.18	128.69	2.00	0.00	0.32	0.00
40.23	123.72	2.00	0.00	0.32	0.00	40.31	116.70	2.00	0.00	0.32	0.00
40.36	107.99	2.00	0.00	0.32	0.00	40.43	101.57	2.00	0.00	0.31	0.00
40.58	97.15	2.00	0.00	0.31	0.00	40.66	94.82	2.00	0.00	0.31	0.00
40.72	93.45	2.00	0.00	0.31	0.00	40.77	92.50	2.00	0.00	0.31	0.00
40.84	91.96	2.00	0.00	0.31	0.00	40.89	91.54	2.00	0.00	0.31	0.00
40.95	91.37	2.00	0.00	0.31	0.00	41.02	92.19	2.00	0.00	0.30	0.00
41.13	94.38	2.00	0.00	0.30	0.00	41.20	97.32	2.00	0.00	0.30	0.00
41.24	100.57	2.00	0.00	0.30	0.00	41.32	103.24	2.00	0.00	0.30	0.00
41.38	105.60	2.00	0.00	0.30	0.00	41.42	106.76	2.00	0.00	0.30	0.00
41.49	107.47	2.00	0.00	0.30	0.00	41.55	107.86	2.00	0.00	0.30	0.00
41.65	108.51	2.00	0.00	0.29	0.00	41.73	109.25	2.00	0.00	0.29	0.00
41.77	110.68	2.00	0.00	0.29	0.00	41.91	111.46	2.00	0.00	0.29	0.00
41.96	111.71	2.00	0.00	0.29	0.00	42.03	110.87	2.00	0.00	0.29	0.00
42.08	110.02	2.00	0.00	0.29	0.00	42.13	109.08	2.00	0.00	0.29	0.00
42.19	108.32	2.00	0.00	0.28	0.00	42.26	107.69	2.00	0.00	0.28	0.00
42.31	106.60	2.00	0.00	0.28	0.00	42.37	105.39	2.00	0.00	0.28	0.00
42.48	104.20	2.00	0.00	0.28	0.00	42.54	105.10	2.00	0.00	0.28	0.00
42.60	107.26	2.00	0.00	0.28	0.00	42.66	110.44	2.00	0.00	0.28	0.00
42.72	113.82	2.00	0.00	0.28	0.00	42.78	117.20	2.00	0.00	0.27	0.00
42.83	120.85	2.00	0.00	0.27	0.00	42.91	124.34	2.00	0.00	0.27	0.00
42.96	127.34	2.00	0.00	0.27	0.00	43.03	127.70	2.00	0.00	0.27	0.00
43.10	127.18	2.00	0.00	0.27	0.00	43.16	125.98	2.00	0.00	0.27	0.00
43.23	126.19	2.00	0.00	0.27	0.00	43.33	125.87	2.00	0.00	0.27	0.00
43.40	125.29	2.00	0.00	0.26	0.00	43.45	123.06	2.00	0.00	0.26	0.00
43.53	120.02	2.00	0.00	0.26	0.00	43.59	116.15	2.00	0.00	0.26	0.00
43.64	112.61	2.00	0.00	0.26	0.00	43.72	109.14	2.00	0.00	0.26	0.00
43.80	106.36	2.00	0.00	0.26	0.00	43.85	104.96	2.00	0.00	0.26	0.00
43.93	104.66	2.00	0.00	0.26	0.00	43.98	105.02	2.00	0.00	0.25	0.00
44.04	105.72	2.00	0.00	0.25	0.00	44.10	106.39	2.00	0.00	0.25	0.00
44.20	106.56	2.00	0.00	0.25	0.00	44.29	106.20	2.00	0.00	0.25	0.00
44.33	105.69	2.00	0.00	0.25	0.00	44.38	105.30	2.00	0.00	0.25	0.00
44.45	104.81	2.00	0.00	0.25	0.00	44.51	104.07	2.00	0.00	0.25	0.00
44.56	102.89	2.00	0.00	0.24	0.00	44.68	101.87	2.00	0.00	0.24	0.00
44.73	101.30	2.00	0.00	0.24	0.00	44.80	101.38	2.00	0.00	0.24	0.00
44.86	101.88	2.00	0.00	0.24	0.00	44.91	102.73	2.00	0.00	0.24	0.00
44.97	103.89	2.00	0.00	0.24	0.00	45.04	104.81	2.00	0.00	0.24	0.00
45.09	105.58	2.00	0.00	0.24	0.00	45.15	106.44	2.00	0.00	0.23	0.00
45.21	107.51	2.00	0.00	0.23	0.00	45.31	108.48	2.00	0.00	0.23	0.00
45.36	109.32	2.00	0.00	0.23	0.00	45.42	110.10	2.00	0.00	0.23	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
45.48	111.04	2.00	0.00	0.23	0.00	45.59	111.75	2.00	0.00	0.23	0.00
45.65	112.23	2.00	0.00	0.23	0.00	45.70	112.45	2.00	0.00	0.23	0.00
45.75	112.88	2.00	0.00	0.22	0.00	45.82	113.46	2.00	0.00	0.22	0.00
45.88	113.53	2.00	0.00	0.22	0.00	46.03	113.60	2.00	0.00	0.22	0.00
46.10	113.84	2.00	0.00	0.22	0.00	46.14	115.81	2.00	0.00	0.22	0.00
46.20	117.65	2.00	0.00	0.22	0.00	46.32	119.21	2.00	0.00	0.21	0.00
46.36	119.48	2.00	0.00	0.21	0.00	46.40	119.70	2.00	0.00	0.21	0.00
46.51	120.11	2.00	0.00	0.21	0.00	46.55	121.09	2.00	0.00	0.21	0.00
46.62	122.02	2.00	0.00	0.21	0.00	46.66	122.48	2.00	0.00	0.21	0.00
46.76	122.17	2.00	0.00	0.21	0.00	46.81	121.38	2.00	0.00	0.21	0.00
46.88	120.15	2.00	0.00	0.21	0.00	46.93	118.64	2.00	0.00	0.20	0.00
47.00	117.15	2.00	0.00	0.20	0.00	47.06	115.67	2.00	0.00	0.20	0.00
47.24	114.55	2.00	0.00	0.20	0.00	47.29	113.79	2.00	0.00	0.20	0.00
47.35	113.32	2.00	0.00	0.20	0.00	47.41	112.83	2.00	0.00	0.20	0.00
47.46	112.06	2.00	0.00	0.20	0.00	47.59	111.31	2.00	0.00	0.19	0.00
47.64	110.57	2.00	0.00	0.19	0.00	47.70	110.01	2.00	0.00	0.19	0.00
47.77	109.64	2.00	0.00	0.19	0.00	47.81	109.19	2.00	0.00	0.19	0.00
47.88	108.63	2.00	0.00	0.19	0.00	47.94	107.76	2.00	0.00	0.19	0.00
47.99	107.22	2.00	0.00	0.19	0.00	48.05	106.96	2.00	0.00	0.19	0.00
48.12	107.02	2.00	0.00	0.18	0.00	48.17	107.18	2.00	0.00	0.18	0.00
48.29	107.66	2.00	0.00	0.18	0.00	48.34	108.67	2.00	0.00	0.18	0.00
48.41	110.04	2.00	0.00	0.18	0.00	48.47	111.66	2.00	0.00	0.18	0.00
48.52	113.23	2.00	0.00	0.18	0.00	48.58	114.55	2.00	0.00	0.18	0.00
48.65	115.05	2.00	0.00	0.18	0.00	48.69	114.68	2.00	0.00	0.17	0.00
48.83	113.97	2.00	0.00	0.17	0.00	48.87	113.51	2.00	0.00	0.17	0.00
48.95	113.72	2.00	0.00	0.17	0.00	49.01	113.80	2.00	0.00	0.17	0.00
49.06	113.80	2.00	0.00	0.17	0.00	49.13	113.00	2.00	0.00	0.17	0.00
49.18	111.73	2.00	0.00	0.17	0.00	49.24	110.03	2.00	0.00	0.17	0.00
49.31	108.82	2.00	0.00	0.16	0.00	49.36	108.15	2.00	0.00	0.16	0.00
49.41	107.64	2.00	0.00	0.16	0.00	49.48	106.92	2.00	0.00	0.16	0.00
49.60	106.36	2.00	0.00	0.16	0.00	49.62	106.39	2.00	0.00	0.16	0.00
49.73	106.70	2.00	0.00	0.16	0.00	49.79	107.13	2.00	0.00	0.16	0.00
49.87	107.27	2.00	0.00	0.15	0.00	49.91	107.29	2.00	0.00	0.15	0.00
49.97	106.97	2.00	0.00	0.15	0.00	50.04	106.63	2.00	0.00	0.15	0.00

Total estimated settlement: 1.69

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

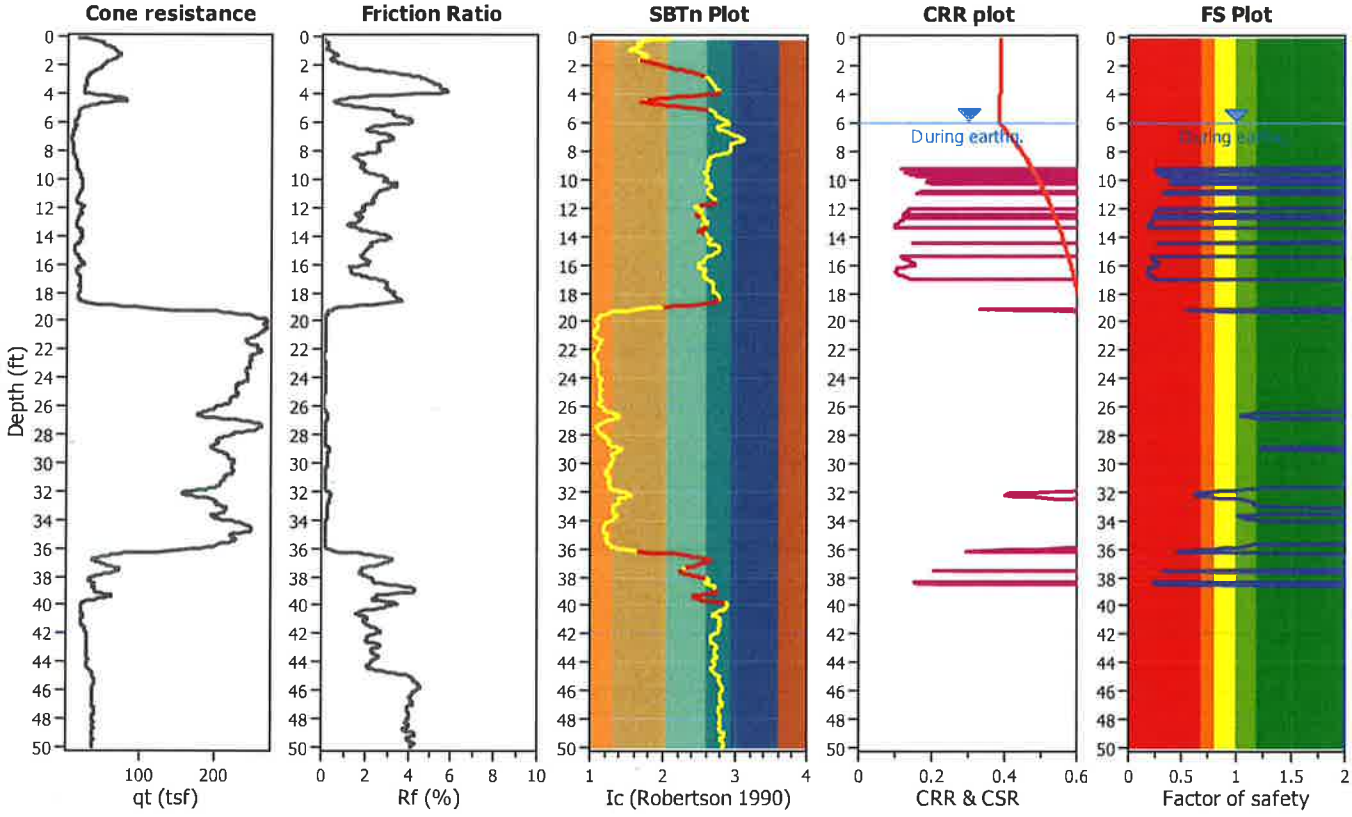
LIQUEFACTION ANALYSIS REPORT

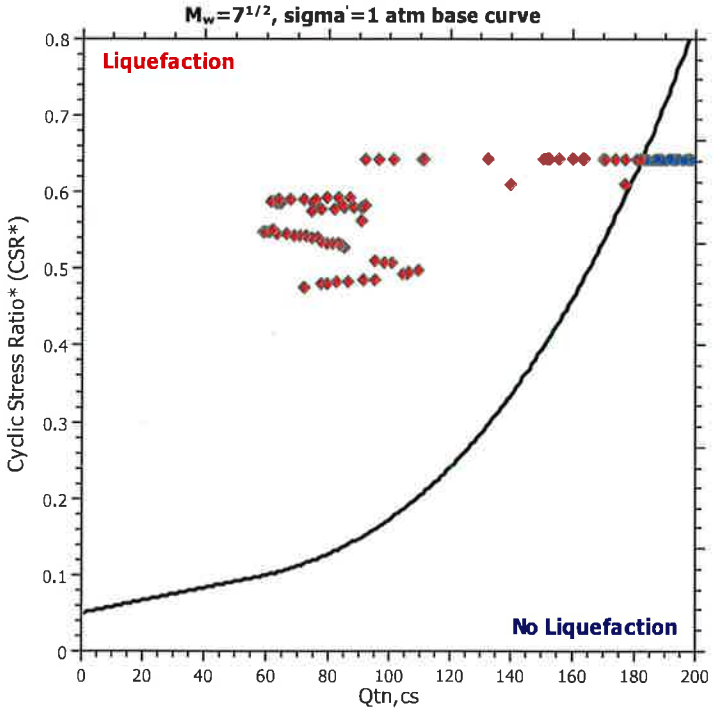
Project title : S-Line Upgrades **Location : Imperial County, CA**

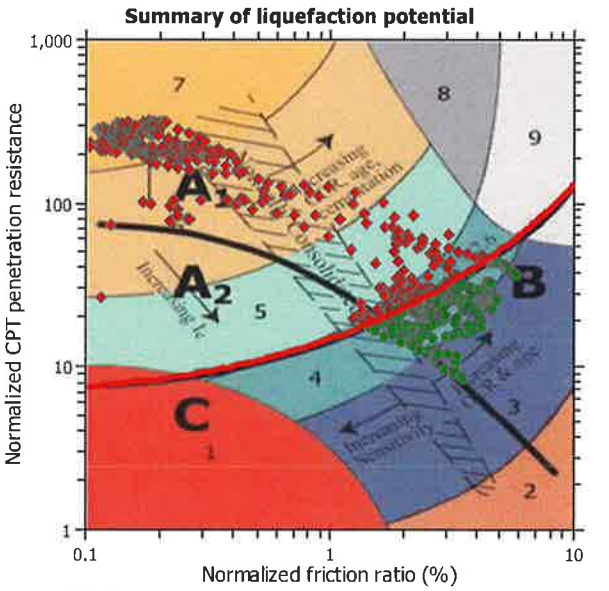
CPT file : CPT-17

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

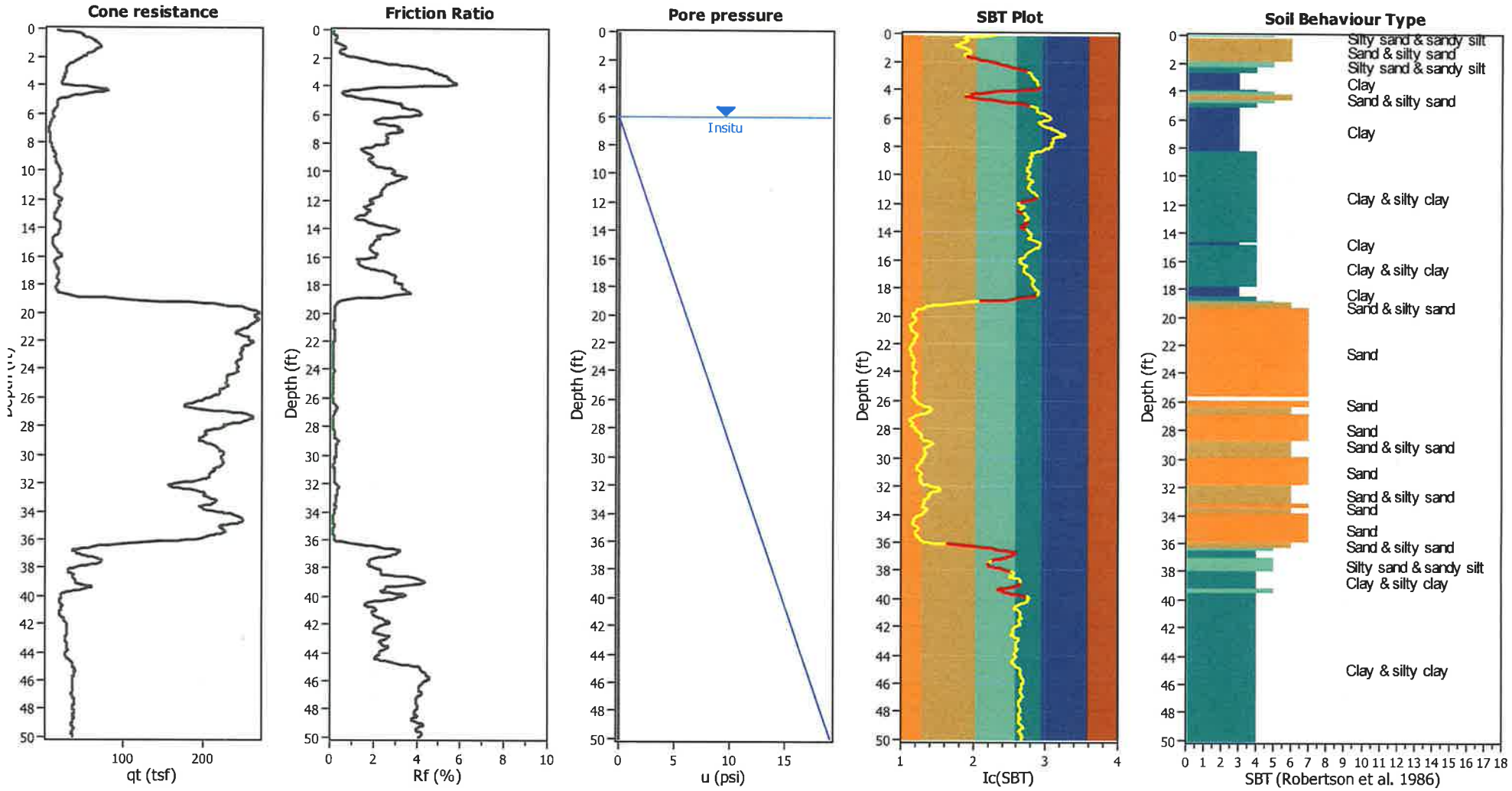






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



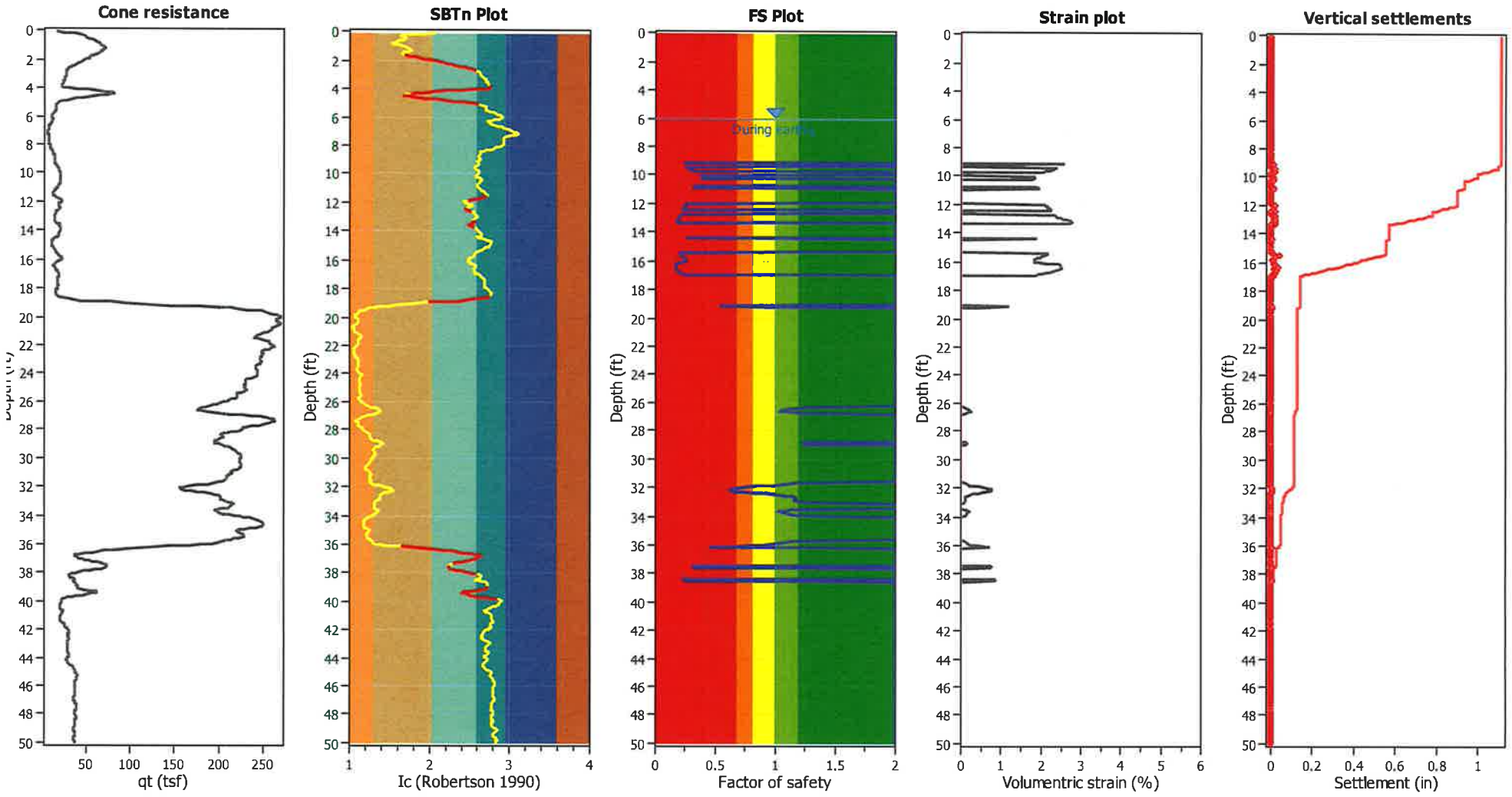
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.01	97.39	2.00	0.00	0.90	0.00	6.07	95.77	2.00	0.00	0.90	0.00
6.13	93.57	2.00	0.00	0.90	0.00	6.18	88.86	2.00	0.00	0.90	0.00
6.27	83.88	2.00	0.00	0.89	0.00	6.30	78.06	2.00	0.00	0.89	0.00
6.37	73.27	2.00	0.00	0.89	0.00	6.48	68.21	2.00	0.00	0.89	0.00
6.55	65.41	2.00	0.00	0.89	0.00	6.64	65.68	2.00	0.00	0.89	0.00
6.69	67.50	2.00	0.00	0.89	0.00	6.73	69.84	2.00	0.00	0.89	0.00
6.77	72.73	2.00	0.00	0.89	0.00	6.88	73.89	2.00	0.00	0.88	0.00
6.92	71.60	2.00	0.00	0.88	0.00	6.97	68.92	2.00	0.00	0.88	0.00
7.06	66.98	2.00	0.00	0.88	0.00	7.11	67.30	2.00	0.00	0.88	0.00
7.16	66.31	2.00	0.00	0.88	0.00	7.26	65.73	2.00	0.00	0.88	0.00
7.31	65.94	2.00	0.00	0.88	0.00	7.42	66.46	2.00	0.00	0.87	0.00
7.48	67.11	2.00	0.00	0.87	0.00	7.53	67.65	2.00	0.00	0.87	0.00
7.60	68.09	2.00	0.00	0.87	0.00	7.66	68.40	2.00	0.00	0.87	0.00
7.72	68.50	2.00	0.00	0.87	0.00	7.79	68.66	2.00	0.00	0.87	0.00
7.84	69.02	2.00	0.00	0.87	0.00	7.90	69.55	2.00	0.00	0.87	0.00
7.97	70.12	2.00	0.00	0.86	0.00	8.01	70.09	2.00	0.00	0.86	0.00
8.09	69.00	2.00	0.00	0.86	0.00	8.15	65.95	2.00	0.00	0.86	0.00
8.27	63.74	2.00	0.00	0.86	0.00	8.32	61.23	2.00	0.00	0.86	0.00
8.37	60.46	2.00	0.00	0.86	0.00	8.45	60.10	2.00	0.00	0.86	0.00
8.50	61.94	2.00	0.00	0.86	0.00	8.58	64.39	2.00	0.00	0.85	0.00
8.63	66.51	2.00	0.00	0.85	0.00	8.69	68.19	2.00	0.00	0.85	0.00
8.76	71.17	2.00	0.00	0.85	0.00	8.87	73.67	2.00	0.00	0.85	0.00
8.94	74.65	2.00	0.00	0.85	0.00	8.99	73.69	2.00	0.00	0.85	0.00
9.04	72.26	2.00	0.00	0.85	0.00	9.12	71.78	2.00	0.00	0.85	0.00
9.16	71.88	0.24	2.59	0.84	0.01	9.21	73.24	2.00	0.00	0.84	0.00
9.29	74.76	2.00	0.00	0.84	0.00	9.34	76.43	2.00	0.00	0.84	0.00
9.42	77.78	0.26	2.41	0.84	0.02	9.47	79.49	0.26	2.37	0.84	0.01
9.52	82.68	0.27	2.29	0.84	0.01	9.60	86.39	0.29	2.21	0.84	0.02
9.65	90.98	0.31	2.11	0.84	0.01	9.71	95.01	0.33	2.04	0.84	0.02
9.78	99.56	2.00	0.00	0.83	0.00	9.90	103.68	2.00	0.00	0.83	0.00
9.95	105.94	2.00	0.00	0.83	0.00	10.02	105.72	0.38	1.85	0.83	0.01
10.09	104.68	0.38	1.87	0.83	0.02	10.15	106.41	0.39	1.84	0.83	0.01
10.22	109.55	0.41	1.79	0.83	0.02	10.27	112.85	2.00	0.00	0.83	0.00
10.33	114.39	2.00	0.00	0.82	0.00	10.40	114.81	2.00	0.00	0.82	0.00
10.48	114.46	2.00	0.00	0.82	0.00	10.51	112.88	2.00	0.00	0.82	0.00
10.57	110.95	2.00	0.00	0.82	0.00	10.64	107.85	2.00	0.00	0.82	0.00
10.74	104.51	2.00	0.00	0.82	0.00	10.81	100.79	0.34	1.90	0.82	0.01
10.88	97.87	0.33	1.94	0.82	0.02	10.92	94.84	0.31	1.99	0.81	0.01
10.99	92.68	2.00	0.00	0.81	0.00	11.05	90.55	2.00	0.00	0.81	0.00
11.11	88.64	2.00	0.00	0.81	0.00	11.18	86.62	2.00	0.00	0.81	0.00
11.23	84.28	2.00	0.00	0.81	0.00	11.34	82.08	2.00	0.00	0.81	0.00
11.41	80.26	2.00	0.00	0.81	0.00	11.45	79.03	2.00	0.00	0.81	0.00
11.51	78.45	2.00	0.00	0.80	0.00	11.58	78.82	2.00	0.00	0.80	0.00
11.65	80.83	2.00	0.00	0.80	0.00	11.71	83.61	2.00	0.00	0.80	0.00
11.76	85.75	2.00	0.00	0.80	0.00	11.90	86.60	2.00	0.00	0.80	0.00
11.94	86.28	2.00	0.00	0.80	0.00	12.01	85.21	0.26	2.12	0.80	0.02
12.07	84.34	0.26	2.14	0.80	0.02	12.12	83.69	0.25	2.15	0.79	0.01
12.19	82.87	0.25	2.16	0.79	0.02	12.25	81.55	0.24	2.19	0.79	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
12.30	79.41	0.24	2.23	0.79	0.01	12.38	77.29	0.23	2.28	0.79	0.02
12.48	75.90	2.00	0.00	0.79	0.00	12.55	75.78	2.00	0.00	0.79	0.00
12.60	76.56	2.00	0.00	0.79	0.00	12.65	76.87	2.00	0.00	0.79	0.00
12.73	76.13	0.22	2.29	0.78	0.02	12.78	74.50	0.22	2.33	0.78	0.01
12.86	72.58	0.21	2.38	0.78	0.02	12.91	70.69	0.21	2.43	0.78	0.01
12.96	68.81	0.20	2.48	0.78	0.02	13.04	66.27	0.20	2.55	0.78	0.02
13.09	63.10	0.19	2.65	0.78	0.02	13.16	60.36	0.18	2.75	0.78	0.02
13.22	58.96	0.18	2.80	0.78	0.02	13.28	59.18	0.18	2.78	0.77	0.02
13.35	61.85	0.19	2.68	0.77	0.02	13.40	67.25	2.00	0.00	0.77	0.00
13.49	72.97	2.00	0.00	0.77	0.00	13.56	77.52	2.00	0.00	0.77	0.00
13.61	81.93	2.00	0.00	0.77	0.00	13.69	86.60	2.00	0.00	0.77	0.00
13.74	91.66	2.00	0.00	0.77	0.00	13.81	96.14	2.00	0.00	0.77	0.00
13.87	100.82	2.00	0.00	0.76	0.00	13.93	104.75	2.00	0.00	0.76	0.00
13.99	107.74	2.00	0.00	0.76	0.00	14.05	109.09	2.00	0.00	0.76	0.00
14.12	109.03	2.00	0.00	0.76	0.00	14.18	106.57	2.00	0.00	0.76	0.00
14.28	101.86	2.00	0.00	0.76	0.00	14.36	96.62	2.00	0.00	0.76	0.00
14.40	90.82	0.27	1.91	0.76	0.01	14.48	86.02	2.00	0.00	0.75	0.00
14.53	81.15	2.00	0.00	0.75	0.00	14.58	77.76	2.00	0.00	0.75	0.00
14.66	75.20	2.00	0.00	0.75	0.00	14.71	71.67	2.00	0.00	0.75	0.00
14.94	70.19	2.00	0.00	0.75	0.00	15.06	69.01	2.00	0.00	0.74	0.00
15.15	70.69	2.00	0.00	0.74	0.00	15.33	71.29	2.00	0.00	0.74	0.00
15.38	74.23	0.20	2.21	0.74	0.01	15.55	77.58	0.21	2.12	0.74	0.04
15.63	81.61	0.23	2.03	0.74	0.02	15.68	84.70	0.24	1.97	0.73	0.01
15.74	88.02	0.25	1.90	0.73	0.01	15.82	90.33	0.26	1.86	0.73	0.02
15.86	91.53	0.26	1.84	0.73	0.01	15.93	91.76	0.26	1.83	0.73	0.02
15.99	92.02	0.26	1.82	0.73	0.01	16.04	84.45	0.23	1.95	0.73	0.01
16.12	74.87	0.20	2.15	0.73	0.02	16.17	64.37	0.18	2.43	0.73	0.02
16.26	63.04	0.18	2.47	0.72	0.02	16.36	62.67	0.18	2.48	0.72	0.03
16.43	61.25	0.17	2.52	0.72	0.02	16.48	61.39	0.17	2.51	0.72	0.01
16.58	63.82	0.18	2.43	0.72	0.03	16.66	67.51	0.18	2.31	0.72	0.02
16.70	71.83	0.19	2.20	0.72	0.01	16.77	75.52	0.20	2.11	0.72	0.02
16.83	79.34	0.21	2.02	0.71	0.02	16.88	83.16	0.23	1.94	0.71	0.01
16.95	86.98	0.24	1.87	0.71	0.02	17.01	91.37	2.00	0.00	0.71	0.00
17.11	95.01	2.00	0.00	0.71	0.00	17.17	97.80	2.00	0.00	0.71	0.00
17.23	99.24	2.00	0.00	0.71	0.00	17.29	100.06	2.00	0.00	0.71	0.00
17.35	100.03	2.00	0.00	0.71	0.00	17.41	99.69	2.00	0.00	0.70	0.00
17.51	98.58	2.00	0.00	0.70	0.00	17.58	98.37	2.00	0.00	0.70	0.00
17.62	98.52	2.00	0.00	0.70	0.00	17.69	99.53	2.00	0.00	0.70	0.00
17.76	100.36	2.00	0.00	0.70	0.00	17.81	101.40	2.00	0.00	0.70	0.00
17.87	102.82	2.00	0.00	0.70	0.00	17.94	104.18	2.00	0.00	0.70	0.00
17.99	104.27	2.00	0.00	0.70	0.00	18.06	103.04	2.00	0.00	0.69	0.00
18.11	101.15	2.00	0.00	0.69	0.00	18.24	100.12	2.00	0.00	0.69	0.00
18.29	100.30	2.00	0.00	0.69	0.00	18.34	101.71	2.00	0.00	0.69	0.00
18.40	103.86	2.00	0.00	0.69	0.00	18.47	106.10	2.00	0.00	0.69	0.00
18.51	109.98	2.00	0.00	0.69	0.00	18.57	113.12	2.00	0.00	0.69	0.00
18.64	116.67	2.00	0.00	0.68	0.00	18.73	118.29	2.00	0.00	0.68	0.00
18.86	120.72	2.00	0.00	0.68	0.00	18.91	126.82	2.00	0.00	0.68	0.00
18.96	125.49	2.00	0.00	0.68	0.00	19.03	129.24	2.00	0.00	0.68	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
19.09	139.72	0.55	1.20	0.68	0.01	19.20	176.87	0.97	0.35	0.67	0.00
19.26	217.71	2.00	0.00	0.67	0.00	19.31	242.03	2.00	0.00	0.67	0.00
19.37	255.46	2.00	0.00	0.67	0.00	19.43	265.90	2.00	0.00	0.67	0.00
19.53	279.74	2.00	0.00	0.67	0.00	19.58	295.73	2.00	0.00	0.67	0.00
19.75	304.66	2.00	0.00	0.67	0.00	19.80	313.10	2.00	0.00	0.66	0.00
19.85	316.15	2.00	0.00	0.66	0.00	19.92	317.97	2.00	0.00	0.66	0.00
19.98	319.17	2.00	0.00	0.66	0.00	20.03	319.02	2.00	0.00	0.66	0.00
20.08	317.09	2.00	0.00	0.66	0.00	20.15	313.41	2.00	0.00	0.66	0.00
20.20	311.30	2.00	0.00	0.66	0.00	20.26	311.48	2.00	0.00	0.66	0.00
20.33	313.62	2.00	0.00	0.66	0.00	20.38	315.38	2.00	0.00	0.65	0.00
20.42	315.62	2.00	0.00	0.65	0.00	20.57	313.32	2.00	0.00	0.65	0.00
20.60	311.23	2.00	0.00	0.65	0.00	20.68	309.35	2.00	0.00	0.65	0.00
20.72	307.68	2.00	0.00	0.65	0.00	20.77	305.46	2.00	0.00	0.65	0.00
20.82	302.89	2.00	0.00	0.65	0.00	20.91	300.98	2.00	0.00	0.65	0.00
20.95	298.63	2.00	0.00	0.64	0.00	21.04	295.21	2.00	0.00	0.64	0.00
21.09	291.15	2.00	0.00	0.64	0.00	21.15	286.53	2.00	0.00	0.64	0.00
21.25	282.39	2.00	0.00	0.64	0.00	21.30	279.52	2.00	0.00	0.64	0.00
21.34	278.67	2.00	0.00	0.64	0.00	21.40	277.31	2.00	0.00	0.64	0.00
21.48	276.39	2.00	0.00	0.64	0.00	21.53	279.12	2.00	0.00	0.64	0.00
21.63	284.62	2.00	0.00	0.63	0.00	21.69	290.69	2.00	0.00	0.63	0.00
21.75	293.02	2.00	0.00	0.63	0.00	21.85	292.79	2.00	0.00	0.63	0.00
21.92	293.13	2.00	0.00	0.63	0.00	21.97	295.24	2.00	0.00	0.63	0.00
22.03	297.52	2.00	0.00	0.63	0.00	22.10	297.60	2.00	0.00	0.63	0.00
22.14	295.66	2.00	0.00	0.62	0.00	22.23	292.59	2.00	0.00	0.62	0.00
22.28	289.98	2.00	0.00	0.62	0.00	22.32	284.22	2.00	0.00	0.62	0.00
22.39	280.83	2.00	0.00	0.62	0.00	22.48	278.89	2.00	0.00	0.62	0.00
22.55	280.61	2.00	0.00	0.62	0.00	22.57	280.51	2.00	0.00	0.62	0.00
22.66	279.08	2.00	0.00	0.62	0.00	22.71	278.16	2.00	0.00	0.62	0.00
22.78	277.36	2.00	0.00	0.61	0.00	22.84	276.35	2.00	0.00	0.61	0.00
22.92	275.49	2.00	0.00	0.61	0.00	22.97	275.50	2.00	0.00	0.61	0.00
23.04	275.63	2.00	0.00	0.61	0.00	23.14	275.59	2.00	0.00	0.61	0.00
23.18	275.25	2.00	0.00	0.61	0.00	23.27	274.57	2.00	0.00	0.61	0.00
23.30	273.70	2.00	0.00	0.61	0.00	23.36	271.19	2.00	0.00	0.60	0.00
23.43	268.43	2.00	0.00	0.60	0.00	23.53	266.55	2.00	0.00	0.60	0.00
23.59	266.54	2.00	0.00	0.60	0.00	23.63	267.17	2.00	0.00	0.60	0.00
23.72	267.64	2.00	0.00	0.60	0.00	23.78	267.64	2.00	0.00	0.60	0.00
23.88	267.30	2.00	0.00	0.60	0.00	23.99	266.34	2.00	0.00	0.59	0.00
24.03	266.14	2.00	0.00	0.59	0.00	24.08	266.29	2.00	0.00	0.59	0.00
24.14	266.63	2.00	0.00	0.59	0.00	24.21	265.66	2.00	0.00	0.59	0.00
24.26	261.81	2.00	0.00	0.59	0.00	24.33	256.63	2.00	0.00	0.59	0.00
24.37	252.45	2.00	0.00	0.59	0.00	24.43	250.86	2.00	0.00	0.59	0.00
24.52	249.84	2.00	0.00	0.58	0.00	24.56	249.35	2.00	0.00	0.58	0.00
24.63	248.84	2.00	0.00	0.58	0.00	24.69	248.68	2.00	0.00	0.58	0.00
24.75	248.41	2.00	0.00	0.58	0.00	24.82	247.36	2.00	0.00	0.58	0.00
24.87	247.74	2.00	0.00	0.58	0.00	25.00	246.34	2.00	0.00	0.58	0.00
25.05	247.91	2.00	0.00	0.58	0.00	25.11	246.99	2.00	0.00	0.57	0.00
25.15	249.19	2.00	0.00	0.57	0.00	25.20	247.38	2.00	0.00	0.57	0.00
25.29	244.47	2.00	0.00	0.57	0.00	25.37	239.54	2.00	0.00	0.57	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
25.42	236.15	2.00	0.00	0.57	0.00	25.47	235.09	2.00	0.00	0.57	0.00
25.55	234.62	2.00	0.00	0.57	0.00	25.64	234.98	2.00	0.00	0.57	0.00
25.69	234.78	2.00	0.00	0.56	0.00	25.74	234.54	2.00	0.00	0.56	0.00
25.80	232.60	2.00	0.00	0.56	0.00	25.86	227.62	2.00	0.00	0.56	0.00
25.97	221.11	2.00	0.00	0.56	0.00	26.04	215.58	2.00	0.00	0.56	0.00
26.08	213.11	2.00	0.00	0.56	0.00	26.13	211.45	2.00	0.00	0.56	0.00
26.20	209.00	2.00	0.00	0.56	0.00	26.26	204.34	2.00	0.00	0.56	0.00
26.37	198.81	1.27	0.10	0.55	0.00	26.43	193.36	1.17	0.14	0.55	0.00
26.48	189.10	1.11	0.20	0.55	0.00	26.54	185.82	1.06	0.20	0.55	0.00
26.61	184.89	1.04	0.27	0.55	0.00	26.66	187.82	1.09	0.20	0.55	0.00
26.73	196.09	1.22	0.14	0.55	0.00	26.84	208.61	2.00	0.00	0.55	0.00
26.92	223.80	2.00	0.00	0.54	0.00	26.96	237.43	2.00	0.00	0.54	0.00
27.02	248.62	2.00	0.00	0.54	0.00	27.09	257.55	2.00	0.00	0.54	0.00
27.14	264.99	2.00	0.00	0.54	0.00	27.21	269.49	2.00	0.00	0.54	0.00
27.27	271.77	2.00	0.00	0.54	0.00	27.33	272.68	2.00	0.00	0.54	0.00
27.40	273.01	2.00	0.00	0.54	0.00	27.45	272.25	2.00	0.00	0.53	0.00
27.51	269.84	2.00	0.00	0.53	0.00	27.58	264.63	2.00	0.00	0.53	0.00
27.69	258.71	2.00	0.00	0.53	0.00	27.76	252.91	2.00	0.00	0.53	0.00
27.81	244.09	2.00	0.00	0.53	0.00	27.85	237.61	2.00	0.00	0.53	0.00
27.92	233.21	2.00	0.00	0.53	0.00	27.97	233.41	2.00	0.00	0.53	0.00
28.06	230.68	2.00	0.00	0.52	0.00	28.13	224.99	2.00	0.00	0.52	0.00
28.19	218.90	2.00	0.00	0.52	0.00	28.24	213.16	2.00	0.00	0.52	0.00
28.30	208.93	2.00	0.00	0.52	0.00	28.36	206.82	2.00	0.00	0.52	0.00
28.41	207.13	2.00	0.00	0.52	0.00	28.53	207.95	2.00	0.00	0.52	0.00
28.59	208.14	2.00	0.00	0.52	0.00	28.63	206.47	2.00	0.00	0.51	0.00
28.70	203.16	2.00	0.00	0.51	0.00	28.76	200.48	2.00	0.00	0.51	0.00
28.81	197.90	1.24	0.13	0.51	0.00	28.94	197.23	1.23	0.13	0.51	0.00
28.99	197.98	1.24	0.13	0.51	0.00	29.05	201.45	2.00	0.00	0.51	0.00
29.12	204.94	2.00	0.00	0.51	0.00	29.16	208.38	2.00	0.00	0.51	0.00
29.22	211.22	2.00	0.00	0.50	0.00	29.29	214.40	2.00	0.00	0.50	0.00
29.40	216.99	2.00	0.00	0.50	0.00	29.47	218.32	2.00	0.00	0.50	0.00
29.52	219.13	2.00	0.00	0.50	0.00	29.62	219.91	2.00	0.00	0.50	0.00
29.69	221.36	2.00	0.00	0.50	0.00	29.74	223.25	2.00	0.00	0.50	0.00
29.80	224.94	2.00	0.00	0.49	0.00	29.91	225.13	2.00	0.00	0.49	0.00
29.99	224.06	2.00	0.00	0.49	0.00	30.05	222.39	2.00	0.00	0.49	0.00
30.10	221.79	2.00	0.00	0.49	0.00	30.17	221.34	2.00	0.00	0.49	0.00
30.22	221.38	2.00	0.00	0.49	0.00	30.29	221.13	2.00	0.00	0.49	0.00
30.34	221.61	2.00	0.00	0.49	0.00	30.46	221.99	2.00	0.00	0.48	0.00
30.52	222.39	2.00	0.00	0.48	0.00	30.58	222.07	2.00	0.00	0.48	0.00
30.64	221.28	2.00	0.00	0.48	0.00	30.69	220.54	2.00	0.00	0.48	0.00
30.75	219.38	2.00	0.00	0.48	0.00	30.81	216.93	2.00	0.00	0.48	0.00
30.84	213.31	2.00	0.00	0.48	0.00	30.93	210.73	2.00	0.00	0.48	0.00
31.01	209.72	2.00	0.00	0.47	0.00	31.05	210.20	2.00	0.00	0.47	0.00
31.15	209.19	2.00	0.00	0.47	0.00	31.20	207.43	2.00	0.00	0.47	0.00
31.24	205.19	2.00	0.00	0.47	0.00	31.31	203.88	2.00	0.00	0.47	0.00
31.38	203.17	2.00	0.00	0.47	0.00	31.50	202.65	2.00	0.00	0.47	0.00
31.55	201.82	2.00	0.00	0.47	0.00	31.60	200.58	2.00	0.00	0.46	0.00
31.66	198.14	1.25	0.12	0.46	0.00	31.73	193.76	1.18	0.12	0.46	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
31.78	187.82	1.08	0.17	0.46	0.00	31.84	180.64	0.98	0.22	0.46	0.00
31.91	170.29	0.84	0.43	0.46	0.00	32.02	160.18	0.72	0.58	0.46	0.01
32.08	152.74	0.64	0.75	0.46	0.01	32.13	150.62	0.62	0.76	0.46	0.00
32.19	151.39	0.63	0.75	0.45	0.01	32.26	155.86	0.67	0.59	0.45	0.00
32.30	162.87	0.75	0.56	0.45	0.00	32.36	170.43	0.84	0.42	0.45	0.00
32.42	177.07	0.93	0.30	0.45	0.00	32.48	183.52	1.02	0.23	0.45	0.00
32.59	188.62	1.10	0.16	0.45	0.00	32.65	192.59	1.16	0.11	0.45	0.00
32.71	193.66	1.18	0.11	0.45	0.00	32.78	193.11	1.17	0.11	0.44	0.00
32.83	192.31	1.15	0.11	0.44	0.00	32.89	192.38	1.16	0.11	0.44	0.00
32.97	194.38	1.19	0.11	0.44	0.00	33.02	197.87	1.25	0.11	0.44	0.00
33.07	201.55	2.00	0.00	0.44	0.00	33.15	204.27	2.00	0.00	0.44	0.00
33.21	205.58	2.00	0.00	0.44	0.00	33.27	204.98	2.00	0.00	0.44	0.00
33.37	203.30	2.00	0.00	0.43	0.00	33.45	200.84	2.00	0.00	0.43	0.00
33.50	198.26	1.26	0.08	0.43	0.00	33.58	190.93	1.13	0.16	0.43	0.00
33.63	186.66	1.07	0.16	0.43	0.00	33.68	183.72	1.03	0.22	0.43	0.00
33.78	186.71	1.07	0.16	0.43	0.00	33.85	189.21	1.11	0.16	0.43	0.00
33.91	193.59	1.18	0.11	0.43	0.00	33.98	199.18	1.27	0.08	0.42	0.00
34.03	204.90	2.00	0.00	0.42	0.00	34.08	210.09	2.00	0.00	0.42	0.00
34.16	214.51	2.00	0.00	0.42	0.00	34.20	220.01	2.00	0.00	0.42	0.00
34.31	224.60	2.00	0.00	0.42	0.00	34.38	228.77	2.00	0.00	0.42	0.00
34.43	231.72	2.00	0.00	0.42	0.00	34.61	233.02	2.00	0.00	0.41	0.00
34.67	233.22	2.00	0.00	0.41	0.00	34.73	231.78	2.00	0.00	0.41	0.00
34.78	229.37	2.00	0.00	0.41	0.00	34.83	225.07	2.00	0.00	0.41	0.00
34.91	218.22	2.00	0.00	0.41	0.00	34.96	211.28	2.00	0.00	0.41	0.00
35.01	206.40	2.00	0.00	0.41	0.00	35.08	204.87	2.00	0.00	0.41	0.00
35.14	205.54	2.00	0.00	0.40	0.00	35.18	207.08	2.00	0.00	0.40	0.00
35.25	208.30	2.00	0.00	0.40	0.00	35.31	209.63	2.00	0.00	0.40	0.00
35.37	210.68	2.00	0.00	0.40	0.00	35.44	210.70	2.00	0.00	0.40	0.00
35.49	208.72	2.00	0.00	0.40	0.00	35.55	204.96	2.00	0.00	0.40	0.00
35.62	200.40	2.00	0.00	0.40	0.00	35.66	196.15	1.22	0.10	0.40	0.00
35.71	192.13	1.15	0.10	0.39	0.00	35.83	187.51	1.08	0.14	0.39	0.00
35.88	181.67	0.99	0.20	0.39	0.00	35.96	173.32	0.89	0.27	0.39	0.00
36.02	163.90	0.76	0.38	0.39	0.00	36.08	151.87	0.63	0.64	0.39	0.00
36.15	132.70	0.46	0.72	0.39	0.01	36.26	124.96	2.00	0.00	0.39	0.00
36.33	117.73	2.00	0.00	0.38	0.00	36.38	116.70	2.00	0.00	0.38	0.00
36.45	116.16	2.00	0.00	0.38	0.00	36.51	116.87	2.00	0.00	0.38	0.00
36.57	117.50	2.00	0.00	0.38	0.00	36.64	118.31	2.00	0.00	0.38	0.00
36.69	116.76	2.00	0.00	0.38	0.00	36.76	113.74	2.00	0.00	0.38	0.00
36.77	111.74	2.00	0.00	0.38	0.00	36.84	112.30	2.00	0.00	0.38	0.00
36.88	113.71	2.00	0.00	0.37	0.00	37.00	115.06	2.00	0.00	0.37	0.00
37.05	116.11	2.00	0.00	0.37	0.00	37.11	116.97	2.00	0.00	0.37	0.00
37.19	117.01	2.00	0.00	0.37	0.00	37.23	116.28	2.00	0.00	0.37	0.00
37.28	113.96	2.00	0.00	0.37	0.00	37.36	111.82	2.00	0.00	0.37	0.00
37.41	110.83	2.00	0.00	0.37	0.00	37.47	110.74	0.32	0.78	0.36	0.01
37.54	111.51	0.33	0.78	0.36	0.01	37.66	109.28	2.00	0.00	0.36	0.00
37.71	105.51	2.00	0.00	0.36	0.00	37.76	99.76	2.00	0.00	0.36	0.00
37.83	95.83	2.00	0.00	0.36	0.00	37.89	93.00	2.00	0.00	0.36	0.00
37.95	91.30	2.00	0.00	0.36	0.00	38.02	90.70	2.00	0.00	0.36	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
38.07	89.27	2.00	0.00	0.35	0.00	38.13	88.31	2.00	0.00	0.35	0.00
38.20	87.38	2.00	0.00	0.35	0.00	38.33	89.08	2.00	0.00	0.35	0.00
38.38	91.70	0.24	0.88	0.35	0.01	38.43	95.94	0.25	0.84	0.35	0.01
38.50	101.01	0.27	0.81	0.35	0.01	38.56	107.65	2.00	0.00	0.35	0.00
38.61	114.20	2.00	0.00	0.35	0.00	38.68	121.47	2.00	0.00	0.34	0.00
38.78	126.87	2.00	0.00	0.34	0.00	38.86	130.75	2.00	0.00	0.34	0.00
38.92	131.81	2.00	0.00	0.34	0.00	38.96	132.17	2.00	0.00	0.34	0.00
39.04	132.37	2.00	0.00	0.34	0.00	39.09	132.20	2.00	0.00	0.34	0.00
39.16	128.90	2.00	0.00	0.34	0.00	39.27	124.20	2.00	0.00	0.33	0.00
39.32	119.90	2.00	0.00	0.33	0.00	39.39	118.26	2.00	0.00	0.33	0.00
39.44	115.19	2.00	0.00	0.33	0.00	39.50	110.09	2.00	0.00	0.33	0.00
39.57	101.01	2.00	0.00	0.33	0.00	39.62	94.21	2.00	0.00	0.33	0.00
39.67	90.71	2.00	0.00	0.33	0.00	39.73	91.45	2.00	0.00	0.33	0.00
39.79	92.31	2.00	0.00	0.33	0.00	39.84	92.23	2.00	0.00	0.32	0.00
39.91	91.45	2.00	0.00	0.32	0.00	39.98	89.57	2.00	0.00	0.32	0.00
40.06	87.39	2.00	0.00	0.32	0.00	40.11	84.85	2.00	0.00	0.32	0.00
40.19	82.60	2.00	0.00	0.32	0.00	40.24	79.07	2.00	0.00	0.32	0.00
40.33	74.08	2.00	0.00	0.32	0.00	40.38	68.62	2.00	0.00	0.32	0.00
40.43	65.07	2.00	0.00	0.31	0.00	40.55	64.13	2.00	0.00	0.31	0.00
40.59	64.67	2.00	0.00	0.31	0.00	40.67	66.28	2.00	0.00	0.31	0.00
40.73	68.46	2.00	0.00	0.31	0.00	40.77	71.41	2.00	0.00	0.31	0.00
40.85	72.96	2.00	0.00	0.31	0.00	40.90	72.64	2.00	0.00	0.31	0.00
41.03	70.93	2.00	0.00	0.30	0.00	41.08	68.88	2.00	0.00	0.30	0.00
41.14	67.98	2.00	0.00	0.30	0.00	41.21	67.93	2.00	0.00	0.30	0.00
41.33	68.95	2.00	0.00	0.30	0.00	41.38	70.57	2.00	0.00	0.30	0.00
41.43	72.43	2.00	0.00	0.30	0.00	41.47	75.09	2.00	0.00	0.30	0.00
41.56	77.66	2.00	0.00	0.30	0.00	41.61	80.81	2.00	0.00	0.29	0.00
41.73	83.36	2.00	0.00	0.29	0.00	41.78	85.78	2.00	0.00	0.29	0.00
41.83	87.53	2.00	0.00	0.29	0.00	41.89	88.74	2.00	0.00	0.29	0.00
41.96	89.05	2.00	0.00	0.29	0.00	42.00	87.74	2.00	0.00	0.29	0.00
42.07	85.09	2.00	0.00	0.29	0.00	42.14	82.57	2.00	0.00	0.29	0.00
42.25	80.50	2.00	0.00	0.28	0.00	42.31	79.75	2.00	0.00	0.28	0.00
42.37	79.36	2.00	0.00	0.28	0.00	42.44	79.62	2.00	0.00	0.28	0.00
42.49	78.11	2.00	0.00	0.28	0.00	42.55	78.42	2.00	0.00	0.28	0.00
42.62	79.80	2.00	0.00	0.28	0.00	42.67	84.45	2.00	0.00	0.28	0.00
42.79	87.39	2.00	0.00	0.27	0.00	42.84	89.28	2.00	0.00	0.27	0.00
42.89	88.04	2.00	0.00	0.27	0.00	43.02	85.86	2.00	0.00	0.27	0.00
43.07	82.90	2.00	0.00	0.27	0.00	43.13	81.49	2.00	0.00	0.27	0.00
43.17	81.05	2.00	0.00	0.27	0.00	43.25	81.59	2.00	0.00	0.27	0.00
43.30	82.36	2.00	0.00	0.27	0.00	43.35	83.02	2.00	0.00	0.27	0.00
43.39	84.12	2.00	0.00	0.26	0.00	43.48	85.45	2.00	0.00	0.26	0.00
43.52	87.14	2.00	0.00	0.26	0.00	43.57	88.39	2.00	0.00	0.26	0.00
43.66	88.29	2.00	0.00	0.26	0.00	43.75	87.21	2.00	0.00	0.26	0.00
43.79	85.22	2.00	0.00	0.26	0.00	43.88	83.86	2.00	0.00	0.26	0.00
43.92	82.69	2.00	0.00	0.26	0.00	43.96	81.80	2.00	0.00	0.25	0.00
44.06	80.90	2.00	0.00	0.25	0.00	44.10	79.44	2.00	0.00	0.25	0.00
44.18	78.55	2.00	0.00	0.25	0.00	44.23	77.78	2.00	0.00	0.25	0.00
44.36	77.66	2.00	0.00	0.25	0.00	44.41	78.43	2.00	0.00	0.25	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
44.47	81.56	2.00	0.00	0.25	0.00	44.54	86.14	2.00	0.00	0.25	0.00
44.58	90.93	2.00	0.00	0.24	0.00	44.63	96.36	2.00	0.00	0.24	0.00
44.76	101.14	2.00	0.00	0.24	0.00	44.81	106.22	2.00	0.00	0.24	0.00
44.88	110.59	2.00	0.00	0.24	0.00	44.94	114.80	2.00	0.00	0.24	0.00
44.99	117.83	2.00	0.00	0.24	0.00	45.05	119.74	2.00	0.00	0.24	0.00
45.12	121.29	2.00	0.00	0.24	0.00	45.19	122.55	2.00	0.00	0.23	0.00
45.25	123.17	2.00	0.00	0.23	0.00	45.29	123.54	2.00	0.00	0.23	0.00
45.35	124.01	2.00	0.00	0.23	0.00	45.42	124.41	2.00	0.00	0.23	0.00
45.49	124.77	2.00	0.00	0.23	0.00	45.55	124.68	2.00	0.00	0.23	0.00
45.65	124.62	2.00	0.00	0.23	0.00	45.73	124.47	2.00	0.00	0.22	0.00
45.78	124.40	2.00	0.00	0.22	0.00	45.85	123.80	2.00	0.00	0.22	0.00
45.91	122.96	2.00	0.00	0.22	0.00	45.96	121.95	2.00	0.00	0.22	0.00
46.03	121.07	2.00	0.00	0.22	0.00	46.08	120.10	2.00	0.00	0.22	0.00
46.18	118.99	2.00	0.00	0.22	0.00	46.28	117.88	2.00	0.00	0.22	0.00
46.35	116.90	2.00	0.00	0.21	0.00	46.41	116.45	2.00	0.00	0.21	0.00
46.46	116.20	2.00	0.00	0.21	0.00	46.53	116.29	2.00	0.00	0.21	0.00
46.58	116.38	2.00	0.00	0.21	0.00	46.65	116.58	2.00	0.00	0.21	0.00
46.72	116.70	2.00	0.00	0.21	0.00	46.76	116.78	2.00	0.00	0.21	0.00
46.83	116.66	2.00	0.00	0.21	0.00	46.90	116.51	2.00	0.00	0.21	0.00
46.94	116.08	2.00	0.00	0.20	0.00	47.03	115.56	2.00	0.00	0.20	0.00
47.07	114.96	2.00	0.00	0.20	0.00	47.12	114.65	2.00	0.00	0.20	0.00
47.20	114.64	2.00	0.00	0.20	0.00	47.25	115.16	2.00	0.00	0.20	0.00
47.33	115.79	2.00	0.00	0.20	0.00	47.38	116.39	2.00	0.00	0.20	0.00
47.50	116.71	2.00	0.00	0.19	0.00	47.56	116.82	2.00	0.00	0.19	0.00
47.73	116.45	2.00	0.00	0.19	0.00	47.79	115.79	2.00	0.00	0.19	0.00
47.87	115.04	2.00	0.00	0.19	0.00	47.91	114.44	2.00	0.00	0.19	0.00
47.97	114.18	2.00	0.00	0.19	0.00	48.04	113.97	2.00	0.00	0.19	0.00
48.09	113.88	2.00	0.00	0.18	0.00	48.21	113.62	2.00	0.00	0.18	0.00
48.27	113.52	2.00	0.00	0.18	0.00	48.32	113.52	2.00	0.00	0.18	0.00
48.39	113.56	2.00	0.00	0.18	0.00	48.44	113.65	2.00	0.00	0.18	0.00
48.51	113.65	2.00	0.00	0.18	0.00	48.58	113.63	2.00	0.00	0.18	0.00
48.62	113.07	2.00	0.00	0.18	0.00	48.70	111.14	2.00	0.00	0.17	0.00
48.75	110.70	2.00	0.00	0.17	0.00	48.80	110.14	2.00	0.00	0.17	0.00
48.88	111.79	2.00	0.00	0.17	0.00	48.93	112.63	2.00	0.00	0.17	0.00
48.98	114.34	2.00	0.00	0.17	0.00	49.04	115.15	2.00	0.00	0.17	0.00
49.10	115.23	2.00	0.00	0.17	0.00	49.17	114.93	2.00	0.00	0.17	0.00
49.22	114.34	2.00	0.00	0.17	0.00	49.31	113.74	2.00	0.00	0.16	0.00
49.35	113.19	2.00	0.00	0.16	0.00	49.43	112.80	2.00	0.00	0.16	0.00
49.48	112.55	2.00	0.00	0.16	0.00	49.59	112.49	2.00	0.00	0.16	0.00
49.65	113.14	2.00	0.00	0.16	0.00	49.70	113.64	2.00	0.00	0.16	0.00
49.76	113.98	2.00	0.00	0.16	0.00	49.83	113.70	2.00	0.00	0.16	0.00
49.88	113.43	2.00	0.00	0.15	0.00	50.01	113.13	2.00	0.00	0.15	0.00

Total estimated settlement: 1.11

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

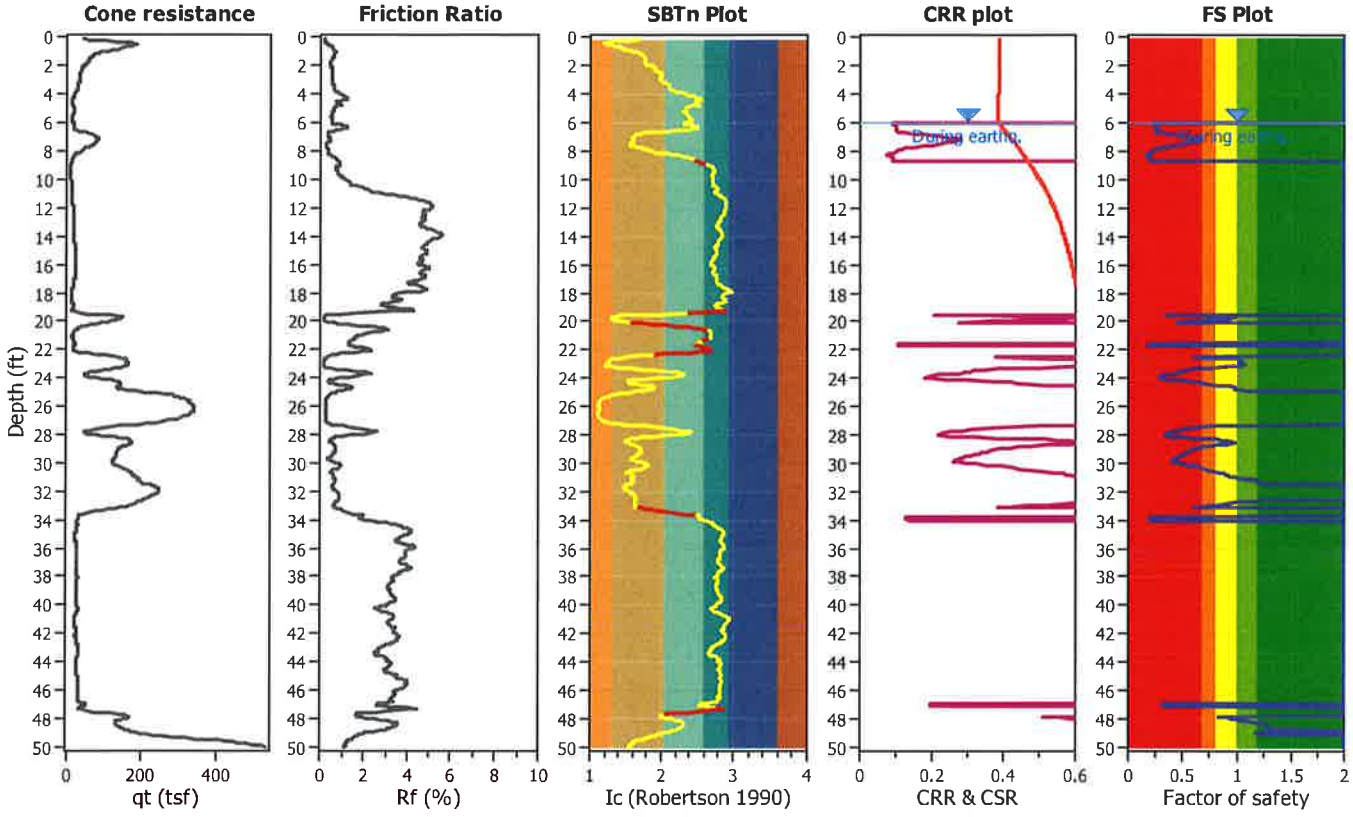
LIQUEFACTION ANALYSIS REPORT

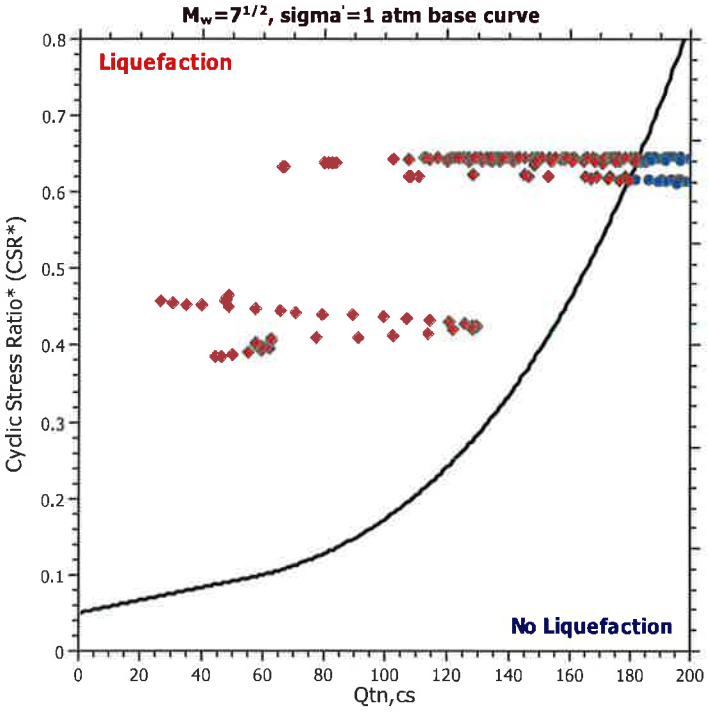
Project title : S-Line Upgrades **Location : Imperial County, CA**

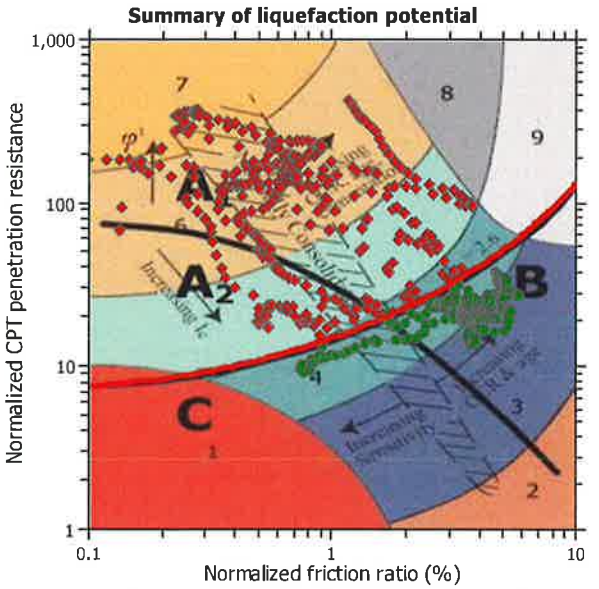
CPT file : CPT-18

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

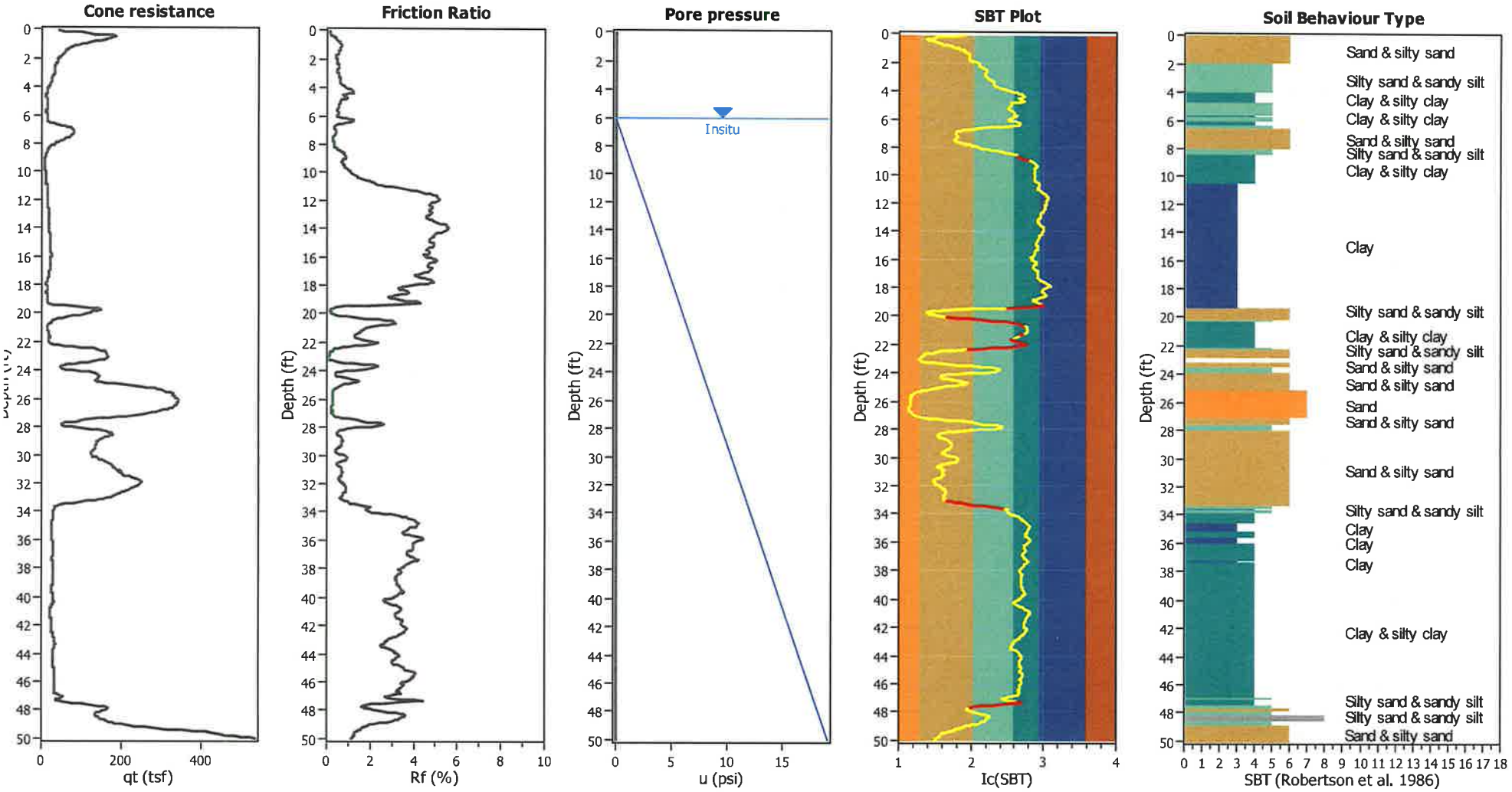






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



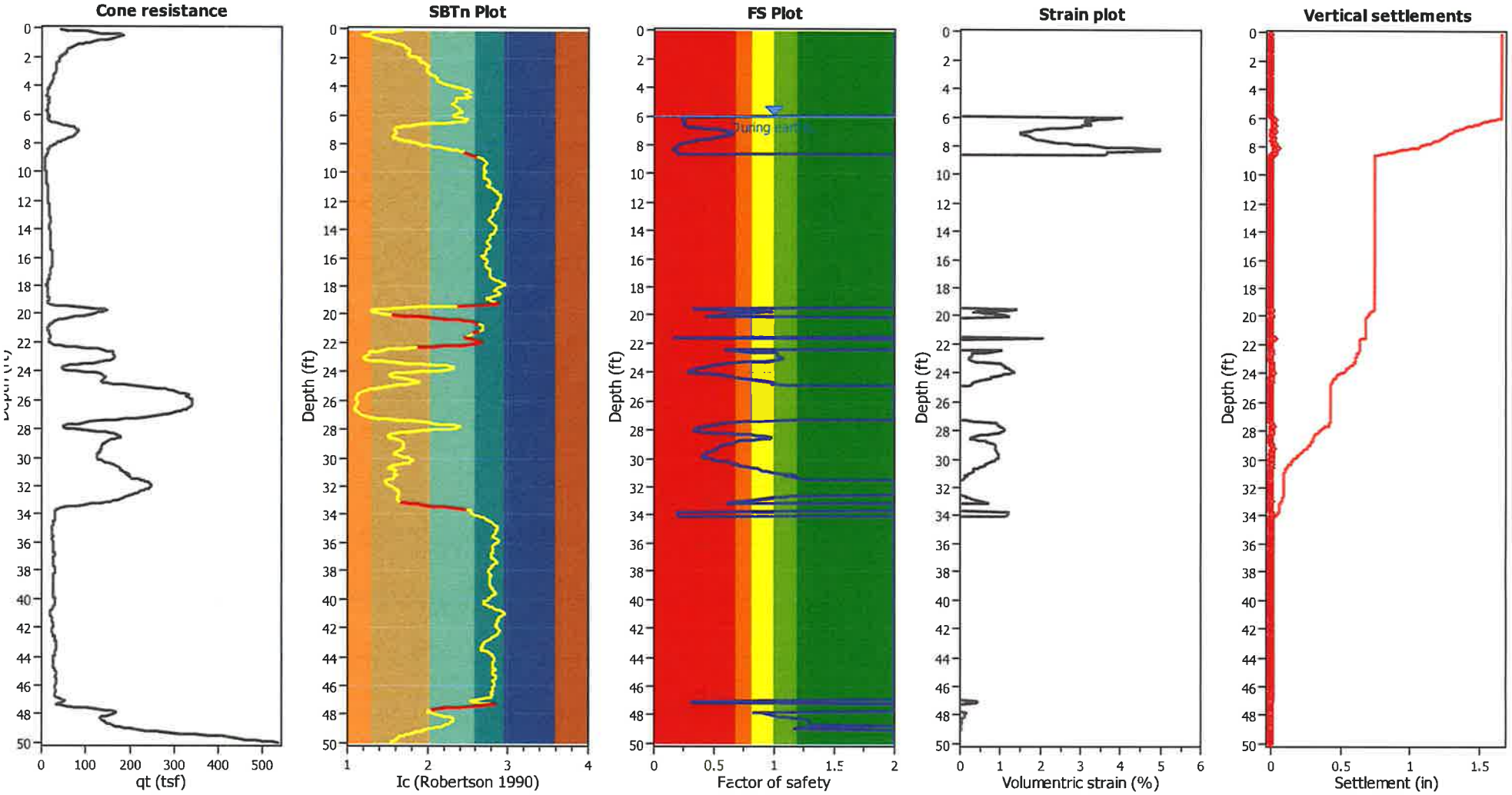
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.00	44.50	0.23	4.08	0.90	0.02	6.05	46.54	0.23	3.93	0.90	0.02
6.12	49.84	0.24	3.71	0.90	0.03	6.18	54.72	0.24	3.43	0.90	0.03
6.23	59.37	0.25	3.21	0.89	0.02	6.30	61.73	0.26	3.10	0.89	0.02
6.35	61.29	0.25	3.12	0.89	0.02	6.41	59.33	0.25	3.20	0.89	0.02
6.47	57.53	0.24	3.27	0.89	0.03	6.54	57.64	0.24	3.26	0.89	0.03
6.59	62.76	0.25	3.04	0.89	0.02	6.65	62.57	0.25	3.05	0.89	0.02
6.71	77.72	0.30	2.55	0.89	0.02	6.77	91.21	0.37	2.23	0.89	0.02
6.84	102.35	0.43	2.03	0.88	0.02	6.89	113.71	0.52	1.86	0.88	0.01
7.02	122.07	0.59	1.75	0.88	0.03	7.07	127.98	0.65	1.52	0.88	0.01
7.12	129.22	0.66	1.50	0.88	0.01	7.19	129.08	0.66	1.50	0.88	0.01
7.25	127.92	0.64	1.67	0.88	0.01	7.30	125.70	0.62	1.70	0.88	0.01
7.38	120.83	0.57	1.75	0.87	0.02	7.50	114.58	0.51	1.82	0.87	0.03
7.55	107.14	0.45	1.93	0.87	0.01	7.61	99.55	0.39	2.04	0.87	0.01
7.68	89.28	0.33	2.23	0.87	0.02	7.76	79.25	0.29	2.46	0.87	0.02
7.84	70.83	0.25	2.69	0.87	0.03	7.89	65.42	0.24	2.87	0.87	0.02
7.95	57.42	0.22	3.19	0.87	0.02	8.07	48.58	0.20	3.65	0.86	0.05
8.12	39.98	0.18	4.27	0.86	0.03	8.19	34.71	0.17	4.79	0.86	0.04
8.24	30.54	0.17	4.99	0.86	0.03	8.30	27.12	0.16	4.98	0.86	0.03
8.37	47.42	0.19	3.70	0.86	0.03	8.42	47.96	0.20	3.66	0.86	0.02
8.47	47.93	0.19	3.66	0.86	0.02	8.55	48.06	0.19	3.64	0.86	0.03
8.60	48.54	0.19	3.61	0.85	0.02	8.67	49.21	2.00	0.00	0.85	0.00
8.73	49.15	2.00	0.00	0.85	0.00	8.86	48.20	2.00	0.00	0.85	0.00
8.95	46.41	2.00	0.00	0.85	0.00	9.01	44.37	2.00	0.00	0.85	0.00
9.08	42.37	2.00	0.00	0.85	0.00	9.13	40.37	2.00	0.00	0.85	0.00
9.26	39.39	2.00	0.00	0.84	0.00	9.31	39.51	2.00	0.00	0.84	0.00
9.39	40.41	2.00	0.00	0.84	0.00	9.44	41.15	2.00	0.00	0.84	0.00
9.49	41.88	2.00	0.00	0.84	0.00	9.57	42.66	2.00	0.00	0.84	0.00
9.62	43.59	2.00	0.00	0.84	0.00	9.68	44.65	2.00	0.00	0.84	0.00
9.74	45.91	2.00	0.00	0.83	0.00	9.81	46.97	2.00	0.00	0.83	0.00
9.87	48.21	2.00	0.00	0.83	0.00	9.97	49.53	2.00	0.00	0.83	0.00
10.05	51.61	2.00	0.00	0.83	0.00	10.16	54.36	2.00	0.00	0.83	0.00
10.23	57.06	2.00	0.00	0.83	0.00	10.28	57.03	2.00	0.00	0.83	0.00
10.35	57.23	2.00	0.00	0.82	0.00	10.41	58.07	2.00	0.00	0.82	0.00
10.45	61.85	2.00	0.00	0.82	0.00	10.53	64.69	2.00	0.00	0.82	0.00
10.58	66.74	2.00	0.00	0.82	0.00	10.64	68.51	2.00	0.00	0.82	0.00
10.71	70.57	2.00	0.00	0.82	0.00	10.79	72.81	2.00	0.00	0.82	0.00
10.84	76.11	2.00	0.00	0.82	0.00	10.93	80.01	2.00	0.00	0.81	0.00
10.98	85.20	2.00	0.00	0.81	0.00	11.04	89.68	2.00	0.00	0.81	0.00
11.10	94.74	2.00	0.00	0.81	0.00	11.22	98.95	2.00	0.00	0.81	0.00
11.28	102.82	2.00	0.00	0.81	0.00	11.33	105.50	2.00	0.00	0.81	0.00
11.38	107.81	2.00	0.00	0.81	0.00	11.46	109.83	2.00	0.00	0.81	0.00
11.51	112.15	2.00	0.00	0.80	0.00	11.58	114.33	2.00	0.00	0.80	0.00
11.64	116.77	2.00	0.00	0.80	0.00	11.76	118.60	2.00	0.00	0.80	0.00
11.81	120.11	2.00	0.00	0.80	0.00	11.87	120.94	2.00	0.00	0.80	0.00
11.93	121.41	2.00	0.00	0.80	0.00	11.98	121.04	2.00	0.00	0.80	0.00
12.11	120.30	2.00	0.00	0.79	0.00	12.16	119.31	2.00	0.00	0.79	0.00
12.21	118.45	2.00	0.00	0.79	0.00	12.29	117.85	2.00	0.00	0.79	0.00
12.34	117.76	2.00	0.00	0.79	0.00	12.40	118.58	2.00	0.00	0.79	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
12.47	119.63	2.00	0.00	0.79	0.00	12.52	120.73	2.00	0.00	0.79	0.00
12.60	121.63	2.00	0.00	0.79	0.00	12.65	122.60	2.00	0.00	0.79	0.00
12.69	124.40	2.00	0.00	0.78	0.00	12.82	125.94	2.00	0.00	0.78	0.00
12.89	127.08	2.00	0.00	0.78	0.00	12.95	126.91	2.00	0.00	0.78	0.00
13.00	126.77	2.00	0.00	0.78	0.00	13.05	127.01	2.00	0.00	0.78	0.00
13.13	127.41	2.00	0.00	0.78	0.00	13.18	128.27	2.00	0.00	0.78	0.00
13.24	129.27	2.00	0.00	0.78	0.00	13.29	130.51	2.00	0.00	0.77	0.00
13.35	131.67	2.00	0.00	0.77	0.00	13.40	133.07	2.00	0.00	0.77	0.00
13.47	133.64	2.00	0.00	0.77	0.00	13.53	134.58	2.00	0.00	0.77	0.00
13.65	135.63	2.00	0.00	0.77	0.00	13.71	137.38	2.00	0.00	0.77	0.00
13.76	138.54	2.00	0.00	0.77	0.00	13.82	139.03	2.00	0.00	0.77	0.00
13.89	139.46	2.00	0.00	0.76	0.00	13.94	139.79	2.00	0.00	0.76	0.00
13.98	139.93	2.00	0.00	0.76	0.00	14.05	139.77	2.00	0.00	0.76	0.00
14.16	139.14	2.00	0.00	0.76	0.00	14.23	138.19	2.00	0.00	0.76	0.00
14.33	136.89	2.00	0.00	0.76	0.00	14.41	135.82	2.00	0.00	0.76	0.00
14.46	135.38	2.00	0.00	0.75	0.00	14.51	135.47	2.00	0.00	0.75	0.00
14.58	135.75	2.00	0.00	0.75	0.00	14.63	135.80	2.00	0.00	0.75	0.00
14.69	135.99	2.00	0.00	0.75	0.00	14.76	136.19	2.00	0.00	0.75	0.00
14.81	136.84	2.00	0.00	0.75	0.00	14.87	137.75	2.00	0.00	0.75	0.00
14.99	138.68	2.00	0.00	0.75	0.00	15.04	138.99	2.00	0.00	0.75	0.00
15.11	138.60	2.00	0.00	0.74	0.00	15.17	137.87	2.00	0.00	0.74	0.00
15.23	137.24	2.00	0.00	0.74	0.00	15.29	136.97	2.00	0.00	0.74	0.00
15.35	136.26	2.00	0.00	0.74	0.00	15.42	136.22	2.00	0.00	0.74	0.00
15.47	136.68	2.00	0.00	0.74	0.00	15.54	138.38	2.00	0.00	0.74	0.00
15.60	140.53	2.00	0.00	0.74	0.00	15.71	142.64	2.00	0.00	0.73	0.00
15.78	143.77	2.00	0.00	0.73	0.00	15.83	143.50	2.00	0.00	0.73	0.00
15.88	142.53	2.00	0.00	0.73	0.00	15.95	142.31	2.00	0.00	0.73	0.00
16.00	142.47	2.00	0.00	0.73	0.00	16.08	143.23	2.00	0.00	0.73	0.00
16.14	143.86	2.00	0.00	0.73	0.00	16.18	144.60	2.00	0.00	0.73	0.00
16.25	145.03	2.00	0.00	0.72	0.00	16.31	145.18	2.00	0.00	0.72	0.00
16.36	143.73	2.00	0.00	0.72	0.00	16.43	141.28	2.00	0.00	0.72	0.00
16.58	139.14	2.00	0.00	0.72	0.00	16.66	138.44	2.00	0.00	0.72	0.00
16.72	138.40	2.00	0.00	0.72	0.00	16.79	138.10	2.00	0.00	0.72	0.00
16.80	137.04	2.00	0.00	0.72	0.00	16.87	135.44	2.00	0.00	0.71	0.00
16.98	132.79	2.00	0.00	0.71	0.00	17.05	130.03	2.00	0.00	0.71	0.00
17.09	127.14	2.00	0.00	0.71	0.00	17.16	123.36	2.00	0.00	0.71	0.00
17.22	119.55	2.00	0.00	0.71	0.00	17.29	116.84	2.00	0.00	0.71	0.00
17.36	116.97	2.00	0.00	0.71	0.00	17.45	118.07	2.00	0.00	0.70	0.00
17.52	118.86	2.00	0.00	0.70	0.00	17.58	118.47	2.00	0.00	0.70	0.00
17.62	117.49	2.00	0.00	0.70	0.00	17.70	115.48	2.00	0.00	0.70	0.00
17.75	112.61	2.00	0.00	0.70	0.00	17.81	108.23	2.00	0.00	0.70	0.00
17.88	103.94	2.00	0.00	0.70	0.00	17.93	99.42	2.00	0.00	0.70	0.00
17.99	95.69	2.00	0.00	0.70	0.00	18.06	92.95	2.00	0.00	0.69	0.00
18.23	92.40	2.00	0.00	0.69	0.00	18.29	93.46	2.00	0.00	0.69	0.00
18.33	94.86	2.00	0.00	0.69	0.00	18.41	95.40	2.00	0.00	0.69	0.00
18.46	95.24	2.00	0.00	0.69	0.00	18.53	95.03	2.00	0.00	0.69	0.00
18.59	94.00	2.00	0.00	0.68	0.00	18.64	93.30	2.00	0.00	0.68	0.00
18.70	91.18	2.00	0.00	0.68	0.00	18.77	90.53	2.00	0.00	0.68	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
18.82	90.84	2.00	0.00	0.68	0.00	18.89	93.41	2.00	0.00	0.68	0.00
18.95	96.24	2.00	0.00	0.68	0.00	19.00	99.41	2.00	0.00	0.68	0.00
19.08	102.74	2.00	0.00	0.68	0.00	19.12	105.58	2.00	0.00	0.68	0.00
19.17	107.37	2.00	0.00	0.68	0.00	19.25	108.30	2.00	0.00	0.67	0.00
19.30	104.20	2.00	0.00	0.67	0.00	19.43	91.37	2.00	0.00	0.67	0.00
19.48	93.31	2.00	0.00	0.67	0.00	19.54	110.93	0.33	1.44	0.67	0.01
19.60	146.08	0.60	1.14	0.67	0.01	19.65	168.94	0.85	0.48	0.67	0.00
19.70	178.42	0.98	0.34	0.67	0.00	19.78	173.36	0.91	0.46	0.66	0.00
19.84	164.79	0.80	0.65	0.66	0.00	19.88	152.78	0.66	0.89	0.66	0.00
19.97	145.04	0.58	1.14	0.66	0.01	20.02	128.22	0.44	1.26	0.66	0.01
20.11	118.94	2.00	0.00	0.66	0.00	20.17	113.99	2.00	0.00	0.66	0.00
20.22	111.74	2.00	0.00	0.66	0.00	20.32	112.82	2.00	0.00	0.66	0.00
20.37	116.40	2.00	0.00	0.65	0.00	20.43	117.02	2.00	0.00	0.65	0.00
20.50	116.36	2.00	0.00	0.65	0.00	20.56	113.67	2.00	0.00	0.65	0.00
20.63	109.65	2.00	0.00	0.65	0.00	20.68	103.73	2.00	0.00	0.65	0.00
20.74	96.31	2.00	0.00	0.65	0.00	20.81	86.55	2.00	0.00	0.65	0.00
20.92	77.11	2.00	0.00	0.65	0.00	20.98	70.05	2.00	0.00	0.64	0.00
21.03	67.03	2.00	0.00	0.64	0.00	21.10	66.10	2.00	0.00	0.64	0.00
21.16	65.95	2.00	0.00	0.64	0.00	21.21	66.84	2.00	0.00	0.64	0.00
21.28	67.80	2.00	0.00	0.64	0.00	21.34	67.21	2.00	0.00	0.64	0.00
21.40	65.47	2.00	0.00	0.64	0.00	21.46	64.94	2.00	0.00	0.64	0.00
21.58	66.14	0.17	2.08	0.63	0.03	21.63	66.88	0.17	2.06	0.63	0.01
21.69	67.63	2.00	0.00	0.63	0.00	21.73	68.04	2.00	0.00	0.63	0.00
21.81	70.26	2.00	0.00	0.63	0.00	21.87	75.33	2.00	0.00	0.63	0.00
21.98	81.31	2.00	0.00	0.63	0.00	22.04	85.74	2.00	0.00	0.63	0.00
22.09	85.92	2.00	0.00	0.63	0.00	22.17	84.56	2.00	0.00	0.62	0.00
22.22	85.71	2.00	0.00	0.62	0.00	22.27	91.78	2.00	0.00	0.62	0.00
22.33	104.88	2.00	0.00	0.62	0.00	22.39	121.53	2.00	0.00	0.62	0.00
22.44	147.84	0.60	1.07	0.62	0.01	22.62	170.40	0.85	0.58	0.62	0.01
22.66	183.06	1.02	0.31	0.62	0.00	22.79	183.82	1.03	0.31	0.61	0.00
22.86	183.51	1.03	0.31	0.61	0.00	22.93	185.29	1.05	0.23	0.61	0.00
22.99	186.28	1.07	0.22	0.61	0.00	23.04	187.02	1.08	0.22	0.61	0.00
23.10	183.64	1.03	0.31	0.61	0.00	23.22	176.22	0.92	0.41	0.61	0.01
23.29	164.09	0.77	0.60	0.61	0.01	23.34	148.24	0.60	1.04	0.60	0.01
23.40	141.20	0.53	1.06	0.60	0.01	23.47	136.68	0.50	1.09	0.60	0.01
23.52	134.51	0.48	1.10	0.60	0.01	23.59	131.16	0.45	1.12	0.60	0.01
23.65	127.16	0.42	1.15	0.60	0.01	23.69	120.17	0.38	1.20	0.60	0.01
23.75	114.17	0.34	1.25	0.60	0.01	23.82	107.26	0.30	1.32	0.60	0.01
23.94	102.77	0.28	1.36	0.59	0.02	24.00	107.59	0.30	1.31	0.59	0.01
24.05	119.89	0.37	1.19	0.59	0.01	24.12	132.97	0.46	1.09	0.59	0.01
24.18	147.54	0.59	1.02	0.59	0.01	24.23	154.47	0.66	0.78	0.59	0.00
24.35	157.02	0.68	0.76	0.59	0.01	24.40	158.35	0.70	0.75	0.59	0.00
24.45	168.86	0.82	0.55	0.59	0.00	24.58	176.95	0.92	0.39	0.58	0.01
24.65	181.41	0.99	0.30	0.58	0.00	24.71	181.41	0.99	0.30	0.58	0.00
24.75	180.89	0.98	0.30	0.58	0.00	24.81	183.02	1.01	0.29	0.58	0.00
24.88	189.46	1.11	0.21	0.58	0.00	24.93	203.40	2.00	0.00	0.58	0.00
24.99	233.07	2.00	0.00	0.58	0.00	25.06	264.86	2.00	0.00	0.58	0.00
25.17	289.12	2.00	0.00	0.57	0.00	25.24	306.36	2.00	0.00	0.57	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
25.28	314.81	2.00	0.00	0.57	0.00	25.35	322.03	2.00	0.00	0.57	0.00
25.41	330.20	2.00	0.00	0.57	0.00	25.48	340.19	2.00	0.00	0.57	0.00
25.54	350.61	2.00	0.00	0.57	0.00	25.59	358.77	2.00	0.00	0.57	0.00
25.65	354.83	2.00	0.00	0.57	0.00	25.68	354.55	2.00	0.00	0.56	0.00
25.72	351.24	2.00	0.00	0.56	0.00	25.80	358.62	2.00	0.00	0.56	0.00
25.90	360.38	2.00	0.00	0.56	0.00	25.94	364.38	2.00	0.00	0.56	0.00
25.99	365.48	2.00	0.00	0.56	0.00	26.09	365.25	2.00	0.00	0.56	0.00
26.13	364.68	2.00	0.00	0.56	0.00	26.19	363.54	2.00	0.00	0.56	0.00
26.25	362.56	2.00	0.00	0.56	0.00	26.35	361.42	2.00	0.00	0.55	0.00
26.39	359.71	2.00	0.00	0.55	0.00	26.45	356.81	2.00	0.00	0.55	0.00
26.52	351.68	2.00	0.00	0.55	0.00	26.61	345.64	2.00	0.00	0.55	0.00
26.66	339.19	2.00	0.00	0.55	0.00	26.71	333.00	2.00	0.00	0.55	0.00
26.78	323.00	2.00	0.00	0.55	0.00	26.87	311.82	2.00	0.00	0.54	0.00
26.93	300.07	2.00	0.00	0.54	0.00	26.99	289.95	2.00	0.00	0.54	0.00
27.05	270.60	2.00	0.00	0.54	0.00	27.13	247.24	2.00	0.00	0.54	0.00
27.21	220.02	2.00	0.00	0.54	0.00	27.27	196.78	1.22	0.14	0.54	0.00
27.31	172.95	0.87	0.37	0.54	0.00	27.36	164.79	0.77	0.53	0.54	0.00
27.43	147.40	0.58	0.93	0.54	0.01	27.63	135.41	0.48	0.97	0.53	0.02
27.69	129.12	0.43	1.01	0.53	0.01	27.75	125.36	0.41	1.03	0.53	0.01
27.80	121.19	0.38	1.06	0.53	0.01	27.88	116.73	0.35	1.09	0.53	0.01
27.95	112.73	0.33	1.11	0.53	0.01	28.01	112.82	0.33	1.11	0.53	0.01
28.11	122.78	0.39	1.03	0.52	0.01	28.16	138.67	0.51	0.93	0.52	0.01
28.22	148.80	0.60	0.89	0.52	0.01	28.28	161.55	0.73	0.65	0.52	0.00
28.33	167.44	0.80	0.50	0.52	0.00	28.39	171.94	0.86	0.36	0.52	0.00
28.43	176.48	0.91	0.35	0.52	0.00	28.53	181.03	0.98	0.26	0.52	0.00
28.58	180.23	0.97	0.26	0.52	0.00	28.65	174.78	0.89	0.35	0.51	0.00
28.70	167.78	0.80	0.49	0.51	0.00	28.75	160.92	0.72	0.64	0.51	0.00
28.82	157.35	0.68	0.66	0.51	0.01	28.88	153.10	0.64	0.84	0.51	0.01
28.99	149.10	0.60	0.87	0.51	0.01	29.06	145.12	0.56	0.87	0.51	0.01
29.22	142.66	0.54	0.88	0.50	0.02	29.28	140.75	0.53	0.89	0.50	0.01
29.33	139.23	0.51	0.90	0.50	0.01	29.40	137.10	0.49	0.91	0.50	0.01
29.45	134.30	0.47	0.92	0.50	0.01	29.51	132.31	0.46	0.93	0.50	0.01
29.59	130.50	0.44	0.94	0.50	0.01	29.63	128.52	0.43	0.95	0.50	0.01
29.69	126.63	0.42	0.96	0.50	0.01	29.76	124.96	0.40	0.96	0.50	0.01
29.82	124.02	0.40	0.97	0.49	0.01	29.94	128.99	0.43	0.93	0.49	0.01
29.98	133.55	0.47	0.91	0.49	0.01	30.03	138.13	0.50	0.88	0.49	0.00
30.12	143.14	0.55	0.85	0.49	0.01	30.16	150.43	0.61	0.82	0.49	0.00
30.34	155.26	0.66	0.64	0.49	0.01	30.39	158.36	0.70	0.62	0.48	0.00
30.46	158.73	0.70	0.62	0.48	0.01	30.57	165.45	0.78	0.47	0.48	0.01
30.64	170.96	0.84	0.45	0.48	0.00	30.69	172.89	0.87	0.33	0.48	0.00
30.75	173.85	0.88	0.33	0.48	0.00	30.81	174.61	0.89	0.33	0.48	0.00
30.87	175.82	0.91	0.32	0.48	0.00	30.91	178.00	0.94	0.32	0.48	0.00
30.99	181.58	0.99	0.24	0.47	0.00	31.05	186.54	1.06	0.17	0.47	0.00
31.09	191.65	1.14	0.17	0.47	0.00	31.16	194.50	1.19	0.12	0.47	0.00
31.22	188.22	1.09	0.17	0.47	0.00	31.25	193.21	1.16	0.12	0.47	0.00
31.46	199.72	1.27	0.08	0.47	0.00	31.50	215.44	2.00	0.00	0.47	0.00
31.56	219.79	2.00	0.00	0.47	0.00	31.63	223.83	2.00	0.00	0.46	0.00
31.68	228.43	2.00	0.00	0.46	0.00	31.73	233.54	2.00	0.00	0.46	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
31.80	238.12	2.00	0.00	0.46	0.00	31.85	240.82	2.00	0.00	0.46	0.00
31.91	241.27	2.00	0.00	0.46	0.00	31.98	239.94	2.00	0.00	0.46	0.00
32.03	237.67	2.00	0.00	0.46	0.00	32.10	234.65	2.00	0.00	0.46	0.00
32.16	230.85	2.00	0.00	0.45	0.00	32.21	226.50	2.00	0.00	0.45	0.00
32.27	221.65	2.00	0.00	0.45	0.00	32.34	216.67	2.00	0.00	0.45	0.00
32.39	211.67	2.00	0.00	0.45	0.00	32.47	206.56	2.00	0.00	0.45	0.00
32.51	201.54	2.00	0.00	0.45	0.00	32.57	196.57	1.23	0.11	0.45	0.00
32.65	191.57	1.14	0.16	0.45	0.00	32.69	186.58	1.07	0.16	0.45	0.00
32.75	181.55	0.99	0.23	0.44	0.00	32.82	174.78	0.90	0.30	0.44	0.00
32.93	167.83	0.81	0.42	0.44	0.01	33.00	160.42	0.72	0.55	0.44	0.00
33.05	153.50	0.65	0.59	0.44	0.00	33.09	148.82	0.60	0.75	0.44	0.00
33.17	142.43	2.00	0.00	0.44	0.00	33.23	135.01	2.00	0.00	0.44	0.00
33.28	124.06	2.00	0.00	0.44	0.00	33.36	110.48	2.00	0.00	0.43	0.00
33.40	97.55	2.00	0.00	0.43	0.00	33.48	89.09	2.00	0.00	0.43	0.00
33.58	86.30	2.00	0.00	0.43	0.00	33.64	87.11	2.00	0.00	0.43	0.00
33.69	85.16	2.00	0.00	0.43	0.00	33.75	82.21	0.21	1.17	0.43	0.01
33.79	80.17	0.20	1.20	0.43	0.01	33.88	79.74	0.20	1.20	0.43	0.01
33.93	81.19	0.20	1.18	0.42	0.01	34.02	83.91	0.21	1.14	0.42	0.01
34.06	88.60	2.00	0.00	0.42	0.00	34.13	94.07	2.00	0.00	0.42	0.00
34.19	100.21	2.00	0.00	0.42	0.00	34.28	105.60	2.00	0.00	0.42	0.00
34.34	109.32	2.00	0.00	0.42	0.00	34.39	110.99	2.00	0.00	0.42	0.00
34.46	111.27	2.00	0.00	0.42	0.00	34.52	111.26	2.00	0.00	0.41	0.00
34.59	111.32	2.00	0.00	0.41	0.00	34.69	111.21	2.00	0.00	0.41	0.00
34.77	110.87	2.00	0.00	0.41	0.00	34.82	110.31	2.00	0.00	0.41	0.00
34.87	109.06	2.00	0.00	0.41	0.00	35.04	107.05	2.00	0.00	0.41	0.00
35.12	103.46	2.00	0.00	0.40	0.00	35.30	100.86	2.00	0.00	0.40	0.00
35.35	99.32	2.00	0.00	0.40	0.00	35.42	99.49	2.00	0.00	0.40	0.00
35.47	99.48	2.00	0.00	0.40	0.00	35.52	99.54	2.00	0.00	0.40	0.00
35.57	100.63	2.00	0.00	0.40	0.00	35.65	103.47	2.00	0.00	0.40	0.00
35.75	107.10	2.00	0.00	0.39	0.00	35.83	110.39	2.00	0.00	0.39	0.00
35.88	111.83	2.00	0.00	0.39	0.00	35.95	112.19	2.00	0.00	0.39	0.00
36.01	111.93	2.00	0.00	0.39	0.00	36.05	111.68	2.00	0.00	0.39	0.00
36.12	111.22	2.00	0.00	0.39	0.00	36.19	110.69	2.00	0.00	0.39	0.00
36.23	110.43	2.00	0.00	0.39	0.00	36.48	110.32	2.00	0.00	0.38	0.00
36.54	110.64	2.00	0.00	0.38	0.00	36.59	110.76	2.00	0.00	0.38	0.00
36.64	110.40	2.00	0.00	0.38	0.00	36.72	109.50	2.00	0.00	0.38	0.00
36.76	108.45	2.00	0.00	0.38	0.00	36.83	107.54	2.00	0.00	0.38	0.00
36.94	106.93	2.00	0.00	0.37	0.00	37.02	106.48	2.00	0.00	0.37	0.00
37.07	106.18	2.00	0.00	0.37	0.00	37.12	106.47	2.00	0.00	0.37	0.00
37.20	107.31	2.00	0.00	0.37	0.00	37.25	108.49	2.00	0.00	0.37	0.00
37.31	109.33	2.00	0.00	0.37	0.00	37.37	109.88	2.00	0.00	0.37	0.00
37.42	109.68	2.00	0.00	0.37	0.00	37.51	108.75	2.00	0.00	0.36	0.00
37.58	107.43	2.00	0.00	0.36	0.00	37.62	106.26	2.00	0.00	0.36	0.00
37.70	105.64	2.00	0.00	0.36	0.00	37.75	105.27	2.00	0.00	0.36	0.00
37.81	105.22	2.00	0.00	0.36	0.00	37.88	104.67	2.00	0.00	0.36	0.00
37.93	103.37	2.00	0.00	0.36	0.00	38.05	102.12	2.00	0.00	0.36	0.00
38.11	101.46	2.00	0.00	0.35	0.00	38.17	101.50	2.00	0.00	0.35	0.00
38.24	101.22	2.00	0.00	0.35	0.00	38.29	100.47	2.00	0.00	0.35	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
38.37	99.53	2.00	0.00	0.35	0.00	38.42	98.60	2.00	0.00	0.35	0.00
38.46	97.79	2.00	0.00	0.35	0.00	38.54	97.24	2.00	0.00	0.35	0.00
38.59	96.97	2.00	0.00	0.35	0.00	38.71	96.82	2.00	0.00	0.34	0.00
38.76	96.79	2.00	0.00	0.34	0.00	38.81	96.81	2.00	0.00	0.34	0.00
38.85	96.92	2.00	0.00	0.34	0.00	38.94	96.83	2.00	0.00	0.34	0.00
39.00	96.81	2.00	0.00	0.34	0.00	39.07	96.88	2.00	0.00	0.34	0.00
39.12	96.90	2.00	0.00	0.34	0.00	39.18	96.89	2.00	0.00	0.34	0.00
39.25	96.80	2.00	0.00	0.33	0.00	39.34	96.75	2.00	0.00	0.33	0.00
39.40	96.75	2.00	0.00	0.33	0.00	39.47	96.79	2.00	0.00	0.33	0.00
39.52	97.07	2.00	0.00	0.33	0.00	39.60	97.20	2.00	0.00	0.33	0.00
39.65	97.29	2.00	0.00	0.33	0.00	39.70	97.15	2.00	0.00	0.33	0.00
39.77	96.98	2.00	0.00	0.33	0.00	39.88	96.73	2.00	0.00	0.32	0.00
39.94	96.63	2.00	0.00	0.32	0.00	40.01	96.56	2.00	0.00	0.32	0.00
40.06	96.17	2.00	0.00	0.32	0.00	40.14	92.76	2.00	0.00	0.32	0.00
40.18	90.81	2.00	0.00	0.32	0.00	40.25	89.44	2.00	0.00	0.32	0.00
40.31	91.27	2.00	0.00	0.32	0.00	40.37	91.98	2.00	0.00	0.32	0.00
40.49	92.81	2.00	0.00	0.31	0.00	40.52	93.60	2.00	0.00	0.31	0.00
40.57	94.25	2.00	0.00	0.31	0.00	40.64	93.77	2.00	0.00	0.31	0.00
40.72	92.46	2.00	0.00	0.31	0.00	40.78	90.07	2.00	0.00	0.31	0.00
40.85	87.98	2.00	0.00	0.31	0.00	40.89	85.93	2.00	0.00	0.31	0.00
40.98	84.34	2.00	0.00	0.31	0.00	41.06	83.19	2.00	0.00	0.30	0.00
41.09	83.18	2.00	0.00	0.30	0.00	41.17	83.13	2.00	0.00	0.30	0.00
41.21	84.07	2.00	0.00	0.30	0.00	41.29	85.74	2.00	0.00	0.30	0.00
41.43	88.39	2.00	0.00	0.30	0.00	41.50	90.84	2.00	0.00	0.30	0.00
41.56	92.76	2.00	0.00	0.30	0.00	41.61	94.05	2.00	0.00	0.29	0.00
41.67	94.40	2.00	0.00	0.29	0.00	41.73	94.27	2.00	0.00	0.29	0.00
41.78	94.07	2.00	0.00	0.29	0.00	41.85	94.06	2.00	0.00	0.29	0.00
41.91	94.09	2.00	0.00	0.29	0.00	41.95	94.21	2.00	0.00	0.29	0.00
42.03	94.35	2.00	0.00	0.29	0.00	42.09	94.53	2.00	0.00	0.29	0.00
42.13	94.62	2.00	0.00	0.29	0.00	42.21	94.75	2.00	0.00	0.28	0.00
42.26	95.40	2.00	0.00	0.28	0.00	42.48	96.05	2.00	0.00	0.28	0.00
42.55	96.77	2.00	0.00	0.28	0.00	42.62	96.88	2.00	0.00	0.28	0.00
42.66	96.74	2.00	0.00	0.28	0.00	42.72	96.25	2.00	0.00	0.28	0.00
42.79	95.77	2.00	0.00	0.27	0.00	42.84	95.33	2.00	0.00	0.27	0.00
42.91	95.04	2.00	0.00	0.27	0.00	42.97	94.57	2.00	0.00	0.27	0.00
43.02	93.91	2.00	0.00	0.27	0.00	43.09	93.22	2.00	0.00	0.27	0.00
43.14	92.90	2.00	0.00	0.27	0.00	43.20	92.95	2.00	0.00	0.27	0.00
43.27	92.83	2.00	0.00	0.27	0.00	43.32	92.28	2.00	0.00	0.27	0.00
43.38	90.77	2.00	0.00	0.26	0.00	43.44	90.15	2.00	0.00	0.26	0.00
43.50	90.20	2.00	0.00	0.26	0.00	43.55	91.34	2.00	0.00	0.26	0.00
43.62	92.34	2.00	0.00	0.26	0.00	43.72	92.70	2.00	0.00	0.26	0.00
43.80	92.95	2.00	0.00	0.26	0.00	43.86	93.00	2.00	0.00	0.26	0.00
43.94	93.34	2.00	0.00	0.26	0.00	43.98	93.81	2.00	0.00	0.25	0.00
44.07	94.17	2.00	0.00	0.25	0.00	44.12	94.42	2.00	0.00	0.25	0.00
44.16	94.18	2.00	0.00	0.25	0.00	44.25	93.16	2.00	0.00	0.25	0.00
44.39	91.98	2.00	0.00	0.25	0.00	44.46	91.06	2.00	0.00	0.25	0.00
44.51	90.74	2.00	0.00	0.25	0.00	44.56	90.59	2.00	0.00	0.24	0.00
44.62	90.48	2.00	0.00	0.24	0.00	44.69	90.53	2.00	0.00	0.24	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
44.74	91.11	2.00	0.00	0.24	0.00	44.79	93.60	2.00	0.00	0.24	0.00
44.91	96.43	2.00	0.00	0.24	0.00	44.96	99.32	2.00	0.00	0.24	0.00
45.02	100.78	2.00	0.00	0.24	0.00	45.09	102.20	2.00	0.00	0.24	0.00
45.14	104.06	2.00	0.00	0.23	0.00	45.22	106.01	2.00	0.00	0.23	0.00
45.26	107.68	2.00	0.00	0.23	0.00	45.33	108.37	2.00	0.00	0.23	0.00
45.39	108.67	2.00	0.00	0.23	0.00	45.46	108.69	2.00	0.00	0.23	0.00
45.53	109.03	2.00	0.00	0.23	0.00	45.58	109.59	2.00	0.00	0.23	0.00
45.62	110.23	2.00	0.00	0.23	0.00	45.71	110.23	2.00	0.00	0.23	0.00
45.75	109.48	2.00	0.00	0.22	0.00	45.80	107.62	2.00	0.00	0.22	0.00
45.88	104.87	2.00	0.00	0.22	0.00	45.98	101.73	2.00	0.00	0.22	0.00
46.05	99.57	2.00	0.00	0.22	0.00	46.10	98.55	2.00	0.00	0.22	0.00
46.16	98.74	2.00	0.00	0.22	0.00	46.23	100.66	2.00	0.00	0.22	0.00
46.41	99.97	2.00	0.00	0.21	0.00	46.46	99.47	2.00	0.00	0.21	0.00
46.51	97.18	2.00	0.00	0.21	0.00	46.58	97.49	2.00	0.00	0.21	0.00
46.63	95.97	2.00	0.00	0.21	0.00	46.70	95.90	2.00	0.00	0.21	0.00
46.76	96.69	2.00	0.00	0.21	0.00	46.80	100.14	2.00	0.00	0.21	0.00
46.86	103.63	2.00	0.00	0.21	0.00	46.92	106.35	2.00	0.00	0.20	0.00
46.99	107.46	0.31	0.45	0.20	0.00	47.06	107.45	0.31	0.45	0.20	0.00
47.13	108.13	0.32	0.44	0.20	0.00	47.22	110.54	2.00	0.00	0.20	0.00
47.26	113.84	2.00	0.00	0.20	0.00	47.35	116.26	2.00	0.00	0.20	0.00
47.38	119.42	2.00	0.00	0.20	0.00	47.48	121.77	2.00	0.00	0.20	0.00
47.57	124.28	2.00	0.00	0.19	0.00	47.58	128.63	2.00	0.00	0.19	0.00
47.66	136.45	2.00	0.00	0.19	0.00	47.73	148.22	2.00	0.00	0.19	0.00
47.79	159.19	2.00	0.00	0.19	0.00	47.87	166.80	0.83	0.18	0.19	0.00
47.91	172.77	0.91	0.13	0.19	0.00	48.01	176.05	0.95	0.10	0.19	0.00
48.05	179.28	1.00	0.10	0.19	0.00	48.14	182.18	1.04	0.09	0.18	0.00
48.19	186.13	1.10	0.07	0.18	0.00	48.23	190.48	1.17	0.05	0.18	0.00
48.32	193.96	1.23	0.05	0.18	0.00	48.36	196.54	1.28	0.03	0.18	0.00
48.45	196.98	1.29	0.03	0.18	0.00	48.52	197.17	1.29	0.03	0.18	0.00
48.58	197.32	1.29	0.03	0.18	0.00	48.64	198.15	1.31	0.03	0.18	0.00
48.69	199.09	1.33	0.03	0.17	0.00	48.76	200.58	2.00	0.00	0.17	0.00
48.85	196.19	1.28	0.03	0.17	0.00	48.93	191.98	1.21	0.04	0.17	0.00
48.98	189.68	1.17	0.04	0.17	0.00	49.03	195.66	1.27	0.03	0.17	0.00
49.11	204.68	2.00	0.00	0.17	0.00	49.16	215.63	2.00	0.00	0.17	0.00
49.25	229.35	2.00	0.00	0.17	0.00	49.29	248.13	2.00	0.00	0.16	0.00
49.38	267.90	2.00	0.00	0.16	0.00	49.43	290.16	2.00	0.00	0.16	0.00
49.51	307.53	2.00	0.00	0.16	0.00	49.55	324.09	2.00	0.00	0.16	0.00
49.64	336.16	2.00	0.00	0.16	0.00	49.68	351.37	2.00	0.00	0.16	0.00
49.77	363.77	2.00	0.00	0.16	0.00	49.81	380.93	2.00	0.00	0.16	0.00
49.89	394.27	2.00	0.00	0.15	0.00	49.95	410.31	2.00	0.00	0.15	0.00
50.03	419.42	2.00	0.00	0.15	0.00						

Total estimated settlement: 1.66

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

LIQUEFACTION ANALYSIS REPORT

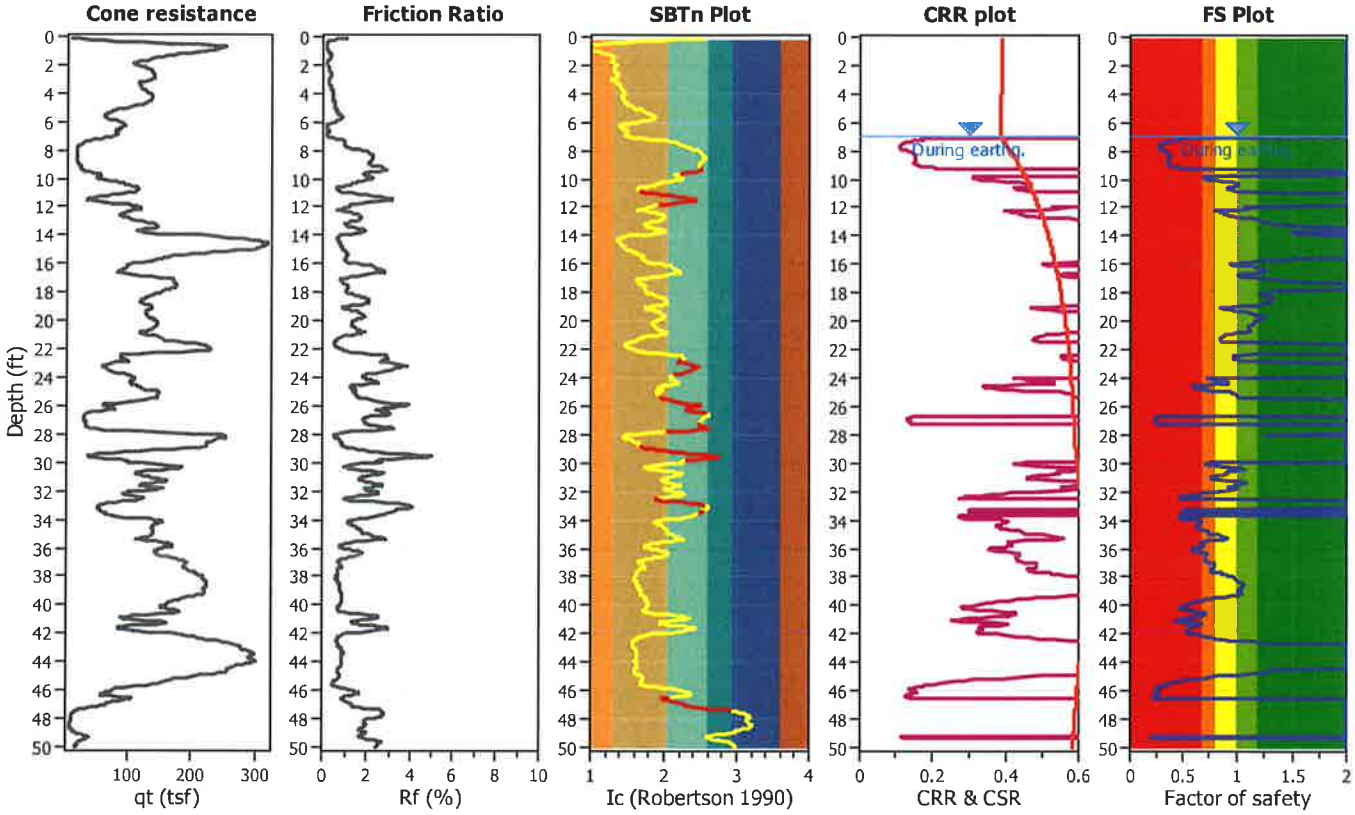
Project title : S-Line Upgrades

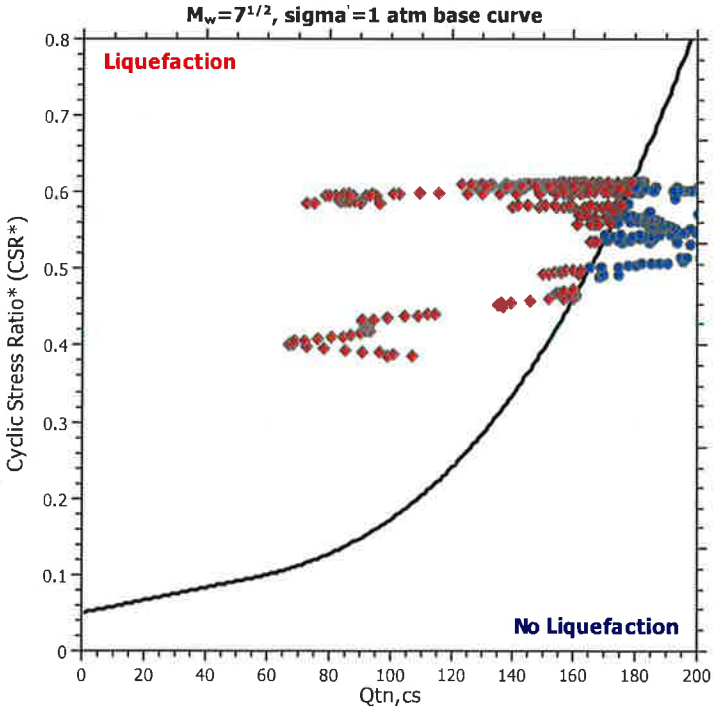
Location : Imperial County, CA

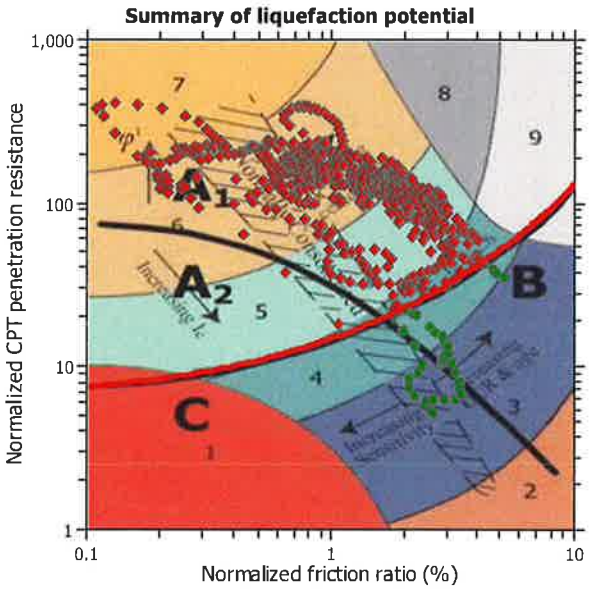
CPT file : CPT-19

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	7.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

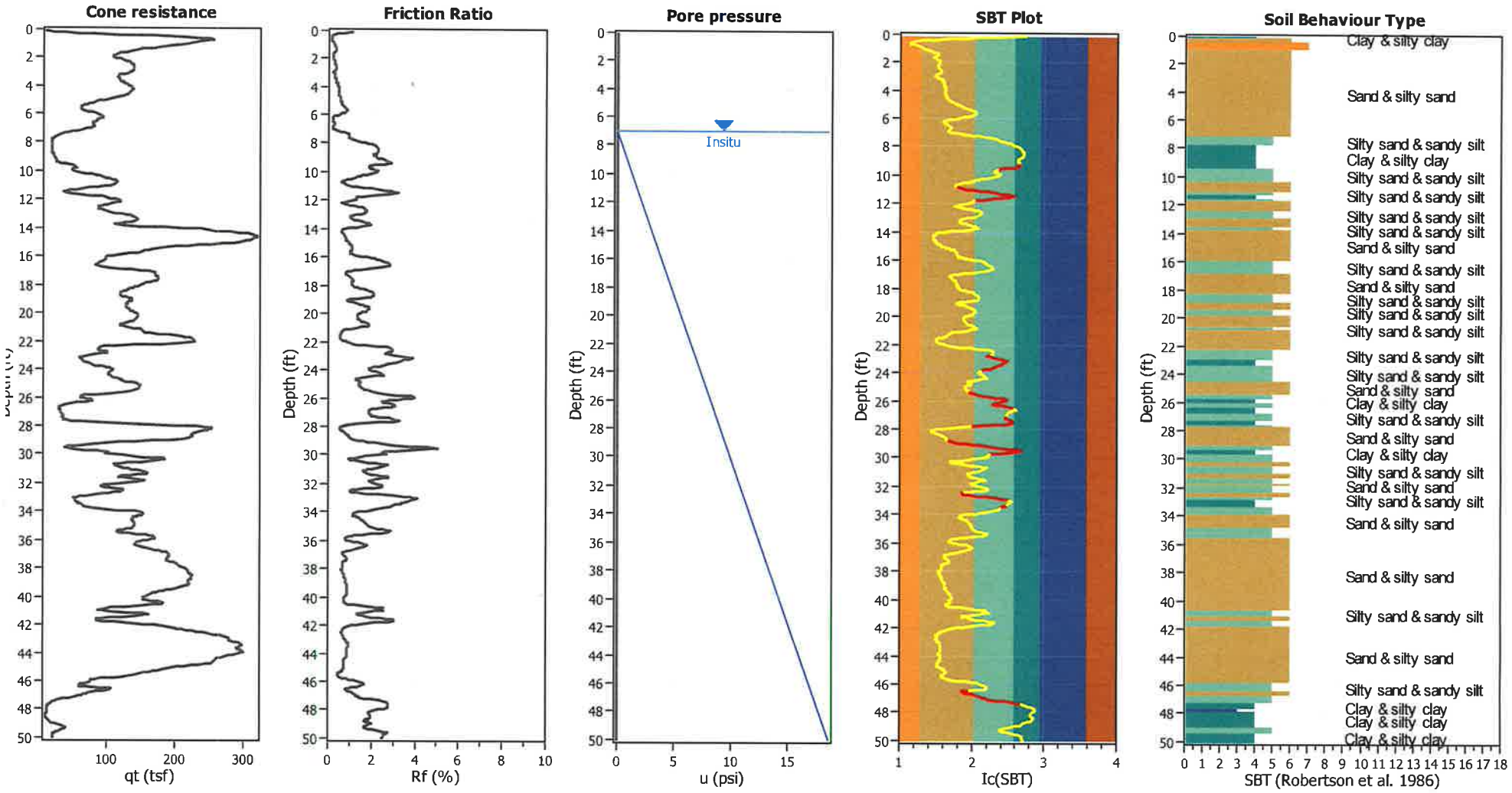






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



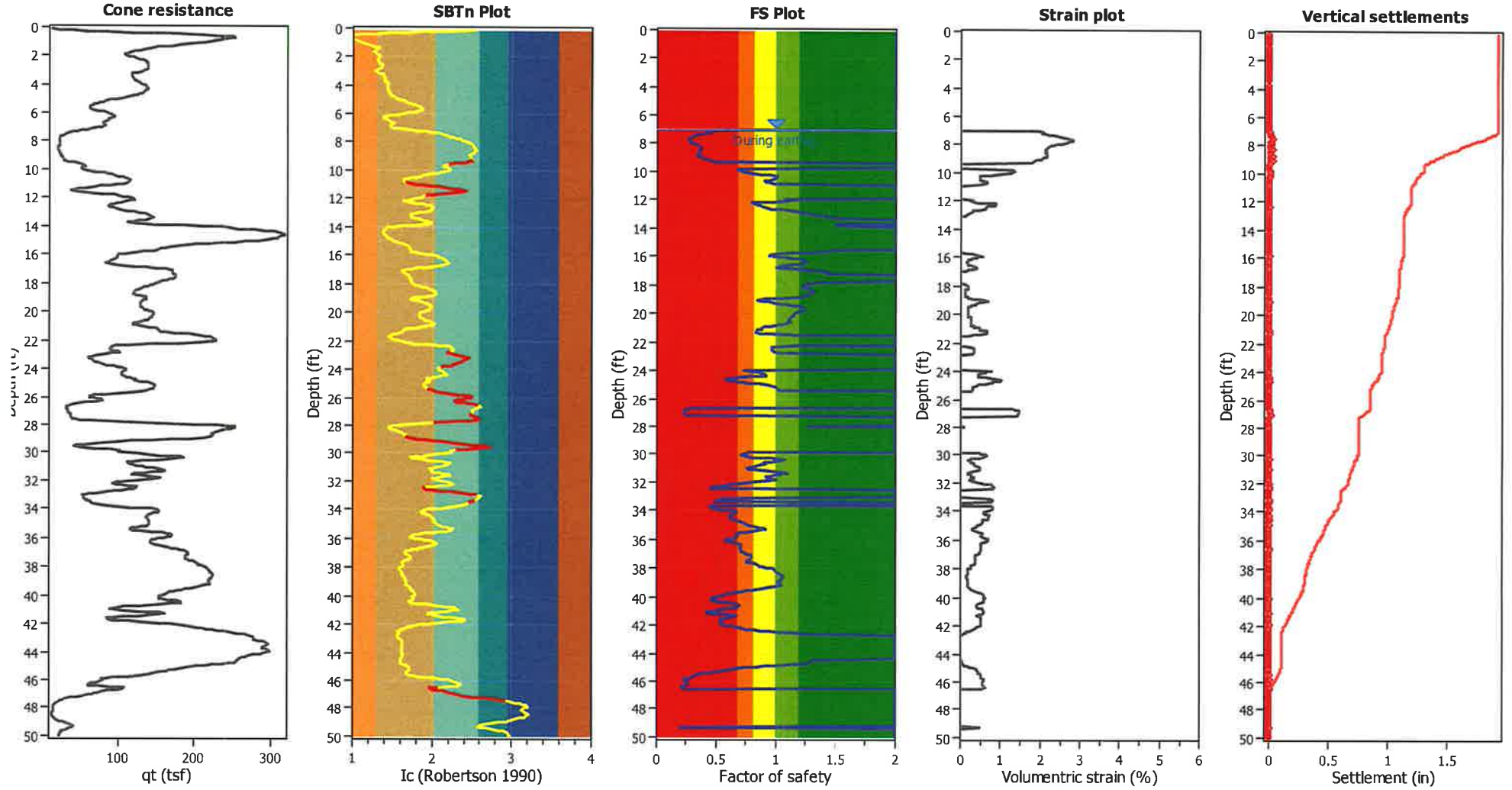
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	7.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

:	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
7.07	107.18	0.50	1.94	0.88	0.02	7.12	98.55	0.44	2.08	0.88	0.01
7.19	100.66	0.45	2.04	0.88	0.02	7.25	96.13	0.42	2.12	0.88	0.02
7.29	90.60	0.38	2.22	0.88	0.01	7.36	84.86	0.35	2.34	0.88	0.02
7.43	78.20	0.31	2.50	0.87	0.02	7.54	72.45	0.29	2.65	0.87	0.04
7.60	68.27	0.27	2.78	0.87	0.02	7.66	67.07	0.27	2.82	0.87	0.02
7.73	67.43	0.27	2.81	0.87	0.02	7.78	68.83	0.27	2.76	0.87	0.02
7.85	71.84	0.28	2.66	0.87	0.02	7.91	76.43	0.30	2.52	0.87	0.02
7.97	80.51	0.31	2.41	0.86	0.02	8.03	84.43	0.33	2.32	0.86	0.02
8.09	86.92	0.34	2.26	0.86	0.02	8.14	89.96	0.36	2.20	0.86	0.01
8.27	91.90	0.36	2.15	0.86	0.03	8.32	93.15	0.37	2.13	0.86	0.01
8.40	92.70	0.37	2.13	0.86	0.02	8.44	92.28	0.36	2.14	0.86	0.01
8.51	91.96	0.36	2.14	0.86	0.02	8.57	91.99	0.36	2.14	0.85	0.02
8.62	91.69	0.36	2.14	0.85	0.01	8.75	91.17	0.35	2.15	0.85	0.03
8.80	90.61	0.35	2.16	0.85	0.01	8.88	90.94	0.35	2.15	0.85	0.02
8.93	94.10	0.36	2.08	0.85	0.01	9.06	98.84	0.39	2.00	0.85	0.03
9.11	104.42	0.42	1.91	0.85	0.01	9.16	108.59	0.45	1.84	0.84	0.01
9.24	111.73	0.48	1.80	0.84	0.02	9.29	114.09	0.49	1.77	0.84	0.01
9.36	116.91	2.00	0.00	0.84	0.00	9.41	118.96	2.00	0.00	0.84	0.00
9.47	118.46	2.00	0.00	0.84	0.00	9.54	118.50	2.00	0.00	0.84	0.00
9.59	124.98	2.00	0.00	0.84	0.00	9.72	132.40	2.00	0.00	0.84	0.00
9.76	136.58	0.70	1.32	0.83	0.01	9.83	135.37	0.69	1.33	0.83	0.01
9.89	134.94	0.68	1.34	0.83	0.01	9.94	136.22	0.69	1.32	0.83	0.01
10.00	139.66	0.73	1.27	0.83	0.01	10.07	145.33	0.80	0.98	0.83	0.01
10.19	151.61	0.88	0.70	0.83	0.01	10.25	156.81	0.95	0.48	0.83	0.00
10.29	160.02	1.00	0.47	0.83	0.00	10.35	161.09	1.01	0.47	0.82	0.00
10.42	160.78	1.00	0.47	0.82	0.00	10.47	160.05	0.99	0.47	0.82	0.00
10.54	158.91	0.97	0.47	0.82	0.00	10.60	156.52	0.93	0.66	0.82	0.00
10.65	154.58	0.90	0.67	0.82	0.00	10.71	155.88	0.92	0.67	0.82	0.00
10.77	157.01	0.93	0.66	0.82	0.01	10.88	160.22	0.98	0.46	0.82	0.01
10.95	164.12	2.00	0.00	0.81	0.00	11.00	165.51	2.00	0.00	0.81	0.00
11.05	166.17	2.00	0.00	0.81	0.00	11.13	164.46	2.00	0.00	0.81	0.00
11.18	163.37	2.00	0.00	0.81	0.00	11.24	160.13	2.00	0.00	0.81	0.00
11.31	156.06	2.00	0.00	0.81	0.00	11.36	148.28	2.00	0.00	0.81	0.00
11.44	143.51	2.00	0.00	0.81	0.00	11.49	141.64	2.00	0.00	0.81	0.00
11.55	141.30	2.00	0.00	0.80	0.00	11.62	140.88	2.00	0.00	0.80	0.00
11.74	147.40	2.00	0.00	0.80	0.00	11.80	157.17	2.00	0.00	0.80	0.00
11.85	163.30	2.00	0.00	0.80	0.00	11.92	168.73	1.08	0.31	0.80	0.00
11.97	175.10	1.18	0.22	0.80	0.00	12.08	169.92	1.09	0.31	0.80	0.00
12.14	161.80	0.96	0.45	0.79	0.00	12.19	149.90	0.80	0.89	0.79	0.01
12.25	151.96	0.82	0.87	0.79	0.01	12.33	153.73	0.84	0.86	0.79	0.01
12.38	155.85	0.87	0.64	0.79	0.00	12.43	156.29	0.88	0.64	0.79	0.00
12.49	157.40	0.89	0.63	0.79	0.00	12.54	159.75	0.92	0.62	0.79	0.00
12.63	162.55	0.96	0.44	0.79	0.00	12.69	165.52	1.00	0.43	0.78	0.00
12.73	169.37	1.06	0.31	0.78	0.00	12.80	174.74	1.15	0.30	0.78	0.00
12.91	178.14	1.20	0.21	0.78	0.00	12.98	180.86	1.25	0.15	0.78	0.00
13.03	182.50	1.28	0.15	0.78	0.00	13.08	185.40	1.33	0.15	0.78	0.00
13.14	188.07	1.38	0.00	0.78	0.00	13.20	190.57	1.43	0.00	0.78	0.00
13.26	195.94	1.54	0.00	0.78	0.00	13.38	204.01	2.00	0.00	0.77	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
13.43	212.07	2.00	0.00	0.77	0.00	13.49	215.77	2.00	0.00	0.77	0.00
13.56	213.15	2.00	0.00	0.77	0.00	13.60	208.24	2.00	0.00	0.77	0.00
13.67	201.19	2.00	0.00	0.77	0.00	13.73	194.85	1.50	0.00	0.77	0.00
13.78	196.77	1.53	0.00	0.77	0.00	13.91	209.58	2.00	0.00	0.76	0.00
13.96	232.34	2.00	0.00	0.76	0.00	14.01	266.27	2.00	0.00	0.76	0.00
14.07	297.15	2.00	0.00	0.76	0.00	14.18	323.42	2.00	0.00	0.76	0.00
14.25	347.86	2.00	0.00	0.76	0.00	14.31	364.52	2.00	0.00	0.76	0.00
14.36	378.19	2.00	0.00	0.76	0.00	14.42	386.90	2.00	0.00	0.76	0.00
14.48	391.82	2.00	0.00	0.75	0.00	14.53	392.95	2.00	0.00	0.75	0.00
14.60	391.06	2.00	0.00	0.75	0.00	14.66	387.16	2.00	0.00	0.75	0.00
14.71	382.67	2.00	0.00	0.75	0.00	14.79	377.81	2.00	0.00	0.75	0.00
14.84	370.33	2.00	0.00	0.75	0.00	14.97	358.50	2.00	0.00	0.75	0.00
15.02	342.61	2.00	0.00	0.75	0.00	15.06	324.45	2.00	0.00	0.74	0.00
15.13	303.78	2.00	0.00	0.74	0.00	15.19	282.51	2.00	0.00	0.74	0.00
15.24	261.76	2.00	0.00	0.74	0.00	15.30	246.26	2.00	0.00	0.74	0.00
15.37	229.12	2.00	0.00	0.74	0.00	15.48	214.53	2.00	0.00	0.74	0.00
15.55	202.91	2.00	0.00	0.74	0.00	15.59	197.93	1.51	0.00	0.74	0.00
15.65	193.53	1.42	0.00	0.73	0.00	15.72	184.96	1.25	0.14	0.73	0.00
15.77	175.99	1.10	0.28	0.73	0.00	15.90	166.93	0.96	0.40	0.73	0.01
15.94	165.53	0.94	0.54	0.73	0.00	16.02	167.36	0.96	0.40	0.73	0.00
16.07	171.41	1.02	0.39	0.73	0.00	16.11	174.90	1.08	0.28	0.73	0.00
16.15	178.92	1.14	0.27	0.73	0.00	16.21	182.15	1.19	0.19	0.73	0.00
16.33	184.59	1.23	0.19	0.72	0.00	16.38	186.06	1.26	0.13	0.72	0.00
16.43	185.97	1.26	0.13	0.72	0.00	16.50	185.32	1.24	0.19	0.72	0.00
16.55	183.07	1.20	0.19	0.72	0.00	16.61	179.21	1.14	0.27	0.72	0.00
16.68	173.25	1.04	0.38	0.72	0.00	16.78	170.80	1.00	0.38	0.72	0.00
16.86	175.41	1.07	0.27	0.71	0.00	16.91	181.79	1.18	0.19	0.71	0.00
16.97	188.18	1.29	0.13	0.71	0.00	17.04	191.93	1.36	0.00	0.71	0.00
17.08	194.52	1.40	0.00	0.71	0.00	17.15	196.33	1.44	0.00	0.71	0.00
17.20	195.75	1.43	0.00	0.71	0.00	17.31	200.12	2.00	0.00	0.71	0.00
17.39	205.00	2.00	0.00	0.71	0.00	17.44	208.65	2.00	0.00	0.70	0.00
17.49	211.40	2.00	0.00	0.70	0.00	17.57	212.58	2.00	0.00	0.70	0.00
17.61	212.42	2.00	0.00	0.70	0.00	17.68	209.42	2.00	0.00	0.70	0.00
17.74	204.54	2.00	0.00	0.70	0.00	17.79	198.26	1.46	0.00	0.70	0.00
17.87	192.87	1.36	0.00	0.70	0.00	17.92	188.37	1.27	0.13	0.70	0.00
18.03	186.26	1.23	0.18	0.69	0.00	18.10	185.19	1.21	0.18	0.69	0.00
18.15	186.25	1.23	0.18	0.69	0.00	18.23	186.89	1.24	0.18	0.69	0.00
18.28	188.42	1.27	0.13	0.69	0.00	18.34	190.14	1.30	0.13	0.69	0.00
18.41	191.60	1.32	0.13	0.69	0.00	18.45	191.84	1.33	0.13	0.69	0.00
18.52	190.61	1.31	0.13	0.69	0.00	18.59	189.92	1.29	0.13	0.68	0.00
18.70	188.58	1.27	0.13	0.68	0.00	18.76	187.28	1.24	0.18	0.68	0.00
18.82	185.56	1.21	0.18	0.68	0.00	18.89	183.71	1.18	0.18	0.68	0.00
18.94	174.45	1.03	0.36	0.68	0.00	18.99	167.02	0.92	0.50	0.68	0.00
19.07	161.23	0.84	0.68	0.68	0.01	19.12	165.78	0.90	0.50	0.68	0.00
19.16	168.33	0.94	0.49	0.68	0.00	19.29	171.64	0.98	0.36	0.67	0.01
19.33	174.94	1.03	0.35	0.67	0.00	19.36	178.61	1.09	0.25	0.67	0.00
19.43	181.50	1.14	0.25	0.67	0.00	19.52	184.49	1.18	0.18	0.67	0.00
19.57	187.27	1.23	0.18	0.67	0.00	19.65	188.38	1.25	0.17	0.67	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
19.71	188.18	1.25	0.17	0.67	0.00	19.83	186.98	1.22	0.17	0.66	0.00
19.87	185.86	1.20	0.17	0.66	0.00	19.91	185.00	1.19	0.18	0.66	0.00
19.97	183.95	1.17	0.18	0.66	0.00	20.02	183.31	1.16	0.18	0.66	0.00
20.11	182.96	1.15	0.18	0.66	0.00	20.15	182.90	1.15	0.18	0.66	0.00
20.24	182.24	1.14	0.25	0.66	0.00	20.28	181.42	1.12	0.25	0.66	0.00
20.36	180.67	1.11	0.25	0.65	0.00	20.43	180.60	1.11	0.25	0.65	0.00
20.49	180.88	1.11	0.24	0.65	0.00	20.59	181.18	1.12	0.24	0.65	0.00
20.64	180.93	1.11	0.24	0.65	0.00	20.73	179.62	1.09	0.24	0.65	0.00
20.77	177.61	1.06	0.25	0.65	0.00	20.85	174.22	1.01	0.34	0.65	0.00
20.89	170.46	0.95	0.35	0.65	0.00	20.94	166.92	0.90	0.47	0.65	0.00
21.01	165.24	0.88	0.48	0.64	0.00	21.07	164.85	0.87	0.48	0.64	0.00
21.16	162.68	0.84	0.64	0.64	0.01	21.34	161.99	0.83	0.64	0.64	0.01
21.39	164.38	0.86	0.48	0.64	0.00	21.46	171.68	0.96	0.34	0.64	0.00
21.51	184.60	1.16	0.17	0.64	0.00	21.57	200.90	2.00	0.00	0.63	0.00
21.63	215.93	2.00	0.00	0.63	0.00	21.68	226.14	2.00	0.00	0.63	0.00
21.73	231.74	2.00	0.00	0.63	0.00	21.83	234.56	2.00	0.00	0.63	0.00
21.91	236.20	2.00	0.00	0.63	0.00	21.95	237.36	2.00	0.00	0.63	0.00
22.01	237.67	2.00	0.00	0.63	0.00	22.07	235.37	2.00	0.00	0.63	0.00
22.12	222.94	2.00	0.00	0.63	0.00	22.23	205.66	2.00	0.00	0.62	0.00
22.29	185.19	1.17	0.16	0.62	0.00	22.35	174.41	1.00	0.33	0.62	0.00
22.38	172.39	0.97	0.33	0.62	0.00	22.45	172.06	0.96	0.33	0.62	0.00
22.51	172.07	0.96	0.33	0.62	0.00	22.60	172.67	0.97	0.33	0.62	0.00
22.64	173.40	0.98	0.33	0.62	0.00	22.71	175.31	1.01	0.32	0.62	0.00
22.78	176.35	1.02	0.32	0.61	0.00	22.86	173.92	2.00	0.00	0.61	0.00
22.91	168.84	2.00	0.00	0.61	0.00	22.99	164.82	2.00	0.00	0.61	0.00
23.04	164.98	2.00	0.00	0.61	0.00	23.15	165.79	2.00	0.00	0.61	0.00
23.21	165.43	2.00	0.00	0.61	0.00	23.26	162.99	2.00	0.00	0.61	0.00
23.31	159.72	2.00	0.00	0.60	0.00	23.38	156.80	2.00	0.00	0.60	0.00
23.44	153.56	2.00	0.00	0.60	0.00	23.56	150.33	2.00	0.00	0.60	0.00
23.74	147.66	2.00	0.00	0.60	0.00	23.79	147.53	2.00	0.00	0.60	0.00
23.85	148.62	2.00	0.00	0.60	0.00	23.92	151.10	2.00	0.00	0.59	0.00
23.97	154.29	0.73	0.79	0.59	0.00	24.04	157.16	0.76	0.62	0.59	0.01
24.10	160.02	0.79	0.61	0.59	0.00	24.14	163.66	0.84	0.58	0.59	0.00
24.23	167.33	0.89	0.43	0.59	0.00	24.28	169.48	0.92	0.42	0.59	0.00
24.41	169.42	0.92	0.42	0.59	0.01	24.45	158.84	0.78	0.61	0.59	0.00
24.52	148.62	0.66	0.82	0.58	0.01	24.59	140.04	0.58	1.03	0.58	0.01
24.63	141.59	0.59	1.02	0.58	0.01	24.70	145.28	0.63	1.00	0.58	0.01
24.76	149.29	0.67	0.81	0.58	0.01	24.81	150.89	0.69	0.79	0.58	0.00
24.85	153.86	0.72	0.77	0.58	0.00	24.87	158.60	0.77	0.60	0.58	0.00
24.95	165.79	0.86	0.43	0.58	0.00	25.00	171.13	0.94	0.41	0.58	0.00
25.09	173.62	0.97	0.30	0.57	0.00	25.14	174.84	0.99	0.30	0.57	0.00
25.22	175.47	1.00	0.30	0.57	0.00	25.34	176.41	1.01	0.30	0.57	0.00
25.40	177.86	1.03	0.29	0.57	0.00	25.44	178.56	2.00	0.00	0.57	0.00
25.48	179.82	2.00	0.00	0.57	0.00	25.53	180.43	2.00	0.00	0.57	0.00
25.67	177.57	2.00	0.00	0.56	0.00	25.71	171.58	2.00	0.00	0.56	0.00
25.84	167.09	2.00	0.00	0.56	0.00	25.89	165.24	2.00	0.00	0.56	0.00
25.94	163.28	2.00	0.00	0.56	0.00	26.01	160.30	2.00	0.00	0.56	0.00
26.06	157.65	2.00	0.00	0.56	0.00	26.11	154.21	2.00	0.00	0.56	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
26.17	150.28	2.00	0.00	0.56	0.00	26.23	145.45	2.00	0.00	0.56	0.00
26.29	139.70	2.00	0.00	0.55	0.00	26.34	133.04	2.00	0.00	0.55	0.00
26.41	127.70	2.00	0.00	0.55	0.00	26.46	121.04	2.00	0.00	0.55	0.00
26.57	113.54	2.00	0.00	0.55	0.00	26.64	103.76	2.00	0.00	0.55	0.00
26.68	96.24	0.28	1.32	0.55	0.01	26.73	89.89	0.25	1.39	0.55	0.01
26.81	85.25	0.23	1.45	0.55	0.01	26.86	83.15	0.23	1.48	0.54	0.01
26.91	82.97	0.23	1.48	0.54	0.01	26.97	83.83	0.23	1.47	0.54	0.01
27.08	84.98	0.23	1.44	0.54	0.02	27.13	86.50	0.24	1.42	0.54	0.01
27.19	88.37	0.25	1.39	0.54	0.01	27.25	89.55	2.00	0.00	0.54	0.00
27.30	92.98	2.00	0.00	0.54	0.00	27.38	96.09	2.00	0.00	0.54	0.00
27.43	106.24	2.00	0.00	0.54	0.00	27.54	114.72	2.00	0.00	0.53	0.00
27.61	122.41	2.00	0.00	0.53	0.00	27.65	124.08	2.00	0.00	0.53	0.00
27.72	122.14	2.00	0.00	0.53	0.00	27.78	129.05	2.00	0.00	0.53	0.00
27.89	156.58	2.00	0.00	0.53	0.00	27.96	193.09	1.27	0.10	0.53	0.00
28.01	218.59	2.00	0.00	0.53	0.00	28.06	231.74	2.00	0.00	0.52	0.00
28.10	237.99	2.00	0.00	0.52	0.00	28.20	237.87	2.00	0.00	0.52	0.00
28.25	236.45	2.00	0.00	0.52	0.00	28.29	232.33	2.00	0.00	0.52	0.00
28.35	226.83	2.00	0.00	0.52	0.00	28.42	219.33	2.00	0.00	0.52	0.00
28.53	212.86	2.00	0.00	0.52	0.00	28.60	208.42	2.00	0.00	0.52	0.00
28.64	208.67	2.00	0.00	0.51	0.00	28.70	208.82	2.00	0.00	0.51	0.00
28.77	209.75	2.00	0.00	0.51	0.00	28.82	211.84	2.00	0.00	0.51	0.00
28.93	210.57	2.00	0.00	0.51	0.00	28.99	202.12	2.00	0.00	0.51	0.00
29.04	186.88	2.00	0.00	0.51	0.00	29.09	171.80	2.00	0.00	0.51	0.00
29.17	160.87	2.00	0.00	0.51	0.00	29.22	152.50	2.00	0.00	0.50	0.00
29.35	146.39	2.00	0.00	0.50	0.00	29.39	145.09	2.00	0.00	0.50	0.00
29.44	146.28	2.00	0.00	0.50	0.00	29.53	147.49	2.00	0.00	0.50	0.00
29.58	145.48	2.00	0.00	0.50	0.00	29.64	143.90	2.00	0.00	0.50	0.00
29.70	143.06	2.00	0.00	0.50	0.00	29.75	148.64	2.00	0.00	0.50	0.00
29.83	154.63	2.00	0.00	0.49	0.00	29.88	158.72	0.76	0.51	0.49	0.00
29.93	159.09	0.76	0.51	0.49	0.00	30.01	156.89	0.74	0.64	0.49	0.01
30.06	154.29	0.71	0.65	0.49	0.00	30.23	162.40	0.80	0.49	0.49	0.01
30.29	174.73	0.96	0.26	0.49	0.00	30.36	179.91	1.04	0.25	0.49	0.00
30.41	182.00	1.07	0.18	0.48	0.00	30.48	179.23	1.03	0.25	0.48	0.00
30.54	174.19	0.95	0.25	0.48	0.00	30.60	170.76	0.91	0.34	0.48	0.00
30.67	169.91	0.89	0.34	0.48	0.00	30.72	171.41	0.91	0.34	0.48	0.00
30.77	166.83	0.85	0.35	0.48	0.00	30.85	163.62	0.81	0.47	0.48	0.00
30.95	159.34	0.76	0.49	0.48	0.01	31.02	160.08	0.77	0.48	0.47	0.00
31.07	159.83	0.76	0.48	0.47	0.00	31.12	164.02	0.82	0.47	0.47	0.00
31.18	172.86	0.93	0.33	0.47	0.00	31.29	181.15	1.05	0.18	0.47	0.00
31.36	184.02	1.10	0.17	0.47	0.00	31.41	180.82	1.05	0.24	0.47	0.00
31.46	178.45	1.01	0.24	0.47	0.00	31.53	176.78	0.99	0.24	0.47	0.00
31.58	174.44	0.95	0.24	0.46	0.00	31.64	171.76	0.91	0.33	0.46	0.00
31.72	172.58	0.93	0.32	0.46	0.00	31.76	176.85	0.99	0.24	0.46	0.00
31.83	178.15	1.00	0.24	0.46	0.00	31.89	171.00	0.90	0.33	0.46	0.00
32.00	160.80	0.77	0.46	0.46	0.01	32.07	152.60	0.68	0.62	0.46	0.00
32.11	148.76	0.64	0.78	0.46	0.00	32.19	143.68	0.59	0.79	0.45	0.01
32.29	138.11	0.54	0.81	0.45	0.01	32.35	130.94	0.48	0.85	0.45	0.01
32.42	129.27	0.46	0.85	0.45	0.01	32.47	127.88	0.45	0.86	0.45	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
32.55	125.69	2.00	0.00	0.45	0.00	32.60	124.07	2.00	0.00	0.45	0.00
32.66	125.50	2.00	0.00	0.45	0.00	32.73	130.67	2.00	0.00	0.45	0.00
32.78	140.38	2.00	0.00	0.44	0.00	32.84	147.44	2.00	0.00	0.44	0.00
32.91	149.60	2.00	0.00	0.44	0.00	32.95	147.01	2.00	0.00	0.44	0.00
33.02	144.19	2.00	0.00	0.44	0.00	33.08	144.12	2.00	0.00	0.44	0.00
33.18	139.93	0.55	0.78	0.44	0.01	33.26	137.12	0.53	0.79	0.44	0.01
33.31	133.39	0.50	0.80	0.44	0.00	33.39	133.17	0.49	0.80	0.43	0.01
33.44	132.74	2.00	0.00	0.43	0.00	33.50	131.31	2.00	0.00	0.43	0.00
33.57	130.99	2.00	0.00	0.43	0.00	33.62	128.66	2.00	0.00	0.43	0.00
33.67	127.71	0.45	0.82	0.43	0.00	33.75	127.82	0.45	0.82	0.43	0.01
33.86	132.70	0.49	0.79	0.43	0.01	33.92	141.22	0.56	0.75	0.43	0.01
33.97	148.28	0.63	0.73	0.42	0.00	34.00	149.97	0.65	0.71	0.42	0.00
34.06	151.74	0.66	0.58	0.42	0.00	34.13	150.44	0.65	0.58	0.42	0.00
34.24	149.69	0.64	0.71	0.42	0.01	34.31	148.05	0.63	0.72	0.42	0.01
34.35	146.59	0.61	0.71	0.42	0.00	34.40	146.93	0.62	0.71	0.42	0.00
34.50	148.12	0.63	0.71	0.42	0.01	34.57	148.77	0.63	0.71	0.41	0.01
34.61	151.08	0.66	0.57	0.41	0.00	34.66	153.79	0.69	0.55	0.41	0.00
34.75	156.68	0.72	0.53	0.41	0.01	34.93	158.58	0.74	0.52	0.41	0.01
35.01	160.77	0.76	0.41	0.41	0.00	35.06	165.09	0.82	0.40	0.41	0.00
35.18	168.71	0.86	0.29	0.40	0.00	35.24	172.19	0.91	0.28	0.40	0.00
35.29	172.41	0.91	0.28	0.40	0.00	35.35	170.21	0.88	0.29	0.40	0.00
35.41	165.12	0.82	0.39	0.40	0.00	35.46	158.46	0.74	0.51	0.40	0.00
35.53	153.34	0.68	0.53	0.40	0.00	35.59	151.98	0.67	0.54	0.40	0.00
35.63	152.94	0.68	0.53	0.40	0.00	35.69	153.64	0.68	0.53	0.40	0.00
35.76	153.20	0.68	0.53	0.39	0.00	35.82	151.83	0.66	0.53	0.39	0.00
35.90	149.99	0.64	0.66	0.39	0.01	35.94	147.24	0.62	0.68	0.39	0.00
36.00	144.27	0.59	0.67	0.39	0.00	36.07	142.78	0.57	0.68	0.39	0.01
36.12	144.00	0.58	0.67	0.39	0.00	36.17	147.84	0.62	0.67	0.39	0.00
36.25	152.15	0.67	0.52	0.39	0.00	36.30	155.34	0.70	0.51	0.38	0.00
36.36	156.39	0.71	0.50	0.38	0.00	36.43	156.21	0.71	0.50	0.38	0.00
36.54	155.31	0.70	0.50	0.38	0.01	36.65	155.67	0.70	0.50	0.38	0.01
36.70	155.92	0.71	0.49	0.38	0.00	36.78	155.68	0.70	0.49	0.38	0.00
36.83	156.16	0.71	0.49	0.38	0.00	36.88	156.70	0.72	0.49	0.37	0.00
36.94	158.97	0.74	0.48	0.37	0.00	37.00	161.13	0.77	0.38	0.37	0.00
37.06	162.87	0.79	0.37	0.37	0.00	37.12	162.99	0.79	0.37	0.37	0.00
37.16	163.20	0.79	0.37	0.37	0.00	37.21	163.29	0.79	0.37	0.37	0.00
37.29	163.51	0.79	0.36	0.37	0.00	37.36	162.30	0.78	0.37	0.37	0.00
37.42	160.62	0.76	0.37	0.37	0.00	37.47	159.84	0.75	0.37	0.36	0.00
37.56	160.65	0.76	0.37	0.36	0.00	37.61	163.49	0.79	0.36	0.36	0.00
37.69	166.36	0.83	0.35	0.36	0.00	37.73	168.05	0.85	0.26	0.36	0.00
37.83	168.87	0.86	0.26	0.36	0.00	37.87	171.30	0.89	0.25	0.36	0.00
37.95	174.09	0.93	0.25	0.36	0.00	38.00	176.96	0.97	0.18	0.36	0.00
38.09	178.11	0.99	0.18	0.35	0.00	38.15	178.52	0.99	0.18	0.35	0.00
38.21	179.10	1.00	0.18	0.35	0.00	38.30	179.71	1.01	0.18	0.35	0.00
38.34	180.67	1.03	0.18	0.35	0.00	38.39	181.68	1.04	0.18	0.35	0.00
38.47	182.50	1.05	0.13	0.35	0.00	38.53	183.01	1.06	0.13	0.35	0.00
38.62	182.65	1.06	0.13	0.35	0.00	38.66	182.18	1.05	0.17	0.34	0.00
38.75	182.04	1.05	0.17	0.34	0.00	38.80	181.21	1.04	0.17	0.34	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
38.89	180.71	1.03	0.17	0.34	0.00	38.94	179.84	1.01	0.17	0.34	0.00
38.99	180.58	1.03	0.17	0.34	0.00	39.10	180.95	1.03	0.17	0.34	0.00
39.15	181.90	1.05	0.17	0.34	0.00	39.19	181.47	1.04	0.17	0.34	0.00
39.26	179.64	1.01	0.17	0.33	0.00	39.32	174.91	0.94	0.23	0.33	0.00
39.43	169.34	0.87	0.24	0.33	0.00	39.47	163.53	0.80	0.33	0.33	0.00
39.54	159.68	0.75	0.34	0.33	0.00	39.58	155.93	0.71	0.43	0.33	0.00
39.64	151.48	0.66	0.45	0.33	0.00	39.73	147.34	0.62	0.57	0.33	0.01
39.77	143.94	0.58	0.56	0.33	0.00	39.85	142.28	0.57	0.57	0.32	0.01
39.90	137.66	0.53	0.58	0.32	0.00	40.03	133.32	0.49	0.59	0.32	0.01
40.08	129.41	0.46	0.61	0.32	0.00	40.12	129.99	0.47	0.60	0.32	0.00
40.20	130.12	0.47	0.60	0.32	0.01	40.24	132.81	0.49	0.59	0.32	0.00
40.30	138.21	0.53	0.57	0.32	0.00	40.39	145.13	0.60	0.54	0.32	0.01
40.44	151.35	0.66	0.43	0.31	0.00	40.50	154.90	0.70	0.41	0.31	0.00
40.56	155.15	0.70	0.41	0.31	0.00	40.68	154.01	0.69	0.41	0.31	0.01
40.74	151.48	0.66	0.42	0.31	0.00	40.78	145.41	0.60	0.53	0.31	0.00
40.85	138.39	0.54	0.55	0.31	0.00	40.92	132.34	0.48	0.57	0.31	0.00
40.96	126.22	0.44	0.59	0.31	0.00	41.09	123.21	0.42	0.60	0.30	0.01
41.13	131.52	0.48	0.57	0.30	0.00	41.19	143.99	0.59	0.52	0.30	0.00
41.27	151.42	0.66	0.41	0.30	0.00	41.31	151.91	0.67	0.41	0.30	0.00
41.37	147.28	0.62	0.52	0.30	0.00	41.44	142.11	0.57	0.52	0.30	0.00
41.49	138.88	0.54	0.53	0.30	0.00	41.56	138.55	0.54	0.53	0.30	0.00
41.62	139.27	0.54	0.52	0.29	0.00	41.67	139.95	0.55	0.52	0.29	0.00
41.75	139.47	0.55	0.52	0.29	0.01	41.80	137.65	0.53	0.52	0.29	0.00
41.91	138.37	0.54	0.52	0.29	0.01	41.98	142.88	0.58	0.50	0.29	0.00
42.03	147.20	0.62	0.50	0.29	0.00	42.09	152.08	0.67	0.39	0.29	0.00
42.20	156.21	0.72	0.37	0.28	0.00	42.26	160.04	0.76	0.29	0.28	0.00
42.32	164.71	0.82	0.28	0.28	0.00	42.37	169.67	0.88	0.20	0.28	0.00
42.44	174.97	0.95	0.15	0.28	0.00	42.51	180.65	1.04	0.14	0.28	0.00
42.55	187.07	1.14	0.10	0.28	0.00	42.62	193.86	1.25	0.07	0.28	0.00
42.68	200.45	2.00	0.00	0.28	0.00	42.73	207.28	2.00	0.00	0.28	0.00
42.86	212.16	2.00	0.00	0.27	0.00	42.92	215.62	2.00	0.00	0.27	0.00
42.97	216.09	2.00	0.00	0.27	0.00	43.00	215.70	2.00	0.00	0.27	0.00
43.08	215.76	2.00	0.00	0.27	0.00	43.12	217.95	2.00	0.00	0.27	0.00
43.21	221.42	2.00	0.00	0.27	0.00	43.26	225.71	2.00	0.00	0.27	0.00
43.35	228.62	2.00	0.00	0.27	0.00	43.40	230.62	2.00	0.00	0.26	0.00
43.44	229.54	2.00	0.00	0.26	0.00	43.55	227.08	2.00	0.00	0.26	0.00
43.59	225.46	2.00	0.00	0.26	0.00	43.64	223.41	2.00	0.00	0.26	0.00
43.70	223.98	2.00	0.00	0.26	0.00	43.78	225.64	2.00	0.00	0.26	0.00
43.89	229.13	2.00	0.00	0.26	0.00	43.93	230.23	2.00	0.00	0.26	0.00
43.99	228.18	2.00	0.00	0.25	0.00	44.06	224.18	2.00	0.00	0.25	0.00
44.10	218.97	2.00	0.00	0.25	0.00	44.19	213.26	2.00	0.00	0.25	0.00
44.23	207.81	2.00	0.00	0.25	0.00	44.33	203.52	2.00	0.00	0.25	0.00
44.40	200.27	2.00	0.00	0.25	0.00	44.46	197.95	1.33	0.04	0.25	0.00
44.56	195.94	1.30	0.04	0.24	0.00	44.62	194.86	1.28	0.04	0.24	0.00
44.66	194.25	1.27	0.04	0.24	0.00	44.71	192.53	1.24	0.06	0.24	0.00
44.77	186.19	1.13	0.09	0.24	0.00	44.86	177.46	1.00	0.12	0.24	0.00
44.90	170.70	0.90	0.17	0.24	0.00	44.96	164.90	0.83	0.23	0.24	0.00
45.02	156.87	0.73	0.31	0.24	0.00	45.12	148.83	0.65	0.40	0.24	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
45.17	141.03	0.57	0.41	0.23	0.00	45.23	135.50	0.52	0.43	0.23	0.00
45.30	130.24	0.48	0.44	0.23	0.00	45.35	124.33	0.44	0.45	0.23	0.00
45.42	115.80	0.38	0.48	0.23	0.00	45.53	109.30	0.34	0.50	0.23	0.01
45.61	102.45	0.30	0.52	0.23	0.00	45.65	100.85	0.29	0.52	0.23	0.00
45.78	93.67	0.26	0.55	0.22	0.01	45.83	86.20	0.23	0.59	0.22	0.00
45.87	84.28	0.23	0.60	0.22	0.00	45.94	86.59	0.24	0.58	0.22	0.00
46.02	91.85	0.25	0.55	0.22	0.00	46.10	94.70	0.27	0.53	0.22	0.01
46.17	93.19	0.26	0.54	0.22	0.00	46.21	87.65	0.24	0.56	0.22	0.00
46.36	81.94	0.22	0.59	0.22	0.00	46.36	78.71	0.21	0.61	0.21	0.01
46.41	80.10	0.21	0.60	0.21	0.00	46.51	86.31	0.23	0.56	0.21	0.01
46.56	93.93	2.00	0.00	0.21	0.00	46.61	94.30	2.00	0.00	0.21	0.00
46.68	90.60	2.00	0.00	0.21	0.00	46.74	86.26	2.00	0.00	0.21	0.00
46.84	83.07	2.00	0.00	0.21	0.00	46.91	81.94	2.00	0.00	0.20	0.00
46.96	81.17	2.00	0.00	0.20	0.00	47.00	80.48	2.00	0.00	0.20	0.00
47.05	79.18	2.00	0.00	0.20	0.00	47.14	77.87	2.00	0.00	0.20	0.00
47.18	77.24	2.00	0.00	0.20	0.00	47.26	77.26	2.00	0.00	0.20	0.00
47.36	76.95	2.00	0.00	0.20	0.00	47.39	75.21	2.00	0.00	0.20	0.00
47.45	72.86	2.00	0.00	0.20	0.00	47.51	69.84	2.00	0.00	0.19	0.00
47.61	66.97	2.00	0.00	0.19	0.00	47.65	64.12	2.00	0.00	0.19	0.00
47.73	62.23	2.00	0.00	0.19	0.00	47.78	60.26	2.00	0.00	0.19	0.00
47.87	58.86	2.00	0.00	0.19	0.00	47.91	57.17	2.00	0.00	0.19	0.00
48.00	54.83	2.00	0.00	0.19	0.00	48.05	52.61	2.00	0.00	0.19	0.00
48.12	50.89	2.00	0.00	0.18	0.00	48.17	50.22	2.00	0.00	0.18	0.00
48.29	49.55	2.00	0.00	0.18	0.00	48.35	48.86	2.00	0.00	0.18	0.00
48.40	48.66	2.00	0.00	0.18	0.00	48.46	48.60	2.00	0.00	0.18	0.00
48.49	48.60	2.00	0.00	0.18	0.00	48.59	48.83	2.00	0.00	0.18	0.00
48.68	49.25	2.00	0.00	0.17	0.00	48.69	50.29	2.00	0.00	0.17	0.00
48.77	52.02	2.00	0.00	0.17	0.00	48.85	54.24	2.00	0.00	0.17	0.00
48.89	58.16	2.00	0.00	0.17	0.00	48.99	61.34	2.00	0.00	0.17	0.00
49.02	65.71	2.00	0.00	0.17	0.00	49.13	67.90	2.00	0.00	0.17	0.00
49.15	70.75	2.00	0.00	0.17	0.00	49.26	72.50	0.20	0.50	0.17	0.01
49.29	74.80	0.20	0.49	0.16	0.00	49.35	76.32	2.00	0.00	0.16	0.00
49.43	77.42	2.00	0.00	0.16	0.00	49.49	77.99	2.00	0.00	0.16	0.00
49.56	77.82	2.00	0.00	0.16	0.00	49.62	76.22	2.00	0.00	0.16	0.00
49.70	73.47	2.00	0.00	0.16	0.00	49.74	70.76	2.00	0.00	0.16	0.00
49.84	69.35	2.00	0.00	0.16	0.00	49.91	68.63	2.00	0.00	0.15	0.00
49.96	67.76	2.00	0.00	0.15	0.00	50.01	67.00	2.00	0.00	0.15	0.00

Total estimated settlement: 1.92

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

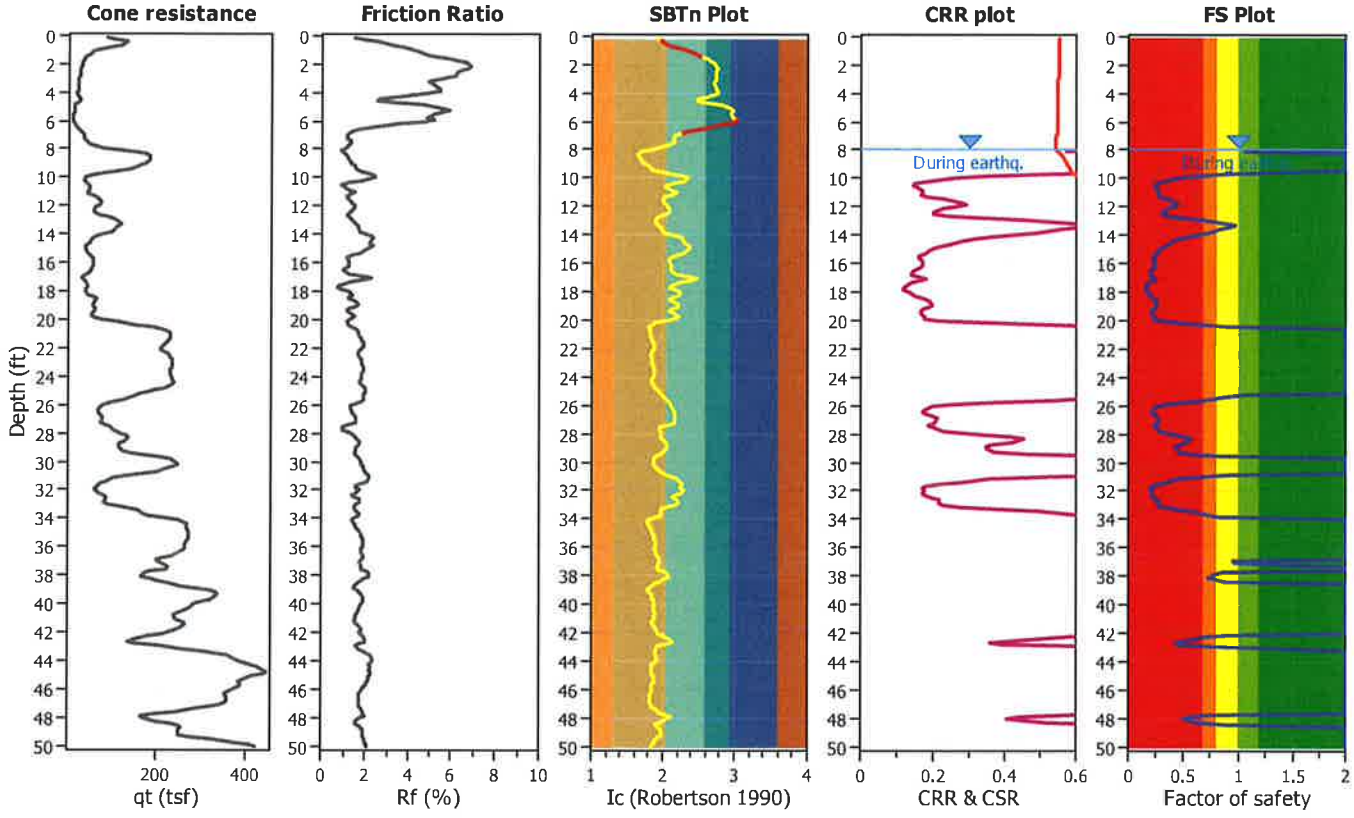
LIQUEFACTION ANALYSIS REPORT

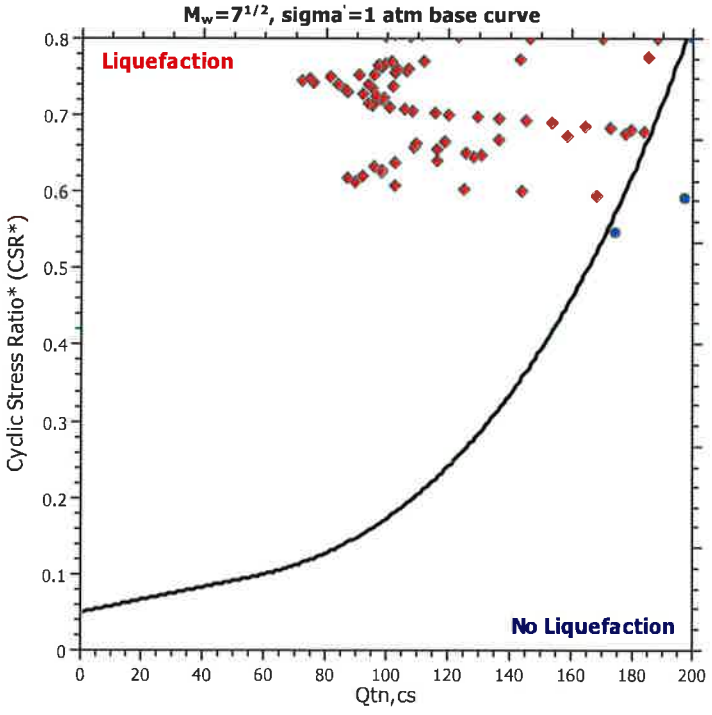
Project title : S-Line Upgrades **Location : Imperial County, CA**

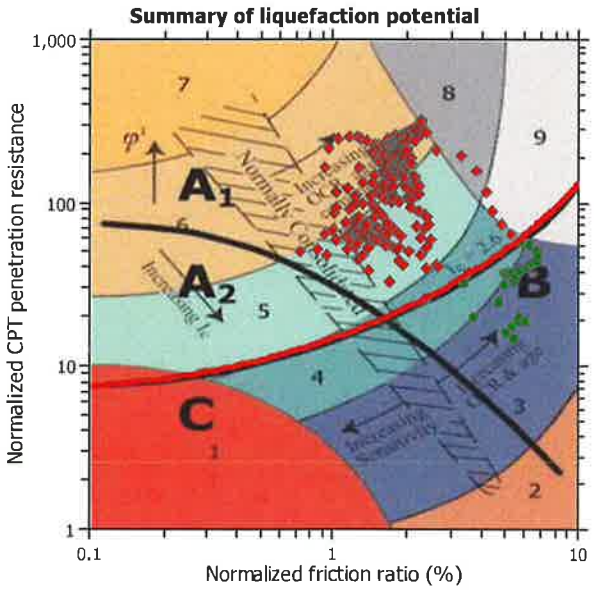
CPT file : CPT-20

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.78	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

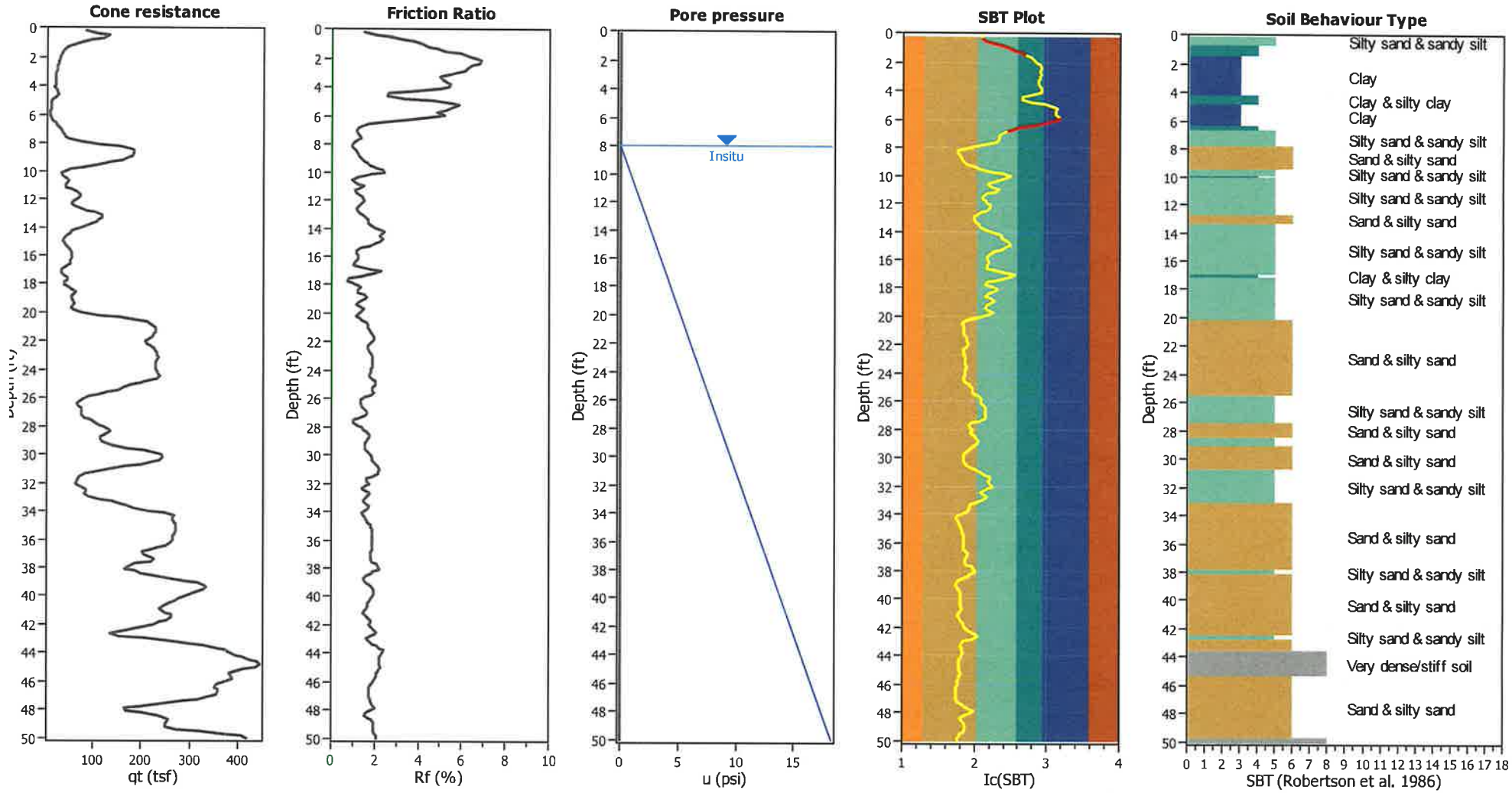






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



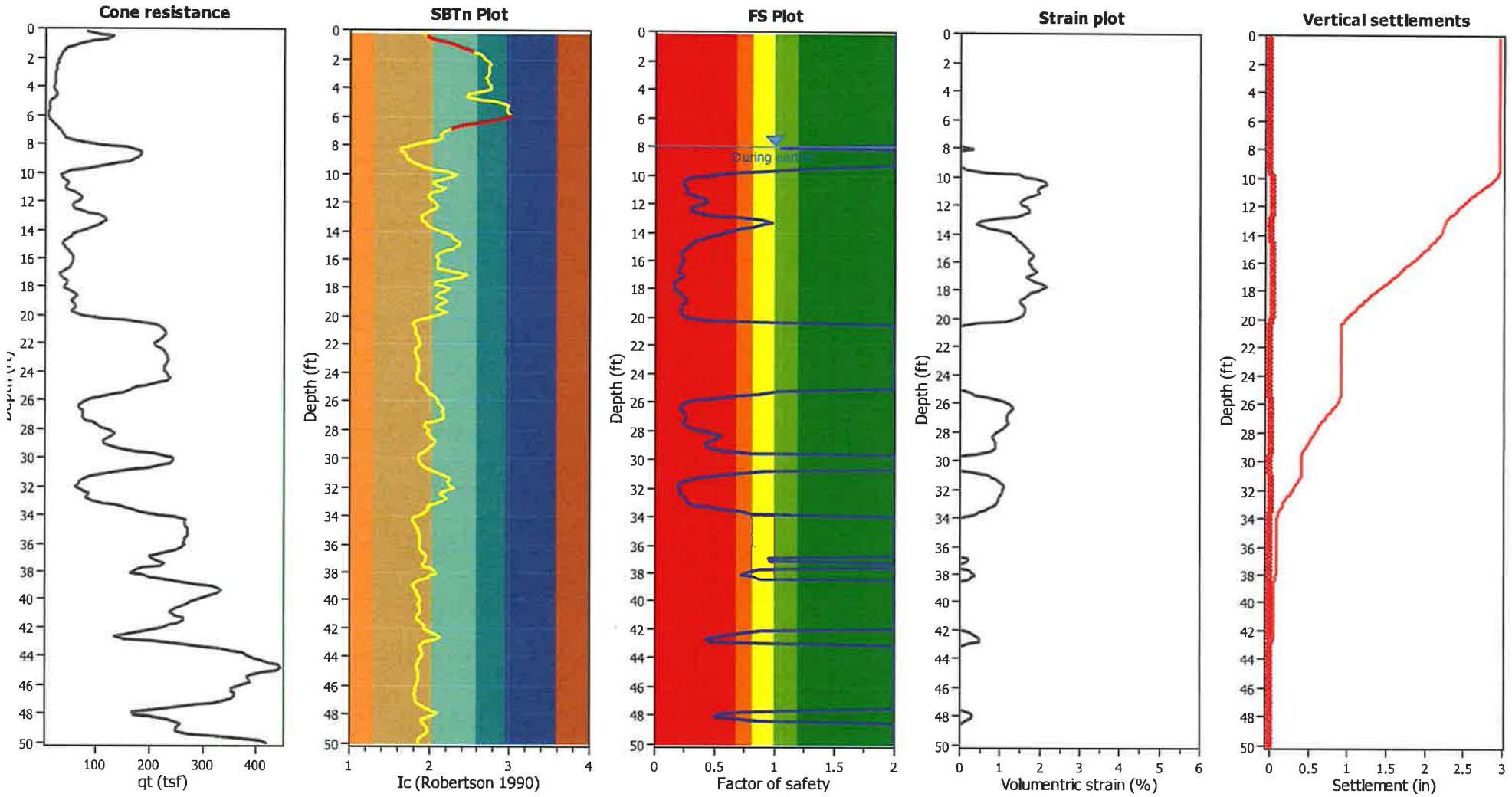
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.78	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	174.35	1.05	0.33	0.86	0.01	8.20	218.11	2.00	0.00	0.86	0.00
8.37	245.41	2.00	0.00	0.86	0.00	8.53	261.12	2.00	0.00	0.86	0.00
8.69	263.62	2.00	0.00	0.85	0.00	8.86	260.94	2.00	0.00	0.85	0.00
9.02	256.79	2.00	0.00	0.85	0.00	9.19	247.22	2.00	0.00	0.84	0.00
9.35	226.84	2.00	0.00	0.84	0.00	9.51	197.49	1.35	0.15	0.84	0.00
9.68	167.94	0.87	0.61	0.84	0.01	9.84	143.49	0.59	1.45	0.83	0.03
10.01	124.70	0.43	1.62	0.83	0.03	10.17	102.79	0.30	1.89	0.83	0.04
10.33	89.17	0.24	2.12	0.82	0.04	10.50	86.90	0.23	2.16	0.82	0.04
10.66	92.13	0.25	2.05	0.82	0.04	10.83	97.86	0.27	1.94	0.82	0.04
10.99	98.41	0.27	1.93	0.81	0.04	11.15	95.76	0.26	1.96	0.81	0.04
11.32	102.47	0.28	1.85	0.81	0.04	11.48	116.28	0.35	1.66	0.81	0.03
11.65	128.25	0.43	1.53	0.80	0.03	11.81	130.85	0.44	1.50	0.80	0.03
11.98	125.70	0.41	1.54	0.80	0.03	12.14	116.49	0.35	1.64	0.79	0.03
12.30	108.85	0.30	1.73	0.79	0.03	12.47	109.26	0.30	1.71	0.79	0.03
12.63	118.62	0.35	1.60	0.79	0.03	12.80	136.50	0.47	1.42	0.78	0.03
12.96	158.66	0.67	1.00	0.78	0.02	13.12	177.21	0.89	0.52	0.78	0.01
13.29	183.86	0.97	0.39	0.77	0.01	13.45	179.54	0.91	0.51	0.77	0.01
13.62	172.56	0.82	0.70	0.77	0.01	13.78	164.21	0.72	0.93	0.77	0.02
13.94	153.86	0.61	1.24	0.76	0.02	14.11	144.70	0.52	1.31	0.76	0.03
14.27	136.41	0.45	1.37	0.76	0.03	14.44	129.58	0.40	1.43	0.76	0.03
14.60	120.07	0.34	1.51	0.75	0.03	14.76	115.44	0.32	1.56	0.75	0.03
14.93	108.24	0.28	1.64	0.75	0.03	15.09	105.33	0.27	1.67	0.74	0.03
15.26	100.64	0.25	1.72	0.74	0.03	15.42	95.03	0.22	1.80	0.74	0.04
15.58	93.45	0.22	1.82	0.74	0.04	15.75	95.94	0.23	1.77	0.73	0.03
15.91	98.37	0.23	1.73	0.73	0.03	16.08	99.03	0.24	1.71	0.73	0.03
16.24	96.52	0.23	1.74	0.72	0.03	16.40	91.72	0.21	1.81	0.72	0.04
16.57	86.68	0.19	1.89	0.72	0.04	16.73	86.13	0.19	1.89	0.72	0.04
16.90	94.83	0.22	1.74	0.71	0.03	17.06	101.88	0.24	1.64	0.71	0.03
17.22	93.98	0.21	1.74	0.71	0.03	17.39	84.05	0.18	1.90	0.71	0.04
17.55	75.58	0.16	2.07	0.70	0.04	17.72	71.75	0.15	2.15	0.70	0.04
17.88	74.09	0.16	2.08	0.70	0.04	18.04	81.11	0.17	1.93	0.69	0.04
18.21	90.31	0.20	1.76	0.69	0.03	18.37	95.58	0.21	1.67	0.69	0.03
18.54	102.56	0.24	1.57	0.69	0.03	18.70	106.31	0.25	1.52	0.68	0.03
18.86	106.59	0.25	1.51	0.68	0.03	19.03	103.06	0.24	1.54	0.68	0.03
19.19	97.88	0.22	1.60	0.67	0.03	19.36	97.30	0.22	1.61	0.67	0.03
19.52	97.05	0.22	1.60	0.67	0.03	19.69	99.68	0.22	1.56	0.67	0.03
19.85	100.97	0.23	1.54	0.66	0.03	20.01	112.03	0.27	1.41	0.66	0.03
20.18	143.40	0.46	1.14	0.66	0.02	20.34	185.18	0.87	0.41	0.66	0.01
20.51	225.62	2.00	0.00	0.65	0.00	20.67	251.32	2.00	0.00	0.65	0.00
20.83	263.89	2.00	0.00	0.65	0.00	21.00	270.95	2.00	0.00	0.64	0.00
21.16	272.25	2.00	0.00	0.64	0.00	21.33	275.33	2.00	0.00	0.64	0.00
21.49	273.96	2.00	0.00	0.64	0.00	21.65	270.84	2.00	0.00	0.63	0.00
21.82	261.69	2.00	0.00	0.63	0.00	21.98	254.11	2.00	0.00	0.63	0.00
22.15	250.03	2.00	0.00	0.62	0.00	22.31	254.16	2.00	0.00	0.62	0.00
22.47	261.19	2.00	0.00	0.62	0.00	22.64	266.42	2.00	0.00	0.62	0.00
22.80	270.22	2.00	0.00	0.61	0.00	22.97	271.73	2.00	0.00	0.61	0.00
23.13	273.15	2.00	0.00	0.61	0.00	23.29	271.49	2.00	0.00	0.61	0.00
23.46	268.10	2.00	0.00	0.60	0.00	23.62	265.23	2.00	0.00	0.60	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	263.50	2.00	0.00	0.60	0.00	23.95	261.79	2.00	0.00	0.59	0.00
24.11	263.13	2.00	0.00	0.59	0.00	24.28	264.05	2.00	0.00	0.59	0.00
24.44	266.47	2.00	0.00	0.59	0.00	24.61	263.03	2.00	0.00	0.58	0.00
24.77	253.18	2.00	0.00	0.58	0.00	24.93	233.55	2.00	0.00	0.58	0.00
25.10	214.59	2.00	0.00	0.57	0.00	25.26	199.95	1.03	0.27	0.57	0.01
25.43	187.94	0.87	0.35	0.57	0.01	25.59	169.97	0.67	0.66	0.57	0.01
25.75	146.10	0.46	0.96	0.56	0.02	25.92	123.25	0.32	1.10	0.56	0.02
26.08	107.22	0.24	1.23	0.56	0.02	26.25	99.63	0.21	1.30	0.56	0.03
26.41	98.75	0.21	1.30	0.55	0.03	26.57	102.31	0.22	1.26	0.55	0.02
26.74	107.21	0.24	1.21	0.55	0.02	26.90	111.29	0.26	1.16	0.54	0.02
27.07	110.51	0.25	1.17	0.54	0.02	27.23	108.36	0.25	1.18	0.54	0.02
27.40	103.95	0.23	1.21	0.54	0.02	27.56	108.18	0.24	1.17	0.53	0.02
27.72	115.62	0.28	1.10	0.53	0.02	27.89	128.25	0.34	1.00	0.53	0.02
28.05	140.65	0.42	0.93	0.52	0.02	28.22	153.81	0.51	0.86	0.52	0.02
28.38	158.74	0.55	0.81	0.52	0.02	28.54	154.55	0.52	0.84	0.52	0.02
28.71	146.15	0.45	0.88	0.51	0.02	28.87	141.93	0.42	0.90	0.51	0.02
29.04	142.04	0.42	0.89	0.51	0.02	29.20	146.09	0.45	0.86	0.51	0.02
29.36	159.71	0.56	0.77	0.50	0.02	29.53	184.62	0.81	0.41	0.50	0.01
29.69	214.79	2.00	0.00	0.50	0.00	29.86	237.37	2.00	0.00	0.49	0.00
30.02	250.38	2.00	0.00	0.49	0.00	30.18	253.43	2.00	0.00	0.49	0.00
30.35	247.73	2.00	0.00	0.49	0.00	30.51	236.86	2.00	0.00	0.48	0.00
30.68	219.43	2.00	0.00	0.48	0.00	30.84	194.55	0.92	0.28	0.48	0.01
31.00	167.85	0.62	0.68	0.47	0.01	31.17	143.83	0.43	0.82	0.47	0.02
31.33	127.43	0.33	0.90	0.47	0.02	31.50	111.44	0.25	1.00	0.47	0.02
31.66	101.00	0.21	1.07	0.46	0.02	31.82	97.43	0.20	1.10	0.46	0.02
31.99	99.89	0.21	1.07	0.46	0.02	32.15	98.70	0.20	1.07	0.46	0.02
32.32	101.78	0.21	1.04	0.45	0.02	32.48	108.05	0.23	0.99	0.45	0.02
32.64	113.69	0.26	0.94	0.45	0.02	32.81	113.73	0.26	0.93	0.44	0.02
32.97	115.96	0.27	0.91	0.44	0.02	33.14	127.97	0.33	0.84	0.44	0.02
33.30	147.25	0.45	0.74	0.44	0.01	33.46	164.62	0.59	0.64	0.43	0.01
33.63	177.66	0.71	0.47	0.43	0.01	33.79	186.59	0.81	0.35	0.43	0.01
33.96	207.18	2.00	0.00	0.42	0.00	34.12	229.15	2.00	0.00	0.42	0.00
34.28	245.70	2.00	0.00	0.42	0.00	34.45	247.15	2.00	0.00	0.42	0.00
34.61	248.39	2.00	0.00	0.41	0.00	34.78	252.34	2.00	0.00	0.41	0.00
34.94	256.90	2.00	0.00	0.41	0.00	35.10	257.79	2.00	0.00	0.41	0.00
35.27	257.75	2.00	0.00	0.40	0.00	35.43	257.33	2.00	0.00	0.40	0.00
35.60	254.57	2.00	0.00	0.40	0.00	35.76	252.57	2.00	0.00	0.39	0.00
35.93	251.10	2.00	0.00	0.39	0.00	36.09	250.00	2.00	0.00	0.39	0.00
36.25	245.88	2.00	0.00	0.39	0.00	36.42	238.21	2.00	0.00	0.38	0.00
36.58	226.30	2.00	0.00	0.38	0.00	36.75	210.53	2.00	0.00	0.38	0.00
36.91	198.25	0.95	0.21	0.37	0.00	37.07	199.62	0.96	0.17	0.37	0.00
37.24	210.68	2.00	0.00	0.37	0.00	37.40	215.93	2.00	0.00	0.37	0.00
37.57	211.31	2.00	0.00	0.36	0.00	37.73	191.49	0.86	0.22	0.36	0.00
37.89	184.65	0.78	0.30	0.36	0.01	38.06	179.33	0.72	0.38	0.35	0.01
38.22	187.27	0.81	0.29	0.35	0.01	38.39	192.73	0.88	0.21	0.35	0.00
38.55	203.44	2.00	0.00	0.35	0.00	38.71	223.53	2.00	0.00	0.34	0.00
38.88	248.79	2.00	0.00	0.34	0.00	39.04	273.78	2.00	0.00	0.34	0.00
39.21	288.07	2.00	0.00	0.34	0.00	39.37	293.19	2.00	0.00	0.33	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	290.22	2.00	0.00	0.33	0.00	39.70	280.76	2.00	0.00	0.33	0.00
39.86	266.96	2.00	0.00	0.32	0.00	40.03	253.67	2.00	0.00	0.32	0.00
40.19	243.85	2.00	0.00	0.32	0.00	40.35	236.27	2.00	0.00	0.32	0.00
40.52	228.21	2.00	0.00	0.31	0.00	40.68	218.39	2.00	0.00	0.31	0.00
40.85	209.90	2.00	0.00	0.31	0.00	41.01	208.63	2.00	0.00	0.30	0.00
41.17	214.31	2.00	0.00	0.30	0.00	41.34	225.16	2.00	0.00	0.30	0.00
41.50	228.01	2.00	0.00	0.30	0.00	41.67	222.48	2.00	0.00	0.29	0.00
41.83	212.07	2.00	0.00	0.29	0.00	41.99	202.51	2.00	0.00	0.29	0.00
42.16	191.80	0.37	0.17	0.29	0.00	42.32	175.00	0.69	0.31	0.28	0.01
42.49	156.45	0.52	0.45	0.28	0.01	42.65	144.31	0.43	0.48	0.28	0.01
42.81	149.02	0.46	0.46	0.27	0.01	42.98	181.95	0.76	0.23	0.27	0.00
43.14	221.20	2.00	0.00	0.27	0.00	43.31	256.34	2.00	0.00	0.27	0.00
43.47	281.96	2.00	0.00	0.26	0.00	43.64	306.11	2.00	0.00	0.26	0.00
43.80	322.99	2.00	0.00	0.26	0.00	43.96	327.28	2.00	0.00	0.25	0.00
44.13	333.04	2.00	0.00	0.25	0.00	44.29	339.66	2.00	0.00	0.25	0.00
44.46	352.07	2.00	0.00	0.25	0.00	44.62	361.93	2.00	0.00	0.24	0.00
44.78	366.26	2.00	0.00	0.24	0.00	44.95	359.56	2.00	0.00	0.24	0.00
45.11	340.45	2.00	0.00	0.24	0.00	45.28	322.65	2.00	0.00	0.23	0.00
45.44	313.57	2.00	0.00	0.23	0.00	45.60	315.32	2.00	0.00	0.23	0.00
45.77	313.16	2.00	0.00	0.22	0.00	45.93	304.61	2.00	0.00	0.22	0.00
46.10	289.47	2.00	0.00	0.22	0.00	46.26	282.22	2.00	0.00	0.22	0.00
46.42	279.50	2.00	0.00	0.21	0.00	46.59	282.92	2.00	0.00	0.21	0.00
46.75	281.59	2.00	0.00	0.21	0.00	46.92	278.77	2.00	0.00	0.20	0.00
47.08	269.60	2.00	0.00	0.20	0.00	47.24	255.63	2.00	0.00	0.20	0.00
47.41	233.78	2.00	0.00	0.20	0.00	47.57	205.80	2.00	0.00	0.19	0.00
47.74	175.73	0.71	0.21	0.19	0.00	47.90	156.99	0.54	0.30	0.19	0.01
48.06	151.77	0.50	0.31	0.19	0.01	48.23	167.64	0.63	0.26	0.18	0.01
48.39	188.12	0.86	0.11	0.18	0.00	48.56	203.70	2.00	0.00	0.18	0.00
48.72	210.96	2.00	0.00	0.17	0.00	48.88	209.84	2.00	0.00	0.17	0.00
49.05	207.63	2.00	0.00	0.17	0.00	49.21	206.73	2.00	0.00	0.17	0.00
49.38	222.91	2.00	0.00	0.16	0.00	49.54	255.85	2.00	0.00	0.16	0.00
49.70	290.56	2.00	0.00	0.16	0.00	49.87	315.85	2.00	0.00	0.15	0.00
50.03	323.64	2.00	0.00	0.15	0.00						

Total estimated settlement: 2.96

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

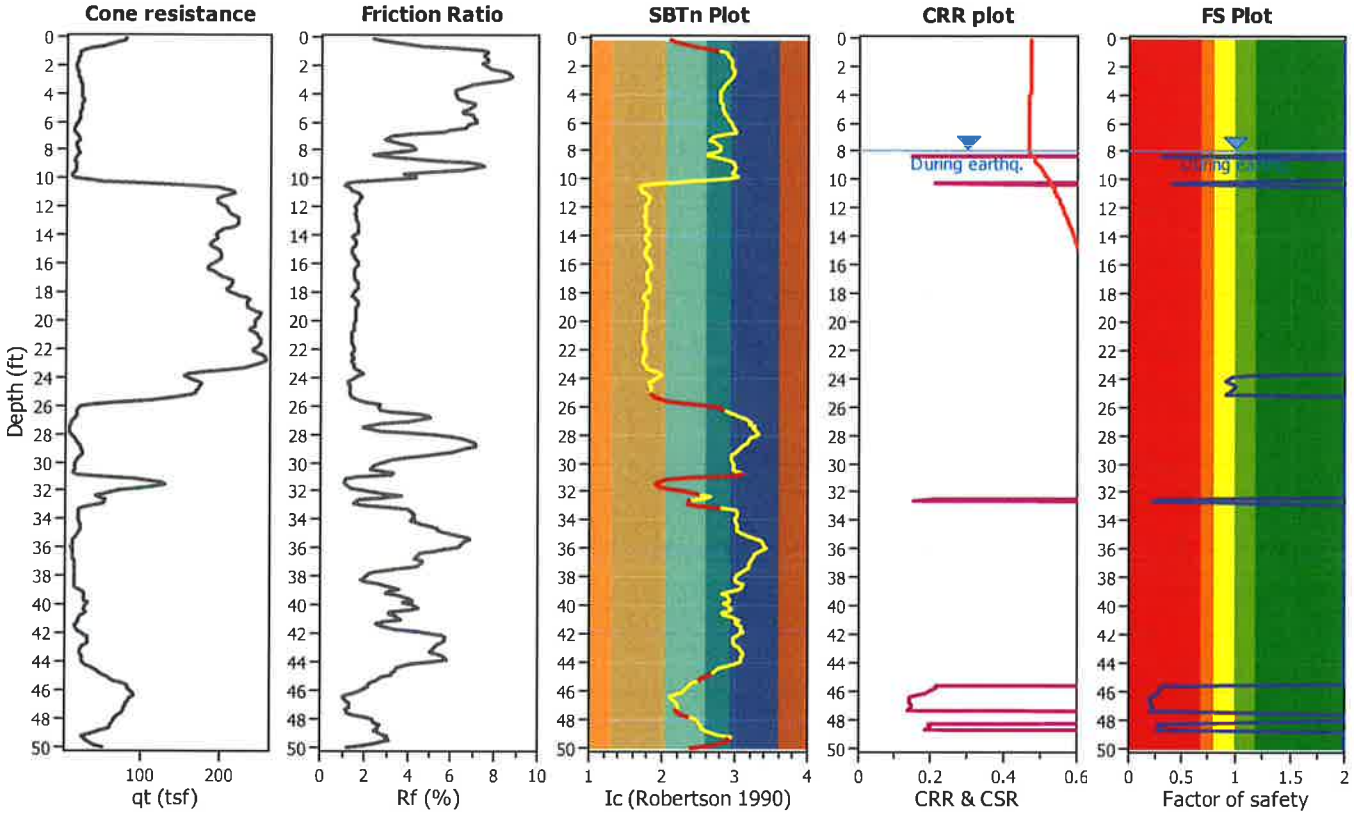
LIQUEFACTION ANALYSIS REPORT

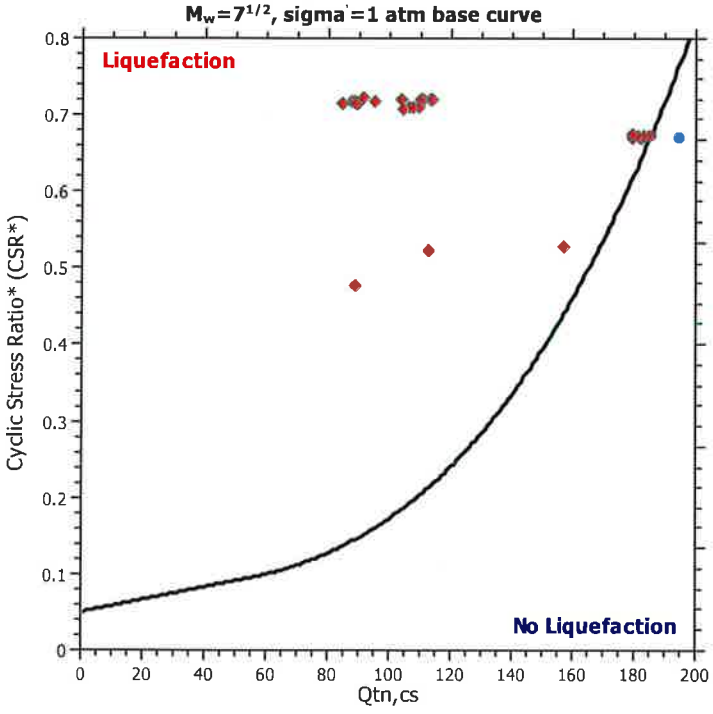
Project title : S-Line Upgrades **Location : Imperial County, CA**

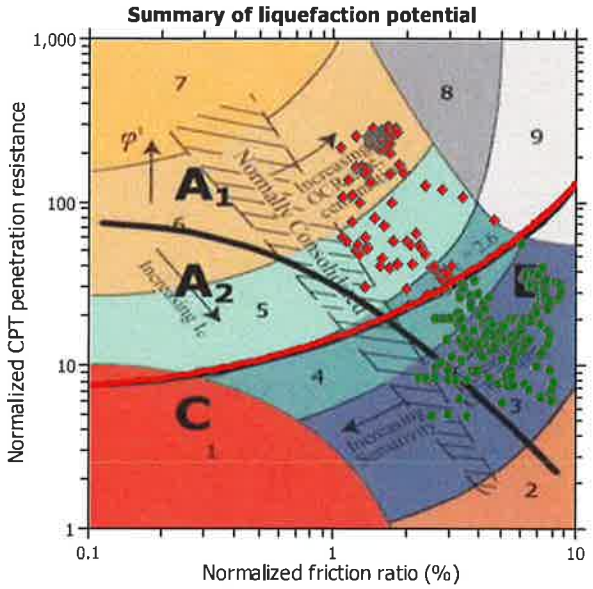
CPT file : CPT-21

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.67	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

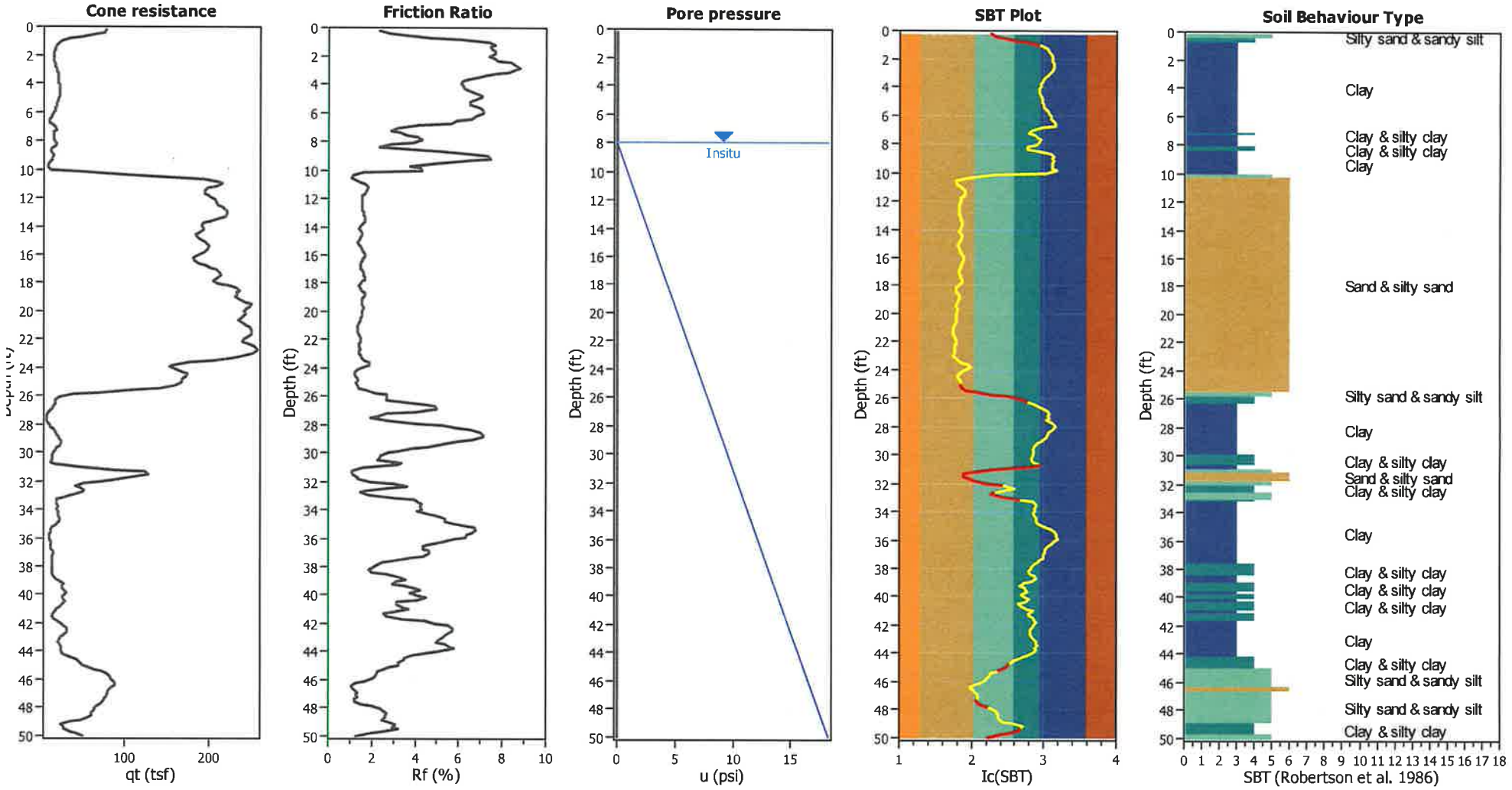






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



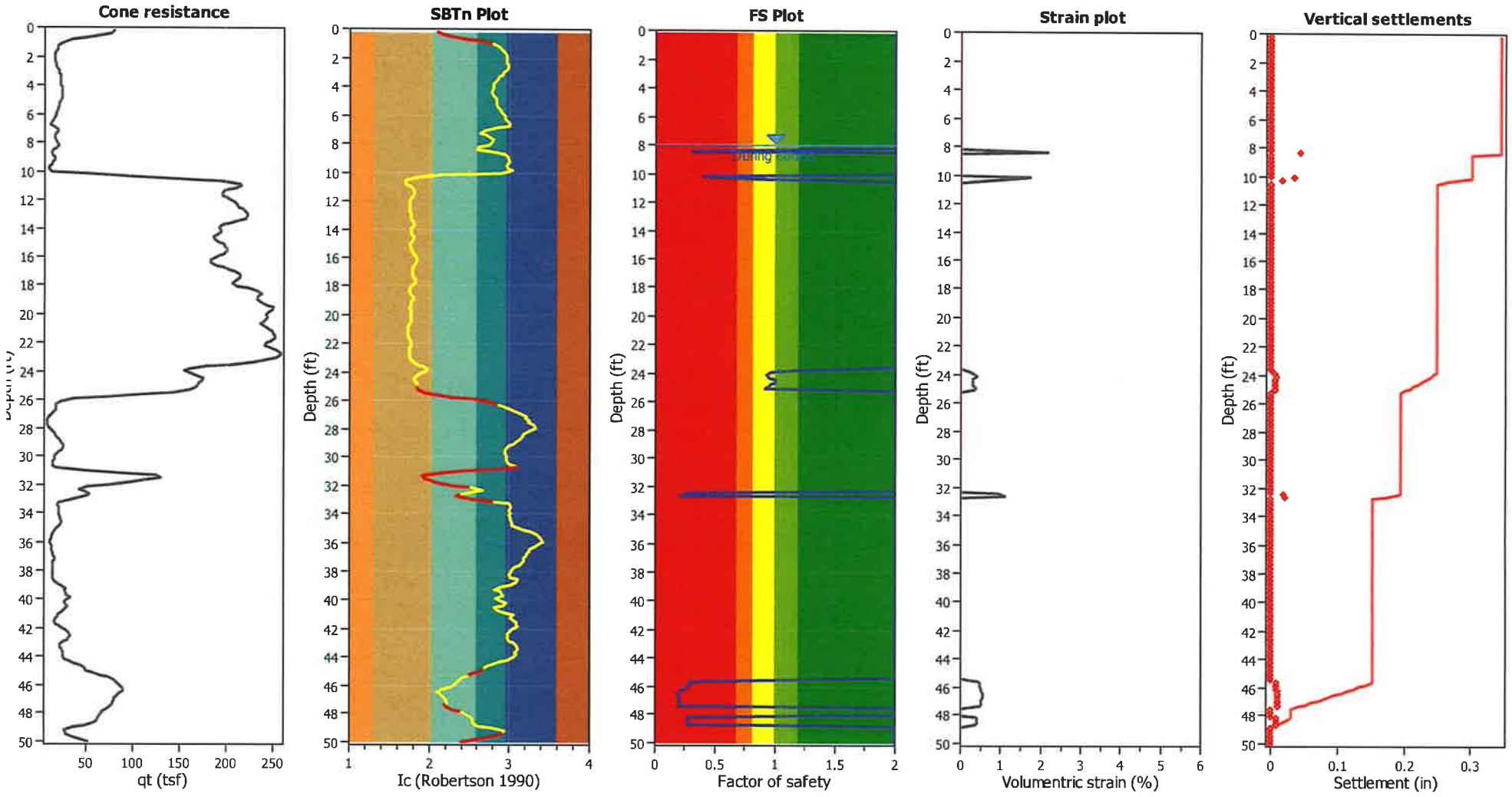
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.67	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	114.78	2.00	0.00	0.86	0.00	8.20	102.25	2.00	0.00	0.86	0.00
8.37	88.70	0.30	2.21	0.86	0.04	8.53	94.56	2.00	0.00	0.86	0.00
8.69	116.28	2.00	0.00	0.85	0.00	8.86	136.38	2.00	0.00	0.85	0.00
9.02	149.78	2.00	0.00	0.85	0.00	9.19	146.95	2.00	0.00	0.84	0.00
9.35	132.36	2.00	0.00	0.84	0.00	9.51	107.59	2.00	0.00	0.84	0.00
9.68	86.23	2.00	0.00	0.84	0.00	9.84	88.35	2.00	0.00	0.83	0.00
10.01	103.89	2.00	0.00	0.83	0.00	10.17	112.39	0.40	1.76	0.83	0.03
10.33	156.97	0.83	0.87	0.82	0.02	10.50	219.91	2.00	0.00	0.82	0.00
10.66	264.37	2.00	0.00	0.82	0.00	10.83	296.68	2.00	0.00	0.82	0.00
10.99	310.05	2.00	0.00	0.81	0.00	11.15	308.14	2.00	0.00	0.81	0.00
11.32	296.49	2.00	0.00	0.81	0.00	11.48	288.25	2.00	0.00	0.81	0.00
11.65	282.18	2.00	0.00	0.80	0.00	11.81	281.37	2.00	0.00	0.80	0.00
11.98	282.32	2.00	0.00	0.80	0.00	12.14	285.98	2.00	0.00	0.79	0.00
12.30	287.34	2.00	0.00	0.79	0.00	12.47	287.65	2.00	0.00	0.79	0.00
12.63	291.97	2.00	0.00	0.79	0.00	12.80	296.37	2.00	0.00	0.78	0.00
12.96	298.25	2.00	0.00	0.78	0.00	13.12	298.79	2.00	0.00	0.78	0.00
13.29	297.43	2.00	0.00	0.77	0.00	13.45	290.73	2.00	0.00	0.77	0.00
13.62	277.69	2.00	0.00	0.77	0.00	13.78	264.65	2.00	0.00	0.77	0.00
13.94	254.93	2.00	0.00	0.76	0.00	14.11	253.60	2.00	0.00	0.76	0.00
14.27	252.76	2.00	0.00	0.76	0.00	14.44	251.52	2.00	0.00	0.76	0.00
14.60	246.70	2.00	0.00	0.75	0.00	14.76	243.77	2.00	0.00	0.75	0.00
14.93	244.87	2.00	0.00	0.75	0.00	15.09	247.56	2.00	0.00	0.74	0.00
15.26	251.61	2.00	0.00	0.74	0.00	15.42	254.17	2.00	0.00	0.74	0.00
15.58	255.43	2.00	0.00	0.74	0.00	15.75	254.07	2.00	0.00	0.73	0.00
15.91	250.74	2.00	0.00	0.73	0.00	16.08	243.89	2.00	0.00	0.73	0.00
16.24	237.34	2.00	0.00	0.72	0.00	16.40	234.72	2.00	0.00	0.72	0.00
16.57	237.22	2.00	0.00	0.72	0.00	16.73	243.52	2.00	0.00	0.72	0.00
16.90	250.16	2.00	0.00	0.71	0.00	17.06	257.20	2.00	0.00	0.71	0.00
17.22	262.70	2.00	0.00	0.71	0.00	17.39	264.63	2.00	0.00	0.71	0.00
17.55	263.30	2.00	0.00	0.70	0.00	17.72	258.44	2.00	0.00	0.70	0.00
17.88	252.24	2.00	0.00	0.70	0.00	18.04	251.16	2.00	0.00	0.69	0.00
18.21	258.33	2.00	0.00	0.69	0.00	18.37	269.79	2.00	0.00	0.69	0.00
18.54	277.33	2.00	0.00	0.69	0.00	18.70	278.01	2.00	0.00	0.68	0.00
18.86	275.98	2.00	0.00	0.68	0.00	19.03	273.23	2.00	0.00	0.68	0.00
19.19	274.13	2.00	0.00	0.67	0.00	19.36	278.81	2.00	0.00	0.67	0.00
19.52	284.42	2.00	0.00	0.67	0.00	19.69	284.10	2.00	0.00	0.67	0.00
19.85	279.85	2.00	0.00	0.66	0.00	20.01	274.81	2.00	0.00	0.66	0.00
20.18	274.37	2.00	0.00	0.66	0.00	20.34	271.58	2.00	0.00	0.66	0.00
20.51	266.64	2.00	0.00	0.65	0.00	20.67	261.21	2.00	0.00	0.65	0.00
20.83	261.71	2.00	0.00	0.65	0.00	21.00	265.45	2.00	0.00	0.64	0.00
21.16	266.87	2.00	0.00	0.64	0.00	21.33	267.46	2.00	0.00	0.64	0.00
21.49	267.75	2.00	0.00	0.64	0.00	21.65	269.42	2.00	0.00	0.63	0.00
21.82	266.88	2.00	0.00	0.63	0.00	21.98	262.93	2.00	0.00	0.63	0.00
22.15	259.42	2.00	0.00	0.62	0.00	22.31	262.25	2.00	0.00	0.62	0.00
22.47	268.50	2.00	0.00	0.62	0.00	22.64	271.74	2.00	0.00	0.62	0.00
22.80	270.07	2.00	0.00	0.61	0.00	22.97	265.24	2.00	0.00	0.61	0.00
23.13	258.65	2.00	0.00	0.61	0.00	23.29	246.94	2.00	0.00	0.61	0.00
23.46	230.38	2.00	0.00	0.60	0.00	23.62	210.57	2.00	0.00	0.60	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	194.96	1.15	0.21	0.60	0.00	23.95	182.57	0.96	0.30	0.59	0.01
24.11	179.46	0.92	0.39	0.59	0.01	24.28	181.84	0.95	0.30	0.59	0.01
24.44	184.91	0.99	0.29	0.59	0.01	24.61	185.64	1.00	0.29	0.58	0.01
24.77	183.01	0.97	0.29	0.58	0.01	24.93	181.24	0.94	0.38	0.58	0.01
25.10	179.44	0.92	0.38	0.57	0.01	25.26	173.97	2.00	0.00	0.57	0.00
25.43	161.15	2.00	0.00	0.57	0.00	25.59	140.99	2.00	0.00	0.57	0.00
25.75	120.35	2.00	0.00	0.56	0.00	25.92	104.28	2.00	0.00	0.56	0.00
26.08	84.86	2.00	0.00	0.56	0.00	26.25	77.20	2.00	0.00	0.56	0.00
26.41	84.29	2.00	0.00	0.55	0.00	26.57	96.70	2.00	0.00	0.55	0.00
26.74	99.30	2.00	0.00	0.55	0.00	26.90	90.36	2.00	0.00	0.54	0.00
27.07	72.56	2.00	0.00	0.54	0.00	27.23	56.93	2.00	0.00	0.54	0.00
27.40	49.87	2.00	0.00	0.54	0.00	27.56	46.50	2.00	0.00	0.53	0.00
27.72	52.52	2.00	0.00	0.53	0.00	27.89	64.59	2.00	0.00	0.53	0.00
28.05	80.26	2.00	0.00	0.52	0.00	28.22	94.48	2.00	0.00	0.52	0.00
28.38	106.73	2.00	0.00	0.52	0.00	28.54	116.63	2.00	0.00	0.52	0.00
28.71	123.61	2.00	0.00	0.51	0.00	28.87	127.62	2.00	0.00	0.51	0.00
29.04	128.45	2.00	0.00	0.51	0.00	29.20	126.34	2.00	0.00	0.51	0.00
29.36	118.86	2.00	0.00	0.50	0.00	29.53	107.52	2.00	0.00	0.50	0.00
29.69	93.63	2.00	0.00	0.50	0.00	29.86	80.98	2.00	0.00	0.49	0.00
30.02	71.96	2.00	0.00	0.49	0.00	30.18	66.60	2.00	0.00	0.49	0.00
30.35	64.29	2.00	0.00	0.49	0.00	30.51	62.74	2.00	0.00	0.48	0.00
30.68	72.00	2.00	0.00	0.48	0.00	30.84	79.32	2.00	0.00	0.48	0.00
31.00	87.08	2.00	0.00	0.47	0.00	31.17	103.36	2.00	0.00	0.47	0.00
31.33	127.89	2.00	0.00	0.47	0.00	31.50	133.43	2.00	0.00	0.47	0.00
31.66	126.18	2.00	0.00	0.46	0.00	31.82	115.44	2.00	0.00	0.46	0.00
31.99	110.47	2.00	0.00	0.46	0.00	32.15	118.81	2.00	0.00	0.46	0.00
32.32	121.96	2.00	0.00	0.45	0.00	32.48	110.88	0.29	0.97	0.45	0.02
32.64	91.09	0.21	1.13	0.45	0.02	32.81	83.86	2.00	0.00	0.44	0.00
32.97	84.03	2.00	0.00	0.44	0.00	33.14	91.10	2.00	0.00	0.44	0.00
33.30	89.90	2.00	0.00	0.44	0.00	33.46	90.62	2.00	0.00	0.43	0.00
33.63	93.37	2.00	0.00	0.43	0.00	33.79	94.19	2.00	0.00	0.43	0.00
33.96	94.01	2.00	0.00	0.42	0.00	34.12	92.87	2.00	0.00	0.42	0.00
34.28	98.68	2.00	0.00	0.42	0.00	34.45	104.48	2.00	0.00	0.42	0.00
34.61	109.64	2.00	0.00	0.41	0.00	34.78	108.51	2.00	0.00	0.41	0.00
34.94	106.25	2.00	0.00	0.41	0.00	35.10	102.82	2.00	0.00	0.41	0.00
35.27	96.76	2.00	0.00	0.40	0.00	35.43	90.09	2.00	0.00	0.40	0.00
35.60	84.71	2.00	0.00	0.40	0.00	35.76	81.24	2.00	0.00	0.39	0.00
35.93	77.53	2.00	0.00	0.39	0.00	36.09	76.65	2.00	0.00	0.39	0.00
36.25	77.41	2.00	0.00	0.39	0.00	36.42	75.66	2.00	0.00	0.38	0.00
36.58	74.05	2.00	0.00	0.38	0.00	36.75	75.57	2.00	0.00	0.38	0.00
36.91	80.18	2.00	0.00	0.37	0.00	37.07	82.65	2.00	0.00	0.37	0.00
37.24	79.54	2.00	0.00	0.37	0.00	37.40	73.25	2.00	0.00	0.37	0.00
37.57	65.96	2.00	0.00	0.36	0.00	37.73	61.36	2.00	0.00	0.36	0.00
37.89	59.34	2.00	0.00	0.36	0.00	38.06	57.71	2.00	0.00	0.35	0.00
38.22	55.92	2.00	0.00	0.35	0.00	38.39	56.84	2.00	0.00	0.35	0.00
38.55	62.96	2.00	0.00	0.35	0.00	38.71	71.73	2.00	0.00	0.34	0.00
38.88	82.02	2.00	0.00	0.34	0.00	39.04	84.78	2.00	0.00	0.34	0.00
39.21	87.81	2.00	0.00	0.34	0.00	39.37	91.59	2.00	0.00	0.33	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	99.86	2.00	0.00	0.33	0.00	39.70	103.57	2.00	0.00	0.33	0.00
39.86	103.57	2.00	0.00	0.32	0.00	40.03	103.48	2.00	0.00	0.32	0.00
40.19	103.28	2.00	0.00	0.32	0.00	40.35	99.79	2.00	0.00	0.32	0.00
40.52	92.18	2.00	0.00	0.31	0.00	40.68	87.82	2.00	0.00	0.31	0.00
40.85	84.25	2.00	0.00	0.31	0.00	41.01	81.32	2.00	0.00	0.30	0.00
41.17	72.61	2.00	0.00	0.30	0.00	41.34	64.84	2.00	0.00	0.30	0.00
41.50	63.73	2.00	0.00	0.30	0.00	41.67	73.57	2.00	0.00	0.29	0.00
41.83	87.53	2.00	0.00	0.29	0.00	41.99	101.03	2.00	0.00	0.29	0.00
42.16	113.09	2.00	0.00	0.29	0.00	42.32	121.86	2.00	0.00	0.28	0.00
42.49	124.05	2.00	0.00	0.28	0.00	42.65	120.95	2.00	0.00	0.28	0.00
42.81	113.93	2.00	0.00	0.27	0.00	42.98	105.91	2.00	0.00	0.27	0.00
43.14	97.89	2.00	0.00	0.27	0.00	43.31	95.08	2.00	0.00	0.27	0.00
43.47	100.58	2.00	0.00	0.26	0.00	43.64	107.71	2.00	0.00	0.26	0.00
43.80	110.11	2.00	0.00	0.26	0.00	43.96	103.39	2.00	0.00	0.25	0.00
44.13	97.25	2.00	0.00	0.25	0.00	44.29	98.42	2.00	0.00	0.25	0.00
44.46	103.47	2.00	0.00	0.25	0.00	44.62	109.02	2.00	0.00	0.24	0.00
44.78	109.79	2.00	0.00	0.24	0.00	44.95	111.93	2.00	0.00	0.24	0.00
45.11	109.24	2.00	0.00	0.24	0.00	45.28	108.60	2.00	0.00	0.23	0.00
45.44	110.75	2.00	0.00	0.23	0.00	45.60	112.90	0.30	0.48	0.23	0.01
45.77	113.55	0.30	0.47	0.22	0.01	45.93	109.89	0.28	0.48	0.22	0.01
46.10	108.85	0.26	0.50	0.22	0.01	46.26	95.23	0.22	0.53	0.22	0.01
46.42	88.47	0.20	0.55	0.21	0.01	46.59	87.38	0.20	0.55	0.21	0.01
46.75	88.00	0.20	0.54	0.21	0.01	46.92	89.53	0.20	0.52	0.20	0.01
47.08	88.65	0.20	0.52	0.20	0.01	47.24	88.60	0.20	0.51	0.20	0.01
47.41	84.28	0.19	0.53	0.20	0.01	47.57	83.80	2.00	0.00	0.19	0.00
47.74	88.63	2.00	0.00	0.19	0.00	47.90	98.20	2.00	0.00	0.19	0.00
48.06	105.39	2.00	0.00	0.19	0.00	48.23	106.49	0.27	0.41	0.18	0.01
48.39	109.31	0.28	0.39	0.18	0.01	48.56	107.21	0.27	0.39	0.18	0.01
48.72	104.54	0.26	0.39	0.17	0.01	48.88	94.00	2.00	0.00	0.17	0.00
49.05	87.17	2.00	0.00	0.17	0.00	49.21	79.52	2.00	0.00	0.17	0.00
49.38	80.84	2.00	0.00	0.16	0.00	49.54	84.51	2.00	0.00	0.16	0.00
49.70	82.58	2.00	0.00	0.16	0.00	49.87	78.36	2.00	0.00	0.15	0.00
50.03	70.57	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.34

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

LIQUEFACTION ANALYSIS REPORT

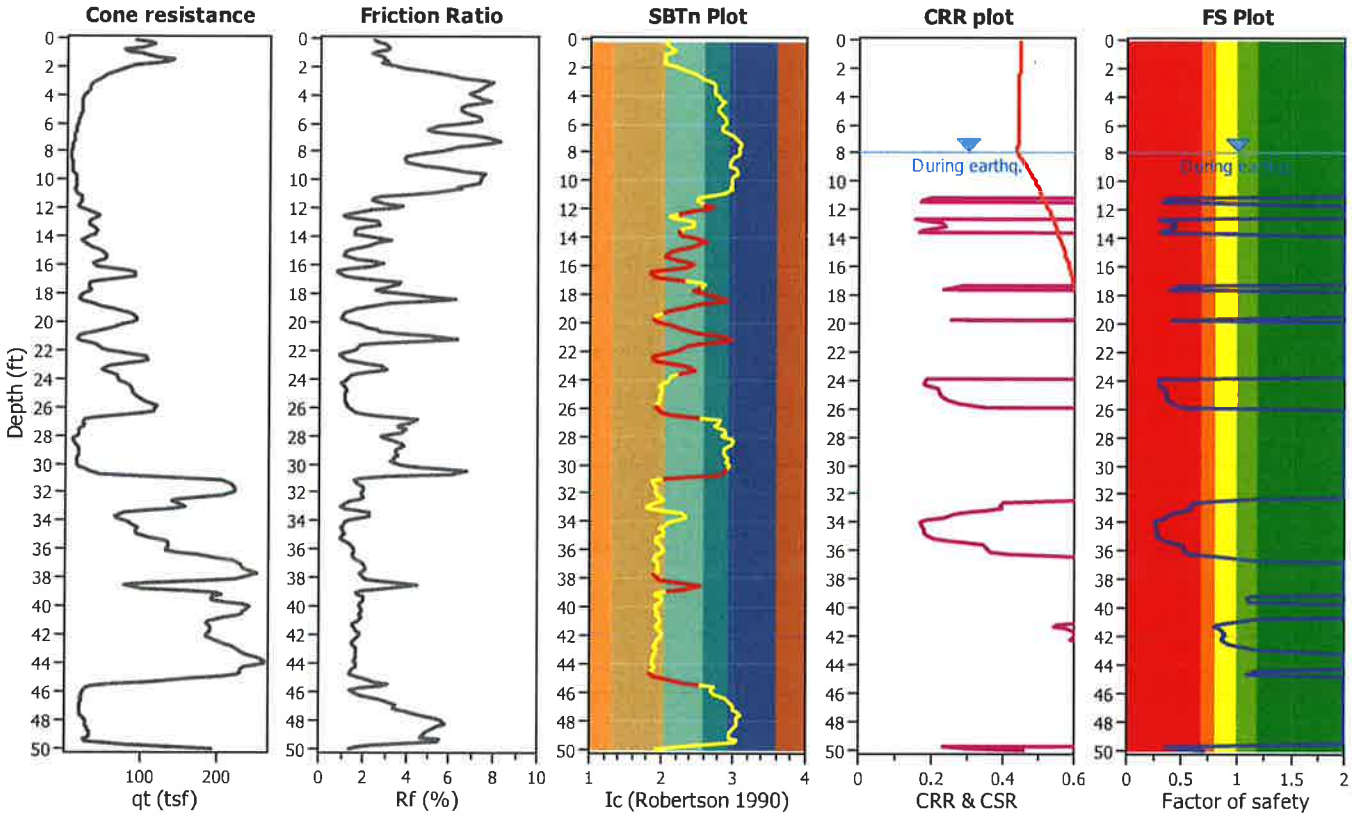
Project title : S-Line Upgrades

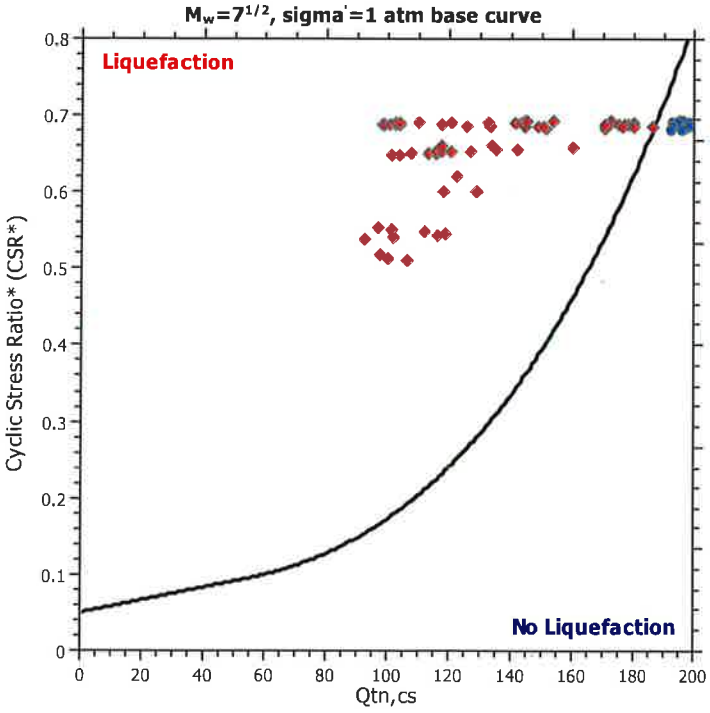
Location : Imperial County, CA

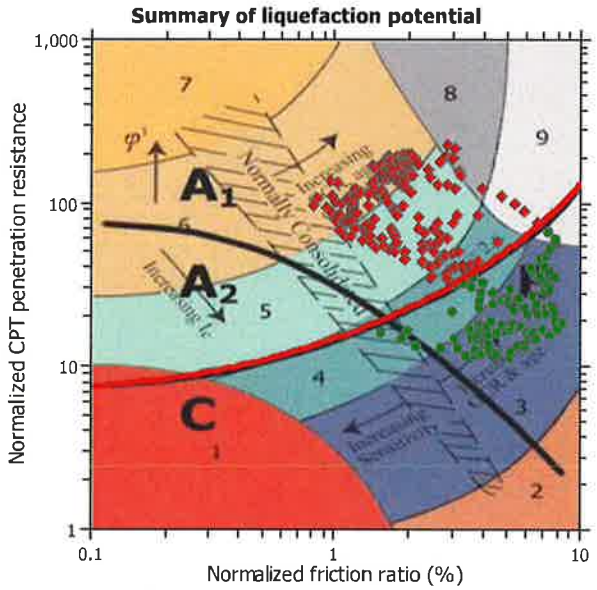
CPT file : CPT-22

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

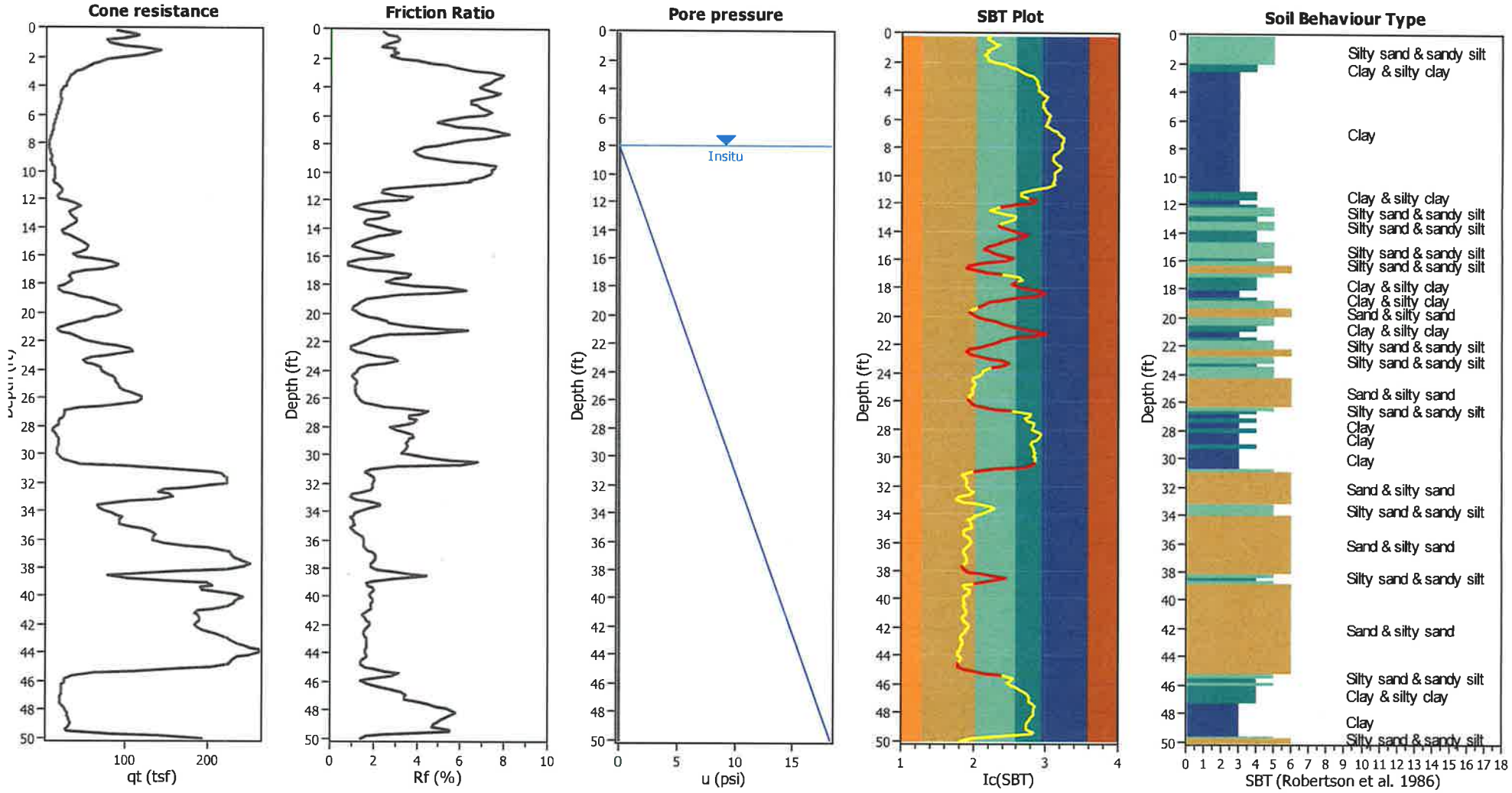






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



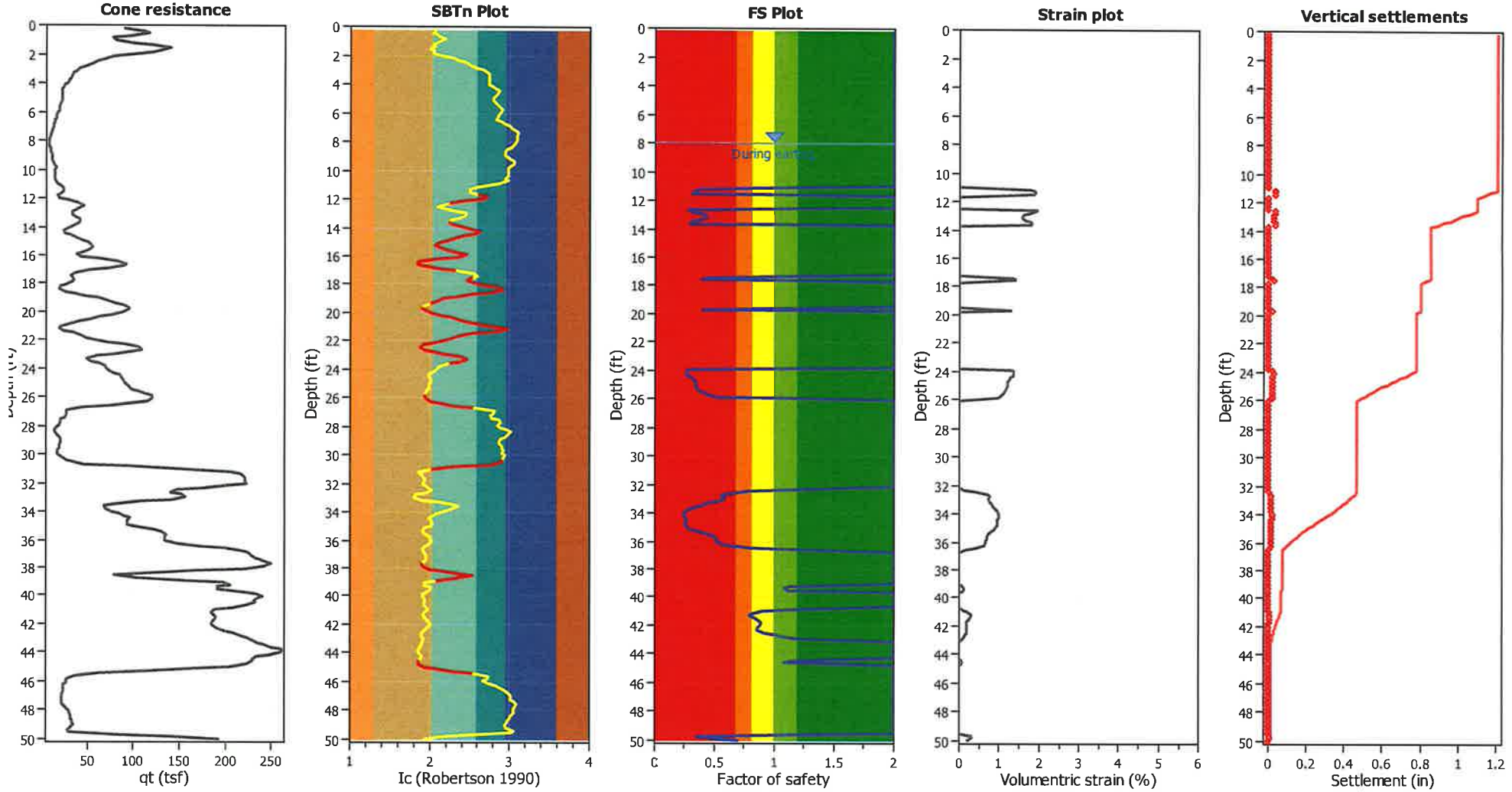
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	91.94	2.00	0.00	0.86	0.00	8.20	86.63	2.00	0.00	0.86	0.00
8.37	84.85	2.00	0.00	0.86	0.00	8.53	86.88	2.00	0.00	0.86	0.00
8.69	91.77	2.00	0.00	0.85	0.00	8.86	98.19	2.00	0.00	0.85	0.00
9.02	104.06	2.00	0.00	0.85	0.00	9.19	111.04	2.00	0.00	0.84	0.00
9.35	122.34	2.00	0.00	0.84	0.00	9.51	137.67	2.00	0.00	0.84	0.00
9.68	147.59	2.00	0.00	0.84	0.00	9.84	150.64	2.00	0.00	0.83	0.00
10.01	150.19	2.00	0.00	0.83	0.00	10.17	148.17	2.00	0.00	0.83	0.00
10.33	144.83	2.00	0.00	0.82	0.00	10.50	137.18	2.00	0.00	0.82	0.00
10.66	134.15	2.00	0.00	0.82	0.00	10.83	128.52	2.00	0.00	0.82	0.00
10.99	122.78	2.00	0.00	0.81	0.00	11.15	106.50	0.38	1.80	0.81	0.04
11.32	100.18	0.34	1.89	0.81	0.04	11.48	97.80	0.32	1.92	0.81	0.04
11.65	107.04	2.00	0.00	0.80	0.00	11.81	115.00	2.00	0.00	0.80	0.00
11.98	114.21	2.00	0.00	0.80	0.00	12.14	104.40	2.00	0.00	0.79	0.00
12.30	93.36	2.00	0.00	0.79	0.00	12.47	90.22	2.00	0.00	0.79	0.00
12.63	92.41	0.29	1.96	0.79	0.04	12.80	101.86	0.33	1.80	0.78	0.04
12.96	116.27	0.42	1.61	0.78	0.03	13.12	118.88	0.43	1.58	0.78	0.03
13.29	111.79	0.33	1.65	0.77	0.03	13.45	101.08	0.32	1.79	0.77	0.04
13.62	96.91	0.30	1.84	0.77	0.04	13.78	96.70	2.00	0.00	0.77	0.00
13.94	104.89	2.00	0.00	0.76	0.00	14.11	106.89	2.00	0.00	0.76	0.00
14.27	112.15	2.00	0.00	0.76	0.00	14.44	105.68	2.00	0.00	0.76	0.00
14.60	102.61	2.00	0.00	0.75	0.00	14.76	97.76	2.00	0.00	0.75	0.00
14.93	94.40	2.00	0.00	0.75	0.00	15.09	92.92	2.00	0.00	0.74	0.00
15.26	93.26	2.00	0.00	0.74	0.00	15.42	101.06	2.00	0.00	0.74	0.00
15.58	110.87	2.00	0.00	0.74	0.00	15.75	120.47	2.00	0.00	0.73	0.00
15.91	125.52	2.00	0.00	0.73	0.00	16.08	115.60	2.00	0.00	0.73	0.00
16.24	106.88	2.00	0.00	0.72	0.00	16.40	112.27	2.00	0.00	0.72	0.00
16.57	122.35	2.00	0.00	0.72	0.00	16.73	129.51	2.00	0.00	0.72	0.00
16.90	130.57	2.00	0.00	0.71	0.00	17.06	133.25	2.00	0.00	0.71	0.00
17.22	137.64	2.00	0.00	0.71	0.00	17.39	128.60	0.46	1.34	0.71	0.03
17.55	118.22	0.39	1.43	0.70	0.03	17.72	110.35	2.00	0.00	0.70	0.00
17.88	113.77	2.00	0.00	0.70	0.00	18.04	123.03	2.00	0.00	0.69	0.00
18.21	134.38	2.00	0.00	0.69	0.00	18.37	141.59	2.00	0.00	0.69	0.00
18.54	137.53	2.00	0.00	0.69	0.00	18.70	124.29	2.00	0.00	0.68	0.00
18.86	115.50	2.00	0.00	0.68	0.00	19.03	112.30	2.00	0.00	0.68	0.00
19.19	115.09	2.00	0.00	0.67	0.00	19.36	116.52	2.00	0.00	0.67	0.00
19.52	120.04	2.00	0.00	0.67	0.00	19.69	122.78	0.41	1.32	0.67	0.03
19.85	126.65	2.00	0.00	0.66	0.00	20.01	127.28	2.00	0.00	0.66	0.00
20.18	127.33	2.00	0.00	0.66	0.00	20.34	126.19	2.00	0.00	0.66	0.00
20.51	128.37	2.00	0.00	0.65	0.00	20.67	119.94	2.00	0.00	0.65	0.00
20.83	120.98	2.00	0.00	0.65	0.00	21.00	123.31	2.00	0.00	0.64	0.00
21.16	132.42	2.00	0.00	0.64	0.00	21.33	127.24	2.00	0.00	0.64	0.00
21.49	108.36	2.00	0.00	0.64	0.00	21.65	96.70	2.00	0.00	0.63	0.00
21.82	97.06	2.00	0.00	0.63	0.00	21.98	100.82	2.00	0.00	0.63	0.00
22.15	105.14	2.00	0.00	0.62	0.00	22.31	111.88	2.00	0.00	0.62	0.00
22.47	126.92	2.00	0.00	0.62	0.00	22.64	137.62	2.00	0.00	0.62	0.00
22.80	140.68	2.00	0.00	0.61	0.00	22.97	137.08	2.00	0.00	0.61	0.00
23.13	136.39	2.00	0.00	0.61	0.00	23.29	132.45	2.00	0.00	0.61	0.00
23.46	121.09	2.00	0.00	0.60	0.00	23.62	108.66	2.00	0.00	0.60	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	105.72	2.00	0.00	0.60	0.00	23.95	103.63	0.28	1.35	0.59	0.03
24.11	101.30	0.27	1.37	0.59	0.03	24.28	101.53	0.27	1.36	0.59	0.03
24.44	107.49	0.30	1.29	0.59	0.03	24.61	113.09	0.33	1.23	0.58	0.02
24.77	115.60	0.34	1.20	0.58	0.02	24.93	115.42	0.34	1.20	0.58	0.02
25.10	115.72	0.34	1.19	0.57	0.02	25.26	117.61	0.35	1.17	0.57	0.02
25.43	120.88	0.37	1.14	0.57	0.02	25.59	127.17	0.41	1.09	0.57	0.02
25.75	135.00	0.47	1.03	0.56	0.02	25.92	142.06	0.53	0.98	0.56	0.02
26.08	143.67	2.00	0.00	0.56	0.00	26.25	145.27	2.00	0.00	0.56	0.00
26.41	141.63	2.00	0.00	0.55	0.00	26.57	135.40	2.00	0.00	0.55	0.00
26.74	127.99	2.00	0.00	0.55	0.00	26.90	121.71	2.00	0.00	0.54	0.00
27.07	114.71	2.00	0.00	0.54	0.00	27.23	109.56	2.00	0.00	0.54	0.00
27.40	105.03	2.00	0.00	0.54	0.00	27.56	102.07	2.00	0.00	0.53	0.00
27.72	97.64	2.00	0.00	0.53	0.00	27.89	89.62	2.00	0.00	0.53	0.00
28.05	78.84	2.00	0.00	0.52	0.00	28.22	74.68	2.00	0.00	0.52	0.00
28.38	78.22	2.00	0.00	0.52	0.00	28.54	88.13	2.00	0.00	0.52	0.00
28.71	93.44	2.00	0.00	0.51	0.00	28.87	95.48	2.00	0.00	0.51	0.00
29.04	94.93	2.00	0.00	0.51	0.00	29.20	94.49	2.00	0.00	0.51	0.00
29.36	92.42	2.00	0.00	0.50	0.00	29.53	89.09	2.00	0.00	0.50	0.00
29.69	87.60	2.00	0.00	0.50	0.00	29.86	85.57	2.00	0.00	0.49	0.00
30.02	90.07	2.00	0.00	0.49	0.00	30.18	105.51	2.00	0.00	0.49	0.00
30.35	130.50	2.00	0.00	0.49	0.00	30.51	160.24	2.00	0.00	0.48	0.00
30.68	174.22	2.00	0.00	0.48	0.00	30.84	166.62	2.00	0.00	0.48	0.00
31.00	180.46	2.00	0.00	0.47	0.00	31.17	212.74	2.00	0.00	0.47	0.00
31.33	227.25	2.00	0.00	0.47	0.00	31.50	234.96	2.00	0.00	0.47	0.00
31.66	239.23	2.00	0.00	0.46	0.00	31.82	238.46	2.00	0.00	0.46	0.00
31.99	236.27	2.00	0.00	0.46	0.00	32.15	220.39	2.00	0.00	0.46	0.00
32.32	197.58	1.17	0.11	0.45	0.00	32.48	170.60	0.79	0.42	0.45	0.01
32.64	151.26	0.59	0.74	0.45	0.01	32.81	149.01	0.57	0.76	0.44	0.01
32.97	150.52	0.58	0.74	0.44	0.01	33.14	144.22	0.52	0.76	0.44	0.01
33.30	133.26	0.44	0.80	0.44	0.02	33.46	125.78	0.39	0.84	0.43	0.02
33.63	117.27	0.33	0.88	0.43	0.02	33.79	103.89	0.27	0.97	0.43	0.02
33.96	98.38	0.25	1.01	0.42	0.02	34.12	98.59	0.25	1.00	0.42	0.02
34.28	100.76	0.25	0.97	0.42	0.02	34.45	102.69	0.26	0.95	0.42	0.02
34.61	102.67	0.26	0.95	0.41	0.02	34.78	102.67	0.26	0.94	0.41	0.02
34.94	103.62	0.27	0.93	0.41	0.02	35.10	109.75	0.29	0.88	0.41	0.02
35.27	120.91	0.35	0.80	0.40	0.02	35.43	132.23	0.43	0.74	0.40	0.01
35.60	141.17	0.49	0.70	0.40	0.01	35.76	143.11	0.51	0.69	0.39	0.01
35.93	144.35	0.52	0.68	0.39	0.01	36.09	145.00	0.53	0.67	0.39	0.01
36.25	153.64	0.60	0.63	0.39	0.01	36.42	172.72	0.81	0.35	0.38	0.01
36.58	195.41	1.12	0.14	0.38	0.00	36.75	214.50	2.00	0.00	0.38	0.00
36.91	224.76	2.00	0.00	0.37	0.00	37.07	229.70	2.00	0.00	0.37	0.00
37.24	233.16	2.00	0.00	0.37	0.00	37.40	235.91	2.00	0.00	0.37	0.00
37.57	238.06	2.00	0.00	0.36	0.00	37.73	239.16	2.00	0.00	0.36	0.00
37.89	233.54	2.00	0.00	0.36	0.00	38.06	223.44	2.00	0.00	0.35	0.00
38.22	203.13	2.00	0.00	0.35	0.00	38.39	184.34	2.00	0.00	0.35	0.00
38.55	172.32	2.00	0.00	0.35	0.00	38.71	155.22	2.00	0.00	0.34	0.00
38.88	167.17	2.00	0.00	0.34	0.00	39.04	189.06	2.00	0.00	0.34	0.00
39.21	196.22	1.13	0.12	0.34	0.00	39.37	193.22	1.09	0.12	0.33	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	194.79	1.11	0.12	0.33	0.00	39.70	205.12	2.00	0.00	0.33	0.00
39.86	217.54	2.00	0.00	0.32	0.00	40.03	225.18	2.00	0.00	0.32	0.00
40.19	222.57	2.00	0.00	0.32	0.00	40.35	219.29	2.00	0.00	0.32	0.00
40.52	217.05	2.00	0.00	0.31	0.00	40.68	209.96	2.00	0.00	0.31	0.00
40.85	198.56	1.17	0.08	0.31	0.00	41.01	180.09	0.90	0.20	0.30	0.00
41.17	172.03	0.80	0.28	0.30	0.01	41.34	170.57	0.79	0.28	0.30	0.01
41.50	175.17	0.84	0.27	0.30	0.01	41.67	178.12	0.88	0.20	0.29	0.00
41.83	179.28	0.90	0.19	0.29	0.00	41.99	176.11	0.88	0.19	0.29	0.00
42.16	176.64	0.86	0.19	0.29	0.00	42.32	176.04	0.86	0.19	0.28	0.00
42.49	180.19	0.91	0.18	0.28	0.00	42.65	186.16	0.99	0.14	0.28	0.00
42.81	193.15	1.09	0.10	0.27	0.00	42.98	198.59	1.18	0.07	0.27	0.00
43.14	203.15	2.00	0.00	0.27	0.00	43.31	207.16	2.00	0.00	0.27	0.00
43.47	211.79	2.00	0.00	0.26	0.00	43.64	216.94	2.00	0.00	0.26	0.00
43.80	222.48	2.00	0.00	0.26	0.00	43.96	223.28	2.00	0.00	0.25	0.00
44.13	215.80	2.00	0.00	0.25	0.00	44.29	204.13	2.00	0.00	0.25	0.00
44.46	196.22	1.15	0.06	0.25	0.00	44.62	192.31	1.09	0.09	0.24	0.00
44.78	189.08	2.00	0.00	0.24	0.00	44.95	180.13	2.00	0.00	0.24	0.00
45.11	163.46	2.00	0.00	0.24	0.00	45.28	143.02	2.00	0.00	0.23	0.00
45.44	120.82	2.00	0.00	0.23	0.00	45.60	91.27	2.00	0.00	0.23	0.00
45.77	68.15	2.00	0.00	0.22	0.00	45.93	59.89	2.00	0.00	0.22	0.00
46.10	63.75	2.00	0.00	0.22	0.00	46.26	64.95	2.00	0.00	0.22	0.00
46.42	70.98	2.00	0.00	0.21	0.00	46.59	75.76	2.00	0.00	0.21	0.00
46.75	80.95	2.00	0.00	0.21	0.00	46.92	81.43	2.00	0.00	0.20	0.00
47.08	80.77	2.00	0.00	0.20	0.00	47.24	80.35	2.00	0.00	0.20	0.00
47.41	83.69	2.00	0.00	0.20	0.00	47.57	89.10	2.00	0.00	0.19	0.00
47.74	98.10	2.00	0.00	0.19	0.00	47.90	106.70	2.00	0.00	0.19	0.00
48.06	112.45	2.00	0.00	0.19	0.00	48.23	114.59	2.00	0.00	0.18	0.00
48.39	113.83	2.00	0.00	0.18	0.00	48.56	113.22	2.00	0.00	0.18	0.00
48.72	112.61	2.00	0.00	0.17	0.00	48.88	111.56	2.00	0.00	0.17	0.00
49.05	110.30	2.00	0.00	0.17	0.00	49.21	106.76	2.00	0.00	0.17	0.00
49.38	108.76	2.00	0.00	0.16	0.00	49.54	112.06	2.00	0.00	0.16	0.00
49.70	117.21	0.35	0.32	0.16	0.01	49.87	133.70	0.46	0.29	0.15	0.01
50.03	159.78	0.70	0.19	0.15	0.00						

Total estimated settlement: 1.21

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

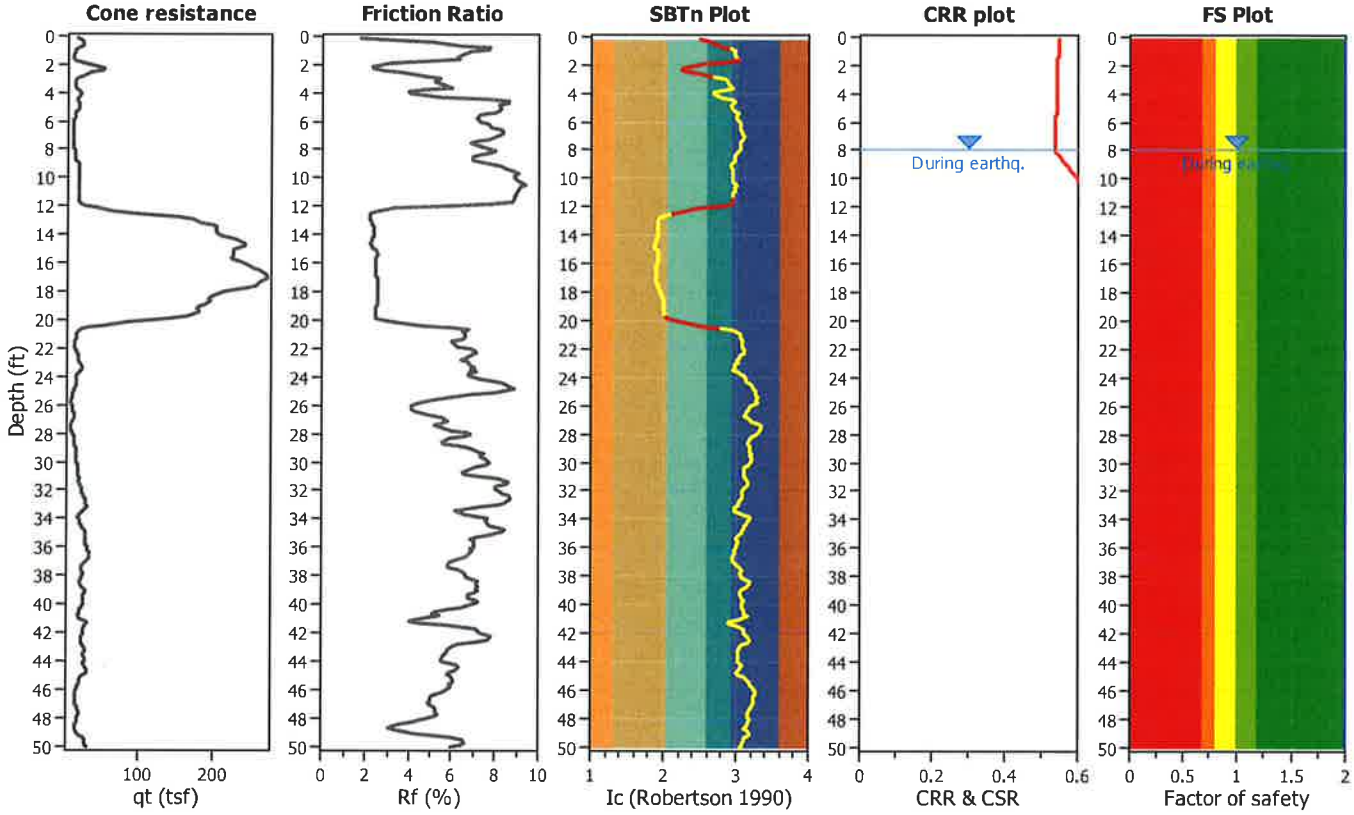
LIQUEFACTION ANALYSIS REPORT

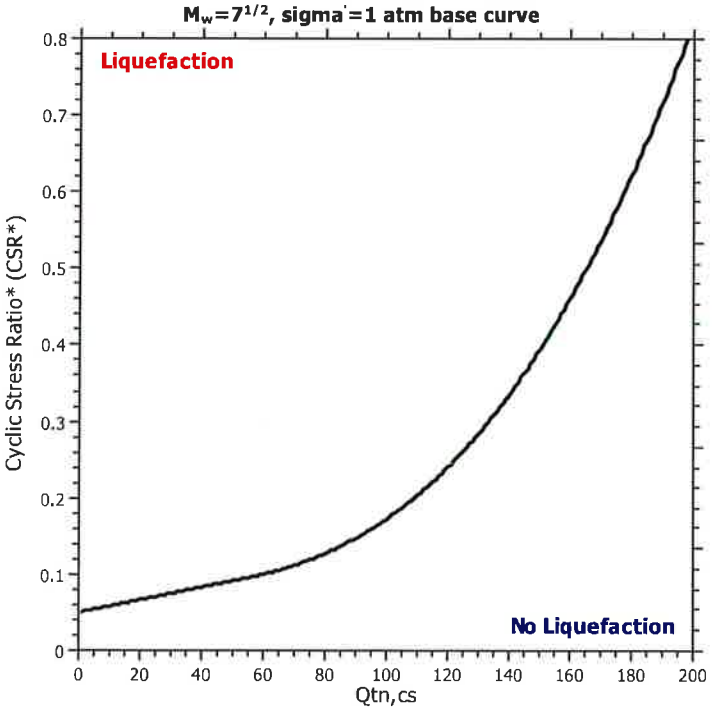
Project title : S-Line Upgrades **Location : Imperial County, CA**

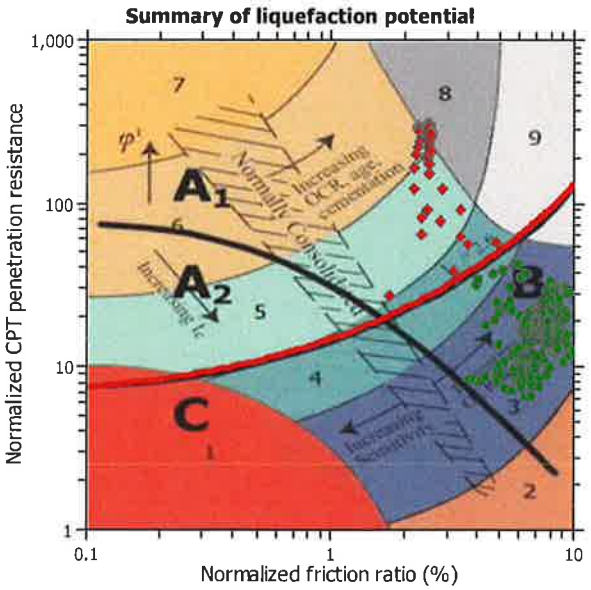
CPT file : CPT-23

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.77	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

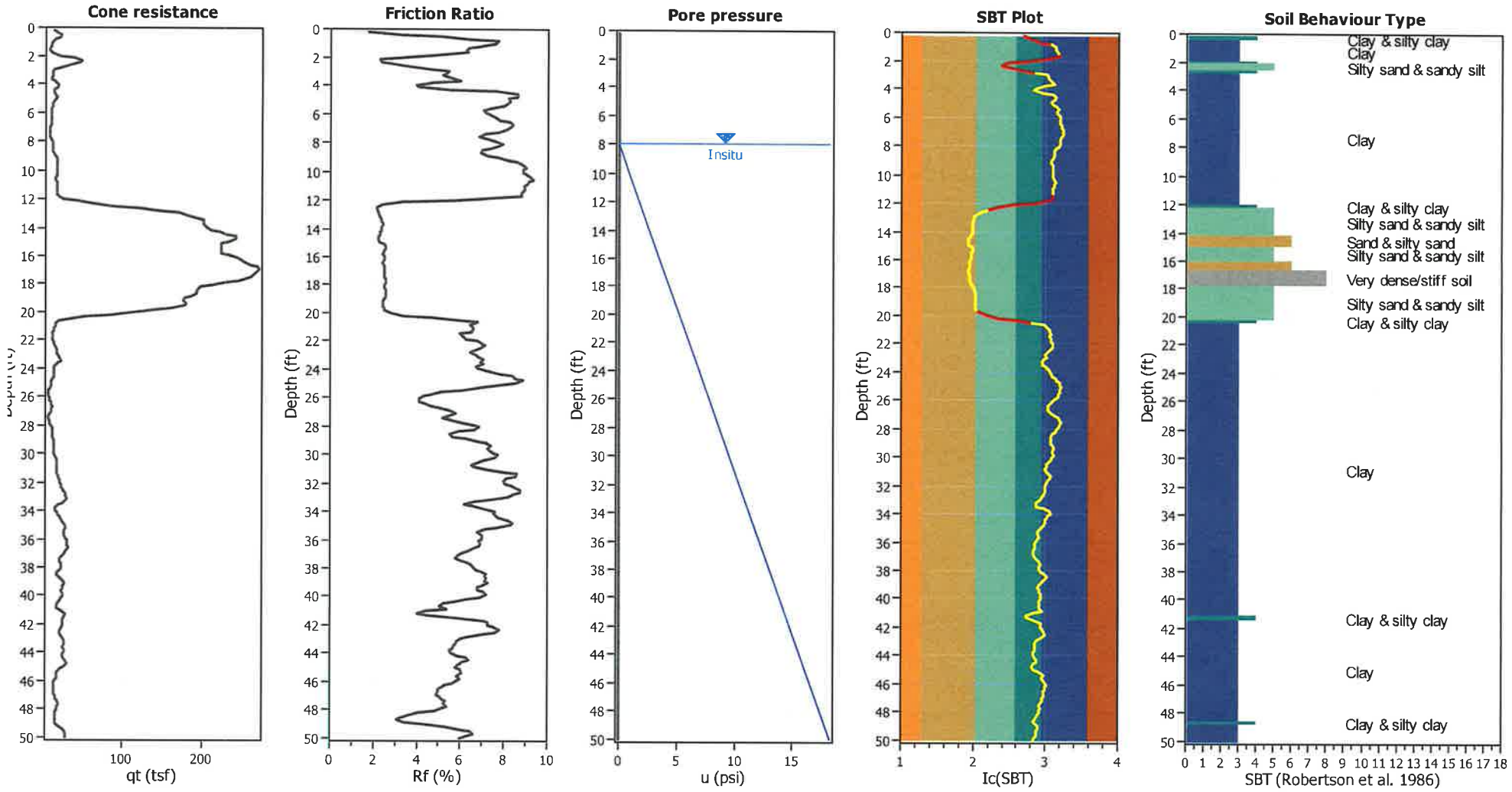






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



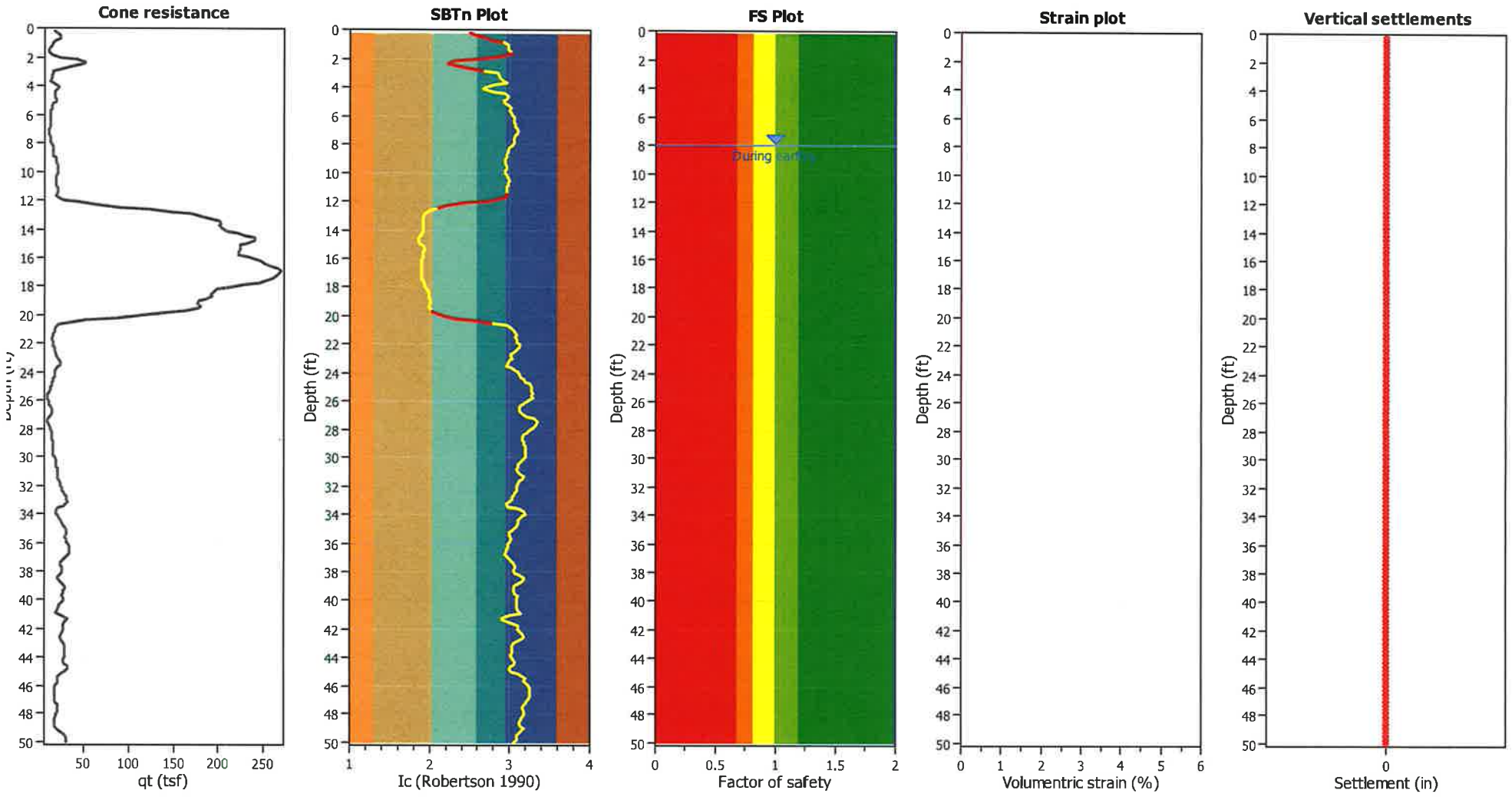
nput parameters and analysis data

nalysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
nes correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
oints to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
arthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
eak ground acceleration:	0.77	Use fill:	No	Limit depth applied:	No
epth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



bbreviations

::	Total cone resistance (cone resistance q_c corrected for pore water effects)
:	Soil Behaviour Type Index
S:	Calculated Factor of Safety against liquefaction
olumentric strain:	Post-liquefaction volumentric strain

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	147.73	2.00	0.00	0.86	0.00	8.20	153.08	2.00	0.00	0.86	0.00
8.37	150.39	2.00	0.00	0.86	0.00	8.53	143.71	2.00	0.00	0.86	0.00
8.69	143.72	2.00	0.00	0.85	0.00	8.86	154.08	2.00	0.00	0.85	0.00
9.02	167.04	2.00	0.00	0.85	0.00	9.19	178.05	2.00	0.00	0.84	0.00
9.35	184.42	2.00	0.00	0.84	0.00	9.51	188.16	2.00	0.00	0.84	0.00
9.68	190.27	2.00	0.00	0.84	0.00	9.84	190.56	2.00	0.00	0.83	0.00
10.01	190.88	2.00	0.00	0.83	0.00	10.17	190.51	2.00	0.00	0.83	0.00
10.33	189.32	2.00	0.00	0.82	0.00	10.50	187.91	2.00	0.00	0.82	0.00
10.66	186.06	2.00	0.00	0.82	0.00	10.83	187.09	2.00	0.00	0.82	0.00
10.99	187.99	2.00	0.00	0.81	0.00	11.15	190.42	2.00	0.00	0.81	0.00
11.32	189.81	2.00	0.00	0.81	0.00	11.48	187.98	2.00	0.00	0.81	0.00
11.65	186.62	2.00	0.00	0.80	0.00	11.81	181.56	2.00	0.00	0.80	0.00
11.98	172.55	2.00	0.00	0.80	0.00	12.14	151.84	2.00	0.00	0.79	0.00
12.30	153.32	2.00	0.00	0.79	0.00	12.47	175.95	2.00	0.00	0.79	0.00
12.63	213.84	2.00	0.00	0.79	0.00	12.80	247.92	2.00	0.00	0.78	0.00
12.96	272.92	2.00	0.00	0.78	0.00	13.12	287.31	2.00	0.00	0.78	0.00
13.29	301.92	2.00	0.00	0.77	0.00	13.45	311.75	2.00	0.00	0.77	0.00
13.62	312.11	2.00	0.00	0.77	0.00	13.78	310.66	2.00	0.00	0.77	0.00
13.94	311.47	2.00	0.00	0.76	0.00	14.11	316.02	2.00	0.00	0.76	0.00
14.27	324.39	2.00	0.00	0.76	0.00	14.44	334.08	2.00	0.00	0.76	0.00
14.60	340.71	2.00	0.00	0.75	0.00	14.76	339.65	2.00	0.00	0.75	0.00
14.93	329.09	2.00	0.00	0.75	0.00	15.09	328.77	2.00	0.00	0.74	0.00
15.26	331.05	2.00	0.00	0.74	0.00	15.42	330.25	2.00	0.00	0.74	0.00
15.58	322.94	2.00	0.00	0.74	0.00	15.75	320.73	2.00	0.00	0.73	0.00
15.91	330.99	2.00	0.00	0.73	0.00	16.08	340.59	2.00	0.00	0.73	0.00
16.24	344.34	2.00	0.00	0.72	0.00	16.40	348.11	2.00	0.00	0.72	0.00
16.57	355.51	2.00	0.00	0.72	0.00	16.73	363.15	2.00	0.00	0.72	0.00
16.90	366.22	2.00	0.00	0.71	0.00	17.06	364.16	2.00	0.00	0.71	0.00
17.22	358.48	2.00	0.00	0.71	0.00	17.39	352.09	2.00	0.00	0.71	0.00
17.55	346.33	2.00	0.00	0.70	0.00	17.72	335.51	2.00	0.00	0.70	0.00
17.88	315.70	2.00	0.00	0.70	0.00	18.04	295.26	2.00	0.00	0.69	0.00
18.21	279.15	2.00	0.00	0.69	0.00	18.37	275.46	2.00	0.00	0.69	0.00
18.54	273.69	2.00	0.00	0.69	0.00	18.70	272.36	2.00	0.00	0.68	0.00
18.86	264.45	2.00	0.00	0.68	0.00	19.03	254.08	2.00	0.00	0.68	0.00
19.19	248.66	2.00	0.00	0.67	0.00	19.36	250.95	2.00	0.00	0.67	0.00
19.52	248.11	2.00	0.00	0.67	0.00	19.69	234.23	2.00	0.00	0.67	0.00
19.85	214.14	2.00	0.00	0.66	0.00	20.01	195.86	2.00	0.00	0.66	0.00
20.18	181.91	2.00	0.00	0.66	0.00	20.34	175.46	2.00	0.00	0.66	0.00
20.51	162.63	2.00	0.00	0.65	0.00	20.67	145.24	2.00	0.00	0.65	0.00
20.83	130.53	2.00	0.00	0.65	0.00	21.00	126.21	2.00	0.00	0.64	0.00
21.16	123.05	2.00	0.00	0.64	0.00	21.33	118.51	2.00	0.00	0.64	0.00
21.49	112.38	2.00	0.00	0.64	0.00	21.65	111.53	2.00	0.00	0.63	0.00
21.82	113.69	2.00	0.00	0.63	0.00	21.98	118.13	2.00	0.00	0.63	0.00
22.15	121.21	2.00	0.00	0.62	0.00	22.31	125.48	2.00	0.00	0.62	0.00
22.47	128.88	2.00	0.00	0.62	0.00	22.64	130.36	2.00	0.00	0.62	0.00
22.80	129.38	2.00	0.00	0.61	0.00	22.97	132.65	2.00	0.00	0.61	0.00
23.13	139.94	2.00	0.00	0.61	0.00	23.29	148.65	2.00	0.00	0.61	0.00
23.46	147.75	2.00	0.00	0.60	0.00	23.62	139.40	2.00	0.00	0.60	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	125.36	2.00	0.00	0.60	0.00	23.95	121.24	2.00	0.00	0.59	0.00
24.11	124.92	2.00	0.00	0.59	0.00	24.28	129.77	2.00	0.00	0.59	0.00
24.44	130.45	2.00	0.00	0.59	0.00	24.61	127.34	2.00	0.00	0.58	0.00
24.77	123.76	2.00	0.00	0.58	0.00	24.93	117.46	2.00	0.00	0.58	0.00
25.10	110.05	2.00	0.00	0.57	0.00	25.26	99.97	2.00	0.00	0.57	0.00
25.43	88.52	2.00	0.00	0.57	0.00	25.59	78.53	2.00	0.00	0.57	0.00
25.75	73.49	2.00	0.00	0.56	0.00	25.92	72.80	2.00	0.00	0.56	0.00
26.08	74.54	2.00	0.00	0.56	0.00	26.25	78.15	2.00	0.00	0.56	0.00
26.41	82.51	2.00	0.00	0.55	0.00	26.57	87.53	2.00	0.00	0.55	0.00
26.74	93.00	2.00	0.00	0.55	0.00	26.90	95.20	2.00	0.00	0.54	0.00
27.07	91.41	2.00	0.00	0.54	0.00	27.23	81.59	2.00	0.00	0.54	0.00
27.40	74.36	2.00	0.00	0.54	0.00	27.56	75.87	2.00	0.00	0.53	0.00
27.72	83.57	2.00	0.00	0.53	0.00	27.89	93.60	2.00	0.00	0.53	0.00
28.05	99.96	2.00	0.00	0.52	0.00	28.22	101.66	2.00	0.00	0.52	0.00
28.38	97.90	2.00	0.00	0.52	0.00	28.54	94.85	2.00	0.00	0.52	0.00
28.71	96.88	2.00	0.00	0.51	0.00	28.87	103.59	2.00	0.00	0.51	0.00
29.04	110.06	2.00	0.00	0.51	0.00	29.20	113.59	2.00	0.00	0.51	0.00
29.36	114.21	2.00	0.00	0.50	0.00	29.53	113.75	2.00	0.00	0.50	0.00
29.69	113.80	2.00	0.00	0.50	0.00	29.86	115.74	2.00	0.00	0.49	0.00
30.02	119.17	2.00	0.00	0.49	0.00	30.18	122.52	2.00	0.00	0.49	0.00
30.35	122.95	2.00	0.00	0.49	0.00	30.51	120.86	2.00	0.00	0.48	0.00
30.68	117.65	2.00	0.00	0.48	0.00	30.84	119.57	2.00	0.00	0.48	0.00
31.00	125.75	2.00	0.00	0.47	0.00	31.17	132.72	2.00	0.00	0.47	0.00
31.33	136.03	2.00	0.00	0.47	0.00	31.50	137.65	2.00	0.00	0.47	0.00
31.66	138.03	2.00	0.00	0.46	0.00	31.82	139.88	2.00	0.00	0.46	0.00
31.99	142.60	2.00	0.00	0.46	0.00	32.15	147.05	2.00	0.00	0.46	0.00
32.32	152.70	2.00	0.00	0.45	0.00	32.48	158.03	2.00	0.00	0.45	0.00
32.64	161.69	2.00	0.00	0.45	0.00	32.81	161.62	2.00	0.00	0.44	0.00
32.97	158.91	2.00	0.00	0.44	0.00	33.14	153.79	2.00	0.00	0.44	0.00
33.30	144.38	2.00	0.00	0.44	0.00	33.46	130.22	2.00	0.00	0.43	0.00
33.63	117.94	2.00	0.00	0.43	0.00	33.79	113.20	2.00	0.00	0.43	0.00
33.96	118.10	2.00	0.00	0.42	0.00	34.12	124.26	2.00	0.00	0.42	0.00
34.28	130.09	2.00	0.00	0.42	0.00	34.45	135.55	2.00	0.00	0.42	0.00
34.61	143.18	2.00	0.00	0.41	0.00	34.78	149.08	2.00	0.00	0.41	0.00
34.94	152.06	2.00	0.00	0.41	0.00	35.10	149.53	2.00	0.00	0.41	0.00
35.27	144.58	2.00	0.00	0.40	0.00	35.43	139.73	2.00	0.00	0.40	0.00
35.60	139.30	2.00	0.00	0.40	0.00	35.76	140.98	2.00	0.00	0.39	0.00
35.93	144.00	2.00	0.00	0.39	0.00	36.09	145.20	2.00	0.00	0.39	0.00
36.25	146.90	2.00	0.00	0.39	0.00	36.42	146.63	2.00	0.00	0.38	0.00
36.58	144.87	2.00	0.00	0.38	0.00	36.75	140.91	2.00	0.00	0.38	0.00
36.91	134.43	2.00	0.00	0.37	0.00	37.07	125.29	2.00	0.00	0.37	0.00
37.24	117.05	2.00	0.00	0.37	0.00	37.40	114.40	2.00	0.00	0.37	0.00
37.57	118.58	2.00	0.00	0.36	0.00	37.73	122.68	2.00	0.00	0.36	0.00
37.89	125.05	2.00	0.00	0.36	0.00	38.06	124.68	2.00	0.00	0.35	0.00
38.22	121.03	2.00	0.00	0.35	0.00	38.39	115.91	2.00	0.00	0.35	0.00
38.55	114.55	2.00	0.00	0.35	0.00	38.71	122.27	2.00	0.00	0.34	0.00
38.88	131.84	2.00	0.00	0.34	0.00	39.04	136.55	2.00	0.00	0.34	0.00
39.21	134.37	2.00	0.00	0.34	0.00	39.37	129.30	2.00	0.00	0.33	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

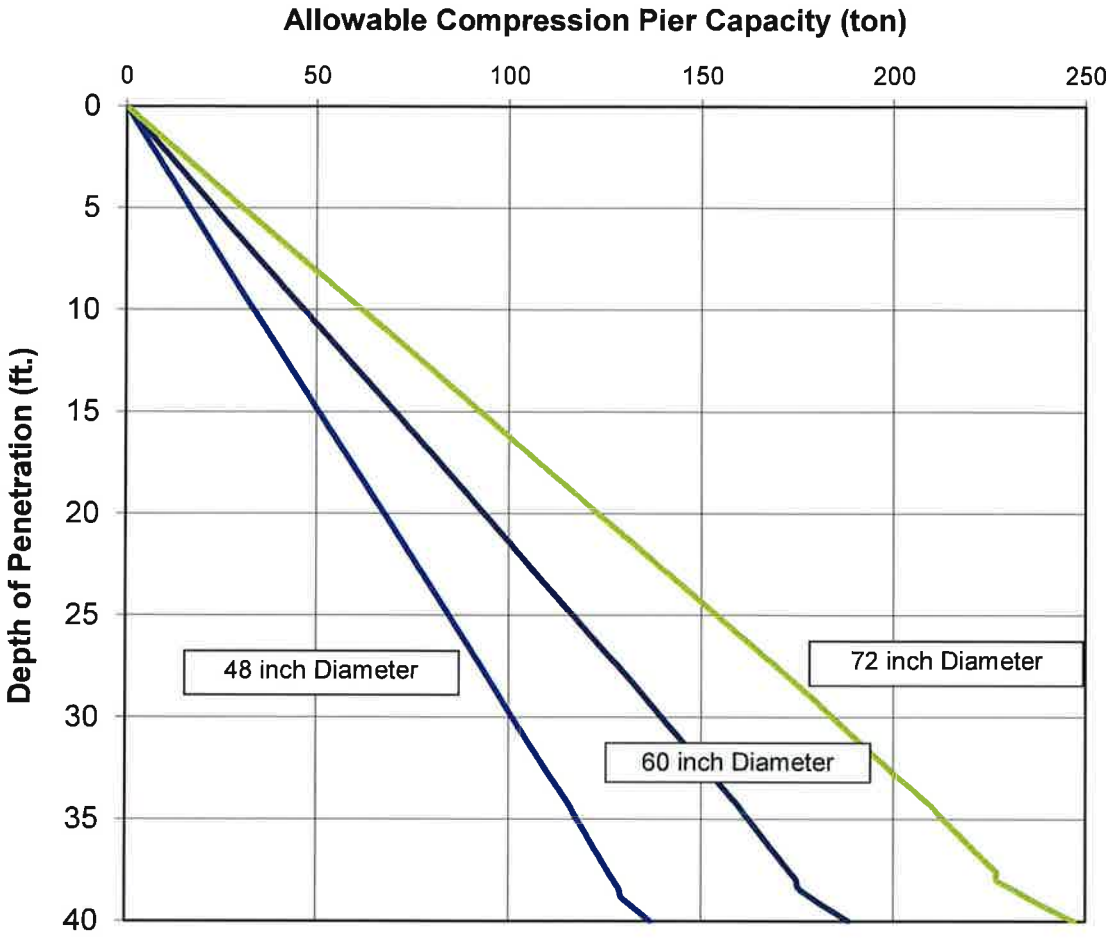
Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	126.10	2.00	0.00	0.33	0.00	39.70	126.75	2.00	0.00	0.33	0.00
39.86	129.08	2.00	0.00	0.32	0.00	40.03	126.92	2.00	0.00	0.32	0.00
40.19	118.23	2.00	0.00	0.32	0.00	40.35	107.12	2.00	0.00	0.32	0.00
40.52	99.87	2.00	0.00	0.31	0.00	40.68	96.44	2.00	0.00	0.31	0.00
40.85	96.05	2.00	0.00	0.31	0.00	41.01	95.26	2.00	0.00	0.30	0.00
41.17	100.62	2.00	0.00	0.30	0.00	41.34	109.83	2.00	0.00	0.30	0.00
41.50	121.20	2.00	0.00	0.30	0.00	41.67	126.13	2.00	0.00	0.29	0.00
41.83	127.18	2.00	0.00	0.29	0.00	41.99	127.87	2.00	0.00	0.29	0.00
42.16	129.03	2.00	0.00	0.29	0.00	42.32	127.18	2.00	0.00	0.28	0.00
42.49	121.89	2.00	0.00	0.28	0.00	42.65	117.55	2.00	0.00	0.28	0.00
42.81	116.05	2.00	0.00	0.27	0.00	42.98	117.61	2.00	0.00	0.27	0.00
43.14	117.95	2.00	0.00	0.27	0.00	43.31	116.81	2.00	0.00	0.27	0.00
43.47	115.08	2.00	0.00	0.26	0.00	43.64	113.92	2.00	0.00	0.26	0.00
43.80	113.72	2.00	0.00	0.26	0.00	43.96	113.76	2.00	0.00	0.25	0.00
44.13	115.34	2.00	0.00	0.25	0.00	44.29	118.49	2.00	0.00	0.25	0.00
44.46	122.52	2.00	0.00	0.25	0.00	44.62	124.19	2.00	0.00	0.24	0.00
44.78	122.46	2.00	0.00	0.24	0.00	44.95	116.91	2.00	0.00	0.24	0.00
45.11	110.15	2.00	0.00	0.24	0.00	45.28	102.85	2.00	0.00	0.23	0.00
45.44	99.64	2.00	0.00	0.23	0.00	45.60	98.22	2.00	0.00	0.23	0.00
45.77	96.76	2.00	0.00	0.22	0.00	45.93	92.46	2.00	0.00	0.22	0.00
46.10	87.51	2.00	0.00	0.22	0.00	46.26	84.00	2.00	0.00	0.22	0.00
46.42	82.17	2.00	0.00	0.21	0.00	46.59	81.17	2.00	0.00	0.21	0.00
46.75	81.18	2.00	0.00	0.21	0.00	46.92	81.53	2.00	0.00	0.20	0.00
47.08	84.23	2.00	0.00	0.20	0.00	47.24	87.56	2.00	0.00	0.20	0.00
47.41	91.12	2.00	0.00	0.20	0.00	47.57	92.98	2.00	0.00	0.19	0.00
47.74	93.37	2.00	0.00	0.19	0.00	47.90	91.11	2.00	0.00	0.19	0.00
48.06	86.02	2.00	0.00	0.19	0.00	48.23	78.72	2.00	0.00	0.18	0.00
48.39	72.68	2.00	0.00	0.18	0.00	48.56	69.04	2.00	0.00	0.18	0.00
48.72	67.62	2.00	0.00	0.17	0.00	48.88	70.40	2.00	0.00	0.17	0.00
49.05	79.13	2.00	0.00	0.17	0.00	49.21	95.20	2.00	0.00	0.17	0.00
49.38	108.76	2.00	0.00	0.16	0.00	49.54	118.39	2.00	0.00	0.16	0.00
49.70	120.95	2.00	0.00	0.16	0.00	49.87	119.63	2.00	0.00	0.15	0.00
50.03	116.68	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.00

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

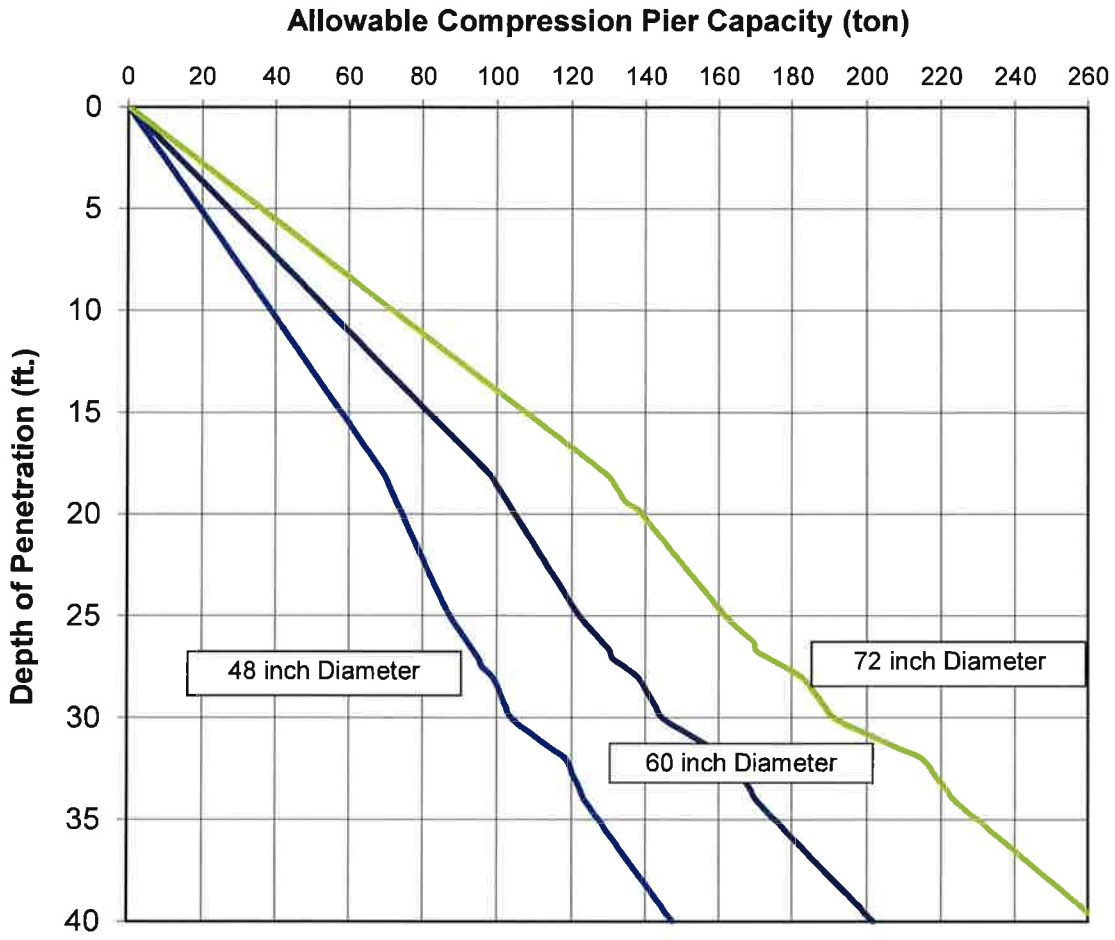
APPENDIX E



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

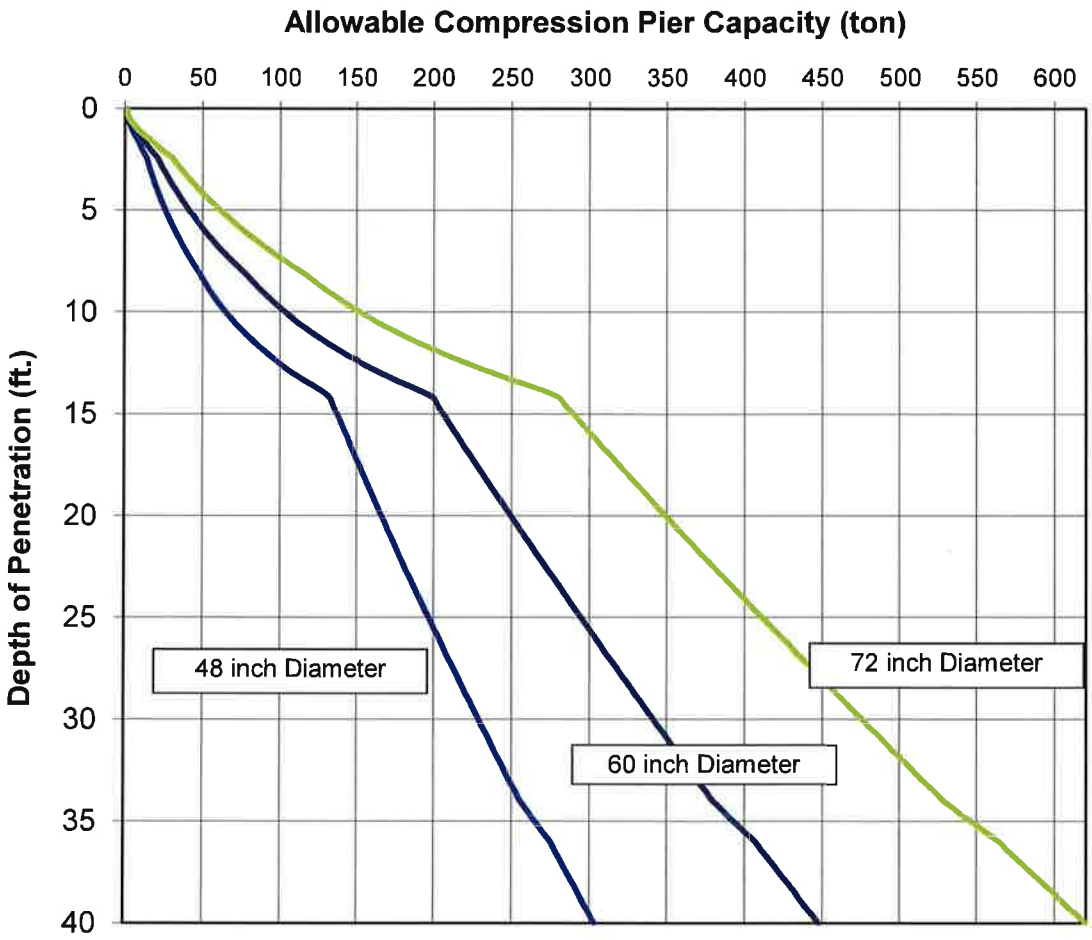
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-1**	**Figure** **E-1**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

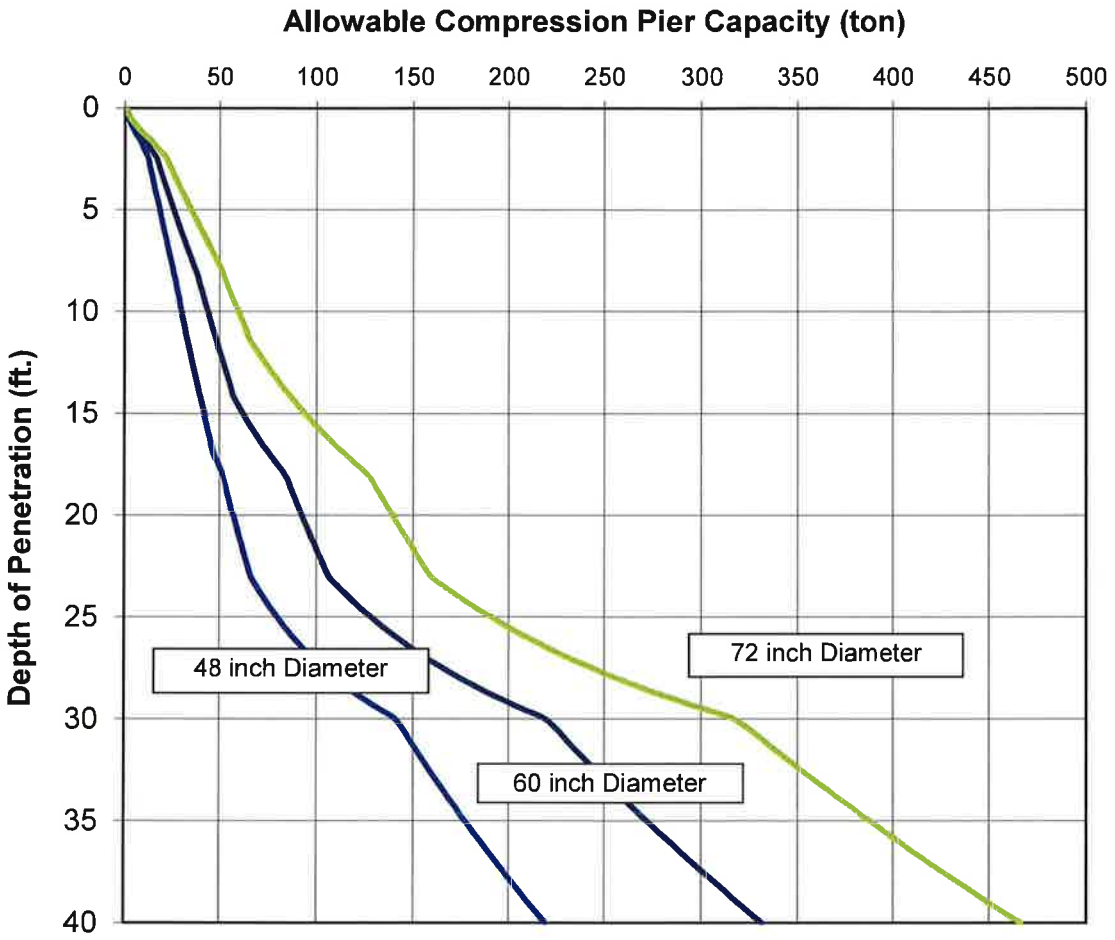
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-2**	**Figure** **E-2**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

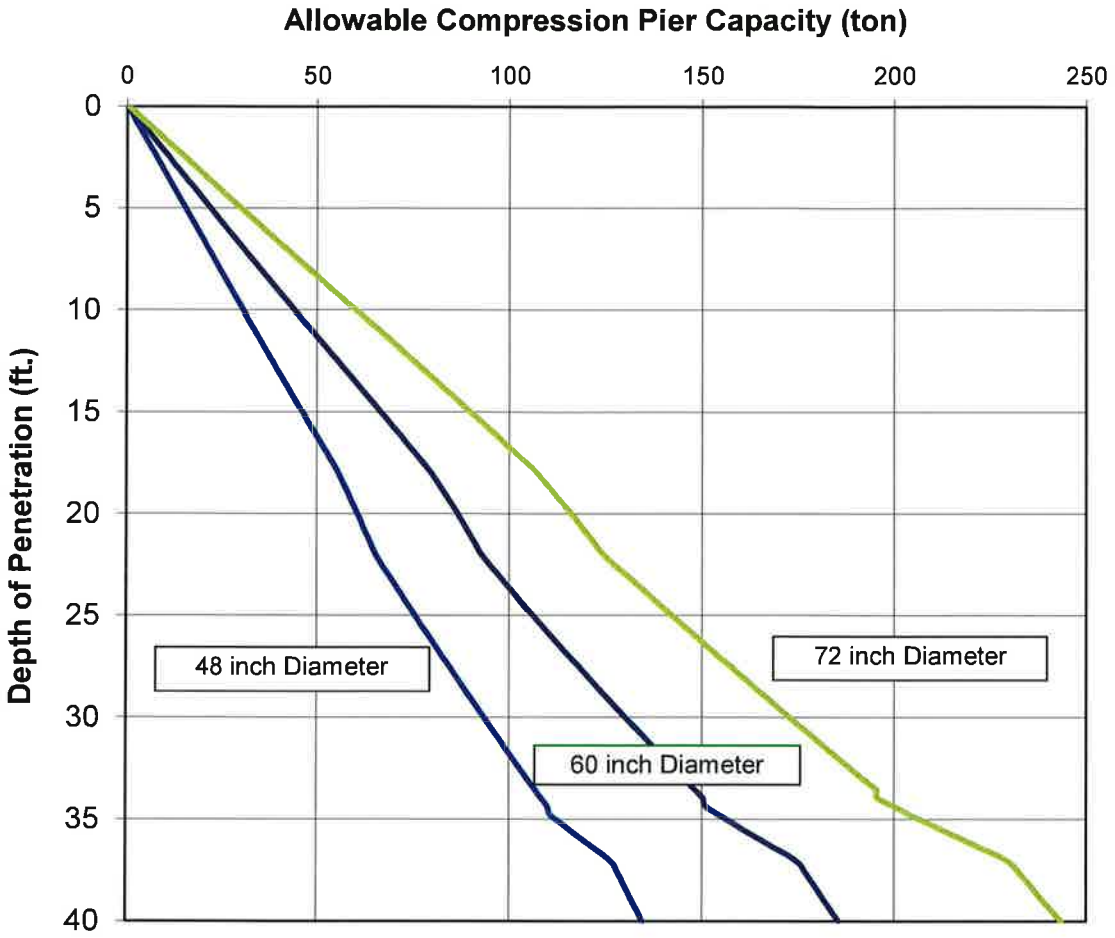
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-3**	**Figure** **E-3**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

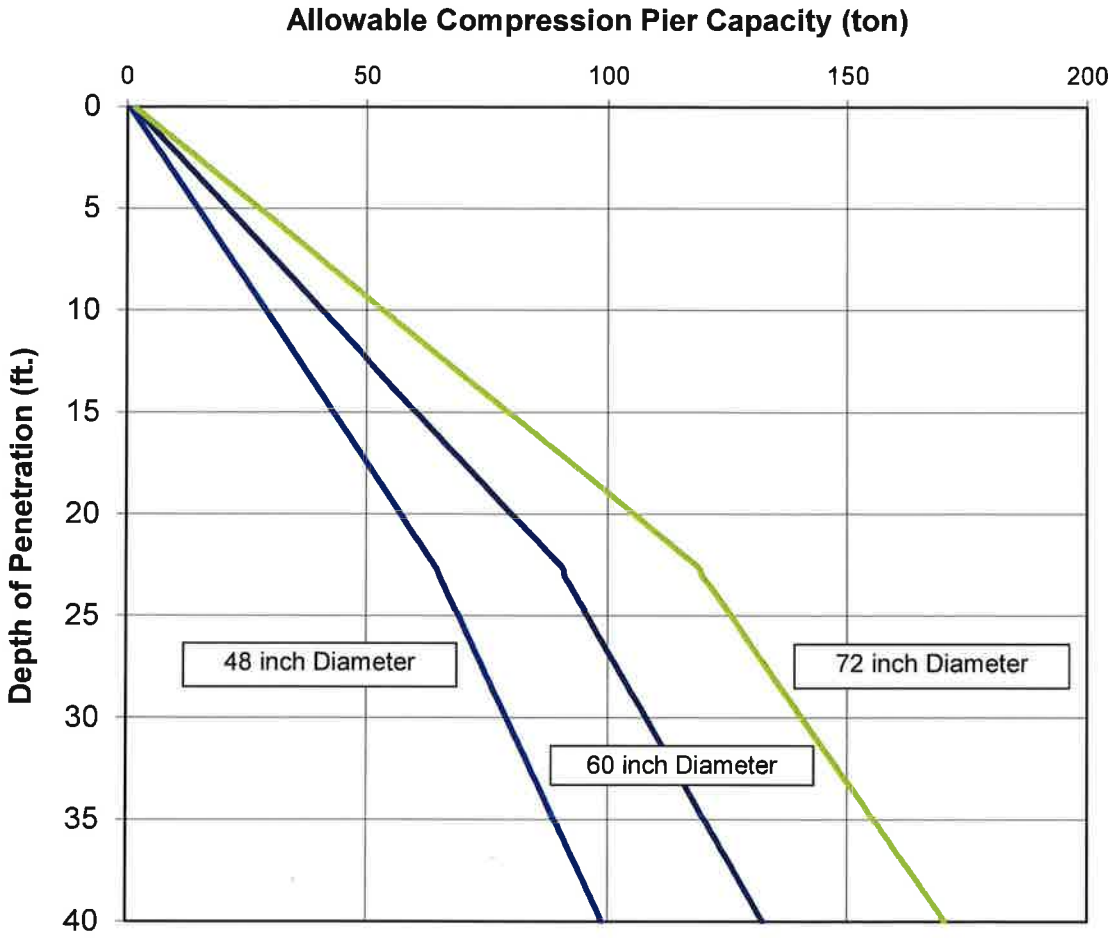
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-4**	**Figure** **E-4**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

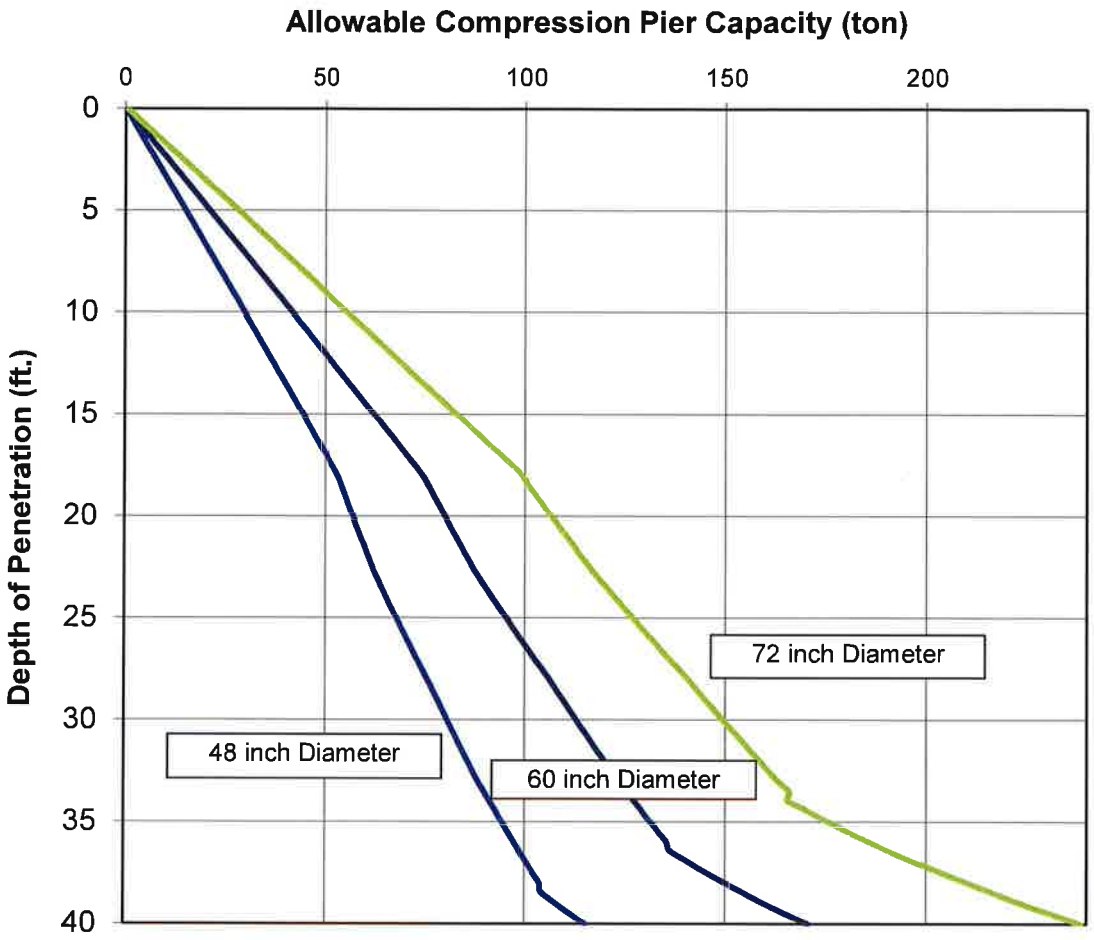
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-5**	**Figure** **E-5**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

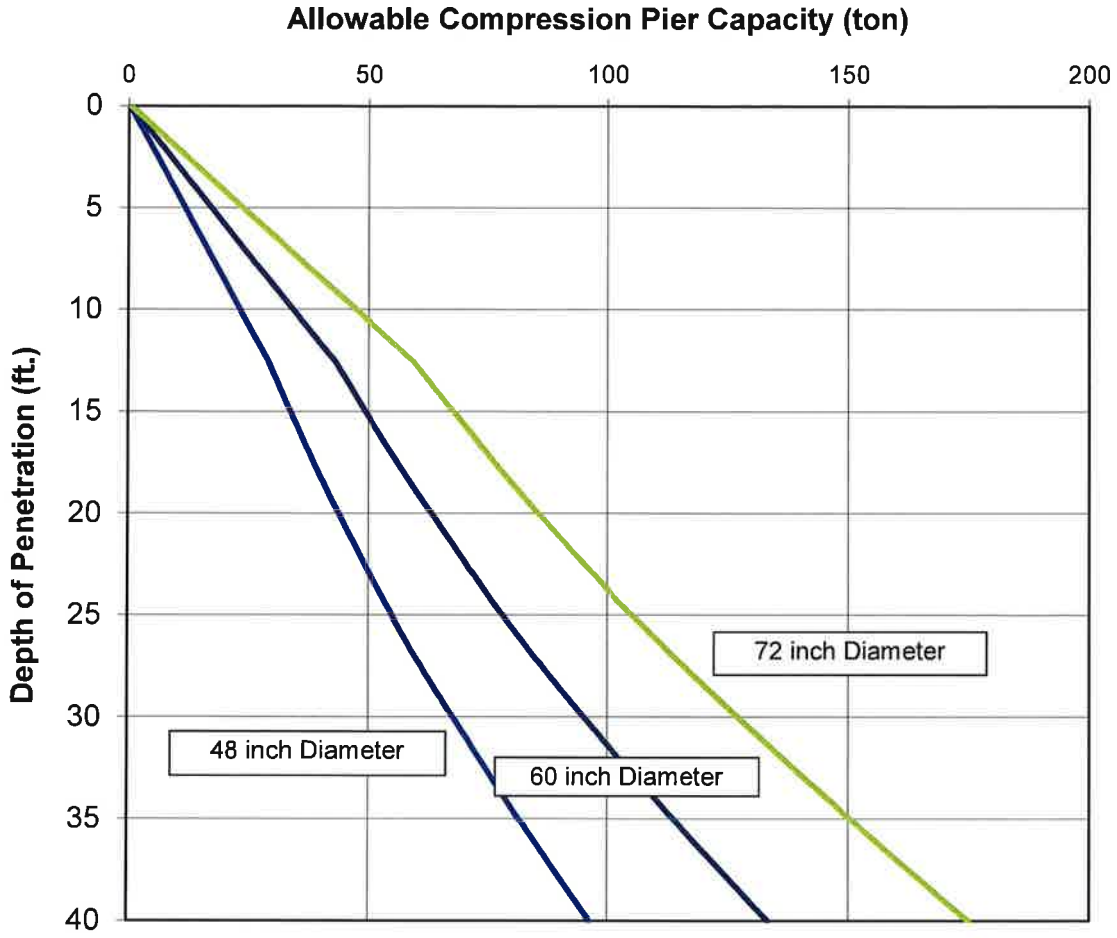
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-6**	**Figure** **E-6**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

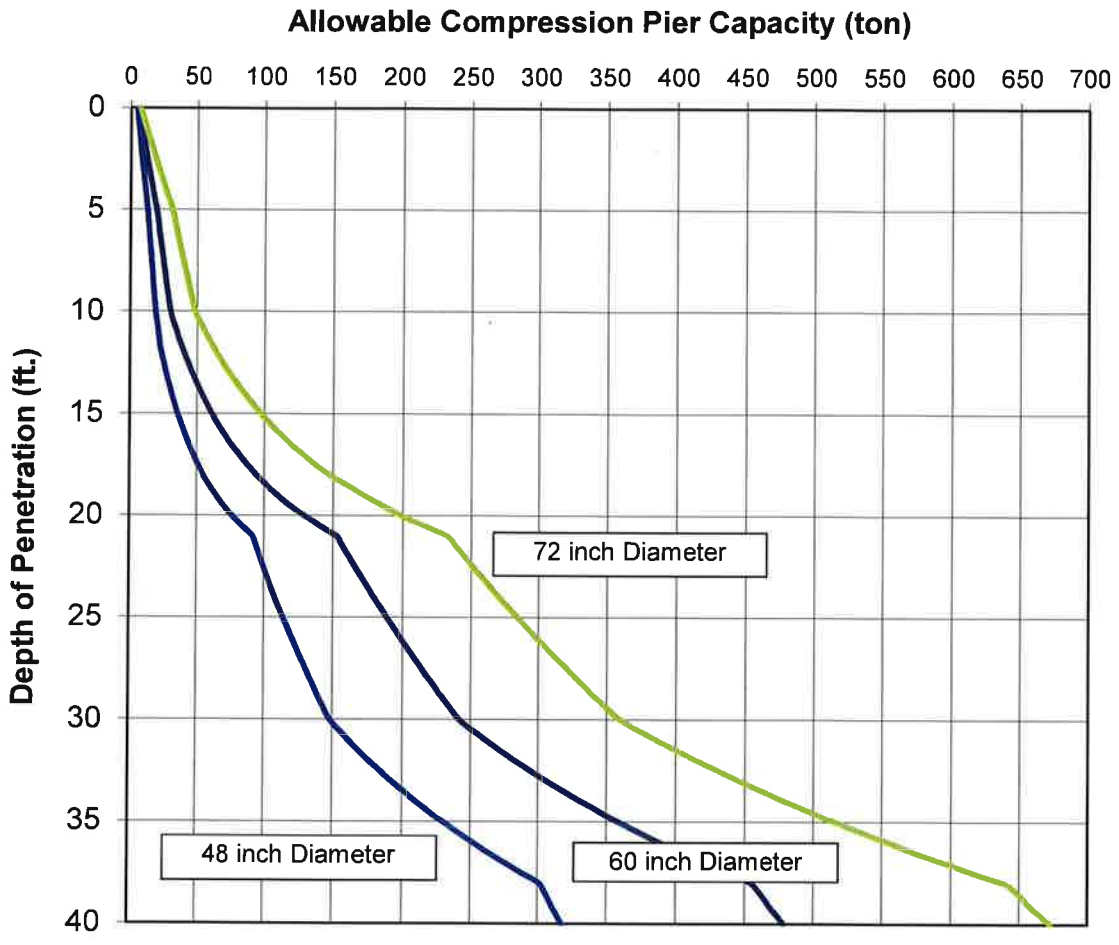
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-7**	**Figure** **E-7**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

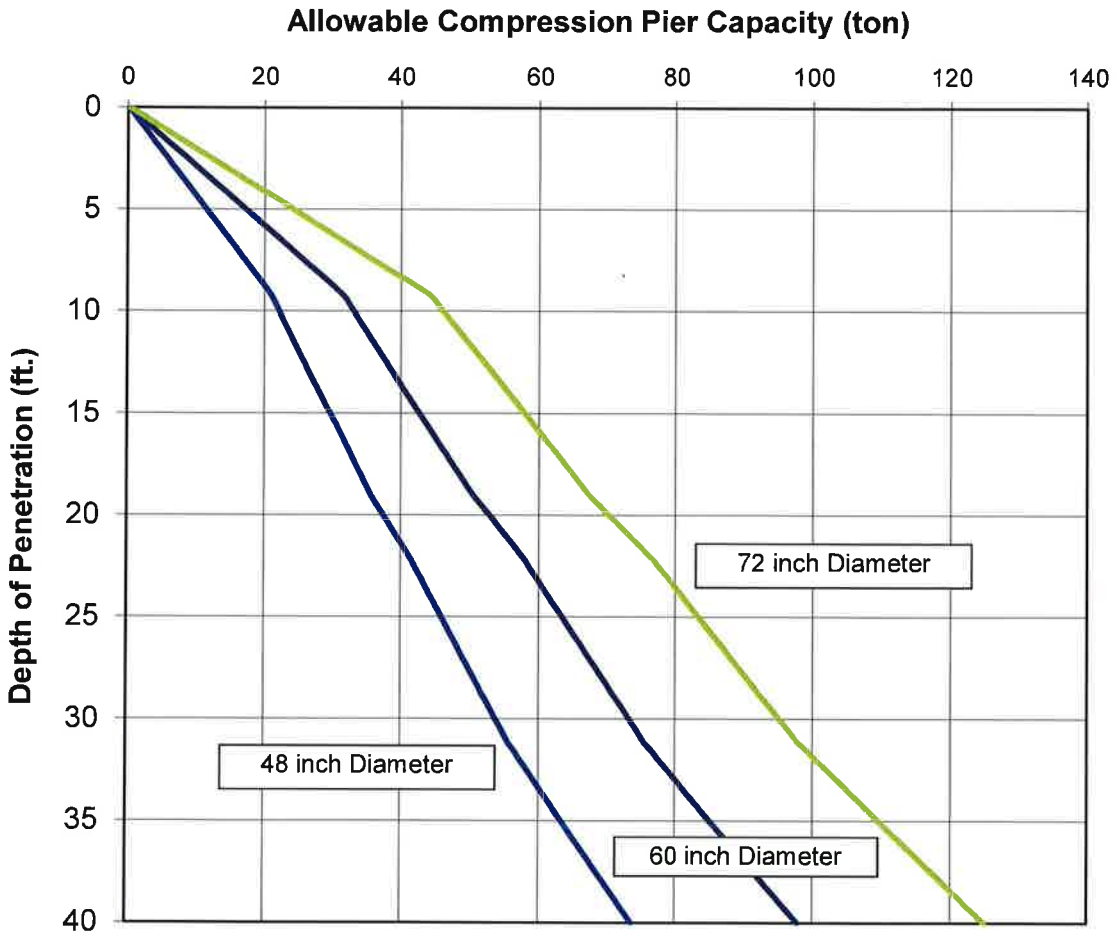
LANDMARK Geo-Engineers and Geologists Project No.: LE20107	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-8**	**Figure** **E-8**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

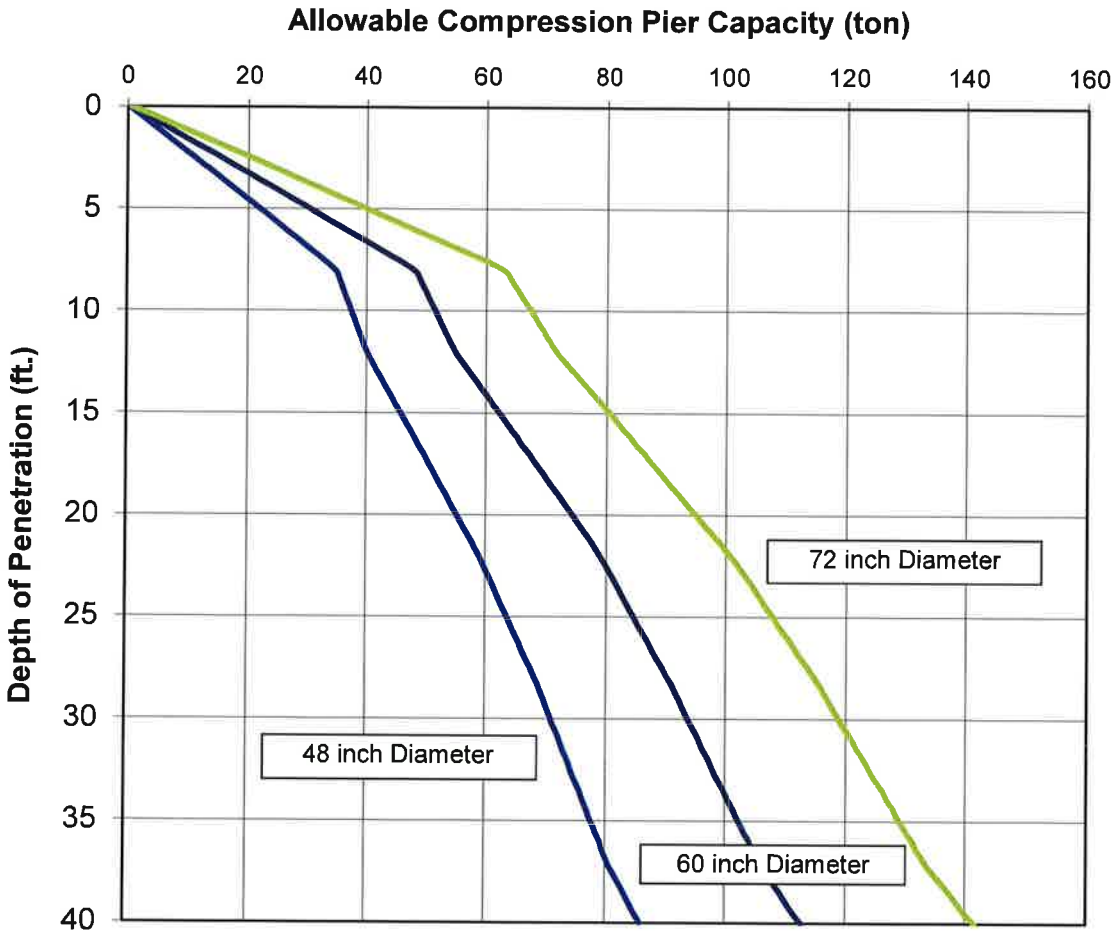
LANDMARK Geo-Engineers and Geologists Project No.: LE20107	Drilled Pier Compression Capacity Chart 230 kV "S" Transmission Line Upgrade El Centro, California CPT-9	Figure E-9



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-10**	**Figure** **E-10**



Notes:

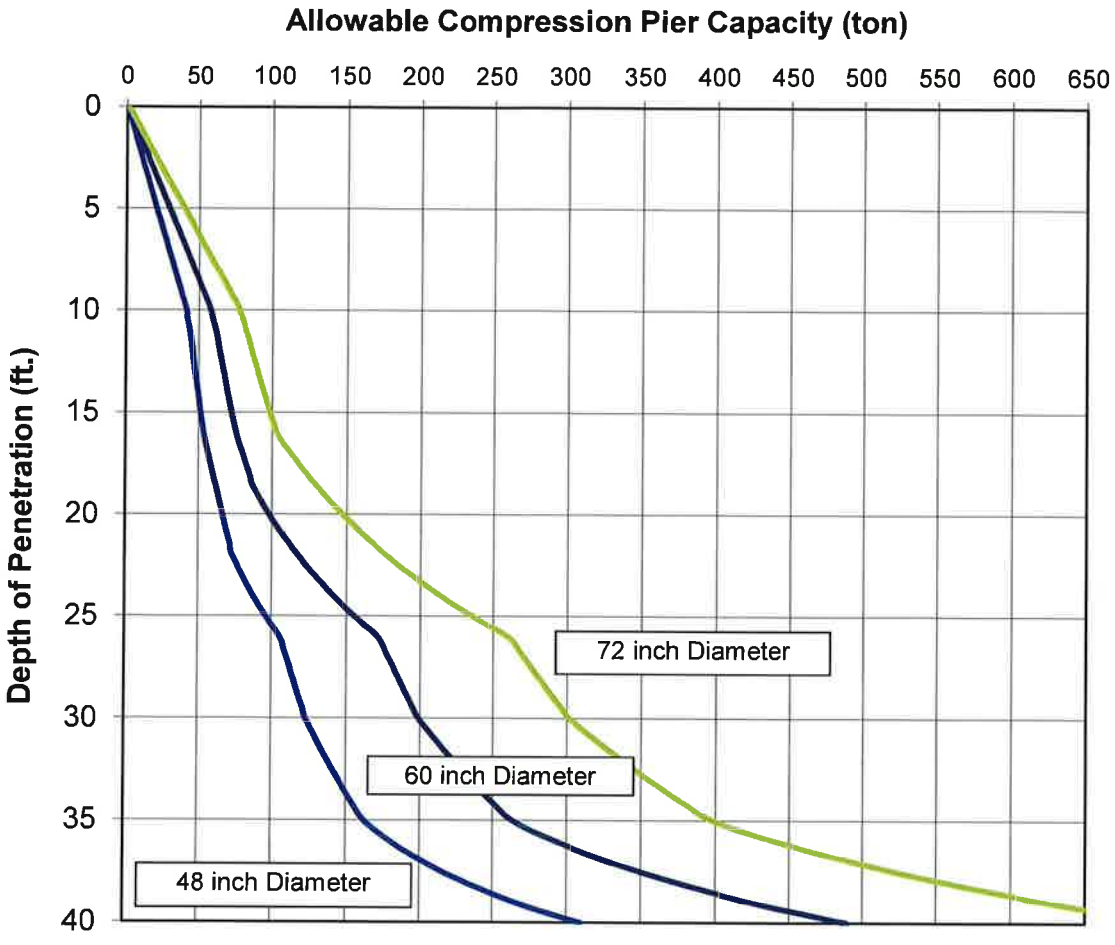
1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Drilled Pier Compression Capacity Chart
230 kV "S" Transmission Line Upgrade
El Centro, California
CPT-11

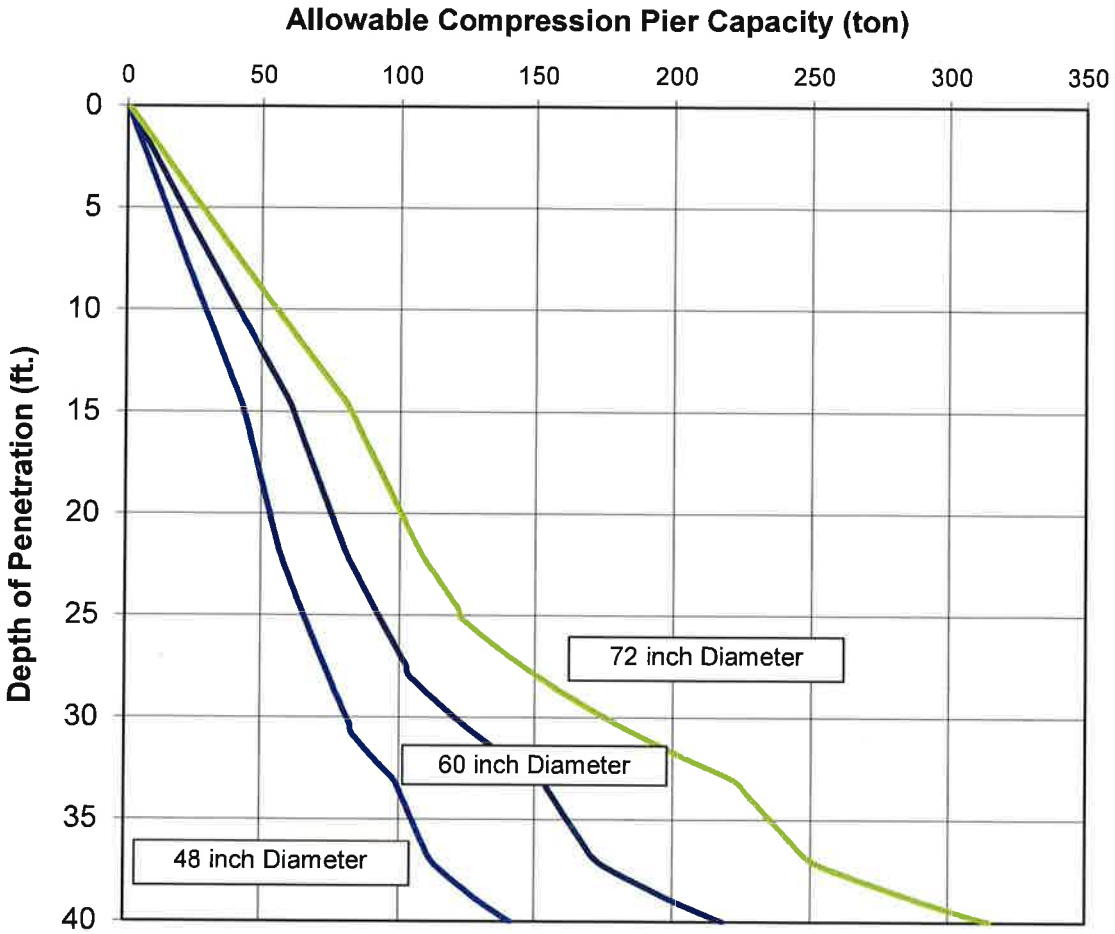
Figure
E-11



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

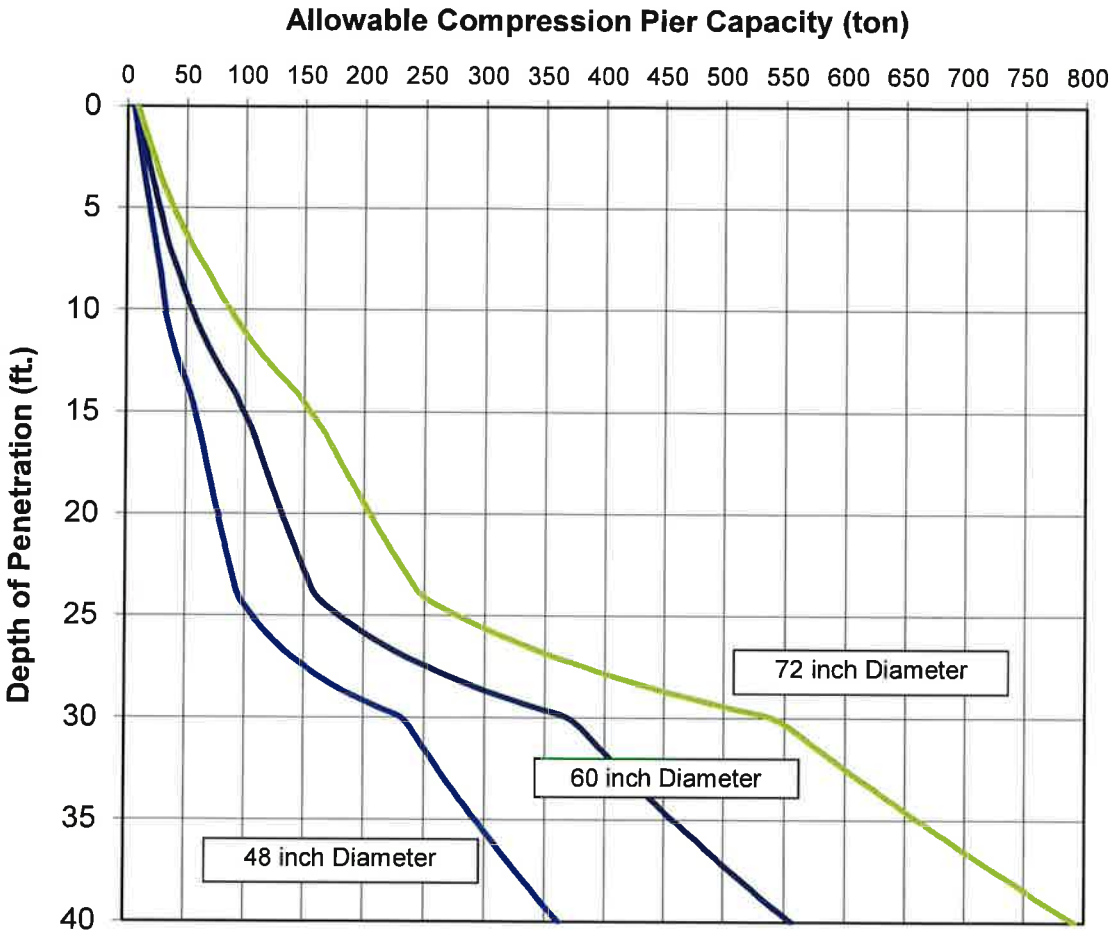
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-12**	**Figure** **E-12**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

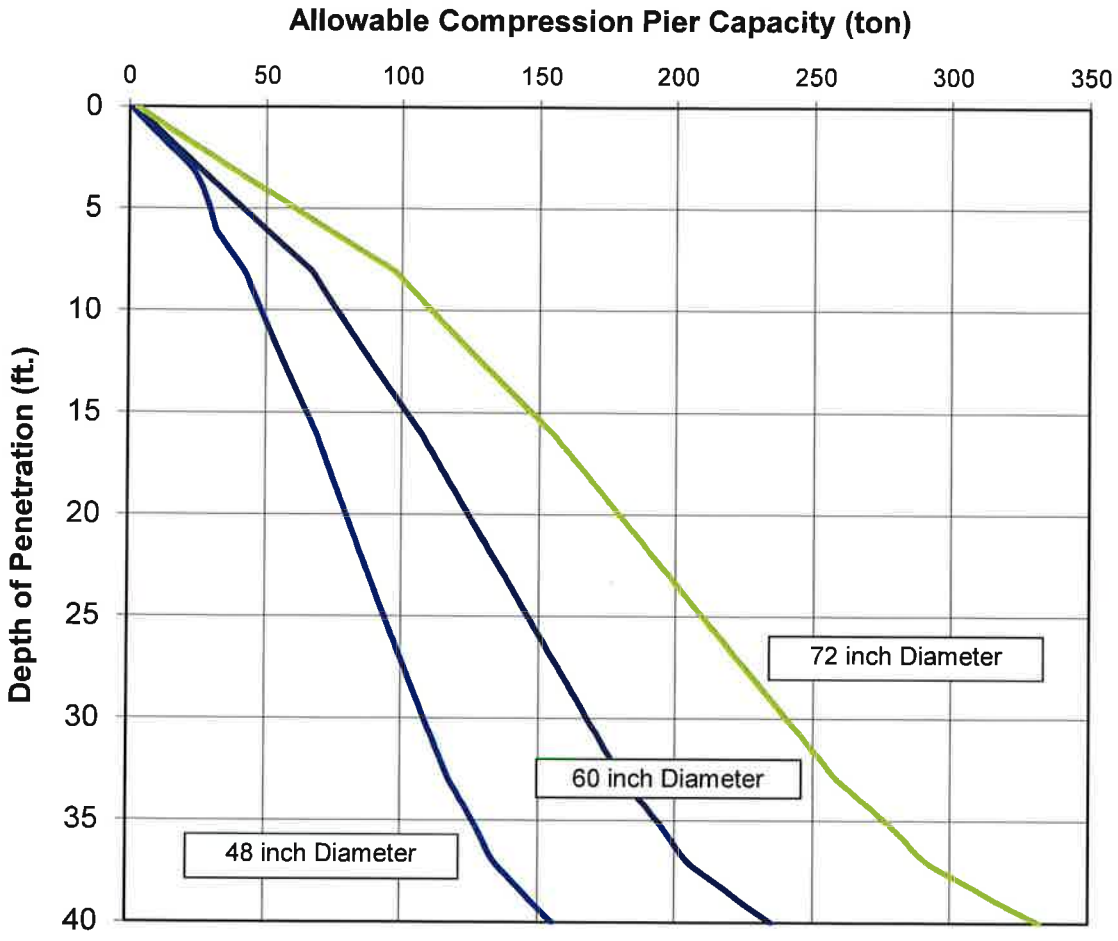
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-13**	**Figure** **E-13**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

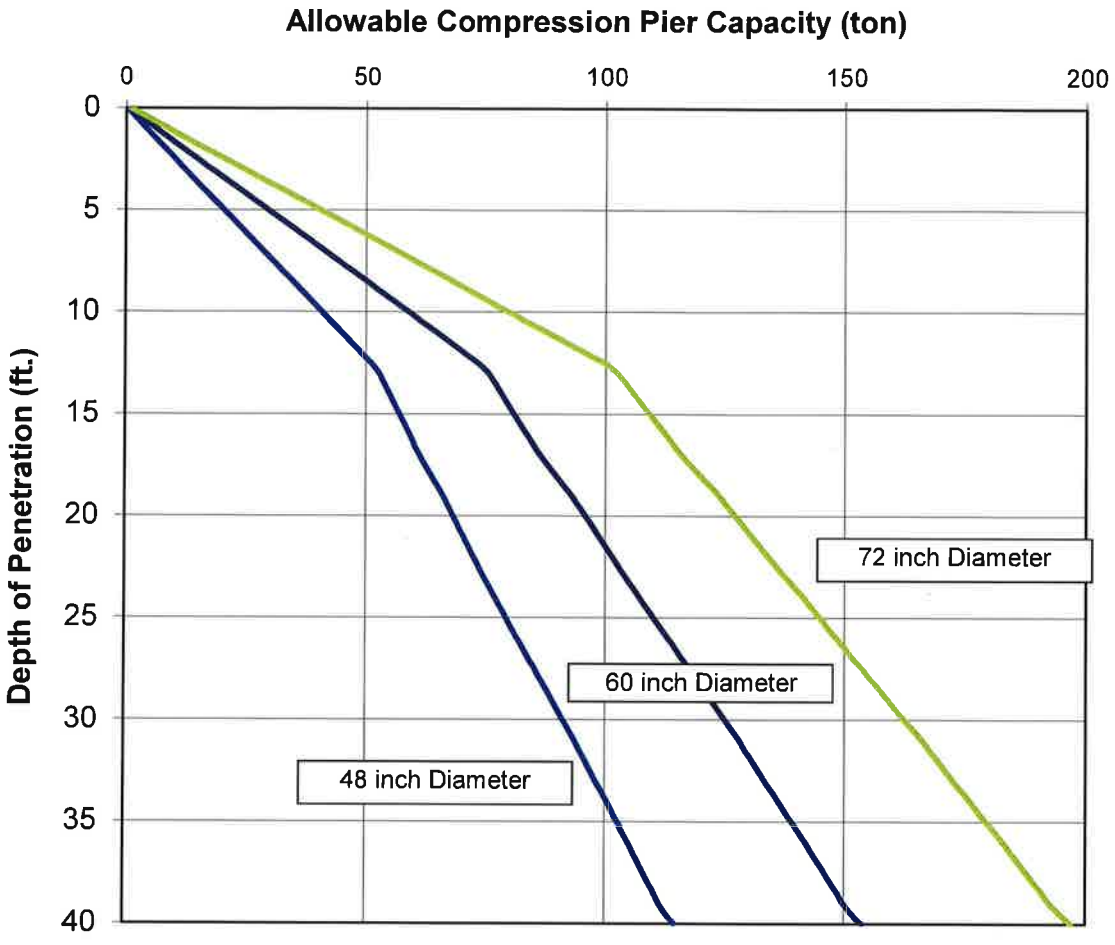
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-14**	**Figure** **E-14**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

LANDMARK Geo-Engineers and Geologists Project No.: LE20107	Drilled Pier Compression Capacity Chart 230 kV "S" Transmission Line Upgrade El Centro, California CPT-15	Figure E-15



Notes:

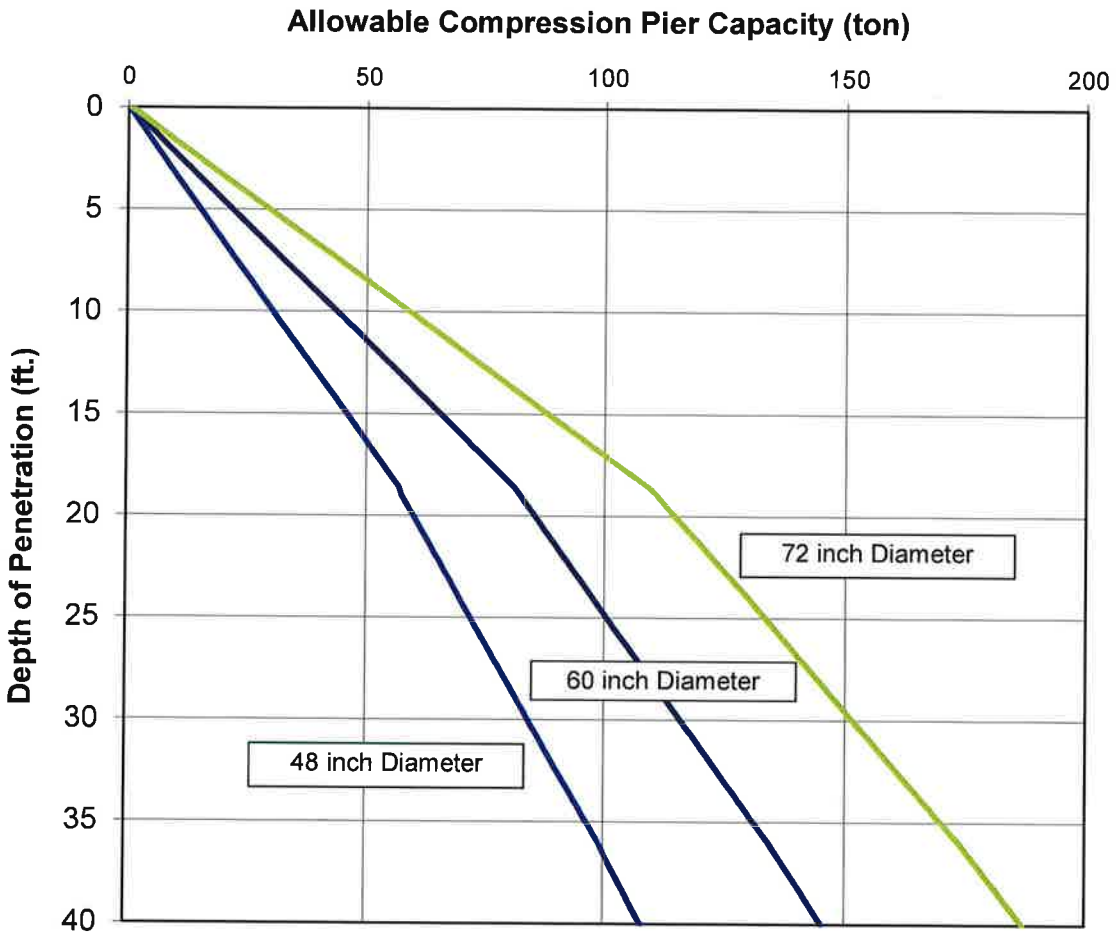
1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Drilled Pier Compression Capacity Chart
230 kV "S" Transmission Line Upgrade
El Centro, California
CPT-16

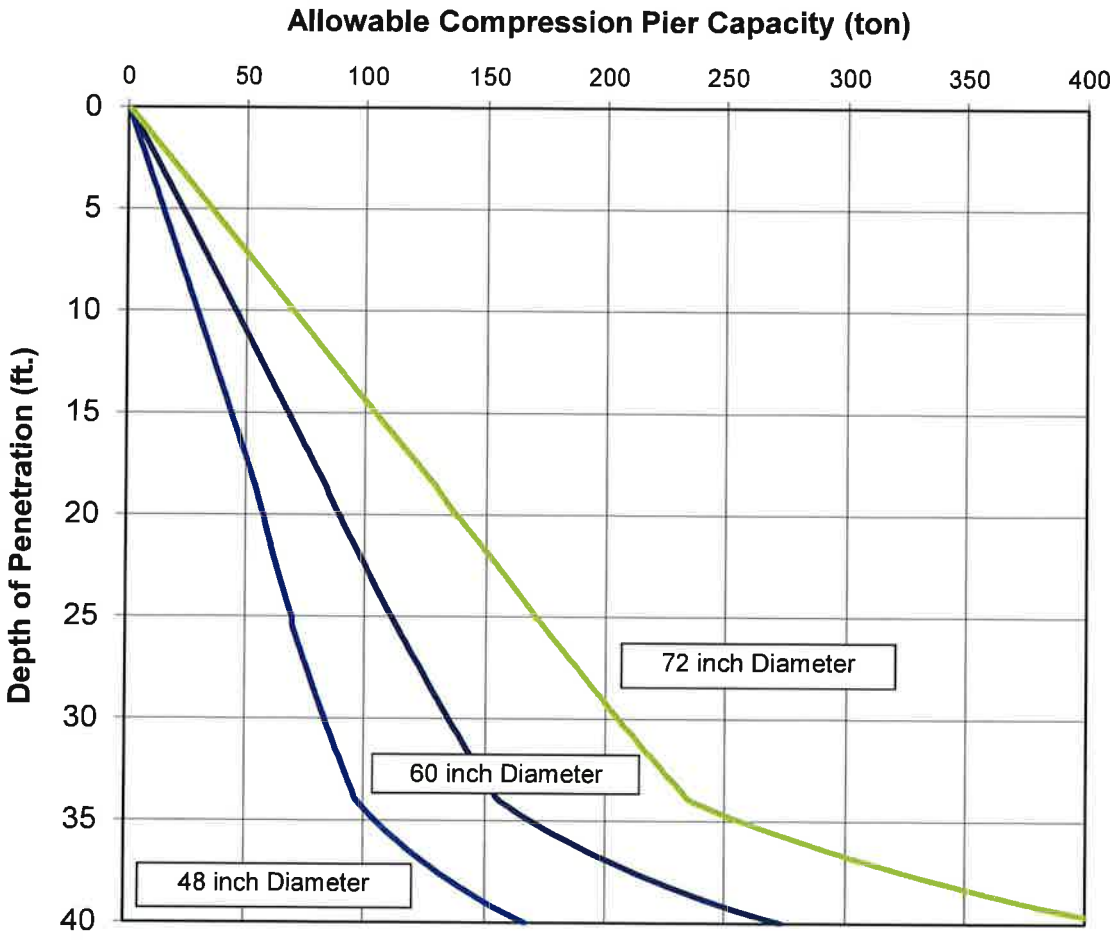
Figure
E-16



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

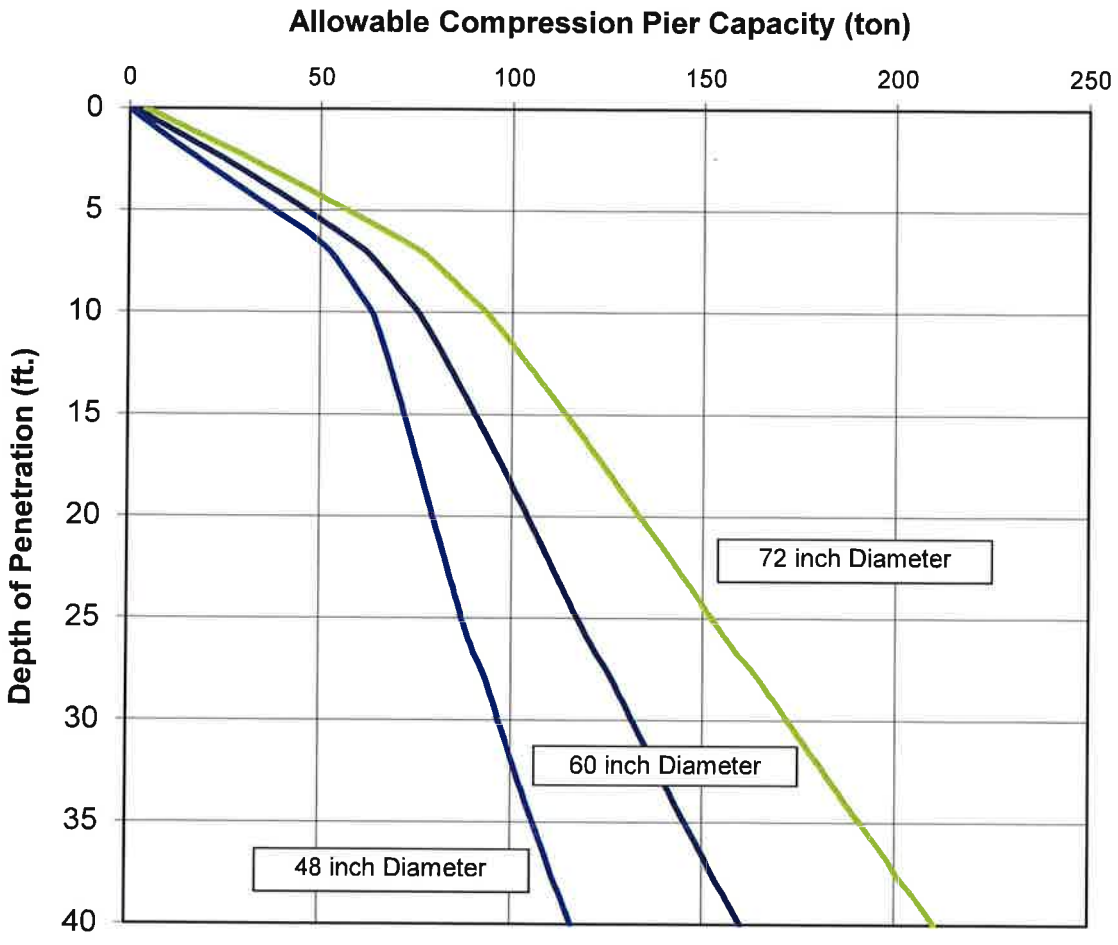
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-17**	**Figure** **E-17**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

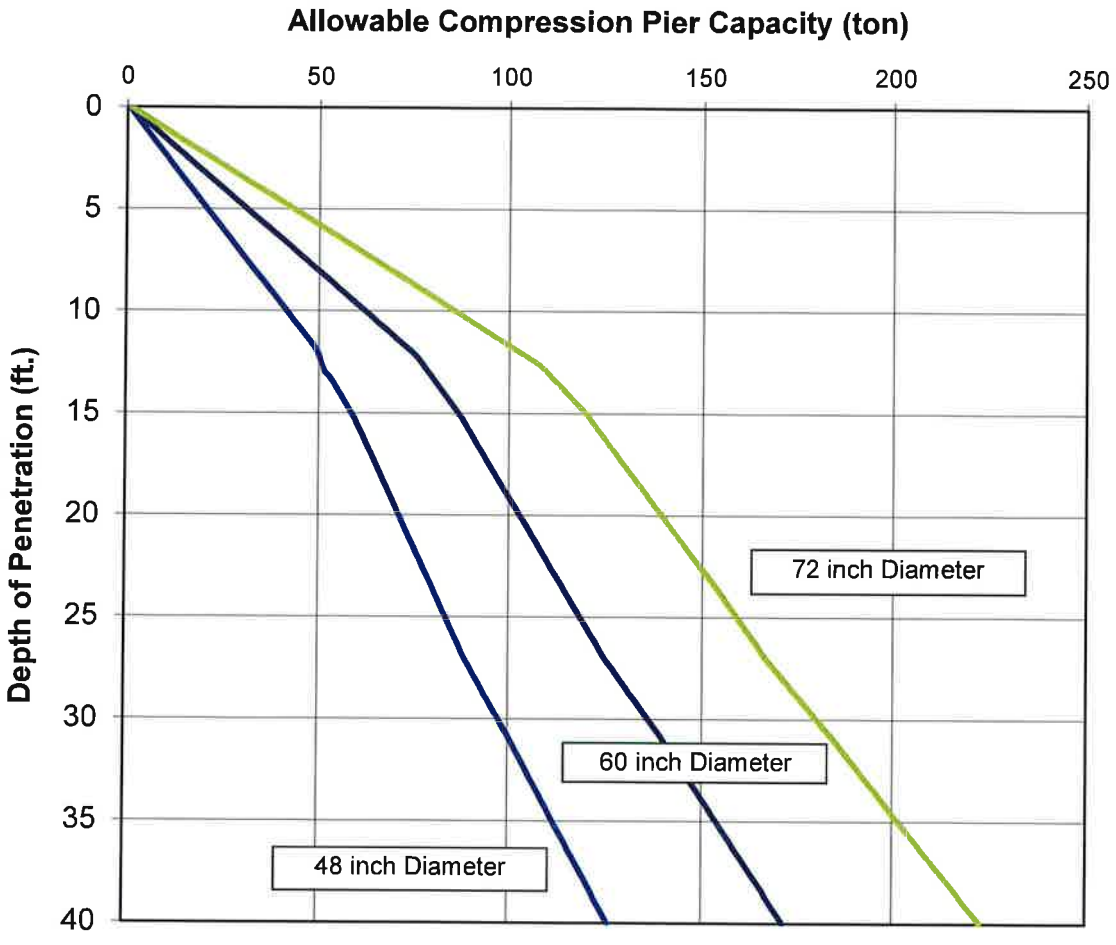
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-18**	**Figure** **E-18**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

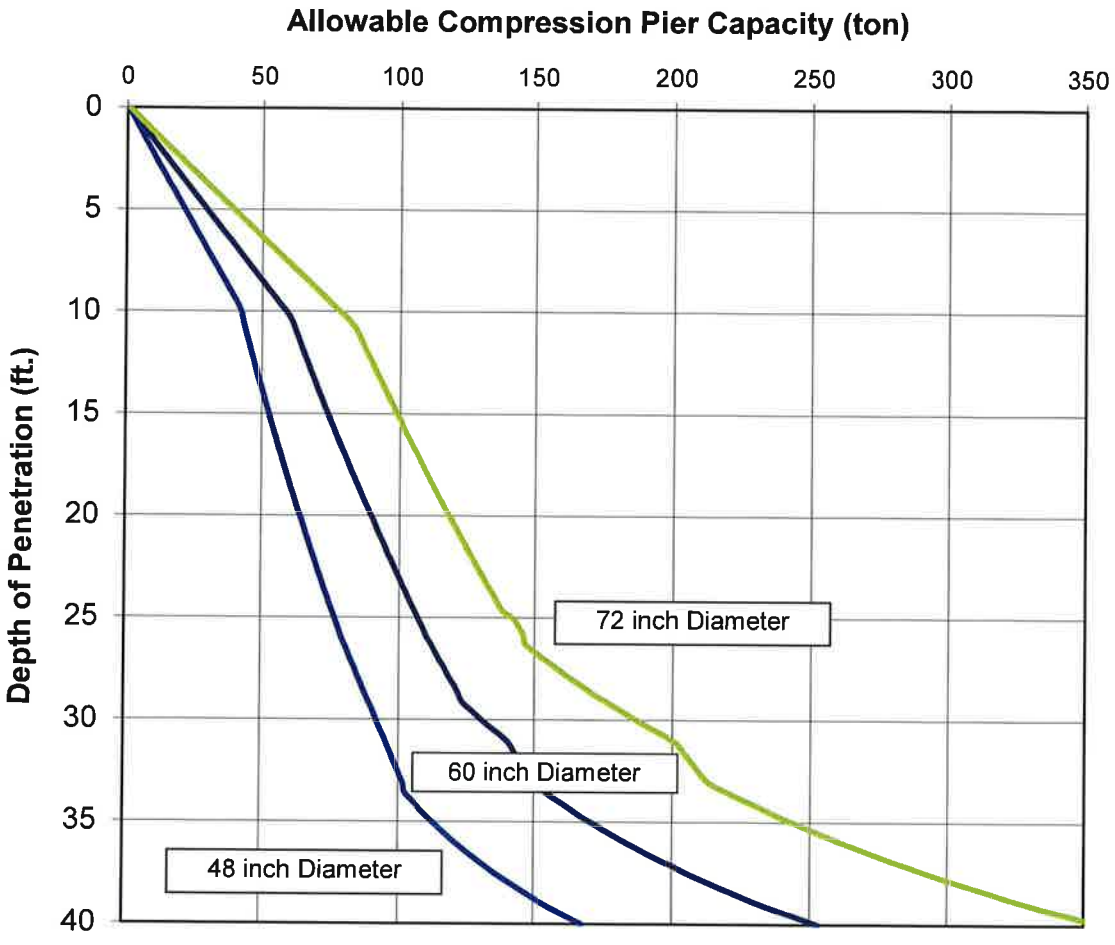
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-19**	**Figure** **E-19**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

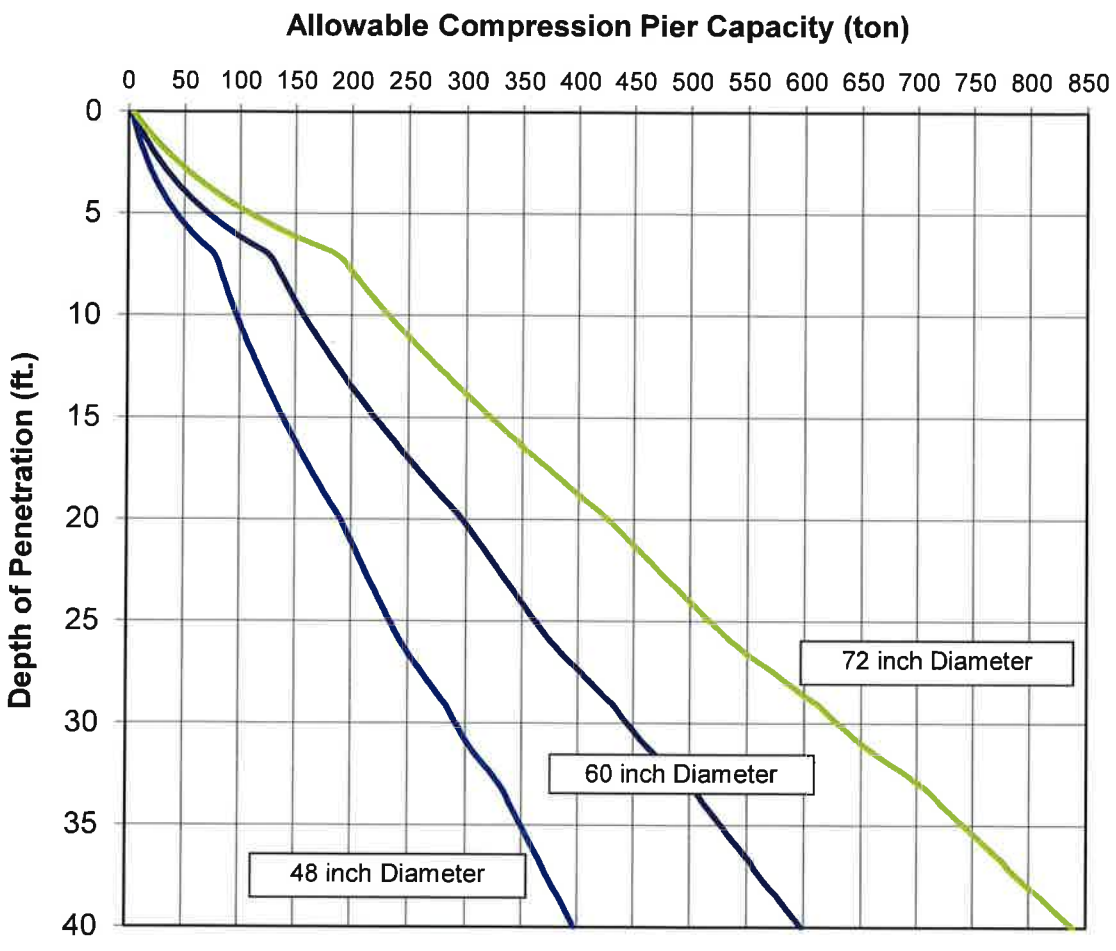
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-20**	**Figure** **E-20**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

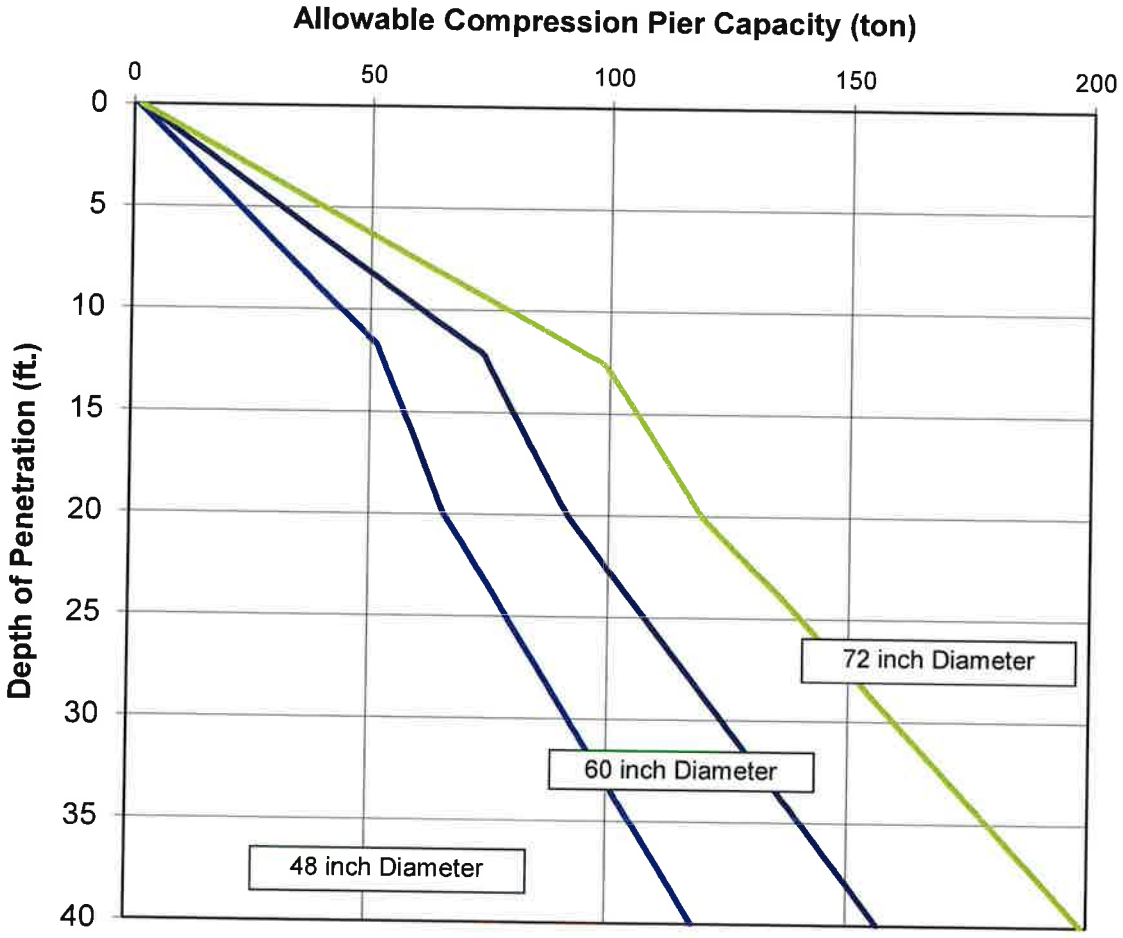
LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-21**	**Figure** **E-21**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

LANDMARK Geo-Engineers and Geologists **Project No.: LE20107**	**Drilled Pier Compression Capacity Chart** **230 kV "S" Transmission Line Upgrade** **El Centro, California** **CPT-22**	**Figure** **E-22**



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pier diameter.

LANDMARK
Geo-Engineers and Geologists

Project No.: LE20107

Drilled Pier Compression Capacity Chart
230 kV "S" Transmission Line Upgrade
El Centro, California
CPT-23

Figure
E-23