PROJECT REPORT

TO: ENVIRONMENTAL EVALUATION COMMITTEE

FROM: PLANNING & DEVELOPMENT SERVICES

AGENDA DATE: May 28, 2020

AGENDA TIME: 1:30 PM / No. 2

PROJECT TYPE: Heber 2 Geothermal CUP #19-0017 SUPERVISOR DIST #2

LOCATION: 855 Dogwood Road, Heber SPA area, CA

APN: 054-250-031-000

PARCELS SIZE: 40 AC

GENERAL PLAN (existing) Heber SPA

GENERAL PLAN (proposed) N/A

ZONE (existing) A-2 (General Agriculture/Geothermal)

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: 05/28/2020

INITIAL STUDY: #19-0020

☐ NEGATIVE DECLARATION ☐ MITIGATED NEGATIVE DECLARATION ☐ EIR

DEPARTMENTAL REPORTS / APPROVALS:

PUBLIC WORKS	☐ NONE	☒ ATTACHED
AG. COMMISSIONER	☒ NONE	☐ ATTACHED
APCD	☐ NONE	☒ ATTACHED
DEH/EHS	☒ NONE	☐ ATTACHED
FIRE/OES	☐ NONE	☒ ATTACHED

OTHER: CUPA

REQUESTED ACTION:

(See Attached)

Planning & Development Services Department
801 MAIN STREET, EL CENTRO, CA, 92243 (442) 265-1736
(Jim Minnick, Director)

☐ NEGATIVE DECLARATION
☐ MITIGATED NEGATIVE DECLARATION

Initial Study & Environmental Analysis
For:

Heber 2 Geothermal Repower Project
CUP No. 19-0017

Prepared By:

COUNTY OF IMPERIAL
Planning & Development Services Department
801 Main Street
El Centro, CA 92243
(442) 265-1736
www.icpds.com

May 2020

TABLE OF CONTENTS

PAGE

SECTION 1

I. INTRODUCTION 3

SECTION 2

II. ENVIRONMENTAL CHECKLIST 8
PROJECT SUMMARY 9
ENVIRONMENTAL ANALYSIS 13

I. AESTHETICS 16
II. AGRICULTURE AND FOREST RESOURCES 16
III. AIR QUALITY 17
IV. BIOLOGICAL RESOURCES 19
V. CULTURAL RESOURCES 21
VI. ENERGY 21
VII. GEOLOGY AND SOILS 22
VIII. GREENHOUSE GAS EMISSION 23
IX. HAZARDS AND HAZARDOUS MATERIALS 24
X. HYDROLOGY AND WATER QUALITY 26
XI. LAND USE AND PLANNING 27
XII. MINERAL RESOURCES 28
XIII. NOISE 28
XIV. POPULATION AND HOUSING 29
XV. PUBLIC SERVICES 29
XVI. RECREATION 30
XVII. TRANSPORTATION 30
XVIII. TRIBAL CULTURAL RESOURCES 31
XIX. UTILITIES AND SERVICE SYSTEMS 32
XX. WILDFIRE 32

SECTION 3

III. MANDATORY FINDINGS OF SIGNIFICANCE 34
IV. PERSONS AND ORGANIZATIONS CONSULTED 35
V. REFERENCES 36
VI. NEGATIVE DECLARATION - COUNTY OF IMPERIAL 39
27 FINDINGS 41

SECTION 4

VIII. RESPONSE TO COMMENTS (IF ANY) 42
IX. MITIGATION MONITORING & REPORTING PROGRAM (MMRP) (IF ANY) 43

SECTION 1
INTRODUCTION

A. PURPOSE

This document is a ☐ policy-level, ☒ project level Initial Study for evaluation of potential environmental impacts resulting with the proposed installation of new geothermal energy converters and three isopentane storage tanks, located at the existing Heber 2 Geothermal Energy Complex located on APN 054-250-031 at 855 Dogwood Road, Heber, CA 92249 (see Exhibit "A" & "B").

B. CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) REQUIREMENTS AND THE IMPERIAL COUNTY'S GUIDELINES FOR IMPLEMENTING CEQA

As defined by Section 15063 of the State California Environmental Quality Act (CEQA) Guidelines and Section 7 of the County's "CEQA Regulations Guidelines for the Implementation of CEQA, as amended", 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 applications will not result in any potentially significant environmental impacts and therefore, a Negative Declaration is deemed as the appropriate document to provide necessary environmental evaluations and clearance as identified hereinafter.

This Initial Study and Negative Declaration are prepared in conformance with the California Environmental Quality Act of 1970, as amended (Public Resources Code, Section 21000 et. seq.); Section 15070 of the State & County of Imperial's Guidelines for Implementation of the California Environmental Quality Act of 1970, as amended (California Code of Regulations, Title 14, Chapter 3, Section 15000, et. seq.); 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 Guidelines for Implementing 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 AND NEGATIVE DECLARATION

This Initial Study and Negative Declaration are informational documents which are 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 and Negative Declaration, prepared for the project will be circulated for a period of 20 days (*30-days if submitted to the State Clearinghouse for a project of area-wide significance*) for public and agency review and comments. At the conclusion, if comments are received, the County Planning & Development Services Department will prepare a document entitled "Responses to Comments" which will be forwarded to any commenting entity and be made part of the record within 10-days of any project consideration.

D. CONTENTS OF INITIAL STUDY & NEGATIVE DECLARATION

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 applications and those issue areas that would have either a significant impact, potentially significant impact, or no impact.

PROJECT SUMMARY, LOCATION AND EVIRONMENTAL SETTINGS describes the proposed project 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.

IV. PERSONS AND ORGANIZATIONS CONSULTED identifies those persons consulted and involved in preparation of this Initial Study and Negative Declaration.

V. REFERENCES lists bibliographical materials used in preparation of this document.

VI. NEGATIVE DECLARATION – COUNTY OF IMPERIAL

VII. FINDINGS

SECTION 4

VIII. RESPONSE TO COMMENTS (IF ANY)

IX. MITIGATION MONITORING & REPORTING PROGRAM (MMRP) (IF ANY)

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 applications.
2. **Less Than Significant Impact:** The proposed applications 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 applications 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 and Negative Declaration 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 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. <u>**Tiered Documents**</u>

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]). This document incorporates by reference appropriate information from the "Final Environmental Impact Report and Environmental Assessment for the "County of Imperial General Plan EIR" prepared by Brian F. Mooney Associates in 1993 and updates.

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 and updates are 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.

- The material to be incorporated in this document will include general background information (CEQA Guidelines Section 15150[f]). This has been previously discussed in this document.

Appendices

Appendix A - Site Photographs
Appendix B - Biological Resources Clearance Memorandum
Appendix C - Water Quality Management Plan
Appendix D - Geo-technical Site Conditions Memorandum and Technical Report
Appendix E - Air Emissions Memorandum
Appendix F - Isopentane Hazard Assessment
Appendix G - Imperial County Reclamation Plan Application

Figures

Figure 1 - Location of Heber 2 Geothermal Power Plant .... **Error! Bookmark not defined.**
Figure 2 – Proposed and Existing Facilities .... **Error! Bookmark not defined.**
Figure 3 – Facility Integration Diagram ....
Figure 4 – Example of Proposed ORMAT Energy Converters ....
Figure 5 – Example of Proposed Above Ground Storage Tank (10,000 gallon)........
Figure 6 – Photo of Project Site (June 13, 2019) ....

II. Environmental Checklist

1. **Project Title:** Heber 2 Geothermal Repower Project

2. **Lead Agency**: Imperial County Planning & Development Services Department

3. **Contact person and phone number**: David Black, Planner IV, (442)265-1736

4. **Address**: 801 Main Street, El Centro CA, 92243

5. **E-mail**: davidblack@co.imperial.ca.us

6. **Project location**: APN 054-250-031-000; 855 Dogwood Road, Heber, CA 92249. See Exhibit A and B.

7. **Project sponsor's name and address**: Second Imperial Geothermal Company; 6140 Plumas St., Reno, NV 89519

8. **General Plan designation**: Heber SPA area

9. **Zoning**: A-2-G-SPA, General Agriculture (A-2), Geothermal Overlay Zone (G), and in the Heber Specific Plan Area (SPA)

10. **Description of project**: Perform CUP amendment to allow for installation of two new water-cooled ORMAT Energy Converters (OECs) to replace six old units from 1992; three 10,000 gallon isopentane above ground storage tanks; and, additional pipes to connect the proposed facilities with the existing Heber 2 Geothermal Energy Complex. All proposed facilities would be developed within the existing Heber 2 Complex and fence line. The total project disturbance from developing the new facilities is approximately 4 acres. The CUP amendment application also proposes to renew the permitted life of the entire Heber 2 Complex (including the Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049). The proposed facility upgrades would allow the Heber 2 Complex to run more efficiently and refurbish the Heber 2 Complex to the original nameplate capacity (33 megawatts) without expanding the existing facility beyond the current footprint, and produce clean renewable energy in the Imperial Valley for the next three decades.

11. **Surrounding land uses and setting**: Briefly describe the project's surroundings: Surrounding land uses include a solar energy facility to the west of the Project Site, a commercial aggregate/rock supplier to the south, and agriculture to the north and east. The primary use in the general surrounding area is agriculture. The closest residences to the Project Site are in the town of Heber, approximately 3,500 feet to the northeast of the Heber 2 Complex.

12. **Other public agencies whose approval is required** (e.g., permits, financing approval, or participation agreement.): None

13. **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 confidentially, etc.?**

Note: Conducting consultation early in the CEQA process allows tribal governments, lead agencies, and project proponents to discuss the level of environmental review, identify and address potential adverse impacts to tribal cultural resources, and reduce the potential for delay and conflict in the environmental review process. (See Public Resources Code, Section 21080.3.2). Information may also be available from the California Native American Heritage Commission's Sacred Lands File per Public Resources Code, Section 5097.96 and the California Historical Resources Information System administered by the California Office of Historic Preservation. Please also note that Public Resources Code, Section 21082.3 (c) contains provisions specific to confidentiality.

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 (EEC) DETERMINATION

After Review of the Initial Study, the Environmental Evaluation Committee 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 WILDLIFE DE MINIMIS IMPACT FINDING: ☐ Yes ☐ No

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

Jim Minnick, Director of Planning/EEC Chairman

Date:

PROJECT SUMMARY

See attached Initial Study for additional information.

A. Project Location: The proposed development would occur entirely on the 39.99-acre Assessor's Parcel Number (APN) 054-250-031. This parcel also includes geothermal facilities for the Goulds 2 and Heber South projects. The address for the Heber 2 Complex is 855 Dogwood Road, Heber, CA 92249. The legal description is Tract 44, Township 16 South, Range 14 East, SBB&M. See Exhibit A and B.

B. Project Summary: Install two new water-cooled ORMAT Energy Converters (OECs) to replace six old units from 1992; install three 10,000 gallon isopentane above ground storage tanks; and, additional pipes to connect the proposed facilities with the existing Heber 2 Geothermal Energy Complex. All proposed facilities will be developed within the existing Heber 2 Complex and fence line. The total project disturbance from developing the new facilities is approximately 4 acres. The CUP amendment application also proposes to renew the permitted life of the entire Heber 2 Complex (including the Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049). The proposed facility upgrades would allow the Heber 2 Complex to run more efficiently and refurbish the Heber 2 Complex to the original nameplate capacity **(33 megawatts)** without expanding the existing facility beyond the current footprint, and produce clean renewable energy in the Imperial Valley for the next three decades.

C. Environmental Setting:
Within the existing Heber 2 Complex, the Project Site is vacant of any vegetation or topographic features, consisting of exposed gravel and/or soil. No wetlands or jurisdictional waters are located on the Project Site. The closest jurisdictional water is the New River, located approximately 1.3 miles to the southwest of the Project Site, across Willoughby Road. The Project Site is not suitable habitat for any sensitive species.

D. Analysis: Taking into account the numerous voluntary environmental protection measures proposed by the Applicant, the Project is not expected to result in any significant effects. All impacts in the Initial Study were identified to be Less Than Significant or No Impact, primarily due to the fully developed nature of the Project Site as an existing geothermal energy complex. Therefore, no additional mitigation measures were prescribed.

E. General Plan Consistency: The proposed Project is consistent with the General Plan, located within the geothermal energy overlay zone allowing for major geothermal projects. All proposed developments would occur within the fence-line of the existing Heber 2 Geothermal Energy Complex and not increase the footprint on the energy facility. Construction activities and facility operations would be performed in line with the elements of the General Plan (Land Use; Housing; Circulation and Scenic Highways; Noise; Seismic and Public Safety; Conservation and Open Space; Agricultural; Geothermal and Transmission; Water).

Exhibit "A"
Vicinity Map
Figure 1

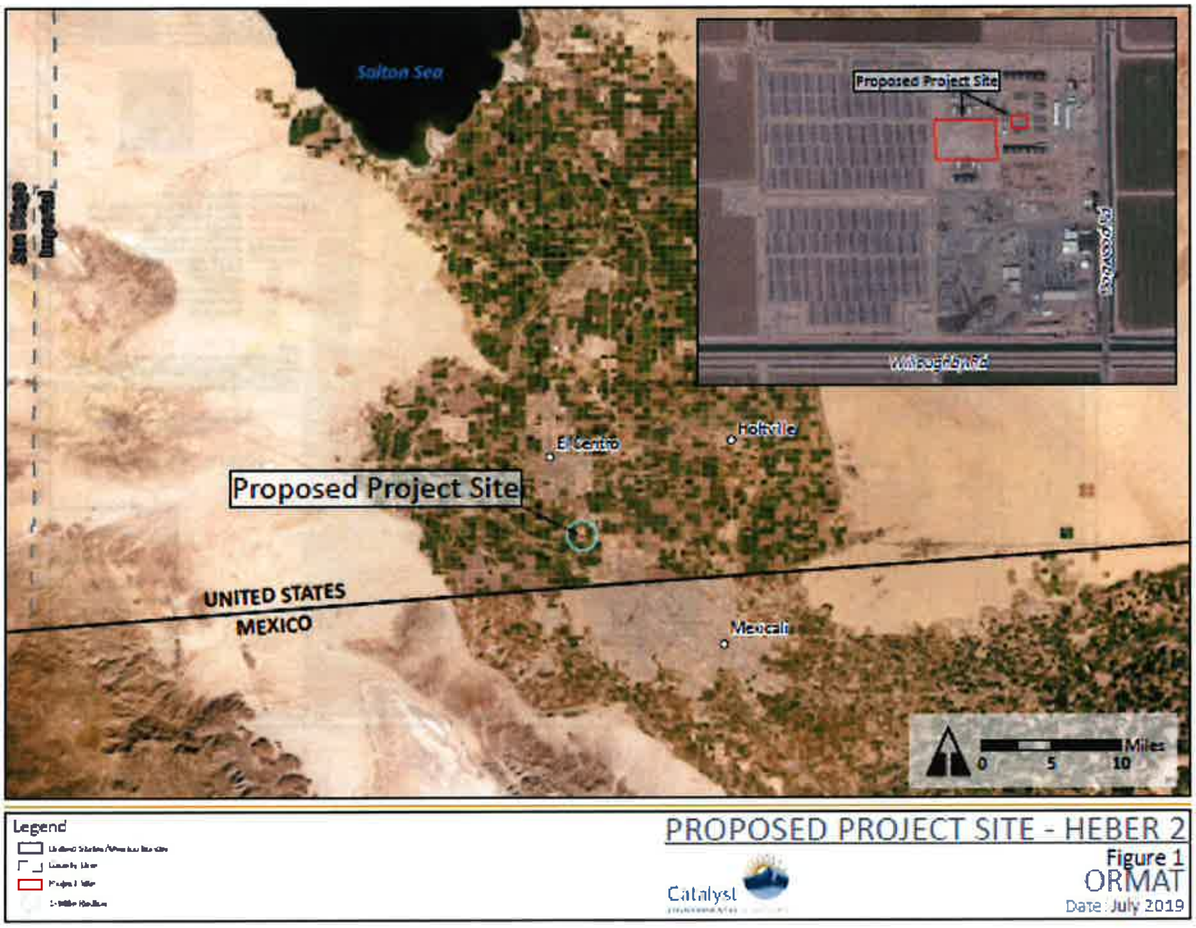


Exhibit "B"
Site Plan
Figure 2

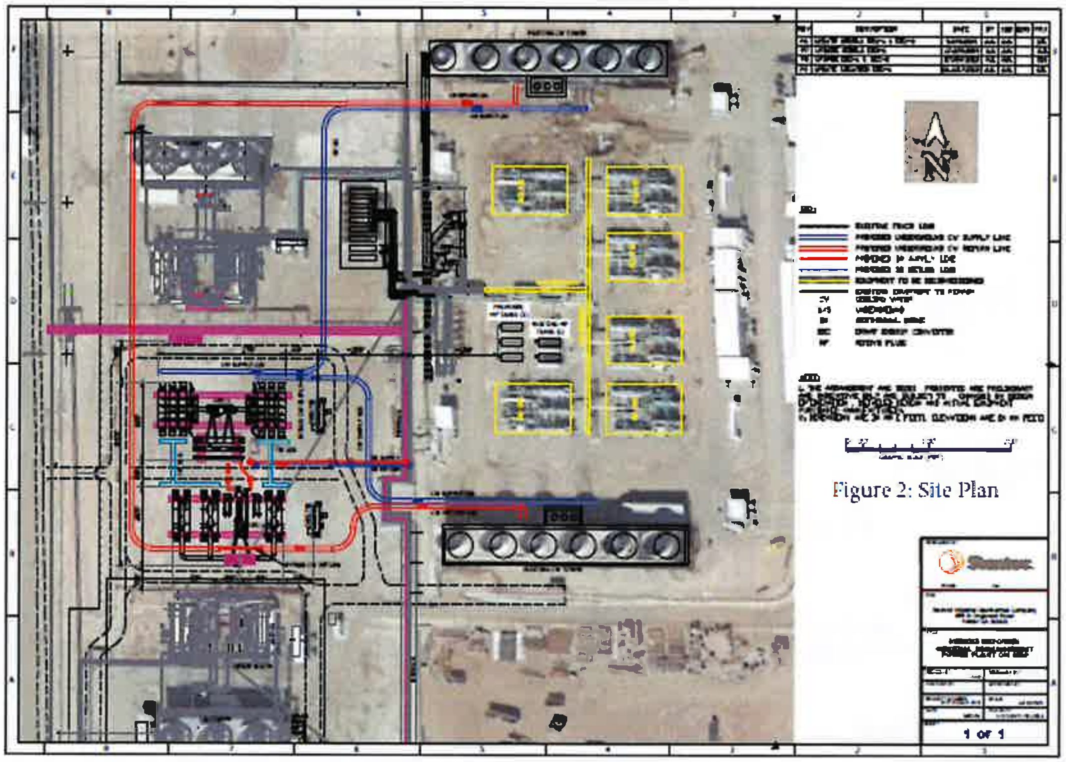


Figure 2: Site Plan

Figure 4- Example of Proposed ORMAT Energy Converters

Figure 5 Example of Proposed Above Ground Storage Tank (10,000 gallon)

Figure 6- Photo of Project Site (June 13, 2019)

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

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

I. *AESTHETICS*

Except as provided in Public Resources Code Section 21099, would the project:

	PSI	PSUMI	LTSI	NI
a) Have a substantial adverse effect on a scenic vista or scenic highway?	☐	☐	☐	☒

a) No Impact. No scenic vistas or scenic highways are present on or in the vicinity of the Project Site; therefore, no impacts would occur to these aesthetic resources.

	PSI	PSUMI	LTSI	NI
b) Substantially damage scenic resources, including, but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒

b) No Impact. The Project would be developed within an existing power plant, on undeveloped lands with no scenic characteristics (i.e., site lacks vegetation, topography, or buildings), and no state scenic highways exist in the vicinity of the Project Site. Therefore, the Project would not impact any scenic resources.

	PSI	PSUMI	LTSI	NI
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surrounding? (Public views are those that are experienced from publicly accessible vantage point.) If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☐	☐	☒	☐

c) Less Than Significant. During the construction phase, a crane may be visible to travelers on Dogwood Road or in the vicinity of the Project Site. However, crane use is anticipated to be temporary (less than eight months) and would be removed from the Project Site after construction of the proposed facilities is complete.

The Project will be developed within an existing power plant, and the proposed facilities would blend in with the existing energy facilities. The proposed facilities would render no noticeable changes to the Heber 2 site/plant to travelers on Dogwood Road or in the vicinity of the Project Site. The Imperial County General/Zoning Plan allows for "Major Geothermal" projects on the Project Site and, taking into account the existing power plant, the Project would not impact the visual character of the site or its surroundings.

	PSI	PSUMI	LTSI	NI
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

d) No Impact. The Project would not introduce any new light sources to the Project Site or surrounding area. Lighting is present at the Heber 2 Complex, but no additional lighting is proposed as part of the Project.

II. *AGRICULTURE AND FOREST RESOURCES*

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:

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

a) No Impact. The Project Site is presently used for geothermal energy operations and is uncultivated. No Prime, Unique, or Important farmlands are present on the Project Site (DOC 2016). No land use or farmland conversion would occur as result of the

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

Project.

b)	Conflict with existing zoning for agricultural use, or a Williamson Act Contract?	☐	☐	☐	☒

b) No Impact. The Project Site is zoned for agriculture and geothermal energy projects, and the Project does not conflict with Imperial County's General/Zoning Plan. The Project Site is not subject to 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))?	☐	☐	☐	☒

c) No Impact. The Project site is not zoned for, nor does it contain, forest land or timber land. As such, the Project would not impact forest or timberlands.

d)	Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒

d) No Impact. The Project site does not contain any forest land and would not convert any forest lands; therefore, the Project would not impact forest lands.

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?	☐	☐	☐	☒

e) No Impact. There is no farmland or forest land present on the Project Site, which is used for ongoing geothermal energy generation (DOC 2016). The proposed facilities would be constructed within the existing power plant site and no offsite disturbances would occur; therefore, no conversion of farmland or forest land would occur as result of the Project.

III. *AIR QUALITY*

Where available, the significance criteria established by the applicable air quality management district or air pollution control district may be relied upon to the following determinations. Would the Project:

a)	Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☒	☐

a) Less Than Significant. The Project Site is located within the ICAPCD, and the Heber 2 Complex has an existing Permit to Operate (PTO) issued by ICAPCD. Emissions of criteria pollutants, which are limited to fugitive releases of isopentane, a volatile organic compound (VOC), are monitored at the Heber 2 Complex. Modeling was performed to forecast the amount of potential isopentane emissions (Appendix **F)** to evaluate a potential significant exceedance of the limits established in the Imperial County CEQA Air Quality Handbook.

Current isopentane emissions at the Heber 2 Complex are approximately 117.5 lbs/day, and the modeled future emissions with the new facilities are estimated to be 64.5 lbs/day (**Table 2**). Under the existing PTO, the Heber 2 Complex is authorized to emit between 137 and 218 lbs/day of isopentane (dependent on time of year). The expected change in isopentane emissions with the new facilities would decline by approximately 53 lbs/day or 3.1 tons/year, which is significantly less than the existing emissions profile of the Heber 2 Complex and well under the authorized release amount. SIGC is applying to ICAPCD for a new PTO with reduced emissions thresholds to 137 to 202 lbs/day. Therefore, considering the emissions reduction from the new facilities, the Project would not conflict with or obstruct the implementation of the ICAPCD air quality plan.

Table Existing and Modeled Future Isopentane Emissions

Heber 2 Complex Total Emissions

Isopentane Emissions	lbs / day	tons / year
Actual Emissions (2017 – 2018)	117.5	14.9
Estimated Potential Future Emissions	64.5	11.8
Emissions Increase	-52.9	-3.1
Permit Limit (varies)	137 - 218	

		PSI	PSUMI	LTSI	NI
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?	☐	☐	☒	☐

b) Less Than Significant. The Project would not violate any air quality standards or plan. The Heber 2

Complex has a PTO from the ICAPCD, which specifies the amount of isopentane, a VOC, authorized for release. The Heber 2 Complex is permitted to release between 137 and 218 lbs/day, depending on time of year. As noted in **Table 2** above, isopentane emissions with the new facilities are expected to decrease approximately 53 lbs/day, for a total of 64.5 lbs/day. SIGC is applying to ICAPCD for a new PTO with reduced emissions thresholds to 137 to 202 lbs/day. Therefore, considering the emissions reduction from the new facilities, the Project would not violate the existing PTO or contribute to an existing air quality violation.

Emissions from construction equipment would be temporary and not exceed any air quality thresholds or significantly contribute to an existing regional nonattainment condition (i.e. particulate matter, ozone). As described in Section 2.1.7, air quality measures would be implemented during construction of the proposed facilities to minimize the potential for fugitive dust and particulate matter releases. All air quality control measures would be in line with the Imperial County 2018 PM_{10} Plan and Imperial County 2018 $PM_{2.5}$ Plan. Through the application of these measures, the construction of the Project would limit visible dust emissions and particulate matter emissions to 20 percent opacity and/or 150 lbs/day, and therefore, be in compliance with Imperial County's approach to minimizing these construction-related emissions.

		PSI	PSUMI	LTSI	NI
c)	Expose sensitive receptors to substantial pollutants concentrations?	☐	☐	☒	☐

c) Less Than Significant. Significant adverse cumulative air quality impacts could occur if the proposed Project resulted in a cumulatively considerable net increase of a criteria pollutant for which ICAPCD exceeds federal and state ambient air quality standards and has been designated as an area of non- attainment by the USEPA and/or CARB. The ICAPCD is a non-attainment area for ozone and fine particulate matter.

To determine whether air quality impacts from a proposed project are significant, the project's potential contribution to cumulative impacts would be assessed utilizing the same significance criteria as for project-specific impacts. Therefore, if an individual project generates construction or operational emissions that exceed the ICAPCD's recommended daily thresholds for project-specific impacts, that project would also cause a cumulatively considerable increase in emissions for those pollutants for which the ICAPCD is in nonattainment and therefore, would be considered to have significant adverse cumulative air quality impacts.

As discussed in Section 2.1.7, air quality measures would be implemented during construction of the proposed facilities to minimize the potential for fugitive dust and particulate matter releases. All air quality control measures would be in line with the Imperial County 2018 PM_{10} Plan and Imperial County 2018 $PM_{2.5}$ Plan. Through the application of these measures, the construction of the Project would limit visible dust emissions and particulate matter emissions to 20 percent opacity and/or 150 lbs/day, and therefore, be in compliance with Imperial County's approach to minimizing these construction-related emissions. Ozone, which is formed by a complex series of chemical reactions and the precursors of which stem from the use of fuel-combusting equipment (e.g., backhoes, trucks), would also be limited to the construction phase of the Project. To limit the amount ozone emissions from construction equipment, vehicles and equipment would be turned off when not in use and not left idling to minimize unnecessary emissions. The temporary and relatively low amount of ozone emissions from the construction equipment would result in a less than significant cumulative effect to the existing nonattainment statusof the ICAPCD.

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)
d) Result in other emissions (such as those leading to odors adversely affecting a substantial number of people?	☐	☐	☒	☐

d) Less Than Significant. Land uses that are considered more sensitive to changes in air quality than others are referred to as sensitive receptors. Land uses such as primary and secondary schools, hospitals, and convalescent homes are sensitive to poor air quality because the very young, the old, and the infirm are more susceptible to respiratory infections and other air quality-related health problems than the general public. Residential uses are considered sensitive because people in residential areas are often at home for extended periods of time, so they could be exposed to pollutants for extended periods. Recreational areas are considered moderately sensitive to poor air quality because vigorous exercise associated with recreation places a high demand on the human respiratory function.

The nearest sensitive receptors to the Project Site are the residences approximately 3,500 feet to the northeast of the Project Site. As discussed in **Appendix F**, air emissions from the Heber 2 Complex would be limited to isopentane, which is a VOC. The Heber 2 Complex is permitted to release between 137 and 218 lbs/day, depending on time of year. Isopentane emissions with the new facilities are estimated to decrease by approximately 53 lbs/day of isopentane, representing approximately a 54 percent decrease from current emissions and well below permitted limits (**Table 2**).The Project would not exceed the release limits established in the PTO, which are health-based; therefore, the Project would not expose any sensitive receptors to a significant exposure of pollutant concentrations.

Isopentane has a petroleum-like odor; however as noted previously, the Project would result in a decrease of approximately 53 lbs/day of isopentane, representing approximately a 54 percent decrease from current emissions and well below permitted limits (Table 2). Utilizing the existing Heber 2 power generation infrastructure, the additional facilities will not produce a significant odor. No odor complaints have ever been filed against the Heber 2 facilities and the existing facilities are not a significant source of odor. Further, the Project Site is located in an agrarian area that is not densely populated. The closest residences are located 3,500 feet to the northeast of the Project Site. During construction, diesel emissions from construction equipment may be sources of odor. These emissions would be temporary and minimal based on the small number of heavy vehicles that would be required for Project construction. Therefore, Project-related odors would be limited to the temporary construction phase and would not result in a significant source of odor to a substantial number of people.

IV. ***BIOLOGICAL RESOURCES*** ***Would the project:***

	PSI	PSUMI	LTSI	NI
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 Wildlife or U.S. Fish and Wildlife Service?	☐	☐	☐	☒

a) No Impact. The potential for sensitive species to occur on or in the vicinity of the Project Site was evaluated using information from the U.S. Fish and Wildlife (USFWS) Information, Planning, and Consultation System (IPaC System); California Natural Diversity Database (CNDDB); and California Native Plant Society (CNPS) Rare Plant Program.

No federally listed threatened or endangered plant species have the potential to occur on or near the project site (USFWS 2019a). Five plant species listed by the CNPS have the potential to occur in the Heber quadrangle (CNPS 2019):

- Watson's amaranth (*Amaranthus watsonii*)
- Abrams' spurge (*Euphorbia abramsiana*)
- California satintail (*Imperata brevifolia*)
- ribbed cryptantha (*Johnstonella costata*)
- winged cryptantha (*Johnstonella holoptera*)

No federally listed threatened or endangered wildlife species have the potential to occur on the Project Site and no critical habitat exists on or near the Project Site (USFWS 2019a, b). No California special status species are known to occur on the Project Site (CDFW 2019).

The following six migratory bird species are listed by IPaC as having the potential to occur in the vicinity of the Project Site:

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

- Burrowing owl (*Athene cunicularia*)
- Costa's hummingbird (*Calypte costae*)
- Gila woodpecker (*Melanerpes uropygialis*)
- Long-billed curlew (*Numenius americanus*)
- Rufous hummingbird (*Selasphorus rufus*)
- Whimbrel (*Numenius phaeopus*)

Considering the Project Site is completely devoid of any vegetation or water resources, the proposed disturbance area is not suitable habitat for any of the sensitive species identified above. Further, the Project Site is not designated by Imperial County for native habitat or conservation. Therefore, no impacts to species or habitat would occur as result of the Project. Additionally, as proposed as an Environmental Protection Measure, SIGC will perform a pre-construction survey to verify the absence of any sensitive species (i.e. burrowing owl).

	PSI	PSUMI	LTSI	NI
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☐	☐	☐	☒

b) No Impact. As discussed in Section 3.1.4, no water resources or sensitive communities are present on or near the Project Site (see Figure 6 above and Appendix A). Neither construction nor operation of the proposed facilities would create any substantially adverse offsite impacts. Therefore, no impacts to riparian habitat or sensitive natural communities would occur as a result of the Project.

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

c) No Impact. As discussed in Section 3.1.4, no wetlands or water resources are present on the Project Site; therefore, no impacts to wetland, riparian resources, or jurisdictional waters would occur as result of the Project.

	PSI	PSUMI	LTSI	NI
d) Would the project interfere substantially with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒

d) No Impact. The existing Heber 2 Complex site is entirely fenced for security purposes, precluding wildlife from using the site as habitat or for migration. Further, the Project Site is entirely devoid of vegetation or water features that could be used as suitable resident or migratory habitat. Therefore, the development of the proposed facilities within the existing plant site would not remove suitable wildlife habitat or migratory corridor/connectivity, nor would the facilities impede the use of nursery sites.

	PSI	PSUMI	LTSI	NI
e) Conflict with any local policies or ordinance protecting biological resource, such as a tree preservation policy or ordinance?	☐	☐	☐	☒

e) No Impact. No local policies or ordinances protecting biological resources, including the Fish and Game Natural Areas established in the Imperial County General Plan, pertain to the Project Site. Further, the Project Site is completely devoid of any vegetation or water resources that could serve as suitable habitat for trees or wildlife. Therefore, no impacts to any local policies/ordinances would be impacted by the Project.

	PSI	PSUMI	LTSI	NI
f) Conflict with the provisions of an adopted Habitat	☐	☐	☐	☒

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?

f) No Impact. There are no HCPs or similar conservation areas/plans for the Project Site or its vicinity. Therefore, the Project would not impacted any HCPs or other conservation plans.

V. *CULTURAL RESOURCES* *Would the project:*

		PSI	PSUMI	LTSI	NI
a)	Cause a substantial adverse change in the significance of a historical resource pursuant to §15064.5?	☐	☐	☐	☒

a) No Impact. A records search of the California Historical Resources Information System (CHRIS), which is managed by the California Office of Historic Preservation (OHP), for previous cultural and historic resource surveys previously performed on/near the Project Site was performed did not identify any recorded historical resources on the Project Site or immediate vicinity (Appendix C). Further, there are no buildings or structures present on the Project Site. Therefore, the Project would not result in any impacts to historical resources.

		PSI	PSUMI	LTSI	NI
b)	Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒

b) No Impact. The CHRIS records search did not identify any recorded cultural or archaeological resources on the Project Site or immediate vicinity (Appendix C). Considering that the Project Site was completely disturbed when the Heber 2 Complex was constructed, the probability of encountering an unforeseen/buried resource is very low. As discussed in Section 2.1.8 above, Project construction personnel would monitor areas during surface disturbing activities and if any potential cultural or archaeological resources are encountered, all construction affecting the discovery site would be suspended immediately until a qualified archaeologist has reviewed the findings. An Unanticipated Discoveries Plan would be prepared prior to resuming construction. Therefore, the Project is anticipated to result in no significant effects to archaeological or cultural resources.

		PSI	PSUMI	LTSI	NI
c)	Disturb any human remains, including those interred outside of dedicated cemeteries?	☐	☐	☒	☐

c) Less Than Significant. Considering that the Project Site was completely disturbed when the Heber 2 power plant was constructed, the probability of encountering unforeseen/buried human remains is very low. As discussed in Section 2.1.8 above, Project construction personnel would monitor areas during surface disturbing activities and if any potential cultural or archaeological resources are encountered, all construction affecting the discovery site would be suspended immediately until a qualified archaeologist has reviewed the findings. An Unanticipated Discoveries Plan would be prepared prior to resuming construction. Therefore, the Project is anticipated to result in no or less than significant effects to human remains.

VI. *ENERGY* *Would the project:*

		PSI	PSUMI	LTSI	NI
a)	Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☐	☒

a) No Impact: The proposed facility upgrades would allow the Heber 2 Complex to run more efficiently and refurbish the Heber 2 Complex to the original nameplate capacity (33 megawatts) without expanding the existing facility beyond the current footprint, and produce clean renewable energy in the Imperial Valley for the next three decades.

		PSI	PSUMI	LTSI	NI
b)	Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☐	☒

b) No Impact: The Project would allow for the continued operation of a permitted major geothermal energy power plant that utilizes the geothermal energy zone established by Imperial County. The proposed facilities would not increase the use of the geothermal resource/reservoir, rather allow the existing Heber 2 Complex to operate more efficiently and return its nameplate energy generation capacity to 33 MW. The Heber 2 Complex has been producing renewable energy since 1992 and the proposed facilities would allow for that to be extended until 2049, assisting with meeting the state mandates for renewable energy and reducing greenhouse gas emissions.

VII. *GEOLOGY AND SOILS* ***Would the project:***

	PSI	PSUMI	LTSI	NI
a) Directly or indirectly cause potential substantial adverse effects, including risk of loss, injury, or death involving:	☐	☐	☒	☐

Less Than Significant. As discussed in Section 3.1.2, the Imperial Valley is seismically active and contains numerous active faults (ICPDS 2015). A formal geotechnical investigation of the Project Site's soil characteristics, seismic conditions, storm-water infiltration, site stability, and potential for liquefaction was conducted. A summary memorandum and full technical report are attached as **Appendix E.** A computer-aided search assessed known faults and seismic zones within 36 miles of the Project Site. The Imperial Fault located 9.4 miles southwest of the Project Site was the closest mapped Earthquake Fault Zone. The Project Site is not located in an established fault zone as identified by the Alquist-Priolo Earthquake Fault Zoning Maps (Bryant 2007). In the event of an earthquake, seismic ground-shaking could be experienced in the vicinity of the Project Site, as is typical throughout Southern California. The Project Site is not located in a landslide zone. The Project Site is not located in a potential seiche, tsunami, or mudflow zone.

No deep subsurface activities (i.e. deeper than 6 feet) are proposed as part of the Project; thus, no ruptures to faults or fissures would occur as a result of the Project. Seismic ground-shaking and seismically induced liquefaction could result in structural damage to power plant infrastructure and facilities. However, the Project does not involve any infrastructure or facilities that would include human occupancy, and the risk of injury at the Project Site associated with ground-shaking, landslides, tsunami/seiche or liquefaction is very low. Therefore, impacts to people or structures from the Project would be less than significant.

	PSI	PSUMI	LTSI	NI
1) 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?	☐	☐	☒	☐

1) Less an Significant. As discussed in Section 3.1.2, the Imperial Valley is seismically active and contains numerous active faults (ICPDS 2015). A formal geotechnical investigation of the Project Site's soil characteristics, seismic conditions, storm-water infiltration, site stability, and potential for liquefaction was conducted. A summary memorandum and full technical report are attached as Appendix E. A computer-aided search assessed known faults and seismic zones within 36 miles of the Project Site. The Imperial Fault located 9.4 miles southwest of the Project Site was the closest mapped Earthquake Fault Zone. The Project Site is not located in an established fault zone as identified by the Alquist-Priolo Earthquake Fault Zoning Maps (Bryant 2007). In the event of an earthquake, seismic ground-shaking could be experienced in the vicinity of the Project Site, as is typical throughout Southern California. The Project Site is not located in a landslide zone. The Project Site is not located in a potential seiche, tsunami, or mudflow zone.

No deep subsurface activities (i.e. deeper than 6 feet) are proposed as part of the Project; thus, no ruptures to faults or fissures would occur as a result of the Project. Seismic ground-shaking and seismically induced liquefaction could result in structural damage to power plant infrastructure and facilities. However, the Project does not involve any infrastructure or facilities that would include human occupancy, and the risk of injury at the Project Site associated with ground-shaking, landslides, tsunami/seiche or liquefaction is very low. Therefore, impacts to people or structures from the Project would be less than significant.

	PSI	PSUMI	LTSI	NI
2) Strong Seismic ground shaking? **2) Less than Significant** (see above a)	☐	☐	☒	☐
3) Seismic-related ground failure, including liquefaction and seiche/tsunami? **3) Less than Significant** (see above a)	☐	☐	☒	☐
4) Landslides? **4) Less than Significant** (see above a)	☐	☐	☒	☐

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐

b) Less Than Significant. Minor excavation and compaction activities would occur to prepare the appropriate bases for the OEC units and the ABSTs. The Project Site is an active geothermal energy station and does not contain high-value topsoil. Any soils excavated for site preparation would be backfilled to the excavation areas, assuming that these soils are free of debris. No pervious surfaces would be created as part of the Project, and storm-water would be allowed to infiltrate on bare soils, which represent the current conditions. Therefore, less than significant soil impacts are anticipated to occur as result of the Project.

	PSI	PSUMI	LTSI	NI
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 landslides, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒

c) No Impact. Development of the proposed facilities would not result in the destabilization of any soils or geologic units that could cause a landslide, subsidence, or liquefaction. The primary soil unit present on the Project Site is dry silty clays, which are not expansive or unstable soils (Olive, 1989). Therefore, no impacts on unstable soils or geologic units would occur due to the Project.

	PSI	PSUMI	LTSI	NI
d) Be located on expansive soil, as defined in the latest Uniform Building Code, creating substantial direct or indirect risk to life or property?	☐	☐	☐	☒

d) No Impact. Development of the proposed facilities would not result in the destabilization of any soils or geologic units that could cause a landslide, subsidence, or liquefaction. The primary soil unit present on the Project Site is dry silty clays, which are not expansive or unstable soils (Olive, 1989). Therefore, no impacts on unstable soils or geologic units would occur from the Project.

	PSI	PSUMI	LTSI	NI
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒

e) No Impact. The Project does not include any septic tanks or wastewater disposal systems; thus, no impact to soils from wastewater systems/management would occur as a result of the Project.

	PSI	PSUMI	LTSI	NI
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐

f) Less Than Significant. Considering that the Project Site was completely disturbed when the Heber 2 power plant was constructed, the probability of encountering an unforeseen/buried human remains is very low. As discussed in Section 2.1.8 above, Project construction personnel would monitor areas during surface disturbing activities and if any potential cultural or archaeological resources are encountered, all construction affecting the discovery site would be suspended immediately until a qualified archaeologist has reviewed the findings. An Unanticipated Discoveries Plan would be prepared prior to resuming construction. Therefore, the Project is anticipated to result in no or less than significant effects to human remains.

VIII. *GREENHOUSE GAS EMISSION* ***Would the project:***

	PSI	PSUMI	LTSI	NI
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐

a) Less Than Significant. The construction of the Project involves diesel- and gasoline-fueled equipment, such as trucks, excavators, and powered hand tools. These tools emit greenhouse gases, but these emissions would be minor, temporary (approximately eight months), and well under the 10,000 CO_2e lb/day threshold established by AB 32.

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

Greenhouse gas emissions from the Heber 2 Complex after the new facilities are developed would not increase. Therefore, greenhouse gas emissions as result of the Project would be less than significant.

	PSI	PSUMI	LTSI	NI
b) Conflict with an applicable plan or policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

b) Less Than Significant. The Project would not contribute a significant amount of greenhouse gases, with most being emitted during the temporary construction phase. Long-term emissions from the Heber 2 Complex would remain the same or very similar to the existing emissions profile. Therefore, less than significant impacts to any greenhouse gas reduction plans, policy, or regulations would be caused, and only during Project construction.

IX. ***HAZARDS AND HAZARDOUS MATERIALS*** ***Would the project:***

	PSI	PSUMI	LTSI	NI
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐

a) Less than Significant. The Project would utilize isopentane as the motive fluid to generate energy from the geothermal resource/fluids. The Project proposes to install three additional 10,000-gallon ABSTs for additional isopentane storage/use. Isopentane is a regulated substance by the USEPA. The Heber 2 Complex is classified as Prevention Program 3 and is regulated by USEPA's Risk Management Program for Chemical Accidental Release Prevention (40 CFR 68.20-68.42) because isopentane is stored on site in excess of 10,000 lbs. Isopentane would be delivered to the Project Site by a licensed commercial transport company, in accordance with US DOT regulations for the transport of dangerous goods.

A Hazard Assessment (HA) was prepared to assess the potential effects and risks of the additional isopentane storage/use by the Project (**Appendix G**). The HA analyzed the isopentane storage/use by identifying the worst-case scenarios and endpoints of concern (as defined by EPA RMP and 40 CFR 68.22) including the following:

- Explosion (an overpressure of 1 psi)
- Radiant Heat/Exposure Time (a radiant heat of 5 kW/m^2 for 40 seconds)
- Lower Flammability Limit (as provided by NFPA)

Using these criteria, the HA assessed the worst-case scenario of a catastrophic failure of one of the three new 10,000-gallon isopentane tanks. As modeled in the HA, the worst-case scenario event would have an impact up to 0.3 miles, or 1,584 feet. The closest potentially affected public are the residences approximately 3,500 feet to the northeast of the isopentane tanks. Therefore, the public or environment would not be exposed to a significant hazard through the Project's use/storage/transport of isopentane.

A certified fire protection engineer survey and analysis of current and proposed fire suppression and detection equipment will be performed to evaluate the current systems performance and coverage of protection prior to construction. This analysis will evaluate proposed fire suppression and detection equipment in conjunction with existing equipment and be reviewed and approved by the Fire Department and OES prior to building permits approval. Isopentane leak or fire will require a large scale evacuation area and create a large scale hazardous material incident with a large operational zone.To minimize potential extremely dangerous condition to firefighters and hazardous material teams Imperial County Fire Department is requiring that a Drone be purchase for Imperial County Fire Department. The final cost, details, and equipment of the drone shall be determined prior the issuance of the building permit. Additionally, the following requirements will be conditioned in the proposed Conditional Use Permit. The drone usage will help reduce required monitoring and compliance impacts to a level of less than significant.

- All isopentane above ground storage tanks will be protected by approved automatic fire suppression equipment. All automatic fire suppression will be installed and maintained to the current adapted fire code and regulation.
- An approved automatic fire detection system will be installed as per the California Fire Code. All fire detection systems will be installed and maintained to the current adapted fire code and regulations.
- Fire department access roads and gates will be in accordance with the current adapted fire code and the facility will maintain a Knox Box for access on site.
- Compliance with all required sections of the firecode.

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

- Applicant will provide product containment areas(s) for both product and water run-off in case of fire applications and retained for removal.

		PSI	PSUMI	LTSI	NI
b)	Create a significant hazard to the public or the environment through reasonable foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐

b) Less than Significant see above (a)

		PSI	PSUMI	LTSI	NI
c)	Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒

c) No Impact. There are no schools or sensitive receptors within a quarter-mile of the Project Site (Appendix G). The closest potential sensitive receptors are located approximately 3,500 feet to the northeast of the Project Site. Therefore, no impacts to schools or sensitive receptors from nominal isopentane releases/emissions would occur due to the Project.

		PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

d) No Impact. The Project Site is not located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, therefore, would not create a significant hazard to the public or environment.

		PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

e) No Impact. The Project Site is not located in an airport land use plan or within two miles of an active airport. Therefore, the Project would have no impact on ongoing or planned airport activities or people/employees.

		PSI	PSUMI	LTSI	NI
f)	Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒

f) No Impact. The proposed facilities would be located within the existing Heber 2 Complex site and would not interfere with any emergency response or evacuation plans. Construction equipment delivering large components of the proposed facilities may temporarily block Dogwood Road to ensure safe delivery of the components, but these blockages are expected to be temporary (i.e., 5 minutes) and not significantly impede traffic flow. Therefore, no impacts to emergency response or evacuation plans would occur as result of the Project.

		PSI	PSUMI	LTSI	NI
g)	Expose people or structures, either directly or indirectly, to a significant risk of loss, injury or death involving wildland fires?	☐	☐	☐	☒

g) No Impact. The Project Site is not located in areas considered wildlands, as the vast majority of the surrounding area is cultivated farmlands. The Project Site does not lie within a fire hazard zone and is not subject to risk of wildland fires (CalFire, 2007). Therefore, there would be no impact associated with risk from wildlands fire.

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

X. ***HYDROLOGY AND WATER QUALITY*** ***Would the project:***

	PSI	PSUMI	LTSI	NI
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☐	☐	☐	☒

a) No Impact. The proposed Project would not discharge any waste fluids or substances, nor violate any water quality standards; therefore, no impacts to water quality would occur as result of the Project.

	PSI	PSUMI	LTSI	NI
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☐	☒

b) No Impact. The proposed Project would not require additional groundwater/geothermal fluids. One production and two injection wells are present on the Heber 2 site and the quantity of injection fluid would remain the same under the Project. Therefore, no impacts to groundwater supplies would occur as result of the Project.

	PSI	PSUMI	LTSI	NI
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:	☐	☐	☒	☐

c) No Impact. The Project would not divert or alter any existing streams or canals on/near the Project Site. The Project would create less than 200 square feet of impervious surface to accommodate the proposed facilities. The remainder of the Project Site would be exposed dirt/gravel. Therefore, the Project would not increase storm-water runoff or result in on- or off-site flooding.

	PSI	PSUMI	LTSI	NI
(i) result in substantial erosion or siltation on- or off-site;	☐	☐	☒	☐

i) **Less Than Significant.** The Project would not divert or alter any existing streams or canals on/near the Project Site. The Project Site was graded during the original construction of the Heber 2 Complex in 1992 and site preparation activities would not significantly alter the existing grade of the Project Site. A Water Quality Management Plan (WQMP) prepared for the Project assesses potential effects to storm-water and provides recommendations and Best Management Practices (BMPs) to minimize potential erosion and siltation effects (**Appendix D**). Through the application of the WQMP, construction effects from site preparation would not result in a less than significant effect to existing drainage patterns.

	PSI	PSUMI	LTSI	NI
(ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;	☐	☐	☒	☒

ii) **Less Than Significant.** The Project would not divert or alter any existing streams or canals on/near the Project Site. The Project Site was graded during the original construction of the Heber 2 Complex in 1992 and site preparation activities would not significantly alter the existing grade of the Project Site. A Water Quality Management Plan (WQMP) prepared for the Project assesses potential effects to stormwater and provides recommendations and Best Management Practices (BMPs) to minimize potential erosion and siltation effects (**Appendix D**). Through the application of the WQMP, construction effects from site preparation would not result in a less than significant effect to existing drainage patterns.

	PSI	PSUMI	LTSI	NI
(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;	☐	☐	☒	☐

iii) **Less Than Significant.** The Project would not divert or alter any existing streams or canals on/near the Project Site. The Project Site was graded during the original construction of the Heber 2 Complex in 1992 and site preparation activities would not significantly alter the existing grade of the Project Site. A Water Quality Management Plan (WQMP) prepared for the Project assesses potential effects to stormwater and provides recommendations and Best Management Practices (BMPs) to minimize potential erosion and siltation effects (**Appendix D**). Through the application of the WQMP,

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)
construction effects from site preparation would not result in a less than significant effect to existing drainage patterns (iv) impede or redirect flood flows?	☐	☐	☒	☐

iv) **Less Than Significant.** The Project would not divert or alter any existing streams or canals on/near the Project Site. The Project Site was graded during the original construction of the Heber 2 Complex in 1992 and site preparation activities would not significantly alter the existing grade of the Project Site. A Water Quality Management Plan (WQMP) prepared for the Project assesses potential effects to stormwater and provides recommendations and Best Management Practices (BMPs) to minimize potential erosion and siltation effects (**Appendix D**). Through the application of the WQMP, construction effects from site preparation would not result in a less than significant effect to existing drainage patterns.

	PSI	PSUMI	LTSI	NI
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	☐	☐	☐	☒

d) No Impact. The Project Site is not located in a potential seiche, tsunami, or mudflow zone. Additionally, the Geotechnical Analysis (Appendix E) concludes that liquefaction would not occur at the Project Site due to the cohesive nature of the subsurface soils. Therefore, the Project would not expose any people or structures to a significant risk of loss, injury, or death involving a seiche, tsunami, or mudflow.

	PSI	PSUMI	LTSI	NI
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☐	☒

e) Less Than Significant. Construction of the proposed facilities would not significantly alter the existing stormwater drainage pattern or grade. The existing site condition is exposed soils and gravel, and after site preparation, this area would be returned to a soil/gravel surface. The Project would create less than 200 square feet of impervious surface to accommodate the proposed facilities. The remainder of the Project Site would be exposed dirt/gravel that follows the existing grade of the Site. Stormwater would be allowed to infiltrate and would follow the existing drainage patterns to the existing Heber 2 stormwater facilities. With less than 200 square feet of impervious surfaces being developed as part of the Project, the amount of stormwater to the existing basins would not increase. Therefore, the Project would cause a less than significant addition of stormwater to the existing stormwater infrastructure and would create a less than significant amount of stormwater pollution. The proposed facilities would not discharge any fluids or substances to surface waters; therefore, construction of the Project is the only phase during which water quality may be impacted. Construction activities would have the potential to expose site soils to erosion and mobilize sediments in stormwater. However, with the application of the WQMP (**Appendix D**), on- and off-site erosion and siltation impacts to water quality related to construction of the Project would be less than significant.

XI. *LAND USE AND PLANNING* *Would the project:*

	PSI	PSUMI	LTSI	NI
a) Physically divide an established community?	☐	☐	☐	☒

a) No Impact. As discussed in Section 3.1, the Project Site is zoned for major geothermal energy projects by Imperial County, and the Project is consistent with the standards and objectives set forth in the Imperial County Renewable Energy Plan. Therefore, the Project is consistent with the land use designations established by Imperial County and will not result in an incompatible land use. Furthermore, the closest residents are approximately 3,500 feet to the northeast to the Heber 2 site and would not experience a physical effect from the construction or operation of the proposed facilities.

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

b) No Impact. The Project Site is zoned as A-2-G-SPA, for General Agriculture (A-2), Geothermal Overlay Zone (G), and in the Heber Specific Plan Area (SPA). The Project site is entirely within the Imperial County Geothermal Overlay Zone. "Major Geothermal Projects" in the overlay zone are permitted through the CUP process, as was the original Heber 2 project. The Heber SPA is intended "to allow for commercial, residential, industrial, renewable energy and other employment oriented development in a mixed used orientation" (Land Use Element of the Imperial County General Plan, 2015). Therefore, the proposed Project conforms to the standards and goals set forth in the Imperial County General Plan and the Renewable Energy and Transmission Element of County of Imperial General Plan (2015) and would not result in an effect to land use/planning. No habitat conservation plans or natural community conservation plans are designate for the Project Site; therefore, the Project would not result in any impact to these plans or programs.

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

XII. ***MINERAL RESOURCES*** ***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?	☐	☐	☐	☒

a) No Impact. The Project would allow for the continued operation of a permitted major geothermal energy power plant that utilizes the geothermal energy zone established by Imperial County. The proposed facilities would not increase the use of the geothermal resource/reservoir, rather allow the existing Heber 2 Complex to operate more efficiently and return its nameplate energy generation capacity to 33 MW. The Heber 2 Complex has been producing renewable energy since 1992 and the proposed facilities would allow for that to be extended until 2049, assisting with meeting the state mandates for renewable energy and reducing greenhouse gas emissions. Therefore, the Project would result in no impacts to a known mineral resource.

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?	☐	☐	☐	☒

b) No Impact. The Project Site is zoned by Imperial County for major geothermal energy projects, and the Project is in conformance with this land use designation. The proposed facilities would not increase the use of the geothermal resource/reservoir, rather allow the existing Heber 2 Complex to operate more efficiently and return its nameplate energy generation capacity to 33 MW. The Project would not prohibit any additional development of geothermal energy facilities in Imperial County. Therefore, the Project would not result in the loss of availability of this unique local geothermal resource.

XIII. ***NOISE*** ***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?	☐	☐	☐	☒

a) No Impact. Per the Imperial County Noise Ordinance, the noise limit for the Project Site, which is considered an Industrial facility by the ordinance, is 75 decibels (one-hour average sound level) and allowed to operate 24 hours per day. The proposed facilities would not represent a significant new source of noise, as the OECs and storage tanks are fully contained units (see Figure 4 and Figure 5 above for pictures of the proposed facilities). Further, the new OEC units would replace dated equipment, and may result in a reduction in operational noise. Considering the Project is within the "normally acceptable" range established by Imperial County and the Project is not anticipated to increase noise emissions from the existing plant, the Project operation would result in a less than significant noise impact. Additionally, the closest receptors to facility noise are located approximately 3,500 feet to the northwest of the Project Site and well out of range from hearing the facility. The Heber 2 Complex has never received a noise complaint.

Construction activities would be limited to 7 a.m. to 7 p.m. Monday through Friday, and 9 a.m. to 5 p.m. on Saturday, per the Imperial County Noise Ordinance. During construction, noise emissions would be periodic and temporary, depending on the use of the heavy equipment (i.e., semi-truck trailers, flatbed trucks, excavators/bulldozers, and a crane). Smaller hand tools such as drills, compressors, and welding equipment would be used consistently during the construction phase (approximately eight months). Construction noise from the development of the proposed facilities would likely be drowned out from the existing noise conditions at the Heber 2 Complex, which is permitted to emit up to 75 decibels any time of the day (§90702.00 – Sound Level Limits). Further, there are no sensitive receptors in close proximity to the Heber 2 site, and the closest residence is over 3,500 feet away from the Project Site. Therefore, Project construction and operation would not expose of noise to people and would not exceed county noise ordinance levels.

b) Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐

b) Less Than Significant: The only phase of the Project that would generate vibration or ground-borne noise is the site preparation activities, which include minor excavation and compaction. Site preparation activities would result in varying degrees of temporary ground vibration, depending on the specific construction equipment used and operations involved. All heavy, mobile construction equipment would be temporary.

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

c) No Impact The project site is not located within the vicinity of a private airstrip and or airport land use plan or within two miles of a public airport or public use airport.

XIV. *POPULATION AND HOUSING* *Would the project:*

	PSI	PSUMI	LTSI	NI
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and business) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒

a) No Impact. The Project would require a temporary increase in labor force (15 workers) during the short-term construction period (approximately eight months). It is assumed that the workforce would be from southern California and would likely not require accommodations. The Project does not involve the construction of any new housing or commercial areas that would attract new residents to the area. The proposed project improvements are designed within the existing footprint to the current ongoing geothermal operation. The expansion would not appear to induce population growth in the area. The construction of work is temporary and any additional full time work would not appear to be substantial impact.

	PSI	PSUMI	LTSI	NI
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

b) No Impact. Construction of the proposed Project would not displace any existing people in the vicinity of the Project Site. Therefore, no impacts to residents would occur as result of the Project The project development within the existing geothermal facility will be to replace, repair and update is electrical generation site. There would not appear to be any displacement of full time workers. The construction is temporary.

XV. *PUBLIC SERVICES*

	PSI	PSUMI	LTSI	NI
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:	☐	☐	☒	☐
1) Fire Protection?	☐	☐	☒	☐

1) Less Than Significant. Considering that the existing environment is an operating geothermal energy plant, the Project would not significantly increase the demand for public services. Additional fire response could be needed in the instance of a catastrophic event with an isopentane tank. A Hazard Assessment (**Appendix G**) was prepared for the Project and concluded that the likelihood of a catastrophic event is highly unlikely. Therefore, potential impacts to public services are less than significant.

	PSI	PSUMI	LTSI	NI
2) Police Protection?	☐	☐	☐	☒

2) No Impact. This proposed project would not appear to impact police protection at the site or nearby neighborhoods. The construction is within the footprint of the existing facility. The Project would not result in any new security risks, nor an increase in population or housing; therefore, the Project would not impact police protection services.

	PSI	PSUMI	LTSI	NI
3) Schools?	☐	☐	☐	☒

3) No Impact. The Project would not result in an increase in population or housing and would not require additional school services.

	PSI	PSUMI	LTSI	NI
4) Parks?	☐	☐	☐	☒

4) No Impact. The Project would not result in an increase in population or housing and would not increase demand/use for local parks.

	PSI	PSUMI	LTSI	NI
5) Other Public Facilities?	☐	☐	☐	☒

5) No Impact. The Project would not put an increased burden on off-site public services, including existing fire, police, school and other governmental services. Therefore, no impact would occur.

XVI. *RECREATION*

	PSI	PSUMI	LTSI	NI
a) Would the project increase the use of the existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒

a) No Impact. The Project would require a temporary increase in labor force during the short-term construction period (approximately eight months). It is assumed that the workforce would be local and not require accommodations. Therefore, the Project would not result in an increase in population that would increase use of existing neighborhood or regional recreational facilities. Therefore, no impact would occur as result of developing the Project.

	PSI	PSUMI	LTSI	NI
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse effect on the environment?	☐	☐	☐	☒

b) No Impact. Development of the proposed facilities would not restrict or preclude access to any recreational opportunities or assets/parks in the area. The Project would require a temporary increase in labor force during the short-term construction period (approximately eight months). It is assumed that the workforce would be local and not require accommodations. Therefore, the Project would have no impact on the in demand/use of recreational facilities that would have an adverse physical effect on the environment.

XVII. *TRANSPORTATION* *Would the project:*

	PSI	PSUMI	LTSI	NI
a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☐	☐	☒	☐

1) **Less Than Significant**. Lone site access is provided via Dogwood Road, which is classified as a Regional Arterial in the Imperial County Long Range Transportation Plan (2013). Dogwood Road's Average Daily Traffic (ADT) is approximately 15,000 vehicles per day and its level of service (LOS) is E. LOS E indicates that this arterial is operating at capacity and traffic flow can be irregular.

Construction of the proposed facilities may result in nominal and short-term increases in vehicle trips by construction workers and construction vehicles on area roadways. These trips would include construction workers commuting to and from the Project Site, haul truck trips associated with the transfer and disposal of materials, and material and equipment deliveries. The number of construction-related trips would vary each day, depending on construction phase, planned activity, and material needs.

Construction traffic on roadways in the immediate vicinity of the Project site and along haul routes could result in nominal and short-term increases in traffic volumes. The presence of construction trucks, with their slower speeds and larger turning radii, may temporarily reduce roadway capacities in the immediate vicinity of the Project Site. These nominal impacts of construction traffic would be most noticeable in the immediate vicinity of the Project site and less noticeable farther away and on regional roadways. Considering that no new employees would be hired to support the new facilities, all traffic-related impacts would be temporary and only occur during the construction phase (eight months).

Therefore, Project construction would cause incremental, short-term increases in traffic but construction-related trips are expected to be approximately 25-40 per day and well under the thresholds for developing a transportation management plan (i.e. 800 commercial/industrial trips). Therefore, Project construction would not conflict with any applicable transportation plans (i.e., Imperial County State Transportation Improvement Program/Plan, 2016) or contribute to a long-term decrease in LOS.

		Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)
b)	Would the project conflict or be inconsistent with the CEQA Guidelines section 15064.3, subdivision (b)?	☐	☐	☒	☐

b) Less Than Significant. Please see **(a)**

		PSI	PSUMI	LTSI	NI
c)	Substantially increases hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒

c) No Impact. The Project does not include any aviation-related use and would have no impact on airports. The Project would also not require any modification of flight paths for existing airports. Therefore, no impact to air traffic patterns would occur as result of the Project.

		PSI	PSUMI	LTSI	NI
d)	Result in inadequate emergency access?	☐	☐	☐	☒

d) No Impact. All proposed facilities would be constructed within the existing Heber 2 Complex site and not introduce any transportation hazards, design features, or incompatible uses with surrounding roadways. Therefore, there would be no increase to hazards due to the Project design. Emergency vehicle access is identified and designated at the Heber 2 site, and these areas would not be changed as result of the proposed developments. Therefore, no impacts to emergency access to the plant site or surrounding area would occur under the Project.

XVIII. *TRIBAL CULTURAL RESOURCES*

		PSI	PSUMI	LTSI	NI
a)	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:	☐	☐	☐	☒
	(i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as define in Public Resources Code Section 5020.1(k), or	☐	☐	☐	☒

(i) No Impact. There are no known tribal cultural resources present on the Project Site. The Project Site is completely devoid of any vegetation, water, or natural features that could be defined as a tribal cultural resource or traditional use area. Further, considering the Project Site was entirely disturbed when the Heber 2 power plant was developed, the probability of encountering an unforeseen/buried tribal cultural resource is very low. As described in Section 2.1.8 above, Project construction personnel would monitor areas during surface disturbing activities and if any potential tribal cultural resources are encountered, all construction affecting the discovery site would be suspended immediately until a qualified archaeologist has reviewed the findings. An Unanticipated Discoveries Plan would be prepared prior to resuming construction. Therefore, the Project is anticipated to result in no impacts to tribal cultural resources.

		PSI	PSUMI	LTSI	NI
	(ii) 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 is subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American Tribe.	☐	☐	☐	☒

(ii) No Impact please see(i)

	Potentially Significant Impact (PSI)	Potentially Significant Unless Mitigation Incorporated (PSUMI)	Less Than Significant Impact (LTSI)	No Impact (NI)

XIX. ***UTILITIES AND SERVICE SYSTEMS*** ***Would the project:***

	PSI	PSUMI	LTSI	NI
a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or stormwater drainage, electric power, natural gas, or telecommunications facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒

a) No Impact. Construction of the proposed facilities would not generate/discharge any wastewater. Portable toilets would be brought on-site per California Code of Regulations, Title 8, Section 1526, Subchapter 4, Construction Safety Orders Article 3, General §1526, Toilets at Construction Jobsites and disposed of at the appropriate wastewater facility, resulting in no impact to RWQCB requirements. Heber 2 Complex employees have permanent bathrooms in the existing facilities, and no new wastewater would be generated from the operation of the proposed facilities. Therefore, no impacts to wastewater would occur as a result of the Project.

	PSI	PSUMI	LTSI	NI
b) Have sufficient water supplies available to serve the project from existing and reasonably foreseeable future development during normal, dry and multiple dry years?	☐	☐	☐	☒

b) No Impact. The Project would not require any additional water supplies and no new water rights would be required. Therefore, no impacts to any water entitlements or resources would occur as a result of the Project.

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

c) No Impact. Project construction would not generate any wastewater, and Project operation would not increase the amount of wastewater generated at the existing Heber 2 Complex. Therefore, no impacts to the wastewater treatment utility's service capacity would occur under the Project.

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

d) No Impact: Project construction waste generation would likely be limited to packaging for equipment and supplies, and construction personnel waste (i.e., wrappers, food waste). There are two active waste disposal facilities/landfills in Imperial County that are accepting wastes and these facilities have the capacity to service to the Project. Operation of the proposed facilities would not generate any solid waste. Therefore, the Project would not result in an impact to the waste disposal facilities in Imperial County.

	PSI	PSUMI	LTSI	NI
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☐	☒

e) No Impact. Project construction waste generation would likely be limited to packaging for equipment and supplies, and construction personnel waste (i.e., wrappers, food waste). No hazardous wastes would be generated as result of Project construction or operation. Operation of the proposed facilities would not generate any solid wastes. All construction wastes would be disposed of at the appropriate receiving facility, and there are two active waste disposal facilities/landfills operating in Imperial County that can service the Project. Therefore, the Project would not violate any federal, state, or local solid wastes statutes or regulation.

XX. ***WILDFIRE***

If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the Project:

	PSI	PSUMI	LTSI	NI
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒

a) No Impact: The Second Imperial Geothermal Co. site is not located or near state responsibility, areas or lands classified as very high, high or moderate hazard severity zones.

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**
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?	☐	☐	☐	☒

2) No Impact: The project site, Second Imperial Geothermal Co. project is not located or near state responsibility, areas or lands classified as very high, high or moderate hazard severity zones. The project appears to be surrounded by agricultural related land.

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

c) No Impact: The existing Heber 2 Emergency Response Plan addresses project construction and operations. The proposed work is within the existing footprint of ongoing geothermal activities in the Heber 2 plant site. There appears to be no impacts to existing roads, emergency water sources, power lines or other utilities in or near this work.

	PSI	PSUMI	LTSI	NI
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?	☐	☐	☐	☒

d) No Impact: The project is located on mostly flat terrain. The existing geothermal facility has been in operation for a number of years and there would appear to no impacts from landslides, runoff or drainage changes.

Note: Authority cited: Sections 21083 and 21083.05, Public Resources Code. Reference: Section 65088.4, Gov. Code; Sections 21080(c), 21080.1, 21080.3, 21083, 21083.05, 21083.3, 21093, 21094, 21095, and 21151, Public Resources Code; Sundstrom v. County of Mendocino,(1988) 202 Cal.App.3d 296; Leonoff v. Monterey Board of Supervisors, (1990) 222 Cal.App.3d 1337; Eureka Citizens for Responsible Govt. v. City of Eureka (2007) 147 Cal.App.4th 357; Protect the Historic Amador Waterways v. Amador Water Agency (2004) 116 Cal.App.4th at 1109; San Franciscans Upholding the Downtown Plan v. City and County of San Francisco (2002) 102 Cal.App.4th 656.

Revised 2009- CEQA
Revised 2011- ICPDS
Revised 2016 – ICPDS
Revised 2017 – ICPDS
Revised 2019 – ICPDS

	Potentially Significant Impact **(PSI)**	Potentially Significant Unless Mitigation Incorporated **(PSUMI)**	Less Than Significant Impact **(LTSI)**	No Impact **(NI)**

SECTION 3
III. MANDATORY FINDINGS OF SIGNIFICANCE

The following are Mandatory Findings of Significance in accordance with Section 15065 of the CEQA Guidelines.

	PSI	PSUMI	LTSI	NI
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, eliminate tribal cultural resources 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?	☐	☐	☐	☐

IV. PERSONS AND ORGANIZATIONS CONSULTED

This section identifies those persons who prepared or contributed to preparation of this document. This section is prepared in accordance with Section 15129 of the CEQA Guidelines.

A. COUNTY OF IMPERIAL

- Jim Minnick, Director of Planning & Development Services
- Michael Abraham, AICP, Assistant Director of Planning & Development Services
- David Black, Project Planner
- Imperial County Air Pollution Control District
- Department of Public Works
- Fire Department
- Ag Commissioner
- Environmental Health Services
- Sheriff's Office

B. OTHER AGENCIES/ORGANIZATIONS

- **DTSC Imperial CUPA**

(Written or oral comments received on the checklist prior to circulation)

V. REFERENCES

1) "County of Imperial General Plan EIR", prepared by Brian F. Mooney & Associates in 1993; and as Amended by County in 1996, 1998, 2001, 2003, 2006 & 2008, 2015, 2016.

2) Bryant, William A. and Earl W. Hart. 2007. Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Studies Zoning Act with Index to Earthquake Fault Zones Maps, Department of Conservation, California Geological Survey, Special Publication 42.
3) ASTM International. 2019. Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (DM1557). Website available online at: https://www.astm.org/Standards/D1557. Accessed on March 2020.
4) California Air Resources Board (CARB). 2017. Ambient Air Quality Standards. Web site (accessed on March 2020) available at: https://www.arb.ca.gov/research/aaqs/aaqs2.pdf
5) California Department of Conservation (DOC). 2016. California Important Farmland Finder. Web site (accessed on March 2020) and available at: http://maps.conservation.ca.gov/ciff/ciff.html .
6) California Department of Conservation (DOC). 2016. The Land Conservation Act. Web site (accessed on March 2020) available at: http://www.conservation.ca.gov/dlrp/lca. Accessed on March 2020.
7) California Department of Fish and Wildlife. 2019. California Special Status Species. Web site available at: https://www.wildlife.ca.gov/Conservation/SSC. Accessed on March 2020.
8) California Department of Fish and Wildlife. 2019. CNDDB Maps and Data. Website available online at: https://www.wildlife.ca.gov/Data/CNDDB/Maps-and-Data. Accessed on March 2020.
9) California Department of Industrial Relations (DIR). 2016. Safety and Health Protocol on the Job. Web site (accessed on March 2020) available at: https://www.dir.ca.gov/dosh/dosh_publications/shpstreng012000.pdf.
10) California Department of Resources Recycling and Recovery (CalRecycle). 2017. Integrated Waste Management Plans. Web site (accessed on March 2020) available at: http://www.calrecycle.ca.gov/stateagency/IWMPlans/default.htm.
11) California Department of Toxic Substances Control (DTSC). 2010. Certified Union Program Agencies (CUPA). Web site (accessed on March 2020) available at: http://www.dtsc.ca.gov/HazardousWaste/CertifiedUnifiedProgramAgencies.cfm.
12) California Department of Transportation (Caltrans). 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol. Web site (accessed on March 2020) available at: http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013B.pdf.
13) California Department of Transportation. 2017. California Scenic Highway Mapping System. Web site (accessed March 2020) available at:http://www.dot.ca.gov/hq/LandArch/16_livability/scenic_highways/index.htm.
14) California Department of Water Resources. 2003. California's Groundwater. Website available online at: https://water.ca.gov/LegacyFiles/pubs/groundwater/bulletin_118/california's_groundwater bulletin_1 18 - update_2003_/bulletin118_entire.pdf. Accessed on March 2020.
15) California Endangered Species Act (CESA); Fish and Game Code 2081. 1970. Available online at: https://www.wildlife.ca.gov/Conservation/CESA
16) California Environmental Quality Act (CEQA) Statutes and Guidelines. 2016. Available online at: http://resources.ca.gov/ceqa/docs/2016_CEQA_Statutes_and_Guidelines.pdf.
17) California Native Plant Society (CNPS). 2019. Inventory of Rare and Endangered Plants of California. Website available online at: http://www.rareplants.cnps.org/. Accessed on March 2020
18) California Office of Planning and Research. 2003. General Plan Guidelines. Web site (accessed on

March 2020) available at: http://opr.ca.gov/docs/General_Plan_Guidelines_2003.pdf.

19) California State Geological Survey (CGS). 2015. Regulatory Maps. Web site (accessed on March 2020) available at: http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.

20) California Statutes and Regulations for the Division of Oil, Gas, and Geothermal Resources. January 2018. Website available online at: https://www.conservation.ca.gov/index/Documents/DOGGR%20Statutes%202018%20%20updated%20 4-4.pdf. Accessed on March 2020.

21) Endangered Species Act of 1973; 16 USC 35. 1973. Available online at: https://www.fws.gov/endangered/esa-library/pdf/ESAall.pdf

22) Federal Highway Administration (FHWA). 2006. Construction Noise Handbook. Web site (accessed on March 2020) available at: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/.

23) Federal Highway Administration (FHWA). 2011. Highway Traffic Noise: Analysis and Abatement. Web site (accessed on March 2020) available at: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_gui dance/revguidance.pdf.

24) Federal Highway Administration (FHWA). 2017. California State Byways List. Web site (accessed on May 10, 2017) available at: https://www.fhwa.dot.gov/byways/states/CA.

25) Federal Motor Carrier Safety Administration (FMCSA). 2014. How to Comply with Federal Hazardous Materials Regulations. Web site (accessed on March 2020) available at: https://www.fmcsa.dot.gov/regulations/hazardous-materials/how-comply-federal-hazardous-materials- regulations.

26) Federal Water Pollution Control Act (Clean Water Act). 33 USC 1251 et seq. 2002. Available online at: https://www.epa.gov/sites/production/files/2017-08/documents/federal-water-pollution-control-act-508full.pdf

27) Imperial County. 1998. General Plan. Website available online at: http://www.icpds.com/CMS/Media/GENERAL-PLAN--(OVERVIEW).pdf. Accessed on March 2020

28) Imperial County. 2013. Long Range Transportation Plan. Website available online at: http://www.imperialctc.org/media/managed/2013_LRTP_Final_Approved_11-13-13%20reduced.pdf. Accessed on March 2020.

29) Imperial County. 2015. Renewable Energy and Transmission Element of County of Imperial General Plan. Website available online at: http://www.icpds.com/CMS/Media/Renewable-Energy-and-Transmission-Element-2015.pdf. Accessed on March 2020.

30) Imperial County Planning and Development Services. 2015. Maps. Website available online at: http://www.icpds.com/?pid=577. Accessed on March 2020.

31) Imperial IRWMP. 2012. Integrated Regional Water Management Plan – Groundwater Management Planning Elements Guidance Document. Website available line at: https://www.iid.com/home/showdocument?id=9546. Accessed on March 2020.

32) Landmark. 2019. Geotechnical Report Update: Heber 2 Repower Plant Expansion.

33) National Resource Conservation Service. 2019. Web Soil Survey GIS Portal. Available online at: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Accessed on March 2020.

34) Office of the State Fire Marshall (CalFire). 2007. Fire Hazard Severity Zones Map. Website available online at: https://osfm.fire.ca.gov/divisions/wildfire-prevention-planning-engineering/wildland-hazardsbuilding-codes/fire-hazard-severity-zones-maps/. Accessed on March 2020

35) Olive, WW., et al. 1989. Swelling Clays Map of the Conterminous United States. Website available online at: https://pubs.er.usgs.gov/publication/i1940. March 2020.

36) United States Census Bureau. 2016. Quick Facts. Web site available at: https://www.census.gov/quickfacts/table/PST045216/0617568,00. March 2020.

37) United States Environmental Protection Agency (EPA). 2015. National Ambient Air Quality Standards. Web site (accessed on March 2020) is available at: https://www.epa.gov/criteria-air-pollutants/naaqstable

38) United States Environmental Protection Agency (EPA). 2016. Laws and Regulations. Web site (accessed on March 2020) available at: https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

39) United States Environmental Protection Agency (EPA). 2019. Chemical Accident Prevention Provisions(40 CFR 68.20-68.42). website available online at: https://www.ecfr.gov/cgi-bin/textidx?c=ecfr&SID=b843807afdc641b203ffec44aa671d36&rgn=div5&view=text&node=40:16.0.1.1.5&idno=40. Accessed on March 2020.

40) United States Fish and Wildlife Service. 2019. Information for Planning and Consultation (IPaC). Website available online at: https://ecos.fws.gov/ipac/. Accessed on March 2020.

41) United States Fish and Wildlife Service. 2019. National Wetlands Inventory – Wetlands Mapper. Website available online at: https://www.fws.gov/wetlands/data/Mapper.html. Accessed on March 2020.

42) United States Geological Survey (USGS). 1990. The San Andreas Fault System, California, Robert E.Wallace, editor, U.S. Geological Survey Professional Paper 1515.

43) United States Geological Survey (USGS). 2011. Oregon Geologic Map Data. Website available online at:https://mrdata.usgs.gov/geology/state/state.php?state=OR. Accessed on March 2020

VI. NEGATIVE DECLARATION – County of Imperial

The following Negative Declaration is being circulated for public review in accordance with the California Environmental Quality Act Section 21091 and 21092 of the Public Resources Code.

Project Name: Heber 2 Geothermal Repower Project

Project Applicant: Second Imperial Geothermal Company

Project Location: The proposed development would occur entirely on the 39.99-acre Assessor's Parcel Number (APN) 054-250-031. This parcel also includes geothermal facilities for the Goulds 2 and Heber South projects. The address for the Heber 2 Complex is 855 Dogwood Road, Heber, CA 92249. The legal description is Tract 44, Township 16 South, Range 14 East, SBB&M. See Exhibit A and B.

Description of Project: Perform CUP amendment to allow for installation of two new water-cooled ORMAT Energy Converters (OECs) to replace six old units from 1992; three 10,000 gallon isopentane above ground storage tanks; and, additional pipes to connect the proposed facilities with the existing Heber 2 Geothermal Energy Complex. All proposed facilities would be developed within the existing Heber 2 Complex and fence line. The total project disturbance from developing the new facilities is approximately 4 acres. The CUP amendment application also proposes to renew the permitted life of the entire Heber 2 Complex (including the Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049). The proposed facility upgrades would allow the Heber 2 Complex to run more efficiently and refurbish the Heber 2 Complex to the original nameplate capacity (33 megawatts) without expanding the existing facility beyond the current footprint, and produce clean renewable energy in the Imperial Valley for the next three decades.

The proposed Project Site is within the existing Heber 2 power plant area, and all proposed facilities would be located within the existing fence line and permit area. As an active energy generation facility, the Project Site is devoid of any vegetation, streams/wetlands, or existing facilities (**Figure 6**). As observed in **Figure 2** (site plan), **Figure 6** (photo of Project Site), and **exhibits A & B** (site photos), the proposed facilities would be installed in the vacant, undeveloped areas of the Heber 2 site.

The Project Site is entirely within APN 054-250-031, which is zoned as A-2-G-SPA, for General Agriculture (A-2), Geothermal Overlay Zone (G), and in the Heber Specific Plan Area (SPA). The Project Site is entirely within the Imperial County Geothermal Overlay Zone. "Major Geothermal Projects" in the overlay zone are permitted through the CUP process, as was the original Heber 2 project. The Heber SPA is intended "to allow for commercial, residential, industrial, renewable energy and other employment oriented development in a mixed used orientation" (Land Use Element of the Imperial County General Plan, 2015). Therefore, the proposed Project conforms to the standards and goals set forth in the Imperial County General Plan and the Renewable Energy and Transmission Element of County of Imperial General Plan (2015).

Surrounding land uses include a solar energy facility to the west of the Project Site, a commercial aggregate/rock supplier to the south, and agriculture to the north and east. The primary use in the general surrounding area is agriculture. The closest residences to the Project Site are in the town of Heber, approximately 3,500 feet to the northeast of the Project Site.

VII. FINDINGS

This is to advise that the County of Imperial, acting as the lead agency, has conducted an Initial Study to determine if the project may have a significant effect on the environmental and is proposing this Negative Declaration based upon the following findings:

☐ The Initial Study shows that there is no substantial evidence that the project may have a significant effect on the environment and a NEGATIVE DECLARATION will be prepared.

☐ The Initial Study identifies potentially significant effects but:

(1) Proposals made or agreed to by the applicant before this proposed Mitigated Negative Declaration was released for public review would avoid the effects or mitigate the effects to a point where clearly no significant effects would occur.

(2) There is no substantial evidence before the agency that the project may have a significant effect on the environment.

(3) Mitigation measures are required to ensure all potentially significant impacts are reduced to levels of insignificance.

A NEGATIVE DECLARATION will be prepared.

If adopted, the Negative Declaration means that an Environmental Impact Report will not be required. Reasons to support this finding are included in the attached Initial Study. The project file and all related documents are available for review at the County of Imperial, Planning & Development Services Department, 801 Main Street, El Centro, CA 92243 (442) 265-1736.

NOTICE

The public are invited to comment on the proposed Negative Declaration during the review period.

Date of Determination Jim Minnick, Director of Planning & Development Services

The Applicant hereby acknowledges and accepts the results of the Environmental Evaluation Committee (EEC) and hereby agrees to implement all Mitigation Measures, if applicable, as outlined in the MMRP.

Applicant Signature Date

SECTION 4

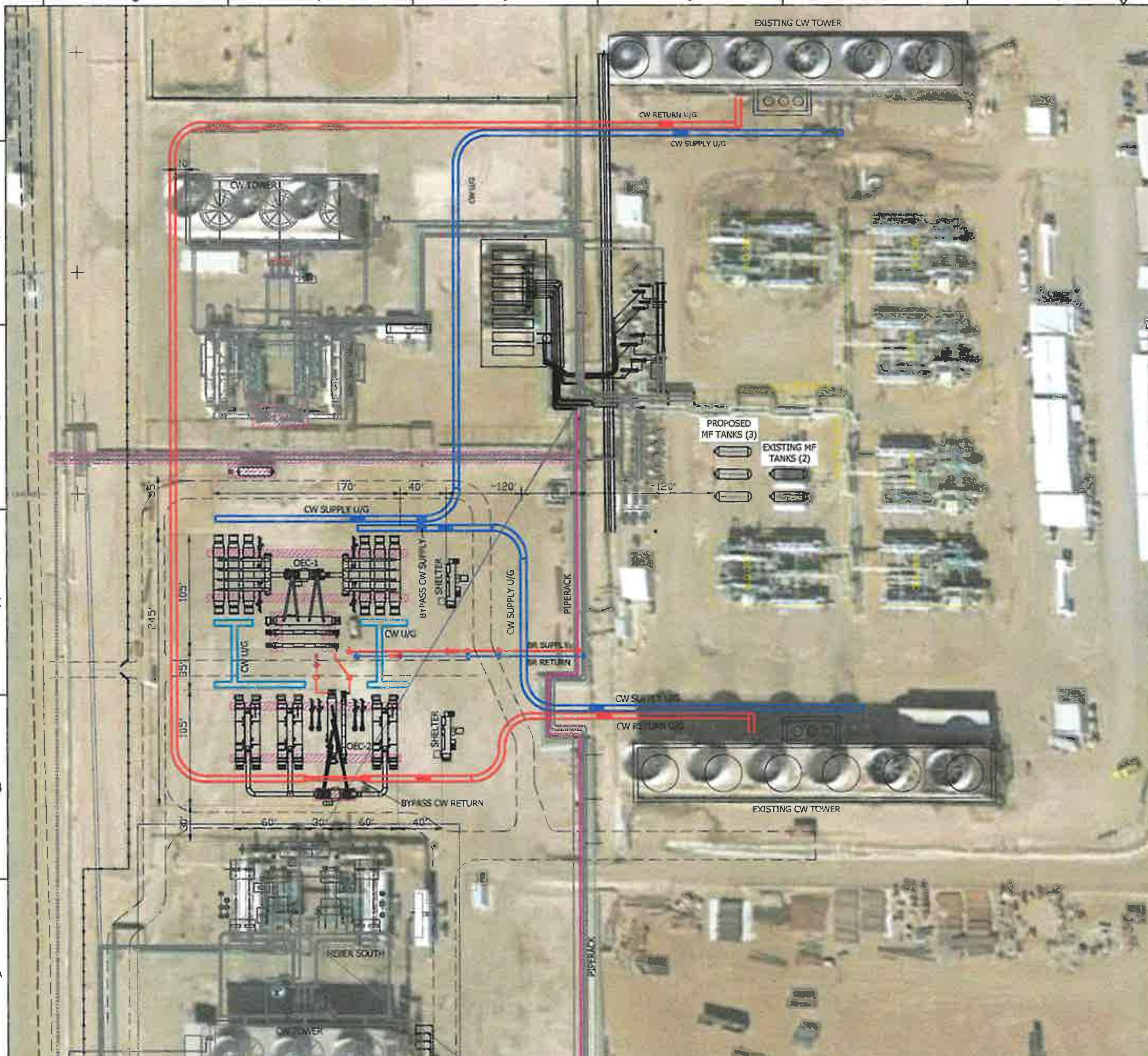
VIII. RESPONSE TO COMMENTS

N/A

IX. MITIGATION MONITORING & REPORTING PROGRAM (MMRP)

N/A

S:\ 054\250\031\CUP19-0017\IS



REV	DESCRIPTION	DATE	BY	CHK	ENG	PRJ
P6	UPDATE MODELS OES-1 & OEC-2	5.APR.2019	A.S.	A.N.		S.H.
P7	UPDATE MODELS OES-1	17.APR.2019	A.S.	A.N.		S.H.
P8	UPDATE OEC-1 & OEC-2	27.MAY.2019	A.S.	A.N.		S.H.
P9	UPDATE LOCATION OEC-1	18.JULY.2019	A.S.	A.N.		S.H.

KEY:

- EXISTING FENCE LINE
- PROPOSED UNDERGROUND CW SUPPLY LINE
- PROPOSED UNDERGROUND CW RETURN LINE
- PROPOSED BR SUPPLY LINE
- PROPOSED BR RETURN LINE
- EQUIPMENT TO BE DECOMMISSIONED
- EXISTING EQUIPMENT TO REMAIN

CW COOLING WATER
U/G UNDERGROUND
BR GEOTHERMAL BRINE
OEC ORMAT ENERGY CONVERTOR
MF MOTIVE FLUID

NOTE:

1. THE ARRANGEMENT AND SIZES PRESENTED ARE PRELIMINARY AND INDICATIVE ONLY AND SUBJECT TO CHANGED ON DESIGN OPTIMIZATION , DETAILED DESIGN AND ACTUAL EQUIPMENT PURCHASED (MANUFACTURED).
2. DIMENSIONS ARE IN MM [FEET], ELEVATIONS ARE IN MM FEET]

0 20' 100' 200'
GRAPHIC SCALE (FEET)

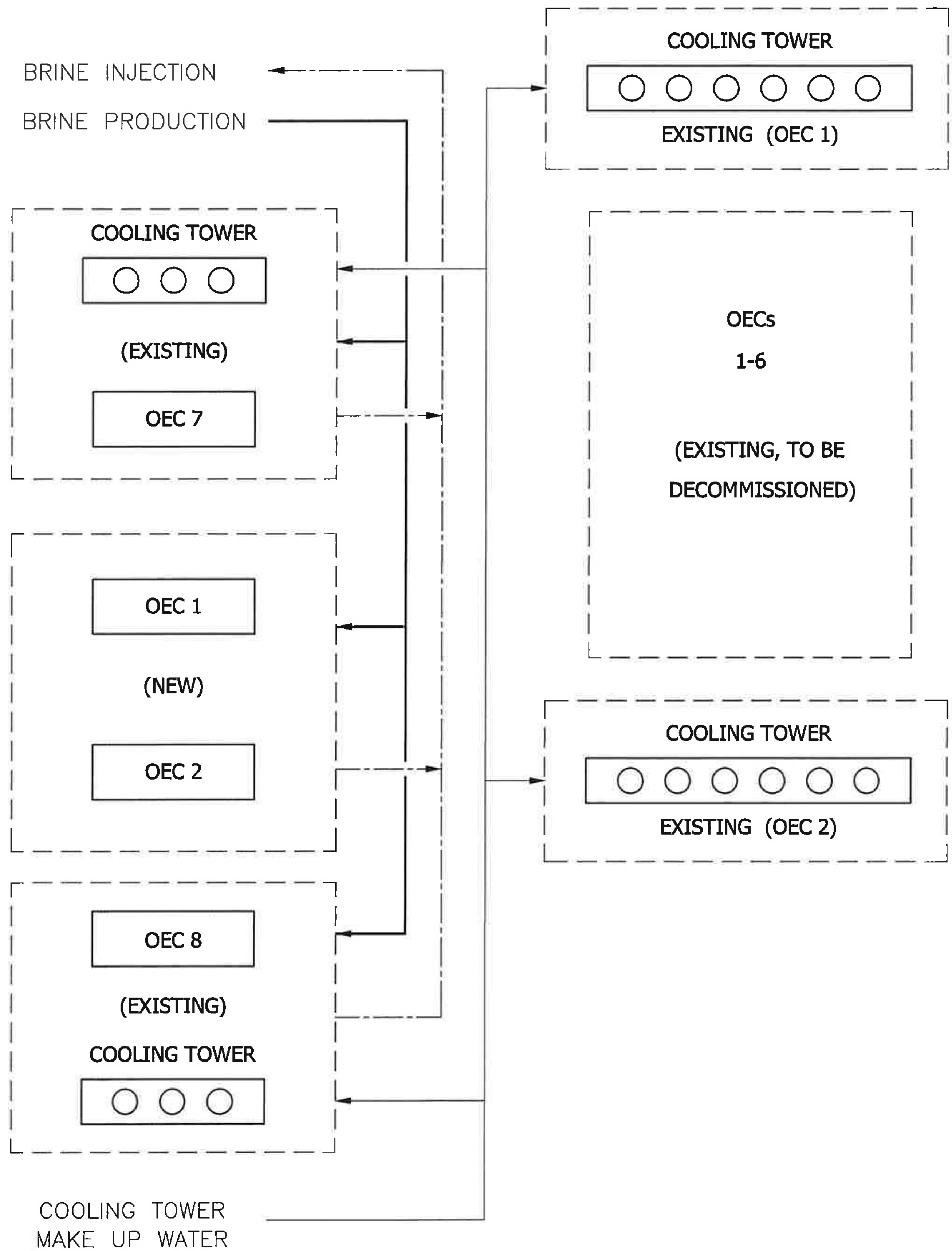
PREPARED BY
Stantec
PHONE FAX

FOR
Second Imperial Geothermal Company
855 B Dogwood Road
Heber CA 92249

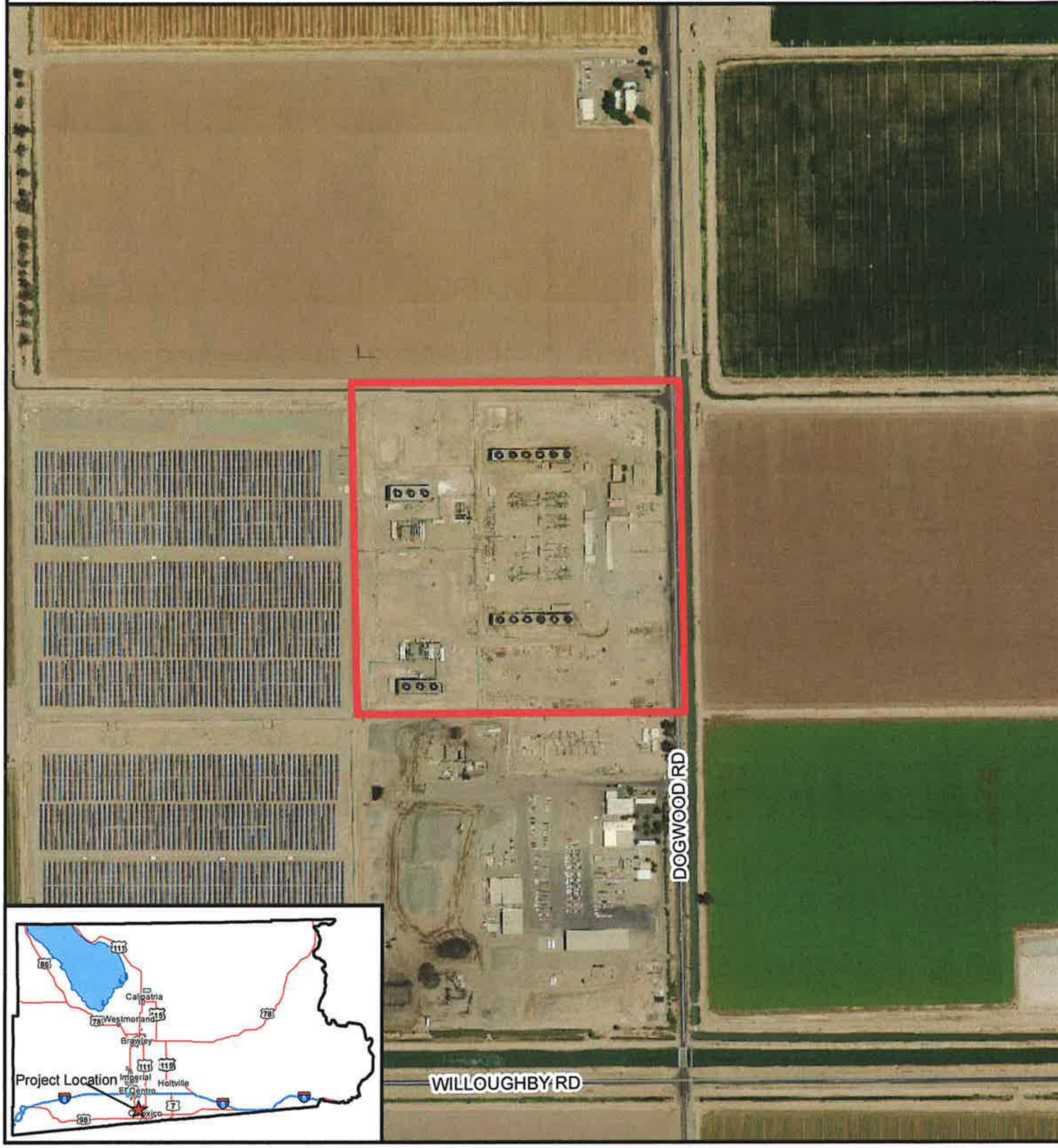
TITLE
HEBER2 REPOWER GENERAL ARRANGEMENT POWER PLANT ON MAP

DRAWN BY KAM	DESIGNED BY
CHECKED BY	APPROVED BY
PROJECT NUMBER 0101 01234 01 0123	SCALE AS SHOWN
DATE 04/01/04	FILE PATH K:\CLIENTS OR JOB #
SHEET **1 OF 1**	

INTEGRATION OF HEBER II FACILITIES



PROJECT LOCATION MAP



SECOND IMPERIAL GEOTHERMAL CO.
CUP #19-0017
APN #054-250-031

Project Parcel

N

APPENDIX A

Site Photographs

(Collected on June 1, 2019 and June 13, 2019)

Photo 1 – western portion of development site.

Photo 2 – southwest portion of development site.

Photo 3 – northwestern portion of development site.

Photo 4 – northern portion of development site.

Photo 5 – central portion of development site.

Photo 6 – central portion of development site.

Photo 7 – northern portion of development site.

Biological Resources Clearance Memorandum

Date: June 3, 2019

From: Catalyst Environmental Solutions

RE: **Biological Resources Clearance Survey for the Heber 2 Geothermal Repower Project**

INTRODUCTION

The Second Imperial Geothermal Company (SIGC), a wholly owned subsidiary of ORMAT Nevada, Inc (ORMAT), owns and operates the Heber 2 Geothermal Energy Complex, which was originally constructed in 1992 and expanded in 2006. SIGC proposes to amend the existing Conditional Use Permit (CUP; No. 06-0006) to install two water-cooled ORMAT Energy Converters (OECs) to replace six old units from 1992; three 10,000 gallon isopentane above ground storage tanks; and, additional pipeline to connect the proposed facilities with the existing Heber 2 Complex (hereinafter, "Project"). All proposed facilities would be developed within the existing Heber 2 Complex and fence line. The proposed action also includes the extension of the permitted life of the entire Heber 2 facility (including the Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049). The objective of the Project is to improve the efficiency of geothermal energy generation and refurbish the Heber 2 Complex to the original net generation of 33 megawatts (MW) gross. The total project footprint from developing the proposed facilities is approximately 4 acres, with all disturbances occurring within the existing power plant fence line.

Th purpose of this technical memorandum is to verify the absence of any sensitive biological resources occurring on/near the proposed development site at the Heber 2 Complex in Imperial County and to demonstrate the proposed project's compliance with applicable federal and state regulations.

Project Location

The Heber 2 Complex is located on private lands owned by ORMAT in southern Imperial County (**Figure 1**). The proposed development would occur entirely on Assessor's Parcel Number (APN) 054-250-031, which is a 39.99-acre property. The address for Heber 2 is 855 Dogwood Road, Heber, CA 92249.

Project Description

Existing Facilities

The existing Heber 2 Geothermal Energy Power Plant (Heber 2) was permitted for development under CUP No. 06-0006 in 1996 and consists of the following facilities:

- The Heber 2 Complex currently generates less than the 33 MW net generation capacity, the proposed improvements will restore the facility's generation capacity to 33 MW of renewable energy.

- The Heber 2 Complex currently includes two injection wells, two six-cell cooling towers, an electrical substation, emergency fire water pump, evacuation skid system-vapor recovery maintenance unit, control room, office space, maintenance facilities, two 10,000 gallons isopentane storage tanks, piping, and ancillary equipment/facilities.
- The parcel where the Heber 2 Complex site is located is approximately 40 acres and is enclosed by security fencing.
- Operations personnel are present at the Heber 2 Complex during routine working hours (8am-5pm), and the facility is monitored 24 hours per day from the control room at the Heber 1 geothermal power plant, approximately 1 mile to the east.

Proposed Facilities

SIGC proposes to install two new water-cooled ORMAT Energy Converters (OECs); three 10,000 gallon above ground storage tanks; and, additional pipeline to connect the proposed facilities with the existing Heber 2 Complex (hereinafter, "Project"). This application also proposes to extend the permitted life of the entire Heber 2 Complex (including the related Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049). The objective of the Project is to improve the efficiency of geothermal energy generation and refurbish the Heber 2 Complex to the original nameplate generation of 33 megawatts (MW). The total project disturbance from developing the new OECs is approximately 4 acres, all within the existing power plant footprint and fencing. Figure 2 provides a site plan of the proposed and existing facilities.

The existing OEC units would be shut down, disassembled, and removed from the Heber 2 site likely immediately after the completion of the development of the proposed facilities, and no later than 5 years after issuance of the CUP.

The development site is completely devoid of any vegetation and is actively disturbed as part of ongoing energy generation operations at Heber 2. Appendix A provides photographs of the development site. Considering its current condition, site preparation for the installation of the proposed facilities would be limited to minor excavation and soil/gravel compaction.

ORMAT Energy Converter-1 (OEC-1)

The proposed OEC-1 unit is a two-turbine combined cycle binary unit, operating on a subcritical Rankine cycle, with isopentane as the motive fluid for the system. This system also consists of a generator, turbines, vaporizer, water cooled condensers, preheaters and recuperators, with the OEC served by the existing evacuation skid/vapor recovery maintenance unit (VRMU) for purging and maintenance events. The design capacity for the unit is 25.43 MW Gross.

ORMAT Energy Converter-2 (OEC-2)

The proposed OEC-2 unit is a two-cycle binary unit, operating on a subcritical Rankine cycle, with isopentane as the motive fluid for the system. This system also consists of a generator, turbines, vaporizers, water cooled condensers and preheaters, with the OEC served by the existing portable evacuation skid/vapor recovery maintenance unit (VRMU) for purging and maintenance events. The design capacity for the unit is 14.01 MW Gross.

Three Additional Isopentane Above Ground Storage Tanks

To support the new OEC units, three new ABSTs for additional isopentane supply would be installed. There are two existing ABSTs, and the new ABSTs would be sited adjacent to the existing tanks. Each ABST has a capacity of 10,000 gallons.

Construction Schedule

The proposed developments are anticipated to take up to eight months to install, test, and become fully integrated with the existing system. Construction will initiate immediately after all permits are secured.

REGULATORY FRAMEWORK

Federal

Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531-1544) protects federal listed threatened and endangered species from unlawful take (harass, harm, pursue, hunt, shoot, kill ,wound, collect, capture, trap or attempt to do so) or significantly modify habitat. If a proposed project would jeopardize a threatened or endangered species, then a Section 7 consultation with a federal agency could be required.

Migratory Bird Treaty Act (50 Code Federal Regulations (CFR) 10.13) is a federal statute with several foreign countries to protect species that migrate between countries. Over 1000 species are listed and may not be disrupted during nesting activities. It is illegal to collect any part (nest, feather, eggs, etc.) of a listed species, disturb species while nesting or offer for trade or barter any listed species or parts thereof.

Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) protects bald and golden eagles from take (harass, harm, pursue, hunt, shoot, kill, wound, collect, capture, trap or attempt to do so) or interference with breeding, feeding or sheltering activities.

Clean Water Act, 1972 (CWA 33 U.S.C. 1251 et seq.) regulates discharges into waters of the U.S. EPA is given the responsibility to implement programs to prevent pollution.

State of California

California Environmental Quality Act (CEQA) Title 14 CA Code of Regulations 15380 requires that endangered, rare or threatened species or subspecies of animals or plants be identified within the influence of the project. If any such species are found, appropriate measures should be identified to avoid, minimize or mitigate to the extent possible the effects of the project.

Native Plant Protection Act CDFG Code Section 1900-1913 prohibits the taking, possessing, or sale within the stare of any plant listed by CDFG as rare, threatened or endangered. Landowners may be allowed to take these species if CDFW is notified at least 10 days prior to plant removal or if these plants are found within public right of ways.

California Fish and Game Codes 3503, 3503.5. 3513 protect migratory birds, bird nests, and eggs including raptors (birds of prey) and raptor nests from take unless authorized by CDFW.

California Fish and Game Code Section 1600 (as amended) regulates activities that substantially diverts or obstructs the natural flow of any river, stream or lake or uses materials from a streambed. This can include riparian habitat associated with watercourses.

State of CA Fully Protected Species identifies and provides additional protection to species that are rare or face possible extinction. These species may not be taken or possessed at any time except for scientific research or relocation for protection of livestock.

Porter-Cologne Water Quality Control Act (as amended) is administered by the State Water Resource Control Board (SWRCB) to protect water quality and is an avenue to implement California responsibilities under the federal Clean Water Act. This act regulates discharge of waste into a water resource.

EXISTING CONDITIONS

Topography and Soils

The entire Heber 2 project site contains Holtville silty clay, wet (63.2%) and Imperial-Glenbar silty clay loams, wet, 0-2 percent slopes (36.8%) (NRCS 2019). The proposed 4 acres of disturbance contains Imperial-Glenbar silty clay loams, wet, 0-2 percent slopes. The project site is relatively flat and located at approximately -5 below sea level.

Vegetation

No vegetation is present on the project site. The site is classified as "Agricultural and Developed Vegetation" and "Developed and Other Human Use" (USGS 2011). The project site is surrounded on all sides by farmland (Agricultural and Developed Vegetation).

Jurisdictional Waters

No wetlands or jurisdictional waters are located on the project site. Man-made channels are located along the southern (Central Main Canal - classified as R2UBHx), northern and eastern (both classified as R4SBCx) property line of the project site (USFWS 2019c).

Wildlife

The project site is developed with an active geothermal plant. Due to lack of vegetation and water, no amphibians, fish, or reptiles are expected to occur onsite. Due to the developed and active nature of the site, no mammals or birds are expected to inhabit the site. Mammals including coyote (*Canis latrans*) and pocket gopher (*Thomomys* spp.) have been observed in the vicinity of the project but are not likely to occur onsite due to security fencing. Common bird species including red tailed hawk (*Buteo jamaicensis*), crow (*Corvus* spp.) pigeon (*Columbia livia*) have been observed in the vicinity of the project and could be transient visitors to the site.

SENSITIVE AND SPECIAL STATUS SPECIES

The potential for sensitive species to occur in the vicinity of the project site was evaluated using information from the U.S. Fish and Wildlife (USFWS) Information, Planning, and Consultation System (IPaC System); California Natural Diversity Database (CNDDB); and California Native Plant Society (CNPS) Rare Plant Program.

Special Status Plants

No federally listed threatened or endangered plant species have the potential to occur on or near the project site (USFWS 2019a).

Five plant species listed by the CNPS have the potential to occur in the Heber quandrangle in which Heber 2 Complex is located (CNPS 2019):

- Watson's amaranth (*Amaranthus watsonii*)
- Abrams' spurge (*Euphorbia abramsiana)*
- California satintail (*Imperata brevifolia*)
- ribbed cryptantha (*Johnstonella costata*)

- winged cryptantha (*Johnstonella holoptera*)

Special Status Wildlife Species

No federally listed threatened or endangered wildlife species have the potential to occur on the project site and no critical habitat exists on or near the project site (USFWS 2019a, b). The following six migratory bird species are listed by IPaC as having the potential to occur on or near the project site:

- Burrowing owl (*Athene cunicularia*)
- Costa's hummingbird (*Calypte costae*)
- Gila woodpecker (*Melanerpes uropygialis*)
- Long-billed curlew (*Numenius americanus*)
- Rufous hummingbird (*Selasphorus rufus*)
- Whimbrel (*Numenius phaeopus*)

No California special status species are known to occur on the project site (CDFW 2019).

BIOLOGICAL RESOURCES CLEARANCE SURVEY

Methodology

On Saturday, June 1, 2019, biologist Amy Plesetz conducted a biological compliance clearance survey of the ORMAT Heber Site 2 via pedestrian survey.

Findings

The area to be disturbed for the Heber 2 project is completely void of any vegetation. There is no suitable habitat for special-status plant species. There are no tall trees that would encourage raptor nesting, no suitable habitat for burrowing owl, and no food source for hummingbirds. No wildlife or traces of wildlife, including nesting birds, were observed.

The area immediately to the west of the proposed disturbed area is developed with solar panels with scarce disturbed-like vegetation that does not provide suitable habitat for any special-status or common species. Areas north and south of the proposed disturbed area contain geothermal plant facilities. Active farmland surrounds the entire project site.

There may be suitable habitat for burrowing owl in the project vicinity, but this habitat is off-site and more than 500 feet away.

POTENTIAL PROJECTS IMPACTS

No impacts to biological resources from the proposed project are expected due to the developed nature of the site, small project footprint, lack of vegetation and suitable habitat for wildlife, and lack of wildlife traces observed during the biological site visit (June 1, 2019).

No canals or drain structures will be removed or impacted; therefore, there will be no impacts to jurisdictional waters.

RECOMMENDED AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

- Speed limits of 10 mph would be observed on the project site in order to minimize dust and avoid collision and incidental mortality of transient wildlife.
- The site is void of vegetation; however, vegetation control, including invasive species eradication, will be controlled to prevent growth under/near the proposed facilities.

BIBLIOGRAPHY

California Department of Fish and Wildlife (CDFW). 2019. California Natural Diversity Database. Accessed 13 June 2019.

California Native Plant Society (CNPS). 2019. Inventory of Rare and Endangered Plants of California (online edition, v8-03 0.39). Website http://www.rareplants.cnps.org. Accessed 12 June 2019.

Natural Resource Conservation Service (NRCS). 2019. SUGGO Database.

U.S. Geological Survey (USGS). 2011. GAP/LANDFIRE National Terrestrial Ecosystems 2011. Website: https://maps.usgs.gov/terrestrial-ecosystems-2011/. Accessed 13 June 2019.

U.S. Fish and Wildlife Service (USFWS). 2019a. IPac Resource List.

USFWS 2019b. Critical Habitat for Threatened & Endangered Species Website. Website: https://fws.maps.arcgis.com/home/webmap/viewer.html. Accessed 12 June 1029.

USFWS. 2019c. National Wetlands Inventory, Wetlands Mapper. Website: https://www.fws.gov/wetlands/data/Mapper.html. Accessed 12 June 2019.

Legend

- United States/Mexico Border
- County Line
- Project Site
- 1-Mile Radius

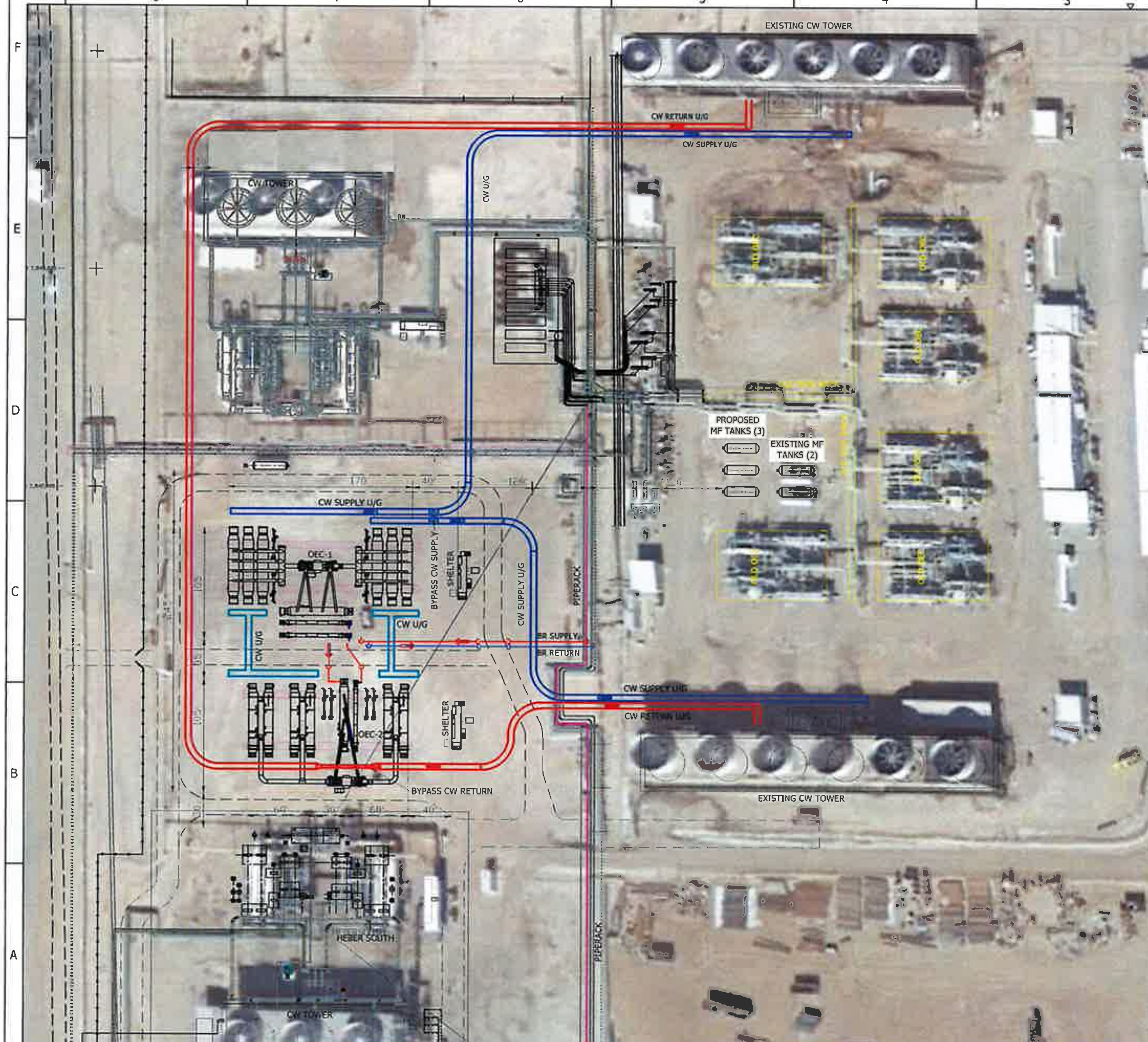
PROPOSED PROJECT SITE - HEBER 2

Catalyst ENVIRONMENTAL SOLUTIONS

Figure 1

ORMAT

Date: July 2019



REV	DESCRIPTION	DATE	BY	CHK	ENG	PRJ
P6	UPDATE MODELS DES-1 & OEC-2	5.APR.2019	A.S.	A.N.		S.H.
P7	UPDATE MODELS DES-1	17.APR.2019	A.S.	A.N.		S.H.
P8	UPDATE OEC-1 & OEC-2	27.MAY.2019	A.S.	A.N.		S.H.
P9	UPDATE LOCATION OEC-1	18.JULY.2019	A.S.	A.N.		S.H.

N

KEY:

- EXISTING FENCE LINE
- PROPOSED UNDERGROUND CW SUPPLY LINE
- PROPOSED UNDERGROUND CW RETURN LINE
- PROPOSED BR SUPPLY LINE
- PROPOSED BR RETURN LINE
- EQUIPMENT TO BE DECOMMISSIONED
- EXISTING EQUIPMENT TO REMAIN
- CW COOLING WATER
- U/G UNDERGROUND
- BR GEOTHERMAL BRINE
- OEC ORMAT ENERGY CONVERTOR
- MF MOTIVE FLUID

NOTE:

1. THE ARRANGEMENT AND SIZES PRESENTED ARE PRELIMINARY AND INDICATIVE ONLY AND SUBJECT TO CHANGED ON DESIGN OPTIMIZATION, DETAILED DESIGN AND ACTUAL EQUIPMENT PURCHASED (MANUFACTURED).
2. DIMENSIONS ARE IN MM (FEET), ELEVATIONS ARE IN MM FEET)

0 20' 100' 200'

GRAPHIC SCALE (FEET)

PREPARED BY

Stantec

PHONE FAX

FOR

Second Imperial Geothermal Company
855 B Dogwood Road
Heber CA 92249

TITLE

HEBER2 REPOWER GENERAL ARRANGEMENT POWER PLANT ON MAP

DRAWN BY: KAM	DESIGNED BY:
CHECKED BY:	APPROVED BY:
PROJECT NUMBER: 0107 01334 01 0133	SCALE: AS SHOWN
DATE: 04/01/04	FILE PATH: K:\CLIENT\OR JOB #
SHEET: 1 OF 1	

APPENDIX A

Site Photographs

(Collected on June 1, 2019 and June 13, 2019)

Photo 1 – western portion of development site.

Photo 2 – southwest portion of development site.

Photo 3 – northwestern portion of development site.

Photo 4 – northern portion of development site.

Photo 5 – central portion of development site.

Photo 6 – central portion of development site.

Photo 7 – northern portion of development site.

Water Quality Management Plan
Heber 2 Geothermal Repower Project
(855 Dogwood Road, Heber, California)

July 2019

Prepared By:

Catalyst
ENVIRONMENTAL SOLUTIONS

Catalyst Environnemental Solutions
315 Montana Avenue, Suite 311
Santa Monica, CA 90403

Prepared For:

ORMAT
Second Imperial Geothermal Company (ORMAT Nevada Inc.)
947 Dogwood Road
Heber, CA 92249

This Page is Intentionally Blank

Document Information

Prepared for	Second Imperial Geothermal Company (ORMAT Nevada Inc.)
Project Name	Heber 2 Geothermal Repower Project 855 Dogwood Road, Heber, California
Address	Second Imperial Geothermal Company 947 Dogwood Road Heber, CA 92249
Project Manager	Ben Pogue bpogue@ce.solutions
Project Engineer	Paden Voget, P.E. pvoget@ce.solutions State of California Professional Engineer #69238
Date	July 19, 2019

This Page is Intentionally Blank

Professional Certification

Water Quality Management Plan

Heber 2 Geothermal Repower Project

This report has been prepared by Catalyst Environmental Solutions Corporation under the professional supervision of the Principal(s) and/or staff whose signature(s) appear hereon.

The scope of work and specifications are presented in accordance with generally accepted professional engineering practice and those of the California State Water Resources Control Board Order No. 20013-001-DWQ. There is no other warranty either expressed or implied.

Paden Voget, PE
State of California Professional Engineer #69238

This Page is Intentionally Blank

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Second Imperial Geothermal Company (ORMAT Nevada Inc.) by Catalyst Environmental solutions. The WQMP is intended to comply with the requirements of the County of Imperial and the Phase II Small MS4 General Permit Imperial Valley Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of the site consistent with the Phase II Small MS4 Permit and the intent of the County of Imperial and the unincorporated community of Heber. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	CUP No. 06-0006	Grading Permit Number(s)	N/A
Tract/Parcel Map Number(s):	APN 054-250-031	Building Permit Number(s)	N/A
CUP, SUP, and/or APN:			06-0006
Owner's Signature			
Owner Name:	Connie Stechman		
Title:	VP, Finance		
Company:	Ormat Nevada Inc.		
Address:	6140 Plumas Street, Reno, NV 89519		
Email:	cstechman@ormat.com		
Telephone:	775-356-9029		
Signature:	Connie Stechman	Date:	8/12/19

Table of Contents

SECTION 1 **Project Description** ... **1**
1.1 Site Location ... 1
1.2 Land Use and Topography ... 1
1.3 Site Geology, Hydrogeology, and Soils ... 1
1.4 Hydromodificaiton Applicability ... 2
1.5 Potential Stormwater Pollutants ... 2
SECTION 2 **Best Management Practices** ... **4**
2.1 Non-Structural BMPs ... 4
2.1.1 Good Housekeeping ... 5
2.1.2 Preventative Maintenance ... 5
2.1.3 Spill Response ... 5
2.1.4 Material Handling and Storage ... 6
2.1.5 Employee Training ... 6
2.1.6 Waste Handling/Recycling ... 6
2.1.7 Record Keeping and Internal Reporting ... 6
2.1.8 Erosion Control and Site Stabilization ... 6
SECTION 3 **Operation and Maintenance Plan** ... **7**
3.1 Maintenance Responsibility ... 7
3.2 Maintenance Actions and Frequency ... 7
3.3 Maintenance Procedures ... 8
SECTION 4 **References** ... **9**

Tables

Table 1: Pollutants of Concern
Table 2: Non-Structural Source Control BMPs
Table 3: Maintenance Indicators and Actions for BMPs

Figures

Figure 1: Proposed Project Site – Heber 2
Figure 2: Drainage Canals
Figure 3: Project Infrastructure

SECTION 1 **Project Description**

The Second Imperial Geothermal Company, a wholly owned subsidiary of ORMAT Nevada Inc (ORMAT), owns and operates the Heber 2 Geothermal Energy Complex. The proposed Heber 2 Geothermal Repower Project (Project) is located at 855 Dogwood Road, Heber, California within unincorporated Imperial County. The Project includes the installation of two water-cooled ORMAT Energy Converters (OECs) to replace six old units from 1992; three 10,000 gallon isopentane above ground storage tanks; and, additional pipeline to connect the proposed facilities with the existing Heber 2 Complex (Site). The total project disturbance from developing the new OECs is approximately 4 acres, all within the existing power plant complex and fence line. A vicinity map of the Project Site is included in **Figure 1**.

The Project includes the replacement of six air-cooled OECs with two water-cooled OECs. The pre-Project pervious area is roughly 4 acres. The Project will result in less than 200 square feet of area converted in impervious surface area resulting from installation of equipment footings/foundations. In addition, no grading is proposed for the Project. Accordingly, the Project will not result in a change to the existing grade and stormwater flows and drainage will not be altered from existing conditions. **Figure 2** illustrates the existing drainage facilities in the vicinity of the Project. **Figure 3** provides a site plan of the proposed facilities.

1.1 SITE LOCATION

The Site includes approximately 4 acres within the Heber quadrangle of the U.S. Geological Survey (USGS) 7.5" topographic map, and sits within Township 16 South, Range 14 East of the San Bernardino Base and Meridian in Imperial County, California.

1.2 LAND USE AND TOPOGRAPHY

The Project is located on private lands owned by ORMAT in southern Imperial County as shown in **Figure 1**. The Project site includes approximately 4 acres entirely within the Assessor's Parcel Number (APN) 054-250-031, which is a 39.99-acre property. APN 054-250-031 is zoned as A-2-G SPA, for General Agriculture (A-2), Geothermal Overlay Zone (G), and in the Heber Specific Plan Area (SPA). The Project Site lies at an elevation approximately 15 feet below mean sea level (msl) in the Imperial Valley region of the California low desert. The surrounding properties lie on terrain which is flat, part of a large agricultural valley.is The Site is currently vacant and unimproved. The Site is also devoid of vegetation and is actively disturbed as part of ongoing energy generation operations at Heber 2. Adjacent properties outside of the fenced operations yard consists of agricultural land to the north and a solar farm to the west.

1.3 SITE GEOLOGY, HYDROGEOLOGY, AND SOILS

The part of Imperial County containing Heber lies within the Pliocene to Holocene, Q Geologic Unit (McCrink et al. 2011). Three natural geomorphic provinces underlay Imperial County, including the Peninsular Ranges, the Colorado Desert, and the Mojave Desert. The Colorado Desert geomorphic province spans central Imperial County and contains the Salton Sea and the Imperial valley. This Basin and Range province, sometimes referred to as the Salton Trough, is composed of a low-lying barren desert basin located between alluvium-covered, active branches of the San Andreas Fault containing Cenozoic sedimentary rocks and alluvial, lacustrine, and eolian deposits. The surface of sediments in the middle of the trough are about 275 feet below sea-level (bsl) (Digital Desert, 2019).

Surface water in the area of the Site consists of canals and agricultural drains operated and maintained by the Imperial Irrigation District. Canals adjacent to the Project Site include Date Drain No. 3, Date Drain No. 3a, Date Drain No. 3b, and Date Drain No. 3c as illustrated in **Figure 2**. These canals ultimately drain to the Alamo River, a tributary to the Salton Sea. Surface runoff within the Project Site occurs primarily as sheetflow across the lot generally to the north, eventually flowing into the adjoining ditches.

The regional groundwater flow direction within the Imperial Valley is toward the Salton Sea, a closed basin with a surface elevation of approximately 225 feet below sea level. Groundwater flow in the Project area flows in a general northwest direction.

Dry lean silty clays dominate the project site surface extending to approximately 4 to 5 feet below ground surface (bgs). These silty clays are underlain by moist stiff clays from approximately 6 ft to 38-40 ft bgs. Silty clay to clayey silt dominate 40-50 ft bgs to the extent of geotechnical exploration (Landmark 2019).

1.4 HYDROMODIFICAITON APPLICABILITY

As discussed above, the Project would result in less than 50 square feet of impervious area from pre-Project conditions. In addition, no grading is proposed for the Project or changes to the permeability of the Site. As such, the post-development runoff volume, time of concentration, and peak flow velocity would not be altered from that of the pre-development condition.

1.5 POTENTIAL STORMWATER POLLUTANTS

Table 1 summarizes expected stormwater pollutants of concern based on land use and site activities.

Table 1. Pollutants of Concern

Pollutant	Potential to Impact Stormwater (Y/N)	Additional Information and Comments
Pathogens (Bacterial/Virus)	N	--
Nutrients – Phosphorous	N	--
Nutrients - Nitrogen	N	--
Noxious Aquatic Plants	N	--
Sediment	Y	Overland flows over unpaved surface may result in sediment in stormwater runoff
Metals	Y	Leaks/spills in Project area may result in metals in stormwater runoff
Oil and Grease	Y	Leaks/spills in Project area may result in oil and grease in stormwater runoff

Trash/Debris	Y	**Improperly disposed of trash/debris may result in trash in stormwater runoff**
Pesticides/Herbicides	N	--
Other	N	--

SECTION 2 Best Management Practices

This section describes the Best Management Practices (BMPs) that will be implemented and maintained throughout the life of the project. The BMPs will be used to prevent and minimize water pollution that can be caused by stormwater runoff. **Table 2** details the BMPs selected to be implemented at the Site based on the potential pollutants. Note that the Site is within the existing operational footprint and is subject to the existing policies and programs implemented by ORMAT for the facility. Because the Project does not propose any changes to the existing stormwater volume, peak flow velocity, time of concentration or drainage patterns, no structural BMPs are proposed.

Table 2. Non-Structural Source Control BMPs

Pollutant Source	Pollutant	BMP	Existing?	New/Revised?
Stormwater run-on and runoff	Erosion, sediment, contaminated stormwater	• Stabilize drainage with rocks, gravel, vegetation, or riprap • Provide perimeter control to isolate sediment (loose dirt). Includes earthen berms, fiber rolls, silt fence, etc.	X	
Vehicle Track Out	Sediment, Dust	• Provide tracking control devise • Conduct street sweeping	X	
Work Areas	Trash	• Regularly monitor and clean trash • Provide employee training for good housekeeping	X	
Equipment Areas (OECs, ITLUs, pipes)	Isopentane, sediment	• Control drainage patterns with berms • Use water truck for dust control • Conduct routine inspections	X	X
Stored materials and equipment maintenance	Oil, grease, hydraulic fluid, anti-freeze, metals	• Provide good housekeeping training • Store materials in secondary containment • Spill kit and response training	X	

In addition to the activities listed above, ORMAT follows all approved operational guidelines that are currently in place. Temporary and permanent soil erosion control BMPs will be implemented in conformance with the BMP Fact Sheets provided in the CASQA Stormwater Best Management Practice Handbook – Industrial and Commercial (2014).

2.1 NON-STRUCTURAL BMPS

The following are prevention practices utilized to minimize the probability of pollution of stormwater discharge.

2.1.1 Good Housekeeping

As a component of this program, good housekeeping practices are performed so that facility is kept in a clean and orderly condition. Proper housekeeping practices include:

- Periodic cleanup of equipment, as needed, based upon facility inspections,
- Sweeping impervious surfaces, as needed, based upon facility inspections,
- Proper waste disposal practices and covering of waste storage areas at all times,
- Proper storage and covering of materials at all times,
- Removal of any oil-stained soil/gravel, especially around equipment locations and loading areas,
- Cleaning of significant oil and grease stains on surfaces that drain to the stormwater drainage areas, and
- Cleaning the exterior of oil containers on hydraulic machinery upon discovery of an accumulation of hydraulic fluid.

2.1.2 Preventative Maintenance

As a component of this program, operations and maintenance staff perform preventative maintenance of stormwater management devices to assure their proper operation. Preventative maintenance of stormwater management devices includes the following:

- Cleaning of accumulated sediment, potential contaminants, and debris from the Site;
- Inspection of secondary containment structures as part of the regular daily visual inspections;
- Maintenance and inspection of secondary containment structures, as needed, based upon inspections;
- Daily inspection and maintenance of equipment and associated piping and valves as required by preventive maintenance procedures;
- Inspection and maintenance of rainfall protection coverings for waste storage bins and receptacles on a periodic basis; and
- A comprehensive preventive maintenance schedule is performed on all facility operations equipment as part of routine procedures.

2.1.3 Spill Response

Spill prevention and response is performed according to the facility's SPCC Plan . Copies of this plan are located in the on-site ORMAT office.

A limited amount of spill cleanup equipment is stored onsite. This equipment is found within hazardous material storage areas. Detailed information concerning spill cleanup equipment and resources is included in the SPCC Plan.

The volume of containment areas surrounding each potential source is designed to hold the contents of a spill from the largest vessel / container. The SPCC Plan summarizes the capacity of potential sources and volume of the respective secondary containment areas.

2.1.4 Material Handling and Storage

The primary hazardous material to be stored on-site is isopentane. The additional isopentane will be stored in the appropriately designed (3x) 10,000 gallon above ground storage tanks, as well as the existing (2x) 10,000 gallon tanks. The isopentane is used as a motive fluid for geothermal energy generation and is not directly discharged, rather is released as an air emission. Therefore, the isopentane would not be directly exposed to stormwater. All other hazardous waste would be stored in 55-gallon drums and other Department of Transportation (DOT) approved packaging within a contained area located on the Site. Stormwater that accumulates within the hazardous material and hazardous waste containment area is collected via vacuum truck and disposed of off-site or recycled back into the production system. A bill of lading, non-hazardous waste manifest or uniform hazardous waste manifest is used to document all such shipments.

2.1.5 Employee Training

A combined annual Storm Water Compliance / SPCC Plan training program is conducted for the Pollution Prevention Team members and operations personnel. Participants undergo stormwater management training for all areas and operations at this facility, as well as reviewing the spill response, control and countermeasure procedures. Other stormwater training is done on an as-needed basis.

2.1.6 Waste Handling/Recycling

At times, product or oily waste streams are transferred from the facility in 55-gallon drums. A bill of lading, non-hazardous waste manifest or uniform hazardous waste manifest is used to document all such shipments. Operations or contractor personnel closely monitor loading of transport vehicles. Collection and satellite accumulation containers for hazardous and non-hazardous waste are kept covered to prevent contact with stormwater. Appropriate spill control equipment and supplies are kept readily available in case of a spill.

2.1.7 Record Keeping and Internal Reporting

All inspection, sampling, maintenance, corrective action records, and any other information that is a part of this plan are maintained at the facility office. All records are maintained for a period of at least three (3) years.

2.1.8 Erosion Control and Site Stabilization

Permanent BMPs used at the facility to prevent soil erosion include routing runoff along earthen swales or drainage areas, and preventing run-off with berms along certain sections of the property line. Temporary BMPs used at the Site to prevent soil erosion include the use of sandbags, crushed rock, and silt fence. These BMPs are used as and where needed, especially in areas that are undeveloped or in the process of being developed.

SECTION 3 Operation and Maintenance Plan

The Heber 2 Geothermal Repower Project is located at 855 Dogwood Road, Heber, California. The following non-structural water quality best management practices (BMPs) are proposed for the Project:

- Good Housekeeping
- Preventative Maintenance
- Spill Response
- Material Handling and Storage
- Employee Training
- Waste Handling/Recycling
- Record Keeping and Internal Reporting
- Erosion Control and Site Stabilization

3.1 MAINTENANCE RESPONSIBILITY

The Second Imperial Geothermal Company, a wholly owned subsidiary of ORMAT Nevada Inc (ORMAT) is the property owner and is responsible for BMP maintenance. Since ORMAT is the owner, no access agreement or easement is necessary to maintain the BMPs. ORMAT funds will be used to support Operation and Maintenance (O&M) activities to maintain BMP functionality. ORMAT maintenance staff are expected to perform the maintenance.

3.2 MAINTENANCE ACTIONS AND FREQUENCY

Maintenance actions are generally grouped into two categories: routine and intermittent.

Routine Maintenance

Routine inspections of the Project facilities and grounds will be performed annually. During these inspections staff evaluate if there is significant accumulation of trash, debris, or sediment that would need to be removed. Cleaning is done as needed based on the results of the inspections. The inspection frequency may be adjusted based on experience at the site (e.g., if inspections rarely find any material that needs to be cleaned out, then the inspection frequency can be reduced).

Intermittent Maintenance

Intermittent maintenance activities include more substantial maintenance that is not required as frequently as routine maintenance. The most likely form of intermediate maintenance is removal of sediment from existing drainage infrastructure and detention basins where necessary to maintain the capacity of the basins. Given that the Project Site is pervious and will not be graded or significantly altered and that rain is infrequent in Heber, this type of maintenance is expected to be required approximately once every year.

3.3 MAINTENANCE PROCEDURES

During each maintenance visit, the maintenance crew will evaluate existing drainage paths and infrastructure by inspecting for the maintenance indicators in **Table 3**. When a maintenance indicator is observed, the action described in the "Maintenance Actions" column will be taken.

Note that regardless of the projected maintenance type (routine or intermittent) described in the previous section, when a maintenance indicator is observed, the required maintenance action will be taken. For example, if significant sediment accumulation is observed in year three instead, then the accumulated sediment will still be cleaned out, even though the estimated frequency was once every year.

Table 3-1. Maintenance Indicators and Actions for BMPs

Typical Maintenance Indicator	Maintenance Action
Erosion due to concentrated stormwater runoff flow	Repair eroded areas and make appropriate corrective measures such as adding berm or stone at flow entry points, or re-grading as necessary.
Accumulated sediment, litter, or debris	Remove and properly dispose of accumulated materials, without damage to stormwater drainage structures.
Standing water	Remove any obstructions or debris or invasive vegetation, loosing or replace top-soil to allow for better infiltration, or minor re-grading for proper drainage.
Obstructed inlet or outlet structures	Clear obstructions.
Damage to structural components such as inlet or outlet structures	Repair or replace as applicable.

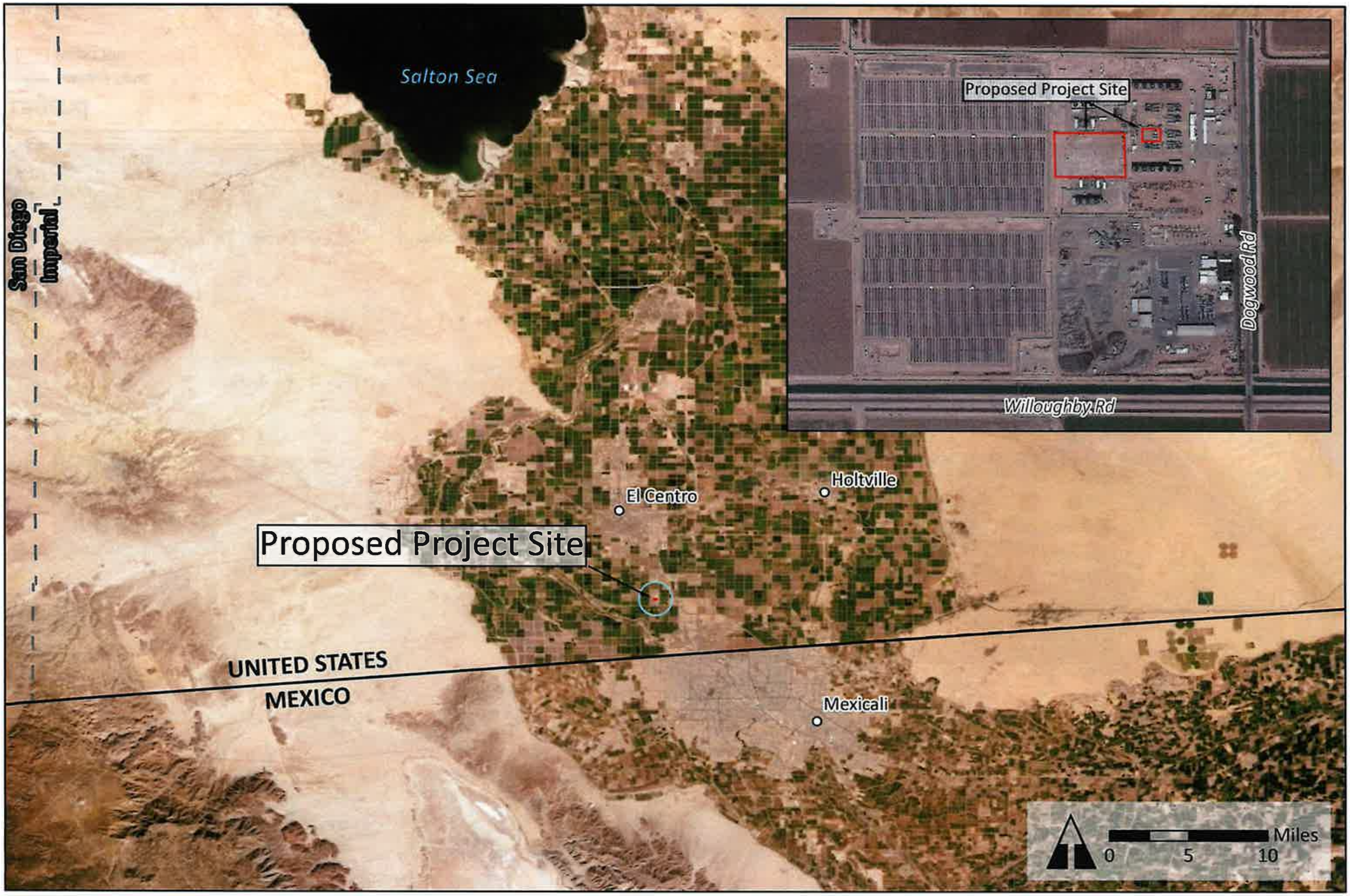
SECTION 4 References

Digital Desert. 2019. Ecological Sections: Mojave Desert. Available online at: http://digital-desert.com/ecosections/322c.htm).

Landmark Consultants, Inc. (Landmark). 2019. Geotechnical Report Update, Heber 2 Repower Project, Heber, California. Prepared for Ormat Nevada. April 2019.

McCrink, T.P., Pridmore, C.L., Tinsley, J.C., Sickler, R.R., Brandenberg, S.J., and J.P. Stewart. 2011. Liquefaction and other ground failures in Imperial County, California, from the April 4, 2010, El Mayor–Cucapah earthquake: U.S. Geological Survey Open-File Report 2011–1071 and California Geological Survey Special Report 220, 94 p. pamphlet, 1 pl., scale 1:51,440. Available at http://pubs.usgs.gov/of/2011/1071.

Figures



Legend
- United States/Mexico Border
- County Line
- Project Site
- 1-Mile Radius

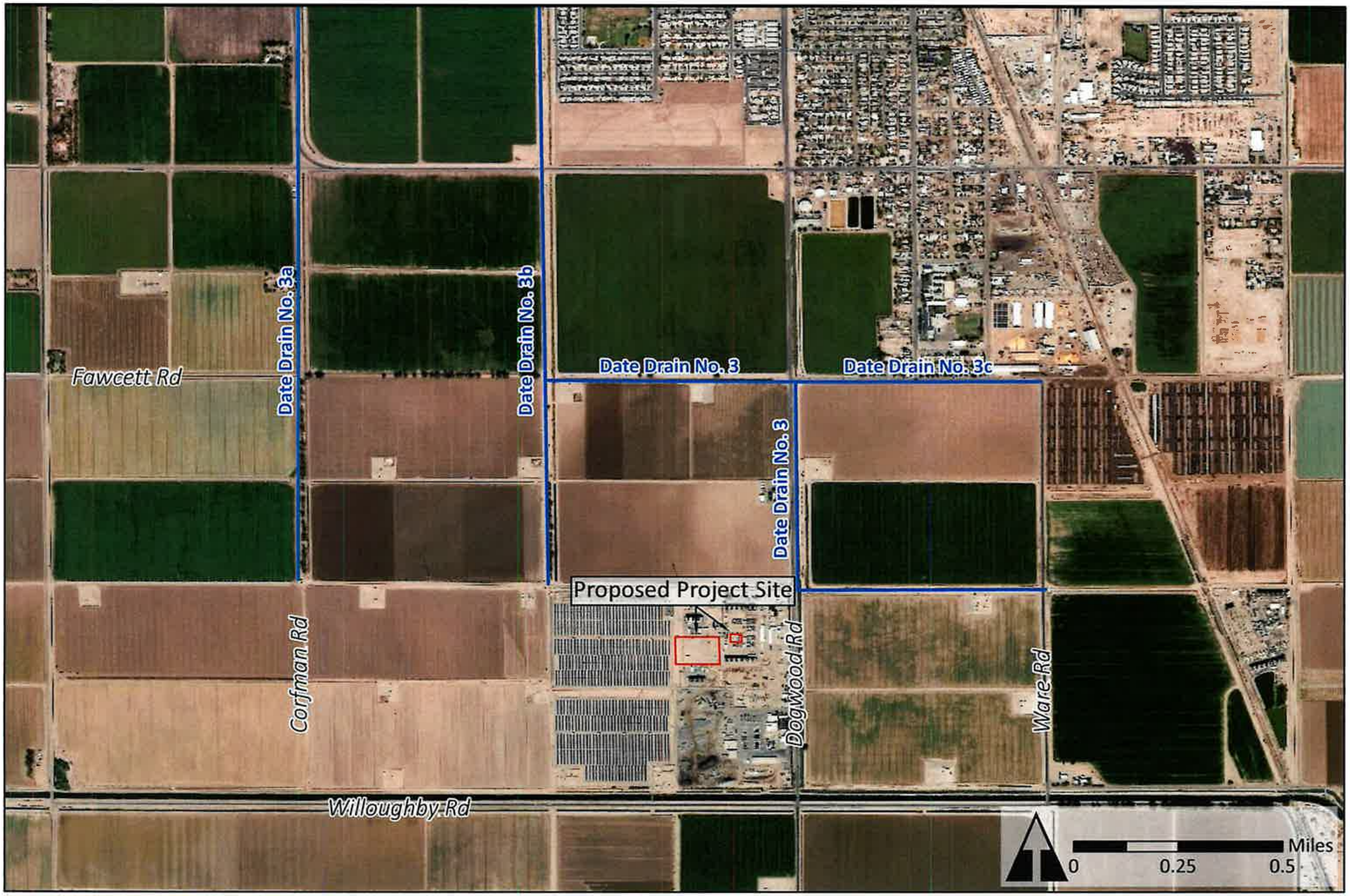
PROPOSED PROJECT SITE - HEBER 2

Catalyst ENVIRONMENTAL SOLUTIONS

Figure 1

ORMAT

Date: July 2019

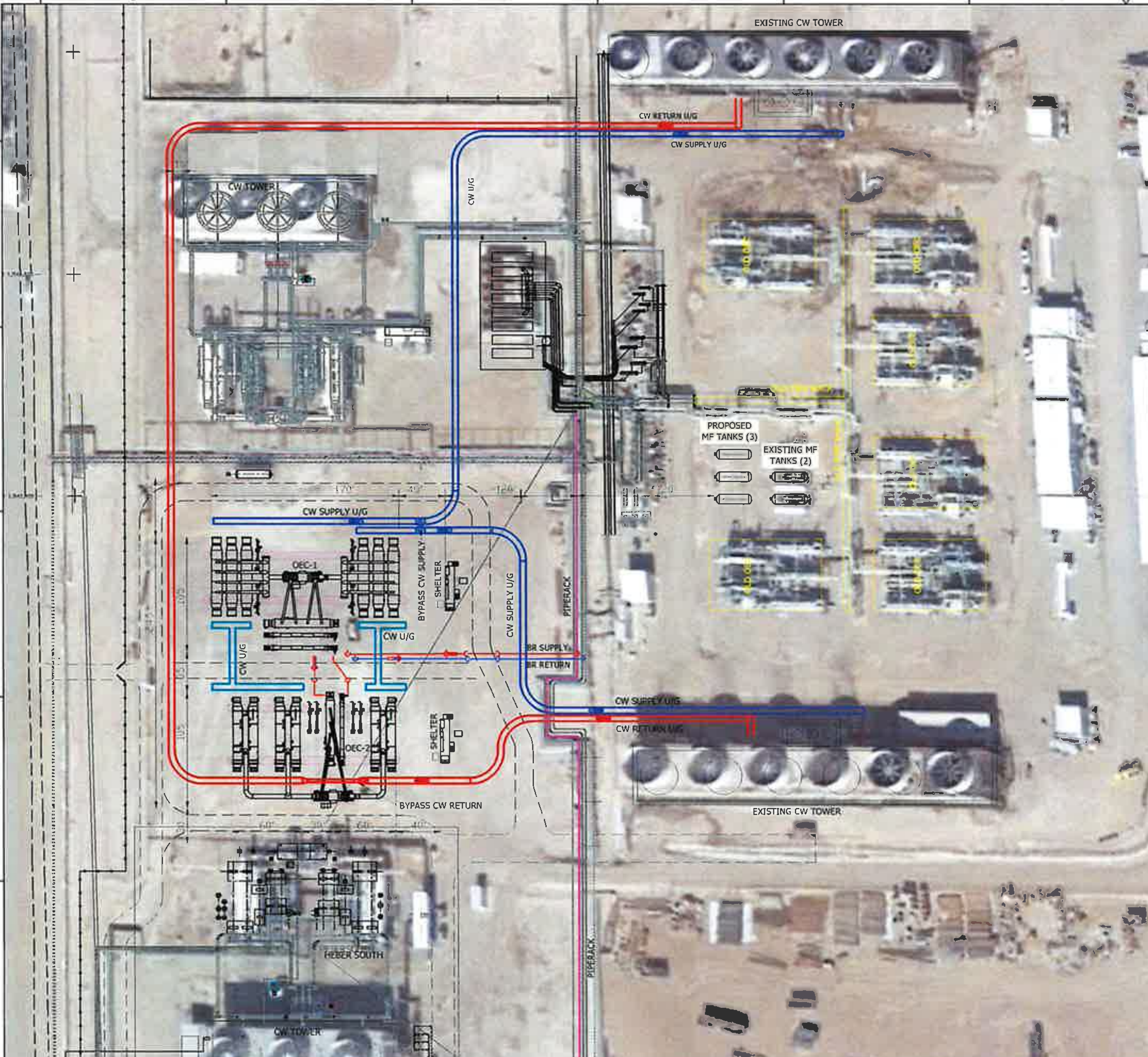


Legend
- Drainage Canal
- Project Site

DRAINAGE CANALS

Figure 2
ORMAT
Date: July 2019

Catalyst ENVIRONMENTAL SOLUTIONS



REV	DESCRIPTION	DATE	BY	CHK	ENG	PRJ
P6	UPDATE MODELS OES-1 & OEC-2	5.APR.2019	A.S.	A.N.		S.H.
P7	UPDATE MODELS OES-1	17.APR.2019	A.S.	A.N.		S.H.
P8	UPDATE OEC-1 & OEC-2	27.MAY.2019	A.S.	A.N.		S.H.
P9	UPDATE LOCATION OEC-1	18.JULY.2019	A.S.	A.N.		S.H.

N

KEY:

- EXISTING FENCE LINE
- PROPOSED UNDERGROUND CW SUPPLY LINE
- PROPOSED UNDERGROUND CW RETURN LINE
- PROPOSED BR SUPPLY LINE
- PROPOSED BR RETURN LINE
- EQUIPMENT TO BE DECOMMISSIONED
- EXISTING EQUIPMENT TO REMAIN

CW — COOLING WATER
U/G — UNDERGROUND
BR — GEOTHERMAL BRINE
OEC — ORMAT ENERGY CONVERTOR
MF — MOTIVE FLUID

NOTE:

1. THE ARRANGEMENT AND SIZES PRESENTED ARE PRELIMINARY AND INDICATIVE ONLY AND SUBJECT TO CHANGED ON DESIGN OPTIMIZATION, DETAILED DESIGN AND ACTUAL EQUIPMENT PURCHASED (MANUFACTURER).
2. DIMENSIONS ARE IN MM (FEET), ELEVATIONS ARE IN MM (FEET).

0 20' 100' 200'

GRAPHIC SCALE (FEET)

PREPARED BY

Stantec

PHONE FAX

FOR

Second Imperial Geothermal Company
855 B Dogwood Road
Heber CA 92249

TITLE

HEBER2 REPOWER
GENERAL ARRANGEMENT
POWER PLANT ON MAP

DRAWN BY KAM	DESIGNED BY
CHECKED BY	APPROVED BY
PROJECT NUMBER 0107 01234 01 0123	SCALE AS SHOWN
DATE 04/01/04	FILE PATH K:\CLIENT\JOB #
SHEET **1 OF 1**	

Catalyst
ENVIRONMENTAL SOLUTIONS

Geotechnical Site Summary Memorandum

Date: July 2019

From: Catalyst Environmental Solutions - Dan Tormey, P.G., Ph.D; Ben Pogue, M.P.A., P.M.P., A.I.C.P.

RE: Heber 2 Geothermal Repower Project – Geotechnical Site Assessment

---

This technical memorandum provides a summary of the geotechnical conditions for the Heber 2 project site, located at the Second Imperial Geothermal Company's (a wholly owned subsidiary of ORMAT Nevada, Inc.) existing Heber 2 Geothermal Energy Complex at 855 Dogwood Road, Heber, California, in Imperial County. Site-specific information was gathered from available online resources and extrapolated from the *Geotechnical Report Update* prepared by Landmark Consultants (Landmark, 2019). Landmark's report provides an update to previous geotechnical reports conducted at the site (Landmark 2005, 2007) and reflects the adoption of the 2016 California Building Code (CBC) and Imperial County's geotechnical engineering standard of practice.

Desktop reconnaissance was conducted to gather information on the geological-geotechnical site conditions, soil conditions, seismic conditions, liquefaction potential, site stability, and stormwater infiltration potential. Collectively, this memorandum provides a comprehensive review of the project site's geotechnical conditions to support the development of a California Environmental Quality Act (CEQA) Initial Study/Negative Declaration (IS/ND), as opposed to an as-graded, or as-built geotechnical report.

1.0 Geological/Geotechnical Site Conditions

The part of Imperial County containing Heber lies within the Pliocene to Holocene, Q Geologic Unit (McCrink et al. 2011). Three natural geomorphic provinces underlay Imperial County, including the Peninsular Ranges, the Colorado Desert, and the Mojave Desert. The Colorado Desert geomorphic province spans central Imperial County and contains the Salton Sea and the Imperial valley. This Basin and Range province, sometimes referred to as the Salton Trough, is composed of a low-lying barren desert basin located between alluvium-covered, active branches of the San Andreas Fault containing Cenozoic sedimentary rocks and alluvial, lacustrine, and eolian deposits. The surface of sediments in the middle of the trough are about 275 feet below sea-level (bsl) (Digital Desert, 2019).

2.0 Soil Conditions

There are approximately 28 soil types found in the region of the project area (Aco, Antho, Carrizo, Carsitas, Chuckwalla, Cibola, Coachella, Fluvaquents, Gadsden, Gilman, Glenbar, Holtville, Imperial, Indio, Kofa, Lagunita, Laposa, Laveen, Mecca, Meloland, Niland, Orita, Ripley, Rositas, Salorthids, Superstition, Torriorthents, and Vint). Glenbar, Holtville, and Imperial parent spoils are formed from fine-textured, stratified alluvial basin deposits (ICPDS 2015). The clay material deposited during the formation of the Colorado River delta terrace is the original source of Holtville and Imperial parent soils. Many of the other soils were formed from fan sediment originating from large gullies created by runoff into the Salton Sea. Imperial County soils are characterized by hyperthermic soil temperature and aridic soil moisture regimes (Digital Desert, 2019).

Dry lean silty clays dominate the project site surface extending to approximately 4 to 5 feet below ground surface (bgs). These silty clays are underlain by moist stiff clays from approximately 6 ft to 38-40 ft bgs. Silty clay to clayey silt dominate 40-50 ft bgs to the extent of geotechnical exploration (Landmark 2019).

3.0 Seismic Conditions/Liquefaction Potential

There are several active faults in the Imperial Valley, including the Brawley Fault Zone, San Jacinto Fault Zone (contains the Coyote Creek Fault, the Elmore Ranch Fault, and the Wienert Fault), the Elsinore Fault (contains the Laguna Salada Fault), the Imperial Fault, the San Andreas Fault Zone, and the Superstitions Hills Fault (ICPDS 2015). There are several mapped faults of the San Andreas Fault System across the valley, which is comprised of the San Andreas, San Jacinto, and Elsinore Fault Zones. Landmark (2019) employed a computer-aided search approach to assess known faults and seismic zones within 36 miles of the project site. The Imperial Fault located 9.4 miles southwest of the project site was the closest mapped Earthquake Fault Zone.

Earthquake hazard zones are characterized by areas susceptible to fault ruptures (ground surface breaks/cracks along a fault), liquefaction, and landslides. Ground shaking can occur during an earthquake, and its intensity is related to the proximity of the area to the fault, the focal depth, soil types, the location of the epicenter, and the size (magnitude) of the earthquake. Soils formed from alluvial deposits are more prone to ground shaking than dense materials such as bedrock. Moderate to strong ground motion could be expected in the project area; however, ground motions could vary considerably due to potential attenuation by rock and soil deposits, as well as the type of fault and direction of rupture (Landmark 2019). Soils in the project area were classified as Site Class D, which is characterized by a stiff soil profile. Further, Landmark determined a Seismic Design Category of D based on a Risk Category III.

Liquefaction occurs when loosely packed, saturated soil or sediment at or near the ground surface loses its strength, which can lead to excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations (Imperial County 2015). Landslide and liquefaction zones have not been mapped in this area (ICPDS 2015); however, the Colorado River Delta region of southern Imperial County (including Heber) is a seismically active area. Landmark (2019) evaluated liquefaction potential at the project site using the 1997 NCEER Liquefaction Workshop methods. Due to the cohesive nature of the subsurface soils, liquefaction is not anticipated at the project site, and mitigation is not recommended.

Several significant earthquakes have occurred in the vicinity with corresponding surface fault ruptures and liquefaction events (McCrink et al. 2011). Four earthquakes greater than magnitude 5 were recorded near Heber, between 1915 and 1979. The El Mayor-Cucapah earthquake (magnitude 7.2) that occurred throughout southern Imperial valley in 2010 caused widespread liquefaction near the towns of Calexico (immediately south of Heber) and El Centro (immediately north of Heber).

4.0 Stormwater Infiltration Potential

Encouraging stormwater infiltration by means of a stormwater management plan (SWMP) can improve water conservation by reducing evaporation and increasing groundwater recharge, as well avoiding erosion and potential damage to concrete foundations and slabs. Beneficial water quality of streams and rivers can also be maintained by preventing discharge of stormwater containing sediments and other materials. The City of El Centro and City of Imperial SMP provide best management practices (BMPs) for stormwater management by commercial businesses and industrial operations (City of El Centro and Imperial County 2013).

Heber also has a Master Drainage Plan (established in 2006), although the town's management of stormwater defers to the Imperial County Planning and Development guidelines and the county Public Works Department. The Imperial Irrigation District board adopted the Imperial Integrated Regional Water Management Plan (IRWMP) in 2012 (GEI 2012). The plan was developed to support the efforts to meet the County's future water resource demands while conforming to California Department of Water Resources guidelines.

Groundwater is encountered approximately 8 to 10 feet bgs at the project site (Landmark 2019). Onsite infiltration potential (capacity of the most limiting layer to transmit water [Ksat]) ranges from very low to moderately low (0.00 to 0.06 inches per hour) (Holtville silty clay, wet; approximately 71% of the project site) to moderately high (0.20 to 0.57 inches per hour) (Imperial-Glenbar silty clay loams, wet; approximately 29% of the project site). These soil types are also considered to be moderately well drained (NRCS 2019). Evaporation potential is considered poor at the project site.

5.0 Site Stability

The project site is located within the seismically active Imperial Valley and has the potential for ground disturbance based on soil and subsurface characteristics. Recommendations for the expansion project, including engineered design and earthquake-resistant construction complying with the latest edition of the CBC for Site Class D are provided in Landmark's updated geotechnical report (2019).

6.0 References

City of El Centro and City of Imperial. 2013. Stormwater Management Plan. August 15, 2013.

City of San Diego. 2018. Guidelines for Geotechnical Reports. Available at https://www.sandiego.gov/sites/default/files/legacy/development-services/pdf/industry/geoguidelines.pdf.

Digital Desert. 2019. Ecological Sections: Mojave Desert. Available online at: http://digital-desert.com/ecosections/322c.htm).

GEI Consultants, Inc. (GEI). 2012. Imperial Integrated Regional Water Management Plan. Appendix C - Disadvantaged Community Needs Assessment Technical Memorandum (Working Group Draft). Prepared for the Imperial Water Forum. October 2012. Available at http://imperialirwmp.org/2013%20Updates/finalirwmp.html.

Imperial County. 2015. Final EIR. SEPV Dixieland East and West Solar Farm Projects. SCH No. 2015051043. December 2015.

Imperial County Planning and Development Services (ICPDS). 2015. Baseline Environmental Inventory Report, Imperial County Conservation and Open Space Element Update. June 2015.

Landmark Consultants, Inc. (Landmark). 2019. Geotechnical Report Update, Heber 2 Repower Project, Heber, California. Prepared for SIGC/ORMAT Nevada. April 2019.

Landmark. 2007. Geotechnical Investigation, Proposed Heber South Geothermal Plant, Dogwood Road, Heber, California. Prepared for SIGC/ORMAT. May 2007.

Landmark. 2005. Geotechnical Report, New Turbine Generator and Cooling Tower, Heber 2 Geothermal Plant, Heber, California. Prepared for SIGC/ORMAT. January 2005.

McCrink, T.P., Pridmore, C.L., Tinsley, J.C., Sickler, R.R., Brandenberg, S.J., and J.P. Stewart. 2011. Liquefaction and other ground failures in Imperial County, California, from the April 4, 2010, El Mayor–Cucapah earthquake: U.S. Geological Survey Open-File Report 2011–1071 and California Geological Survey Special Report 220, 94 p. pamphlet, 1 pl., scale 1:51,440. Available at http://pubs.usgs.gov/of/2011/1071.

Natural Resources Conservation Service (NRCS). 2019. Web Soil Survey, National Cooperative Soil Survey. Report generated on June 5, 2019.

Geotechnical Report Update

Heber 2 Repower Project
Heber, CA

Prepared for:

Ormat Nevada
1010 Power Plant Road
Reno, NV 89521

Prepared by:

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243
(760) 370-3000

April 2019

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

April 30, 2019

Mr. Shlomi Huberman
Ormat Nevada
1010 Power Plant Road
Reno, NV 89521

Geotechnical Report Update
Proposed Heber 2 Repower Project
855 Dogwood Road
Heber, California
LCI Report No. LE19075

Dear Mr. Huberman:

Landmark Consultants, Inc. is providing this geotechnical report for the project at the Heber 2 Repower geothermal power plant. This report updates Landmark's 2004 and 2007 Geotechnical Reports for the power plant located at 855 Dogwood Road southwest of Heber, California. The update addresses changes made due to the adoption of the 2016 California Building Code (CBC) and geotechnical engineering standard of practice in Imperial County. The original reports (LCI Report No. LE04354, dated January 10, 2005 and LCI Report No. LE07178, dated May 9, 2007) are provided in Appendix D and Appendix E, respectively.

This update report presents selected elements of our findings and professional opinions only. It does not present all details that may be 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 Geotechnical Report Update, and with the active participation of the engineer of record who developed them during design and construction of the project.

Seismic Parameters

Seismic Risk: The project site 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). We have performed a computer-aided search of known faults or seismic zones that lie within a 36 mile (57 kilometer) radius of the project site as provided in Table 1.

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. A legend for the regional fault map is presented on Figure 2. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along active or potentially active faults. An active fault is one that has ruptured during Holocene time (roughly within the last 11,000 years). A fault that has ruptured during the last 1.8 million years (Quaternary time), but has not been proven by direct evidence to have not moved within Holocene time is considered to be potentially active. A fault that has not moved during both Pleistocene and Holocene time (that is no movement within the last 1.8 million years) is considered to be inactive. Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2000a) indicates that the nearest mapped Earthquake Fault Zones are the Imperial fault located approximately 9.4 miles southwest of the project site.

Site Acceleration: The project site is considered likely to be subjected to moderate 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. Accelerations 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 2016 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, 2019) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. **The site soils have been classified as Site Class D (stiff soil profile).**

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. Design earthquake ground motion parameters are provided in Table 2. **A Risk Category III was determined using Table 1604.5 and the Seismic Design Category is D since S_1 is less than 0.75.**

The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration (PGA_M) value was determined from the "U.S. Seismic Design Maps Web Application" (SEAOC, 2019) for liquefaction and seismic settlement analysis in accordance with 2016 CBC Section 1803.5.12 and CGS Note 48 ($PGA_M = F_{PGA}*PGA$). **A PGA_M value of 0.50g is used for liquefaction settlement analysis.**

Subsurface Soil and Groundwater

Subsurface soils encountered during Landmark's 2004 and 2007 geotechnical studies consist of surficial dry very stiff lean silty clays to a depth of 4 to 5 feet. Stiff clays extend from about 6 feet to a depth of 38 to 40 feet. Silty clay to clayey silt was encountered from 40 to 50 feet, the maximum depth of exploration. The subsurface logs (Plates B-1 through B-5 in Appendix B) depict the stratigraphic relationships of the various soil types. Groundwater was not noted in the CPT soundings, but is typically encountered at a depth of about 8 to 10 feet below ground surface at the plant site.

Liquefaction Potential

Liquefaction potential at the project site 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}. A PGA_M value of 0.50g was used in the analysis with a 15-foot groundwater depth 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). Computer printouts of the liquefaction analyses are provided in Appendix C.

Liquefaction is not expected occur at the project site due to the cohesive nature of the subsurface soils. No mitigation is required for liquefaction induced settlements at this project site.

Site Preparation

Structure Subgrade Preparation: The exposed surface soil within foundation areas should be removed to 18 inches below the foundation elevation or existing grade (whichever is lower) extending five feet beyond all foundation lines. Exposed subgrade should be neat cut (flat blade on bucket).

A minimum of 18 inches of Caltrans Class 2 aggregate base shall be placed and compacted in 6 inch maximum lifts to 95% of ASTM D1557 maximum dry density below each foundation or mat slab.

Imported fill soil (if required) should have a Plasticity Index less than 15 and sulfates (SO_4) less than 1,000 ppm or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported granular fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least 95% of ASTM D1557 maximum dry density at optimum moisture ±2%.

Trench Backfill: On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill. Backfill soil within paved areas should be placed in layers not more than 6 inches in thickness and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 95%. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material. Pipe envelope/bedding should either be clean sand (Sand Equivalent SE>30). Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the geotechnical parameters for site development.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have footings extended to a minimum of 24 inches below grade. The existing soil beneath the structure foundation prepared in the manner described for foundations except the preparation needed only to extend 12 inches below and beyond the footing.

Foundations and Settlements

Shallow spread footings and continuous wall footings are suitable to support the structures associated with the plant upgrades. Footings shall be founded on a layer of properly prepared and compacted soil as described in Section 4.1. The foundations may be designed using an allowable soil bearing pressure of 2,000 psf at 18-inch embedment depth when foundations are supported on compacted Caltrans Class 2 aggregate base (extending a minimum of 1.5 feet below footings).

The allowable soil pressure may be increased by 20% for each foot of embedment depth in excess of 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 4,000 psf.

Flat Plate Structural Mats: Structural mats may be designed for a modulus of subgrade reaction (Ks) of 100 pci when placed on compacted clay or a subgrade modulus of 250 pci when placed on 2.5 feet of granular fill. Mats shall overlay 2 inches of sand and a 10-mil polyethylene vapor retarder. The structure support pad shall be moisture conditioned and recompacted as specified in Section 4.1 of this report.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 300 pcf to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.35 may also be used at the base of the footings to resist lateral loading. Foundation movement under the estimated loadings are estimated to not exceed ½ inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed.

Note: The entire plant area overlays a geothermal fluids reservoir that geothermal fluids extraction and reinjection is causing annual ground surface settlement of 1 to 2 inches per year. The settlement is not uniform.

Drilled Piers: New foundations may be supported on cast-in-place, drilled piers. Design criteria are provided below.

***Vertical Capacity*:** Vertical capacity for 24 and 36-inch diameter shafts are presented in Figure 3. 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 24 and 36-inch diameter shafts are given in the table shown below. The allowable horizontal deflection has been assumed to be one-half inch (0.50 inch).

Table 3 – Lateral Capacities

Shaft Diameter (in.)	24		36	
Head Condition	Free	(*) Fixed	Free	(*) Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5
Minimum Length (ft.)	10	10	10	10
Lateral Capacity (kips)	15.6	50.8	20.0	65.0
Maximum Moment (foot-kips)	42.2	-293.3	53.7	-362.4
@Depth from Pier Head (ft.)	4.2	0	4.2	0
Minimum Length (ft.)	20	20	20	20
Lateral Capacity (kips)	32.0	70.5	52.0	124.0
Maximum Moment (foot-kips)	142.5	-393.3	266.7	-1025.0
@Depth from Pier Head (ft.)	9.0	0	9.8	0
Minimum Length (ft.)	30	30	30	30
Lateral Capacity (kips)	32.5	73.5	65.8	152.0
Maximum Moment (foot-kips)	145.0	-407.5	413.3	-1141.7
@Depth from Pier Head (ft.)	9.0	0	11.6	0

(*) Fixed head is defined as there is no rotation in the pier head (concrete foundation surrounding the pier heads).

Uplift Capacity: Pier capacity in tension may be assumed to be 50% of the compression capacity.

Settlement: Total settlements (non-seismic) of less than ¼ inch, and differential movement of about two-thirds of total movement for single pier designed according to the preceding recommendations. If pier spacing is at least 2.5 pier diameters center-to-center, no reduction in axial load capacity is considered necessary for group effect.

Note: The entire plant area overlays a geothermal fluids reservoir that geothermal fluids extraction and reinjection is causing annual ground surface settlement of 1 to 2 inches per year. The settlement is not uniform.

Note: Soil strength parameters obtained from field data and laboratory testing were modified based on our engineering judgment and our previous experience in the general site vicinity.

Soil Parameters: Interpretive engineering soil parameters of the subsurface soil for use in the Allpile Computer Program are presented in the table below.

Table 4 – Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Lateral Soil Modulus, k (pci)	e_{50} or Dr	Strength Reduction Factor
SM	0 to 5	115	34°	0	80	45.0	1.0
CL-CH	5 to 12	125	---	1.25	315	0.85	1.0
CL-CH	12 to 40	125	---	1.75	550	0.70	1.0
ML	40 to 50	120	24°	0.50	225	1.00	1.0

***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. All drilled piers extending below groundwater shall be cased to prevent caving or lateral deformation. Groundwater is expected to be encountered at approximately 8 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.

Slabs-On-Grade

Structural Concrete: Structural concrete slabs are those slabs (foundations) that underlie structures or covered housekeeping slabs (shades). Concrete slabs and flatwork shall be a minimum of 6 inches thick due to equipment loads. Concrete slab and flatwork reinforcement should consist of chaired rebar slab reinforcement (minimum of No. 3 bars at 18-inch centers, both horizontal directions) placed at slab mid-height to resist drying shrinkage cracking. Slab thickness and steel reinforcement are minimums only and should be verified by the structural engineer/designer knowing the actual project loadings.

All steel components of the foundation system should be protected from corrosion by maintaining a 3-inch minimum concrete cover of densely consolidated concrete at footings (by use of a vibrator).

Control joints should be provided in all concrete slabs-on-grade at a maximum spacing (in feet) of 2 to 3 times the slab thickness (in inches) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce randomly oriented contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or sawcut (¼ of slab depth) within 6 to 8 hours of concrete placement. Construction (cold) joints in foundations and area flatwork should either be thickened butt-joints with dowels or a thickened keyed-joint designed to resist vertical deflection at the joint.

All joints in flatwork should be sealed to prevent moisture, vermin, or foreign material intrusion. Precautions should be taken to prevent curling of slabs in this arid desert region (refer to ACI guidelines).

Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site. The native soils were found to have S1 to S2 (moderate to severe) levels of sulfate ion concentration (1,052 to 3,006 ppm). 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 5. 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

A minimum of 6.0 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including foundations and housekeeping slabs). Admixtures may be required to allow placement of this low water/cement ratio concrete.

The native soil has moderate to very severe level of chloride ion concentration (210 to 3,040 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. Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 3 inches of densely consolidated concrete. ***No metallic water pipes or conduits should be placed below foundations.***

Foundation designs shall provide a minimum concrete cover of three (3) inches around steel reinforcing or embedded components (anchor bolts, etc.) exposed to native soil. If the 3-inch concrete edge distance cannot be achieved, all embedded steel components (anchor bolts, etc.) shall be epoxy coated for corrosion protection (in accordance with ASTM D3963/A934) or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings.

Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete.

Excavations

All site excavations should conform to CalOSHA requirements for Type C soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may cut nearly vertical for short duration. Sandy soil slopes should be kept moist, but not saturated, to reduce the potential of raveling or sloughing. Excavations below 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type C soil.

Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

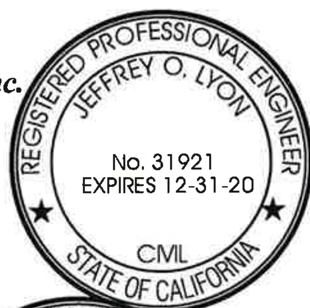
Seismic Design

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 and Cerro Prieto 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 CBC for Site Class D using the seismic coefficients given in Table 2 of this report.

Closure

We did not encounter soil conditions that would preclude implementation of the proposed project provided the recommendations contained in this report are implemented in the design and construction of this project. 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
President

Steven K. Williams, PG, EG
Senior Engineering Geologist

Julian R. Avalos, PE
Senior Engineer

TABLES

Table 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	7.0	11.2	7	62 ± 6	20 ± 5
Superstition Hills	8.4	13.5	6.6	23 ± 2	4 ± 2
Unnamed 2*	8.5	13.6			
Brawley *	8.8	14.1			
Rico *	9.9	15.9			
Unnamed 1*	12.0	19.2			
Borrego (Mexico)*	13.0	20.7			
Yuha*	13.3	21.2			
Superstition Mountain	14.7	23.5	6.6	24 ± 2	5 ± 3
Laguna Salada	14.8	23.6	7	67 ± 7	3.5 ± 1.5
Cerro Prieto *	15.2	24.3			
Pescadores (Mexico)*	17.2	27.5			
Shell Beds	17.3	27.6			
Yuha Well *	17.8	28.5			
Cucapah (Mexico)*	18.4	29.4			
Vista de Anza*	20.4	32.7			
Painted Gorge Wash*	24.0	38.4			
Ocotillo*	25.4	40.6			
Elmore Ranch	28.3	45.3	6.6	29 ± 3	1 ± 0.5
Elsinore - Coyote Mountain	29.1	46.6	6.8	39 ± 4	4 ± 2
San Jacinto - Borrego	33.6	53.8	6.6	29 ± 3	4 ± 2
Algodones *	35.6	57.0			

* Note: Faults not included in CGS database.

Table 2
2016 California Building Code (CBC) and ASCE 7-10 Seismic Parameters

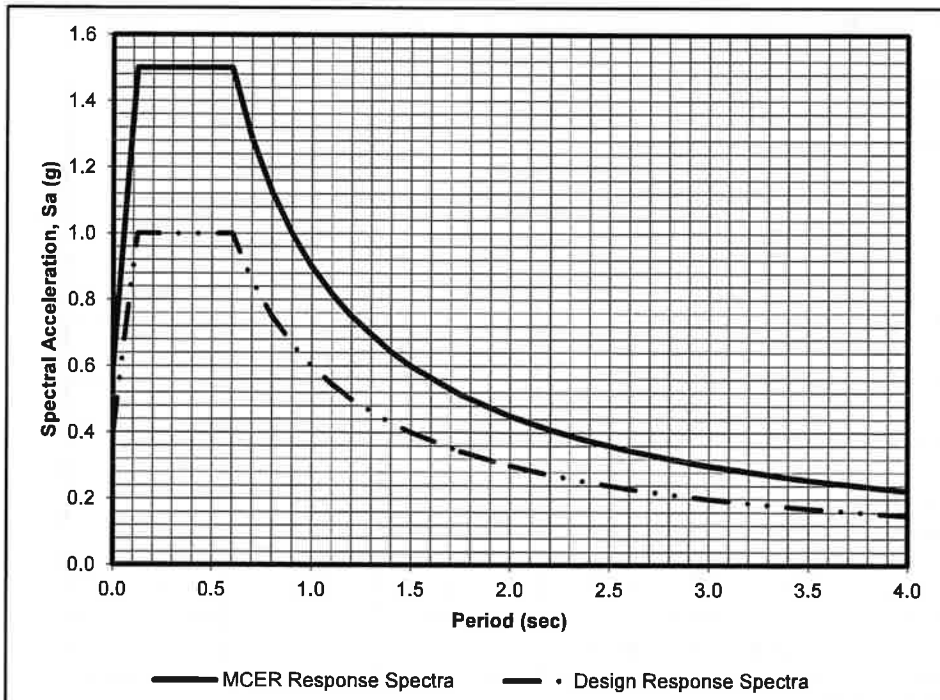
			ASCE 7-10 Reference
Soil Site Class:	D		Table 20.3-1
Latitude:	32.7139	N	
Longitude:	-115.5375	W	
Risk Category:	III		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

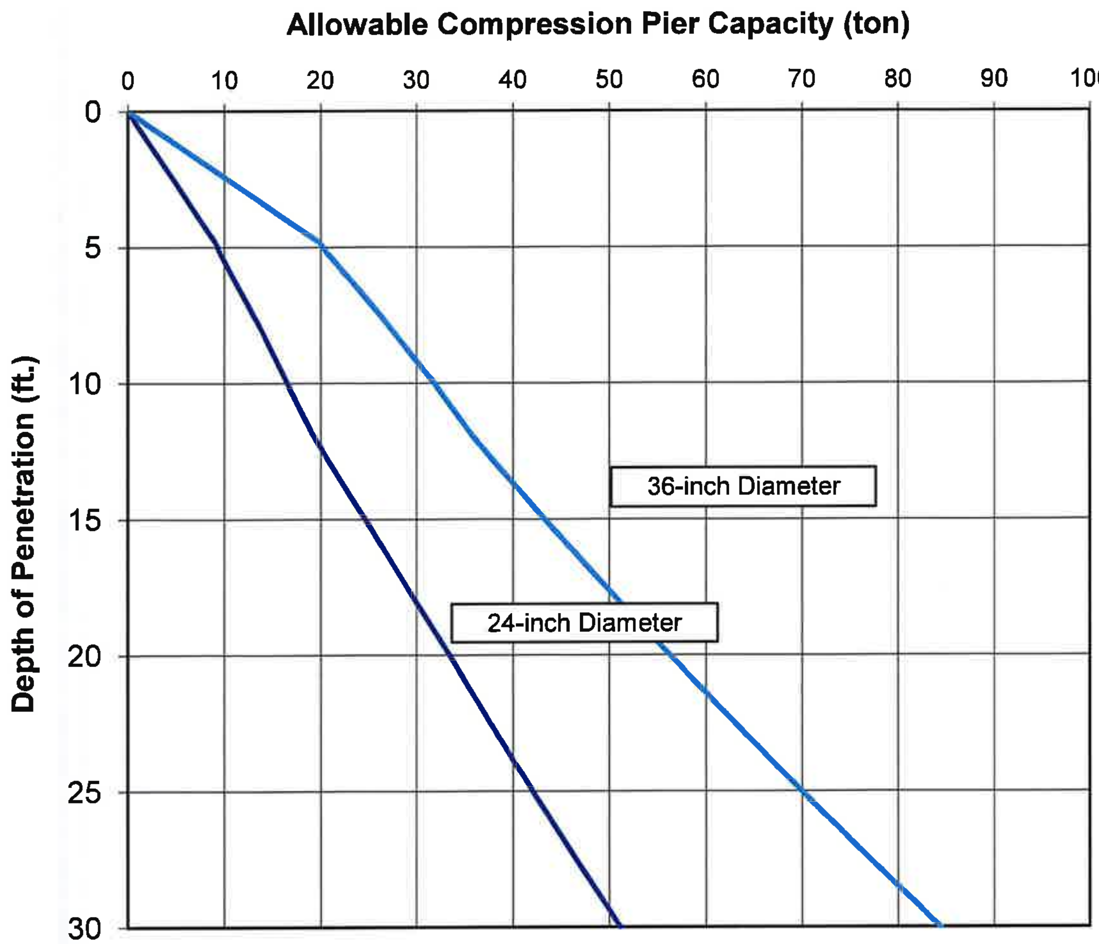
Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	CBC Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	CBC Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	CBC Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.50	CBC Table 1613.3.3(2)	
MCE_R 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}	0.900 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}	0.600 g	$= 2/3*S_{M1}$	CBC Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	1.106		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	1.073		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	0.50 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.12	1.00	1.50
0.60	1.00	1.50
0.70	0.86	1.29
0.80	0.75	1.13
0.90	0.67	1.00
1.00	0.60	0.90
1.10	0.55	0.82
1.20	0.50	0.75
1.20	0.50	0.75
1.40	0.43	0.64
1.50	0.40	0.60
1.75	0.34	0.51
2.00	0.30	0.45
2.20	0.27	0.41
2.40	0.25	0.38
2.60	0.23	0.35
2.80	0.21	0.32
3.00	0.20	0.30
3.50	0.17	0.26
4.00	0.15	0.23

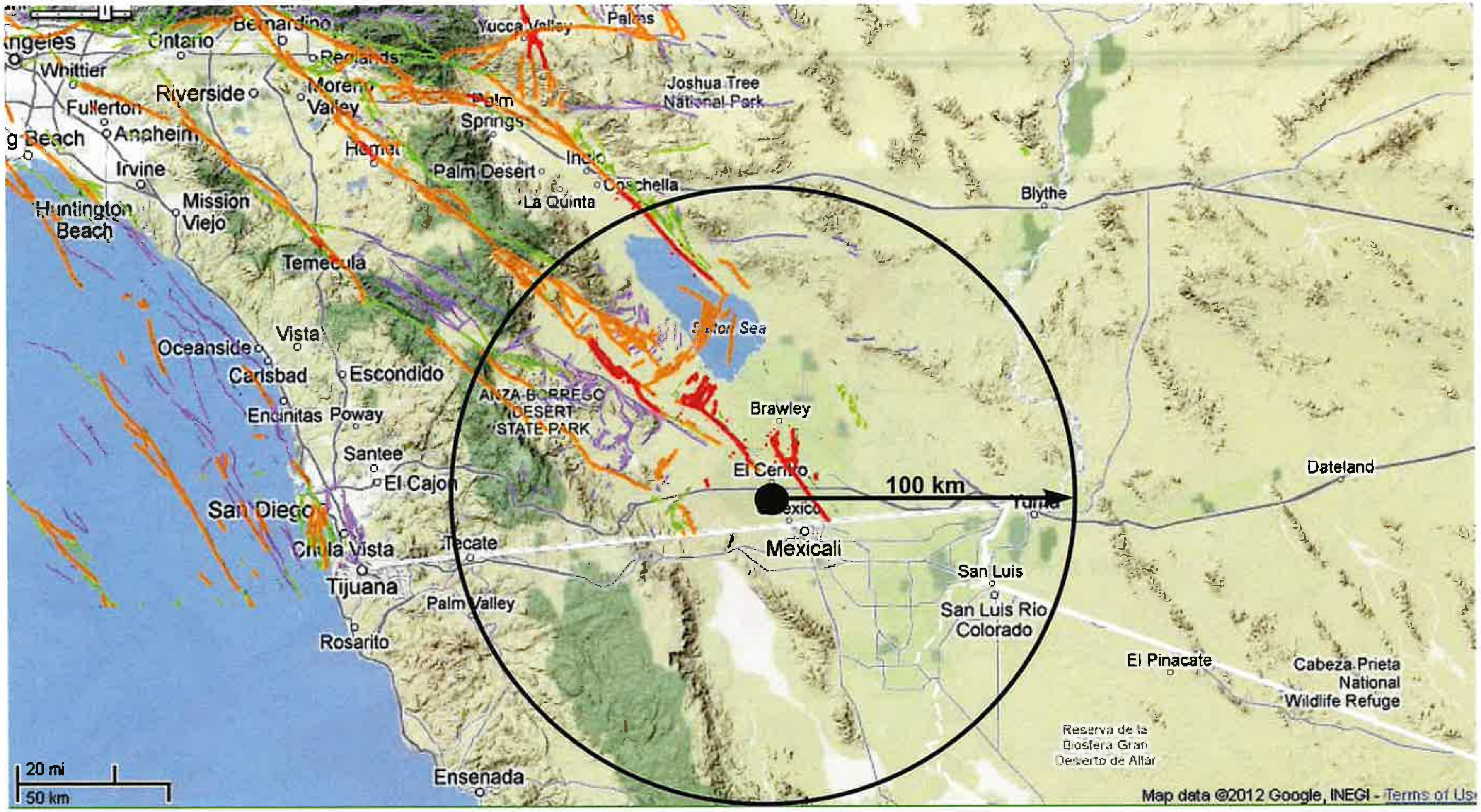


Notes:

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 pile diameter.

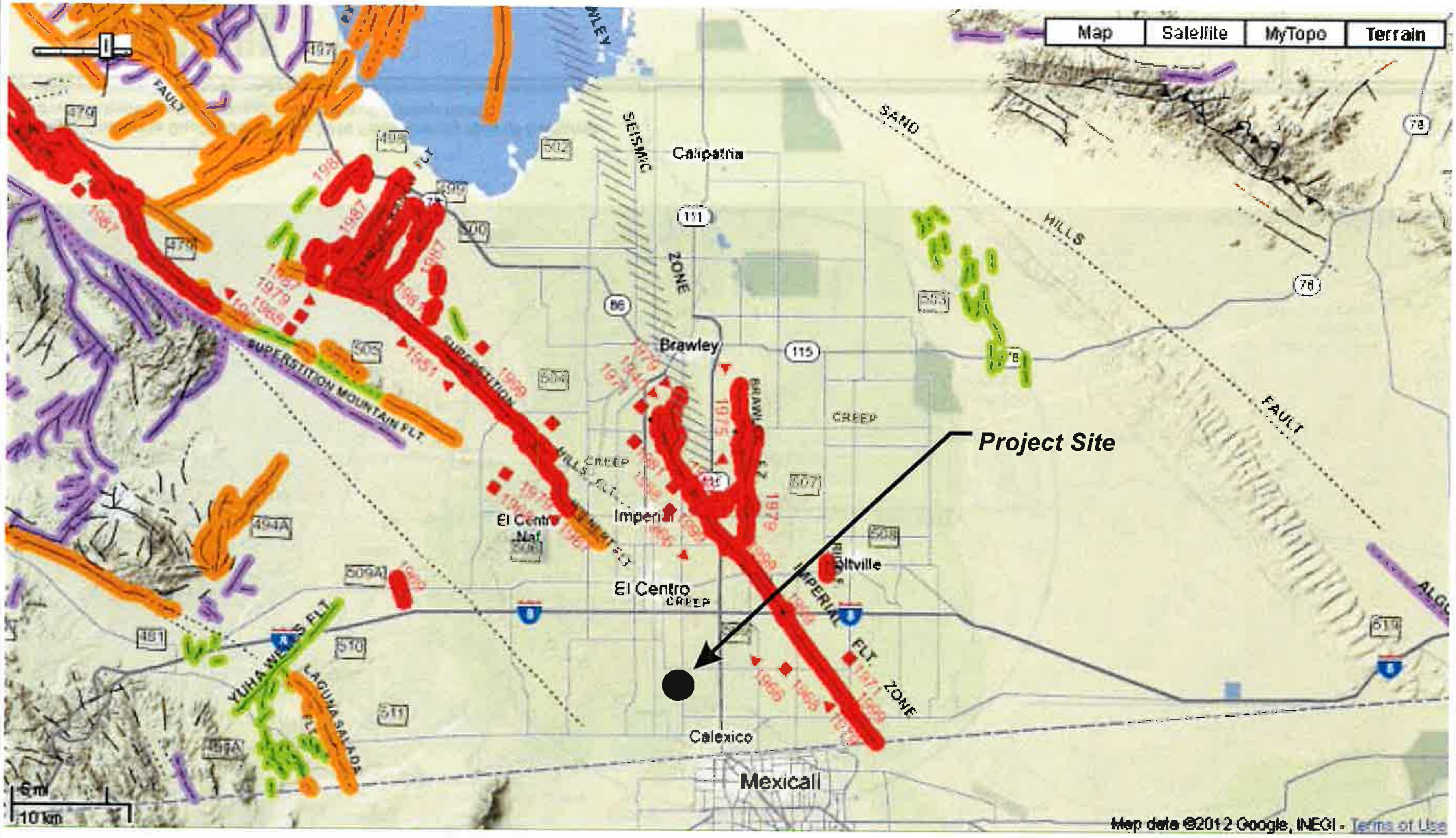
LANDMARK Geo-Engineers and Geologists a DBE/MBE/SBE Company Project No.: LE19075	**Drilled Pier Compression Capacity Chart Ormat's Heber #2 Plant Expansion Heber, California**	**Figure 3**

FIGURES



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

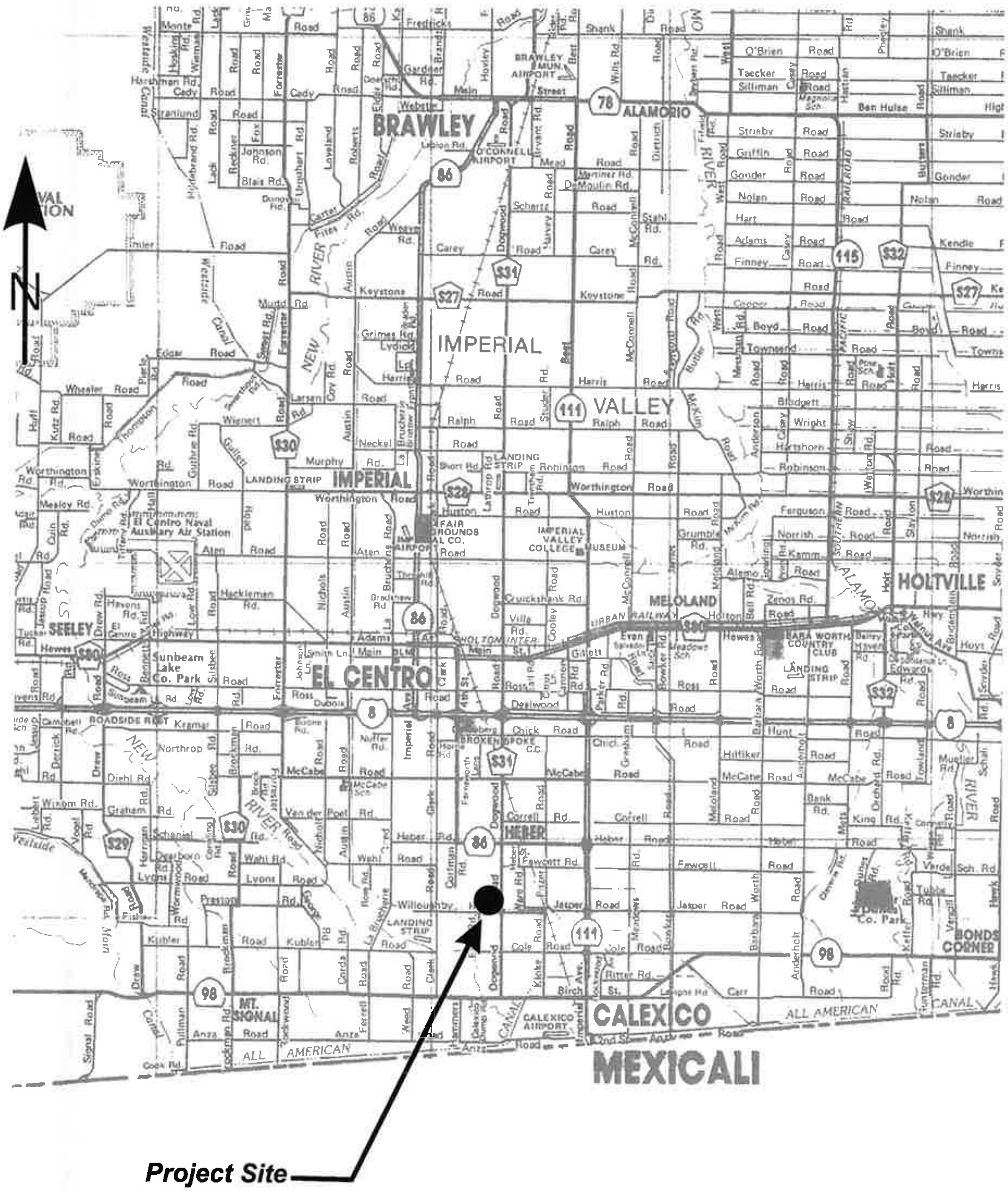
LANDMARK Geo-Engineers and Geologists Project No.: LE19075	Regional Fault Map	Figure 1



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.: LE19075	Map of Local Faults	Figure 2

APPENDIX A

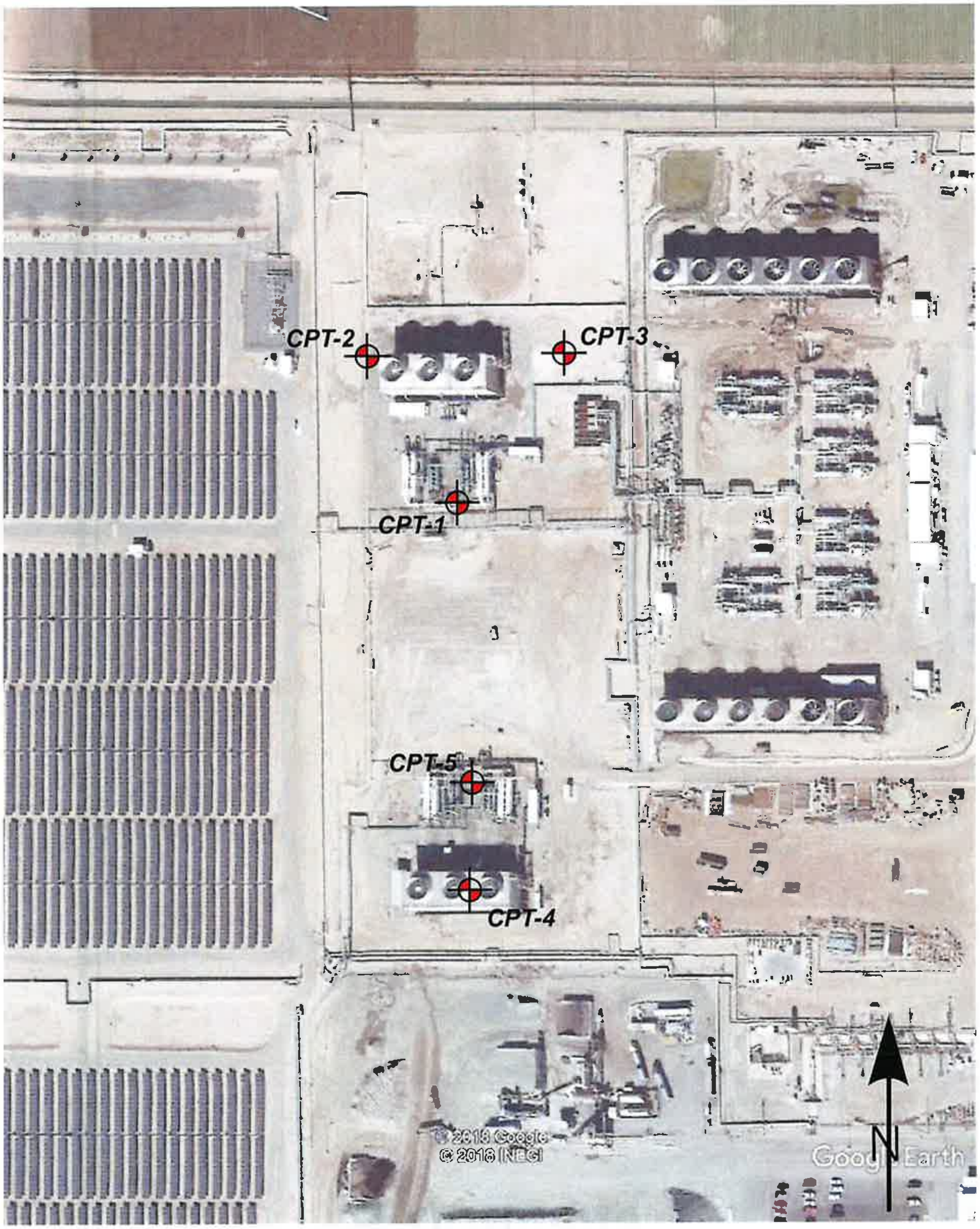


LANDMARK
Geo-Engineers and Geologists

Project No.: LE19075

Vicinity Map

Plate A-1



LANDMARK
Geo-Engineers and Geologists

Project No.: LE19075

Site and Exploration Map

Plate
A-2

APPENDIX B

CLIENT: Ormat Nevada Inc
PROJECT: Heber 2 Repower Project - Heber, CA
LOCATION: See Site and Boring Location Plan

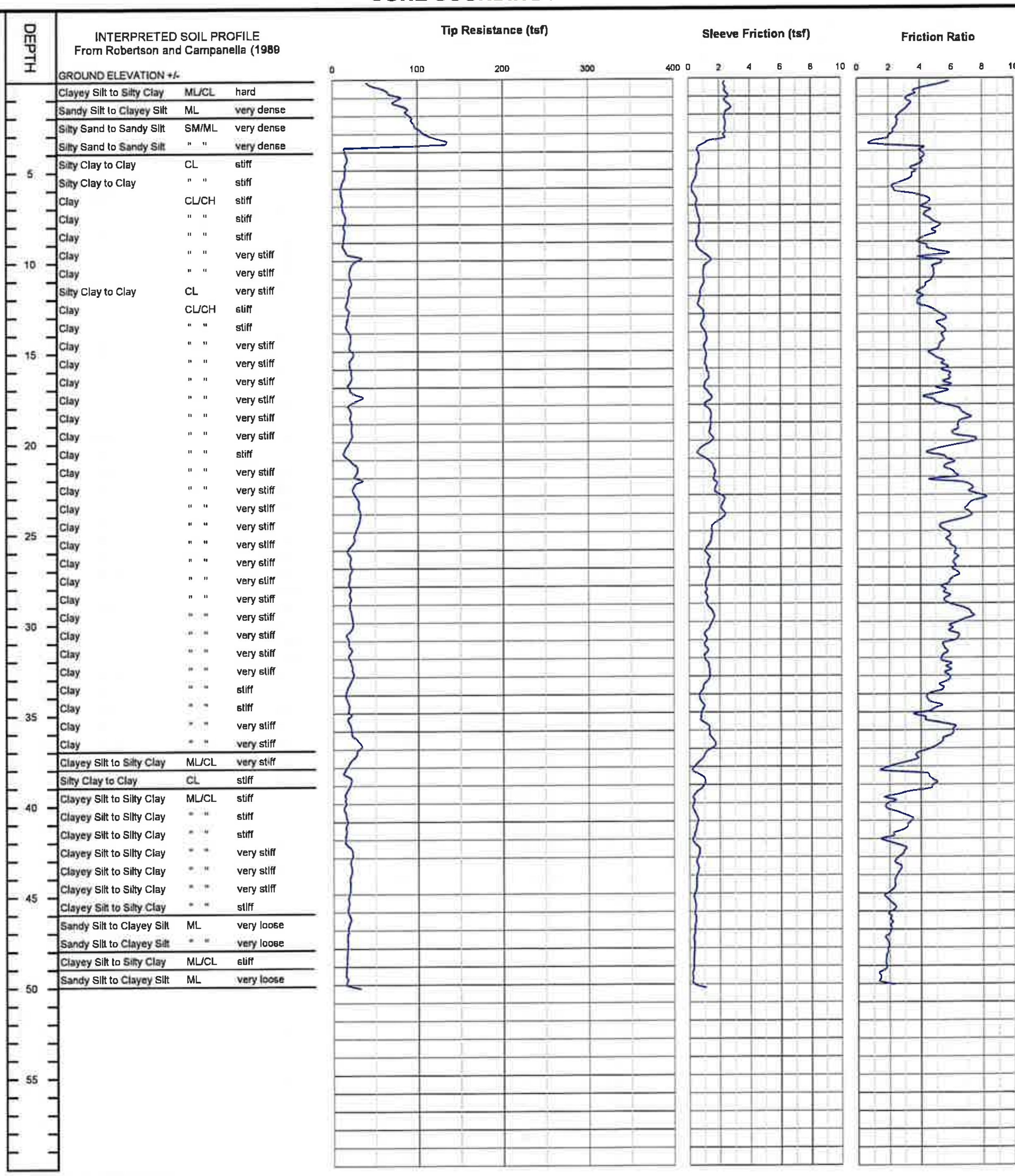
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight
DATE: 12/20/2004

CONE SOUNDING DATA CPT-1

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clayey Silt to Silty Clay	ML/CL	hard
Sandy Silt to Clayey Silt	ML	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	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
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	" "	stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose
Clayey Silt to Silty Clay	ML/CL	stiff
Sandy Silt to Clayey Silt	ML	very loose



END OF SOUNDING AT 50 ft.

Project No.
LE19075

LANDMARK
Geo-Engineers and Geologists

PLATE
B-1

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 12/20/2004

CONE SOUNDING: CPT-1
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	47.46	5.04	Silty Clay to Clay	CL	hard	125	27		60			2.79	>10
0.30	1.0	71.19	3.50	Sandy Silt to Clayey Silt	ML	very dense	115	20	134.6	45	107	43		
0.45	1.5	76.38	3.27	Sandy Silt to Clayey Silt	ML	very dense	115	22	144.4	40	102	42		
0.60	2.0	88.21	2.88	Sandy Silt to Clayey Silt	ML	very dense	115	25	166.8	35	101	42		
0.75	2.5	94.19	2.53	Silty Sand to Sandy Silt	SM/ML	very dense	115	21	178.0	30	100	42		
0.93	3.0	101.94	2.35	Silty Sand to Sandy Silt	SM/ML	very dense	115	23	192.7	30	99	42		
1.08	3.5	123.24	1.66	Sand to Silty Sand	SP/SM	very dense	115	22	233.0	20	102	42		
1.23	4.0	53.93	2.99	Sandy Silt to Clayey Silt	ML	dense	115	15	101.9	45	76	39		
1.38	4.5	16.43	4.19	Clay	CL/CH	stiff	125	13		85			0.95	>10
1.53	5.0	15.53	3.80	Silty Clay to Clay	CL	stiff	125	9		85			0.90	>10
1.68	5.5	13.99	3.48	Silty Clay to Clay	CL	stiff	125	8		85			0.80	>10
1.83	6.0	10.16	2.42	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.58	>10
1.98	6.5	10.41	3.55	Silty Clay to Clay	CL	stiff	125	6		95			0.59	>10
2.13	7.0	11.62	4.38	Clay	CL/CH	stiff	125	9		100			0.66	>10
2.28	7.5	13.29	4.44	Clay	CL/CH	stiff	125	11		95			0.76	>10
2.45	8.0	14.55	4.93	Clay	CL/CH	stiff	125	12		95			0.83	>10
2.60	8.5	13.90	4.96	Clay	CL/CH	stiff	125	11		95			0.79	>10
2.75	9.0	13.23	4.08	Clay	CL/CH	stiff	125	11		95			0.75	>10
2.90	9.5	13.66	4.68	Clay	CL/CH	stiff	125	11		100			0.77	>10
3.05	10.0	26.88	5.00	Clay	CL/CH	very stiff	125	22		80			1.55	>10
3.20	10.5	21.69	5.01	Clay	CL/CH	very stiff	125	17		85			1.24	>10
3.35	11.0	19.84	4.85	Clay	CL/CH	very stiff	125	16		90			1.13	>10
3.50	11.5	21.31	4.45	Silty Clay to Clay	CL	very stiff	125	12		85			1.22	>10
3.65	12.0	18.97	4.00	Silty Clay to Clay	CL	very stiff	125	11		85			1.08	>10
3.80	12.5	16.82	3.88	Silty Clay to Clay	CL	stiff	125	10		90			0.95	>10
3.95	13.0	18.18	4.91	Clay	CL/CH	very stiff	125	15		95			1.03	>10
4.13	13.5	17.33	5.43	Clay	CL/CH	stiff	125	14		100			0.98	>10
4.28	14.0	17.04	5.46	Clay	CL/CH	stiff	125	14		100			0.96	>10
4.43	14.5	21.21	5.45	Clay	CL/CH	very stiff	125	17		100			1.21	>10
4.58	15.0	19.96	5.21	Clay	CL/CH	very stiff	125	16		100			1.13	>10
4.73	15.5	23.41	4.80	Clay	CL/CH	very stiff	125	19		90			1.34	>10
4.88	16.0	20.50	5.51	Clay	CL/CH	very stiff	125	16		100			1.16	>10
5.03	16.5	21.94	5.88	Clay	CL/CH	very stiff	125	18		100			1.25	>10
5.18	17.0	19.22	5.48	Clay	CL/CH	very stiff	125	15		100			1.09	>10
5.33	17.5	27.57	5.03	Clay	CL/CH	very stiff	125	22		90			1.58	>10
5.48	18.0	23.29	5.22	Clay	CL/CH	very stiff	125	19		100			1.32	>10
5.65	18.5	20.85	6.67	Clay	CL/CH	very stiff	125	17		100			1.18	>10
5.80	19.0	21.33	6.77	Clay	CL/CH	very stiff	125	17		100			1.21	>10
5.95	19.5	21.97	6.29	Clay	CL/CH	very stiff	125	18		100			1.24	>10
6.10	20.0	21.34	7.09	Clay	CL/CH	very stiff	125	17		100			1.21	>10
6.25	20.5	15.48	5.72	Clay	CL/CH	stiff	125	12		100			0.86	6.21
6.40	21.0	15.87	5.20	Clay	CL/CH	stiff	125	13		100			0.88	6.32
6.55	21.5	26.53	5.79	Clay	CL/CH	very stiff	125	21		100			1.51	>10
6.70	22.0	27.19	6.21	Clay	CL/CH	very stiff	125	22		100			1.55	>10
6.85	22.5	29.12	6.18	Clay	CL/CH	very stiff	125	23		100			1.66	>10
7.00	23.0	24.40	7.41	Clay	CL/CH	very stiff	125	20		100			1.38	>10
7.18	23.5	29.74	7.65	Clay	CL/CH	very stiff	125	24		100			1.69	>10
7.33	24.0	31.24	7.01	Clay	CL/CH	very stiff	125	25		100			1.78	>10
7.48	24.5	31.71	6.74	Clay	CL/CH	very stiff	125	25		100			1.81	>10
7.63	25.0	28.38	5.36	Clay	CL/CH	very stiff	125	23		100			1.61	>10
7.78	25.5	25.50	5.79	Clay	CL/CH	very stiff	125	20		100			1.44	>10
7.93	26.0	21.23	6.01	Clay	CL/CH	very stiff	125	17		100			1.19	7.85
8.08	26.5	19.41	6.26	Clay	CL/CH	very stiff	125	16		100			1.08	6.54
8.23	27.0	21.10	6.12	Clay	CL/CH	very stiff	125	17		100			1.18	7.27
8.38	27.5	20.13	6.30	Clay	CL/CH	very stiff	125	16		100			1.12	6.54
8.53	28.0	19.23	5.66	Clay	CL/CH	very stiff	125	15		100			1.07	6.00
8.68	28.5	20.08	5.65	Clay	CL/CH	very stiff	125	16		100			1.12	6.32
8.85	29.0	20.55	5.67	Clay	CL/CH	very stiff	125	16		100			1.14	6.32
9.00	29.5	20.76	7.00	Clay	CL/CH	very stiff	125	17		100			1.15	6.32
9.15	30.0	22.80	6.88	Clay	CL/CH	very stiff	125	18		100			1.27	7.27
9.30	30.5	21.60	5.89	Clay	CL/CH	very stiff	125	17		100			1.20	6.43
9.45	31.0	17.19	6.36	Clay	CL/CH	stiff	125	14		100			0.94	4.37
9.60	31.5	20.05	5.47	Clay	CL/CH	very stiff	125	16		100			1.11	5.53
9.75	32.0	19.47	5.50	Clay	CL/CH	very stiff	125	16		100			1.07	5.10
9.90	32.5	21.74	5.63	Clay	CL/CH	very stiff	125	17		100			1.21	6.00
10.05	33.0	23.37	5.76	Clay	CL/CH	very stiff	125	19		100			1.30	6.65
10.20	33.5	20.39	5.56	Clay	CL/CH	very stiff	125	16		100			1.13	5.21
10.38	34.0	15.97	5.12	Clay	CL/CH	stiff	125	13		100			0.86	3.50
10.53	34.5	16.45	4.48	Clay	CL/CH	stiff	125	13		100			0.89	3.58
10.68	35.0	18.50	4.96	Clay	CL/CH	very stiff	125	15		100			1.01	4.18
10.83	35.5	19.11	4.05	Silty Clay to Clay	CL	very stiff	125	11		100			1.05	5.53
10.98	36.0	20.64	5.86	Clay	CL/CH	very stiff	125	17		100			1.13	4.78
11.13	36.5	25.44	5.72	Clay	CL/CH	very stiff	125	20		100			1.42	6.65
11.28	37.0	31.72	4.84	Silty Clay to Clay	CL	very stiff	125	18		100			1.79	>10
11.43	37.5	25.49	3.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.42	>10
11.58	38.0	17.68	2.48	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.96	6.10
11.73	38.5	15.25	3.47	Silty Clay to Clay	CL	stiff	125	9		100			0.81	3.50

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 12/20/2004

CONE SOUNDING: CPT-1
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	20.64	4.84	Clay	CL/CH	very stiff	125	17		100			1.13	4.28
12.05	39.5	15.50	3.51	Silty Clay to Clay	CL	stiff	125	9		100			0.83	3.50
12.20	40.0	14.77	2.00	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	4.18
12.35	40.5	13.50	2.07	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.71	3.58
12.50	41.0	15.96	3.29	Silty Clay to Clay	CL	stiff	125	9		100			0.85	3.50
12.65	41.5	15.32	3.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.81	4.28
12.80	42.0	14.74	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.78	3.91
12.95	42.5	17.48	2.54	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	5.10
13.10	43.0	22.47	2.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.23	7.70
13.25	43.5	20.78	2.49	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.13	6.65
13.40	44.0	21.29	2.62	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.16	6.76
13.58	44.5	19.71	2.35	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.07	5.88
13.73	45.0	19.60	2.17	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.06	5.76
13.88	45.5	18.05	1.84	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.8	100	14	30		
14.03	46.0	17.42	2.29	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.93	4.57
14.18	46.5	19.49	2.03	Sandy Silt to Clayey Silt	ML	very loose	115	6	14.7	100	16	30		
14.33	47.0	17.99	2.10	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.96	4.68
14.48	47.5	16.62	1.85	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.88	4.09
14.63	48.0	16.66	1.91	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.88	4.00
14.78	48.5	15.96	1.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.84	3.74
14.93	49.0	15.56	1.78	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.81	3.58
15.10	49.5	14.89	1.48	Sandy Silt to Clayey Silt	ML	very loose	115	4	11.0	100	7	29		
15.25	50.0	16.44	1.69	Sandy Silt to Clayey Silt	ML	very loose	115	5	12.1	100	10	29		

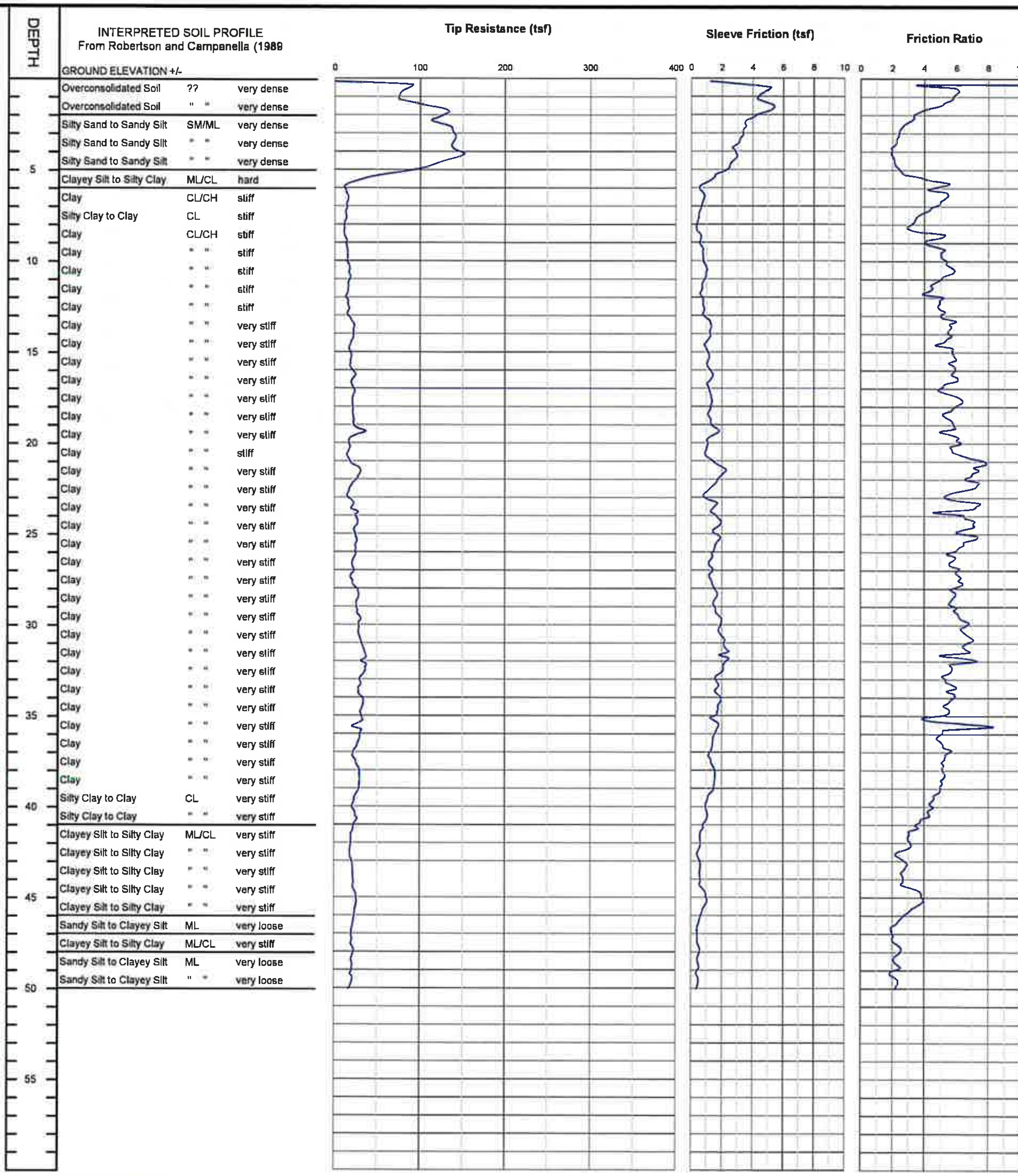
CLIENT: Ormat Nevada Inc
PROJECT: Heber 2 Repower Project - Heber, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight
DATE: 12/20/2004

CONE SOUNDING DATA CPT-2

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-		
Overconsolidated Soil	??	very dense
Overconsolidated Soil	" "	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Silty Sand to Sandy Silt	" "	very dense
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	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
Clayey Silt to Silty Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose



END OF SOUNDING AT 50 ft.

Project No. LE19075	LANDMARK Geo-Engineers and Geologists	PLATE B-2

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 12/20/2004

CONE SOUNDING: CPT-2
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	60.03	169.32	Overconsolidated Soil	??	very dense	120	60	113.5	100	119	45		
0.30	1.0	77.82	5.97	Overconsolidated Soil	??	very dense	120	78	147.1	55	110	43		
0.45	1.5	91.98	5.31	Overconsolidated Soil	??	very dense	120	92	173.9	50	107	43		
0.60	2.0	129.94	3.78	Sandy Silt to Clayey Silt	ML	very dense	115	37	245.6	35	113	44		
0.75	2.5	119.62	3.11	Sandy Silt to Clayey Silt	ML	very dense	115	34	226.1	30	107	43		
0.93	3.0	137.68	2.51	Silty Sand to Sandy Silt	SM/ML	very dense	115	31	260.3	25	108	43		
1.08	3.5	140.87	2.30	Silty Sand to Sandy Silt	SM/ML	very dense	115	31	266.3	25	106	43		
1.23	4.0	139.35	2.04	Silty Sand to Sandy Silt	SM/ML	very dense	115	31	263.4	20	104	43		
1.38	4.5	144.85	2.01	Silty Sand to Sandy Silt	SM/ML	very dense	115	32	273.8	20	103	42		
1.53	5.0	113.08	2.24	Silty Sand to Sandy Silt	SM/ML	very dense	115	25	208.9	25	94	41		
1.68	5.5	52.70	3.38	Clayey Silt to Silty Clay	ML/CL	hard	120	21		50			3.08	>10
1.83	6.0	13.87	4.91	Clay	CL/CH	stiff	125	11		95			0.80	>10
1.98	6.5	15.08	5.36	Clay	CL/CH	stiff	125	12		95			0.87	>10
2.13	7.0	14.77	4.81	Clay	CL/CH	stiff	125	12		95			0.85	>10
2.28	7.5	13.38	3.90	Clay	CL/CH	stiff	125	11		90			0.76	>10
2.45	8.0	12.25	3.27	Silty Clay to Clay	CL	stiff	125	7		90			0.69	>10
2.60	8.5	11.34	3.86	Clay	CL/CH	stiff	125	9		95			0.64	>10
2.75	9.0	13.62	4.43	Clay	CL/CH	stiff	125	11		95			0.77	>10
2.90	9.5	14.76	4.97	Clay	CL/CH	stiff	125	12		95			0.84	>10
3.05	10.0	15.04	5.19	Clay	CL/CH	stiff	125	12		100			0.85	>10
3.20	10.5	17.24	5.61	Clay	CL/CH	stiff	125	14		100			0.98	>10
3.35	11.0	17.82	5.31	Clay	CL/CH	very stiff	125	14		95			1.02	>10
3.50	11.5	16.22	4.53	Clay	CL/CH	stiff	125	13		95			0.92	>10
3.65	12.0	14.59	4.45	Clay	CL/CH	stiff	125	12		100			0.82	>10
3.80	12.5	15.95	4.89	Clay	CL/CH	stiff	125	13		100			0.90	>10
3.95	13.0	16.10	5.07	Clay	CL/CH	stiff	125	13		100			0.91	>10
4.13	13.5	20.52	5.55	Clay	CL/CH	very stiff	125	16		95			1.17	>10
4.28	14.0	22.48	5.55	Clay	CL/CH	very stiff	125	18		95			1.28	>10
4.43	14.5	20.89	5.42	Clay	CL/CH	very stiff	125	17		100			1.19	>10
4.58	15.0	17.79	5.37	Clay	CL/CH	very stiff	125	14		100			1.01	>10
4.73	15.5	19.47	5.86	Clay	CL/CH	very stiff	125	16		100			1.10	>10
4.88	16.0	19.76	5.77	Clay	CL/CH	very stiff	125	16		100			1.12	>10
5.03	16.5	22.53	5.91	Clay	CL/CH	very stiff	125	18		100			1.28	>10
5.18	17.0	21.67	5.09	Clay	CL/CH	very stiff	125	17		100			1.23	>10
5.33	17.5	22.15	5.77	Clay	CL/CH	very stiff	125	18		100			1.26	>10
5.48	18.0	21.43	6.10	Clay	CL/CH	very stiff	125	17		100			1.21	>10
5.65	18.5	21.56	5.34	Clay	CL/CH	very stiff	125	17		100			1.22	>10
5.80	19.0	22.73	5.72	Clay	CL/CH	very stiff	125	18		100			1.29	>10
5.95	19.5	30.63	5.48	Clay	CL/CH	very stiff	125	25		90			1.75	>10
6.10	20.0	17.95	6.14	Clay	CL/CH	very stiff	125	14		100			1.01	8.41
6.25	20.5	17.30	5.70	Clay	CL/CH	stiff	125	14		100			0.97	7.56
6.40	21.0	16.60	6.99	Clay	CL/CH	stiff	125	13		100			0.93	6.76
6.55	21.5	26.75	7.44	Clay	CL/CH	very stiff	125	21		100			1.52	>10
6.70	22.0	28.17	6.81	Clay	CL/CH	very stiff	125	23		100			1.60	>10
6.85	22.5	20.17	7.24	Clay	CL/CH	very stiff	125	16		100			1.13	8.85
7.00	23.0	16.15	5.62	Clay	CL/CH	stiff	125	13		100			0.90	5.88
7.18	23.5	21.37	6.84	Clay	CL/CH	very stiff	125	17		100			1.20	9.19
7.33	24.0	24.23	5.98	Clay	CL/CH	very stiff	125	19		100			1.37	>10
7.48	24.5	27.09	6.88	Clay	CL/CH	very stiff	125	22		100			1.54	>10
7.63	25.0	23.97	6.46	Clay	CL/CH	very stiff	125	19		100			1.35	>10
7.78	25.5	25.90	6.98	Clay	CL/CH	very stiff	125	21		100			1.46	>10
7.93	26.0	24.80	6.17	Clay	CL/CH	very stiff	125	20		100			1.40	>10
8.08	26.5	22.94	5.66	Clay	CL/CH	very stiff	125	18		100			1.29	8.85
8.23	27.0	22.28	5.92	Clay	CL/CH	very stiff	125	18		100			1.25	8.14
8.38	27.5	20.15	6.14	Clay	CL/CH	very stiff	125	16		100			1.12	6.65
8.53	28.0	24.13	6.05	Clay	CL/CH	very stiff	125	19		100			1.36	9.00
8.68	28.5	28.28	5.86	Clay	CL/CH	very stiff	125	23		100			1.60	>10
8.85	29.0	26.02	5.73	Clay	CL/CH	very stiff	125	21		100			1.46	>10
9.00	29.5	28.06	6.01	Clay	CL/CH	very stiff	125	22		100			1.58	>10
9.15	30.0	29.72	6.57	Clay	CL/CH	very stiff	125	24		100			1.68	>10
9.30	30.5	28.55	6.41	Clay	CL/CH	very stiff	125	23		100			1.61	>10
9.45	31.0	31.07	6.84	Clay	CL/CH	very stiff	125	25		100			1.76	>10
9.60	31.5	34.71	6.59	Clay	CL/CH	very stiff	125	28		100			1.97	>10
9.75	32.0	35.27	6.25	Clay	CL/CH	hard	125	28		100			2.00	>10
9.90	32.5	37.01	5.65	Clay	CL/CH	hard	125	30		100			2.10	>10
10.05	33.0	32.37	5.31	Clay	CL/CH	very stiff	125	26		100			1.83	>10
10.20	33.5	30.28	5.70	Clay	CL/CH	very stiff	125	24		100			1.71	>10
10.38	34.0	29.97	5.71	Clay	CL/CH	very stiff	125	24		100			1.69	>10
10.53	34.5	34.16	5.42	Clay	CL/CH	very stiff	125	27		100			1.93	>10
10.68	35.0	31.53	5.44	Clay	CL/CH	very stiff	125	25		100			1.78	>10
10.83	35.5	31.18	4.96	Clay	CL/CH	very stiff	125	25		100			1.76	>10
10.98	36.0	28.08	6.21	Clay	CL/CH	very stiff	125	22		100			1.57	8.14
11.13	36.5	28.95	4.94	Clay	CL/CH	very stiff	125	23		100			1.62	8.41
11.28	37.0	23.74	5.43	Clay	CL/CH	very stiff	125	19		100			1.32	5.88
11.43	37.5	24.03	5.19	Clay	CL/CH	very stiff	125	19		100			1.33	5.88
11.58	38.0	28.73	5.16	Clay	CL/CH	very stiff	125	23		100			1.61	7.70
11.73	38.5	29.89	5.19	Clay	CL/CH	very stiff	125	24		100			1.68	8.14

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 12/20/2004

CONE SOUNDING: CPT-2
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	29.55	5.05	Clay	CL/CH	very stiff	125	24		100			1.65	7.85
12.05	39.5	25.32	4.72	Clay	CL/CH	very stiff	125	20		100			1.40	5.88
12.20	40.0	22.19	4.46	Clay	CL/CH	very stiff	125	18		100			1.22	4.68
12.35	40.5	24.43	4.30	Silty Clay to Clay	CL	very stiff	125	14		100			1.35	7.00
12.50	41.0	24.85	3.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.37	>10
12.65	41.5	21.29	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.16	7.41
12.80	42.0	19.81	3.04	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.08	6.43
12.95	42.5	18.87	2.79	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	5.88
13.10	43.0	19.60	2.48	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.06	6.10
13.25	43.5	21.70	2.84	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.18	7.13
13.40	44.0	22.24	2.62	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	7.27
13.58	44.5	22.52	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.23	7.41
13.73	45.0	25.15	3.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.38	8.85
13.88	45.5	26.20	3.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.45	9.59
14.03	46.0	24.44	3.02	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.34	8.14
14.18	46.5	22.65	2.43	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.24	7.00
14.33	47.0	20.81	1.98	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.7	100	18	30		
14.48	47.5	20.51	2.12	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.4	100	17	30		
14.63	48.0	22.61	2.50	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.23	6.65
14.78	48.5	20.83	2.13	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.5	100	17	30		
14.93	49.0	20.93	2.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.13	5.76
15.10	49.5	20.67	2.11	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.3	100	17	30		
15.25	50.0	19.06	2.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	4.78

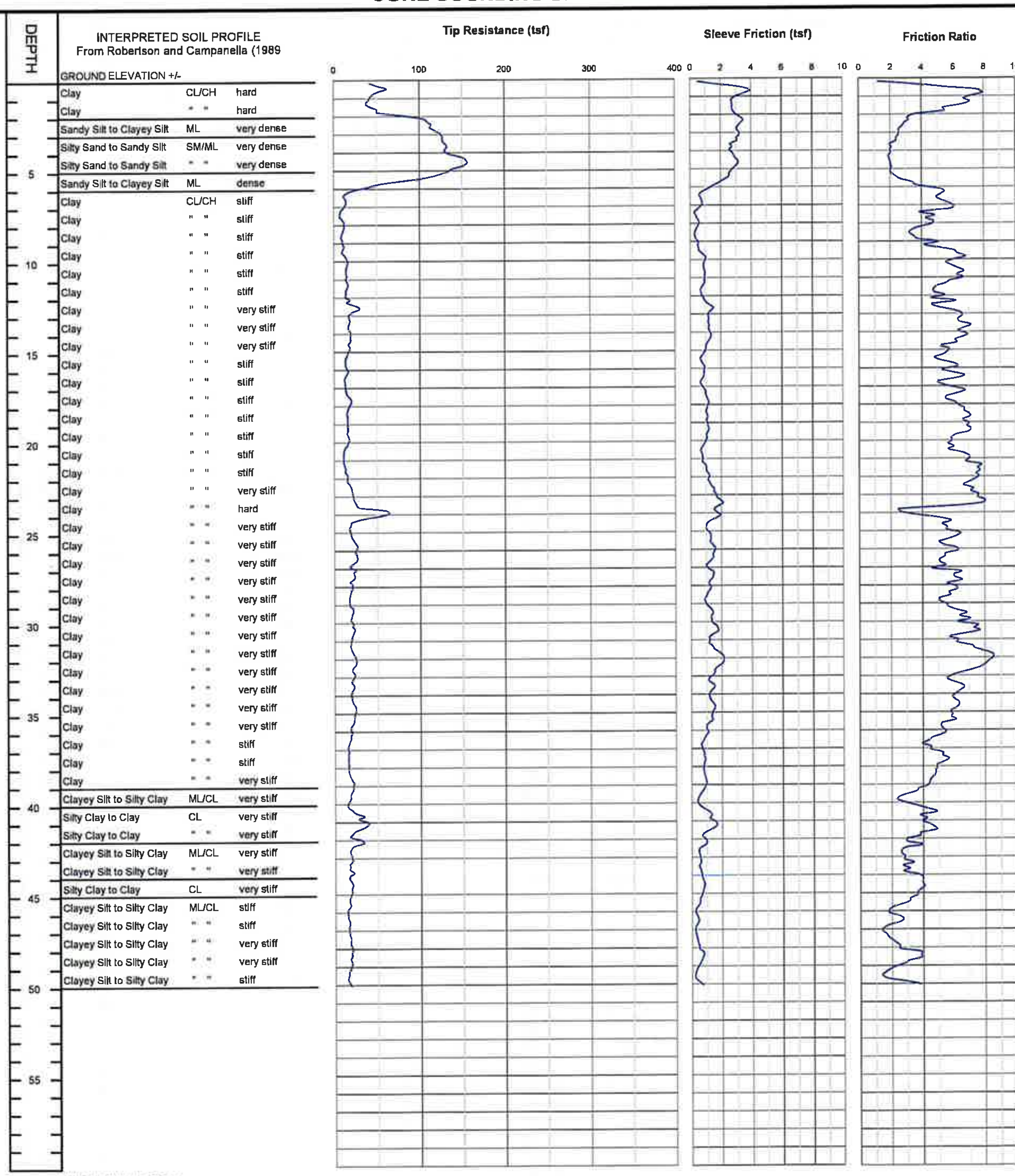
CLIENT: Ormat Nevada Inc
PROJECT: Heber 2 Repower Project - Heber, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight
DATE: 12/20/2004

CONE SOUNDING DATA CPT-3

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-		
Clay	CL/CH	hard
Clay	" "	hard
Sandy Silt to Clayey Silt	ML	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Sandy Silt to Clayey Silt	ML	dense
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	hard
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	very stiff
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	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff



END OF SOUNDING AT 50 ft.

Project No. LE19075	LANDMARK Geo-Engineers and Geologists	PLATE B-3

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 12/20/2004

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	51.76	3.36	Clayey Silt to Silty Clay	ML/CL	hard	120	21		50			3.04	>10
0.30	1.0	46.42	7.56	Clay	CL/CH	hard	125	37		75			2.73	>10
0.45	1.5	40.35	6.79	Clay	CL/CH	hard	125	32		75			2.37	>10
0.60	2.0	61.72	4.80	Silty Clay to Clay	CL	hard	125	35		55			3.62	>10
0.75	2.5	109.67	3.07	Sandy Silt to Clayey Silt	ML	very dense	115	31	207.3	35	104	43		
0.93	3.0	118.60	2.64	Silty Sand to Sandy Silt	SM/ML	very dense	115	26	224.2	30	103	42		
1.08	3.5	127.70	2.43	Silty Sand to Sandy Silt	SM/ML	very dense	115	28	241.4	25	103	42		
1.23	4.0	131.15	2.02	Silty Sand to Sandy Silt	SM/ML	very dense	115	29	247.9	25	102	42		
1.38	4.5	147.55	1.96	Silty Sand to Sandy Silt	SM/ML	very dense	115	33	278.9	20	103	42		
1.53	5.0	148.38	2.05	Silty Sand to Sandy Silt	SM/ML	very dense	115	33	271.7	20	102	42		
1.68	5.5	111.44	2.28	Silty Sand to Sandy Silt	SM/ML	very dense	115	25	194.4	25	92	41		
1.83	6.0	40.17	4.02	Clayey Silt to Silty Clay	ML/CL	hard	120	16		60			2.34	>10
1.98	6.5	13.36	5.18	Clay	CL/CH	stiff	125	11		100			0.76	>10
2.13	7.0	13.22	5.65	Clay	CL/CH	stiff	125	11		100			0.75	>10
2.28	7.5	7.68	4.85	Clay	CL/CH	firm	125	6		100			0.43	6.10
2.45	8.0	11.50	4.55	Clay	CL/CH	stiff	125	9		100			0.65	>10
2.60	8.5	10.61	3.49	Silty Clay to Clay	CL	stiff	125	6		95			0.60	>10
2.75	9.0	9.81	4.10	Clay	CL/CH	stiff	125	8		100			0.55	7.27
2.90	9.5	10.85	5.09	Clay	CL/CH	stiff	125	9		100			0.61	8.27
3.05	10.0	14.61	6.36	Clay	CL/CH	stiff	125	12		100			0.83	>10
3.20	10.5	14.97	5.91	Clay	CL/CH	stiff	125	12		100			0.85	>10
3.35	11.0	14.49	6.53	Clay	CL/CH	stiff	125	12		100			0.82	>10
3.50	11.5	15.94	5.42	Clay	CL/CH	stiff	125	13		100			0.90	>10
3.65	12.0	14.15	5.01	Clay	CL/CH	stiff	125	11		100			0.80	>10
3.80	12.5	20.31	5.15	Clay	CL/CH	very stiff	125	16		95			1.16	>10
3.95	13.0	23.81	5.79	Clay	CL/CH	very stiff	125	19		95			1.36	>10
4.13	13.5	18.35	6.42	Clay	CL/CH	very stiff	125	15		100			1.04	>10
4.28	14.0	18.13	6.73	Clay	CL/CH	very stiff	125	15		100			1.03	>10
4.43	14.5	19.70	6.56	Clay	CL/CH	very stiff	125	16		100			1.12	>10
4.58	15.0	18.07	5.71	Clay	CL/CH	very stiff	125	14		100			1.02	>10
4.73	15.5	14.86	5.24	Clay	CL/CH	stiff	125	12		100			0.83	8.27
4.88	16.0	14.60	5.69	Clay	CL/CH	stiff	125	12		100			0.82	7.70
5.03	16.5	13.49	6.25	Clay	CL/CH	stiff	125	11		100			0.75	6.43
5.18	17.0	13.31	5.44	Clay	CL/CH	stiff	125	11		100			0.74	6.10
5.33	17.5	16.20	6.21	Clay	CL/CH	stiff	125	13		100			0.91	8.27
5.48	18.0	19.16	5.98	Clay	CL/CH	very stiff	125	15		100			1.08	>10
5.65	18.5	15.49	6.80	Clay	CL/CH	stiff	125	12		100			0.86	7.13
5.80	19.0	15.81	6.89	Clay	CL/CH	stiff	125	13		100			0.88	7.13
5.95	19.5	16.32	7.00	Clay	CL/CH	stiff	125	13		100			0.91	7.27
6.10	20.0	17.26	5.95	Clay	CL/CH	stiff	125	14		100			0.97	7.85
6.25	20.5	13.28	5.76	Clay	CL/CH	stiff	125	11		100			0.73	4.89
6.40	21.0	11.14	6.84	Clay	CL/CH	stiff	125	9		100			0.60	3.58
6.55	21.5	12.48	7.40	Clay	CL/CH	stiff	125	10		100			0.68	4.18
6.70	22.0	14.92	7.62	Clay	CL/CH	stiff	125	12		100			0.82	5.42
6.85	22.5	17.77	6.98	Clay	CL/CH	stiff	125	14		100			0.99	7.00
7.00	23.0	21.45	7.34	Clay	CL/CH	very stiff	125	17		100			1.21	9.59
7.18	23.5	24.58	7.84	Clay	CL/CH	very stiff	125	20		100			1.39	>10
7.33	24.0	51.65	3.68	Clayey Silt to Silty Clay	ML/CL	hard	120	21		70			2.98	>10
7.48	24.5	34.37	4.91	Clay	CL/CH	very stiff	125	27		90			1.96	>10
7.63	25.0	18.84	5.44	Clay	CL/CH	very stiff	125	15		100			1.05	6.76
7.78	25.5	21.09	6.11	Clay	CL/CH	very stiff	125	17		100			1.18	8.00
7.93	26.0	26.12	5.49	Clay	CL/CH	very stiff	125	21		100			1.48	>10
8.08	26.5	26.28	5.55	Clay	CL/CH	very stiff	125	21		100			1.48	>10
8.23	27.0	21.92	5.06	Clay	CL/CH	very stiff	125	18		100			1.23	7.85
8.38	27.5	23.63	6.15	Clay	CL/CH	very stiff	125	19		100			1.33	8.85
8.53	28.0	20.49	6.07	Clay	CL/CH	very stiff	125	16		100			1.14	6.65
8.68	28.5	19.11	5.87	Clay	CL/CH	very stiff	125	15		100			1.06	5.88
8.85	29.0	18.15	5.24	Clay	CL/CH	very stiff	125	15		100			1.00	5.21
9.00	29.5	21.72	6.18	Clay	CL/CH	very stiff	125	17		100			1.21	6.88
9.15	30.0	20.63	6.55	Clay	CL/CH	very stiff	125	17		100			1.15	6.21
9.30	30.5	22.90	7.51	Clay	CL/CH	very stiff	125	18		100			1.28	7.13
9.45	31.0	20.57	6.23	Clay	CL/CH	very stiff	125	16		100			1.14	5.88
9.60	31.5	19.55	6.90	Clay	CL/CH	very stiff	125	16		100			1.08	5.31
9.75	32.0	23.76	8.37	Clay	CL/CH	very stiff	125	19		100			1.33	7.13
9.90	32.5	24.30	8.05	Clay	CL/CH	very stiff	125	19		100			1.36	7.27
10.05	33.0	22.78	6.54	Clay	CL/CH	very stiff	125	18		100			1.27	6.32
10.20	33.5	21.56	5.91	Clay	CL/CH	very stiff	125	17		100			1.19	5.76
10.38	34.0	20.82	6.40	Clay	CL/CH	very stiff	125	17		100			1.15	5.31
10.53	34.5	21.17	6.04	Clay	CL/CH	very stiff	125	17		100			1.17	5.31
10.68	35.0	24.71	6.05	Clay	CL/CH	very stiff	125	20		100			1.38	6.65
10.83	35.5	23.14	5.91	Clay	CL/CH	very stiff	125	19		100			1.28	5.88
10.98	36.0	19.96	5.21	Clay	CL/CH	very stiff	125	16		100			1.10	4.57
11.13	36.5	19.03	4.88	Clay	CL/CH	very stiff	125	15		100			1.04	4.18
11.28	37.0	16.19	4.33	Clay	CL/CH	stiff	125	13		100			0.87	3.28
11.43	37.5	16.02	5.36	Clay	CL/CH	stiff	125	13		100			0.86	3.14
11.58	38.0	16.15	5.06	Clay	CL/CH	stiff	125	13		100			0.87	3.14
11.73	38.5	17.81	4.75	Clay	CL/CH	stiff	125	14		100			0.96	3.50

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 12/20/2004

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	21.66	4.41	Silty Clay to Clay	CL	very stiff	125	12		100			1.19	6.00
12.05	39.5	20.18	3.42	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.10	7.13
12.20	40.0	17.00	2.62	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.91	5.31
12.35	40.5	20.64	4.32	Silty Clay to Clay	CL	very stiff	125	12		100			1.13	5.31
12.50	41.0	33.91	4.01	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		100			1.91	>10
12.65	41.5	31.64	4.64	Silty Clay to Clay	CL	very stiff	125	18		100			1.77	>10
12.80	42.0	23.58	3.56	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.30	8.70
12.95	42.5	24.97	3.28	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.38	9.79
13.10	43.0	19.07	2.71	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.03	5.88
13.25	43.5	18.86	2.98	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	5.65
13.40	44.0	19.54	3.20	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.06	5.88
13.58	44.5	19.29	3.97	Silty Clay to Clay	CL	very stiff	125	11		100			1.04	4.18
13.73	45.0	19.79	3.86	Silty Clay to Clay	CL	very stiff	125	11		100			1.07	4.28
13.88	45.5	17.66	3.31	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.94	4.78
14.03	46.0	16.42	2.18	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.87	4.18
14.18	46.5	15.61	2.35	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.82	3.74
14.33	47.0	16.68	1.80	Sandy Silt to Clayey Silt	ML	very loose	115	5	12.5	100	11	30		
14.48	47.5	18.25	1.80	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.7	100	14	30		
14.63	48.0	19.39	2.43	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.04	5.21
14.78	48.5	19.39	3.87	Silty Clay to Clay	CL	very stiff	125	11		100			1.04	3.83
14.93	49.0	19.13	2.69	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	4.89
15.10	49.5	16.46	1.59	Sandy Silt to Clayey Silt	ML	very loose	115	5	12.1	100	10	29		
15.25	50.0	16.91	2.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.89	3.91

CLIENT: Ormat Nevada Inc
PROJECT: Heber 2 Repower Project - Heber, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight

LOCATION: See Site and Boring Location Plan

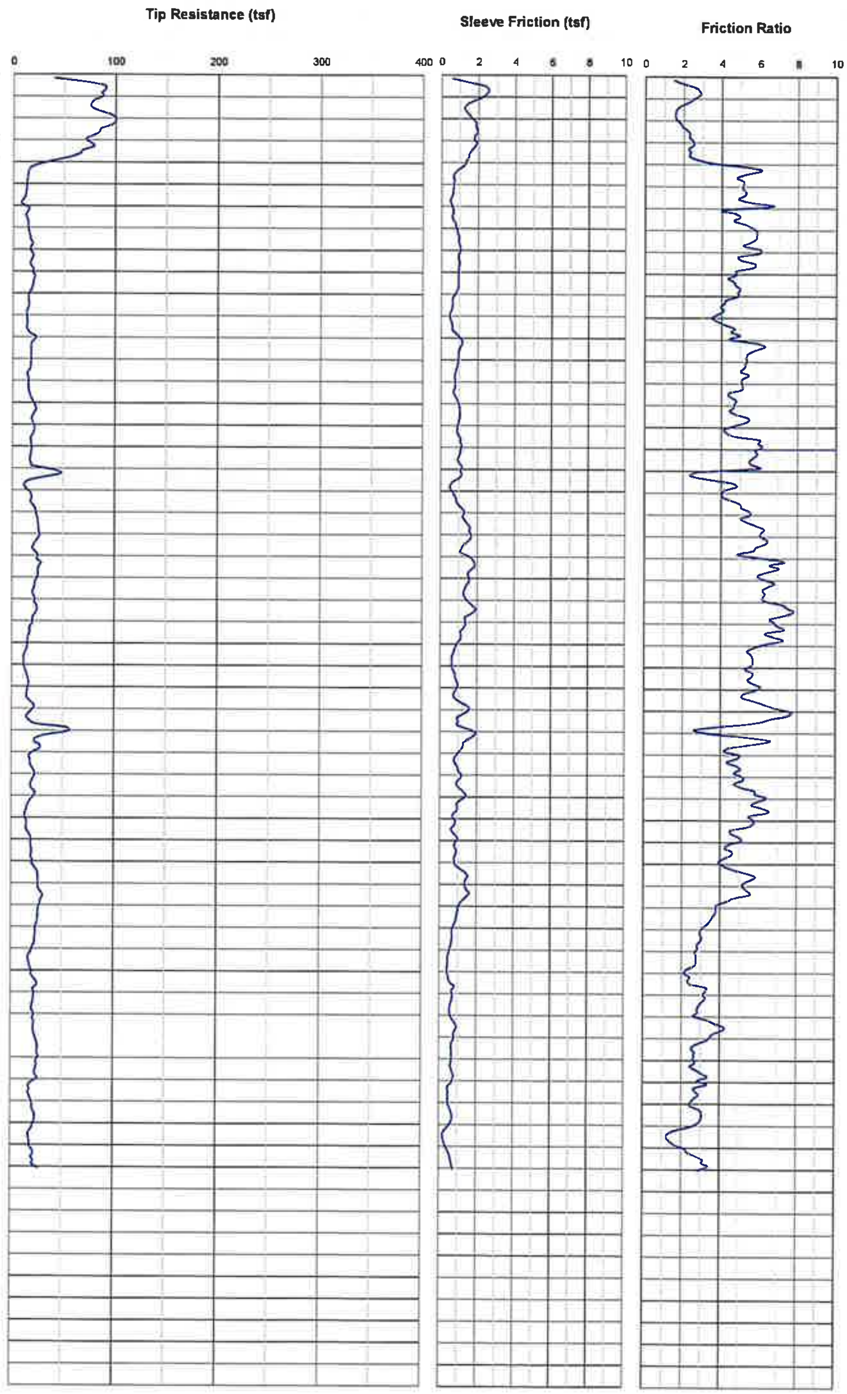
DATE: 5/2/2007

CONE SOUNDING DATA CPT-4

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH			
	Silty Sand to Sandy Silt	SM/ML	very dense
	Silty Sand to Sandy Silt	" "	very dense
	Silty Sand to Sandy Silt	" "	very dense
	Sandy Silt to Clayey Silt	ML	dense
5	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
10	Clay	" "	very stiff
	Silty Clay to Clay	CL	stiff
	Clay	CL/CH	stiff
	Clay	" "	very stiff
	Clay	" "	stiff
15	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
20	Clay	CL/CH	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
25	Clay	" "	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
30	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	stiff
35	Clay	" "	stiff
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
40	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
45	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
	Sandy Silt to Clayey Silt	ML	very loose
50	Clayey Silt to Silty Clay	ML/CL	very stiff
55			



END OF SOUNDING AT 50 ft.

Project No. LE19075	LANDMARK Geo-Engineers and Geologists	PLATE B-4

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA   **Project No:** LE19075   **Date:** 5/2/2007

CONE SOUNDING: CPT-4

Est. GWT (ft): 8

Phi Correlation: 0   0-Schm(78),1-R&C(83),2-PHT(74)

Nk: 17

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 (%)	Phi (deg.)	Su (tsf)	OCR
0.15	0.5	66.25	2.04	Silty Sand to Sandy Silt	SM/ML	very dense	115	15	125.2	35	122	45		
0.30	1.0	88.18	2.75	Sandy Silt to Clayey Silt	ML	very dense	115	25	166.7	35	114	44		
0.45	1.5	77.73	1.95	Silty Sand to Sandy Silt	SM/ML	very dense	115	17	146.9	30	103	42		
0.60	2.0	92.53	1.60	Silty Sand to Sandy Silt	SM/ML	very dense	115	21	174.9	25	103	42		
0.75	2.5	93.95	2.02	Silty Sand to Sandy Silt	SM/ML	very dense	115	21	177.6	25	100	42		
0.93	3.0	77.68	2.40	Silty Sand to Sandy Silt	SM/ML	very dense	115	17	146.8	35	91	41		
1.08	3.5	74.47	2.39	Sandy Silt to Clayey Silt	ML	dense	115	21	140.8	35	88	40		
1.23	4.0	52.73	2.83	Sandy Silt to Clayey Silt	ML	dense	115	15	99.7	45	75	39		
1.38	4.5	18.49	5.55	Clay	CL/CH	very stiff	125	15		90			1.07	>10
1.53	5.0	13.75	5.02	Clay	CL/CH	stiff	125	11		100			0.79	>10
1.68	5.5	12.39	5.11	Clay	CL/CH	stiff	125	10		100			0.71	>10
1.83	6.0	10.98	5.45	Clay	CL/CH	stiff	125	9		100			0.63	>10
1.98	6.5	13.51	4.77	Clay	CL/CH	stiff	125	11		95			0.77	>10
2.13	7.0	14.72	5.56	Clay	CL/CH	stiff	125	12		100			0.84	>10
2.28	7.5	16.58	5.71	Clay	CL/CH	stiff	125	13		95			0.95	>10
2.45	8.0	17.99	5.72	Clay	CL/CH	very stiff	125	14		95			1.03	>10
2.60	8.5	18.67	5.21	Clay	CL/CH	very stiff	125	15		90			1.07	>10
2.75	9.0	19.02	5.07	Clay	CL/CH	very stiff	125	15		90			1.09	>10
2.90	9.5	20.58	4.59	Clay	CL/CH	very stiff	125	16		85			1.18	>10
3.05	10.0	17.46	4.91	Clay	CL/CH	stiff	125	14		90			1.00	>10
3.20	10.5	15.45	4.14	Clay	CL/CH	stiff	125	12		90			0.88	>10
3.35	11.0	13.93	3.83	Silty Clay to Clay	CL	stiff	125	8		95			0.79	>10
3.50	11.5	13.83	4.23	Clay	CL/CH	stiff	125	11		100			0.78	>10
3.65	12.0	18.01	4.65	Clay	CL/CH	very stiff	125	14		95			1.02	>10
3.80	12.5	18.70	5.93	Clay	CL/CH	very stiff	125	15		100			1.06	>10
3.95	13.0	18.01	5.35	Clay	CL/CH	very stiff	125	14		100			1.02	>10
4.13	13.5	17.39	5.15	Clay	CL/CH	stiff	125	14		100			0.99	>10
4.28	14.0	14.93	5.20	Clay	CL/CH	stiff	125	12		100			0.84	9.59
4.43	14.5	15.49	4.86	Clay	CL/CH	stiff	125	12		100			0.87	>10
4.58	15.0	18.22	4.65	Clay	CL/CH	very stiff	125	15		100			1.03	>10
4.73	15.5	22.11	4.64	Clay	CL/CH	very stiff	125	18		90			1.26	>10
4.88	16.0	19.85	4.92	Clay	CL/CH	very stiff	125	16		100			1.13	>10
5.03	16.5	19.77	4.96	Clay	CL/CH	very stiff	125	16		100			1.12	>10
5.18	17.0	18.38	5.96	Clay	CL/CH	very stiff	125	15		100			1.04	>10
5.33	17.5	17.64	5.69	Clay	CL/CH	stiff	125	14		100			0.99	9.79
5.48	18.0	25.50	4.80	Clay	CL/CH	very stiff	125	20		90			1.45	>10
5.65	18.5	32.47	3.36	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		75			1.86	>10
5.80	19.0	13.48	4.36	Clay	CL/CH	stiff	125	11		100			0.75	5.53
5.95	19.5	18.41	4.55	Clay	CL/CH	very stiff	125	15		100			1.03	9.00
6.10	20.0	22.07	5.36	Clay	CL/CH	very stiff	125	18		100			1.25	>10
6.25	20.5	24.57	5.40	Clay	CL/CH	very stiff	125	20		100			1.40	>10
6.40	21.0	26.18	6.13	Clay	CL/CH	very stiff	125	21		100			1.49	>10
6.55	21.5	23.24	6.19	Clay	CL/CH	very stiff	125	19		100			1.31	>10
6.70	22.0	22.66	5.55	Clay	CL/CH	very stiff	125	18		100			1.28	>10
6.85	22.5	26.25	6.97	Clay	CL/CH	very stiff	125	21		100			1.49	>10
7.00	23.0	25.11	6.17	Clay	CL/CH	very stiff	125	20		100			1.42	>10
7.18	23.5	22.18	6.48	Clay	CL/CH	very stiff	125	18		100			1.25	>10
7.33	24.0	21.09	6.24	Clay	CL/CH	very stiff	125	17		100			1.18	8.70
7.48	24.5	23.54	7.51	Clay	CL/CH	very stiff	125	19		100			1.33	>10
7.63	25.0	21.31	6.90	Clay	CL/CH	very stiff	125	17		100			1.19	8.41
7.78	25.5	18.21	6.87	Clay	CL/CH	very stiff	125	15		100			1.01	6.21
7.93	26.0	15.91	6.78	Clay	CL/CH	stiff	125	13		100			0.88	4.89
8.08	26.5	13.54	5.59	Clay	CL/CH	stiff	125	11		100			0.74	3.66
8.23	27.0	11.78	5.53	Clay	CL/CH	stiff	125	9		100			0.63	3.00
8.38	27.5	14.49	5.56	Clay	CL/CH	stiff	125	12		100			0.79	3.91
8.53	28.0	16.02	5.84	Clay	CL/CH	stiff	125	13		100			0.88	4.47
8.68	28.5	15.04	5.37	Clay	CL/CH	stiff	125	12		100			0.82	3.91
8.85	29.0	20.59	6.98	Clay	CL/CH	very stiff	125	16		100			1.15	6.43
9.00	29.5	16.05	6.66	Clay	CL/CH	stiff	125	13		100			0.88	4.18
9.15	30.0	44.48	3.37	Clayey Silt to Silty Clay	ML/CL	hard	120	18		75			2.55	>10
9.30	30.5	27.03	5.86	Clay	CL/CH	very stiff	125	22		100			1.52	9.79
9.45	31.0	24.88	4.56	Clay	CL/CH	very stiff	125	20		100			1.39	8.14
9.60	31.5	17.85	4.68	Clay	CL/CH	stiff	125	14		100			0.98	4.57
9.75	32.0	21.43	4.98	Clay	CL/CH	very stiff	125	17		100			1.19	6.00
9.90	32.5	19.94	5.01	Clay	CL/CH	very stiff	125	16		100			1.10	5.21
10.05	33.0	21.67	6.03	Clay	CL/CH	very stiff	125	17		100			1.20	5.88
10.20	33.5	17.09	5.96	Clay	CL/CH	stiff	125	14		100			0.93	3.91
10.38	34.0	13.75	5.92	Clay	CL/CH	stiff	125	11		100			0.73	2.91
10.53	34.5	14.75	5.27	Clay	CL/CH	stiff	125	12		100			0.79	3.14
10.68	35.0	17.80	4.91	Clay	CL/CH	stiff	125	14		100			0.97	3.91
10.83	35.5	19.50	4.45	Clay	CL/CH	very stiff	125	16		100			1.07	4.47
10.98	36.0	20.06	4.23	Silty Clay to Clay	CL	very stiff	125	11		100			1.10	6.00
11.13	36.5	23.73	5.01	Clay	CL/CH	very stiff	125	19		100			1.32	6.00
11.28	37.0	26.37	5.33	Clay	CL/CH	very stiff	125	21		100			1.47	6.88
11.43	37.5	29.22	5.23	Clay	CL/CH	very stiff	125	23		100			1.64	8.14
11.58	38.0	28.26	4.00	Silty Clay to Clay	CL	very stiff	125	16		100			1.58	>10
11.73	38.5	26.29	3.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.46	>10

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 5/2/2007

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	24.98	3.19	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.39	>10
12.05	39.5	23.62	3.00	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.30	>10
12.20	40.0	21.78	2.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.20	8.27
12.35	40.5	17.57	2.75	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.95	5.53
12.50	41.0	19.10	2.36	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.04	6.32
12.65	41.5	22.54	2.42	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.24	8.27
12.80	42.0	23.41	3.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.29	8.70
12.95	42.5	22.05	3.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.21	7.70
13.10	43.0	21.46	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.17	7.13
13.25	43.5	22.21	3.76	Silty Clay to Clay	CL	very stiff	125	13		100			1.21	5.42
13.40	44.0	22.69	3.76	Silty Clay to Clay	CL	very stiff	125	13		100			1.24	5.53
13.58	44.5	25.69	2.81	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.42	9.59
13.73	45.0	26.50	2.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.46	>10
13.88	45.5	25.22	2.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.39	8.85
14.03	46.0	24.83	3.10	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.36	8.41
14.18	46.5	18.88	2.93	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.01	5.21
14.33	47.0	19.43	2.64	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.05	5.31
14.48	47.5	22.40	3.03	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.22	6.65
14.63	48.0	23.12	2.75	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.26	7.00
14.78	48.5	18.94	1.38	Sandy Silt to Clayey Silt	ML	very loose	115	5	14.1	100	15	30		
14.93	49.0	18.77	1.78	Sandy Silt to Clayey Silt	ML	very loose	115	5	13.9	100	14	30		
15.10	49.5	21.59	2.73	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.17	6.00
15.25	50.0	23.82	3.12	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.30	6.88

CLIENT: Ormat Nevada Inc
PROJECT: Heber 2 Repower Project - Heber, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 23 ton reaction weight
DATE: 5/2/2007

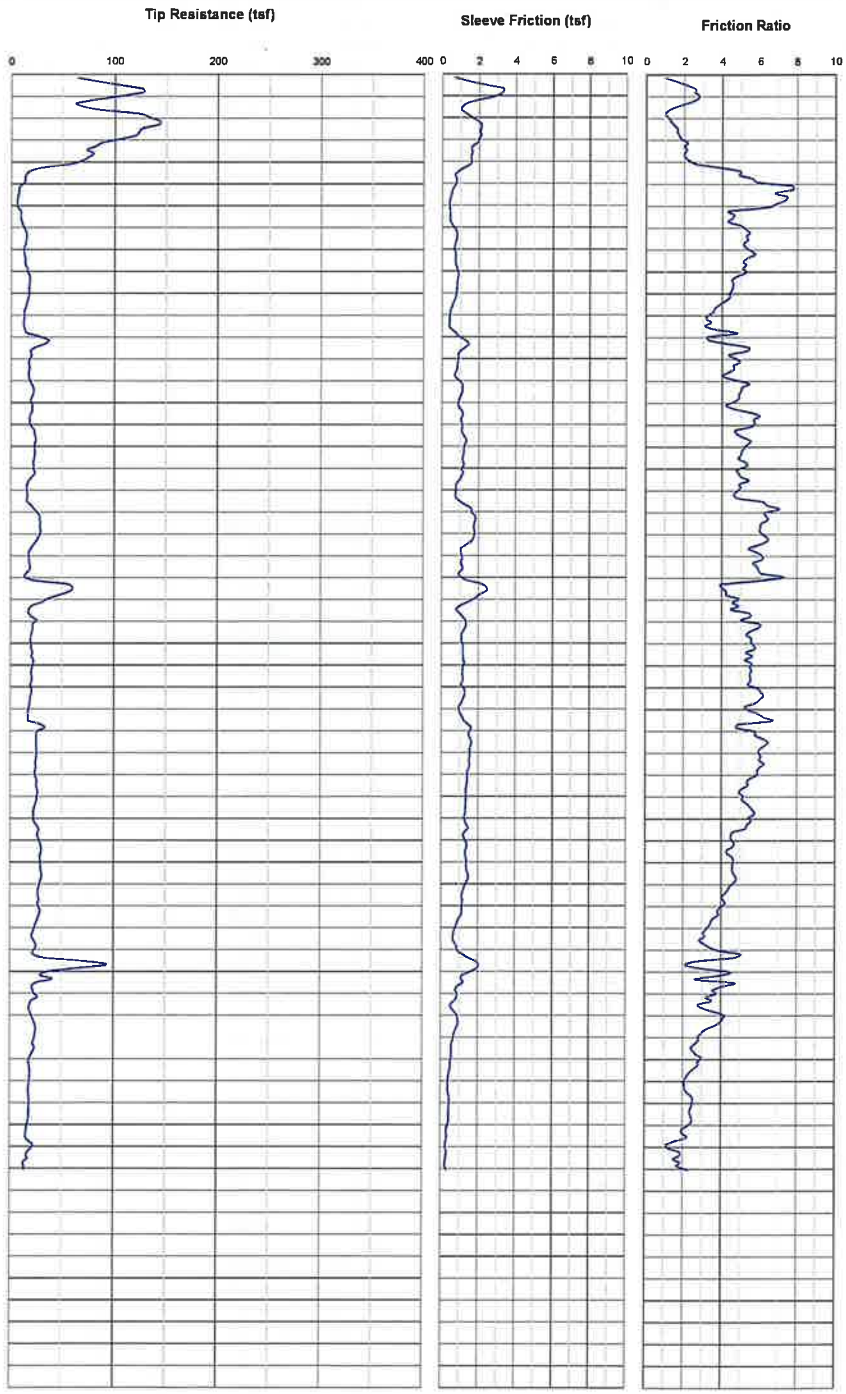
CONE SOUNDING DATA CPT-5

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Sand to Silty Sand	SP/SM	very dense
Silty Sand to Sandy Silt	SM/ML	dense
Clay	CL/CH	very stiff
Clay	" "	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	very stiff
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Silty Clay to Clay	CL	hard
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
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
Clayey Silt to Silty Clay	" "	hard
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
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	stiff



END OF SOUNDING AT 50 ft.

Project No.
LE19075

LANDMARK
Geo-Engineers and Geologists

PLATE
B-5

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 5/2/2007

CONE SOUNDING: CPT-5
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	85.14	1.61	Silty Sand to Sandy Silt	SM/ML	very dense	115	19	161.0	25	130	46		
0.30	1.0	120.36	2.66	Silty Sand to Sandy Silt	SM/ML	very dense	115	27	227.5	30	124	45		
0.45	1.5	72.28	2.13	Silty Sand to Sandy Silt	SM/ML	very dense	115	16	136.6	30	101	42		
0.60	2.0	116.67	1.12	Sand to Silty Sand	SP/SM	very dense	115	21	220.6	15	110	43		
0.75	2.5	138.05	1.48	Sand to Silty Sand	SP/SM	very dense	115	25	261.0	15	111	44		
0.93	3.0	117.13	1.76	Silty Sand to Sandy Silt	SM/ML	very dense	115	26	221.4	20	104	42		
1.08	3.5	81.23	2.12	Silty Sand to Sandy Silt	SM/ML	very dense	115	18	153.5	30	90	41		
1.23	4.0	74.63	2.12	Silty Sand to Sandy Silt	SM/ML	dense	115	17	141.1	30	86	40		
1.38	4.5	34.90	3.90	Clayey Silt to Silty Clay	ML/CL	hard	120	14		60			2.04	>10
1.53	5.0	13.76	5.45	Clay	CL/CH	stiff	125	11		100			0.79	>10
1.68	5.5	7.57	7.44	Clay	CL/CH	firm	125	6		100			0.43	>10
1.83	6.0	5.99	6.88	Clay	CL/CH	firm	125	5		100			0.33	6.10
1.98	6.5	9.47	4.51	Clay	CL/CH	stiff	125	8		100			0.54	>10
2.13	7.0	11.69	4.84	Clay	CL/CH	stiff	125	9		100			0.66	>10
2.28	7.5	14.81	5.37	Clay	CL/CH	stiff	125	12		95			0.85	>10
2.45	8.0	13.05	5.28	Clay	CL/CH	stiff	125	10		100			0.74	>10
2.60	8.5	13.41	5.40	Clay	CL/CH	stiff	125	11		100			0.76	>10
2.75	9.0	15.40	5.21	Clay	CL/CH	stiff	125	12		95			0.88	>10
2.90	9.5	18.24	4.66	Clay	CL/CH	very stiff	125	15		85			1.04	>10
3.05	10.0	17.49	4.50	Clay	CL/CH	stiff	125	14		90			1.00	>10
3.20	10.5	16.07	4.15	Clay	CL/CH	stiff	125	13		90			0.91	>10
3.35	11.0	13.34	3.48	Silty Clay to Clay	CL	stiff	125	8		95			0.75	>10
3.50	11.5	12.52	3.24	Silty Clay to Clay	CL	stiff	125	7		95			0.70	>10
3.65	12.0	18.93	3.91	Silty Clay to Clay	CL	very stiff	125	11		85			1.08	>10
3.80	12.5	31.15	4.38	Silty Clay to Clay	CL	very stiff	125	18		75			1.80	>10
3.95	13.0	19.46	4.78	Clay	CL/CH	very stiff	125	16		95			1.11	>10
4.13	13.5	17.74	4.74	Clay	CL/CH	very stiff	125	14		100			1.01	>10
4.28	14.0	17.58	4.34	Clay	CL/CH	stiff	125	14		95			1.00	>10
4.43	14.5	21.21	5.18	Clay	CL/CH	very stiff	125	17		95			1.21	>10
4.58	15.0	20.43	4.83	Clay	CL/CH	very stiff	125	16		95			1.16	>10
4.73	15.5	20.79	4.75	Clay	CL/CH	very stiff	125	17		95			1.18	>10
4.88	16.0	18.89	5.75	Clay	CL/CH	very stiff	125	15		100			1.07	>10
5.03	16.5	23.41	4.88	Clay	CL/CH	very stiff	125	19		95			1.33	>10
5.18	17.0	23.59	5.34	Clay	CL/CH	very stiff	125	19		95			1.34	>10
5.33	17.5	23.27	4.98	Clay	CL/CH	very stiff	125	19		95			1.32	>10
5.48	18.0	22.19	5.13	Clay	CL/CH	very stiff	125	18		100			1.26	>10
5.65	18.5	20.81	5.10	Clay	CL/CH	very stiff	125	17		100			1.18	>10
5.80	19.0	15.78	4.92	Clay	CL/CH	stiff	125	13		100			0.88	7.13
5.95	19.5	16.06	5.23	Clay	CL/CH	stiff	125	13		100			0.90	7.00
6.10	20.0	22.81	6.58	Clay	CL/CH	very stiff	125	18		100			1.29	>10
6.25	20.5	28.53	6.30	Clay	CL/CH	very stiff	125	23		100			1.63	>10
6.40	21.0	28.99	6.06	Clay	CL/CH	very stiff	125	23		100			1.65	>10
6.55	21.5	24.82	6.26	Clay	CL/CH	very stiff	125	20		100			1.41	>10
6.70	22.0	18.48	5.79	Clay	CL/CH	very stiff	125	15		100			1.03	7.70
6.85	22.5	18.41	5.89	Clay	CL/CH	very stiff	125	15		100			1.03	7.41
7.00	23.0	15.96	6.46	Clay	CL/CH	stiff	125	13		100			0.88	5.76
7.18	23.5	46.63	4.62	Silty Clay to Clay	CL	hard	125	27		75			2.69	>10
7.33	24.0	47.09	4.48	Silty Clay to Clay	CL	hard	125	27		75			2.71	>10
7.48	24.5	23.27	4.67	Clay	CL/CH	very stiff	125	19		100			1.31	>10
7.63	25.0	21.09	5.34	Clay	CL/CH	very stiff	125	17		100			1.18	8.27
7.78	25.5	21.71	5.85	Clay	CL/CH	very stiff	125	17		100			1.22	8.41
7.93	26.0	19.90	5.47	Clay	CL/CH	very stiff	125	16		100			1.11	7.00
8.08	26.5	20.78	5.59	Clay	CL/CH	very stiff	125	17		100			1.16	7.41
8.23	27.0	21.98	5.44	Clay	CL/CH	very stiff	125	18		100			1.23	8.00
8.38	27.5	20.73	5.53	Clay	CL/CH	very stiff	125	17		100			1.16	6.88
8.53	28.0	20.36	5.62	Clay	CL/CH	very stiff	125	16		100			1.13	6.54
8.68	28.5	19.99	6.11	Clay	CL/CH	very stiff	125	16		100			1.11	6.21
8.85	29.0	18.33	5.49	Clay	CL/CH	very stiff	125	15		100			1.01	5.31
9.00	29.5	17.78	6.27	Clay	CL/CH	stiff	125	14		100			0.98	4.89
9.15	30.0	29.76	5.16	Clay	CL/CH	very stiff	125	24		100			1.68	>10
9.30	30.5	25.36	6.14	Clay	CL/CH	very stiff	125	20		100			1.42	8.56
9.45	31.0	25.65	6.08	Clay	CL/CH	very stiff	125	21		100			1.44	8.56
9.60	31.5	24.99	6.11	Clay	CL/CH	very stiff	125	20		100			1.40	8.00
9.75	32.0	24.42	5.93	Clay	CL/CH	very stiff	125	20		100			1.37	7.41
9.90	32.5	25.69	5.42	Clay	CL/CH	very stiff	125	21		100			1.44	8.00
10.05	33.0	26.43	5.06	Clay	CL/CH	very stiff	125	21		100			1.48	8.27
10.20	33.5	24.95	5.31	Clay	CL/CH	very stiff	125	20		100			1.39	7.27
10.38	34.0	22.88	5.62	Clay	CL/CH	very stiff	125	18		100			1.27	6.21
10.53	34.5	25.51	5.40	Clay	CL/CH	very stiff	125	20		100			1.42	7.27
10.68	35.0	27.31	4.56	Silty Clay to Clay	CL	very stiff	125	16		100			1.53	>10
10.83	35.5	30.04	4.55	Silty Clay to Clay	CL	very stiff	125	17		100			1.69	>10
10.98	36.0	29.52	4.52	Silty Clay to Clay	CL	very stiff	125	17		100			1.66	>10
11.13	36.5	30.25	4.64	Silty Clay to Clay	CL	very stiff	125	17		100			1.70	>10
11.28	37.0	29.39	4.68	Silty Clay to Clay	CL	very stiff	125	17		100			1.65	>10
11.43	37.5	27.60	4.22	Silty Clay to Clay	CL	very stiff	125	16		100			1.54	>10
11.58	38.0	27.92	4.11	Silty Clay to Clay	CL	very stiff	125	16		100			1.56	>10
11.73	38.5	28.57	3.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.60	>10

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

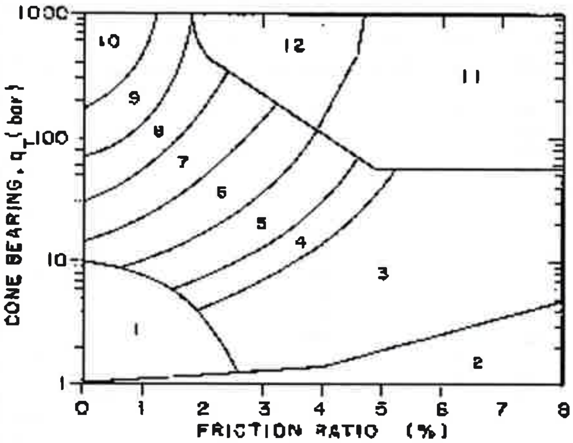
Project: Heber 2 Repower Project - Heber, CA **Project No:** LE19075 **Date:** 5/2/2007

CONE SOUNDING: CPT-5
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	24.62	3.37	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.36	>10
12.05	39.5	22.28	3.04	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.23	8.70
12.20	40.0	24.64	3.45	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.36	>10
12.35	40.5	41.78	4.14	Clayey Silt to Silty Clay	ML/CL	hard	120	17		95			2.37	>10
12.50	41.0	64.96	3.22	Sandy Silt to Clayey Silt	ML	medium dense	115	19	51.8	70	53	35		
12.65	41.5	32.37	3.75	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.82	>10
12.80	42.0	22.75	3.82	Silty Clay to Clay	CL	very stiff	125	13		100			1.25	6.00
12.95	42.5	22.78	3.20	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.25	8.14
13.10	43.0	19.79	3.62	Silty Clay to Clay	CL	very stiff	125	11		100			1.07	4.57
13.25	43.5	23.86	3.91	Silty Clay to Clay	CL	very stiff	125	14		100			1.31	6.10
13.40	44.0	24.93	3.00	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.37	9.19
13.58	44.5	23.46	2.65	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.29	8.00
13.73	45.0	21.13	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.15	6.54
13.88	45.5	19.10	2.73	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.03	5.42
14.03	46.0	19.63	2.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.06	5.65
14.18	46.5	18.74	2.12	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.01	5.10
14.33	47.0	18.93	2.49	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.02	5.10
14.48	47.5	18.85	2.42	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.01	5.00
14.63	48.0	17.53	2.38	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.93	4.37
14.78	48.5	16.01	2.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.84	3.74
14.93	49.0	20.91	1.36	Sandy Silt to Clayey Silt	ML	very loose	115	6	15.5	100	17	30		
15.10	49.5	17.29	1.76	Sandy Silt to Clayey Silt	ML	very loose	115	5	12.8	100	12	30		
15.25	50.0	13.85	1.98	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.71	3.00

Simplified Soil Classification Chart

After Robertson & Campanella (1989)



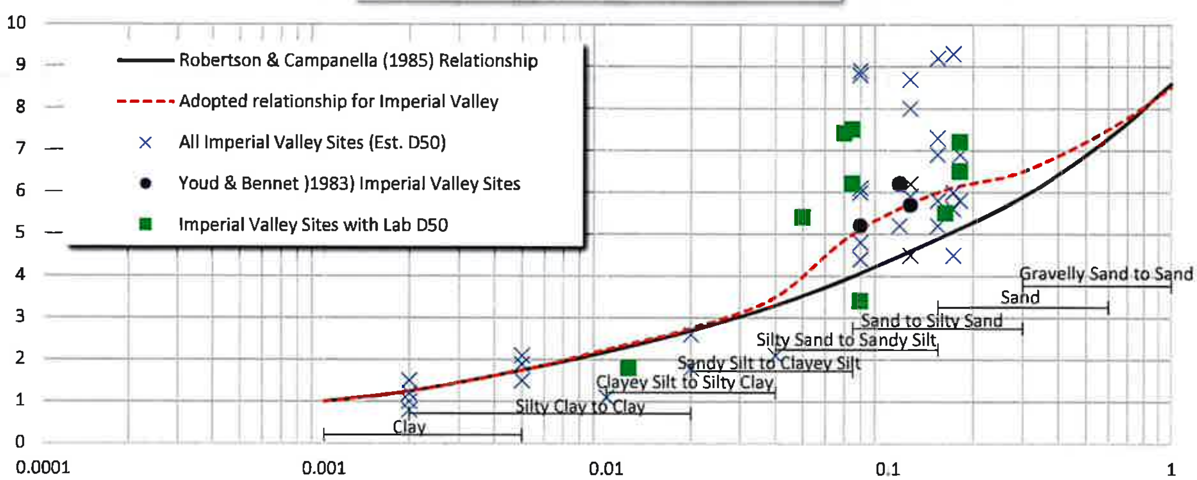
Geotechnical Parameters from CPT Data:

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: LE19075

Key to CPT Interpretation of Logs

Plate B-6

APPENDIX C

LANDMARK Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

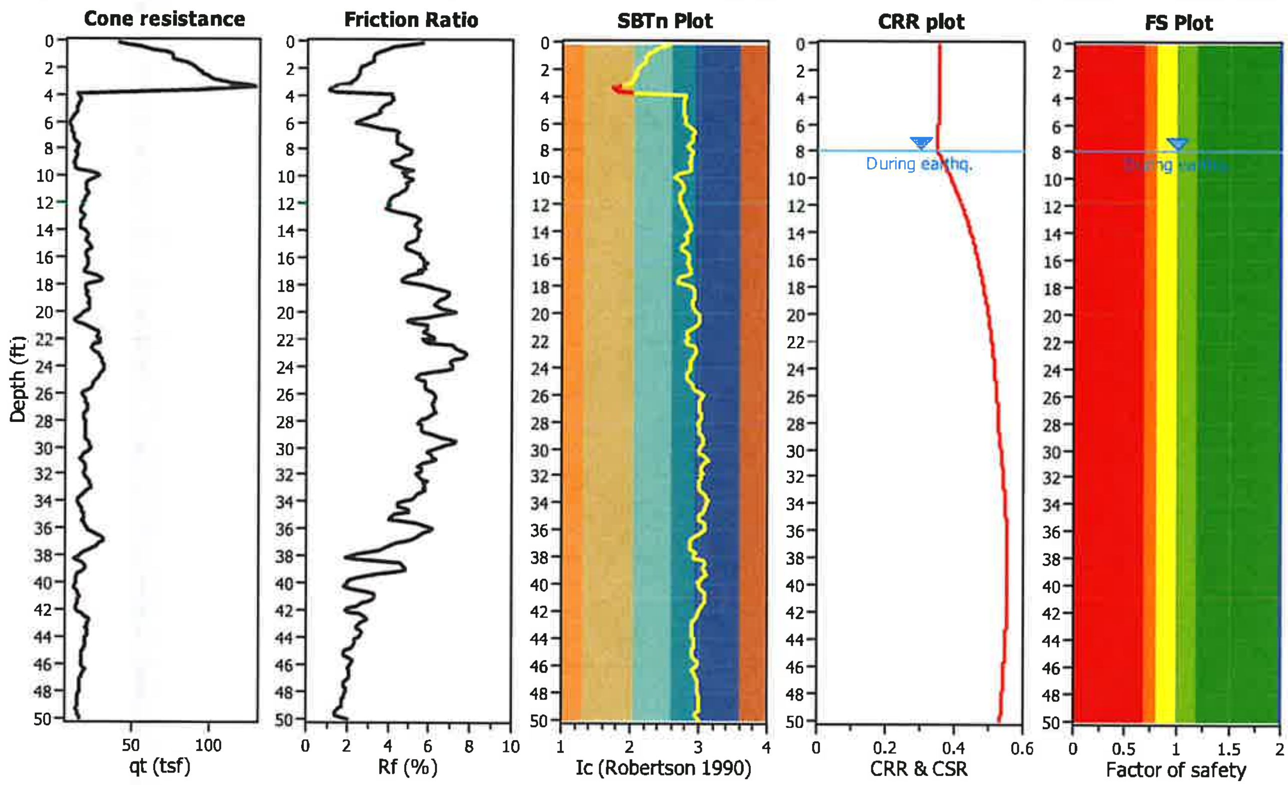
LIQUEFACTION ANALYSIS REPORT

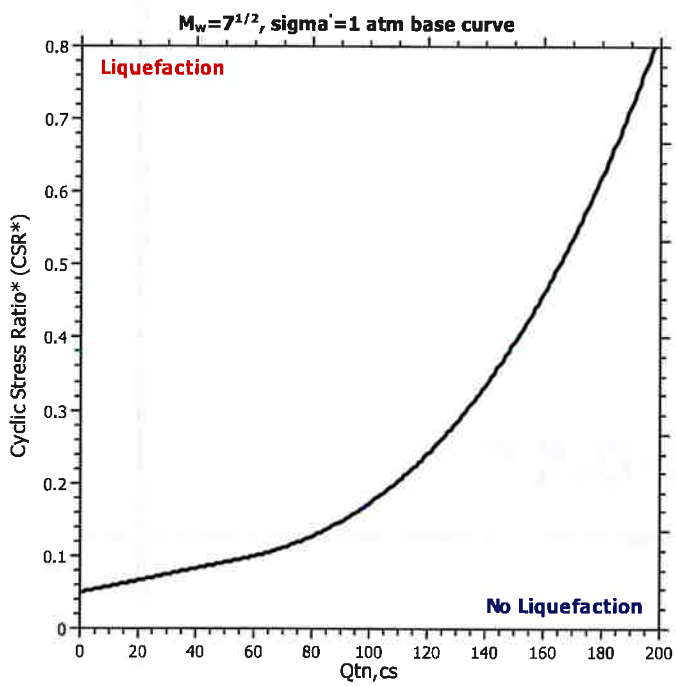
Project title : Heber 2 Repower Project **Location : Heber, CA**

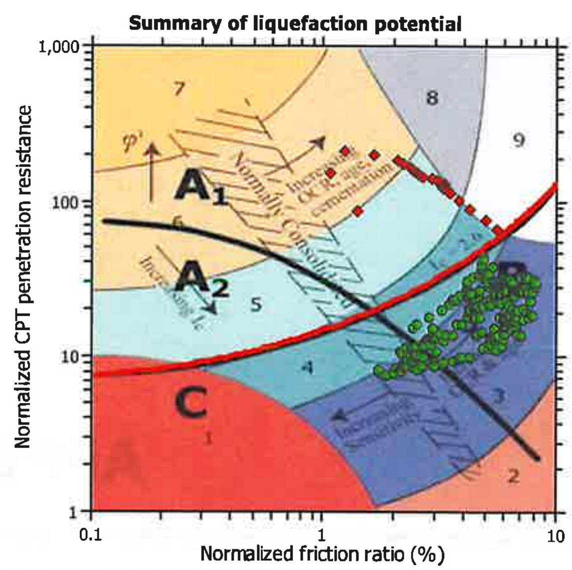
CPT file : CPT-1

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:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

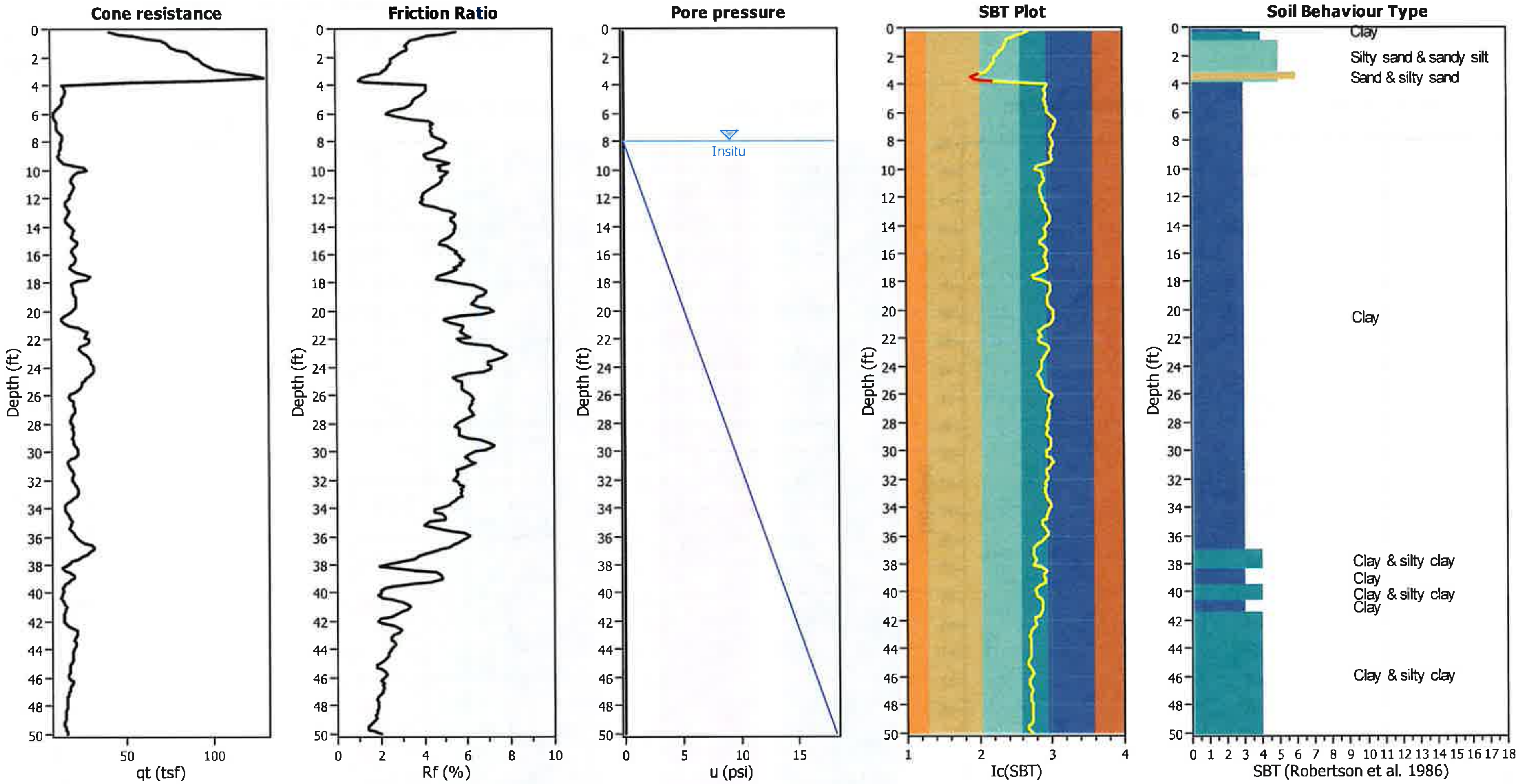






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



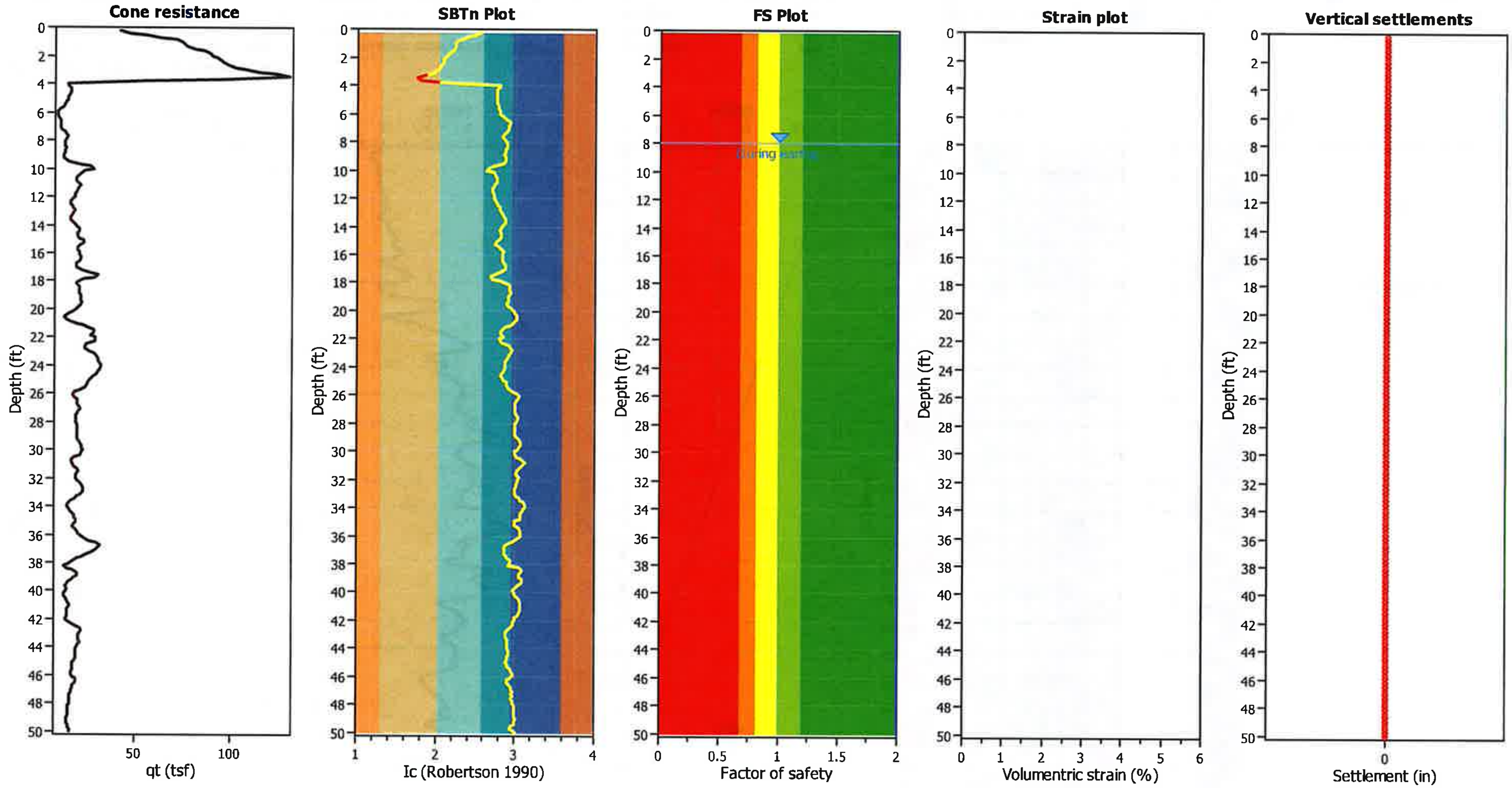
Input parameters and analysis data

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:	0.50	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



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric 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	119.97	2.00	0.00	0.86	0.00	8.20	118.98	2.00	0.00	0.86	0.00
8.37	118.57	2.00	0.00	0.86	0.00	8.53	116.33	2.00	0.00	0.86	0.00
8.69	111.11	2.00	0.00	0.85	0.00	8.86	105.42	2.00	0.00	0.85	0.00
9.02	103.12	2.00	0.00	0.85	0.00	9.19	106.12	2.00	0.00	0.84	0.00
9.35	114.80	2.00	0.00	0.84	0.00	9.51	129.15	2.00	0.00	0.84	0.00
9.68	142.81	2.00	0.00	0.84	0.00	9.84	155.83	2.00	0.00	0.83	0.00
10.01	158.63	2.00	0.00	0.83	0.00	10.17	154.96	2.00	0.00	0.83	0.00
10.33	145.30	2.00	0.00	0.82	0.00	10.50	138.73	2.00	0.00	0.82	0.00
10.66	137.47	2.00	0.00	0.82	0.00	10.83	136.96	2.00	0.00	0.82	0.00
10.99	137.99	2.00	0.00	0.81	0.00	11.15	137.59	2.00	0.00	0.81	0.00
11.32	134.89	2.00	0.00	0.81	0.00	11.48	129.13	2.00	0.00	0.81	0.00
11.65	123.50	2.00	0.00	0.80	0.00	11.81	121.19	2.00	0.00	0.80	0.00
11.98	119.62	2.00	0.00	0.80	0.00	12.14	117.79	2.00	0.00	0.79	0.00
12.30	113.63	2.00	0.00	0.79	0.00	12.47	115.50	2.00	0.00	0.79	0.00
12.63	123.82	2.00	0.00	0.79	0.00	12.80	132.97	2.00	0.00	0.78	0.00
12.96	139.15	2.00	0.00	0.78	0.00	13.12	139.59	2.00	0.00	0.78	0.00
13.29	136.63	2.00	0.00	0.77	0.00	13.45	131.74	2.00	0.00	0.77	0.00
13.62	130.26	2.00	0.00	0.77	0.00	13.78	134.95	2.00	0.00	0.77	0.00
13.94	140.91	2.00	0.00	0.76	0.00	14.11	145.02	2.00	0.00	0.76	0.00
14.27	146.42	2.00	0.00	0.76	0.00	14.44	144.79	2.00	0.00	0.76	0.00
14.60	141.29	2.00	0.00	0.75	0.00	14.76	138.10	2.00	0.00	0.75	0.00
14.93	137.24	2.00	0.00	0.75	0.00	15.09	138.96	2.00	0.00	0.74	0.00
15.26	139.60	2.00	0.00	0.74	0.00	15.42	140.43	2.00	0.00	0.74	0.00
15.58	139.21	2.00	0.00	0.74	0.00	15.75	140.96	2.00	0.00	0.73	0.00
15.91	141.85	2.00	0.00	0.73	0.00	16.08	145.91	2.00	0.00	0.73	0.00
16.24	147.66	2.00	0.00	0.72	0.00	16.40	149.68	2.00	0.00	0.72	0.00
16.57	145.56	2.00	0.00	0.72	0.00	16.73	140.89	2.00	0.00	0.72	0.00
16.90	134.62	2.00	0.00	0.71	0.00	17.06	136.61	2.00	0.00	0.71	0.00
17.22	140.20	2.00	0.00	0.71	0.00	17.39	146.14	2.00	0.00	0.71	0.00
17.55	148.16	2.00	0.00	0.70	0.00	17.72	144.49	2.00	0.00	0.70	0.00
17.88	139.25	2.00	0.00	0.70	0.00	18.04	138.26	2.00	0.00	0.69	0.00
18.21	144.57	2.00	0.00	0.69	0.00	18.37	151.78	2.00	0.00	0.69	0.00
18.54	154.52	2.00	0.00	0.69	0.00	18.70	153.95	2.00	0.00	0.68	0.00
18.86	153.12	2.00	0.00	0.68	0.00	19.03	151.55	2.00	0.00	0.68	0.00
19.19	150.73	2.00	0.00	0.67	0.00	19.36	148.04	2.00	0.00	0.67	0.00
19.52	147.69	2.00	0.00	0.67	0.00	19.69	151.40	2.00	0.00	0.67	0.00
19.85	154.31	2.00	0.00	0.66	0.00	20.01	150.07	2.00	0.00	0.66	0.00
20.18	135.86	2.00	0.00	0.66	0.00	20.34	119.17	2.00	0.00	0.66	0.00
20.51	104.85	2.00	0.00	0.65	0.00	20.67	104.13	2.00	0.00	0.65	0.00
20.83	114.48	2.00	0.00	0.65	0.00	21.00	131.00	2.00	0.00	0.64	0.00
21.16	142.62	2.00	0.00	0.64	0.00	21.33	149.15	2.00	0.00	0.64	0.00
21.49	153.07	2.00	0.00	0.64	0.00	21.65	154.99	2.00	0.00	0.63	0.00
21.82	156.00	2.00	0.00	0.63	0.00	21.98	152.30	2.00	0.00	0.63	0.00
22.15	154.57	2.00	0.00	0.62	0.00	22.31	156.68	2.00	0.00	0.62	0.00
22.47	159.95	2.00	0.00	0.62	0.00	22.64	157.92	2.00	0.00	0.62	0.00
22.80	160.98	2.00	0.00	0.61	0.00	22.97	169.52	2.00	0.00	0.61	0.00
23.13	176.91	2.00	0.00	0.61	0.00	23.29	178.34	2.00	0.00	0.61	0.00
23.46	174.45	2.00	0.00	0.60	0.00	23.62	171.54	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	172.69	2.00	0.00	0.60	0.00	23.95	175.54	2.00	0.00	0.59	0.00
24.11	175.55	2.00	0.00	0.59	0.00	24.28	168.97	2.00	0.00	0.59	0.00
24.44	157.41	2.00	0.00	0.59	0.00	24.61	146.69	2.00	0.00	0.58	0.00
24.77	140.58	2.00	0.00	0.58	0.00	24.93	139.79	2.00	0.00	0.58	0.00
25.10	139.62	2.00	0.00	0.57	0.00	25.26	138.81	2.00	0.00	0.57	0.00
25.43	136.75	2.00	0.00	0.57	0.00	25.59	133.88	2.00	0.00	0.57	0.00
25.75	129.01	2.00	0.00	0.56	0.00	25.92	123.09	2.00	0.00	0.56	0.00
26.08	121.15	2.00	0.00	0.56	0.00	26.25	124.71	2.00	0.00	0.56	0.00
26.41	127.90	2.00	0.00	0.55	0.00	26.57	128.10	2.00	0.00	0.55	0.00
26.74	126.91	2.00	0.00	0.55	0.00	26.90	128.06	2.00	0.00	0.54	0.00
27.07	129.48	2.00	0.00	0.54	0.00	27.23	128.59	2.00	0.00	0.54	0.00
27.40	126.11	2.00	0.00	0.54	0.00	27.56	122.56	2.00	0.00	0.53	0.00
27.72	119.14	2.00	0.00	0.53	0.00	27.89	116.40	2.00	0.00	0.53	0.00
28.05	117.08	2.00	0.00	0.52	0.00	28.22	116.67	2.00	0.00	0.52	0.00
28.38	118.11	2.00	0.00	0.52	0.00	28.54	118.18	2.00	0.00	0.52	0.00
28.71	118.83	2.00	0.00	0.51	0.00	28.87	118.78	2.00	0.00	0.51	0.00
29.04	120.47	2.00	0.00	0.51	0.00	29.20	126.00	2.00	0.00	0.51	0.00
29.36	131.40	2.00	0.00	0.50	0.00	29.53	135.95	2.00	0.00	0.50	0.00
29.69	136.80	2.00	0.00	0.50	0.00	29.86	135.40	2.00	0.00	0.49	0.00
30.02	131.15	2.00	0.00	0.49	0.00	30.18	127.34	2.00	0.00	0.49	0.00
30.35	121.69	2.00	0.00	0.49	0.00	30.51	115.70	2.00	0.00	0.48	0.00
30.68	111.80	2.00	0.00	0.48	0.00	30.84	112.22	2.00	0.00	0.48	0.00
31.00	112.33	2.00	0.00	0.47	0.00	31.17	111.25	2.00	0.00	0.47	0.00
31.33	112.16	2.00	0.00	0.47	0.00	31.50	114.87	2.00	0.00	0.47	0.00
31.66	114.02	2.00	0.00	0.46	0.00	31.82	110.25	2.00	0.00	0.46	0.00
31.99	108.73	2.00	0.00	0.46	0.00	32.15	112.92	2.00	0.00	0.46	0.00
32.32	116.75	2.00	0.00	0.45	0.00	32.48	119.82	2.00	0.00	0.45	0.00
32.64	120.23	2.00	0.00	0.45	0.00	32.81	121.28	2.00	0.00	0.44	0.00
32.97	120.46	2.00	0.00	0.44	0.00	33.14	117.67	2.00	0.00	0.44	0.00
33.30	111.47	2.00	0.00	0.44	0.00	33.46	105.37	2.00	0.00	0.43	0.00
33.63	100.20	2.00	0.00	0.43	0.00	33.79	95.08	2.00	0.00	0.43	0.00
33.96	90.37	2.00	0.00	0.42	0.00	34.12	87.91	2.00	0.00	0.42	0.00
34.28	90.52	2.00	0.00	0.42	0.00	34.45	96.32	2.00	0.00	0.42	0.00
34.61	99.51	2.00	0.00	0.41	0.00	34.78	99.39	2.00	0.00	0.41	0.00
34.94	95.45	2.00	0.00	0.41	0.00	35.10	92.69	2.00	0.00	0.41	0.00
35.27	91.26	2.00	0.00	0.40	0.00	35.43	95.67	2.00	0.00	0.40	0.00
35.60	104.11	2.00	0.00	0.40	0.00	35.76	111.84	2.00	0.00	0.39	0.00
35.93	115.82	2.00	0.00	0.39	0.00	36.09	116.17	2.00	0.00	0.39	0.00
36.25	118.60	2.00	0.00	0.39	0.00	36.42	122.19	2.00	0.00	0.38	0.00
36.58	126.65	2.00	0.00	0.38	0.00	36.75	127.95	2.00	0.00	0.38	0.00
36.91	123.10	2.00	0.00	0.37	0.00	37.07	114.03	2.00	0.00	0.37	0.00
37.24	104.72	2.00	0.00	0.37	0.00	37.40	98.46	2.00	0.00	0.37	0.00
37.57	91.59	2.00	0.00	0.36	0.00	37.73	82.25	2.00	0.00	0.36	0.00
37.89	70.62	2.00	0.00	0.36	0.00	38.06	60.48	2.00	0.00	0.35	0.00
38.22	63.21	2.00	0.00	0.35	0.00	38.39	76.34	2.00	0.00	0.35	0.00
38.55	91.11	2.00	0.00	0.35	0.00	38.71	98.86	2.00	0.00	0.34	0.00
38.88	99.34	2.00	0.00	0.34	0.00	39.04	95.61	2.00	0.00	0.34	0.00
39.21	86.80	2.00	0.00	0.34	0.00	39.37	76.19	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	64.64	2.00	0.00	0.33	0.00	39.70	60.43	2.00	0.00	0.33	0.00
39.86	58.79	2.00	0.00	0.32	0.00	40.03	58.19	2.00	0.00	0.32	0.00
40.19	55.59	2.00	0.00	0.32	0.00	40.35	57.57	2.00	0.00	0.32	0.00
40.52	62.98	2.00	0.00	0.31	0.00	40.68	69.67	2.00	0.00	0.31	0.00
40.85	73.76	2.00	0.00	0.31	0.00	41.01	74.59	2.00	0.00	0.30	0.00
41.17	72.68	2.00	0.00	0.30	0.00	41.34	69.91	2.00	0.00	0.30	0.00
41.50	66.62	2.00	0.00	0.30	0.00	41.67	63.67	2.00	0.00	0.29	0.00
41.83	58.22	2.00	0.00	0.29	0.00	41.99	56.51	2.00	0.00	0.29	0.00
42.16	59.31	2.00	0.00	0.29	0.00	42.32	68.96	2.00	0.00	0.28	0.00
42.49	76.21	2.00	0.00	0.28	0.00	42.65	79.83	2.00	0.00	0.28	0.00
42.81	78.47	2.00	0.00	0.27	0.00	42.98	75.37	2.00	0.00	0.27	0.00
43.14	72.19	2.00	0.00	0.27	0.00	43.31	72.07	2.00	0.00	0.27	0.00
43.47	73.96	2.00	0.00	0.26	0.00	43.64	75.40	2.00	0.00	0.26	0.00
43.80	74.08	2.00	0.00	0.26	0.00	43.96	71.55	2.00	0.00	0.25	0.00
44.13	69.30	2.00	0.00	0.25	0.00	44.29	68.40	2.00	0.00	0.25	0.00
44.46	68.25	2.00	0.00	0.25	0.00	44.62	67.81	2.00	0.00	0.24	0.00
44.78	65.86	2.00	0.00	0.24	0.00	44.95	62.49	2.00	0.00	0.24	0.00
45.11	59.84	2.00	0.00	0.24	0.00	45.28	59.58	2.00	0.00	0.23	0.00
45.44	61.66	2.00	0.00	0.23	0.00	45.60	63.62	2.00	0.00	0.23	0.00
45.77	63.78	2.00	0.00	0.22	0.00	45.93	62.47	2.00	0.00	0.22	0.00
46.10	62.45	2.00	0.00	0.22	0.00	46.26	63.43	2.00	0.00	0.22	0.00
46.42	64.80	2.00	0.00	0.21	0.00	46.59	63.69	2.00	0.00	0.21	0.00
46.75	62.33	2.00	0.00	0.21	0.00	46.92	61.14	2.00	0.00	0.20	0.00
47.08	60.30	2.00	0.00	0.20	0.00	47.24	58.40	2.00	0.00	0.20	0.00
47.41	57.02	2.00	0.00	0.20	0.00	47.57	56.85	2.00	0.00	0.19	0.00
47.74	57.68	2.00	0.00	0.19	0.00	47.90	57.58	2.00	0.00	0.19	0.00
48.06	57.06	2.00	0.00	0.19	0.00	48.23	56.18	2.00	0.00	0.18	0.00
48.39	55.57	2.00	0.00	0.18	0.00	48.56	54.87	2.00	0.00	0.18	0.00
48.72	54.42	2.00	0.00	0.17	0.00	48.88	54.29	2.00	0.00	0.17	0.00
49.05	53.61	2.00	0.00	0.17	0.00	49.21	51.61	2.00	0.00	0.17	0.00
49.38	49.82	2.00	0.00	0.16	0.00	49.54	49.51	2.00	0.00	0.16	0.00
49.70	49.89	2.00	0.00	0.16	0.00	49.87	54.16	2.00	0.00	0.15	0.00
50.03	57.29	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

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

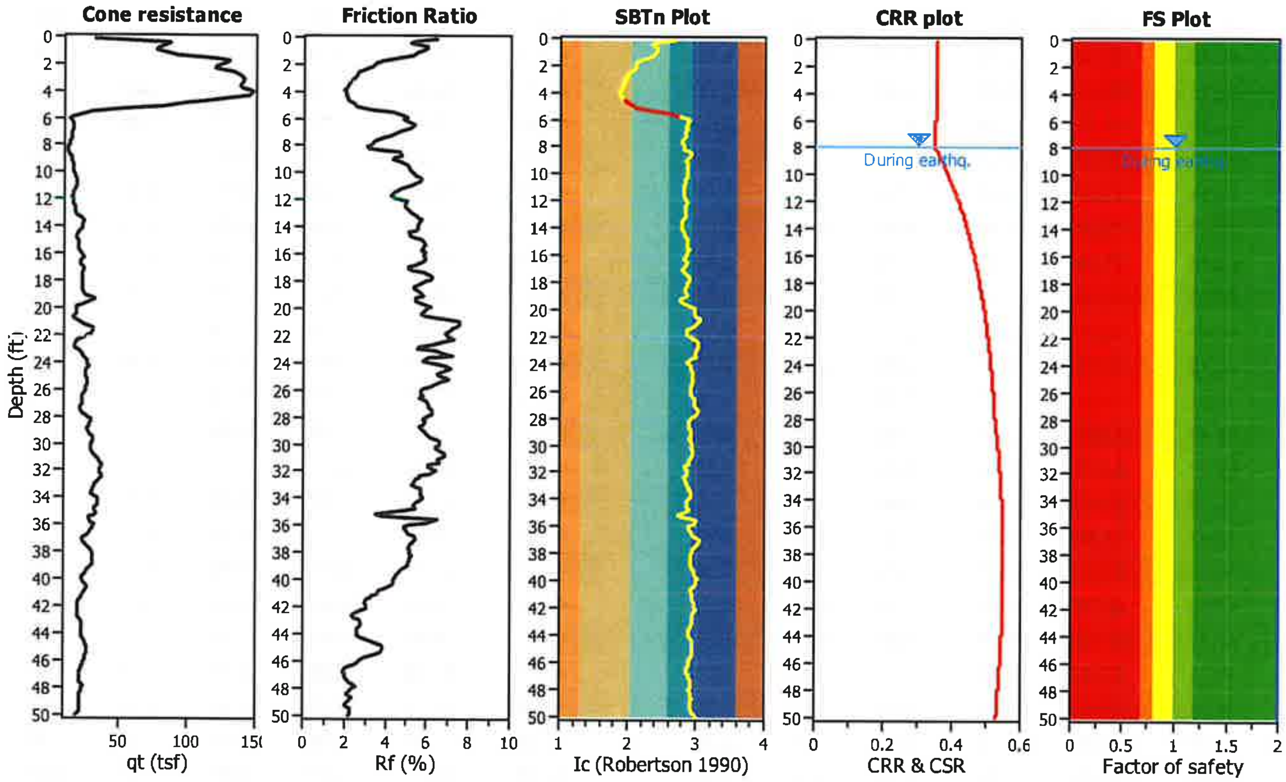
LIQUEFACTION ANALYSIS REPORT

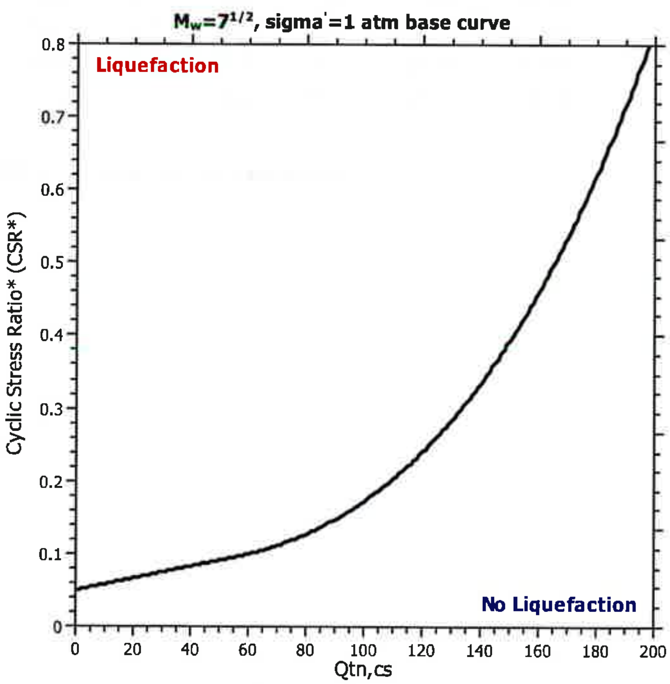
Project title : Heber 2 Repower Project **Location : Heber, CA**

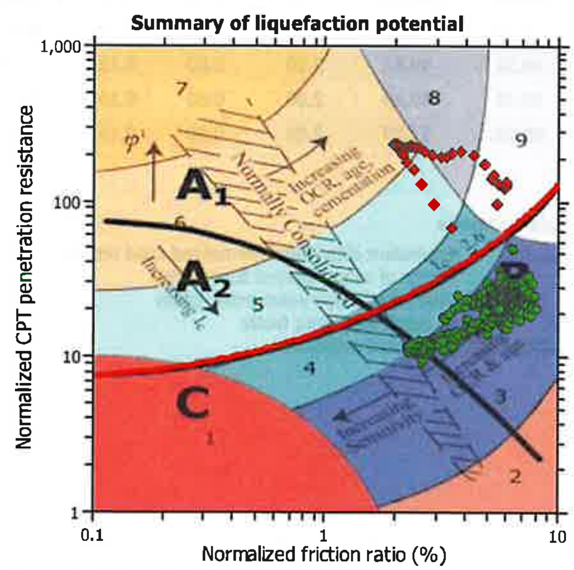
CPT file : CPT-2

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:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

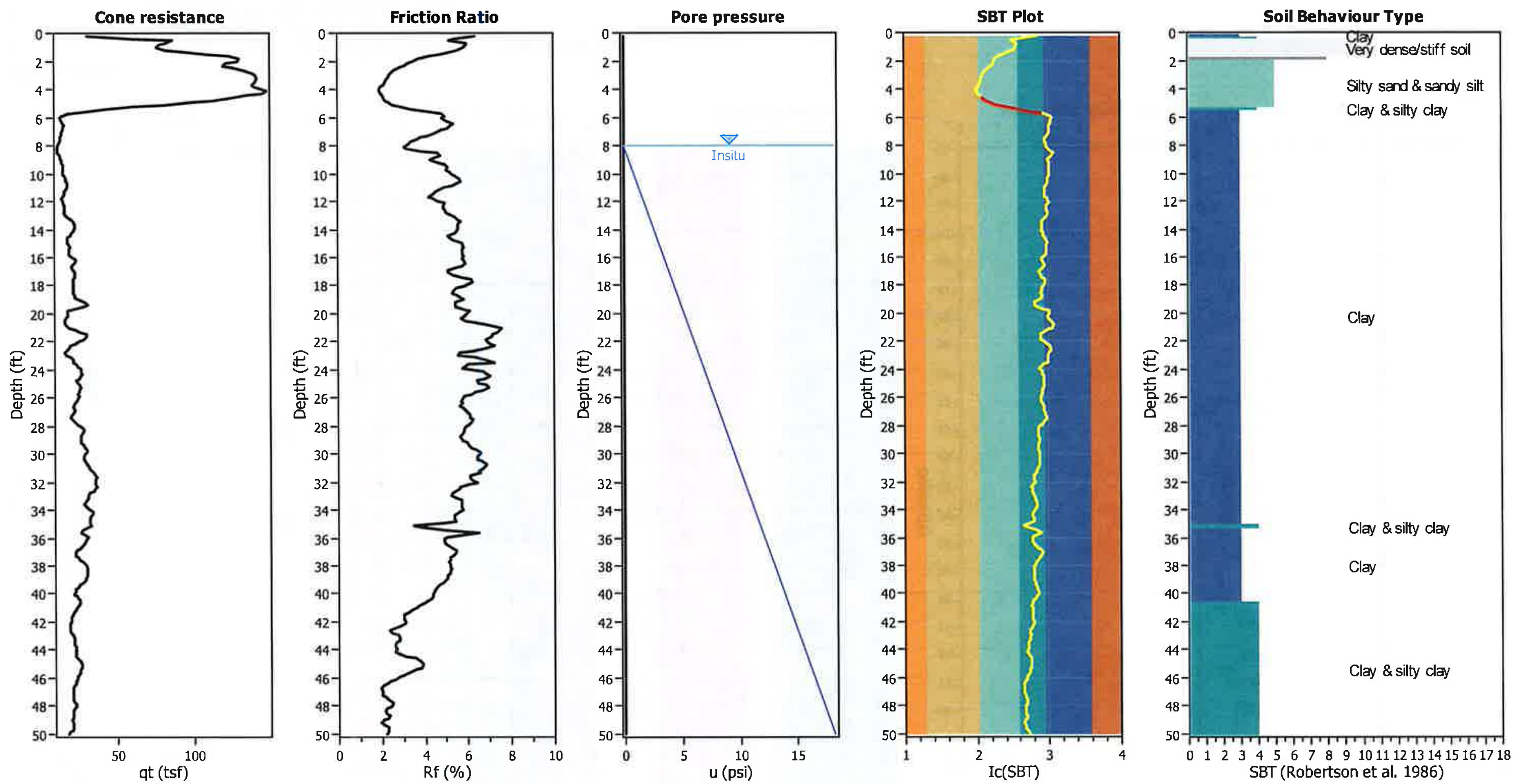






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



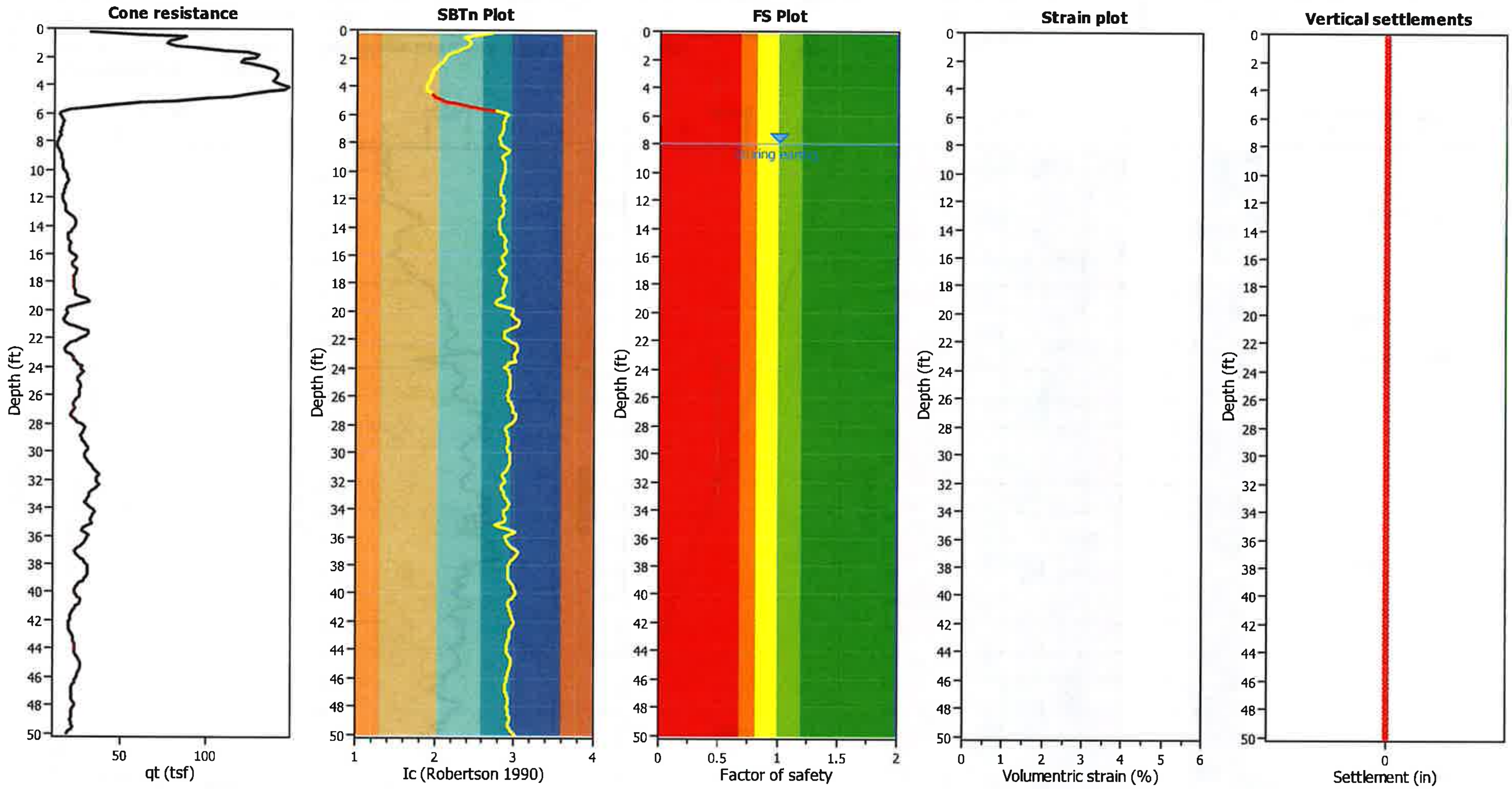
Input parameters and analysis data

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:	0.50	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	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric 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	87.36	2.00	0.00	0.86	0.00	8.20	87.19	2.00	0.00	0.86	0.00
8.37	96.18	2.00	0.00	0.86	0.00	8.53	106.38	2.00	0.00	0.86	0.00
8.69	112.48	2.00	0.00	0.85	0.00	8.86	110.89	2.00	0.00	0.85	0.00
9.02	111.02	2.00	0.00	0.85	0.00	9.19	116.47	2.00	0.00	0.84	0.00
9.35	122.07	2.00	0.00	0.84	0.00	9.51	124.70	2.00	0.00	0.84	0.00
9.68	124.57	2.00	0.00	0.84	0.00	9.84	125.67	2.00	0.00	0.83	0.00
10.01	128.65	2.00	0.00	0.83	0.00	10.17	133.81	2.00	0.00	0.83	0.00
10.33	139.27	2.00	0.00	0.82	0.00	10.50	141.24	2.00	0.00	0.82	0.00
10.66	140.53	2.00	0.00	0.82	0.00	10.83	137.12	2.00	0.00	0.82	0.00
10.99	132.08	2.00	0.00	0.81	0.00	11.15	125.69	2.00	0.00	0.81	0.00
11.32	121.22	2.00	0.00	0.81	0.00	11.48	118.55	2.00	0.00	0.81	0.00
11.65	114.78	2.00	0.00	0.80	0.00	11.81	114.47	2.00	0.00	0.80	0.00
11.98	117.86	2.00	0.00	0.80	0.00	12.14	123.32	2.00	0.00	0.79	0.00
12.30	124.95	2.00	0.00	0.79	0.00	12.47	126.35	2.00	0.00	0.79	0.00
12.63	127.12	2.00	0.00	0.79	0.00	12.80	126.75	2.00	0.00	0.78	0.00
12.96	128.67	2.00	0.00	0.78	0.00	13.12	137.01	2.00	0.00	0.78	0.00
13.29	146.43	2.00	0.00	0.77	0.00	13.45	152.65	2.00	0.00	0.77	0.00
13.62	152.23	2.00	0.00	0.77	0.00	13.78	150.77	2.00	0.00	0.77	0.00
13.94	149.69	2.00	0.00	0.76	0.00	14.11	147.77	2.00	0.00	0.76	0.00
14.27	143.23	2.00	0.00	0.76	0.00	14.44	134.40	2.00	0.00	0.76	0.00
14.60	130.85	2.00	0.00	0.75	0.00	14.76	131.78	2.00	0.00	0.75	0.00
14.93	137.68	2.00	0.00	0.75	0.00	15.09	141.06	2.00	0.00	0.74	0.00
15.26	142.59	2.00	0.00	0.74	0.00	15.42	140.26	2.00	0.00	0.74	0.00
15.58	137.71	2.00	0.00	0.74	0.00	15.75	138.11	2.00	0.00	0.73	0.00
15.91	142.76	2.00	0.00	0.73	0.00	16.08	148.65	2.00	0.00	0.73	0.00
16.24	151.42	2.00	0.00	0.72	0.00	16.40	149.65	2.00	0.00	0.72	0.00
16.57	142.62	2.00	0.00	0.72	0.00	16.73	137.02	2.00	0.00	0.72	0.00
16.90	134.47	2.00	0.00	0.71	0.00	17.06	136.99	2.00	0.00	0.71	0.00
17.22	140.40	2.00	0.00	0.71	0.00	17.39	144.16	2.00	0.00	0.71	0.00
17.55	147.16	2.00	0.00	0.70	0.00	17.72	147.34	2.00	0.00	0.70	0.00
17.88	145.63	2.00	0.00	0.70	0.00	18.04	142.20	2.00	0.00	0.69	0.00
18.21	137.49	2.00	0.00	0.69	0.00	18.37	134.79	2.00	0.00	0.69	0.00
18.54	135.52	2.00	0.00	0.69	0.00	18.70	138.83	2.00	0.00	0.68	0.00
18.86	142.10	2.00	0.00	0.68	0.00	19.03	147.42	2.00	0.00	0.68	0.00
19.19	153.72	2.00	0.00	0.67	0.00	19.36	155.93	2.00	0.00	0.67	0.00
19.52	149.47	2.00	0.00	0.67	0.00	19.69	138.34	2.00	0.00	0.67	0.00
19.85	130.61	2.00	0.00	0.66	0.00	20.01	127.39	2.00	0.00	0.66	0.00
20.18	126.45	2.00	0.00	0.66	0.00	20.34	122.79	2.00	0.00	0.66	0.00
20.51	120.62	2.00	0.00	0.65	0.00	20.67	123.16	2.00	0.00	0.65	0.00
20.83	132.56	2.00	0.00	0.65	0.00	21.00	144.81	2.00	0.00	0.64	0.00
21.16	158.42	2.00	0.00	0.64	0.00	21.33	169.86	2.00	0.00	0.64	0.00
21.49	175.02	2.00	0.00	0.64	0.00	21.65	173.22	2.00	0.00	0.63	0.00
21.82	164.99	2.00	0.00	0.63	0.00	21.98	158.59	2.00	0.00	0.63	0.00
22.15	151.83	2.00	0.00	0.62	0.00	22.31	144.28	2.00	0.00	0.62	0.00
22.47	133.91	2.00	0.00	0.62	0.00	22.64	122.50	2.00	0.00	0.62	0.00
22.80	113.97	2.00	0.00	0.61	0.00	22.97	115.77	2.00	0.00	0.61	0.00
23.13	130.82	2.00	0.00	0.61	0.00	23.29	142.43	2.00	0.00	0.61	0.00
23.46	145.56	2.00	0.00	0.60	0.00	23.62	138.07	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	137.78	2.00	0.00	0.60	0.00	23.95	142.26	2.00	0.00	0.59	0.00
24.11	152.61	2.00	0.00	0.59	0.00	24.28	157.26	2.00	0.00	0.59	0.00
24.44	157.24	2.00	0.00	0.59	0.00	24.61	149.93	2.00	0.00	0.58	0.00
24.77	142.55	2.00	0.00	0.58	0.00	24.93	143.51	2.00	0.00	0.58	0.00
25.10	149.66	2.00	0.00	0.57	0.00	25.26	152.78	2.00	0.00	0.57	0.00
25.43	148.83	2.00	0.00	0.57	0.00	25.59	143.18	2.00	0.00	0.57	0.00
25.75	139.46	2.00	0.00	0.56	0.00	25.92	135.62	2.00	0.00	0.56	0.00
26.08	133.19	2.00	0.00	0.56	0.00	26.25	130.04	2.00	0.00	0.56	0.00
26.41	126.80	2.00	0.00	0.55	0.00	26.57	123.29	2.00	0.00	0.55	0.00
26.74	124.77	2.00	0.00	0.55	0.00	26.90	128.04	2.00	0.00	0.54	0.00
27.07	127.87	2.00	0.00	0.54	0.00	27.23	124.65	2.00	0.00	0.54	0.00
27.40	123.42	2.00	0.00	0.54	0.00	27.56	125.82	2.00	0.00	0.53	0.00
27.72	129.41	2.00	0.00	0.53	0.00	27.89	132.22	2.00	0.00	0.53	0.00
28.05	136.18	2.00	0.00	0.52	0.00	28.22	139.19	2.00	0.00	0.52	0.00
28.38	139.58	2.00	0.00	0.52	0.00	28.54	136.40	2.00	0.00	0.52	0.00
28.71	132.41	2.00	0.00	0.51	0.00	28.87	131.90	2.00	0.00	0.51	0.00
29.04	133.41	2.00	0.00	0.51	0.00	29.20	135.88	2.00	0.00	0.51	0.00
29.36	139.24	2.00	0.00	0.50	0.00	29.53	144.11	2.00	0.00	0.50	0.00
29.69	147.91	2.00	0.00	0.50	0.00	29.86	148.75	2.00	0.00	0.49	0.00
30.02	146.27	2.00	0.00	0.49	0.00	30.18	143.95	2.00	0.00	0.49	0.00
30.35	143.23	2.00	0.00	0.49	0.00	30.51	146.19	2.00	0.00	0.48	0.00
30.68	150.88	2.00	0.00	0.48	0.00	30.84	153.31	2.00	0.00	0.48	0.00
31.00	153.80	2.00	0.00	0.47	0.00	31.17	154.28	2.00	0.00	0.47	0.00
31.33	157.57	2.00	0.00	0.47	0.00	31.50	153.01	2.00	0.00	0.47	0.00
31.66	154.59	2.00	0.00	0.46	0.00	31.82	152.70	2.00	0.00	0.46	0.00
31.99	155.75	2.00	0.00	0.46	0.00	32.15	151.09	2.00	0.00	0.46	0.00
32.32	147.83	2.00	0.00	0.45	0.00	32.48	145.76	2.00	0.00	0.45	0.00
32.64	140.14	2.00	0.00	0.45	0.00	32.81	133.97	2.00	0.00	0.44	0.00
32.97	130.32	2.00	0.00	0.44	0.00	33.14	132.24	2.00	0.00	0.44	0.00
33.30	133.70	2.00	0.00	0.44	0.00	33.46	131.98	2.00	0.00	0.43	0.00
33.63	130.38	2.00	0.00	0.43	0.00	33.79	132.66	2.00	0.00	0.43	0.00
33.96	137.36	2.00	0.00	0.42	0.00	34.12	139.02	2.00	0.00	0.42	0.00
34.28	136.49	2.00	0.00	0.42	0.00	34.45	134.01	2.00	0.00	0.42	0.00
34.61	131.99	2.00	0.00	0.41	0.00	34.78	130.99	2.00	0.00	0.41	0.00
34.94	124.05	2.00	0.00	0.41	0.00	35.10	106.18	2.00	0.00	0.41	0.00
35.27	108.32	2.00	0.00	0.40	0.00	35.43	116.24	2.00	0.00	0.40	0.00
35.60	131.29	2.00	0.00	0.40	0.00	35.76	128.43	2.00	0.00	0.39	0.00
35.93	124.20	2.00	0.00	0.39	0.00	36.09	120.99	2.00	0.00	0.39	0.00
36.25	118.67	2.00	0.00	0.39	0.00	36.42	117.46	2.00	0.00	0.38	0.00
36.58	116.41	2.00	0.00	0.38	0.00	36.75	114.96	2.00	0.00	0.38	0.00
36.91	112.18	2.00	0.00	0.37	0.00	37.07	109.16	2.00	0.00	0.37	0.00
37.24	108.67	2.00	0.00	0.37	0.00	37.40	109.91	2.00	0.00	0.37	0.00
37.57	113.02	2.00	0.00	0.36	0.00	37.73	115.42	2.00	0.00	0.36	0.00
37.89	118.48	2.00	0.00	0.36	0.00	38.06	120.42	2.00	0.00	0.35	0.00
38.22	120.97	2.00	0.00	0.35	0.00	38.39	120.42	2.00	0.00	0.35	0.00
38.55	119.67	2.00	0.00	0.35	0.00	38.71	118.51	2.00	0.00	0.34	0.00
38.88	117.61	2.00	0.00	0.34	0.00	39.04	115.20	2.00	0.00	0.34	0.00
39.21	110.80	2.00	0.00	0.34	0.00	39.37	105.70	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	101.48	2.00	0.00	0.33	0.00	39.70	98.49	2.00	0.00	0.33	0.00
39.86	96.59	2.00	0.00	0.32	0.00	40.03	95.67	2.00	0.00	0.32	0.00
40.19	97.13	2.00	0.00	0.32	0.00	40.35	98.64	2.00	0.00	0.32	0.00
40.52	98.88	2.00	0.00	0.31	0.00	40.68	96.83	2.00	0.00	0.31	0.00
40.85	92.14	2.00	0.00	0.31	0.00	41.01	88.77	2.00	0.00	0.30	0.00
41.17	84.35	2.00	0.00	0.30	0.00	41.34	81.40	2.00	0.00	0.30	0.00
41.50	77.39	2.00	0.00	0.30	0.00	41.67	76.16	2.00	0.00	0.29	0.00
41.83	76.40	2.00	0.00	0.29	0.00	41.99	76.66	2.00	0.00	0.29	0.00
42.16	75.61	2.00	0.00	0.29	0.00	42.32	71.98	2.00	0.00	0.28	0.00
42.49	68.05	2.00	0.00	0.28	0.00	42.65	66.80	2.00	0.00	0.28	0.00
42.81	69.47	2.00	0.00	0.27	0.00	42.98	73.47	2.00	0.00	0.27	0.00
43.14	75.84	2.00	0.00	0.27	0.00	43.31	76.24	2.00	0.00	0.27	0.00
43.47	75.02	2.00	0.00	0.26	0.00	43.64	74.38	2.00	0.00	0.26	0.00
43.80	74.31	2.00	0.00	0.26	0.00	43.96	74.98	2.00	0.00	0.25	0.00
44.13	74.60	2.00	0.00	0.25	0.00	44.29	76.20	2.00	0.00	0.25	0.00
44.46	80.54	2.00	0.00	0.25	0.00	44.62	86.78	2.00	0.00	0.24	0.00
44.78	90.93	2.00	0.00	0.24	0.00	44.95	93.24	2.00	0.00	0.24	0.00
45.11	93.73	2.00	0.00	0.24	0.00	45.28	92.65	2.00	0.00	0.23	0.00
45.44	89.03	2.00	0.00	0.23	0.00	45.60	84.92	2.00	0.00	0.23	0.00
45.77	80.93	2.00	0.00	0.22	0.00	45.93	77.69	2.00	0.00	0.22	0.00
46.10	74.24	2.00	0.00	0.22	0.00	46.26	71.34	2.00	0.00	0.22	0.00
46.42	68.07	2.00	0.00	0.21	0.00	46.59	65.10	2.00	0.00	0.21	0.00
46.75	63.06	2.00	0.00	0.21	0.00	46.92	62.80	2.00	0.00	0.20	0.00
47.08	63.25	2.00	0.00	0.20	0.00	47.24	63.50	2.00	0.00	0.20	0.00
47.41	64.30	2.00	0.00	0.20	0.00	47.57	66.85	2.00	0.00	0.19	0.00
47.74	69.90	2.00	0.00	0.19	0.00	47.90	71.36	2.00	0.00	0.19	0.00
48.06	69.62	2.00	0.00	0.19	0.00	48.23	66.49	2.00	0.00	0.18	0.00
48.39	64.48	2.00	0.00	0.18	0.00	48.56	65.33	2.00	0.00	0.18	0.00
48.72	67.11	2.00	0.00	0.17	0.00	48.88	66.06	2.00	0.00	0.17	0.00
49.05	63.01	2.00	0.00	0.17	0.00	49.21	61.74	2.00	0.00	0.17	0.00
49.38	63.70	2.00	0.00	0.16	0.00	49.54	65.97	2.00	0.00	0.16	0.00
49.70	65.40	2.00	0.00	0.16	0.00	49.87	62.98	2.00	0.00	0.15	0.00
50.03	60.76	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

LANDMARK Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

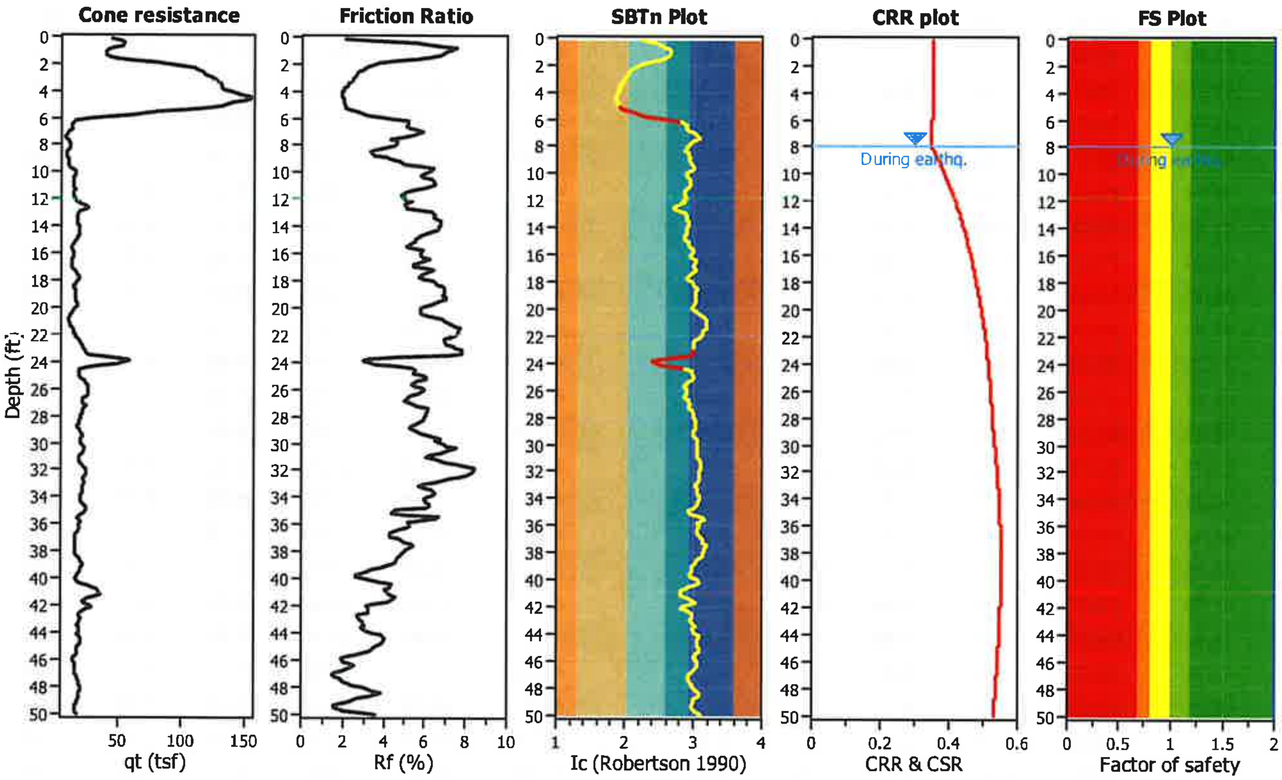
LIQUEFACTION ANALYSIS REPORT

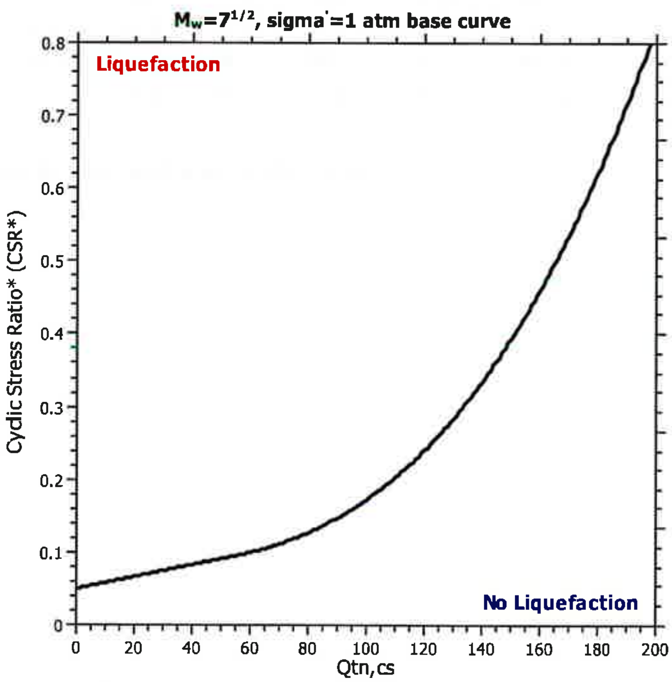
Project title : Heber 2 Repower Project **Location : Heber, CA**

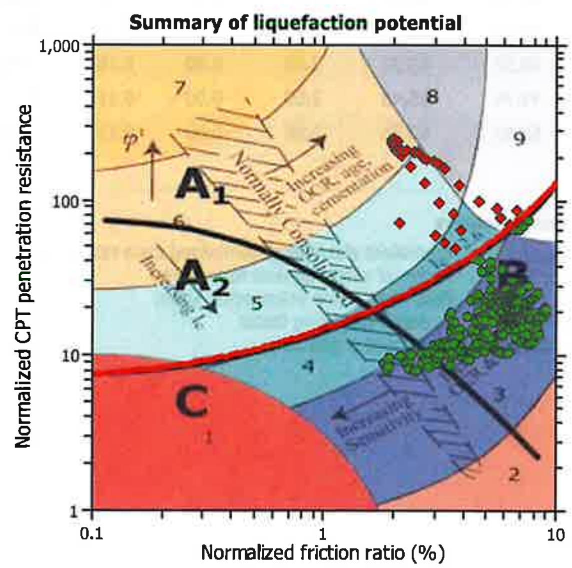
CPT file : CPT-3

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:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

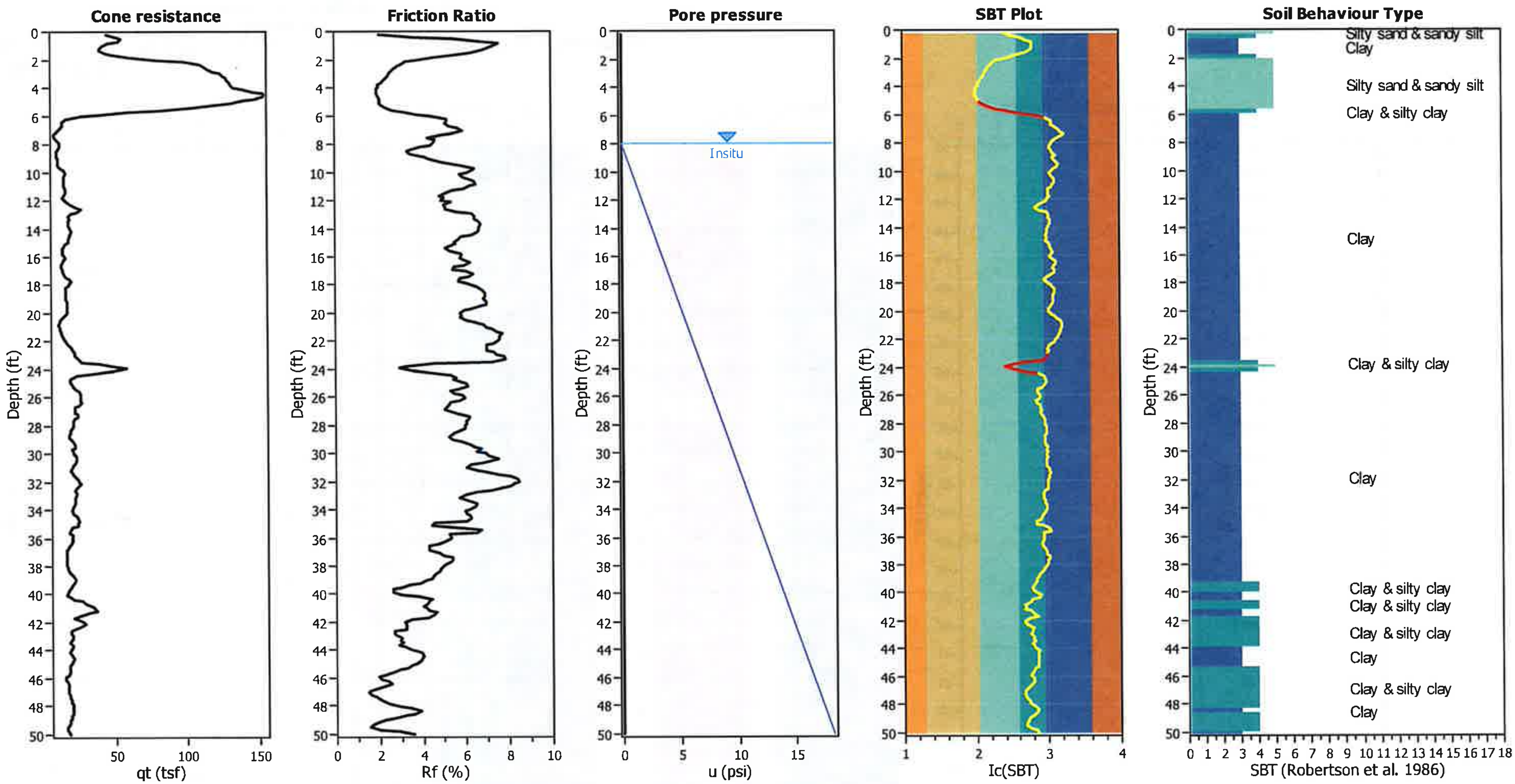






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



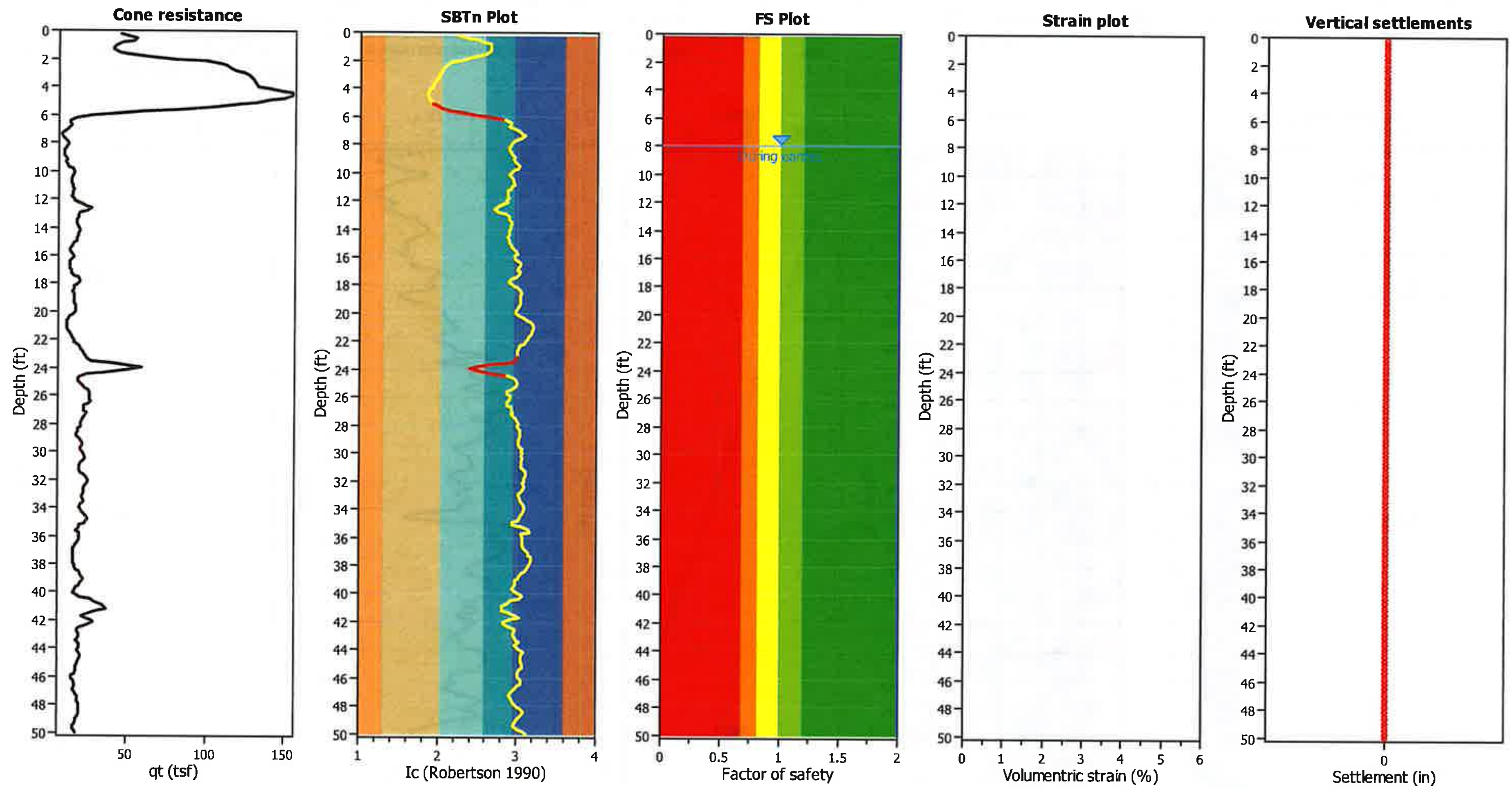
Input parameters and analysis data

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:	0.50	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



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
FS: Calculated Factor of Safety against liquefaction
Volumentric 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	105.22	2.00	0.00	0.86	0.00	8.20	98.09	2.00	0.00	0.86	0.00
8.37	89.48	2.00	0.00	0.86	0.00	8.53	84.06	2.00	0.00	0.86	0.00
8.69	85.12	2.00	0.00	0.85	0.00	8.86	93.40	2.00	0.00	0.85	0.00
9.02	99.67	2.00	0.00	0.85	0.00	9.19	104.91	2.00	0.00	0.84	0.00
9.35	106.95	2.00	0.00	0.84	0.00	9.51	115.87	2.00	0.00	0.84	0.00
9.68	128.34	2.00	0.00	0.84	0.00	9.84	137.59	2.00	0.00	0.83	0.00
10.01	139.16	2.00	0.00	0.83	0.00	10.17	135.75	2.00	0.00	0.83	0.00
10.33	134.00	2.00	0.00	0.82	0.00	10.50	136.19	2.00	0.00	0.82	0.00
10.66	138.03	2.00	0.00	0.82	0.00	10.83	138.95	2.00	0.00	0.82	0.00
10.99	137.77	2.00	0.00	0.81	0.00	11.15	136.64	2.00	0.00	0.81	0.00
11.32	132.10	2.00	0.00	0.81	0.00	11.48	125.76	2.00	0.00	0.81	0.00
11.65	120.13	2.00	0.00	0.80	0.00	11.81	120.19	2.00	0.00	0.80	0.00
11.98	125.19	2.00	0.00	0.80	0.00	12.14	132.55	2.00	0.00	0.79	0.00
12.30	140.53	2.00	0.00	0.79	0.00	12.47	151.43	2.00	0.00	0.79	0.00
12.63	157.43	2.00	0.00	0.79	0.00	12.80	158.94	2.00	0.00	0.78	0.00
12.96	155.22	2.00	0.00	0.78	0.00	13.12	152.28	2.00	0.00	0.78	0.00
13.29	151.52	2.00	0.00	0.77	0.00	13.45	152.54	2.00	0.00	0.77	0.00
13.62	152.19	2.00	0.00	0.77	0.00	13.78	153.09	2.00	0.00	0.77	0.00
13.94	154.64	2.00	0.00	0.76	0.00	14.11	156.69	2.00	0.00	0.76	0.00
14.27	155.45	2.00	0.00	0.76	0.00	14.44	149.53	2.00	0.00	0.76	0.00
14.60	141.82	2.00	0.00	0.75	0.00	14.76	137.16	2.00	0.00	0.75	0.00
14.93	132.83	2.00	0.00	0.75	0.00	15.09	128.46	2.00	0.00	0.74	0.00
15.26	120.02	2.00	0.00	0.74	0.00	15.42	114.98	2.00	0.00	0.74	0.00
15.58	115.12	2.00	0.00	0.74	0.00	15.75	121.64	2.00	0.00	0.73	0.00
15.91	125.61	2.00	0.00	0.73	0.00	16.08	126.76	2.00	0.00	0.73	0.00
16.24	125.34	2.00	0.00	0.72	0.00	16.40	122.47	2.00	0.00	0.72	0.00
16.57	116.72	2.00	0.00	0.72	0.00	16.73	112.12	2.00	0.00	0.72	0.00
16.90	113.22	2.00	0.00	0.71	0.00	17.06	120.49	2.00	0.00	0.71	0.00
17.22	126.45	2.00	0.00	0.71	0.00	17.39	130.53	2.00	0.00	0.71	0.00
17.55	132.64	2.00	0.00	0.70	0.00	17.72	135.99	2.00	0.00	0.70	0.00
17.88	137.42	2.00	0.00	0.70	0.00	18.04	136.58	2.00	0.00	0.69	0.00
18.21	132.83	2.00	0.00	0.69	0.00	18.37	131.91	2.00	0.00	0.69	0.00
18.54	132.44	2.00	0.00	0.69	0.00	18.70	132.83	2.00	0.00	0.68	0.00
18.86	132.94	2.00	0.00	0.68	0.00	19.03	132.94	2.00	0.00	0.68	0.00
19.19	135.47	2.00	0.00	0.67	0.00	19.36	134.98	2.00	0.00	0.67	0.00
19.52	132.82	2.00	0.00	0.67	0.00	19.69	129.87	2.00	0.00	0.67	0.00
19.85	126.97	2.00	0.00	0.66	0.00	20.01	123.39	2.00	0.00	0.66	0.00
20.18	116.87	2.00	0.00	0.66	0.00	20.34	109.55	2.00	0.00	0.66	0.00
20.51	105.52	2.00	0.00	0.65	0.00	20.67	105.35	2.00	0.00	0.65	0.00
20.83	107.65	2.00	0.00	0.65	0.00	21.00	108.62	2.00	0.00	0.64	0.00
21.16	112.61	2.00	0.00	0.64	0.00	21.33	117.42	2.00	0.00	0.64	0.00
21.49	121.92	2.00	0.00	0.64	0.00	21.65	125.67	2.00	0.00	0.63	0.00
21.82	129.09	2.00	0.00	0.63	0.00	21.98	130.92	2.00	0.00	0.63	0.00
22.15	132.02	2.00	0.00	0.62	0.00	22.31	133.84	2.00	0.00	0.62	0.00
22.47	140.34	2.00	0.00	0.62	0.00	22.64	144.51	2.00	0.00	0.62	0.00
22.80	149.71	2.00	0.00	0.61	0.00	22.97	152.21	2.00	0.00	0.61	0.00
23.13	158.62	2.00	0.00	0.61	0.00	23.29	164.29	2.00	0.00	0.61	0.00
23.46	163.34	2.00	0.00	0.60	0.00	23.62	149.57	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	137.21	2.00	0.00	0.60	0.00	23.95	138.01	2.00	0.00	0.59	0.00
24.11	142.14	2.00	0.00	0.59	0.00	24.28	141.20	2.00	0.00	0.59	0.00
24.44	130.89	2.00	0.00	0.59	0.00	24.61	121.03	2.00	0.00	0.58	0.00
24.77	117.62	2.00	0.00	0.58	0.00	24.93	121.38	2.00	0.00	0.58	0.00
25.10	126.27	2.00	0.00	0.57	0.00	25.26	130.22	2.00	0.00	0.57	0.00
25.43	129.59	2.00	0.00	0.57	0.00	25.59	131.09	2.00	0.00	0.57	0.00
25.75	135.18	2.00	0.00	0.56	0.00	25.92	139.49	2.00	0.00	0.56	0.00
26.08	139.40	2.00	0.00	0.56	0.00	26.25	137.13	2.00	0.00	0.56	0.00
26.41	133.24	2.00	0.00	0.55	0.00	26.57	128.22	2.00	0.00	0.55	0.00
26.74	120.94	2.00	0.00	0.55	0.00	26.90	117.65	2.00	0.00	0.54	0.00
27.07	123.39	2.00	0.00	0.54	0.00	27.23	130.15	2.00	0.00	0.54	0.00
27.40	134.00	2.00	0.00	0.54	0.00	27.56	130.29	2.00	0.00	0.53	0.00
27.72	125.72	2.00	0.00	0.53	0.00	27.89	123.53	2.00	0.00	0.53	0.00
28.05	123.09	2.00	0.00	0.52	0.00	28.22	121.41	2.00	0.00	0.52	0.00
28.38	117.09	2.00	0.00	0.52	0.00	28.54	111.50	2.00	0.00	0.52	0.00
28.71	108.31	2.00	0.00	0.51	0.00	28.87	107.69	2.00	0.00	0.51	0.00
29.04	112.56	2.00	0.00	0.51	0.00	29.20	119.74	2.00	0.00	0.51	0.00
29.36	125.93	2.00	0.00	0.50	0.00	29.53	127.06	2.00	0.00	0.50	0.00
29.69	126.51	2.00	0.00	0.50	0.00	29.86	125.39	2.00	0.00	0.49	0.00
30.02	129.92	2.00	0.00	0.49	0.00	30.18	135.27	2.00	0.00	0.49	0.00
30.35	140.32	2.00	0.00	0.49	0.00	30.51	137.30	2.00	0.00	0.48	0.00
30.68	129.14	2.00	0.00	0.48	0.00	30.84	120.95	2.00	0.00	0.48	0.00
31.00	116.56	2.00	0.00	0.47	0.00	31.17	119.19	2.00	0.00	0.47	0.00
31.33	123.11	2.00	0.00	0.47	0.00	31.50	131.51	2.00	0.00	0.47	0.00
31.66	140.19	2.00	0.00	0.46	0.00	31.82	148.00	2.00	0.00	0.46	0.00
31.99	151.97	2.00	0.00	0.46	0.00	32.15	151.52	2.00	0.00	0.46	0.00
32.32	145.89	2.00	0.00	0.45	0.00	32.48	138.22	2.00	0.00	0.45	0.00
32.64	131.44	2.00	0.00	0.45	0.00	32.81	126.66	2.00	0.00	0.44	0.00
32.97	120.92	2.00	0.00	0.44	0.00	33.14	115.82	2.00	0.00	0.44	0.00
33.30	117.32	2.00	0.00	0.44	0.00	33.46	122.10	2.00	0.00	0.43	0.00
33.63	123.45	2.00	0.00	0.43	0.00	33.79	118.97	2.00	0.00	0.43	0.00
33.96	114.29	2.00	0.00	0.42	0.00	34.12	113.26	2.00	0.00	0.42	0.00
34.28	116.07	2.00	0.00	0.42	0.00	34.45	120.77	2.00	0.00	0.42	0.00
34.61	124.37	2.00	0.00	0.41	0.00	34.78	124.30	2.00	0.00	0.41	0.00
34.94	107.22	2.00	0.00	0.41	0.00	35.10	104.14	2.00	0.00	0.41	0.00
35.27	103.90	2.00	0.00	0.40	0.00	35.43	114.48	2.00	0.00	0.40	0.00
35.60	108.91	2.00	0.00	0.40	0.00	35.76	103.69	2.00	0.00	0.39	0.00
35.93	103.19	2.00	0.00	0.39	0.00	36.09	102.94	2.00	0.00	0.39	0.00
36.25	100.79	2.00	0.00	0.39	0.00	36.42	95.16	2.00	0.00	0.38	0.00
36.58	89.61	2.00	0.00	0.38	0.00	36.75	86.08	2.00	0.00	0.38	0.00
36.91	85.66	2.00	0.00	0.37	0.00	37.07	88.52	2.00	0.00	0.37	0.00
37.24	90.83	2.00	0.00	0.37	0.00	37.40	92.89	2.00	0.00	0.37	0.00
37.57	92.98	2.00	0.00	0.36	0.00	37.73	92.32	2.00	0.00	0.36	0.00
37.89	90.55	2.00	0.00	0.36	0.00	38.06	89.64	2.00	0.00	0.35	0.00
38.22	90.25	2.00	0.00	0.35	0.00	38.39	91.89	2.00	0.00	0.35	0.00
38.55	94.23	2.00	0.00	0.35	0.00	38.71	96.50	2.00	0.00	0.34	0.00
38.88	96.89	2.00	0.00	0.34	0.00	39.04	94.80	2.00	0.00	0.34	0.00
39.21	90.16	2.00	0.00	0.34	0.00	39.37	83.66	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	76.97	2.00	0.00	0.33	0.00	39.70	70.89	2.00	0.00	0.33	0.00
39.86	68.91	2.00	0.00	0.32	0.00	40.03	71.76	2.00	0.00	0.32	0.00
40.19	81.13	2.00	0.00	0.32	0.00	40.35	93.57	2.00	0.00	0.32	0.00
40.52	103.75	2.00	0.00	0.31	0.00	40.68	107.44	2.00	0.00	0.31	0.00
40.85	110.91	2.00	0.00	0.31	0.00	41.01	115.14	2.00	0.00	0.30	0.00
41.17	118.91	2.00	0.00	0.30	0.00	41.34	114.80	2.00	0.00	0.30	0.00
41.50	103.67	2.00	0.00	0.30	0.00	41.67	91.95	2.00	0.00	0.29	0.00
41.83	88.04	2.00	0.00	0.29	0.00	41.99	90.47	2.00	0.00	0.29	0.00
42.16	92.83	2.00	0.00	0.29	0.00	42.32	87.29	2.00	0.00	0.28	0.00
42.49	78.72	2.00	0.00	0.28	0.00	42.65	71.54	2.00	0.00	0.28	0.00
42.81	71.84	2.00	0.00	0.27	0.00	42.98	73.65	2.00	0.00	0.27	0.00
43.14	75.58	2.00	0.00	0.27	0.00	43.31	74.00	2.00	0.00	0.27	0.00
43.47	73.64	2.00	0.00	0.26	0.00	43.64	73.86	2.00	0.00	0.26	0.00
43.80	76.92	2.00	0.00	0.26	0.00	43.96	78.92	2.00	0.00	0.25	0.00
44.13	81.06	2.00	0.00	0.25	0.00	44.29	83.91	2.00	0.00	0.25	0.00
44.46	85.95	2.00	0.00	0.25	0.00	44.62	85.68	2.00	0.00	0.24	0.00
44.78	83.55	2.00	0.00	0.24	0.00	44.95	80.58	2.00	0.00	0.24	0.00
45.11	77.10	2.00	0.00	0.24	0.00	45.28	74.16	2.00	0.00	0.23	0.00
45.44	71.31	2.00	0.00	0.23	0.00	45.60	66.96	2.00	0.00	0.23	0.00
45.77	60.99	2.00	0.00	0.22	0.00	45.93	55.97	2.00	0.00	0.22	0.00
46.10	56.91	2.00	0.00	0.22	0.00	46.26	61.03	2.00	0.00	0.22	0.00
46.42	64.41	2.00	0.00	0.21	0.00	46.59	62.81	2.00	0.00	0.21	0.00
46.75	58.05	2.00	0.00	0.21	0.00	46.92	53.06	2.00	0.00	0.20	0.00
47.08	52.59	2.00	0.00	0.20	0.00	47.24	54.97	2.00	0.00	0.20	0.00
47.41	58.19	2.00	0.00	0.20	0.00	47.57	61.05	2.00	0.00	0.19	0.00
47.74	64.16	2.00	0.00	0.19	0.00	47.90	66.86	2.00	0.00	0.19	0.00
48.06	73.10	2.00	0.00	0.19	0.00	48.23	77.76	2.00	0.00	0.18	0.00
48.39	80.72	2.00	0.00	0.18	0.00	48.56	78.24	2.00	0.00	0.18	0.00
48.72	74.42	2.00	0.00	0.17	0.00	48.88	68.90	2.00	0.00	0.17	0.00
49.05	63.15	2.00	0.00	0.17	0.00	49.21	57.14	2.00	0.00	0.17	0.00
49.38	52.74	2.00	0.00	0.16	0.00	49.54	51.53	2.00	0.00	0.16	0.00
49.70	56.86	2.00	0.00	0.16	0.00	49.87	66.86	2.00	0.00	0.15	0.00
50.03	74.65	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

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

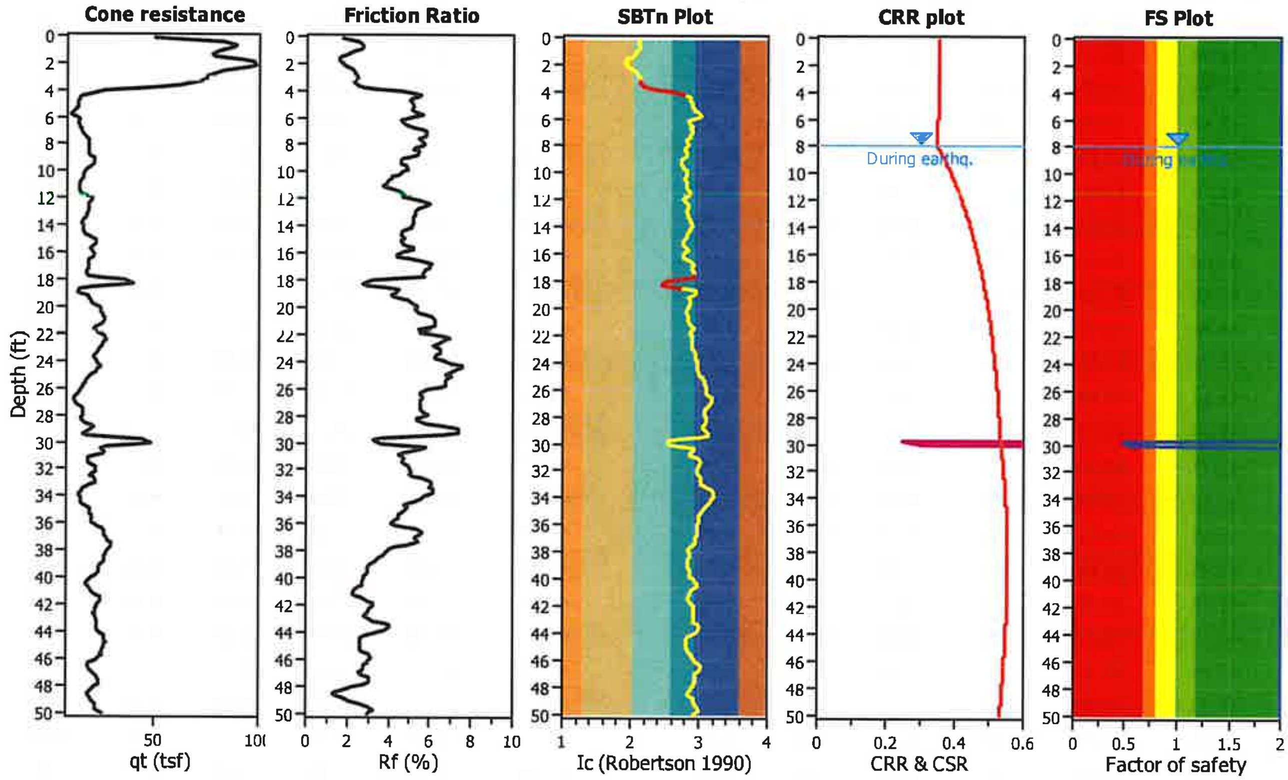
LIQUEFACTION ANALYSIS REPORT

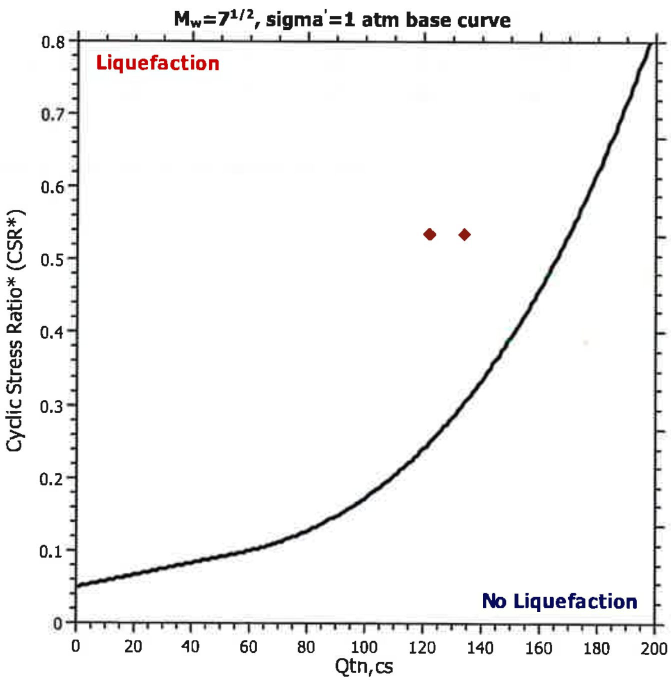
Project title : Heber 2 Repower Project **Location : Heber, CA**

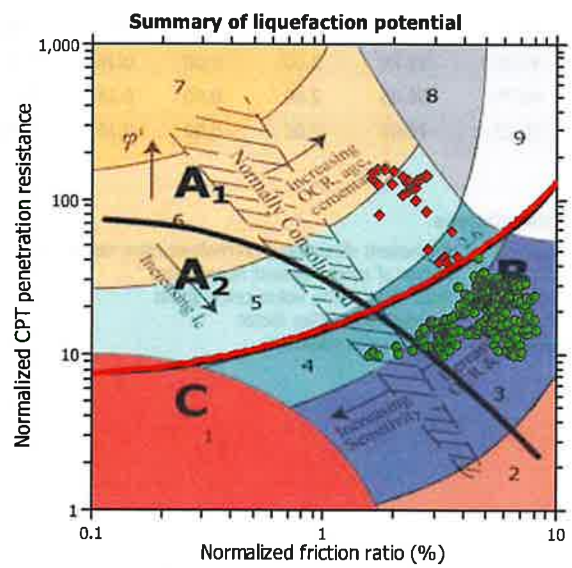
CPT file : CPT-4

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:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

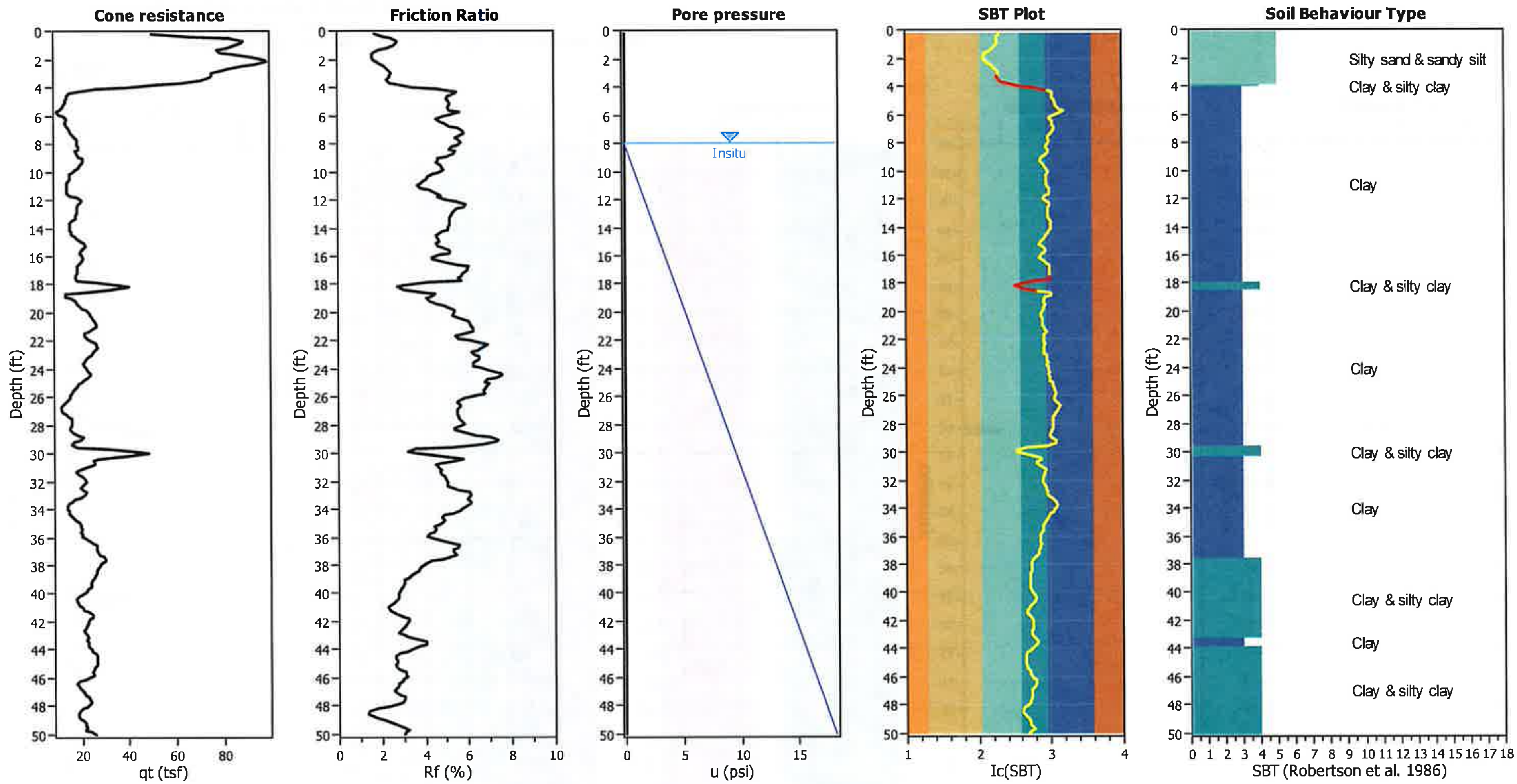






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



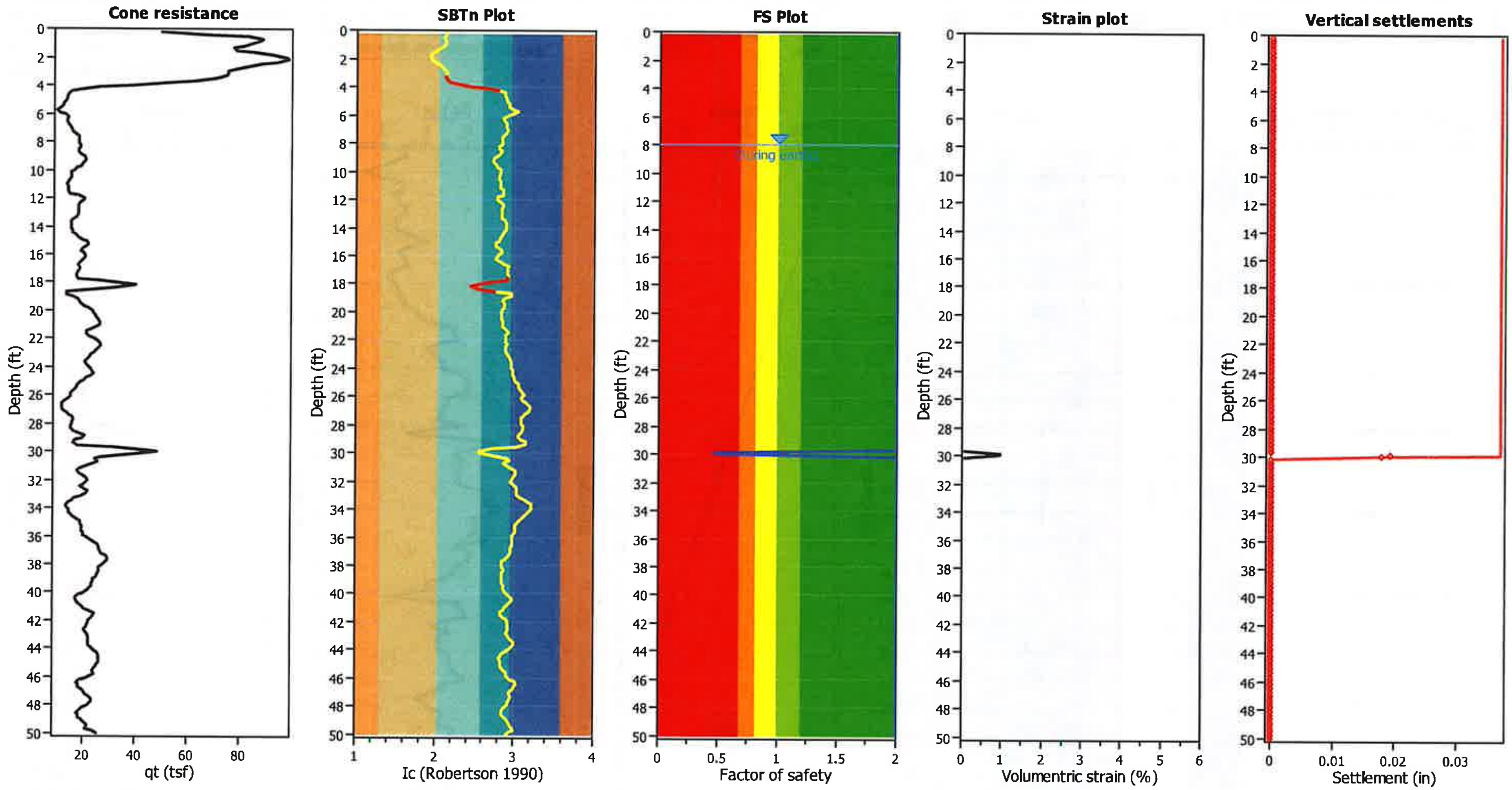
Input parameters and analysis data

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:	0.50	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	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric 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	142.33	2.00	0.00	0.86	0.00	8.20	139.48	2.00	0.00	0.86	0.00
8.37	138.37	2.00	0.00	0.86	0.00	8.53	139.38	2.00	0.00	0.86	0.00
8.69	139.25	2.00	0.00	0.85	0.00	8.86	137.40	2.00	0.00	0.85	0.00
9.02	135.29	2.00	0.00	0.85	0.00	9.19	135.08	2.00	0.00	0.84	0.00
9.35	134.94	2.00	0.00	0.84	0.00	9.51	135.74	2.00	0.00	0.84	0.00
9.68	134.20	2.00	0.00	0.84	0.00	9.84	130.53	2.00	0.00	0.83	0.00
10.01	123.17	2.00	0.00	0.83	0.00	10.17	117.24	2.00	0.00	0.83	0.00
10.33	113.17	2.00	0.00	0.82	0.00	10.50	112.17	2.00	0.00	0.82	0.00
10.66	108.77	2.00	0.00	0.82	0.00	10.83	104.41	2.00	0.00	0.82	0.00
10.99	101.82	2.00	0.00	0.81	0.00	11.15	104.52	2.00	0.00	0.81	0.00
11.32	109.26	2.00	0.00	0.81	0.00	11.48	112.95	2.00	0.00	0.81	0.00
11.65	119.67	2.00	0.00	0.80	0.00	11.81	128.35	2.00	0.00	0.80	0.00
11.98	140.47	2.00	0.00	0.80	0.00	12.14	147.20	2.00	0.00	0.79	0.00
12.30	148.82	2.00	0.00	0.79	0.00	12.47	144.70	2.00	0.00	0.79	0.00
12.63	140.44	2.00	0.00	0.79	0.00	12.80	138.49	2.00	0.00	0.78	0.00
12.96	137.16	2.00	0.00	0.78	0.00	13.12	135.57	2.00	0.00	0.78	0.00
13.29	132.50	2.00	0.00	0.77	0.00	13.45	129.05	2.00	0.00	0.77	0.00
13.62	125.64	2.00	0.00	0.77	0.00	13.78	124.00	2.00	0.00	0.77	0.00
13.94	123.55	2.00	0.00	0.76	0.00	14.11	123.41	2.00	0.00	0.76	0.00
14.27	120.42	2.00	0.00	0.76	0.00	14.44	118.59	2.00	0.00	0.76	0.00
14.60	119.72	2.00	0.00	0.75	0.00	14.76	124.75	2.00	0.00	0.75	0.00
14.93	129.68	2.00	0.00	0.75	0.00	15.09	132.02	2.00	0.00	0.74	0.00
15.26	133.55	2.00	0.00	0.74	0.00	15.42	134.74	2.00	0.00	0.74	0.00
15.58	134.99	2.00	0.00	0.74	0.00	15.75	133.14	2.00	0.00	0.73	0.00
15.91	128.53	2.00	0.00	0.73	0.00	16.08	125.13	2.00	0.00	0.73	0.00
16.24	124.40	2.00	0.00	0.72	0.00	16.40	129.52	2.00	0.00	0.72	0.00
16.57	133.92	2.00	0.00	0.72	0.00	16.73	138.54	2.00	0.00	0.72	0.00
16.90	138.35	2.00	0.00	0.71	0.00	17.06	138.11	2.00	0.00	0.71	0.00
17.22	135.17	2.00	0.00	0.71	0.00	17.39	131.59	2.00	0.00	0.71	0.00
17.55	129.88	2.00	0.00	0.70	0.00	17.72	132.65	2.00	0.00	0.70	0.00
17.88	129.80	2.00	0.00	0.70	0.00	18.04	125.42	2.00	0.00	0.69	0.00
18.21	120.72	2.00	0.00	0.69	0.00	18.37	117.18	2.00	0.00	0.69	0.00
18.54	111.78	2.00	0.00	0.69	0.00	18.70	102.14	2.00	0.00	0.68	0.00
18.86	99.81	2.00	0.00	0.68	0.00	19.03	103.57	2.00	0.00	0.68	0.00
19.19	110.46	2.00	0.00	0.67	0.00	19.36	115.60	2.00	0.00	0.67	0.00
19.52	121.21	2.00	0.00	0.67	0.00	19.69	128.63	2.00	0.00	0.67	0.00
19.85	135.46	2.00	0.00	0.66	0.00	20.01	137.97	2.00	0.00	0.66	0.00
20.18	138.68	2.00	0.00	0.66	0.00	20.34	141.42	2.00	0.00	0.66	0.00
20.51	148.20	2.00	0.00	0.65	0.00	20.67	152.28	2.00	0.00	0.65	0.00
20.83	154.70	2.00	0.00	0.65	0.00	21.00	155.14	2.00	0.00	0.64	0.00
21.16	153.33	2.00	0.00	0.64	0.00	21.33	146.51	2.00	0.00	0.64	0.00
21.49	137.48	2.00	0.00	0.64	0.00	21.65	130.46	2.00	0.00	0.63	0.00
21.82	135.64	2.00	0.00	0.63	0.00	21.98	146.28	2.00	0.00	0.63	0.00
22.15	157.92	2.00	0.00	0.62	0.00	22.31	162.22	2.00	0.00	0.62	0.00
22.47	158.98	2.00	0.00	0.62	0.00	22.64	153.08	2.00	0.00	0.62	0.00
22.80	147.97	2.00	0.00	0.61	0.00	22.97	147.24	2.00	0.00	0.61	0.00
23.13	146.00	2.00	0.00	0.61	0.00	23.29	142.46	2.00	0.00	0.61	0.00
23.46	137.35	2.00	0.00	0.60	0.00	23.62	134.72	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	135.51	2.00	0.00	0.60	0.00	23.95	140.30	2.00	0.00	0.59	0.00
24.11	148.28	2.00	0.00	0.59	0.00	24.28	155.88	2.00	0.00	0.59	0.00
24.44	157.27	2.00	0.00	0.59	0.00	24.61	150.21	2.00	0.00	0.58	0.00
24.77	141.21	2.00	0.00	0.58	0.00	24.93	135.75	2.00	0.00	0.58	0.00
25.10	133.99	2.00	0.00	0.57	0.00	25.26	129.44	2.00	0.00	0.57	0.00
25.43	124.86	2.00	0.00	0.57	0.00	25.59	121.99	2.00	0.00	0.57	0.00
25.75	119.46	2.00	0.00	0.56	0.00	25.92	114.39	2.00	0.00	0.56	0.00
26.08	108.01	2.00	0.00	0.56	0.00	26.25	102.56	2.00	0.00	0.56	0.00
26.41	98.09	2.00	0.00	0.55	0.00	26.57	94.88	2.00	0.00	0.55	0.00
26.74	93.00	2.00	0.00	0.55	0.00	26.90	92.55	2.00	0.00	0.54	0.00
27.07	94.48	2.00	0.00	0.54	0.00	27.23	98.16	2.00	0.00	0.54	0.00
27.40	102.11	2.00	0.00	0.54	0.00	27.56	105.58	2.00	0.00	0.53	0.00
27.72	108.32	2.00	0.00	0.53	0.00	27.89	108.90	2.00	0.00	0.53	0.00
28.05	105.70	2.00	0.00	0.52	0.00	28.22	101.01	2.00	0.00	0.52	0.00
28.38	101.21	2.00	0.00	0.52	0.00	28.54	109.35	2.00	0.00	0.52	0.00
28.71	122.45	2.00	0.00	0.51	0.00	28.87	132.20	2.00	0.00	0.51	0.00
29.04	132.26	2.00	0.00	0.51	0.00	29.20	122.61	2.00	0.00	0.51	0.00
29.36	113.45	2.00	0.00	0.50	0.00	29.53	108.45	2.00	0.00	0.50	0.00
29.69	112.51	2.00	0.00	0.50	0.00	29.86	122.10	0.47	0.98	0.49	0.02
30.02	134.00	0.57	0.90	0.49	0.02	30.18	139.79	2.00	0.00	0.49	0.00
30.35	134.38	2.00	0.00	0.49	0.00	30.51	125.58	2.00	0.00	0.48	0.00
30.68	118.58	2.00	0.00	0.48	0.00	30.84	113.67	2.00	0.00	0.48	0.00
31.00	107.11	2.00	0.00	0.47	0.00	31.17	101.29	2.00	0.00	0.47	0.00
31.33	99.19	2.00	0.00	0.47	0.00	31.50	101.98	2.00	0.00	0.47	0.00
31.66	105.65	2.00	0.00	0.46	0.00	31.82	110.41	2.00	0.00	0.46	0.00
31.99	112.05	2.00	0.00	0.46	0.00	32.15	110.51	2.00	0.00	0.46	0.00
32.32	106.64	2.00	0.00	0.45	0.00	32.48	106.90	2.00	0.00	0.45	0.00
32.64	113.40	2.00	0.00	0.45	0.00	32.81	120.33	2.00	0.00	0.44	0.00
32.97	120.02	2.00	0.00	0.44	0.00	33.14	113.57	2.00	0.00	0.44	0.00
33.30	105.91	2.00	0.00	0.44	0.00	33.46	102.21	2.00	0.00	0.43	0.00
33.63	98.16	2.00	0.00	0.43	0.00	33.79	94.29	2.00	0.00	0.43	0.00
33.96	92.81	2.00	0.00	0.42	0.00	34.12	94.31	2.00	0.00	0.42	0.00
34.28	92.55	2.00	0.00	0.42	0.00	34.45	90.14	2.00	0.00	0.42	0.00
34.61	91.88	2.00	0.00	0.41	0.00	34.78	97.81	2.00	0.00	0.41	0.00
34.94	99.81	2.00	0.00	0.41	0.00	35.10	98.30	2.00	0.00	0.41	0.00
35.27	96.86	2.00	0.00	0.40	0.00	35.43	97.74	2.00	0.00	0.40	0.00
35.60	97.15	2.00	0.00	0.40	0.00	35.76	95.38	2.00	0.00	0.39	0.00
35.93	94.33	2.00	0.00	0.39	0.00	36.09	98.44	2.00	0.00	0.39	0.00
36.25	106.57	2.00	0.00	0.39	0.00	36.42	116.11	2.00	0.00	0.38	0.00
36.58	121.17	2.00	0.00	0.38	0.00	36.75	121.27	2.00	0.00	0.38	0.00
36.91	118.99	2.00	0.00	0.37	0.00	37.07	118.97	2.00	0.00	0.37	0.00
37.24	121.97	2.00	0.00	0.37	0.00	37.40	122.80	2.00	0.00	0.37	0.00
37.57	119.74	2.00	0.00	0.36	0.00	37.73	112.21	2.00	0.00	0.36	0.00
37.89	105.81	2.00	0.00	0.36	0.00	38.06	101.75	2.00	0.00	0.35	0.00
38.22	99.67	2.00	0.00	0.35	0.00	38.39	97.89	2.00	0.00	0.35	0.00
38.55	95.90	2.00	0.00	0.35	0.00	38.71	93.10	2.00	0.00	0.34	0.00
38.88	89.59	2.00	0.00	0.34	0.00	39.04	86.60	2.00	0.00	0.34	0.00
39.21	85.25	2.00	0.00	0.34	0.00	39.37	84.76	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	83.85	2.00	0.00	0.33	0.00	39.70	81.80	2.00	0.00	0.33	0.00
39.86	79.22	2.00	0.00	0.32	0.00	40.03	76.47	2.00	0.00	0.32	0.00
40.19	73.46	2.00	0.00	0.32	0.00	40.35	71.67	2.00	0.00	0.32	0.00
40.52	70.72	2.00	0.00	0.31	0.00	40.68	69.95	2.00	0.00	0.31	0.00
40.85	69.28	2.00	0.00	0.31	0.00	41.01	69.53	2.00	0.00	0.30	0.00
41.17	71.27	2.00	0.00	0.30	0.00	41.34	74.52	2.00	0.00	0.30	0.00
41.50	80.79	2.00	0.00	0.30	0.00	41.67	83.97	2.00	0.00	0.29	0.00
41.83	85.73	2.00	0.00	0.29	0.00	41.99	83.77	2.00	0.00	0.29	0.00
42.16	83.35	2.00	0.00	0.29	0.00	42.32	81.51	2.00	0.00	0.28	0.00
42.49	78.90	2.00	0.00	0.28	0.00	42.65	77.04	2.00	0.00	0.28	0.00
42.81	76.77	2.00	0.00	0.27	0.00	42.98	78.97	2.00	0.00	0.27	0.00
43.14	83.16	2.00	0.00	0.27	0.00	43.31	88.56	2.00	0.00	0.27	0.00
43.47	91.55	2.00	0.00	0.26	0.00	43.64	91.06	2.00	0.00	0.26	0.00
43.80	88.91	2.00	0.00	0.26	0.00	43.96	86.77	2.00	0.00	0.25	0.00
44.13	84.65	2.00	0.00	0.25	0.00	44.29	82.07	2.00	0.00	0.25	0.00
44.46	80.48	2.00	0.00	0.25	0.00	44.62	80.38	2.00	0.00	0.24	0.00
44.78	80.96	2.00	0.00	0.24	0.00	44.95	80.56	2.00	0.00	0.24	0.00
45.11	79.49	2.00	0.00	0.24	0.00	45.28	79.02	2.00	0.00	0.23	0.00
45.44	79.84	2.00	0.00	0.23	0.00	45.60	82.76	2.00	0.00	0.23	0.00
45.77	83.63	2.00	0.00	0.22	0.00	45.93	82.78	2.00	0.00	0.22	0.00
46.10	77.11	2.00	0.00	0.22	0.00	46.26	72.76	2.00	0.00	0.22	0.00
46.42	69.37	2.00	0.00	0.21	0.00	46.59	69.74	2.00	0.00	0.21	0.00
46.75	69.62	2.00	0.00	0.21	0.00	46.92	69.91	2.00	0.00	0.20	0.00
47.08	72.01	2.00	0.00	0.20	0.00	47.24	75.02	2.00	0.00	0.20	0.00
47.41	78.40	2.00	0.00	0.20	0.00	47.57	79.97	2.00	0.00	0.19	0.00
47.74	79.74	2.00	0.00	0.19	0.00	47.90	76.12	2.00	0.00	0.19	0.00
48.06	69.32	2.00	0.00	0.19	0.00	48.23	60.53	2.00	0.00	0.18	0.00
48.39	53.50	2.00	0.00	0.18	0.00	48.56	51.55	2.00	0.00	0.18	0.00
48.72	53.74	2.00	0.00	0.17	0.00	48.88	58.38	2.00	0.00	0.17	0.00
49.05	63.34	2.00	0.00	0.17	0.00	49.21	68.92	2.00	0.00	0.17	0.00
49.38	72.80	2.00	0.00	0.16	0.00	49.54	76.03	2.00	0.00	0.16	0.00
49.70	77.80	2.00	0.00	0.16	0.00	49.87	79.94	2.00	0.00	0.15	0.00
50.03	81.33	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

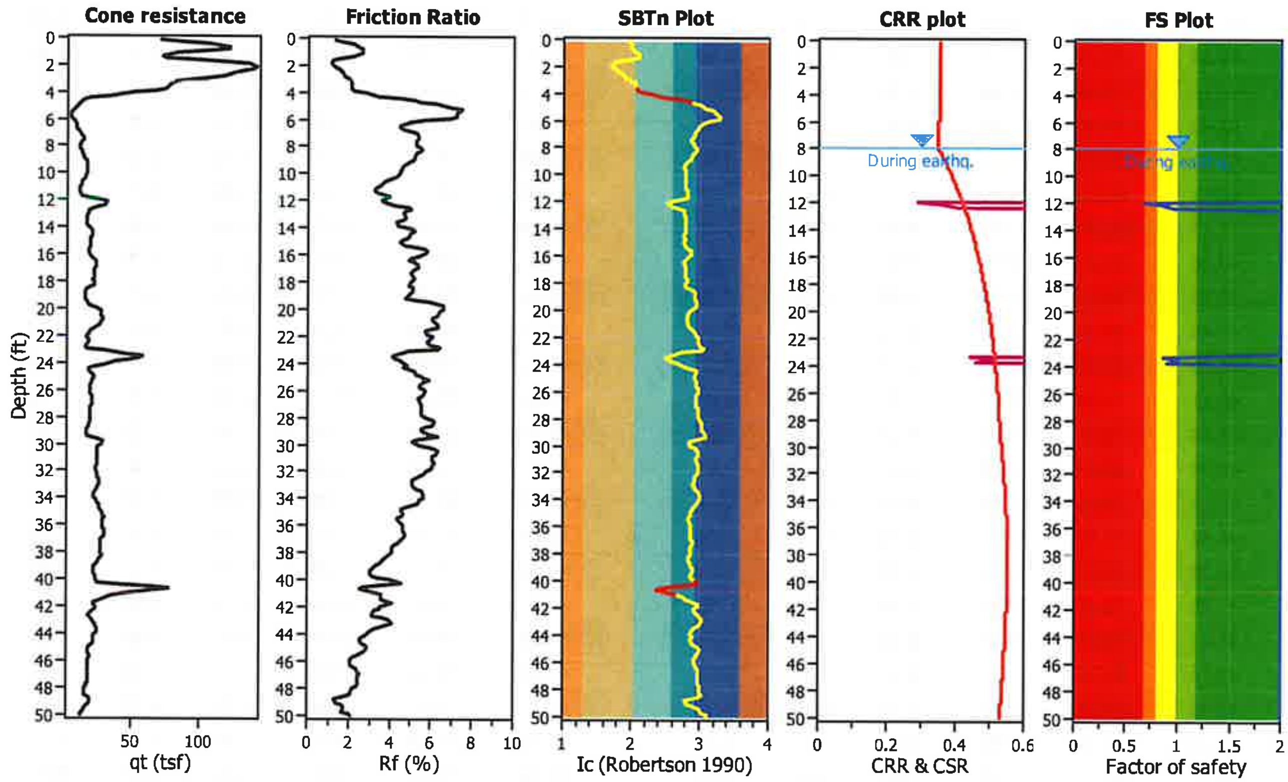
LIQUEFACTION ANALYSIS REPORT

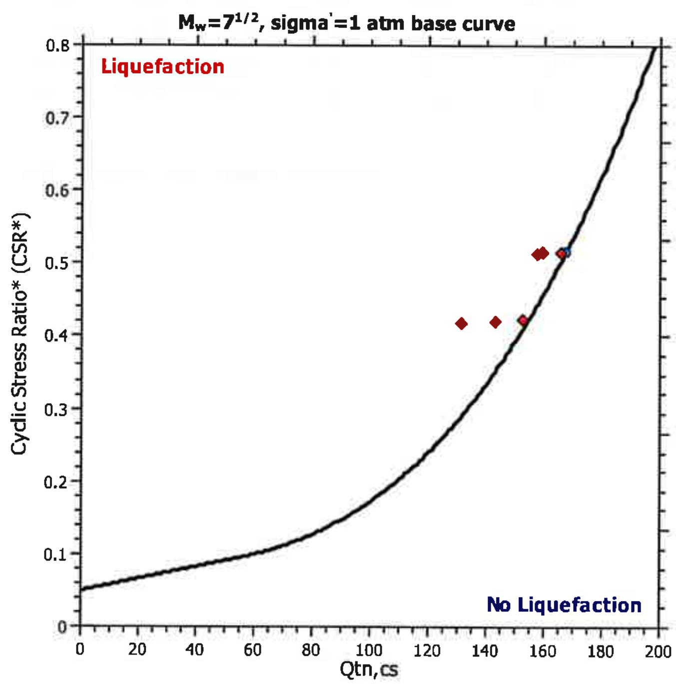
Project title : Heber 2 Repower Project **Location : Heber, CA**

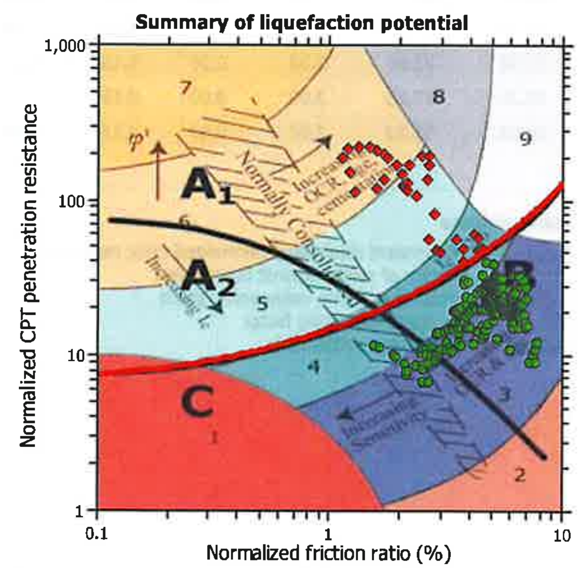
CPT file : CPT-5

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:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

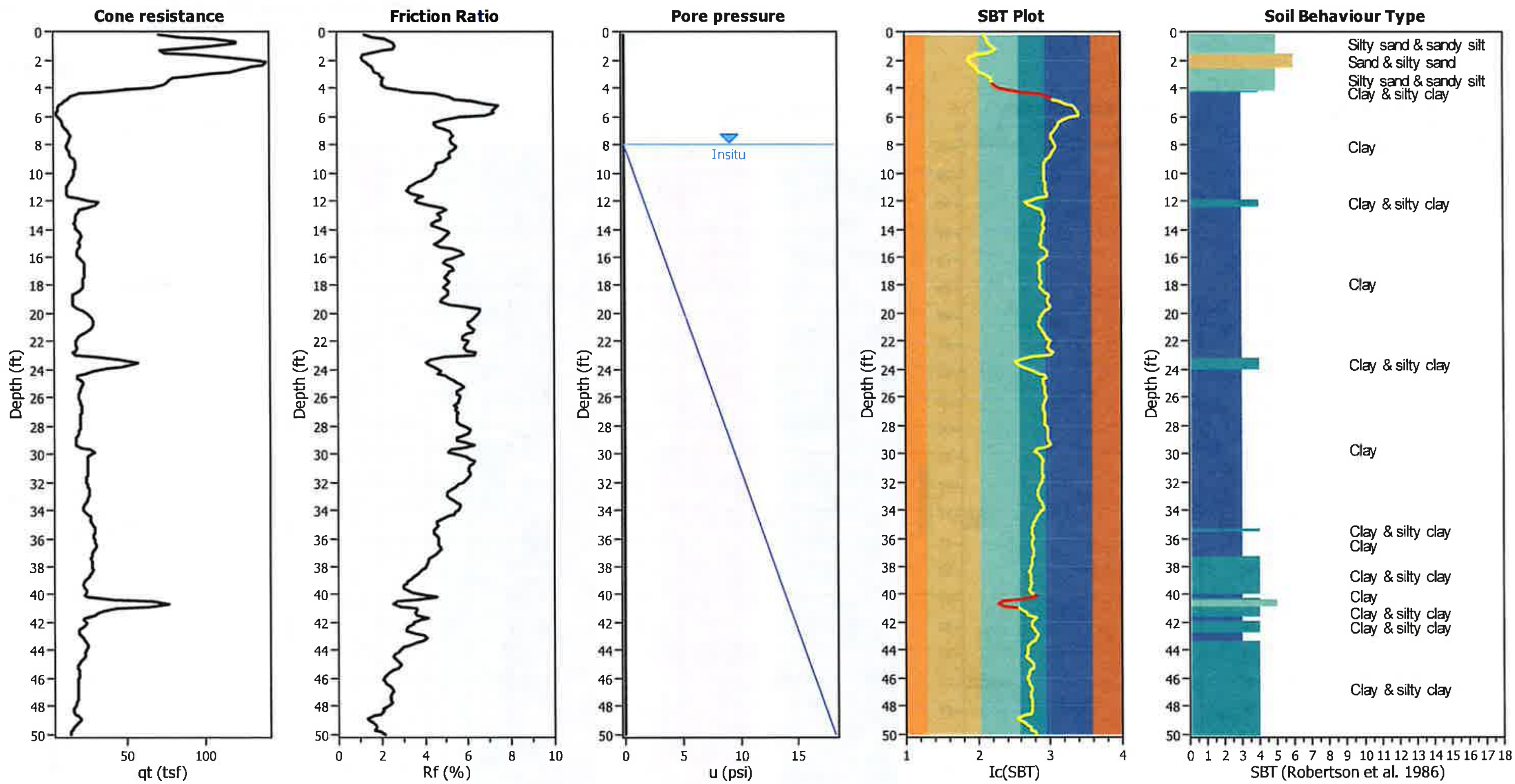






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



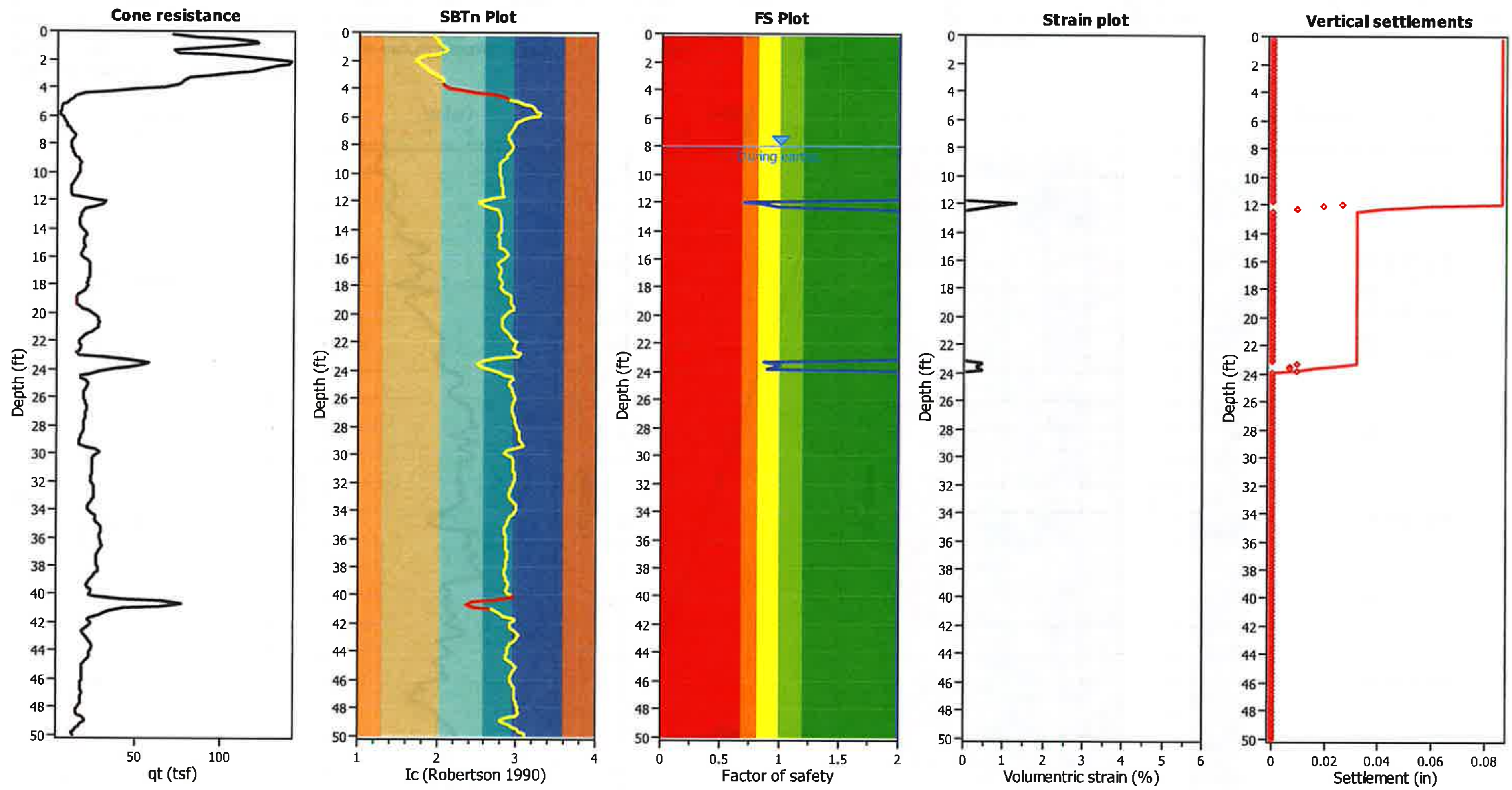
Input parameters and analysis data

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:	0.50	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



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric 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	119.22	2.00	0.00	0.86	0.00	8.20	120.85	2.00	0.00	0.86	0.00
8.37	121.77	2.00	0.00	0.86	0.00	8.53	121.74	2.00	0.00	0.86	0.00
8.69	123.66	2.00	0.00	0.85	0.00	8.86	127.30	2.00	0.00	0.85	0.00
9.02	130.40	2.00	0.00	0.85	0.00	9.19	130.61	2.00	0.00	0.84	0.00
9.35	129.25	2.00	0.00	0.84	0.00	9.51	127.22	2.00	0.00	0.84	0.00
9.68	125.93	2.00	0.00	0.84	0.00	9.84	124.71	2.00	0.00	0.83	0.00
10.01	123.50	2.00	0.00	0.83	0.00	10.17	120.59	2.00	0.00	0.83	0.00
10.33	115.49	2.00	0.00	0.82	0.00	10.50	108.81	2.00	0.00	0.82	0.00
10.66	102.72	2.00	0.00	0.82	0.00	10.83	97.88	2.00	0.00	0.82	0.00
10.99	94.40	2.00	0.00	0.81	0.00	11.15	93.33	2.00	0.00	0.81	0.00
11.32	92.09	2.00	0.00	0.81	0.00	11.48	95.09	2.00	0.00	0.81	0.00
11.65	105.48	2.00	0.00	0.80	0.00	11.81	117.60	2.00	0.00	0.80	0.00
11.98	131.26	0.69	1.33	0.80	0.03	12.14	143.05	0.84	0.96	0.79	0.02
12.30	152.70	0.97	0.47	0.79	0.01	12.47	152.80	2.00	0.00	0.79	0.00
12.63	143.18	2.00	0.00	0.79	0.00	12.80	134.31	2.00	0.00	0.78	0.00
12.96	130.65	2.00	0.00	0.78	0.00	13.12	129.65	2.00	0.00	0.78	0.00
13.29	127.91	2.00	0.00	0.77	0.00	13.45	124.35	2.00	0.00	0.77	0.00
13.62	120.29	2.00	0.00	0.77	0.00	13.78	120.60	2.00	0.00	0.77	0.00
13.94	128.55	2.00	0.00	0.76	0.00	14.11	137.42	2.00	0.00	0.76	0.00
14.27	142.24	2.00	0.00	0.76	0.00	14.44	141.06	2.00	0.00	0.76	0.00
14.60	138.35	2.00	0.00	0.75	0.00	14.76	133.75	2.00	0.00	0.75	0.00
14.93	129.06	2.00	0.00	0.75	0.00	15.09	127.77	2.00	0.00	0.74	0.00
15.26	132.22	2.00	0.00	0.74	0.00	15.42	138.42	2.00	0.00	0.74	0.00
15.58	140.75	2.00	0.00	0.74	0.00	15.75	139.78	2.00	0.00	0.73	0.00
15.91	138.74	2.00	0.00	0.73	0.00	16.08	138.05	2.00	0.00	0.73	0.00
16.24	137.36	2.00	0.00	0.72	0.00	16.40	138.60	2.00	0.00	0.72	0.00
16.57	143.48	2.00	0.00	0.72	0.00	16.73	146.06	2.00	0.00	0.72	0.00
16.90	145.22	2.00	0.00	0.71	0.00	17.06	141.94	2.00	0.00	0.71	0.00
17.22	139.81	2.00	0.00	0.71	0.00	17.39	137.72	2.00	0.00	0.71	0.00
17.55	137.02	2.00	0.00	0.70	0.00	17.72	137.39	2.00	0.00	0.70	0.00
17.88	136.19	2.00	0.00	0.70	0.00	18.04	135.45	2.00	0.00	0.69	0.00
18.21	132.44	2.00	0.00	0.69	0.00	18.37	130.93	2.00	0.00	0.69	0.00
18.54	124.17	2.00	0.00	0.69	0.00	18.70	118.78	2.00	0.00	0.68	0.00
18.86	113.72	2.00	0.00	0.68	0.00	19.03	112.47	2.00	0.00	0.68	0.00
19.19	112.04	2.00	0.00	0.67	0.00	19.36	117.35	2.00	0.00	0.67	0.00
19.52	128.21	2.00	0.00	0.67	0.00	19.69	143.57	2.00	0.00	0.67	0.00
19.85	153.43	2.00	0.00	0.66	0.00	20.01	160.71	2.00	0.00	0.66	0.00
20.18	163.07	2.00	0.00	0.66	0.00	20.34	164.44	2.00	0.00	0.66	0.00
20.51	162.92	2.00	0.00	0.65	0.00	20.67	161.17	2.00	0.00	0.65	0.00
20.83	160.88	2.00	0.00	0.65	0.00	21.00	160.69	2.00	0.00	0.64	0.00
21.16	158.54	2.00	0.00	0.64	0.00	21.33	151.78	2.00	0.00	0.64	0.00
21.49	140.81	2.00	0.00	0.64	0.00	21.65	130.93	2.00	0.00	0.63	0.00
21.82	126.27	2.00	0.00	0.63	0.00	21.98	126.66	2.00	0.00	0.63	0.00
22.15	126.16	2.00	0.00	0.62	0.00	22.31	126.33	2.00	0.00	0.62	0.00
22.47	126.09	2.00	0.00	0.62	0.00	22.64	123.91	2.00	0.00	0.62	0.00
22.80	121.99	2.00	0.00	0.61	0.00	22.97	126.99	2.00	0.00	0.61	0.00
23.13	143.39	2.00	0.00	0.61	0.00	23.29	157.57	0.86	0.48	0.61	0.01
23.46	167.32	1.00	0.33	0.60	0.01	23.62	165.76	0.98	0.33	0.60	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)
23.79	159.66	0.89	0.47	0.60	0.01	23.95	148.21	2.00	0.00	0.59	0.00
24.11	135.94	2.00	0.00	0.59	0.00	24.28	120.89	2.00	0.00	0.59	0.00
24.44	113.50	2.00	0.00	0.59	0.00	24.61	115.23	2.00	0.00	0.58	0.00
24.77	123.04	2.00	0.00	0.58	0.00	24.93	128.87	2.00	0.00	0.58	0.00
25.10	131.54	2.00	0.00	0.57	0.00	25.26	130.14	2.00	0.00	0.57	0.00
25.43	125.79	2.00	0.00	0.57	0.00	25.59	121.98	2.00	0.00	0.57	0.00
25.75	120.15	2.00	0.00	0.56	0.00	25.92	121.20	2.00	0.00	0.56	0.00
26.08	122.21	2.00	0.00	0.56	0.00	26.25	122.93	2.00	0.00	0.56	0.00
26.41	122.83	2.00	0.00	0.55	0.00	26.57	122.65	2.00	0.00	0.55	0.00
26.74	123.77	2.00	0.00	0.55	0.00	26.90	123.52	2.00	0.00	0.54	0.00
27.07	122.85	2.00	0.00	0.54	0.00	27.23	120.78	2.00	0.00	0.54	0.00
27.40	120.44	2.00	0.00	0.54	0.00	27.56	120.16	2.00	0.00	0.53	0.00
27.72	118.94	2.00	0.00	0.53	0.00	27.89	119.67	2.00	0.00	0.53	0.00
28.05	121.33	2.00	0.00	0.52	0.00	28.22	123.92	2.00	0.00	0.52	0.00
28.38	122.71	2.00	0.00	0.52	0.00	28.54	119.82	2.00	0.00	0.52	0.00
28.71	115.02	2.00	0.00	0.51	0.00	28.87	111.29	2.00	0.00	0.51	0.00
29.04	109.61	2.00	0.00	0.51	0.00	29.20	112.15	2.00	0.00	0.51	0.00
29.36	116.02	2.00	0.00	0.50	0.00	29.53	122.43	2.00	0.00	0.50	0.00
29.69	128.66	2.00	0.00	0.50	0.00	29.86	132.51	2.00	0.00	0.49	0.00
30.02	133.32	2.00	0.00	0.49	0.00	30.18	133.01	2.00	0.00	0.49	0.00
30.35	134.24	2.00	0.00	0.49	0.00	30.51	135.73	2.00	0.00	0.48	0.00
30.68	134.98	2.00	0.00	0.48	0.00	30.84	133.52	2.00	0.00	0.48	0.00
31.00	132.42	2.00	0.00	0.47	0.00	31.17	131.76	2.00	0.00	0.47	0.00
31.33	131.41	2.00	0.00	0.47	0.00	31.50	130.79	2.00	0.00	0.47	0.00
31.66	129.46	2.00	0.00	0.46	0.00	31.82	127.40	2.00	0.00	0.46	0.00
31.99	125.47	2.00	0.00	0.46	0.00	32.15	124.76	2.00	0.00	0.46	0.00
32.32	123.94	2.00	0.00	0.45	0.00	32.48	122.71	2.00	0.00	0.45	0.00
32.64	121.40	2.00	0.00	0.45	0.00	32.81	120.70	2.00	0.00	0.44	0.00
32.97	120.37	2.00	0.00	0.44	0.00	33.14	120.33	2.00	0.00	0.44	0.00
33.30	119.72	2.00	0.00	0.44	0.00	33.46	119.43	2.00	0.00	0.43	0.00
33.63	118.76	2.00	0.00	0.43	0.00	33.79	117.66	2.00	0.00	0.43	0.00
33.96	117.16	2.00	0.00	0.42	0.00	34.12	117.75	2.00	0.00	0.42	0.00
34.28	120.54	2.00	0.00	0.42	0.00	34.45	119.94	2.00	0.00	0.42	0.00
34.61	117.36	2.00	0.00	0.41	0.00	34.78	114.03	2.00	0.00	0.41	0.00
34.94	115.06	2.00	0.00	0.41	0.00	35.10	117.56	2.00	0.00	0.41	0.00
35.27	118.09	2.00	0.00	0.40	0.00	35.43	116.84	2.00	0.00	0.40	0.00
35.60	115.80	2.00	0.00	0.40	0.00	35.76	116.35	2.00	0.00	0.39	0.00
35.93	117.12	2.00	0.00	0.39	0.00	36.09	117.39	2.00	0.00	0.39	0.00
36.25	117.58	2.00	0.00	0.39	0.00	36.42	118.84	2.00	0.00	0.38	0.00
36.58	119.93	2.00	0.00	0.38	0.00	36.75	119.47	2.00	0.00	0.38	0.00
36.91	116.76	2.00	0.00	0.37	0.00	37.07	113.06	2.00	0.00	0.37	0.00
37.24	109.88	2.00	0.00	0.37	0.00	37.40	107.43	2.00	0.00	0.37	0.00
37.57	106.75	2.00	0.00	0.36	0.00	37.73	106.32	2.00	0.00	0.36	0.00
37.89	106.17	2.00	0.00	0.36	0.00	38.06	105.28	2.00	0.00	0.35	0.00
38.22	104.58	2.00	0.00	0.35	0.00	38.39	102.50	2.00	0.00	0.35	0.00
38.55	98.98	2.00	0.00	0.35	0.00	38.71	94.70	2.00	0.00	0.34	0.00
38.88	90.90	2.00	0.00	0.34	0.00	39.04	87.39	2.00	0.00	0.34	0.00
39.21	84.59	2.00	0.00	0.34	0.00	39.37	82.78	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	84.00	2.00	0.00	0.33	0.00	39.70	87.03	2.00	0.00	0.33	0.00
39.86	90.97	2.00	0.00	0.32	0.00	40.03	96.73	2.00	0.00	0.32	0.00
40.19	105.29	2.00	0.00	0.32	0.00	40.35	115.76	2.00	0.00	0.32	0.00
40.52	121.29	2.00	0.00	0.31	0.00	40.68	125.41	2.00	0.00	0.31	0.00
40.85	123.12	2.00	0.00	0.31	0.00	41.01	117.19	2.00	0.00	0.30	0.00
41.17	107.63	2.00	0.00	0.30	0.00	41.34	102.80	2.00	0.00	0.30	0.00
41.50	99.33	2.00	0.00	0.30	0.00	41.67	95.42	2.00	0.00	0.29	0.00
41.83	90.50	2.00	0.00	0.29	0.00	41.99	89.98	2.00	0.00	0.29	0.00
42.16	88.92	2.00	0.00	0.29	0.00	42.32	83.52	2.00	0.00	0.28	0.00
42.49	78.18	2.00	0.00	0.28	0.00	42.65	77.51	2.00	0.00	0.28	0.00
42.81	82.85	2.00	0.00	0.27	0.00	42.98	88.58	2.00	0.00	0.27	0.00
43.14	92.04	2.00	0.00	0.27	0.00	43.31	92.24	2.00	0.00	0.27	0.00
43.47	90.25	2.00	0.00	0.26	0.00	43.64	86.84	2.00	0.00	0.26	0.00
43.80	83.41	2.00	0.00	0.26	0.00	43.96	80.95	2.00	0.00	0.25	0.00
44.13	78.49	2.00	0.00	0.25	0.00	44.29	76.67	2.00	0.00	0.25	0.00
44.46	75.23	2.00	0.00	0.25	0.00	44.62	74.90	2.00	0.00	0.24	0.00
44.78	74.57	2.00	0.00	0.24	0.00	44.95	73.31	2.00	0.00	0.24	0.00
45.11	72.32	2.00	0.00	0.24	0.00	45.28	70.79	2.00	0.00	0.23	0.00
45.44	69.68	2.00	0.00	0.23	0.00	45.60	67.68	2.00	0.00	0.23	0.00
45.77	65.78	2.00	0.00	0.22	0.00	45.93	64.39	2.00	0.00	0.22	0.00
46.10	63.45	2.00	0.00	0.22	0.00	46.26	63.10	2.00	0.00	0.22	0.00
46.42	63.80	2.00	0.00	0.21	0.00	46.59	65.52	2.00	0.00	0.21	0.00
46.75	67.21	2.00	0.00	0.21	0.00	46.92	67.86	2.00	0.00	0.20	0.00
47.08	67.38	2.00	0.00	0.20	0.00	47.24	66.55	2.00	0.00	0.20	0.00
47.41	66.19	2.00	0.00	0.20	0.00	47.57	66.07	2.00	0.00	0.19	0.00
47.74	65.63	2.00	0.00	0.19	0.00	47.90	63.67	2.00	0.00	0.19	0.00
48.06	60.77	2.00	0.00	0.19	0.00	48.23	58.45	2.00	0.00	0.18	0.00
48.39	57.99	2.00	0.00	0.18	0.00	48.56	57.54	2.00	0.00	0.18	0.00
48.72	56.34	2.00	0.00	0.17	0.00	48.88	54.30	2.00	0.00	0.17	0.00
49.05	55.00	2.00	0.00	0.17	0.00	49.21	55.85	2.00	0.00	0.17	0.00
49.38	55.75	2.00	0.00	0.16	0.00	49.54	53.84	2.00	0.00	0.16	0.00
49.70	52.12	2.00	0.00	0.16	0.00	49.87	53.14	2.00	0.00	0.15	0.00
50.03	54.80	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.09

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 D

Geotechnical Report

New Turbine Generator and Cooling Tower
Heber 2 Geothermal Plant
Heber, CA

Prepared for:

ORMAT
947 Dogwood Road
Heber, CA 92249

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Prepared by:

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243
(760) 370-3000

January 2005

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

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

January 10, 2005

Mr. Mike Collins
ORMAT
947 Dogwood Road
Heber, CA 92249

Geotechnical Investigation
New Turbine Generator and Cooling Tower
Heber 2 Geothermal Plant
Dogwood Road
Heber, California
LCI Report No. LE04354 (2)

Dear Mr. Collins:

This geotechnical report is provided for design and construction of the new turbine generator and cooling tower additions to the Ormat Heber 2 geothermal power plant located on Dogwood Road southwest of Heber, California. Our geotechnical investigation was conducted in response to your request for our services. The enclosed report describes our soil engineering investigation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

This executive summary presents ***selected*** elements of our findings and recommendations only. It ***does not*** present crucial details needed for the proper application of our findings and recommendations. Our findings, recommendations, and application options are related ***only 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 indicate that the site is predominantly underlain by clays of moderate expansion.

The soil are highly corrosive to metals and contain sufficient sulfates and chlorides to require special concrete mixes (4,500 psi with a 0.45 maximum water cement ratio) and protection of embedded steel building components when concrete is placed in contact with native soil. If the native soils are replaced with imported granular soils with low sulfate and chloride content, no special concrete mixes are required.

Evaluation of liquefaction potential at the site indicates that it is unlikely that the subsurface soil will liquefy under seismically induced groundshaking due to the nature of the soil (clays soils predominate). No mitigation is required for liquefaction effects at this site.

Foundation settlements are indicated on figures 2 thru 5. Differential settlement is estimated to be about of two-thirds of total settlement.

We did not encounter soil conditions that would preclude development of the site for its intended use provided the recommendations contained in this report are implemented in the design and construction of this project.

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.

REGISTERED GEOLOGIST
STEVEN K. WILLIAMS
CERTIFIED ENGINEERING GEOLOGIST
CEG 2261
STATE OF CALIFORNIA

Steven K. Williams, CEG
Senior Engineering Geologist

Julian R. Avalos
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
JEFFREY O. LYON
No. 31921
EXPIRES 12-31-06
CIVIL
STATE OF CALIFORNIA

Jeffrey O. Lyon, PE
President

Distribution:
Client (4)

TABLE OF CONTENTS

Page

Section 1 1
INTRODUCTION 1
1.1 Project Description 1
1.2 Purpose and Scope of Work 1
1.3 Authorization 2
Section 2 3
METHODS OF INVESTIGATION 3
2.1 Field Exploration 3
2.2 Laboratory Testing 4
Section 3 5
DISCUSSION 5
3.1 Site Conditions 5
3.2 Geologic Setting 5
3.3 Seismicity and Faulting 6
3.4 Site Acceleration and UBC Seismic Coefficients 7
3.5 Subsurface Soil 8
3.6 Groundwater 9
3.7 Liquefaction 9
Section 4 11
RECOMMENDATIONS 11
4.1 Site Preparation 11
4.2 Foundations and Settlements 13
4.3 Slabs-On-Grade 14
4.4 Concrete Mixes and Corrosivity 15
4.5 Excavations 16
4.6 Seismic Design 16
Section 5 18
LIMITATIONS AND ADDITIONAL SERVICES 18
5.1 Limitations 18
5.2 Additional Services 19

APPENDIX A: Vicinity and Site Maps
APPENDIX B: Subsurface Soil Logs and Soil Keys
APPENDIX C: Laboratory Test Results
APPENDIX D: References

Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical investigation for the proposed additions to the Ormat Heber 2 geothermal power plant located on Dogwood Road southwest of Heber, California (See Vicinity Map, Plate A-1). The proposed development will consist of the addition of one (1) turbine/generator set and one (1) cooling tower. A site plan for the proposed power plant improvements was not made available to us at the time that this report was prepared.

Small structures may be are planned for electrical control panels, consisting of masonry or panelized concrete construction. Expected footing loads are estimated at 1 to 2 kips per lineal foot for the small structures. Expected plant components, cooling tower and turbine/generator columns loads range from 5 to 400 kips. If structural loads exceed those stated above, we should be notified so we may evaluate their impact on foundation settlement and bearing capacity. Site development will include foundation support pad preparation and underground utility installation.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 50 feet of subsurface soil at selected locations within the site for physical/engineering properties. From the subsequent field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site 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 selected locations and depths.
- Laboratory testing for physical properties of selected samples.
- A 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, professional opinions, and recommendations for the geotechnical aspects of project design and construction.

This report addresses the following geotechnical issues:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, near source factors, and site seismic accelerations
- Liquefaction potential and its mitigation
- Expansive soil and methods of mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above issues are presented for the following:

- Site grading and earthwork
- Foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Concrete slabs-on-grade
- 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

Mr. Mike Collins, Project Manager of Ormat for Power Generation Construction provided authorization by written agreement to proceed with our work on December 14, 2004. We conducted our work according to our written proposal dated December 13, 2004.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on December 20, 2004 using Holguin, Fahan, & Associates, Inc. of Cypress, California to advance three (3) electric cone penetrometer (CPT) soundings to an approximate depth of 50 feet below existing ground surface. The soundings were made at the locations shown on the Site and Exploration Plan (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernable site features.

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 $10cm^2$ conical probe into the ground at a rate of 2cm per second using a 23-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 (ϕ) 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 were produced and presented in final form after review of field and laboratory data and are presented on Plates B-1 through B-3 in Appendix B. A key to the interpretation of CPT soundings is presented on Plate B-4. 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.

2.2 Laboratory Testing

Laboratory tests were conducted on selected bulk soil samples obtained from hand auger borings 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:

- Plasticity Index (ASTM D4318) – used for soil classification and expansive soil design criteria.
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods) – used for concrete mix evaluations and corrosion protection requirements.

The laboratory test results are presented on the subsurface logs (Appendix B) and on Plates C-1, C-2 and C-3 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 plant additions are located in the northwest corner of the Heber 2 geothermal plant on the west side of the existing turbine generators and cooling tower. The area is relatively vacant and approximately has the same elevation as the existing plant facilities. An overhead pipe rack is located to the south side of the proposed location.

Adjacent properties outside of the fenced operations yard consist of agricultural land to the north and west. The site is bounded on the east by Dogwood Road and headquarters facilities of a general engineering construction company lie to the south side. Dogwood Road is slated to be a 6-lane north-south arterial from Calexico to Brawley in Imperial County. Adjacent properties are flat-lying and are approximately at the same elevation with this site.

The project site lies at an elevation of approximately 15 feet below mean sea level (MSL) (El. 985 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 4 inches per year with four months of average summertime temperatures above 100 °F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a geologic structural depression resulting from large scale regional faulting. The 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 since the Miocene Epoch. 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 a fresh water lake (Lake Cahuilla). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

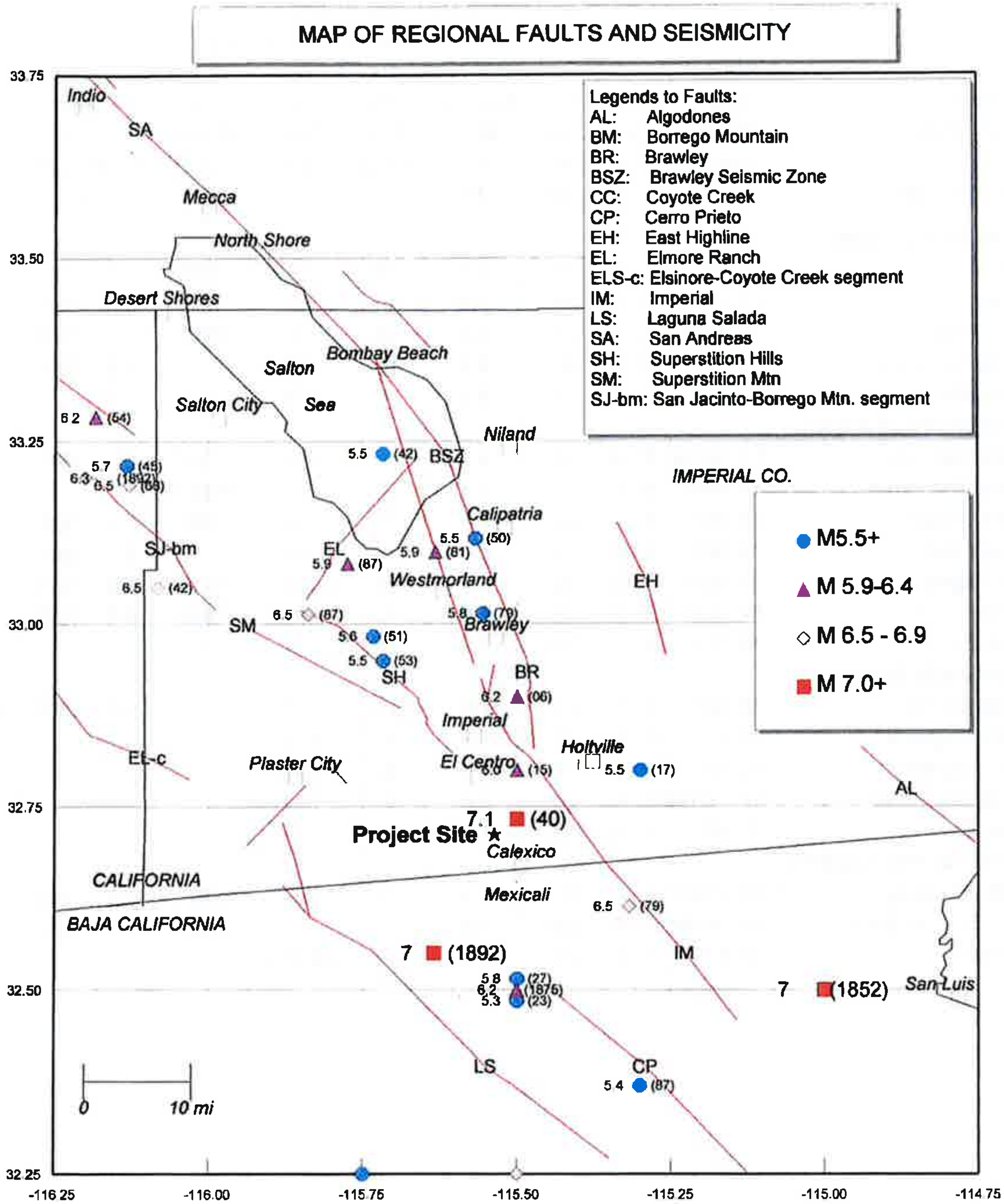
3.3 Seismicity and Faulting

Faulting and Seismic Sources: We have performed a computer-aided search of known faults or seismic zones that lie within a 62 mile (100 kilometers) radius of the project site as shown on Figure 1 and Table 1. The search identifies known faults within this distance and computes deterministic ground accelerations at the site based on the maximum credible earthquake expected on each of the faults and the distance from the fault to the site. The Maximum Magnitude Earthquake (Mmax) listed was taken from published geologic information available for each fault (CDMG OFR 96-08 and Jennings, 1994).

Seismic Risk: The project site is located in the seismically active Imperial Valley of southern California and is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. The proposed site structures should be designed in accordance with the California Building Code (CBC) for near source factors derived from a "Design Basis Earthquake" (DBE). The DBE is defined as the motion having a 10 percent probability of being exceeded in 50 years. The DBE generally corresponds to the Mmax magnitude discussed here.

Seismic Hazards.

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Imperial, Brawley, and Superstition Hills Faults. A further discussion of groundshaking follows in Section 3.4.
- **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the Imperial Valley as shown on USGS and CGS maps. However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.



Faults and Seismic Zones from Jennings (1994), Earthquakes modified from Ellsworth (1990) catalog.

Figure 1. Map of Regional Faults and Seismicity

Table 1
FAULT PARAMETERS & DETERMINISTIC
ESTIMATES OF PEAK GROUND ACCELERATION (PGA)

Fault Name or Seismic Zone	Distance (mi) & Direction from Site		Fault Type		Fault Length (km)	Maximum Magnitude Mmax (Mw)	Avg Slip Rate (mm/yr)	Avg Return Period (yrs)	Date of Last Rupture (year)	Largest Historic Event >5.5M	(year)	Est. Site PGA (g)
Reference Notes: (1)			(2)	(3)	(2)	(4)	(3)	(3)	(3)	(5)		(6)
Imperial Valley Faults												
Imperial	7.0	NE	A	B	62	**7.0**	20	79	1979	7.0	1940	**0.33**
Brawley	8.8	NNE	B	B	14	**7.0**	20	---	1979	5.8	1979	**0.28**
Cerro Prieto	15	SSE	A	B	116	**7.2**	34	50	1980	7.1	1934	**0.21**
Brawley Seismic Zone	16	N	B	B	42	**6.4**	25	24		5.9	1981	**0.13**
East Highline Canal	23	NE	C	C	22	**6.3**	1	774				**0.09**
San Jacinto Fault System												
- Superstition Hills	8.5	NNW	B	A	22	**6.6**	4	250	1987	6.5	1987	**0.23**
- Superstition Mtn.	15	NW	B	A	23	**6.6**	5	500	1440 +/-			**0.16**
- Elmore Ranch	28	NW	B	A	29	**6.6**	1	225	1987	5.9	1987	**0.10**
- Borrego Mtn	34	NW	B	A	29	**6.6**	4	175		6.5	1942	**0.08**
- Anza Segment	51	NW	A	A	90	**7.2**	12	250	1918	6.8	1918	**0.08**
- Coyote Creek	53	NW	B	A	40	**6.8**	4	175	1968	6.5	1968	**0.07**
- Whole Zone	15	NW	A	A	245	**7.5**	---	---				**0.25**
Elsinore Fault System												
- Laguna Salada	16	SW	B	B	67	**7.0**	3.5	336		7.0	1891	**0.18**
- Coyote Segment	29	W	B	A	38	**6.8**	4	625				**0.11**
- Julian Segment	55	WNW	A	A	75	**7.1**	5	340				**0.08**
- Earthquake Valley	57	WNW	B	A	20	**6.5**	2	351				**0.05**
- Whole Zone	29	W	A	A	250	**7.5**	---	---				**0.15**
San Andreas Fault System												
- Coachella Valley	45	NNW	A	A	95	**7.4**	25	220	1690+/-	6.5	1948	**0.10**
- Whole S. Calif. Zone	45	NNW	A	A	458	**7.9**	---	---	1857	7.8	1857	**0.13**
Algodones	36	E	C	C	74	**7.0**	0.1	20,000				**0.10**

Notes:

1. Jennings (1994) and CDMG (1996)
2. CDMG (1996), where Type A faults -- slip rate >5 mm/yr and well constrained paleoseismic data
   Type B faults -- all other faults.
3. WGCEP (1995)
4. CDMG (1996) based on Wells & Coppersmith (1994)
5. Ellsworth Catalog in USGS PP 1515 (1990) and USBR (1976), Mw = moment magnitude,
6. The deterministic estimates of the Site PGA are based on the attenuation relationship of:
   Boore, Joyner, Fumal (1997)

▸ **Liquefaction.** Liquefaction is unlikely to be a potential hazard at the site due to the lack of saturated granular soil (clay soils predominate).

Other Secondary Hazards.

▸ **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic 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, sieches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, sieches, or other seismically-induced flooding is unlikely.

▸ **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 are discussed in more detail in Section 3.5.

3.4 Site Acceleration and UBC Seismic Coefficients

Deterministic horizontal peak ground accelerations (PGA) from maximum probable earthquakes on regional faults have been estimated and are included in Table 1. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations 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.

We have used the computer program FRISKSP (Blake, 2000) to provide a probabilistic estimate of the site PGA using the attenuation relationship of Boore, Joyner, and Fumal (1997) Soil (250). The PGA estimate for the project site having a 10% probability of being exceeded in 50 years (return period of 475 years) is **0.60g**.

CBC Seismic Coefficients: The CBC seismic coefficients are roughly based on an earthquake ground motion that has a 10% probability of being exceeded in 50 years. The following table lists seismic and site coefficients (near source factors) determined by Chapter 16 of the 2001 CBC. ***This site lies within 11.3 km of a Type A fault overlying S_D (stiff) soil.***

CBC Seismic Coefficients for Chapter 16 Seismic Provisions

CBC Code Edition	Soil Profile Type	Seismic Source Type	Distance to Critical Source	Near Source Factors		Seismic Coefficients	
				Na	Nv	Ca	Cv
2001	S_D (stiff soil)	A	< 11.3 km	1.00	1.15	0.44	0.74
Ref. Table	16-J	16-U	---	16-S	16-T	16-Q	16-R

3.5 Subsurface Soil

Subsurface soils encountered during the field exploration conducted on December 20, 2004 indicates that 1.0 to 1.5 feet of stiff clay are at ground surface. Dense to very dense silty sands lie below the clays and extend to a depth of 4 to 5 feet. Stiff to very stiff clays extend a depth of 50 feet, the maximum depth of exploration. The subsurface logs (Plates B-1 through B-3) depict the stratigraphic relationships of the various soil types.

The native surface clays exhibit moderate swell potential (Expansion Index, EI = 51 - 90) when correlated to Plasticity index tests (ASTM D4318) performed on the native clays. The clay is expansive when wetted and can shrink with moisture loss (drying). Development of building foundations, concrete flatwork, and asphaltic concrete pavements should include provisions for mitigating potential swelling forces and reduction in soil strength, which can occur from saturation of the soil. Causes for soil saturation include landscape irrigation, broken utility lines, or capillary rise in moisture upon sealing the ground surface to evaporation. Moisture losses can occur with lack of landscape watering, close proximity of structures to downslopes and root system moisture extraction from deep rooted shrubs and trees placed near the foundations. Typical measures used for industrial projects to remediate expansive soil include:

- replacement of silt/clay with non-expansive granular fill,
- moisture conditioning subgrade soils to a minimum of 5% above optimum moisture (ASTM D1557) for the full range in depth of surface soils.
- design of foundations that are resistant to shrink/swell forces of silt/clay soil.

3.6 Groundwater

Groundwater was not noted on the CPT sounding at the time of exploration, but is typically encountered at approximately 10 to 15 feet below ground surface in the vicinity of the site. 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, drainage, and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition.

3.7 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.

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); and
(4) groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions exist to some degree at this site.

Methods of Analysis: Liquefaction potential at the project site was evaluated using the 1997 NCEER Liquefaction Workshop methods that are based on the Seed, et. al. 1985 and Robertson and Campanella (1985) 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}. A ground acceleration of 0.60g was used in the analysis with a 12 foot groundwater depth.

Liquefaction induced settlements have been estimated using the 1987 Tokimatsu and Seed method. Fines content of liquefiable sands and silt increase the liquefaction resistance in that more cycles of ground motions are required to fully develop pore pressures. The SPT blow counts were adjusted to an equivalent clean sand blow count, $N_{1(60)}$ prior to calculating settlements using Robertson and Wride (1997) adjustments. A computed factor of safety less than 1.0 indicates a liquefiable condition.

Liquefaction Effects: Based on empirical relationships, liquefaction is not expected to occur at the project site.

Section 4
RECOMMENDATIONS

4.1 Site Preparation

Clearing and Grubbing: All surface improvements, debris or vegetation including grass and weeds on the site at the time of construction should be removed from the construction area. Organic strippings should be hauled from the site and not used as fill. Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be dish-shaped to the lowest depth of disturbance and backfilled under observation by the geotechnical engineer's representative with compacted fill as described below.

Structure Subgrade Preparation: The exposed surface soil within the foundation areas should be removed to 12 inches below the foundation elevation or existing grade (whichever is lower). Exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 3 to 8% above optimum moisture content (clays) or 0 to 4% above optimum (silts), and recompacted to at least 90% of the maximum density determined in accordance with ASTM D1557 methods.

The native soil is suitable for use as engineered fill provided it is free from concentrations of organic matter or other deleterious material. The fill soil should be uniformly moisture conditioned by discing and watering to the limits specified above, placed in maximum 8-inch lifts (loose), and compacted to the limits specified above.

Imported fill soil (if required) should have a Plasticity Index less than 15 and sulfates (SO_4) less than 1,000 ppm or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported granular fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least 90% of ASTM D1557 maximum dry density at optimum moisture ±2%.

In areas other than the structures pad which are to receive area concrete slabs, the ground surface should be presaturated to a minimum depth of 18 inches and then scarified to 6 inches, moisture conditioned to a minimum of 5% over optimum, and recompacted to 83-87% of ASTM D1557 maximum density just prior to concrete placement.

Trench Backfill: On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill, but may be difficult to uniformly maintain at specified moistures and compact to the specified densities. Granular material is often more cost effective for backfill of utility trenches.

Backfill soil within roadways or traffic areas should be placed in layers not more that 6 inches in thickness and mechanically compacted to a minimum of 87% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 90%. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material. Pipe envelope/bedding should either be clean sand (Sand Equivalent SE>30) or crushed rock when encountering groundwater. A geotextile filter fabric (Mirafi 140N or equivalent) should be used to encapsulate the crushed rock when placed below groundwater to reduce the potential for in-washing of fines into the gravel void space. Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have the existing soil beneath the structure foundation prepared in the manner recommended for the building pad except the preparation needed only to extend 12 inches below and beyond the footing.

4.2 Foundations and Settlements

Shallow spread footings and continuous wall footings are suitable to support the structures associated with the turbine generator and cooling tower. Footings shall be founded on a layer of properly prepared and compacted soil as described in Section 4.1. The foundations may be designed using an allowable soil bearing pressure of 1,500 psf for compacted native clay soil and 2,000 psf when foundations are supported on imported sands (extending a minimum of 1.0 feet below footings). The allowable soil pressure may be increased by 20% for each foot of embedment depth in excess of 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 3,000 psf (clays). Settlements associated with variable loadings and structure/footing sizes are shown on figures 2 thru 5. As an alternative to shallow spread foundations, flat plate structural mats or grade-beam reinforced foundations may be used to mitigate expansive soil heave.

Flat Plate Structural Mats: Structural mats may be designed for a modulus of subgrade reaction (Ks) of 100 pci when placed on compacted clay or a subgrade modulus of 250 pci when placed on 2.5 feet of granular fill. Mats shall overlay 2 inches of sand and a 10-mil polyethylene vapor retarder. The structure support pad shall be moisture conditioned and recompacted as specified in Section 4.1 of this report.

All exterior and interior foundations should be embedded a minimum of 18 inches below the structure support pad or lowest adjacent final grade, whichever is deeper. Continuous wall footings should have a minimum width of 12 inches. Spread footings should have a minimum width of 24 inches. Recommended concrete reinforcement and sizing for all footings should be provided by the structural engineer.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings or grade beams and frictional resistance developed along the bases of footings or grade beams and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 250 pcf (300 pcf for sands) to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.25 (0.35 for sands) may also be used at the base of the footings or grade beams to resist lateral loading.

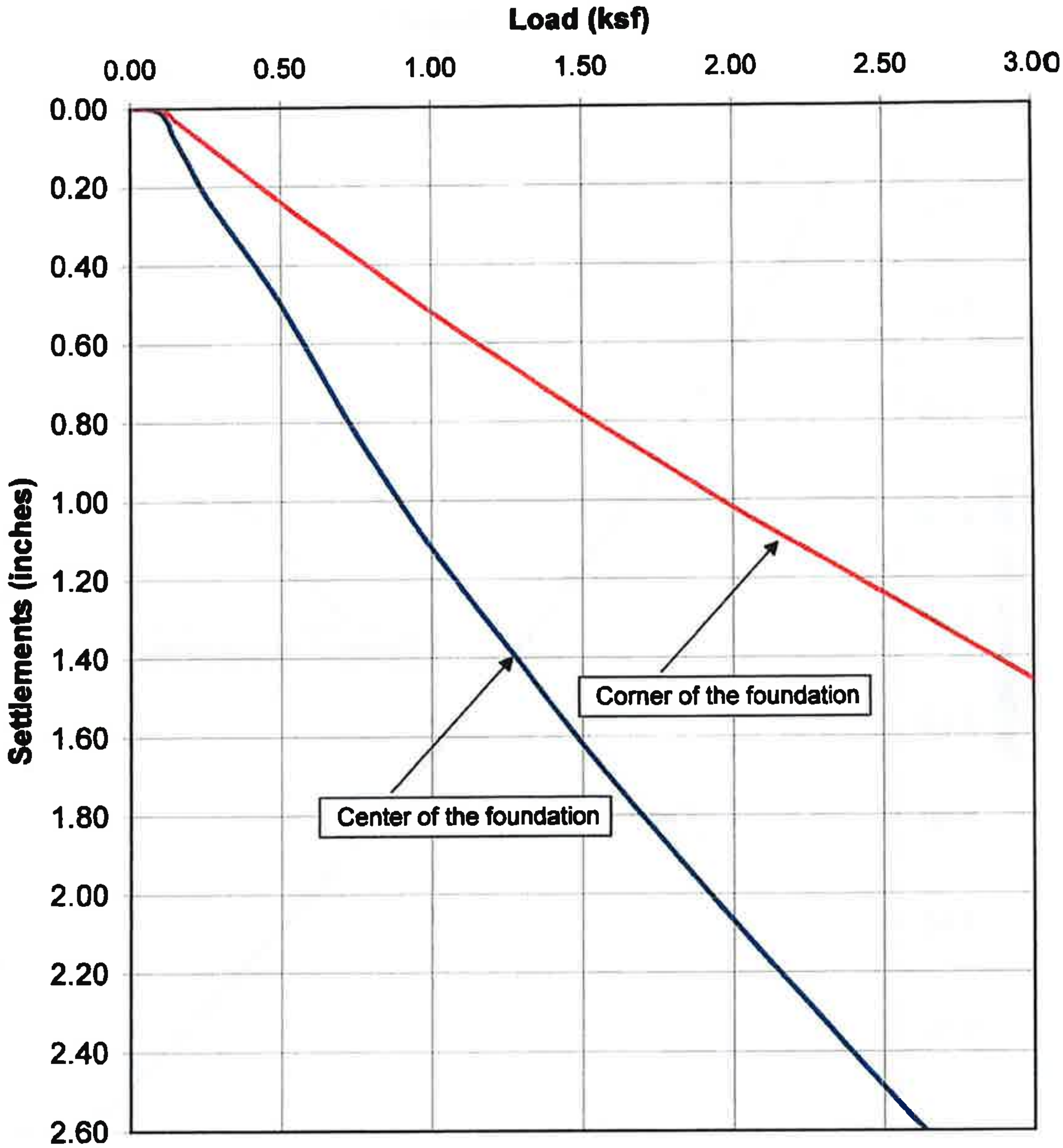
Total foundation movements under estimated loadings are shown on the load/settlement curves (Figures 2 thru 5). Differential movement is estimated to be about two-thirds of total movement

4.3 Slabs-On-Grade

Thin concrete slabs and flatwork (6 inches or less in thickness) placed over native clay soil should be designed in accordance with Chapter 18, Division III of the 2001 CBC (using an Effective Plasticity Index of 17) and shall be a minimum of 5 inches thick due to expansive soil conditions. Concrete floor slabs shall be monolithically placed with the foundations unless placed on 2.5 feet of granular fill or lime treated soil.

The concrete slabs should be underlain by a minimum of 4 inches of clean sand (Sand Equivalent SE>30) or aggregate base or may be placed directly on a 2.5-foot thick granular fill pad (if used) that has been moistened to approximately optimum moisture just before the concrete placement. A 10-mil visqueen vapor retarder, properly lapped and sealed with a 2-inch sand cover and extended a minimum of 12 inches into the footing, should be placed as a capillary break to prevent moisture migration into the slab section. Concrete slabs may be placed directly over a 15-mil vapor retarder if desired (Stego-Wrap or equivalent).

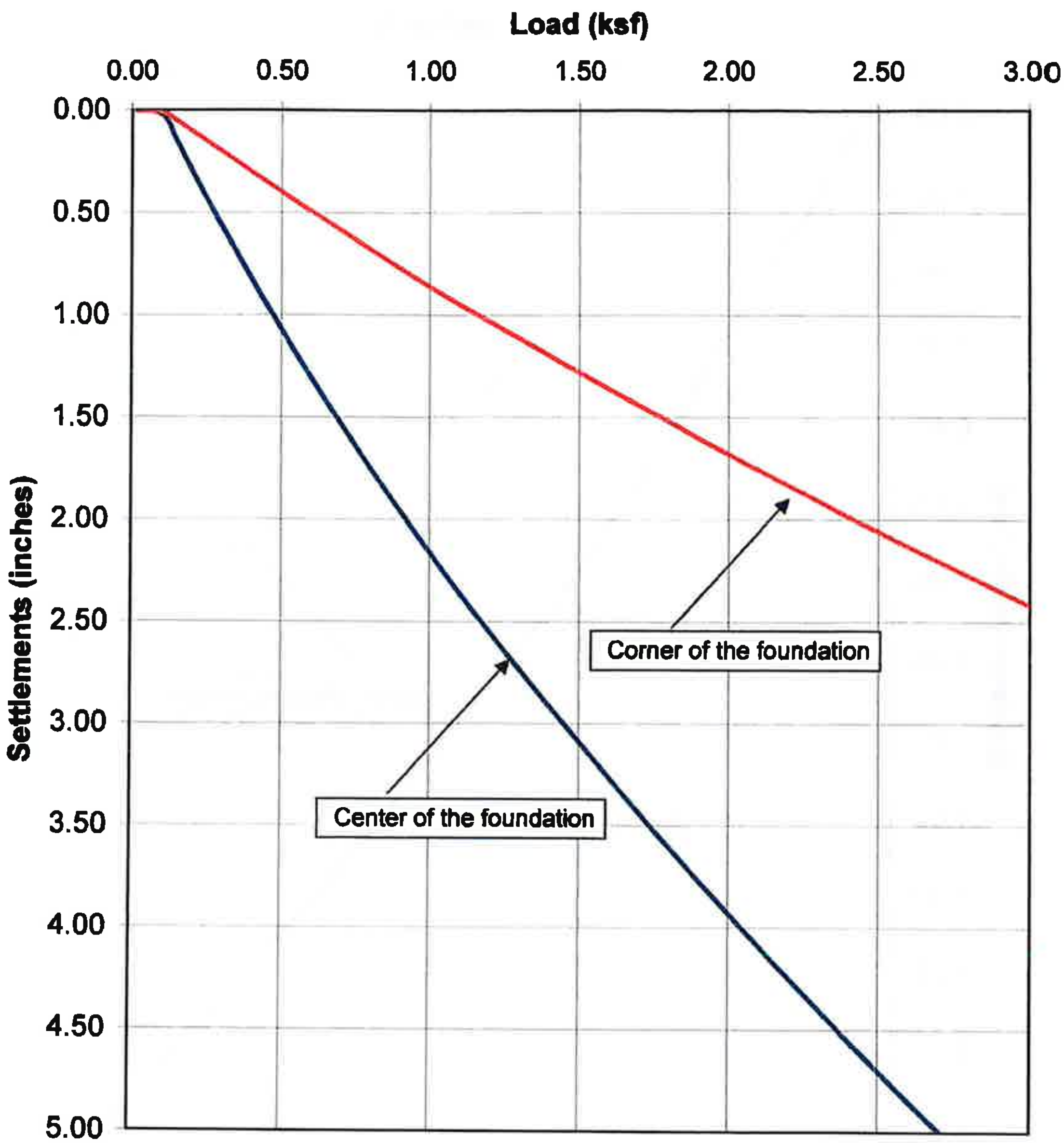
Concrete slab and flatwork reinforcement should consist of chaired rebar slab reinforcement (minimum of No. 4 bars at 18-inch centers, both horizontal directions) placed at slab mid-height to resist potential swell forces and cracking. Slab thickness and steel reinforcement are minimums only and should be verified by the structural engineer/designer knowing the actual project loadings. All steel components of the foundation system should be protected from corrosion by maintaining a 4-inch minimum concrete cover of densely consolidated concrete at footings (by use of a vibrator). The construction joint between the foundation and any mowstrips/sidewalks placed adjacent to foundations should be sealed with a polyurethane based non-hardening sealant to prevent moisture migration between the joint. Epoxy coated embedded steel components or permanent waterproofing membranes placed at the exterior footing sidewall may also be used to mitigate the corrosion potential of concrete placed in contact with native soil.



Notes:

1. A 15' x 15' foundation was used for settlement analysis

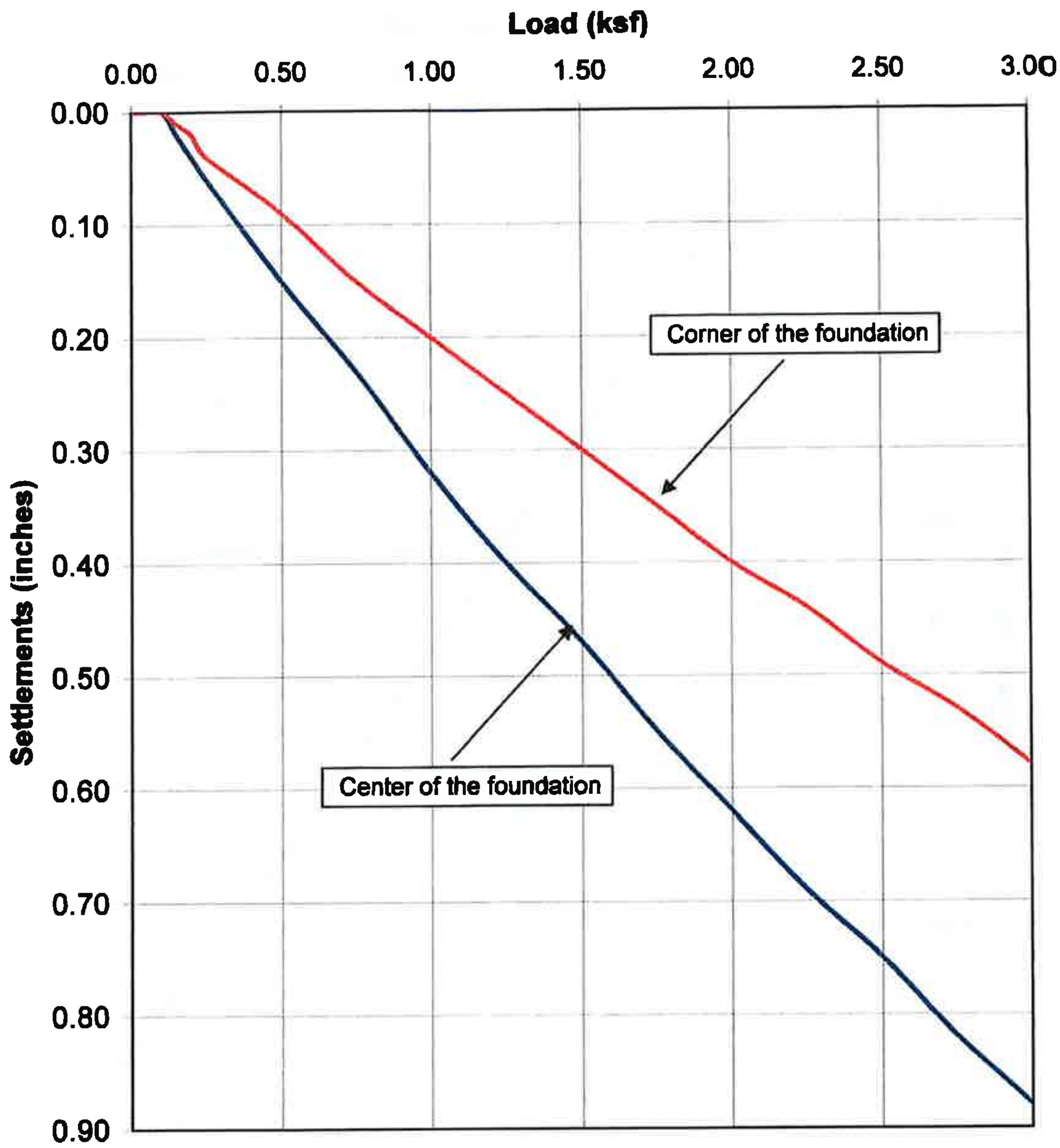
LANDMARK Geo-Engineers and Geologists *a DBE/MBE/SBE Company* **Project No.: LE04354**	**Total Settlements for a Turbine Generator Foundation at Heber 2 Geothermal Plant**	**Figure 2**



Notes:

1. A 30' x 60' foundation was used for settlement analysis

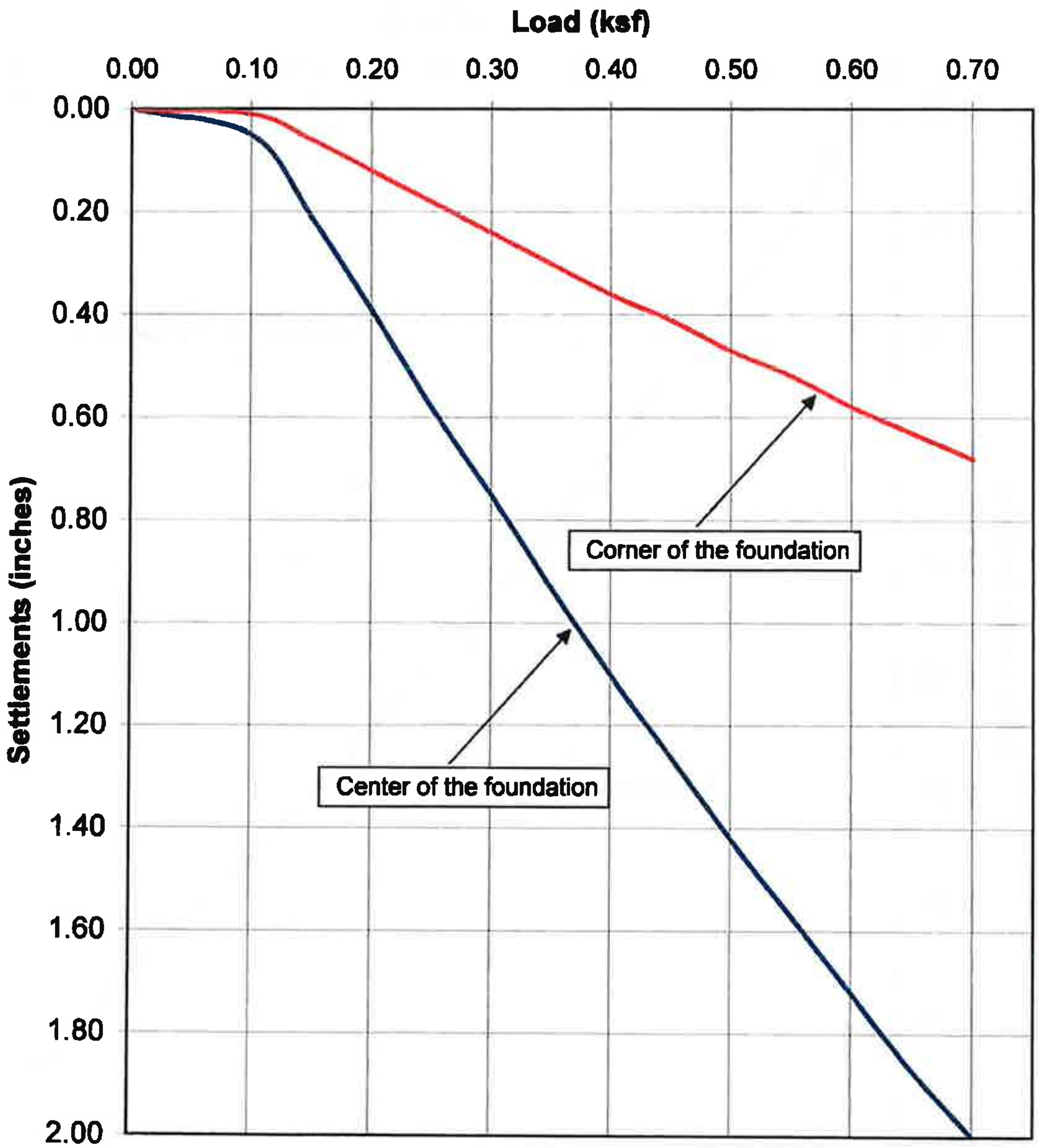
LANDMARK Geo-Engineers and Geologists *a DBE/MBE/SBE Company* **Project No.: LE04354**	**Total Settlements for a Turbine Generator Foundation at Heber 2 Geothermal Plant**	**Figure 3**



Notes:

1. A 5' x 5' foundation was used for settlement analysis

LANDMARK Geo-Engineers and Geologists *a DBE/MBE/SBE Company* **Project No.: LE04354**	**Total Settlements for a Cooling Tower Foundation at Heber 2 Geothermal Plant**	**Figure 4**



Notes:

1. A 60' x 180' foundation was used for settlement analysis

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company
Project No.: LE04354

Total Settlements for a Cooling Tower Foundation at Heber 2 Geothermal Plant

Figure 5

Control joints should be provided in all concrete slabs-on-grade at a maximum spacing (in feet) of 2 to 3 times the slab thickness (in inches) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce randomly oriented contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or sawcut (¼ of slab depth) within 6 to 8 hours of concrete placement. Construction (cold) joints in foundations and area flatwork should either be thickened butt-joints with dowels or a thickened keyed-joint designed to resist vertical deflection at the joint. All joints in flatwork should be sealed to prevent moisture, vermin, or foreign material intrusion. Precautions should be taken to prevent curling of slabs in this arid desert region (refer to ACI guidelines).

All independent flatwork (sidewalks, housekeeping slabs) should be placed on a minimum of 2 inches of concrete sand or aggregate base, dowelled to the perimeter foundations where adjacent to the structures and sloped 1% or more away from the structure. A minimum of 18 inches of moisture conditioned (3% minimum above optimum) and 8 inches of compacted subgrade (83 to 87%) and a 10-mil (minimum) polyethylene separation sheet should underlie the flatwork. All flatwork should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

4.4 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plates C-2 and C-3). The native soils were found to have moderate to severe levels of sulfate ion concentration (1,052 to 3,006 ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The California Building Code recommends that increased quantities of Type II Portland Cement be used at a low water/cement ratio when concrete is subjected to moderate sulfate concentrations. Type V Portland Cement and/or Type II/V cement with 25% flyash replacement is recommended when the concrete is subjected to soil with severe sulfate concentration.

A minimum of 6.25 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project. Admixtures may be required to allow placement of this low water/cement ratio concrete.

There are no special requirements for concrete mixes when foundations are placed on 2.5 feet of low sulfate content granular fill.

The native soil has moderate to very severe level of chloride ion concentration (210 to 3,040 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. Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 4 inches of densely consolidated concrete. ***No metallic pipes or conduits should be placed below foundations.***

Foundation designs shall provide a minimum concrete cover of four (4 inches around steel reinforcing or embedded components (anchor bolts, hold-downs, etc.) exposed to native soil or landscape water (to 18 inches above grade). If the 4-inch concrete edge distance cannot be achieved, all embedded steel components (anchor bolts, hold-downs, etc.) shall be epoxy dipped for corrosion protection or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings. Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete.

4.5 Excavations

All site excavations should conform to CalOSHA requirements for Type B soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type B soil. Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

4.6 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 Brawley, Superstition Hills, and Imperial 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 CBC for Seismic Zone 4 using the seismic coefficients given in Section 3.4 of this report. ***This site lies within 11.3 km of a Type A fault overlying S_D (stiff) soil.***

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The recommendations and conclusions within this report are based on current information regarding the proposed additions to the Ormat Heber 2 geothermal power plant located on Dogwood Road southwest of Heber, California. The conclusions and recommendations of this report are invalid if:

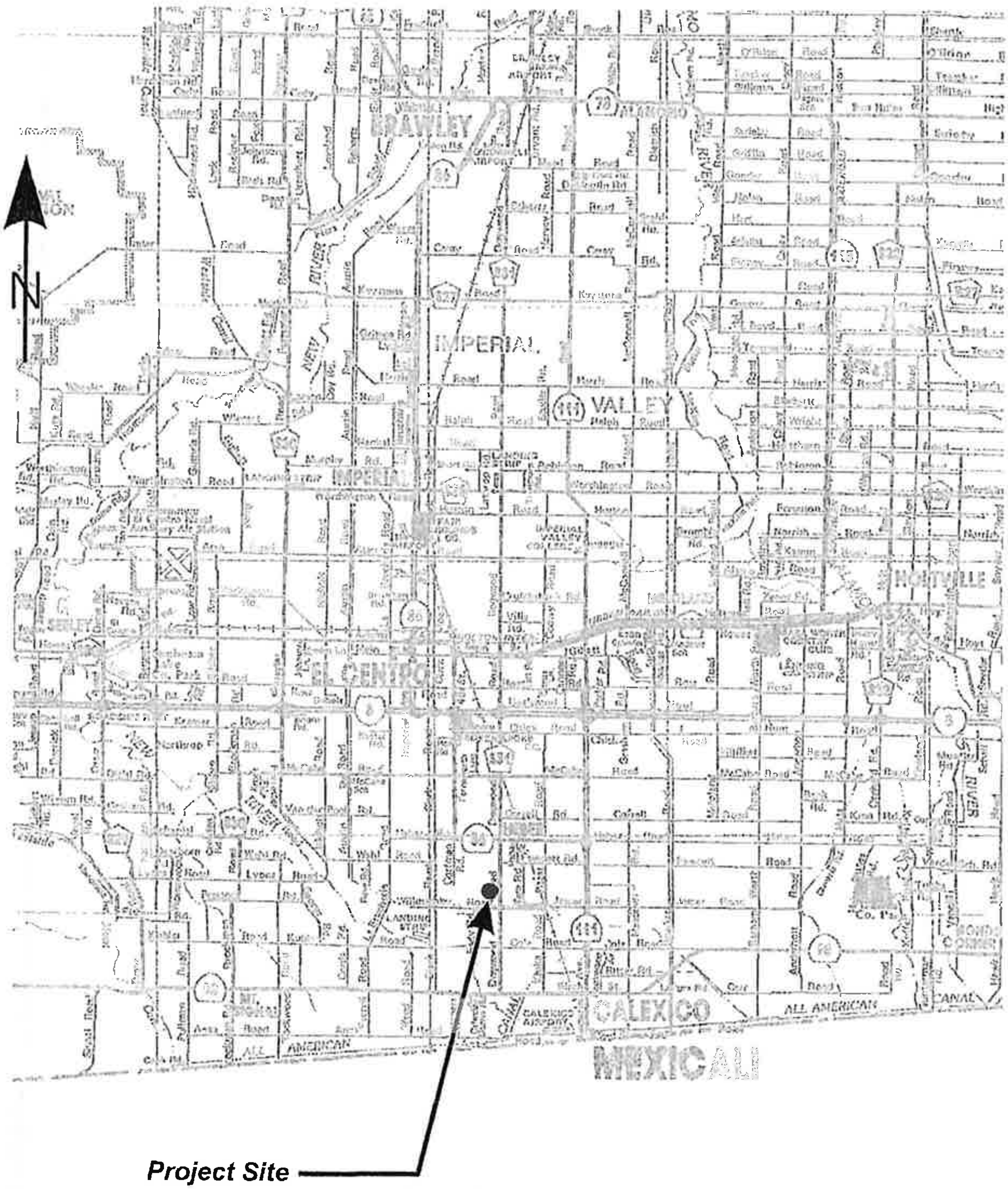
- Structural loads change from those stated or the structures are relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

Findings and recommendations in this report are based on selected points of field exploration, geologic literature, laboratory testing, and our understanding of the proposed project. Our analysis of data and recommendations 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. If detected, these conditions may require additional studies, consultation, and possible design revisions.

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.

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. This report should be considered invalid for periods after two years from the report date without a review of the validity of the findings and recommendations by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice.

APPENDIX A

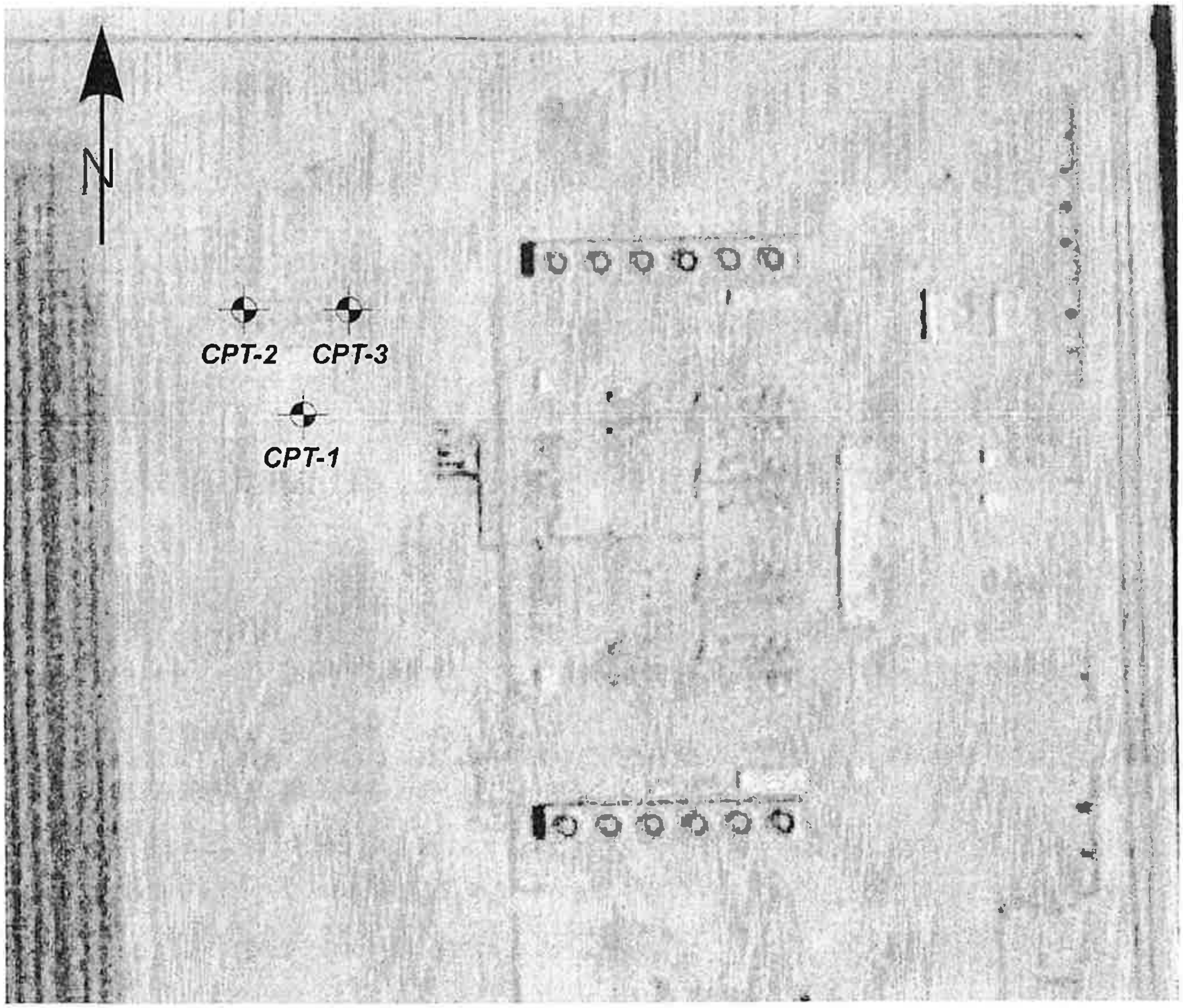


LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No.: LE04354

Vicinity Map

Plate A-1

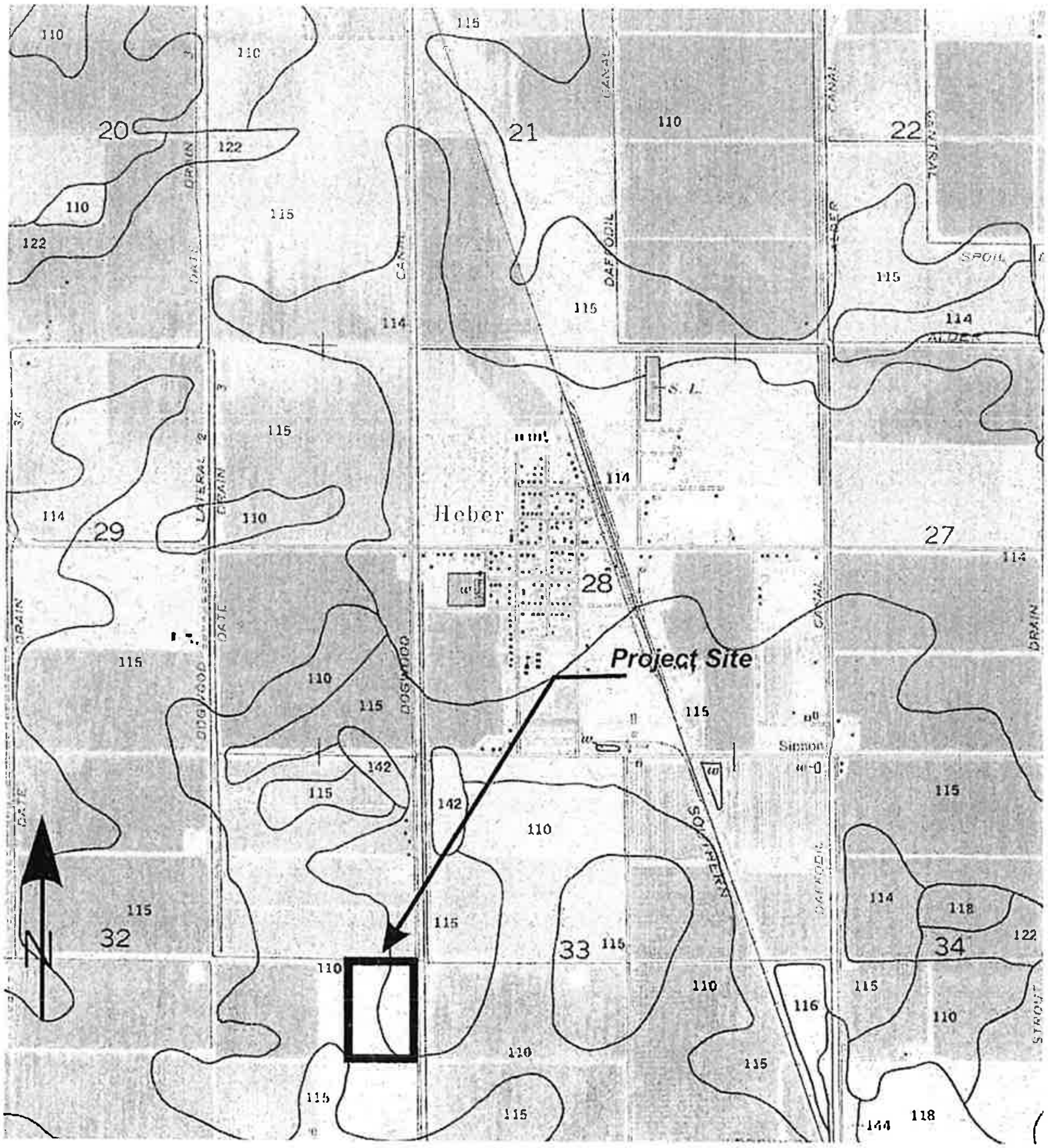


LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No.: LE04354

Site and Exploration Map

Plate A-2



LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

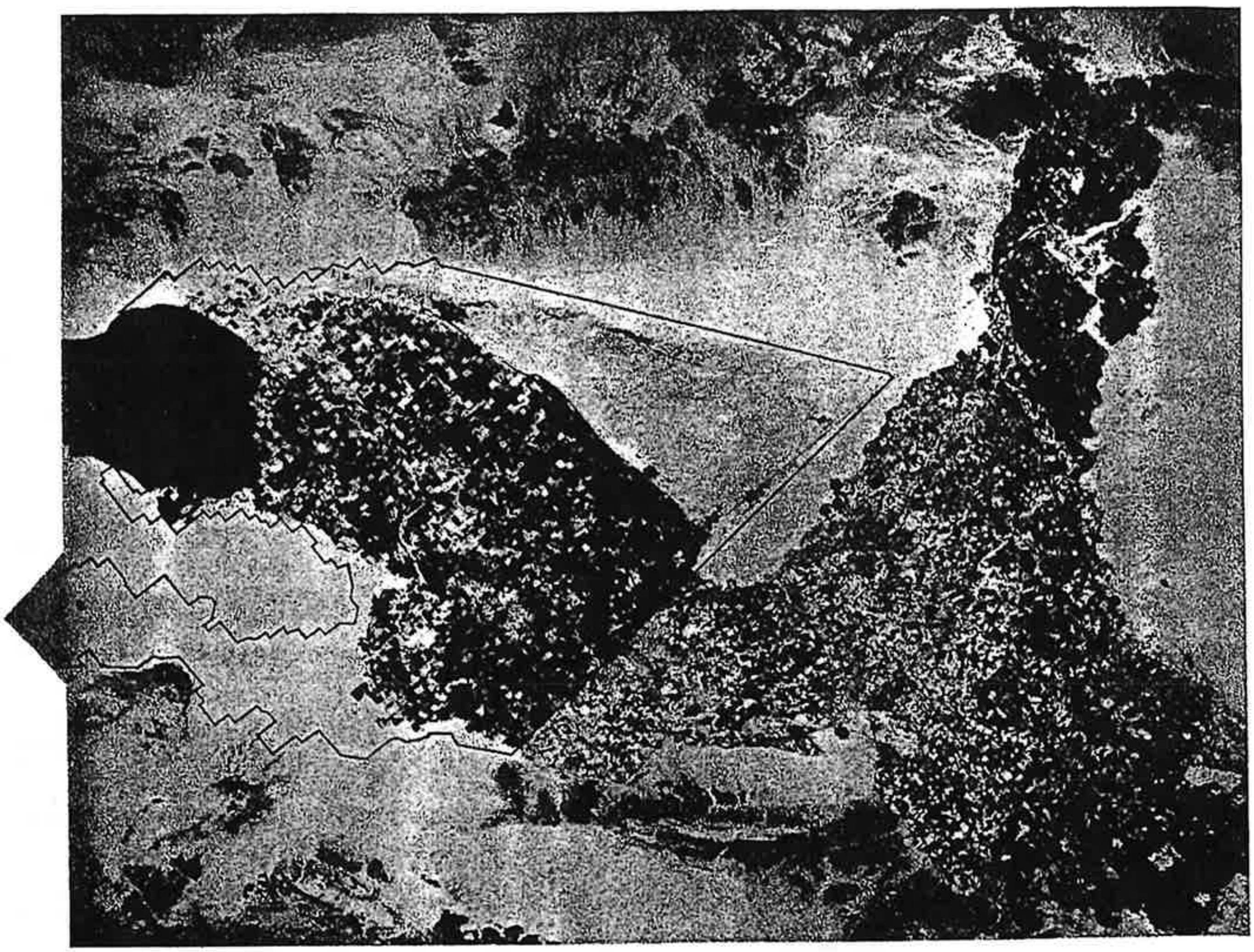
Project No.: LE04354

Soil Survey Map

Plate A-3

Soil Survey of

IMPERIAL COUNTY CALIFORNIA IMPERIAL VALLEY AREA



United States Department of Agriculture Soil Conservation Service
in cooperation with
University of California Agricultural Experiment Station
and
Imperial Irrigation District

TABLE 11.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

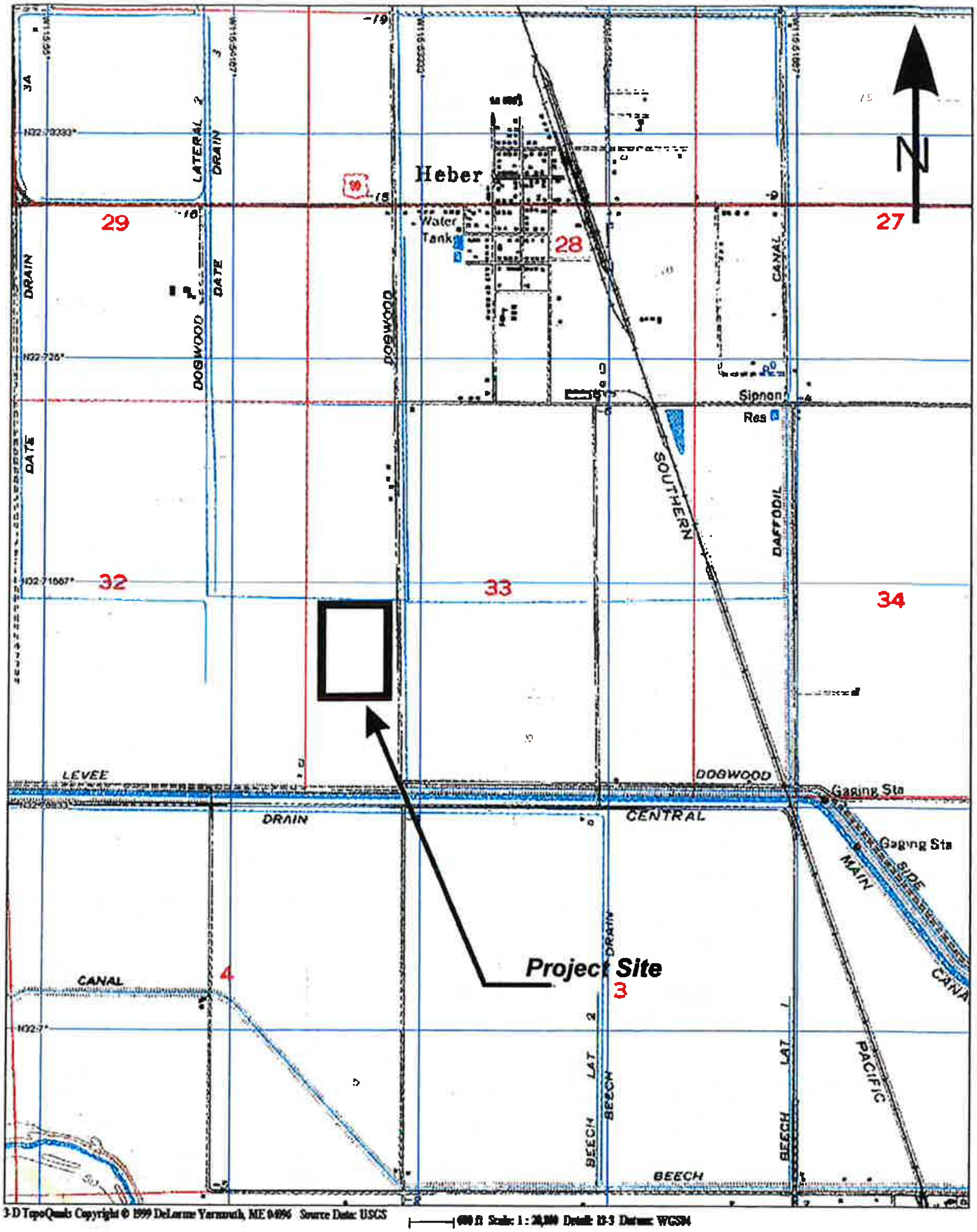
Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
100----------------- Antho	0-13	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	13-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
101*:											
Antho---------------	0-8	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	8-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
Superstition-------	0-6	Fine sand--------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
102*. Badland											
103----------------- Carsitas	0-10	Gravelly sand---	SP, SP-SM	A-1, A-2	0-5	60-90	50-85	30-55	0-10	---	NP
	10-60	Gravelly sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-5	60-90	50-85	25-50	0-10	---	NP
104* Fluvaquents											
105----------------- Glenbar	0-13	Clay loam--------	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
106----------------- Glenbar	0-13	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
107*---------------- Glenbar	0-13	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	100	70-80	20-30	NP-10
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	75-95	35-45	15-30
108----------------- Holtville	0-14	Loam-------------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	14-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
109----------------- Holtville	0-17	Silty clay-------	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
110----------------- Holtville	0-17	Silty clay-------	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
111*:											
Holtville	0-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	10-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
112 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
113 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	100	85-95	50-70	25-45
114 Imperial	0-12	Silty clay	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
115*:											
Imperial	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
116*:											
Imperial	0-13	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	13-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
117, 118 Indio	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
119*:											
Indio	0-12	Loam	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Vint	0-10	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	10-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
120* Laveen	0-12	Loam	ML, CL-ML	A-4	0	100	95-100	75-85	55-65	20-30	NP-10
	12-60	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-95	70-80	55-65	15-25	NP-10

See footnote at end of table.



LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No.: LE04354

Topographic Map

Plate A-4

APPENDIX B

CLIENT: ORMAT

PROJECT: ORMAT Heber 2 Facilities, Heber, CA

LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight

DATE: 12/20/04

LOG OF CONE SOUNDING DATA CPT-1

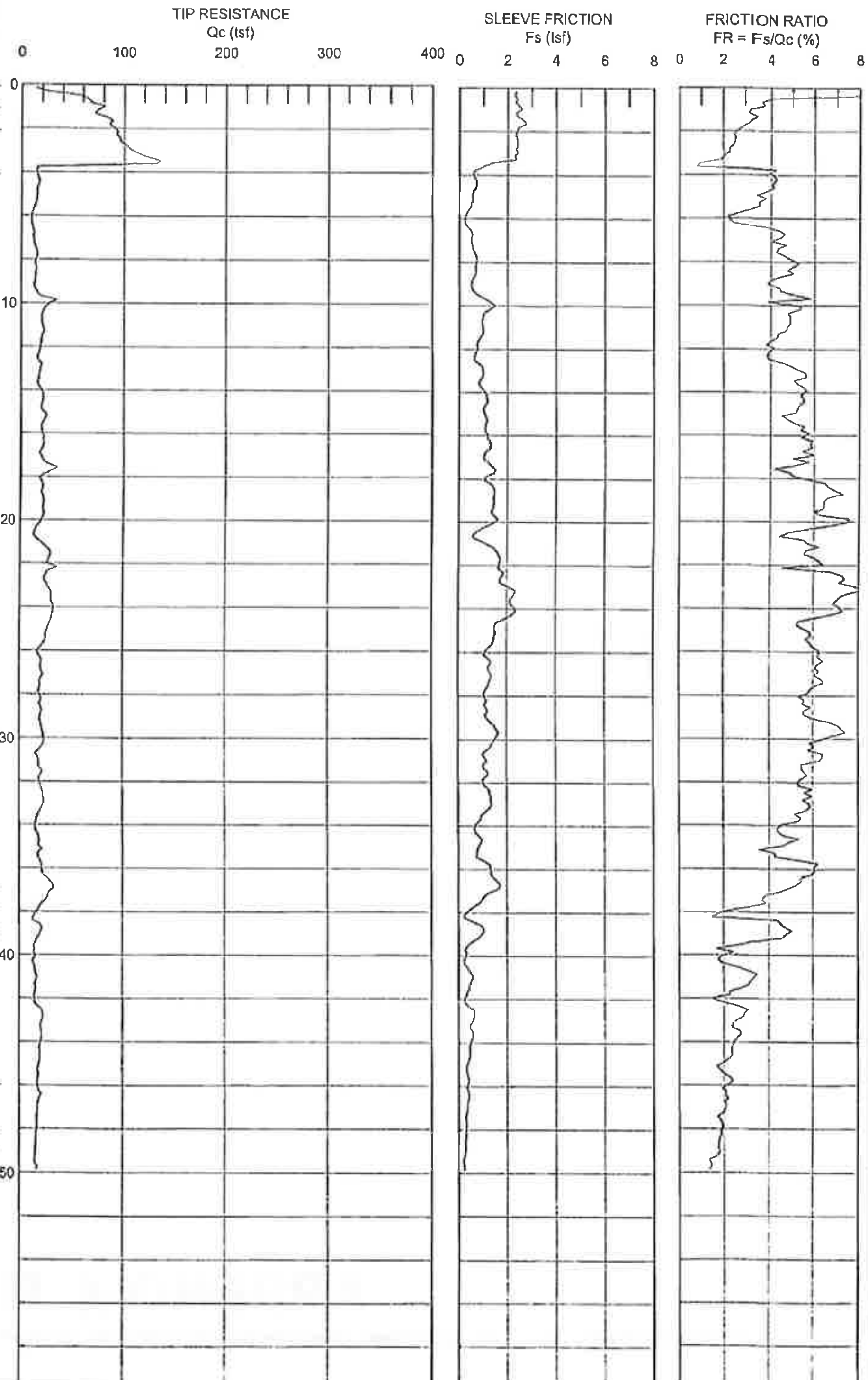
DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

	Clay	CL/CH	hard
	Sandy Silt to Clayey Silt	ML	very dense
	Silty Sand to Sandy Silt	SM/ML	very dense
	Silty Sand to Sandy Silt	" "	very dense
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	stiff
-10-	Clay	" "	very stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
-20-	Clay	" "	very stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
-30-	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Clay to Clay	CL	stiff
-40-	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	" "	very stiff
	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	very loose
	Sandy Silt to Clayey Silt	" "	very loose
	Clayey Silt to Silty Clay	ML/CL	stiff
-50-			

End of Sounding @ 49.5 ft.



Project No: LE04354

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate B-1

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA Project No: LE04354 Date: 12/20/04

CONE SOUNDING: CPT-1

Est. GWT (ft): 12.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
0.15	0.5	31.82	10.13	3	3	Clay	CL/CH	very stiff	125	1.3	25	2.00		95			1.87	>10
0.30	1.0	71.19	3.50	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	20	2.00	134.6	45	107	43		
0.45	1.5	76.38	3.27	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	22	2.00	144.4	40	102	42		
0.60	2.0	88.21	2.88	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	25	2.00	166.8	35	101	42		
0.75	2.5	94.19	2.53	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	21	2.00	178.0	30	100	42		
0.93	3.0	101.94	2.35	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	23	2.00	192.7	30	99	42		
1.08	3.5	123.24	1.66	8	8	Sand to Silty Sand	SP/SM	very dense	115	5.5	22	2.00	233.0	20	102	42		
1.23	4.0	53.93	2.99	6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	15	2.00	101.9	45	76	39		
1.38	4.5	16.43	4.19	3	3	Clay	CL/CH	stiff	125	1.3	13	2.00		85			0.95	>10
1.53	5.0	15.53	3.80	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	1.95		85			0.90	>10
1.68	5.5	13.99	3.48	4	4	Silty Clay to Clay	CL	stiff	125	1.8	8	1.85		85			0.80	>10
1.83	6.0	10.16	2.42	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	4	1.76		85			0.58	>10
1.98	6.5	10.41	3.55	4	4	Silty Clay to Clay	CL	stiff	125	1.8	6	1.69		95			0.59	>10
2.13	7.0	11.62	4.38	3	3	Clay	CL/CH	stiff	125	1.3	9	1.62		100			0.66	>10
2.28	7.5	13.29	4.44	3	3	Clay	CL/CH	stiff	125	1.3	11	1.56		95			0.76	>10
2.45	8.0	14.55	4.93	3	3	Clay	CL/CH	stiff	125	1.3	12	1.51		95			0.83	>10
2.60	8.5	13.90	4.96	3	3	Clay	CL/CH	stiff	125	1.3	11	1.46		100			0.79	>10
2.75	9.0	13.23	4.08	3	3	Clay	CL/CH	stiff	125	1.3	11	1.42		95			0.75	>10
2.90	9.5	13.66	4.68	3	3	Clay	CL/CH	stiff	125	1.3	11	1.38		100			0.77	>10
3.05	10.0	26.88	5.00	3	3	Clay	CL/CH	very stiff	125	1.3	22	1.34		80			1.55	>10
3.20	10.5	21.69	5.01	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.32		90			1.24	>10
3.35	11.0	19.84	4.85	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.30		95			1.13	>10
3.50	11.5	21.31	4.45	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.29		90			1.22	>10
3.65	12.0	18.97	4.00	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.27		90			1.08	>10
3.80	12.5	16.82	3.88	4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.26		95			0.95	>10
3.95	13.0	18.18	4.91	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.24		100			1.03	>10
4.13	13.5	17.33	5.43	3	3	Clay	CL/CH	stiff	125	1.3	14	1.23		100			0.98	>10
4.28	14.0	17.04	5.46	3	3	Clay	CL/CH	stiff	125	1.3	14	1.22		100			0.96	>10
4.43	14.5	21.21	5.45	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.20		100			1.20	>10
4.58	15.0	19.96	5.21	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.19		100			1.13	>10
4.73	15.5	23.41	4.80	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.18		95			1.33	>10
4.88	16.0	20.50	5.51	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.17		100			1.16	>10
5.03	16.5	21.94	5.88	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.15		100			1.24	>10
5.18	17.0	19.22	5.48	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.14		100			1.08	>10
5.33	17.5	27.57	5.03	3	3	Clay	CL/CH	very stiff	125	1.3	22	1.13		95			1.57	>10
5.48	18.0	23.29	5.22	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.12		100			1.32	>10
5.65	18.5	20.85	6.67	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.11		100			1.18	>10
5.80	19.0	21.33	6.77	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.10		100			1.20	>10
5.95	19.5	21.97	6.29	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.09		100			1.24	>10
6.10	20.0	21.34	7.09	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.08		100			1.20	>10
6.25	20.5	15.48	5.72	3	3	Clay	CL/CH	stiff	125	1.3	12	1.07		100			0.86	5.53
6.40	21.0	15.87	5.20	3	3	Clay	CL/CH	stiff	125	1.3	13	1.06		100			0.88	5.65
6.55	21.5	26.53	5.79	3	3	Clay	CL/CH	very stiff	125	1.3	21	1.05		100			1.50	>10
6.70	22.0	27.19	6.21	3	3	Clay	CL/CH	very stiff	125	1.3	22	1.05		100			1.54	>10
6.85	22.5	29.12	6.18	3	3	Clay	CL/CH	very stiff	125	1.3	23	1.04		100			1.65	>10
7.00	23.0	24.40	7.41	3	3	Clay	CL/CH	very stiff	125	1.3	20	1.03		100			1.38	>10
7.18	23.5	29.74	7.65	3	3	Clay	CL/CH	very stiff	125	1.3	24	1.02		100			1.69	>10
7.33	24.0	31.24	7.01	3	3	Clay	CL/CH	very stiff	125	1.3	25	1.01		100			1.78	>10
7.48	24.5	31.71	6.74	3	3	Clay	CL/CH	very stiff	125	1.3	25	1.01		100			1.80	>10
7.63	25.0	28.38	5.36	3	3	Clay	CL/CH	very stiff	125	1.3	23	1.00		100			1.61	>10
7.78	25.5	25.50	5.79	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.99		100			1.44	>10
7.93	26.0	21.23	6.01	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.98		100			1.18	7.00
8.08	26.5	19.41	6.26	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.98		100			1.08	6.00
8.23	27.0	21.10	6.12	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.97		100			1.17	6.65
8.38	27.5	20.13	6.30	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.96		100			1.12	6.00
8.53	28.0	19.23	5.66	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.96		100			1.06	5.42
8.68	28.5	20.08	5.65	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.95		100			1.11	5.76
8.85	29.0	20.55	5.67	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.94		100			1.14	5.88
9.00	29.5	20.76	7.00	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.94		100			1.15	5.88
9.15	30.0	22.80	6.88	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.93		100			1.27	6.65

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA   Project No: LE04354   Date: 12/20/04

CONE SOUNDING: CPT-1

Est. GWT (ft): 12.0   Phi Correlation: 0   0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
9.30	30.5	21.60	5.89	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.93		100			1.20	6.00
9.45	31.0	17.19	6.36	3	3	Clay	CL/CH	stiff	125	1.3	14	0.92		100			0.94	4.00
9.60	31.5	20.05	5.47	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.92		100			1.10	5.10
9.75	32.0	19.47	5.50	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.91		100			1.07	4.68
9.90	32.5	21.74	5.63	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.90		100			1.20	5.53
10.05	33.0	23.37	5.76	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.90		100			1.30	6.10
10.20	33.5	20.39	5.56	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.89		100			1.12	4.78
10.38	34.0	15.97	5.12	3	3	Clay	CL/CH	stiff	125	1.3	13	0.89		100			0.86	3.28
10.53	34.5	16.45	4.48	3	3	Clay	CL/CH	stiff	125	1.3	13	0.88		100			0.89	3.35
10.68	35.0	18.50	4.96	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.88		100			1.01	3.91
10.83	35.5	19.11	4.05	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.87		100			1.04	5.21
10.98	36.0	20.64	5.86	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.87		100			1.13	4.47
11.13	36.5	25.44	5.72	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.86		100			1.41	6.21
11.28	37.0	31.72	4.84	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	0.86		100			1.78	>10
11.43	37.5	25.49	3.77	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.85		100			1.41	>10
11.58	38.0	17.68	2.48	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.85		100			0.95	5.65
11.73	38.5	15.25	3.47	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	0.85		100			0.81	3.35
11.88	39.0	20.64	4.84	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.84		100			1.13	4.00
12.05	39.5	15.50	3.51	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	0.84		100			0.82	3.28
12.20	40.0	14.77	2.00	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.83		100			0.78	3.91
12.35	40.5	13.50	2.07	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	5	0.83		100			0.70	3.43
12.50	41.0	15.96	3.29	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	0.82		100			0.85	3.28
12.65	41.5	15.32	3.05	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.82		100			0.81	4.00
12.80	42.0	14.74	2.01	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.82		100			0.77	3.66
12.95	42.5	17.48	2.54	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.81		100			0.93	4.78
13.10	43.0	22.47	2.80	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.81		100			1.23	7.13
13.25	43.5	20.78	2.49	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.13	6.21
13.40	44.0	21.29	2.62	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.80		100			1.16	6.43
13.58	44.5	19.71	2.35	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.80		100			1.06	5.53
13.73	45.0	19.60	2.17	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.80		100			1.05	5.42
13.88	45.5	18.05	1.84	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.79	13.5	100	13	30		
14.03	46.0	17.42	2.29	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.79		100			0.92	4.28
14.18	46.5	19.49	2.03	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.79	14.5	100	15	30		
14.33	47.0	17.99	2.10	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.96	4.37
14.48	47.5	16.62	1.85	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.88	3.83
14.63	48.0	16.66	1.91	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.88	3.83
14.78	48.5	15.96	1.83	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.77		100			0.83	3.58
14.93	49.0	15.56	1.78	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.77		100			0.81	3.35
15.10	49.5	14.89	1.48	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	4	0.77	10.8	100	7	29		

CLIENT: ORMAT

PROJECT: ORMAT Heber 2 Facilities, Heber, CA

LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight

DATE: 12/20/04

LOG OF CONE SOUNDING DATA CPT-2

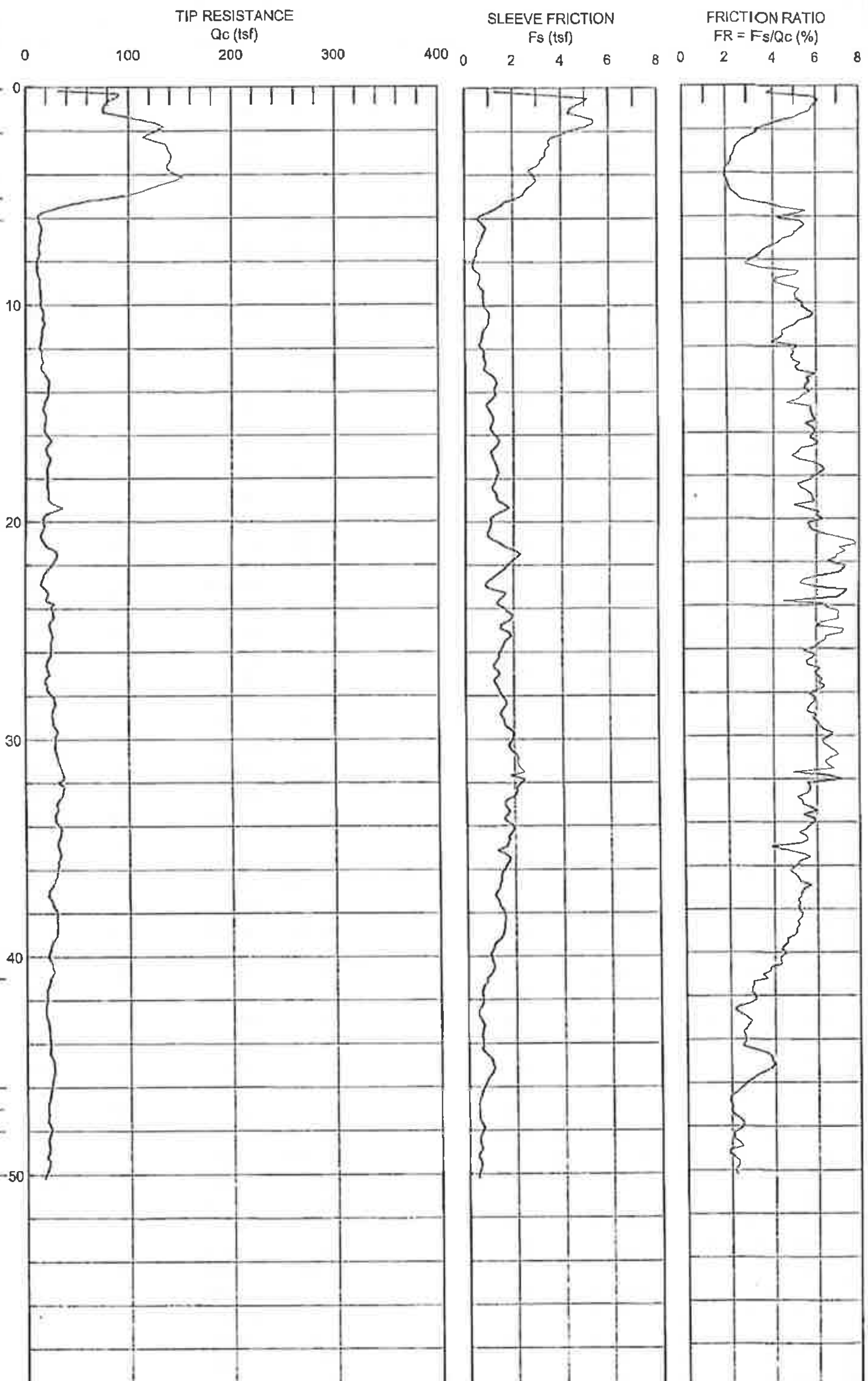
DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

Overconsolidated Soil	??	very dense
Overconsolidated Soil	" "	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Silty Sand to Sandy Silt	" "	very dense
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	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
Clayey Silt to Silty Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose

End of Sounding @ 50.0 ft.



Project No:
LE04354

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate
B-2

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA   Project No: LE04354   Date: 12/20/04

CONE SOUNDING: CPT-2

Est. GWT (ft): 12.0   Phi Correlation: 0   0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17.0 Su (tsf)	OCR
0.15	0.5	70.28	4.52 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	28	2.00		50			4.13	>10
0.30	1.0	77.82	5.97 11	11	Overconsolidated Soil	??	very dense	120	1.0	78	2.00	147.1	55	110	43		
0.45	1.5	91.98	5.31 11	11	Overconsolidated Soil	??	very dense	120	1.0	92	2.00	173.9	50	107	43		
0.60	2.0	129.94	3.78 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	37	2.00	245.6	35	113	44		
0.75	2.5	119.62	3.11 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	34	2.00	226.1	30	107	43		
0.93	3.0	137.68	2.51 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	31	2.00	260.3	25	108	43		
1.08	3.5	140.87	2.30 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	31	2.00	266.3	25	106	43		
1.23	4.0	139.35	2.04 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	31	2.00	263.4	20	104	43		
1.38	4.5	144.85	2.01 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	32	2.00	273.8	20	103	42		
1.53	5.0	113.08	2.24 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	25	1.95	208.9	25	94	41		
1.68	5.5	52.70	3.38 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	1.86		50			3.08	>10
1.83	6.0	13.87	4.91 3	3	Clay	CL/CH	stiff	125	1.3	11	1.77		95			0.80	>10
1.98	6.5	15.08	5.36 3	3	Clay	CL/CH	stiff	125	1.3	12	1.70		95			0.87	>10
2.13	7.0	14.77	4.81 3	3	Clay	CL/CH	stiff	125	1.3	12	1.63		95			0.85	>10
2.28	7.5	13.38	3.90 3	3	Clay	CL/CH	stiff	125	1.3	11	1.57		90			0.76	>10
2.45	8.0	12.25	3.27 4	4	Silty Clay to Clay	CL	stiff	125	1.8	7	1.51		90			0.69	>10
2.60	8.5	11.34	3.86 3	3	Clay	CL/CH	stiff	125	1.3	9	1.46		100			0.64	9.79
2.75	9.0	13.62	4.43 3	3	Clay	CL/CH	stiff	125	1.3	11	1.42		95			0.77	>10
2.90	9.5	14.76	4.97 3	3	Clay	CL/CH	stiff	125	1.3	12	1.38		100			0.84	>10
3.05	10.0	15.04	5.19 3	3	Clay	CL/CH	stiff	125	1.3	12	1.34		100			0.85	>10
3.20	10.5	17.24	5.61 3	3	Clay	CL/CH	stiff	125	1.3	14	1.33		100			0.98	>10
3.35	11.0	17.82	5.31 3	3	Clay	CL/CH	very stiff	125	1.3	14	1.31		100			1.01	>10
3.50	11.5	16.22	4.53 3	3	Clay	CL/CH	stiff	125	1.3	13	1.29		100			0.92	>10
3.65	12.0	14.59	4.45 3	3	Clay	CL/CH	stiff	125	1.3	12	1.28		100			0.82	9.19
3.80	12.5	15.95	4.89 3	3	Clay	CL/CH	stiff	125	1.3	13	1.26		100			0.90	>10
3.95	13.0	16.10	5.07 3	3	Clay	CL/CH	stiff	125	1.3	13	1.25		100			0.91	>10
4.13	13.5	20.52	5.55 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.23		100			1.17	>10
4.28	14.0	22.48	5.55 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.22		100			1.28	>10
4.43	14.5	20.89	5.42 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.21		100			1.19	>10
4.58	15.0	17.79	5.37 3	3	Clay	CL/CH	very stiff	125	1.3	14	1.19		100			1.00	>10
4.73	15.5	19.47	5.86 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.18		100			1.10	>10
4.88	16.0	19.76	5.77 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.17		100			1.12	>10
5.03	16.5	22.53	5.91 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.16		100			1.28	>10
5.18	17.0	21.67	5.09 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.15		100			1.23	>10
5.33	17.5	22.15	5.77 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.13		100			1.25	>10
5.48	18.0	21.43	6.10 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.12		100			1.21	>10
5.65	18.5	21.56	5.34 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.11		100			1.22	>10
5.80	19.0	22.73	5.72 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.10		100			1.29	>10
5.95	19.5	30.63	5.48 3	3	Clay	CL/CH	very stiff	125	1.3	25	1.09		95			1.75	>10
6.10	20.0	17.95	6.14 3	3	Clay	CL/CH	very stiff	125	1.3	14	1.08		100			1.00	7.41
6.25	20.5	17.30	5.70 3	3	Clay	CL/CH	stiff	125	1.3	14	1.07		100			0.96	6.65
6.40	21.0	16.60	6.99 3	3	Clay	CL/CH	stiff	125	1.3	13	1.07		100			0.92	6.10
6.55	21.5	26.75	7.44 3	3	Clay	CL/CH	very stiff	125	1.3	21	1.06		100			1.52	>10
6.70	22.0	28.17	6.81 3	3	Clay	CL/CH	very stiff	125	1.3	23	1.05		100			1.60	>10
6.85	22.5	20.17	7.24 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.04		100			1.13	7.85
7.00	23.0	16.15	5.62 3	3	Clay	CL/CH	stiff	125	1.3	13	1.03		100			0.89	5.21
7.18	23.5	21.37	6.84 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.02		100			1.20	8.27
7.33	24.0	24.23	5.98 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.02		100			1.36	>10
7.48	24.5	27.09	6.88 3	3	Clay	CL/CH	very stiff	125	1.3	22	1.01		100			1.53	>10
7.63	25.0	23.97	6.46 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.00		100			1.35	9.39
7.78	25.5	25.90	6.98 3	3	Clay	CL/CH	very stiff	125	1.3	21	0.99		100			1.46	>10
7.93	26.0	24.80	6.17 3	3	Clay	CL/CH	very stiff	125	1.3	20	0.99		100			1.39	9.59
8.08	26.5	22.94	5.66 3	3	Clay	CL/CH	very stiff	125	1.3	18	0.98		100			1.28	8.00
8.23	27.0	22.28	5.92 3	3	Clay	CL/CH	very stiff	125	1.3	18	0.97		100			1.24	7.27
8.38	27.5	20.15	6.14 3	3	Clay	CL/CH	very stiff	125	1.3	16	0.97		100			1.12	6.10
8.53	28.0	24.13	6.05 3	3	Clay	CL/CH	very stiff	125	1.3	19	0.96		100			1.35	8.14
8.68	28.5	28.28	5.86 3	3	Clay	CL/CH	very stiff	125	1.3	23	0.95		100			1.59	>10
8.85	29.0	26.02	5.73 3	3	Clay	CL/CH	very stiff	125	1.3	21	0.95		100			1.46	8.85
9.00	29.5	28.06	6.01 3	3	Clay	CL/CH	very stiff	125	1.3	22	0.94		100			1.58	>10
9.15	30.0	29.72	6.57 3	3	Clay	CL/CH	very stiff	125	1.3	24	0.93		100			1.68	>10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA Project No: LE04354 Date: 12/20/04

CONE SOUNDING: CPT-2

Est. GWT (ft): 12.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17.0 Su (tsf)	OCR
9.30	30.5	28.55	6.41	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.93		100			1.61	>10
9.45	31.0	31.07	6.84	3	3	Clay	CL/CH	very stiff	125	1.3	25	0.92		100			1.75	>10
9.60	31.5	34.71	6.59	3	3	Clay	CL/CH	very stiff	125	1.3	28	0.92		100			1.97	>10
9.75	32.0	35.27	6.25	3	3	Clay	CL/CH	very stiff	125	1.3	28	0.91		100			2.00	>10
9.90	32.5	37.01	5.65	3	3	Clay	CL/CH	hard	125	1.3	30	0.91		100			2.10	>10
10.05	33.0	32.37	5.31	3	3	Clay	CL/CH	very stiff	125	1.3	26	0.90		100			1.83	>10
10.20	33.5	30.28	5.70	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.89		100			1.70	9.59
10.38	34.0	29.97	5.71	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.89		100			1.68	9.19
10.53	34.5	34.16	5.42	3	3	Clay	CL/CH	very stiff	125	1.3	27	0.88		100			1.93	>10
10.68	35.0	31.53	5.44	3	3	Clay	CL/CH	very stiff	125	1.3	25	0.88		100			1.77	9.79
10.83	35.5	33.18	4.62	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	19	0.87		100			1.87	>10
10.98	36.0	31.41	5.32	3	3	Clay	CL/CH	very stiff	125	1.3	25	0.87		100			1.77	9.19
11.13	36.5	28.95	4.94	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.86		100			1.62	7.70
11.28	37.0	23.74	5.43	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.86		100			1.31	5.42
11.43	37.5	24.03	5.19	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.85		100			1.33	5.42
11.58	38.0	28.73	5.16	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.85		100			1.60	7.13
11.73	38.5	29.89	5.19	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.85		100			1.67	7.56
11.88	39.0	29.55	5.05	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.84		100			1.65	7.27
12.05	39.5	25.32	4.72	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.84		100			1.40	5.53
12.20	40.0	22.19	4.46	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.83		100			1.22	4.37
12.35	40.5	24.43	4.30	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	0.83		100			1.35	6.54
12.50	41.0	24.85	3.66	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.82		100			1.37	9.39
12.65	41.5	21.29	3.25	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.82		100			1.16	6.88
12.80	42.0	19.81	3.04	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.82		100			1.07	6.00
12.95	42.5	18.87	2.79	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.02	5.42
13.10	43.0	19.60	2.48	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.06	5.76
13.25	43.5	21.70	2.84	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.81		100			1.18	6.65
13.40	44.0	22.24	2.62	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.80		100			1.21	6.88
13.58	44.5	22.52	2.78	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.80		100			1.23	6.88
13.73	45.0	25.15	3.77	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.80		100			1.38	8.27
13.88	45.5	26.20	3.80	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.79		100			1.44	8.85
14.03	46.0	24.44	3.02	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.79		100			1.34	7.70
14.18	46.5	22.65	2.43	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.79		100			1.23	6.54
14.33	47.0	20.81	1.98	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.78	15.4	100	17	30		
14.48	47.5	20.51	2.12	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.78	15.1	100	17	30		
14.63	48.0	22.61	2.50	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.78		100			1.23	6.32
14.78	48.5	20.83	2.13	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.77	15.2	100	17	30		
14.93	49.0	20.93	2.27	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.77		100			1.13	5.42
15.10	49.5	20.67	2.11	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.77	15.0	100	16	30		
15.25	50.0	19.06	2.25	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.76		100			1.01	4.47

CLIENT: ORMAT

PROJECT: ORMAT Heber 2 Facilities, Heber, CA

LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight

DATE: 12/20/04

LOG OF CONE SOUNDING DATA CPT-3

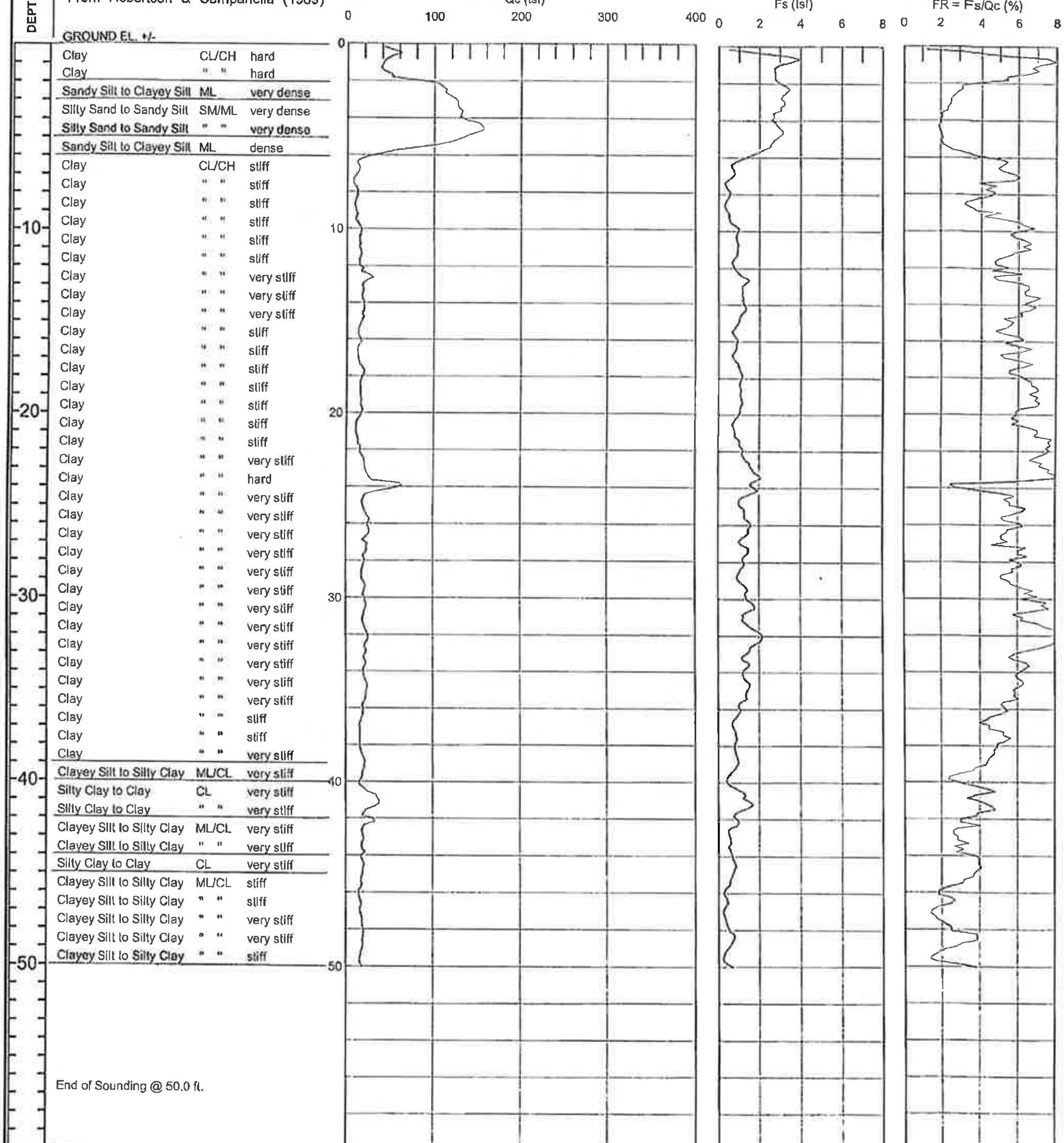
DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

Clay	CL/CH	hard
Clay	" "	hard
Sandy Silt to Clayey Silt	ML	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Sandy Silt to Clayey Silt	ML	dense
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	hard
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	very stiff
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	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff

End of Sounding @ 50.0 ft.



Project No: LE04354

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate B-3

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA Project No: LE04354 Date: 12/20/04

CONE SOUNDING: CPT-3

Est. GWT (ft): 12.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
0.15	0.5	51.76	3.36	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	2.00		50			3.04	>10
0.30	1.0	46.42	7.56	3	3	Clay	CL/CH	hard	125	1.3	37	2.00		75			2.73	>10
0.45	1.5	40.35	6.79	3	3	Clay	CL/CH	hard	125	1.3	32	2.00		75			2.37	>10
0.60	2.0	61.72	4.80	4	4	Silty Clay to Clay	CL	hard	125	1.8	35	2.00		55			3.62	>10
0.75	2.5	109.67	3.07	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	31	2.00	207.3	35	104	43		
0.93	3.0	118.60	2.64	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	26	2.00	224.2	30	103	42		
1.08	3.5	127.70	2.43	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	28	2.00	241.4	25	103	42		
1.23	4.0	131.15	2.02	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	29	2.00	247.9	25	102	42		
1.38	4.5	147.55	1.96	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	33	2.00	278.9	20	103	42		
1.53	5.0	148.38	2.05	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	33	1.94	271.7	20	102	42		
1.68	5.5	111.44	2.28	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	25	1.85	194.4	25	92	41		
1.83	6.0	40.17	4.02	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	16	1.76		60			2.34	>10
1.98	6.5	13.36	5.18	3	3	Clay	CL/CH	stiff	125	1.3	11	1.69		100			0.76	>10
2.13	7.0	13.22	5.65	3	3	Clay	CL/CH	stiff	125	1.3	11	1.62		100			0.75	>10
2.28	7.5	7.68	4.85	3	3	Clay	CL/CH	firm	125	1.3	6	1.56		100			0.43	6.10
2.45	8.0	11.50	4.55	3	3	Clay	CL/CH	stiff	125	1.3	9	1.51		100			0.65	>10
2.60	8.5	10.61	3.49	4	4	Silty Clay to Clay	CL	stiff	125	1.8	6	1.46		95			0.60	>10
2.75	9.0	9.81	4.10	3	3	Clay	CL/CH	stiff	125	1.3	8	1.42		100			0.55	6.54
2.90	9.5	10.85	5.09	3	3	Clay	CL/CH	stiff	125	1.3	9	1.38		100			0.61	7.00
3.05	10.0	14.61	6.36	3	3	Clay	CL/CH	stiff	125	1.3	12	1.34		100			0.82	>10
3.20	10.5	14.97	5.91	3	3	Clay	CL/CH	stiff	125	1.3	12	1.32		100			0.85	>10
3.35	11.0	14.49	6.53	3	3	Clay	CL/CH	stiff	125	1.3	12	1.31		100			0.82	>10
3.50	11.5	15.94	5.42	3	3	Clay	CL/CH	stiff	125	1.3	13	1.29		100			0.90	>10
3.65	12.0	14.15	5.01	3	3	Clay	CL/CH	stiff	125	1.3	11	1.27		100			0.79	8.56
3.80	12.5	20.31	5.15	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.26		95			1.16	>10
3.95	13.0	23.81	5.79	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.24		95			1.36	>10
4.13	13.5	18.35	6.42	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.23		100			1.04	>10
4.28	14.0	18.13	6.73	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.22		100			1.02	>10
4.43	14.5	19.70	6.56	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.20		100			1.12	>10
4.58	15.0	18.07	5.71	3	3	Clay	CL/CH	very stiff	125	1.3	14	1.19		100			1.02	>10
4.73	15.5	14.86	5.24	3	3	Clay	CL/CH	stiff	125	1.3	12	1.18		100			0.83	7.00
4.88	16.0	14.60	5.69	3	3	Clay	CL/CH	stiff	125	1.3	12	1.17		100			0.81	6.65
5.03	16.5	13.49	6.25	3	3	Clay	CL/CH	stiff	125	1.3	11	1.16		100			0.75	5.65
5.18	17.0	13.31	5.44	3	3	Clay	CL/CH	stiff	125	1.3	11	1.14		100			0.74	5.31
5.33	17.5	16.20	6.21	3	3	Clay	CL/CH	stiff	125	1.3	13	1.13		100			0.90	7.13
5.48	18.0	19.16	5.98	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.12		100			1.08	9.59
5.65	18.5	15.49	6.80	3	3	Clay	CL/CH	stiff	125	1.3	12	1.11		100			0.86	6.32
5.80	19.0	15.81	6.89	3	3	Clay	CL/CH	stiff	125	1.3	13	1.10		100			0.88	6.32
5.95	19.5	16.32	7.00	3	3	Clay	CL/CH	stiff	125	1.3	13	1.09		100			0.91	6.43
6.10	20.0	17.26	5.95	3	3	Clay	CL/CH	stiff	125	1.3	14	1.08		100			0.96	6.88
6.25	20.5	13.28	5.76	3	3	Clay	CL/CH	stiff	125	1.3	11	1.07		100			0.73	4.37
6.40	21.0	11.14	6.84	3	3	Clay	CL/CH	stiff	125	1.3	9	1.06		100			0.60	3.28
6.55	21.5	12.48	7.40	3	3	Clay	CL/CH	stiff	125	1.3	10	1.06		100			0.68	3.74
6.70	22.0	14.92	7.62	3	3	Clay	CL/CH	stiff	125	1.3	12	1.05		100			0.82	4.89
6.85	22.5	17.77	6.98	3	3	Clay	CL/CH	stiff	125	1.3	14	1.04		100			0.99	6.32
7.00	23.0	21.45	7.34	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.03		100			1.20	8.41
7.18	23.5	24.58	7.84	3	3	Clay	CL/CH	very stiff	125	1.3	20	1.02		100			1.39	>10
7.33	24.0	51.65	3.68	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	1.02		70			2.98	>10
7.48	24.5	34.37	4.91	3	3	Clay	CL/CH	very stiff	125	1.3	27	1.01		95			1.96	>10
7.63	25.0	18.84	5.44	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.00		100			1.05	6.10
7.78	25.5	21.09	6.11	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.99		100			1.18	7.13
7.93	26.0	26.12	5.49	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.99		100			1.47	>10
8.08	26.5	26.28	5.55	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.98		100			1.48	>10
8.23	27.0	21.92	5.06	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.97		100			1.22	7.13
8.38	27.5	23.63	6.15	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.97		100			1.32	8.00
8.53	28.0	20.49	6.07	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.96		100			1.14	6.10
8.68	28.5	19.11	5.87	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.95		100			1.06	5.31
8.85	29.0	18.15	5.24	3	3	Clay	CL/CH	stiff	125	1.3	15	0.95		100			1.00	4.78
9.00	29.5	21.72	6.18	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.94		100			1.21	6.32
9.15	30.0	20.63	6.55	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.93		100			1.14	5.65

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA   Project No: LE04354   Date: 12/20/04

CONE SOUNDING: CPT-3

Est. GWT (ft): 12.0   Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
9.30	30.5	22.90	7.51	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.93		100			1.27	6.54
9.45	31.0	20.57	6.23	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.92		100			1.14	5.42
9.60	31.5	19.55	6.90	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.92		100			1.08	4.89
9.75	32.0	23.76	8.37	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.91		100			1.32	6.54
9.90	32.5	24.30	8.05	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.90		100			1.35	6.65
10.05	33.0	22.78	6.54	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.90		100			1.26	5.88
10.20	33.5	21.56	5.91	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.89		100			1.19	5.31
10.38	34.0	20.82	6.40	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.89		100			1.15	4.89
10.53	34.5	21.17	6.04	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.88		100			1.17	4.89
10.68	35.0	24.71	6.05	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.88		100			1.37	6.21
10.83	35.5	23.14	5.91	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.87		100			1.28	5.53
10.98	36.0	19.96	5.21	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.87		100			1.09	4.28
11.13	36.5	19.03	4.88	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.86		100			1.04	3.91
11.28	37.0	16.19	4.33	3	3	Clay	CL/CH	stiff	125	1.3	13	0.86		100			0.87	3.07
11.43	37.5	16.02	5.36	3	3	Clay	CL/CH	stiff	125	1.3	13	0.85		100			0.86	3.00
11.58	38.0	16.15	5.06	3	3	Clay	CL/CH	stiff	125	1.3	13	0.85		100			0.86	3.00
11.73	38.5	17.81	4.75	3	3	Clay	CL/CH	stiff	125	1.3	14	0.85		100			0.96	3.35
11.88	39.0	21.66	4.41	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	0.84		100			1.19	5.65
12.05	39.5	20.18	3.42	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.84		100			1.10	6.65
12.20	40.0	17.00	2.62	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.83		100			0.91	5.00
12.35	40.5	20.64	4.32	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	0.83		100			1.12	5.00
12.50	41.0	36.57	3.70	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.82		95			2.06	>10
12.65	41.5	31.64	4.64	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	0.82		100			1.77	>10
12.80	42.0	23.58	3.56	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.82		100			1.29	8.14
12.95	42.5	24.97	3.28	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.81		100			1.37	8.85
13.10	43.0	19.07	2.71	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.03	5.42
13.25	43.5	18.86	2.98	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.01	5.31
13.40	44.0	19.54	3.20	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.80		100			1.05	5.53
13.58	44.5	19.29	3.97	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.80		100			1.04	3.91
13.73	45.0	19.79	3.86	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.80		100			1.07	4.00
13.88	45.5	17.66	3.31	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.79		100			0.94	4.47
14.03	46.0	16.42	2.18	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.79		100			0.87	3.91
14.18	46.5	15.61	2.35	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.78		100			0.82	3.58
14.33	47.0	16.68	1.80	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.78	12.3	100	11	29		
14.48	47.5	18.25	1.80	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.78	13.4	100	13	30		
14.63	48.0	19.39	2.43	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.78		100			1.04	4.89
14.78	48.5	19.39	3.87	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.77		100			1.04	3.58
14.93	49.0	19.13	2.69	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.77		100			1.02	4.57
15.10	49.5	16.46	1.59	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.77	11.9	100	10	29		
15.25	50.0	16.91	2.83	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.76		100			0.89	3.74

APPENDIX C

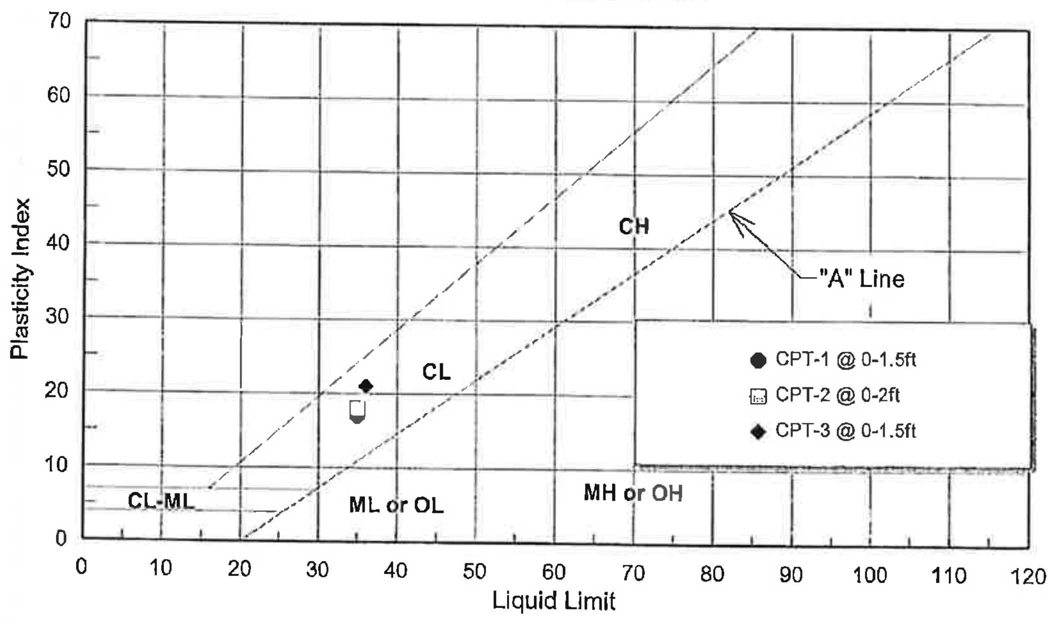
LANDMARK CONSULTANTS, INC.

CLIENT: ORMAT
PROJECT: ORMAT Heber 2 Facilities, Heber, CA
JOB NO: LE04354
DATE: 12/28/04

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classif-ation
CPT-1	0-1.5	35	18	17	CL
CPT-2	0-2	35	17	18	CL
CPT-3	0-1.5	36	15	21	CL

PLASTICITY CHART



LANDMARK Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No: LE04354

Atterberg Limits Test Results

Plate C-1

LANDMARK CONSULTANTS, INC.

CLIENT: ORMAT
PROJECT: ORMAT Heber 2 Facilities, Heber, CA
JOB NO: LE04354
DATE: 12/28/04

CHEMICAL ANALYSES

Boring:	CPT-1	CPT-1	CPT-2	CPT-2	**CalTrans**
Sample Depth, ft:	0-1.5	1.5-3	0-2	2-3	**Method**
pH:	7.9	7.9	7.8	7.9	**643**
Electrical Conductivity (mmhos):	2.5	1.7	1.8	0.9	**424**
Resistivity (ohm-cm):	260	1000	300	1000	**643**
Chloride (Cl), ppm:	3,040	230	1,490	220	**422**
Sulfate (SO4), ppm:	2,812	3,006	1,500	1,106	**417**

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble	0 -1000	Low
	Sulfates	1000 - 2000	Moderate
		2000 - 20,000	Severe
		> 20,000	Very Severe
Normal	Soluble	0 - 200	Low
Grade	Chlorides	200 - 700	Moderate
Steel		700 - 1500	Severe
		> 1500	Very Severe
Normal	Resistivity	1-1000	Very Severe
Grade		1000-2000	Severe
Steel		2000-10,000	Moderate
		10,000+	Low

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No: **LE04354**

Selected Chemical Analyses Results

Plate C-2

LANDMARK CONSULTANTS, INC.

CLIENT: ORMAT
PROJECT: ORMAT Heber 2 Facilities, Heber, CA
JOB NO: LE04354
DATE: 12/28/04

CHEMICAL ANALYSES

Boring:	CPT-3	CPT-3	CalTrans
Sample Depth, ft:	0-1.5	1.5-3	Method
pH:	7.9	7.8	643
Electrical Conductivity (mmhos):	1.5	1.3	424
Resistivity (ohm-cm):	450	1000	643
Chloride (Cl), ppm:	570	210	422
Sulfate (SO4), ppm:	1,785	1,052	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 -1000	Low
		1000 - 2000	Moderate
		2000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1500	Severe
		> 1500	Very Severe
Normal Grade Steel	Resistivity	1-1000	Very Severe
		1000-2000	Severe
		2000-10,000	Moderate
		10,000+	Low

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No: LE04354

Selected Chemical Analyses Results

Plate C-3

APPENDIX D

REFERENCES

Arango I., 1996, Magnitude Scaling Factors for Soil Liquefaction Evaluations: ASCE Geotechnical Journal, Vol. 122, No. 11.

Bartlett, Steven F. and Youd, T. Leslie, 1995, Empirical Prediction of Liquefaction-Induced Lateral Spread: ASCE Geotechnical Journal, Vol. 121, No. 4.

Blake, T. F., 2000, FRISKSP - A computer program for the probabilistic estimation of seismic hazard using faults as earthquake sources.

Boore, D. M., Joyner, W. B., and Fumal, T. E., 1997, Empirical Near-Source Attenuation Relationships for Horizontal and Vertical Components of Peak Ground Acceleration, Peak Ground Velocity, and Pseudo-Absolute Acceleration Response Spectra: Seismological Research Letters, Vol. 68, No. 1, p. 154-179.

Building Seismic Safety Council (BSSC), 1991, NEHRP recommended provisions for the development of seismic regulations of new buildings, Parts 1, 2 and Maps: FEMA 222, January 1992

California Division of Mines and Geology (CDMG), 1996, California Fault Parameters: available at http://www.consrv.ca.gov/dmg/shezp/fltindex.html.

California Division of Mines and Geology (CDMG), 1962, Geologic Map of California – San Diego-El Centro Sheet: California Division of Mines and Geology, Scale 1:250,000.

Ellsworth, W. L., 1990, Earthquake History, 1769-1989 in: The San Andreas Fault System, California: U.S. Geological Survey Professional Paper 1515, 283 p.

International Conference of Building Officials (ICBO), 1997, Uniform Building Code, 1997 Edition.

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.

Jennings, C. W., 1994, Fault activity map of California and Adjacent Areas: California Division of Mines and Geology, DMG Geologic Map No. 6.

Jones, L. and Hauksson, E., 1994, Review of potential earthquake sources in Southern California: Applied Technology Council, Proceedings of ATC 35-1.

Maley, R. P. and Etheredge, E. C., 1981, Strong motion data from the Westmorland, California earthquake of April 26, 1981: U.S. Geological Survey Open File Report 81-1149, 18 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.

Mualchin, L. and Jones, A. L., 1992, Peak acceleration from maximum credible earthquakes in California (Rock and Stiff Soil Sites): California Division of Mines and Geology, DMG Open File Report 92-01.

Naeim, F. and Anderson, J. C., 1993, Classification and evaluation of earthquake records for design: Earthquake Engineering Research Institute, NEHRP Report.

National Research Council, Committee of Earthquake Engineering, 1985, Liquefaction of Soils during Earthquakes: National Academy Press, Washington, D.C.

Porcella, R., Etheredge, E., Maley, R., and Switzer, J., 1987, Strong motion data from the Superstition Hills earthquake of November 24, 1987: U.S. Geological Survey Open File Report 87-672, 56 p.

Robertson, P. K. and Wride, C. E., 1996, Cyclic Liquefaction and its Evaluation based on the SPT and CPT, Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils, NCEER Technical Report 97-0022, p. 41-88.

Seed, Harry B., Idriss, I. M., and Arango I., 1983, Evaluation of liquefaction potential using field performance data: ASCE Geotechnical Journal, Vol. 109, No. 3.

Seed, Harry B., et al, 1985, Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations: ASCE Geotechnical Journal, Vol. 113, No. 8.

Sharp, R. V., 1982, Tectonic setting of the Imperial Valley region: U.S. Geological Survey Professional Paper 1254, p. 5-14.

Sylvester, A. G., 1979, Earthquake damage in Imperial Valley, California May 18, 1940, as reported by T. A. Clark: Bulletin of the Seismological Society of America, v. 69, no. 2, p. 547-568.

Tokimatsu, K. and Seed H. B., 1987, Evaluation of settlements in sands due to earthquake shaking: ASCE Geotechnical Journal, v. 113, no. 8.

U.S. Geological Survey (USGS), 1982, The Imperial Valley California Earthquake of October 15, 1979: Professional Paper 1254, 451 p.

U.S. Geological Survey (USGS), 1990, The San Andreas Fault System, California, Professional Paper 1515.

U.S. Geological Survey (USGS), 1996, National Seismic Hazard Maps: available at http://gldage.cr.usgs.gov

Working Group on California Earthquake Probabilities (WGCEP), 1992, Future seismic hazards in southern California, Phase I Report: California Division of Mines and Geology.

Working Group on California Earthquake Probabilities (WGCEP), 1995, Seismic hazards in southern California, Probable Earthquakes, 1994-2014, Phase II Report: Southern California Earthquake Center.

Youd, T. Leslie and Garris, C. T., 1995, Liquefaction induced ground surface disruption: ASCE Geotechnical Journal, Vol. 121, No. 11.

Youd, T. L. et. al., 2001, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils: Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, p. 817-833.

Zimmerman, R. P., 1981, Soil survey of Imperial County, California, Imperial Valley Area: U.S. Dept. of Agriculture Soil Conservation Service, 112 p.

APPENDIX E

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

May 9, 2007

Mr. Yuri Gal
ORMAT Nevada, Inc.
947 Dogwood Road
Heber, CA 92249

Geotechnical Investigation
Proposed Heber South Geothermal Plant
Dogwood Road
Heber, California
LCI Project No. L07178

Dear Mr. Gal:

Landmark Consultants, Inc. is pleased to present this geotechnical report update for design and construction of the Heber South Geothermal Plant facility located on Dogwood Road south of Heber, California. The project site is located in the southwest corner of the existing Heber geothermal plant site. The proposed plant will consist of one OEC unit, one cooling tower, and various ancillary structures including pumps, filters, and shelter.

This update report presents selected elements of our findings and recommendations only. For the proper application of our findings and recommendations, reading of the full geotechnical report (LCI Report No. LE04354, dated January 5, 2005) is required, and are best evaluated with the active participation of the engineer of record who developed them.

The scope of work consisted of conducting two (2) electronic CPT soundings within the OEC and cooling tower footprints and review of the existing geotechnical report for the Heber 2 plant expansion (Landmark, 2005) to determine suitability of the prior geotechnical report for use with the design and construction of the proposed Heber South plant.

Small structures are planned for electrical control panels, consisting of masonry or panelized concrete construction. Expected footing loads are estimated at 1 to 2 kips per lineal foot for the small structures. Expected plant components, cooling tower and turbine/generator columns loads range from 5 to 400 kips. If structural loads exceed those stated above, we should be notified so we may evaluate their impact on foundation settlement and bearing capacity. Site development will include foundation support pad preparation and underground utility installation.

Subsurface Exploration

Subsurface exploration was performed on May 2, 2007 using Holguin, Fahan, & Associates, Inc. of Cypress, California to advance three (3) electric cone penetrometer (CPT) soundings to an approximate depth of 50 feet below existing ground surface. The soundings were made at the locations shown on the Site and Exploration Plan (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernable site features.

Interpretive logs of the CPT soundings were produced and presented in final form after review of field and laboratory data and are presented on Plates B-1 and B-2 in Appendix B. A key to the interpretation of CPT soundings is presented on Plate B-3. 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.

Subsurface soils encountered during the field exploration conducted on May 2, 2007 consist of medium dense to dense silty sands extend to a depth of 4 to 5 feet below ground surface. Stiff to very stiff clays extend from 4 feet to a depth of 50 feet, the maximum depth of exploration. The subsurface logs (Plates B-1 and B-2) depict the stratigraphic relationships of the various soil types.

Groundwater Elevation

Groundwater was not noted in the CPT soundings at the time of exploration, but is typically encountered at approximately 10 to 15 feet below ground surface in the vicinity of the site. 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, drainage, and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition.

Seismic Parameters

The project site is located in the seismically active Imperial Valley in Southern California, and is considered likely to be subjected to moderate to strong ground shaking from earthquakes in the region. The project site lies approximately 11.3 km southwest of the Imperial Fault. Strong ground shaking can be expected for magnitudes of 6.0 to 7.2 events on the Imperial Fault with a recurrence interval for 6.0 magnitude events at about 29 years. We have used the computer program FRISKSP (Blake, 2000) to provide a probabilistic estimate of the site Peak Ground Acceleration (PGA) using the attenuation relationship of Boore, Joyner, and Fumal (1997) NEHRP D (250). The PGA estimate for the project site having a 10% probability of being exceeded in 50 years (return period of 475 years) is **0.60g**.

CBC Seismic Coefficients: The California Building Code (CBC) seismic response coefficients are calculated from the near-source factors for Seismic Zone 4. The near-source factors are based on the distance from the fault and the seismic source type. The following table lists seismic and site coefficients (near source factors) determined by Chapter 16 of the 2001 CBC. ***This site lies within 11.3 km of a Type A fault overlying S_D (stiff) soil.***

CBC Seismic Coefficients for Chapter 16 Seismic Provisions

CBC Code Edition	Soil Profile Type	Seismic Source Type	Distance to Critical Source	Near Source Factors		Seismic Coefficients	
				Na	Nv	Ca	Cv
2001	S_D (stiff soil)	A	< 11.3 km	1.00	1.15	0.44	0.74
Ref. Table	16-J	16-U	---	16-S	16-T	16-Q	16-R

Liquefaction Potential

Evaluation of liquefaction potential at the site indicates that it is unlikely that the subsurface soil will liquefy under seismically induced groundshaking due to the predominance of cohesive clay (non-liquefiable) subsurface soil below the groundwater depth. No mitigation is required for liquefaction effects at this site.

Lateral Earth Pressures

Earth retaining structures, such as retaining walls, should be designed to resist the soil pressure imposed by the retained soil mass. Walls with granular drained backfill may be designed for an assumed static earth pressure equivalent to that exerted by a fluid weighing 55 pcf for unrestrained (active) conditions (able to rotate 0.1% of wall height), and 70 pcf for restrained (at-rest) conditions.

Surcharge loads should be considered if loads are applied within a zone between the face of the wall and a plane projected behind the wall 45 degrees upward from the base of the wall. The increase in lateral earth pressure acting uniformly against the back of the wall should be taken as 50% of the surcharge load within this zone. Areas of the retaining wall subjected to traffic loads should be designed for a uniform surcharge load equivalent to two feet of native soil.

Walls should be provided with backdrains to reduce the potential for the buildup of hydrostatic pressure. The drainage system should consist of a composite HDPE drainage panel or a 2-foot wide zone of free draining crushed rock placed adjacent to the wall and extending 2/3 the height of the wall. The gravel should be completely enclosed in an approved filter fabric to separate the gravel and backfill soil. A perforated pipe should be placed perforations down at the base of the permeable material at least six inches below finished floor elevations. The pipe should be sloped to drain to an appropriate outlet that is protected against erosion. Walls should be properly waterproofed. The project geotechnical engineer should approve any alternative drain system.

Structure Support Pads/Foundation

The subsurface exploration conducted in May 2007 identified engineering properties of the soil nearly identical to the Landmark, 2005 geotechnical report. The findings and recommendations within the 2005 geotechnical report may be used for the Heber South project. A copy of the Landmark 2005 geotechnical report is provide in Appendix C.

Closure

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.

PROFESSIONAL GEOLOGIST
STEVEN K. WILLIAMS
CERTIFIED ENGINEERING GEOLOGIST
CEG 2261
STATE OF CALIFORNIA

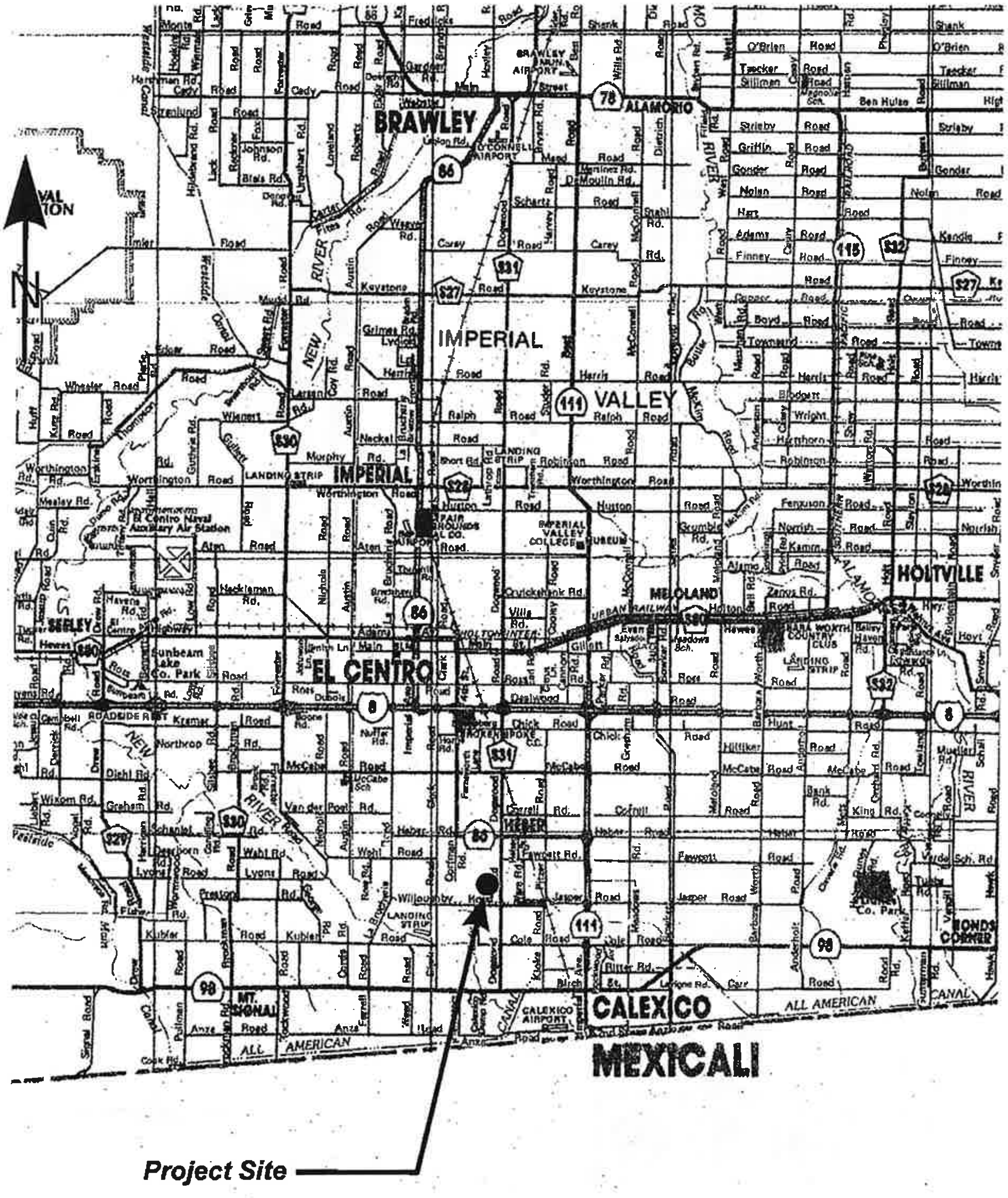
Steven K. Williams, CEG
Senior Engineering Geologist

Julian R. Avalos, EIT
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
JEFFREY O. LYON
No. 31921
EXPIRES 12-31-08
CIVIL
STATE OF CALIFORNIA

Jeffrey O. Lyon, PE
President

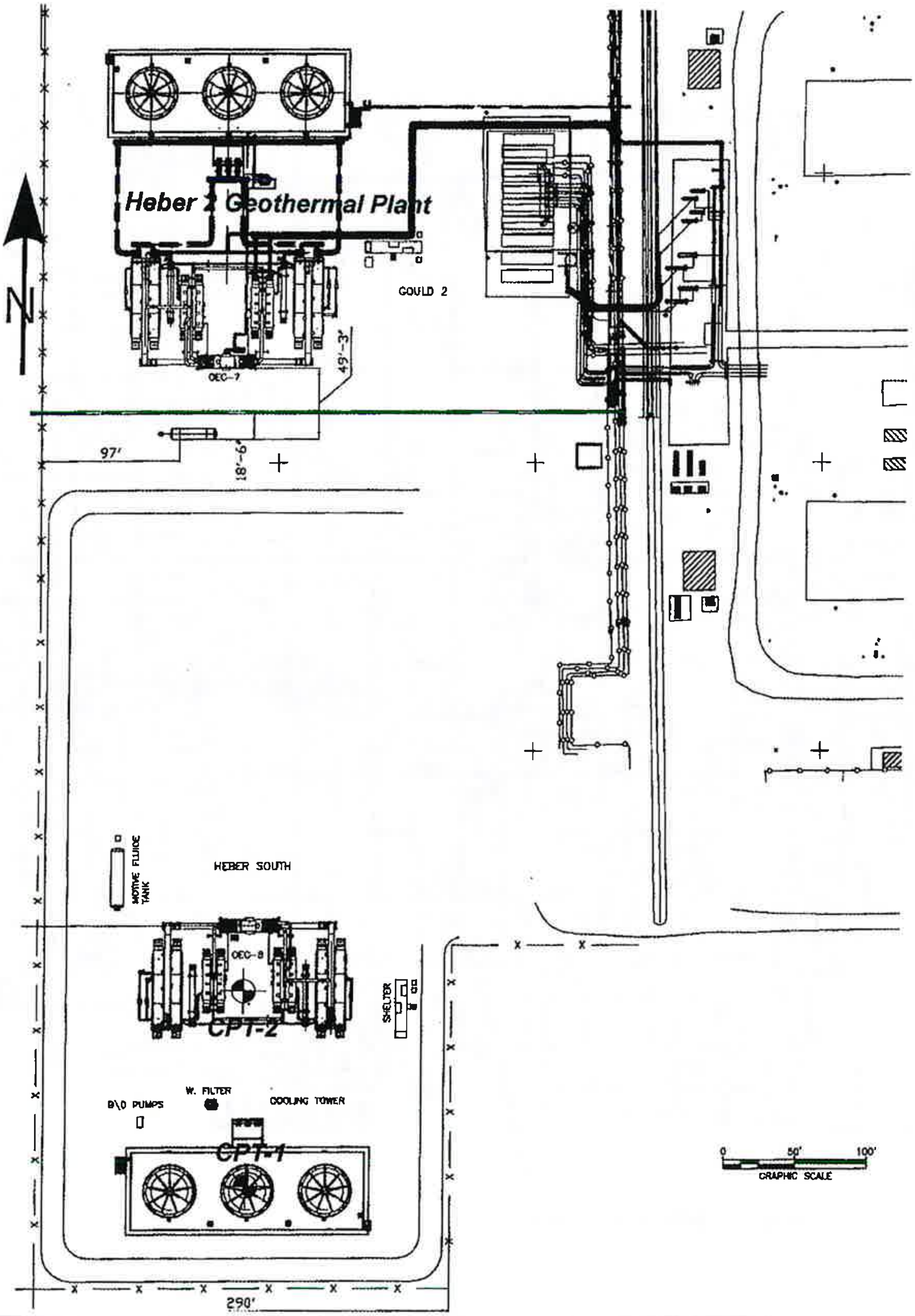
APPENDIX A



LANDMARK
Geo-Engineers and Geologists
Project No.: LE07178

Vicinity Map

Plate
A-1



LANDMARK
Geo-Engineers and Geologists
Project No.: LE07178

Site and Exploration Map

Plate
A-2

APPENDIX B

CLIENT: Ormat Nevada
PROJECT: Heber South Geothermal Plant -- Heber, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight
DATE: 05/02/07

LOG OF CONE SOUNDING DATA CPT-1

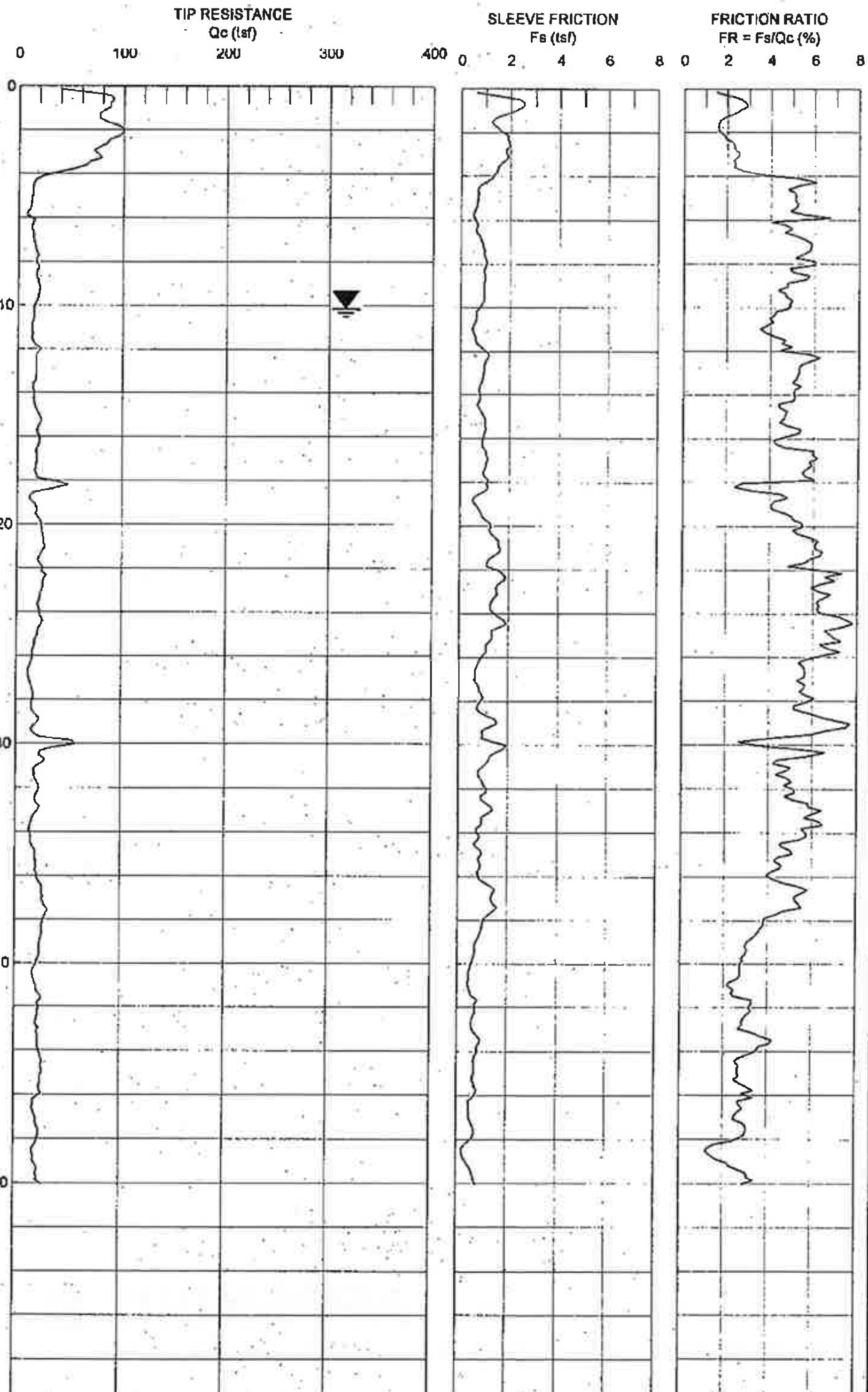
DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Silty Sand to Sandy Silt	" "	very dense
Sandy Silt to Clayey Silt	ML	dense
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	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
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	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
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	very stiff

-10- -20- -30- -40- -50-



End of Sounding @ 50.0 ft.
Anticipated groundwater @ 10.0 ft.

Project No: LE07178

LANDMARK
Geo-Engineers and Geologists

Plate B-1

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber South Plant – Heber, CA Project No: LE07178 Date: 05/02/07

CONE SOUNDING: CPT-1

Est. GWT (ft): 10.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
0.15	0.5	66.25	2.04 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	15	2.00	125.2	35	122	45		
0.30	1.0	88.18	2.75 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	25	2.00	166.7	35	114	44		
0.45	1.5	77.73	1.95 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	17	2.00	146.9	30	103	42		
0.60	2.0	92.53	1.60 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	21	2.00	174.9	25	103	42		
0.75	2.5	93.95	2.02 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	21	2.00	177.6	25	100	42		
0.93	3.0	77.68	2.40 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	17	2.00	146.8	35	91	41		
1.08	3.5	74.47	2.39 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	21	2.00	140.8	35	88	40		
1.23	4.0	52.73	2.83 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	15	2.00	99.7	45	75	39		
1.38	4.5	18.49	5.55 3	3	Clay	CL/CH	very stiff	125	1.3	15	2.00		90			1.07	>10
1.53	5.0	13.75	5.02 3	3	Clay	CL/CH	stiff	125	1.3	11	1.95		100			0.79	>10
1.68	5.5	12.39	5.11 3	3	Clay	CL/CH	stiff	125	1.3	10	1.85		100			0.71	>10
1.83	6.0	10.98	5.45 3	3	Clay	CL/CH	stiff	125	1.3	9	1.77		100			0.63	>10
1.98	6.5	13.51	4.77 3	3	Clay	CL/CH	stiff	125	1.3	11	1.69		95			0.77	>10
2.13	7.0	14.72	5.56 3	3	Clay	CL/CH	stiff	125	1.3	12	1.62		100			0.84	>10
2.28	7.5	16.58	5.71 3	3	Clay	CL/CH	stiff	125	1.3	13	1.56		95			0.95	>10
2.45	8.0	17.99	5.72 3	3	Clay	CL/CH	very stiff	125	1.3	14	1.51		95			1.03	>10
2.60	8.5	18.67	5.21 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.46		90			1.07	>10
2.75	9.0	19.02	5.07 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.42		90			1.09	>10
2.90	9.5	20.56	4.59 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.38		85			1.18	>10
3.05	10.0	17.46	4.91 3	3	Clay	CL/CH	stiff	125	1.3	14	1.34		95			0.99	>10
3.20	10.5	15.45	4.14 3	3	Clay	CL/CH	stiff	125	1.3	12	1.32		95			0.87	>10
3.35	11.0	13.93	3.83 4	4	Silty Clay to Clay	CL	stiff	125	1.8	8	1.31		100			0.78	>10
3.50	11.5	13.83	4.23 3	3	Clay	CL/CH	stiff	125	1.3	11	1.29		100			0.78	8.56
3.65	12.0	18.01	4.65 3	3	Clay	CL/CH	very stiff	125	1.3	14	1.27		95			1.02	>10
3.80	12.5	18.70	5.93 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.26		100			1.06	>10
3.95	13.0	18.01	5.35 3	3	Clay	CL/CH	very stiff	125	1.3	14	1.24		100			1.02	>10
4.13	13.5	17.39	5.15 3	3	Clay	CL/CH	stiff	125	1.3	14	1.23		100			0.98	>10
4.28	14.0	14.93	5.20 3	3	Clay	CL/CH	stiff	125	1.3	12	1.22		100			0.84	8.00
4.43	14.5	15.49	4.86 3	3	Clay	CL/CH	stiff	125	1.3	12	1.20		100			0.87	8.27
4.58	15.0	18.22	4.65 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.19		100			1.03	>10
4.73	15.5	22.11	4.64 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.18		95			1.26	>10
4.88	16.0	19.85	4.92 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.17		100			1.12	>10
5.03	16.5	19.77	4.96 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.16		100			1.12	>10
5.18	17.0	18.38	5.96 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.14		100			1.03	9.39
5.33	17.5	17.64	5.69 3	3	Clay	CL/CH	stiff	125	1.3	14	1.13		100			0.99	8.41
5.48	18.0	25.50	4.80 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.12		95			1.45	>10
5.65	18.5	32.47	3.36 5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	13	1.11		75			1.86	>10
5.80	19.0	13.48	4.36 3	3	Clay	CL/CH	stiff	125	1.3	11	1.10		100			0.74	4.89
5.95	19.5	18.41	4.55 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.09		100			1.03	8.00
6.10	20.0	22.07	5.36 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.08		100			1.25	>10
6.25	20.5	24.57	5.40 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.07		100			1.39	>10
6.40	21.0	26.18	6.13 3	3	Clay	CL/CH	very stiff	125	1.3	21	1.07		100			1.49	>10
6.55	21.5	23.24	6.19 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.06		100			1.31	>10
6.70	22.0	22.66	5.55 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.05		100			1.28	>10
6.85	22.5	26.25	6.97 3	3	Clay	CL/CH	very stiff	125	1.3	21	1.04		100			1.49	>10
7.00	23.0	25.11	6.17 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.03		100			1.42	>10
7.18	23.5	22.18	6.48 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.02		100			1.25	8.70
7.33	24.0	21.09	6.24 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.02		100			1.18	7.85
7.48	24.5	23.54	7.51 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.01		100			1.32	9.39
7.63	25.0	21.31	6.90 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.00		100			1.19	7.56
7.78	25.5	18.21	6.87 3	3	Clay	CL/CH	very stiff	125	1.3	15	0.99		100			1.01	5.65
7.93	26.0	15.91	6.78 3	3	Clay	CL/CH	stiff	125	1.3	13	0.99		100			0.87	4.37
8.08	26.5	13.54	5.59 3	3	Clay	CL/CH	stiff	125	1.3	11	0.98		100			0.73	3.43
8.23	27.0	11.78	5.53 3	3	Clay	CL/CH	stiff	125	1.3	9	0.97		100			0.63	2.73
8.38	27.5	14.49	5.56 3	3	Clay	CL/CH	stiff	125	1.3	12	0.97		100			0.79	3.58
8.53	28.0	16.02	5.84 3	3	Clay	CL/CH	stiff	125	1.3	13	0.96		100			0.87	4.09
8.68	28.5	15.04	5.37 3	3	Clay	CL/CH	stiff	125	1.3	12	0.95		100			0.82	3.66
8.85	29.0	20.59	6.98 3	3	Clay	CL/CH	very stiff	125	1.3	16	0.95		100			1.14	5.88
9.00	29.5	16.05	6.66 3	3	Clay	CL/CH	stiff	125	1.3	13	0.94		100			0.87	3.83
9.15	30.0	44.48	3.37 5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	18	0.93		80			2.54	>10
9.30	30.5	27.03	5.86 3	3	Clay	CL/CH	very stiff	125	1.3	22	0.93		100			1.52	8.85

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber South Plant – Heber, CA Project No: LE07178 Date: 05/02/07

CONE SOUNDING: CPT-1

Est. GWT (ft): 10.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17.0 Su (tsf)	OCR
9.45	31.0	24.88	4.56	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.92		100			1.39	7.41
9.60	31.5	17.65	4.68	3	3	Clay	CL/CH	stiff	125	1.3	14	0.92		100			0.98	4.18
9.75	32.0	21.43	4.98	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.91		100			1.19	5.53
9.90	32.5	19.94	5.01	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.91		100			1.10	4.78
10.05	33.0	21.67	6.03	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.90		100			1.20	5.42
10.20	33.5	17.09	5.96	3	3	Clay	CL/CH	stiff	125	1.3	14	0.89		100			0.93	3.66
10.38	34.0	13.75	5.92	3	3	Clay	CL/CH	stiff	125	1.3	11	0.89		100			0.73	2.65
10.53	34.5	14.75	5.27	3	3	Clay	CL/CH	stiff	125	1.3	12	0.88		100			0.79	2.91
10.68	35.0	17.80	4.91	3	3	Clay	CL/CH	stiff	125	1.3	14	0.88		100			0.97	3.66
10.83	35.5	19.50	4.45	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.87		100			1.07	4.18
10.98	36.0	20.06	4.23	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.87		100			1.10	5.53
11.13	36.5	23.73	5.01	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.86		100			1.31	5.53
11.28	37.0	26.37	5.33	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.86		100			1.47	6.43
11.43	37.5	29.22	5.23	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.85		100			1.63	7.56
11.58	38.0	28.26	4.00	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	16	0.85		100			1.58	9.39
11.73	38.5	26.29	3.66	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.85		100			1.46	>10
11.88	39.0	24.98	3.19	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.84		100			1.38	>10
12.05	39.5	23.62	3.00	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.84		100			1.30	9.00
12.20	40.0	21.78	2.80	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.83		100			1.19	7.56
12.35	40.5	17.57	2.75	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.83		100			0.94	5.21
12.50	41.0	19.10	2.36	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.83		100			1.03	5.88
12.65	41.5	22.54	2.42	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.82		100			1.23	7.70
12.80	42.0	23.41	3.23	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.82		100			1.28	8.14
12.95	42.5	22.05	3.08	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.81		100			1.20	7.13
13.10	43.0	21.46	2.78	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.81		100			1.17	6.65
13.25	43.5	22.21	3.76	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	13	0.81		100			1.21	5.10
13.40	44.0	22.69	3.76	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	13	0.80		100			1.24	5.21
13.58	44.5	25.69	2.61	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.80		100			1.41	8.65
13.73	45.0	26.50	2.66	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.80		100			1.46	9.19
13.88	45.5	25.22	2.66	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.79		100			1.38	8.27
14.03	46.0	24.83	3.10	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.79		100			1.36	7.85
14.18	46.5	18.88	2.93	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.79		100			1.01	4.89
14.33	47.0	19.43	2.64	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.78		100			1.04	5.00
14.48	47.5	22.40	3.03	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.78		100			1.22	6.32
14.63	48.0	23.12	2.75	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.78		100			1.26	6.54
14.78	48.5	18.94	1.38	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.77	13.8	100	14	30		
14.93	49.0	18.77	1.78	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.77	13.7	100	14	30		
15.09	49.5	21.59	2.73	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.77		100			1.16	5.65
15.25	50.0	23.82	3.12	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.76		100			1.29	6.54

CLIENT: Ormat Nevada
PROJECT: Heber South Plant -- Heber, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight
DATE: 05/02/07

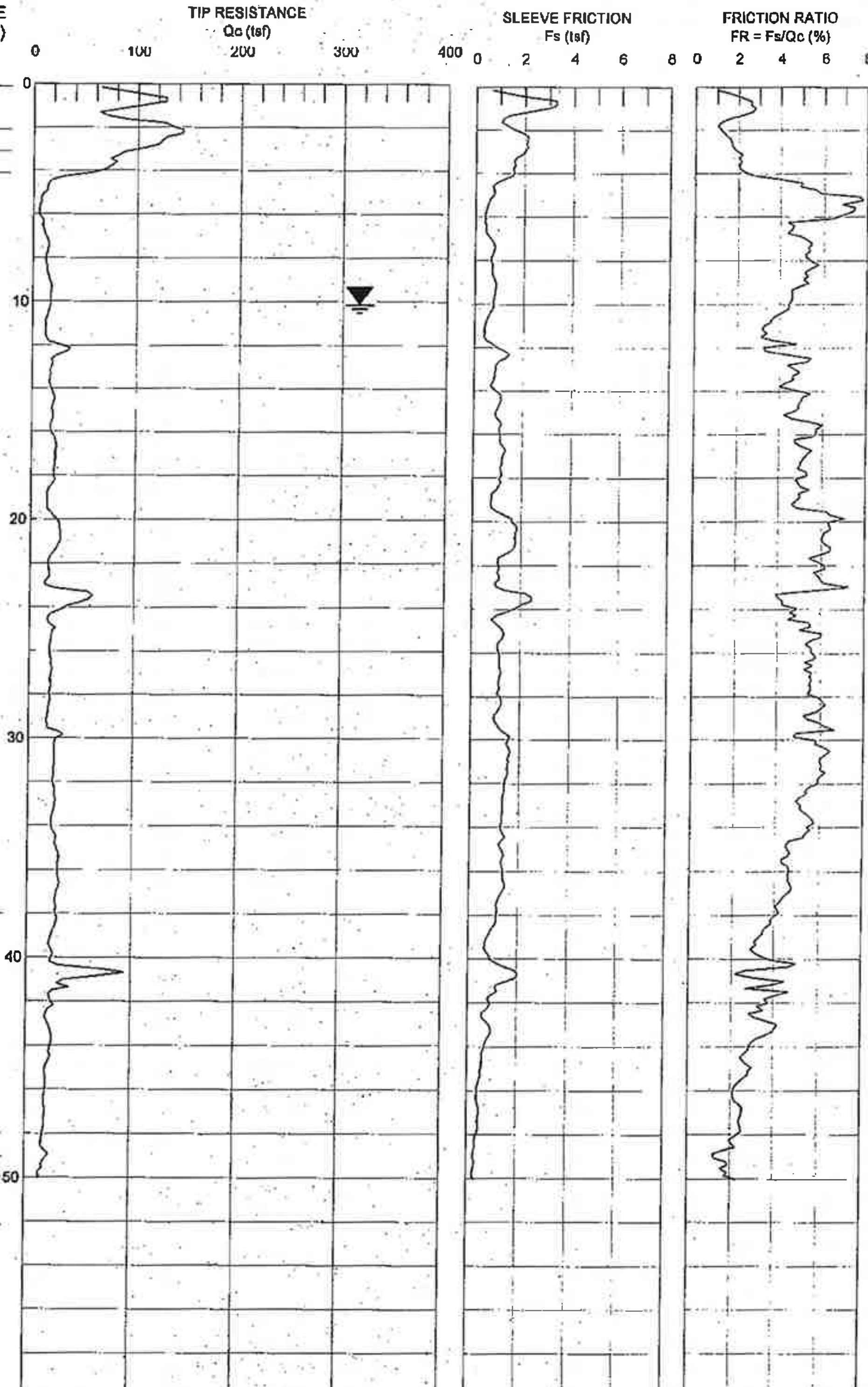
LOG OF CONE SOUNDING DATA CPT-2

DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Sand to Silty Sand	SP/SM	very dense
Silty Sand to Sandy Silt	SM/ML	dense
Clay	CL/CH	very stiff
Clay	" "	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Silty Clay to Clay	" "	very stiff
Clay	CL/CH	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Silty Clay to Clay	CL	hard
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
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
Clayey Silt to Silty Clay	" "	hard
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
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	stiff



End of Sounding @ 50.0 ft.
Anticipated groundwater @ 10.0 ft.

Project No: LE07178

LANDMARK
Geo-Engineers and Geologists

Plate B-2

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber South Plant – Heber, CA   Project No: LE07178   Date: 05/02/07

CONE SOUNDING: CPT-2

Est. GWT (ft): 10.0   Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
0.15	0.5	85.14	1.61	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	19	2.00	161.0	25	130	46		
0.30	1.0	120.36	2.66	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	27	2.00	227.5	30	124	45		
0.45	1.5	72.28	2.13	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	16	2.00	136.6	30	101	42		
0.60	2.0	116.67	1.12	8	8	Sand to Silty Sand	SP/SM	very dense	115	5.5	21	2.00	220.6	15	110	43		
0.75	2.5	138.05	1.48	8	8	Sand to Silty Sand	SP/SM	very dense	115	5.5	25	2.00	261.0	15	111	44		
0.93	3.0	117.13	1.76	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	26	2.00	221.4	20	104	42		
1.08	3.5	81.23	2.12	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	18	2.00	153.5	30	90	41		
1.23	4.0	74.63	2.12	7	7	Silty Sand to Sandy Silt	SM/ML	dense	115	4.5	17	2.00	141.1	30	86	40		
1.38	4.5	34.90	3.90	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	14	2.00		60			2.04	>10
1.53	5.0	13.76	5.45	3	3	Clay	CL/CH	stiff	125	1.3	11	1.96		100			0.79	>10
1.68	5.5	7.57	7.44	3	3	Clay	CL/CH	firm	125	1.3	6	1.86		100			0.43	>10
1.83	6.0	5.99	6.88	3	3	Clay	CL/CH	firm	125	1.3	5	1.77		100			0.33	6.10
1.98	6.5	9.47	4.51	3	3	Clay	CL/CH	stiff	125	1.3	8	1.69		100			0.54	>10
2.13	7.0	11.69	4.84	3	3	Clay	CL/CH	stiff	125	1.3	9	1.63		100			0.66	>10
2.28	7.5	14.81	5.37	3	3	Clay	CL/CH	stiff	125	1.3	12	1.57		95			0.85	>10
2.45	8.0	13.05	5.28	3	3	Clay	CL/CH	stiff	125	1.3	10	1.51		100			0.74	>10
2.60	8.5	13.41	5.40	3	3	Clay	CL/CH	stiff	125	1.3	11	1.46		100			0.76	>10
2.75	9.0	15.40	5.21	3	3	Clay	CL/CH	stiff	125	1.3	12	1.42		100			0.88	>10
2.90	9.5	18.24	4.66	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.38		90			1.04	>10
3.05	10.0	17.49	4.50	3	3	Clay	CL/CH	stiff	125	1.3	14	1.34		95			0.99	>10
3.20	10.5	16.07	4.15	3	3	Clay	CL/CH	stiff	125	1.3	13	1.32		95			0.91	>10
3.35	11.0	13.34	3.48	4	4	Silty Clay to Clay	CL	stiff	125	1.8	8	1.31		95			0.75	>10
3.50	11.5	12.52	3.24	4	4	Silty Clay to Clay	CL	stiff	125	1.8	7	1.29		100			0.70	9.79
3.65	12.0	18.93	3.91	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.28		90			1.08	>10
3.80	12.5	31.15	4.38	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	1.26		75			1.79	>10
3.95	13.0	19.46	4.78	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.25		95			1.10	>10
4.13	13.5	17.74	4.74	3	3	Clay	CL/CH	very stiff	125	1.3	14	1.23		100			1.00	>10
4.28	14.0	17.58	4.34	3	3	Clay	CL/CH	stiff	125	1.3	14	1.22		100			0.99	>10
4.43	14.5	21.21	5.18	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.20		100			1.20	>10
4.58	15.0	20.43	4.83	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.19		100			1.16	>10
4.73	15.5	20.79	4.75	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.18		100			1.18	>10
4.88	16.0	18.89	5.75	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.17		100			1.07	>10
5.03	16.5	23.41	4.88	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.16		95			1.33	>10
5.18	17.0	23.59	5.34	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.14		100			1.34	>10
5.33	17.5	23.27	4.98	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.13		100			1.32	>10
5.48	18.0	22.19	5.13	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.12		100			1.26	>10
5.65	18.5	20.81	5.10	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.11		100			1.17	>10
5.80	19.0	15.78	4.92	3	3	Clay	CL/CH	stiff	125	1.3	13	1.10		100			0.88	6.32
5.95	19.5	16.06	5.23	3	3	Clay	CL/CH	stiff	125	1.3	13	1.09		100			0.89	6.32
6.10	20.0	22.81	6.58	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.08		100			1.29	>10
6.25	20.5	28.53	6.30	3	3	Clay	CL/CH	very stiff	125	1.3	23	1.07		100			1.62	>10
6.40	21.0	28.99	6.06	3	3	Clay	CL/CH	very stiff	125	1.3	23	1.07		100			1.65	>10
6.55	21.5	24.82	6.28	3	3	Clay	CL/CH	very stiff	125	1.3	20	1.06		100			1.40	>10
6.70	22.0	18.48	5.79	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.05		100			1.03	6.88
6.85	22.5	18.41	5.89	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.04		100			1.03	6.65
7.00	23.0	15.96	6.46	3	3	Clay	CL/CH	stiff	125	1.3	13	1.03		100			0.88	5.10
7.18	23.5	46.63	4.62	4	4	Silty Clay to Clay	CL	hard	125	1.8	27	1.02		80			2.68	>10
7.33	24.0	47.09	4.48	4	4	Silty Clay to Clay	CL	hard	125	1.8	27	1.02		80			2.71	>10
7.48	24.5	23.27	4.67	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.01		100			1.31	9.00
7.63	25.0	21.09	5.34	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.00		100			1.18	7.41
7.78	25.5	21.71	5.85	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.99		100			1.21	7.56
7.93	26.0	19.90	5.47	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.99		100			1.11	6.32
8.08	26.5	20.78	5.59	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.98		100			1.16	6.65
8.23	27.0	21.98	5.44	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.97		100			1.23	7.13
8.38	27.5	20.73	5.53	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.97		100			1.15	6.32
8.53	28.0	20.36	5.62	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.96		100			1.13	6.00
8.68	28.5	19.99	6.11	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.95		100			1.11	5.76
8.85	29.0	18.33	5.49	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.95		100			1.01	4.89
9.00	29.5	17.78	6.27	3	3	Clay	CL/CH	stiff	125	1.3	14	0.94		100			0.98	4.47
9.15	30.0	29.76	5.16	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.93		100			1.68	>10
9.30	30.5	25.36	6.14	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.93		100			1.42	7.85

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Heber South Plant – Heber, CA Project No: LE07178 Date: 05/02/07

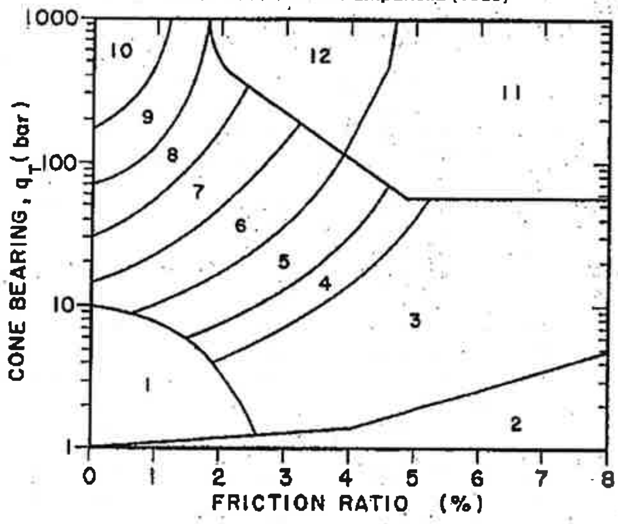
CONE SOUNDING: CPT-2

Est. GWT (ft): 10.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
9.45	31.0	25.65	6.08	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.92		100			1.44	7.85
9.60	31.5	24.99	6.11	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.92		100			1.40	7.27
9.75	32.0	24.42	5.93	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.91		100			1.36	6.88
9.90	32.5	25.69	5.42	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.90		100			1.43	7.27
10.05	33.0	26.43	5.06	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.90		100			1.48	7.56
10.20	33.5	24.95	5.31	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.89		100			1.39	6.65
10.38	34.0	22.88	5.62	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.89		100			1.27	5.65
10.53	34.5	25.51	5.40	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.88		100			1.42	6.65
10.68	35.0	27.31	4.56	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	16	0.88		100			1.53	>10
10.83	35.5	30.04	4.55	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.87		100			1.69	>10
10.98	36.0	29.52	4.52	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.87		100			1.65	>10
11.13	36.5	30.25	4.64	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.86		100			1.70	>10
11.28	37.0	29.39	4.68	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	17	0.86		100			1.64	>10
11.43	37.5	27.60	4.22	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	16	0.85		100			1.54	9.00
11.58	38.0	27.92	4.11	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	16	0.85		100			1.56	9.00
11.73	38.5	28.57	3.77	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	11	0.85		100			1.59	>10
11.88	39.0	24.62	3.37	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.84		100			1.36	>10
12.05	39.5	22.28	3.04	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.84		100			1.22	8.00
12.20	40.0	24.64	3.45	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.83		100			1.36	9.59
12.35	40.5	41.78	4.14	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	17	0.83		95			2.37	>10
12.50	41.0	64.96	3.22	6	6	Sandy Silt to Clayey Silt	ML	medium dense	115	3.5	19	0.83	50.7	70	52	35		
12.65	41.5	32.37	3.75	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	13	0.82		100			1.81	>10
12.80	42.0	22.75	3.82	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	13	0.82		100			1.25	5.53
12.95	42.5	22.78	3.20	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.81		100			1.25	7.56
13.10	43.0	19.79	3.62	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.81		100			1.07	4.28
13.25	43.5	23.86	3.91	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	0.81		100			1.31	5.76
13.40	44.0	24.93	3.00	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.80		100			1.37	8.41
13.58	44.5	23.46	2.65	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.80		100			1.28	7.41
13.73	45.0	21.13	2.78	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.80		100			1.14	6.10
13.88	45.5	19.10	2.73	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.79		100			1.02	5.10
14.03	46.0	19.63	2.23	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.79		100			1.06	5.31
14.18	46.5	18.74	2.12	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	7	0.79		100			1.00	4.78
14.33	47.0	18.93	2.49	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.78		100			1.01	4.78
14.48	47.5	18.85	2.42	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.78		100			1.01	4.68
14.63	48.0	17.53	2.38	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.93	4.09
14.78	48.5	16.01	2.08	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.77		100			0.84	3.58
14.93	49.0	20.91	1.36	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.77	15.2	100	17	30		
15.09	49.5	17.29	1.76	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.77	12.5	100	11	30		
15.25	50.0	13.85	1.98	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.76		100			0.71	2.82

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:

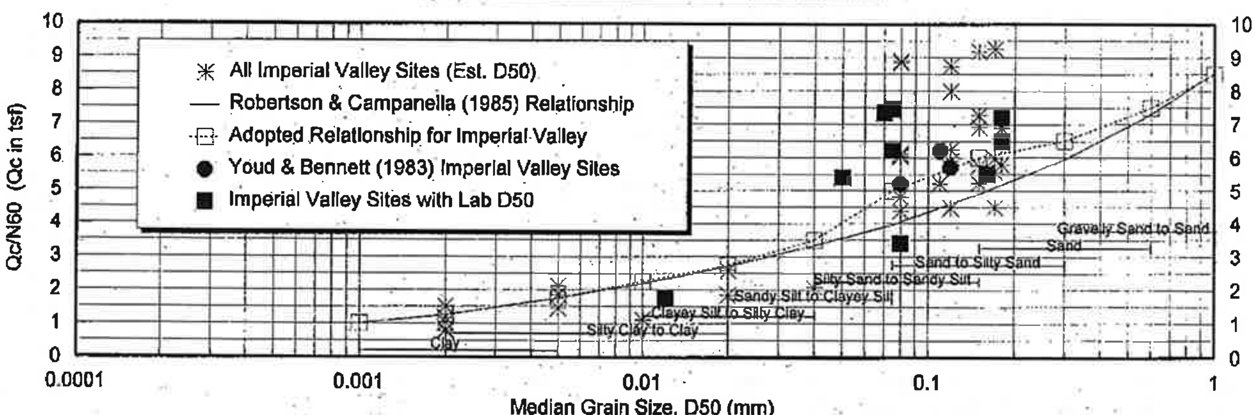
1. Roberton & Campanella (1983) chart: Phi = 5.3 + 24*(log(Qc/p'o))+3(log(Qc/p'o))^2
2. Peck, Hansen & Thornburn (1974) N-Phi Correlation
3. Schmertman (1978) chart [Phi = 28+0.14*Dr for fine uniform sands]

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	0.020
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	0.010
5	Clayey Silt to Silty Clay	ML/CL	120	2	2.75	5-25	90-100	0.020
6	Sandy Silt to Clayey Silt	ML	115	2.5	3.5	NP-10	65-100	0.040
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	5-35	0.150
9	Sand	SP	110	5	6.5	NP	0-5	0.300
10	Gravelly Sand to Sand	SW	115	6	7.5	NP	0-5	0.600
11	Overconsolidated Soil	--	120	1	1	NP	90-100	0.010
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: LE07178

Key to CPT Interpretation of Logs

Plate B-3

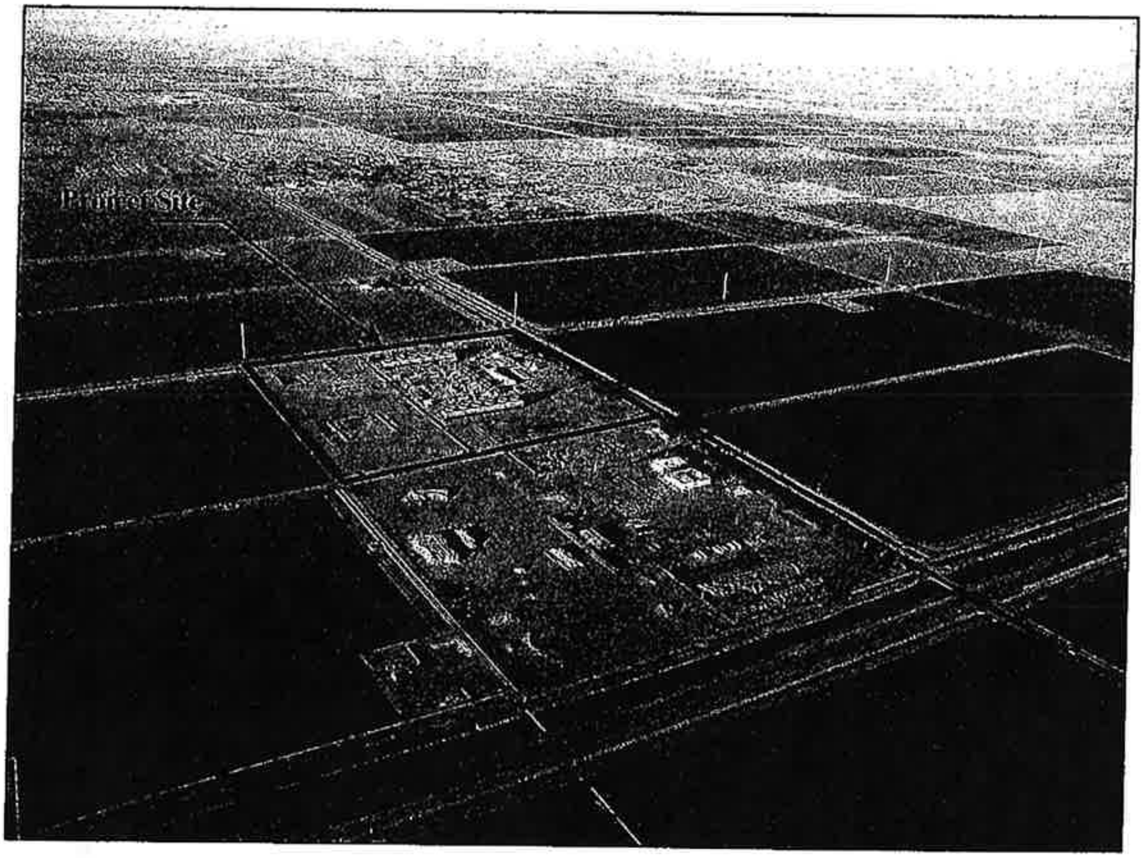
APPENDIX C

Geotechnical Report

New Turbine Generator and Cooling Tower
Heber 2 Geothermal Plant
Heber, CA

Prepared for:

ORMAT
947 Dogwood Road
Heber, CA 92249



LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Prepared by:

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243
(760) 370-3000

January 2005

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

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

January 10, 2005

Mr. Mike Collins
ORMAT
947 Dogwood Road
Heber, CA 92249

Geotechnical Investigation
New Turbine Generator and Cooling Tower
Heber 2 Geothermal Plant
Dogwood Road
Heber, California
LCI Report No. LE04354 (2)

Dear Mr. Collins:

This geotechnical report is provided for design and construction of the new turbine generator and cooling tower additions to the Ormat Heber 2 geothermal power plant located on Dogwood Road southwest of Heber, California. Our geotechnical investigation was conducted in response to your request for our services. The enclosed report describes our soil engineering investigation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

This executive summary presents ***selected*** elements of our findings and recommendations only. It ***does not*** present crucial details needed for the proper application of our findings and recommendations. Our findings, recommendations, and application options are related ***only 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 indicate that the site is predominantly underlain by clays of moderate expansion.

The soil are highly corrosive to metals and contain sufficient sulfates and chlorides to require special concrete mixes (4,500 psi with a 0.45 maximum water cement ratio) and protection of embedded steel building components when concrete is placed in contact with native soil. If the native soils are replaced with imported granular soils with low sulfate and chloride content, no special concrete mixes are required.

Evaluation of liquefaction potential at the site indicates that it is unlikely that the subsurface soil will liquefy under seismically induced groundshaking due to the nature of the soil (clays soils predominate). No mitigation is required for liquefaction effects at this site.

Foundation settlements are indicated on figures 2 thru 5. Differential settlement is estimated to be about of two-thirds of total settlement.

We did not encounter soil conditions that would preclude development of the site for its intended use provided the recommendations contained in this report are implemented in the design and construction of this project.

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.

REGISTERED GEOLOGIST STEVEN K. WILLIAMS CERTIFIED ENGINEERING GEOLOGIST CEG 2261 STATE OF CALIFORNIA

Steven K. Williams, CEG
Senior Engineering Geologist

Julian R. Avalos
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER JEFFREY O. LYON No. 31921 EXPIRES 12-31-04 06 CIVIL STATE OF CALIFORNIA

Jeffrey O. Lyon, PE
President

Distribution:
Client (4)

TABLE OF CONTENTS

Page

Section 1 1
INTRODUCTION 1
1.1 Project Description 1
1.2 Purpose and Scope of Work 1
1.3 Authorization 2
Section 2 3
METHODS OF INVESTIGATION 3
2.1 Field Exploration 3
2.2 Laboratory Testing 4
Section 3 5
DISCUSSION 5
3.1 Site Conditions 5
3.2 Geologic Setting 5
3.3 Seismicity and Faulting 6
3.4 Site Acceleration and UBC Seismic Coefficients 7
3.5 Subsurface Soil 8
3.6 Groundwater 9
3.7 Liquefaction 9
Section 4 11
RECOMMENDATIONS 11
4.1 Site Preparation 11
4.2 Foundations and Settlements 13
4.3 Slabs-On-Grade 14
4.4 Concrete Mixes and Corrosivity 15
4.5 Excavations 16
4.6 Seismic Design 16
Section 5 18
LIMITATIONS AND ADDITIONAL SERVICES 18
5.1 Limitations 18
5.2 Additional Services 19

APPENDIX A: Vicinity and Site Maps
APPENDIX B: Subsurface Soil Logs and Soil Keys
APPENDIX C: Laboratory Test Results
APPENDIX D: References

Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical investigation for the proposed additions to the Ormat Heber 2 geothermal power plant located on Dogwood Road southwest of Heber, California (See Vicinity Map, Plate A-1). The proposed development will consist of the addition of one (1) turbine/generator set and one (1) cooling tower. A site plan for the proposed power plant improvements was not made available to us at the time that this report was prepared.

Small structures may be are planned for electrical control panels, consisting of masonry or panelized concrete construction. Expected footing loads are estimated at 1 to 2 kips per lineal foot for the small structures. Expected plant components, cooling tower and turbine/generator columns loads range from 5 to 400 kips. If structural loads exceed those stated above, we should be notified so we may evaluate their impact on foundation settlement and bearing capacity. Site development will include foundation support pad preparation and underground utility installation.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 50 feet of subsurface soil at selected locations within the site for physical/engineering properties. From the subsequent field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site 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 selected locations and depths.
- Laboratory testing for physical properties of selected samples.
- A 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, professional opinions, and recommendations for the geotechnical aspects of project design and construction.

This report addresses the following geotechnical issues:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, near source factors, and site seismic accelerations
- Liquefaction potential and its mitigation
- Expansive soil and methods of mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above issues are presented for the following:

- Site grading and earthwork
- Foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Concrete slabs-on-grade
- 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

Mr. Mike Collins, Project Manager of Ormat for Power Generation Construction provided authorization by written agreement to proceed with our work on December 14, 2004. We conducted our work according to our written proposal dated December 13, 2004.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on December 20, 2004 using Holguin, Fahan, & Associates, Inc. of Cypress, California to advance three (3) electric cone penetrometer (CPT) soundings to an approximate depth of 50 feet below existing ground surface. The soundings were made at the locations shown on the Site and Exploration Plan (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernable site features.

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 $10cm^2$ conical probe into the ground at a rate of 2cm per second using a 23-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 (ϕ) 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 were produced and presented in final form after review of field and laboratory data and are presented on Plates B-1 through B-3 in Appendix B. A key to the interpretation of CPT soundings is presented on Plate B-4. 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.

2.2 Laboratory Testing

Laboratory tests were conducted on selected bulk soil samples obtained from hand auger borings 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:

- Plasticity Index (ASTM D4318) – used for soil classification and expansive soil design criteria.
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods) – used for concrete mix evaluations and corrosion protection requirements.

The laboratory test results are presented on the subsurface logs (Appendix B) and on Plates C-1, C-2 and C-3 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 plant additions are located in the northwest corner of the Heber 2 geothermal plant on the west side of the existing turbine generators and cooling tower. The area is relatively vacant and approximately has the same elevation as the existing plant facilities. An overhead pipe rack is located to the south side of the proposed location.

Adjacent properties outside of the fenced operations yard consist of agricultural land to the north and west. The site is bounded on the east by Dogwood Road and headquarters facilities of a general engineering construction company lie to the south side. Dogwood Road is slated to be a 6-lane north-south arterial from Calexico to Brawley in Imperial County. Adjacent properties are flat-lying and are approximately at the same elevation with this site.

The project site lies at an elevation of approximately 15 feet below mean sea level (MSL) (El. 985 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 4 inches per year with four months of average summertime temperatures above 100 °F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a geologic structural depression resulting from large scale regional faulting. The 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 since the Miocene Epoch. 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 a fresh water lake (Lake Cahuilla). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

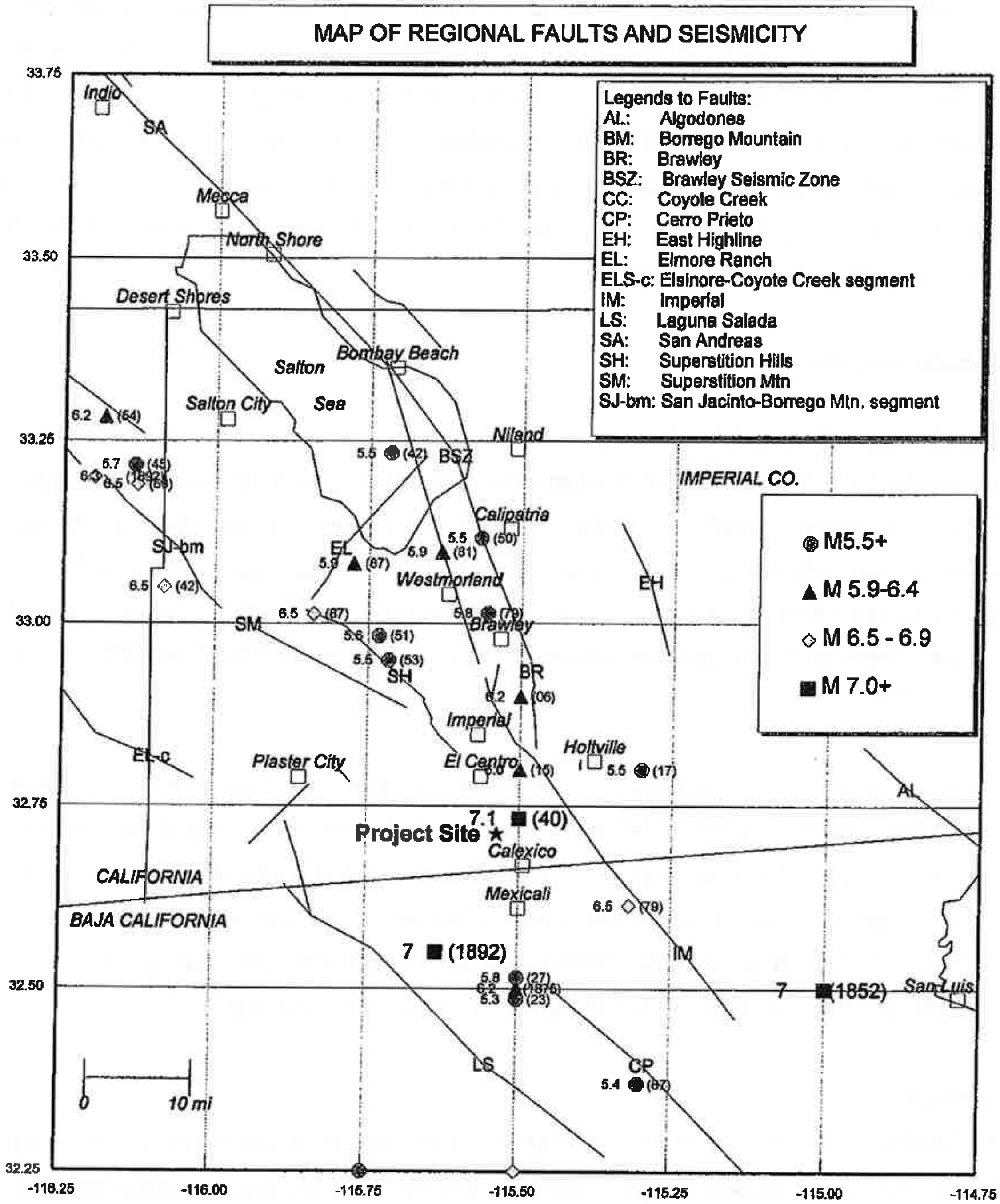
3.3 Seismicity and Faulting

Faulting and Seismic Sources: We have performed a computer-aided search of known faults or seismic zones that lie within a 62 mile (100 kilometers) radius of the project site as shown on Figure 1 and Table 1. The search identifies known faults within this distance and computes deterministic ground accelerations at the site based on the maximum credible earthquake expected on each of the faults and the distance from the fault to the site. The Maximum Magnitude Earthquake (Mmax) listed was taken from published geologic information available for each fault (CDMG OFR 96-08 and Jennings, 1994).

Seismic Risk: The project site is located in the seismically active Imperial Valley of southern California and is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. The proposed site structures should be designed in accordance with the California Building Code (CBC) for near source factors derived from a "Design Basis Earthquake" (DBE). The DBE is defined as the motion having a 10 percent probability of being exceeded in 50 years. The DBE generally corresponds to the Mmax magnitude discussed here.

Seismic Hazards.

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Imperial, Brawley, and Superstition Hills Faults. A further discussion of groundshaking follows in Section 3.4.
- **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the Imperial Valley as shown on USGS and CGS maps. However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.



Faults and Seismic Zones from Jennings (1994), Earthquakes modified from Ellsworth (1990) catalog.

Figure 1. Map of Regional Faults and Seismicity

Table 1
FAULT PARAMETERS & DETERMINISTIC
ESTIMATES OF PEAK GROUND ACCELERATION (PGA)

Fault Name or Seismic Zone	Distance (mi) & Direction from Site	Fault Type		Fault Length (km)	Maximum Magnitude Mmax (Mw)	Avg Slip Rate (mm/yr)	Avg Return Period (yrs)	Date of Last Rupture (year)	Largest Historic Event >5.5M (year)		Est. Site PGA (g)
Reference Notes: (1)		(2)	(3)	(2)	(4)	(3)	(3)	(3)	(5)		(6)
Imperial Valley Faults											
Imperial	7.0 NE	A	B	62	**7.0**	20	79	1979	7.0	1940	**0.33**
Brawley	8.8 NNE	B	B	14	**7.0**	20	—	1979	5.8	1979	**0.28**
Cerro Prieto	15 SSE	A	B	116	**7.2**	34	50	1980	7.1	1934	**0.21**
Brawley Seismic Zone	16 N	B	B	42	**6.4**	25	24		5.9	1981	**0.13**
East Highline Canal	23 NE	C	C	22	**6.3**	1	774				**0.09**
San Jacinto Fault System											
- Superstition Hills	8.5 NNW	B	A	22	**6.6**	4	250	1987	6.5	1987	**0.23**
- Superstition Mtn.	15 NW	B	A	23	**6.6**	5	500	1440 +/-			**0.16**
- Elmore Ranch	28 NW	B	A	29	**6.6**	1	225	1987	5.9	1987	**0.10**
- Borrego Mtn	34 NW	B	A	29	**6.6**	4	175		6.5	1942	**0.08**
- Anza Segment	51 NW	A	A	90	**7.2**	12	250	1918	6.8	1918	**0.08**
- Coyote Creek	53 NW	B	A	40	**6.8**	4	175	1968	6.5	1968	**0.07**
- Whole Zone	15 NW	A	A	245	**7.5**	—	—				**0.25**
Elsinore Fault System											
- Laguna Salada	16 SW	B	B	67	**7.0**	3.5	336		7.0	1891	**0.18**
- Coyote Segment	29 W	B	A	38	**6.8**	4	625				**0.11**
- Julian Segment	55 WNW	A	A	75	**7.1**	5	340				**0.08**
- Earthquake Valley	57 WNW	B	A	20	**6.5**	2	351				**0.05**
- Whole Zone	29 W	A	A	250	**7.5**	—	—				**0.15**
San Andreas Fault System											
- Coachella Valley	45 NNW	A	A	95	**7.4**	25	220	1690+/-	6.5	1948	**0.10**
- Whole S. Calif. Zone	45 NNW	A	A	458	**7.9**	—	—	1857	7.8	1857	**0.13**
Algodones	36 E	C	C	74	**7.0**	0.1	20,000				**0.10**

Notes:

1. Jennings (1994) and CDMG (1996)
2. CDMG (1996), where Type A faults -- slip rate >5 mm/yr and well constrained paleoseismic data
   Type B faults -- all other faults.
3. WGCEP (1995)
4. CDMG (1996) based on Wells & Coppersmith (1994)
5. Ellsworth Catalog in USGS PP 1515 (1990) and USBR (1976), Mw = moment magnitude,
6. The deterministic estimates of the Site PGA are based on the attenuation relationship of: Boore, Joyner, Fumal (1997)

▸ **Liquefaction.** Liquefaction is unlikely to be a potential hazard at the site due to the lack of saturated granular soil (clay soils predominate).

Other Secondary Hazards.

▸ **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic 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, sieches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, sieches, or other seismically-induced flooding is unlikely.

▸ **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 are discussed in more detail in Section 3.5.

3.4 Site Acceleration and UBC Seismic Coefficients

Deterministic horizontal peak ground accelerations (PGA) from maximum probable earthquakes on regional faults have been estimated and are included in Table 1. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations 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.

We have used the computer program FRISKSP (Blake, 2000) to provide a probabilistic estimate of the site PGA using the attenuation relationship of Boore, Joyner, and Fumal (1997) Soil (250). The PGA estimate for the project site having a 10% probability of being exceeded in 50 years (return period of 475 years) is **0.60g**.

CBC Seismic Coefficients: The CBC seismic coefficients are roughly based on an earthquake ground motion that has a 10% probability of being exceeded in 50 years. The following table lists seismic and site coefficients (near source factors) determined by Chapter 16 of the 2001 CBC. ***This site lies within 11.3 km of a Type A fault overlying S_D (stiff) soil.***

CBC Seismic Coefficients for Chapter 16 Seismic Provisions

CBC Code Edition	Soil Profile Type	Seismic Source Type	Distance to Critical Source	Near Source Factors		Seismic Coefficients	
				Na	Nv	Ca	Cv
2001	S_D (stiff soil)	A	< 11.3 km	1.00	1.15	0.44	0.74
Ref. Table	16-J	16-U	---	16-S	16-T	16-Q	16-R

3.5 Subsurface Soil

Subsurface soils encountered during the field exploration conducted on December 20, 2004 indicates that 1.0 to 1.5 feet of stiff clay are at ground surface. Dense to very dense silty sands lie below the clays and extend to a depth of 4 to 5 feet. Stiff to very stiff clays extend a depth of 50 feet, the maximum depth of exploration. The subsurface logs (Plates B-1 through B-3) depict the stratigraphic relationships of the various soil types.

The native surface clays exhibit moderate swell potential (Expansion Index, EI = 51 - 90) when correlated to Plasticity index tests (ASTM D4318) performed on the native clays. The clay is expansive when wetted and can shrink with moisture loss (drying). Development of building foundations, concrete flatwork, and asphaltic concrete pavements should include provisions for mitigating potential swelling forces and reduction in soil strength, which can occur from saturation of the soil. Causes for soil saturation include landscape irrigation, broken utility lines, or capillary rise in moisture upon sealing the ground surface to evaporation. Moisture losses can occur with lack of landscape watering, close proximity of structures to downslopes and root system moisture extraction from deep rooted shrubs and trees placed near the foundations. Typical measures used for industrial projects to remediate expansive soil include:

- replacement of silt/clay with non-expansive granular fill,
- moisture conditioning subgrade soils to a minimum of 5% above optimum moisture (ASTM D1557) for the full range in depth of surface soils.
- design of foundations that are resistant to shrink/swell forces of silt/clay soil.

3.6 Groundwater

Groundwater was not noted on the CPT sounding at the time of exploration, but is typically encountered at approximately 10 to 15 feet below ground surface in the vicinity of the site. 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, drainage, and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition.

3.7 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.

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); and
(4) groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions exist to some degree at this site.

Methods of Analysis: Liquefaction potential at the project site was evaluated using the 1997 NCEER Liquefaction Workshop methods that are based on the Seed, et. al. 1985 and Robertson and Campanella (1985) 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}. A ground acceleration of 0.60g was used in the analysis with a 12 foot groundwater depth.

Liquefaction induced settlements have been estimated using the 1987 Tokimatsu and Seed method. Fines content of liquefiable sands and silt increase the liquefaction resistance in that more cycles of ground motions are required to fully develop pore pressures. The SPT blow counts were adjusted to an equivalent clean sand blow count, $N_{1(60)}$ prior to calculating settlements using Robertson and Wride (1997) adjustments. A computed factor of safety less than 1.0 indicates a liquefiable condition.

Liquefaction Effects: Based on empirical relationships, liquefaction is not expected to occur at the project site.

Section 4
RECOMMENDATIONS

4.1 Site Preparation

Clearing and Grubbing: All surface improvements, debris or vegetation including grass and weeds on the site at the time of construction should be removed from the construction area. Organic strippings should be hauled from the site and not used as fill. Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be dish-shaped to the lowest depth of disturbance and backfilled under observation by the geotechnical engineer's representative with compacted fill as described below.

Structure Subgrade Preparation: The exposed surface soil within the foundation areas should be removed to 12 inches below the foundation elevation or existing grade (whichever is lower). Exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 3 to 8% above optimum moisture content (clays) or 0 to 4% above optimum (silts), and recompacted to at least 90% of the maximum density determined in accordance with ASTM D1557 methods.

The native soil is suitable for use as engineered fill provided it is free from concentrations of organic matter or other deleterious material. The fill soil should be uniformly moisture conditioned by discing and watering to the limits specified above, placed in maximum 8-inch lifts (loose), and compacted to the limits specified above.

Imported fill soil (if required) should have a Plasticity Index less than 15 and sulfates (SO_4) less than 1,000 ppm or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported granular fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least 90% of ASTM D1557 maximum dry density at optimum moisture ±2%.

In areas other than the structures pad which are to receive area concrete slabs, the ground surface should be presaturated to a minimum depth of 18 inches and then scarified to 6 inches, moisture conditioned to a minimum of 5% over optimum, and recompacted to 83-87% of ASTM D1557 maximum density just prior to concrete placement.

Trench Backfill: On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill, but may be difficult to uniformly maintain at specified moistures and compact to the specified densities. Granular material is often more cost effective for backfill of utility trenches.

Backfill soil within roadways or traffic areas should be placed in layers not more that 6 inches in thickness and mechanically compacted to a minimum of 87% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 90%. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material. Pipe envelope/bedding should either be clean sand (Sand Equivalent SE>30) or crushed rock when encountering groundwater. A geotextile filter fabric (Mirafi 140N or equivalent) should be used to encapsulate the crushed rock when placed below groundwater to reduce the potential for in-washing of fines into the gravel void space. Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have the existing soil beneath the structure foundation prepared in the manner recommended for the building pad except the preparation needed only to extend 12 inches below and beyond the footing.

4.2 Foundations and Settlements

Shallow spread footings and continuous wall footings are suitable to support the structures associated with the turbine generator and cooling tower. Footings shall be founded on a layer of properly prepared and compacted soil as described in Section 4.1. The foundations may be designed using an allowable soil bearing pressure of 1,500 psf for compacted native clay soil and 2,000 psf when foundations are supported on imported sands (extending a minimum of 1.0 feet below footings). The allowable soil pressure may be increased by 20% for each foot of embedment depth in excess of 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 3,000 psf (clays). Settlements associated with variable loadings and structure/footing sizes are shown on figures 2 thru 5. As an alternative to shallow spread foundations, flat plate structural mats or grade-beam reinforced foundations may be used to mitigate expansive soil heave.

Flat Plate Structural Mats: Structural mats may be designed for a modulus of subgrade reaction (Ks) of 100 pci when placed on compacted clay or a subgrade modulus of 250 pci when placed on 2.5 feet of granular fill. Mats shall overlay 2 inches of sand and a 10-mil polyethylene vapor retarder. The structure support pad shall be moisture conditioned and recompacted as specified in Section 4.1 of this report.

All exterior and interior foundations should be embedded a minimum of 18 inches below the structure support pad or lowest adjacent final grade, whichever is deeper. Continuous wall footings should have a minimum width of 12 inches. Spread footings should have a minimum width of 24 inches. Recommended concrete reinforcement and sizing for all footings should be provided by the structural engineer.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings or grade beams and frictional resistance developed along the bases of footings or grade beams and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 250 pcf (300 pcf for sands) to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.25 (0.35 for sands) may also be used at the base of the footings or grade beams to resist lateral loading.

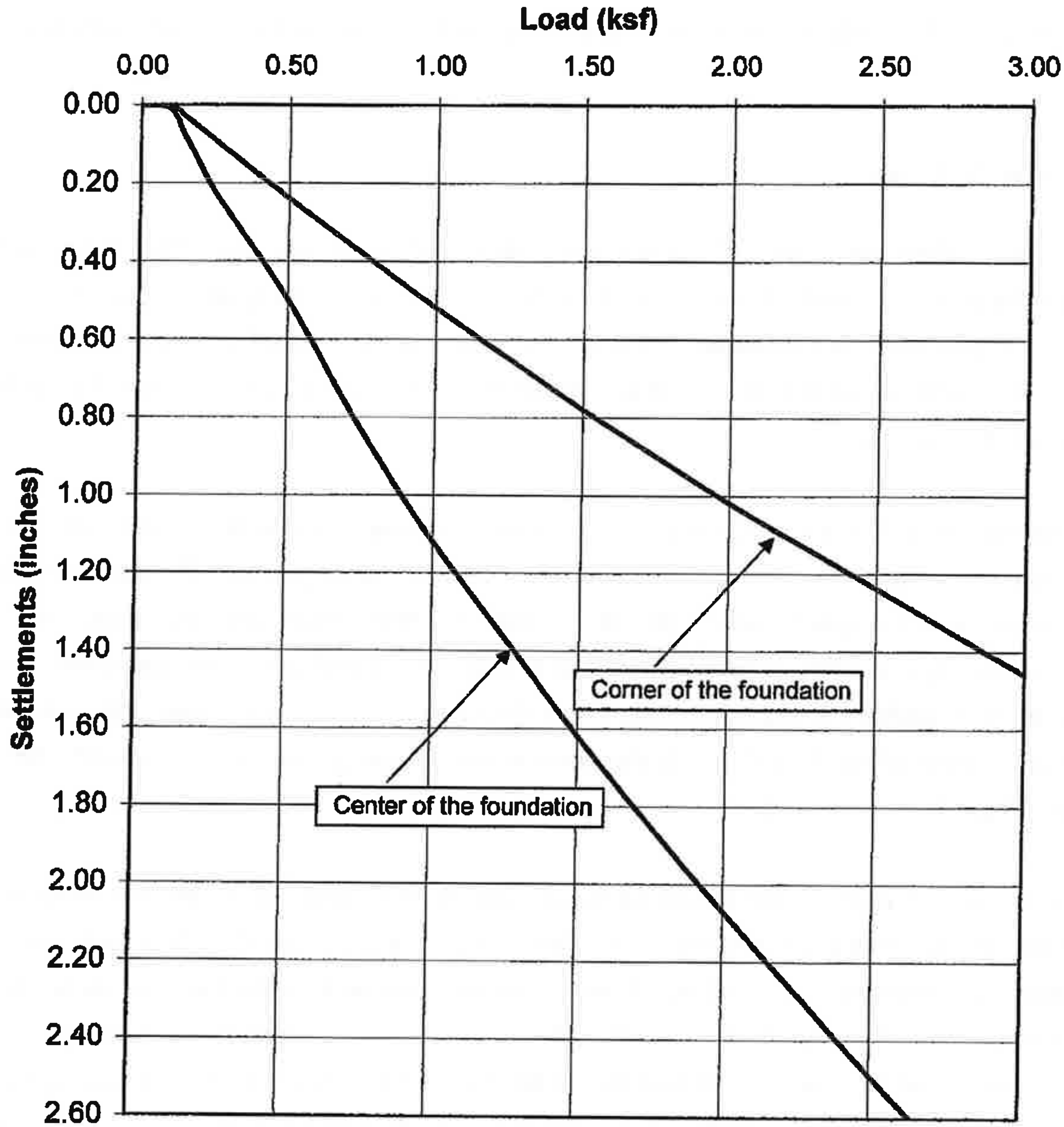
Total foundation movements under estimated loadings are shown on the load/settlement curves (Figures 2 thru 5). Differential movement is estimated to be about two-thirds of total movement

4.3 Slabs-On-Grade

Thin concrete slabs and flatwork (6 inches or less in thickness) placed over native clay soil should be designed in accordance with Chapter 18, Division III of the 2001 CBC (using an Effective Plasticity Index of 17) and shall be a minimum of 5 inches thick due to expansive soil conditions. Concrete floor slabs shall be monolithically placed with the foundations unless placed on 2.5 feet of granular fill or lime treated soil.

The concrete slabs should be underlain by a minimum of 4 inches of clean sand (Sand Equivalent SE>30) or aggregate base or may be placed directly on a 2.5-foot thick granular fill pad (if used) that has been moistened to approximately optimum moisture just before the concrete placement. A 10-mil visqueen vapor retarder, properly lapped and sealed with a 2-inch sand cover and extended a minimum of 12 inches into the footing, should be placed as a capillary break to prevent moisture migration into the slab section. Concrete slabs may be placed directly over a 15-mil vapor retarder if desired (Stego-Wrap or equivalent).

Concrete slab and flatwork reinforcement should consist of chaired rebar slab reinforcement (minimum of No. 4 bars at 18-inch centers, both horizontal directions) placed at slab mid-height to resist potential swell forces and cracking. Slab thickness and steel reinforcement are minimums only and should be verified by the structural engineer/designer knowing the actual project loadings. All steel components of the foundation system should be protected from corrosion by maintaining a 4-inch minimum concrete cover of densely consolidated concrete at footings (by use of a vibrator). The construction joint between the foundation and any mowstrips/sidewalks placed adjacent to foundations should be sealed with a polyurethane based non-hardening sealant to prevent moisture migration between the joint. Epoxy coated embedded steel components or permanent waterproofing membranes placed at the exterior footing sidewall may also be used to mitigate the corrosion potential of concrete placed in contact with native soil.



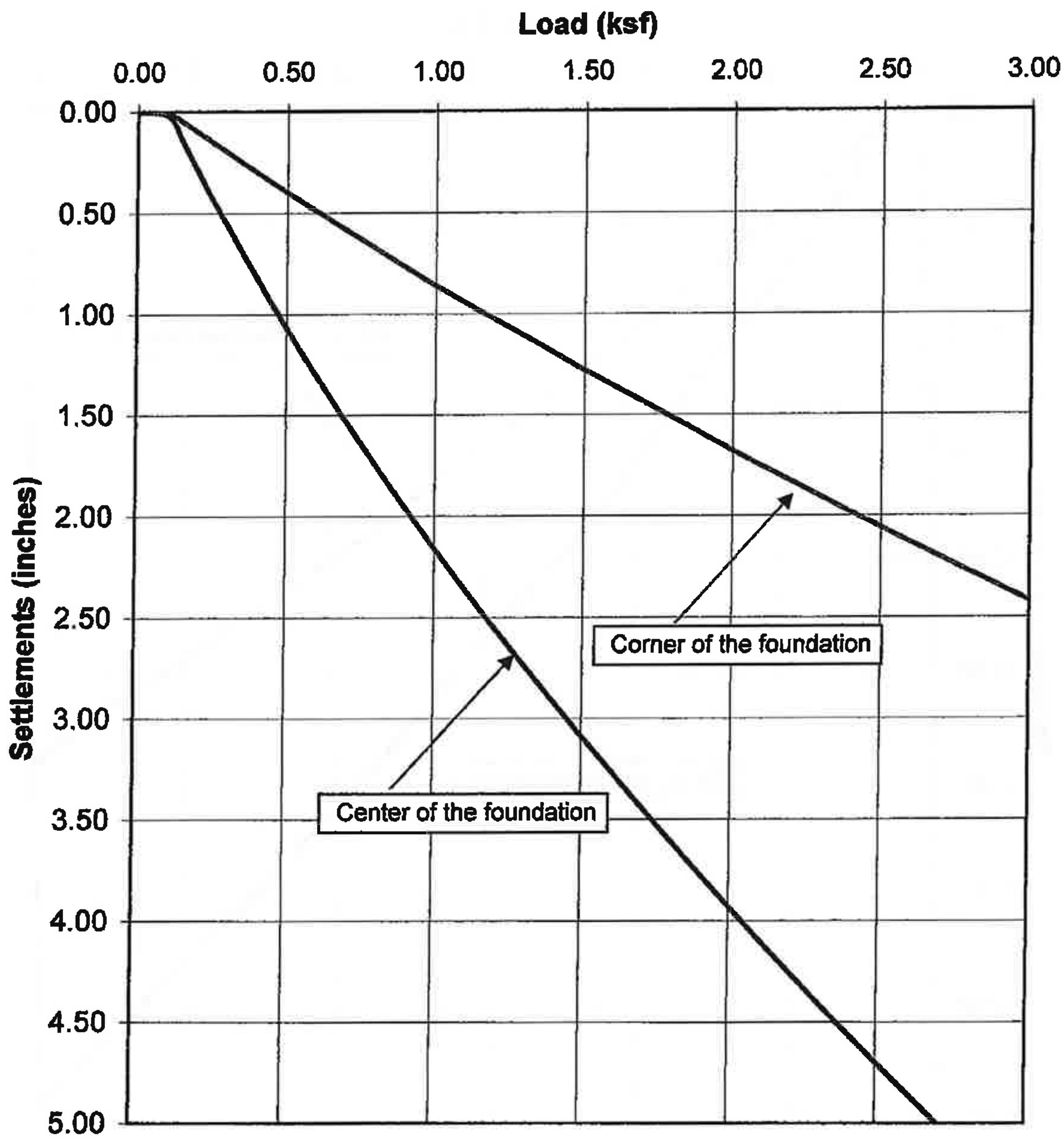
Notes:

1. A 15' x 15' foundation was used for settlement analysis

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company
Project No.: LE04354

Total Settlements for a Turbine Generator Foundation at Heber 2 Geothermal Plant

Figure 2



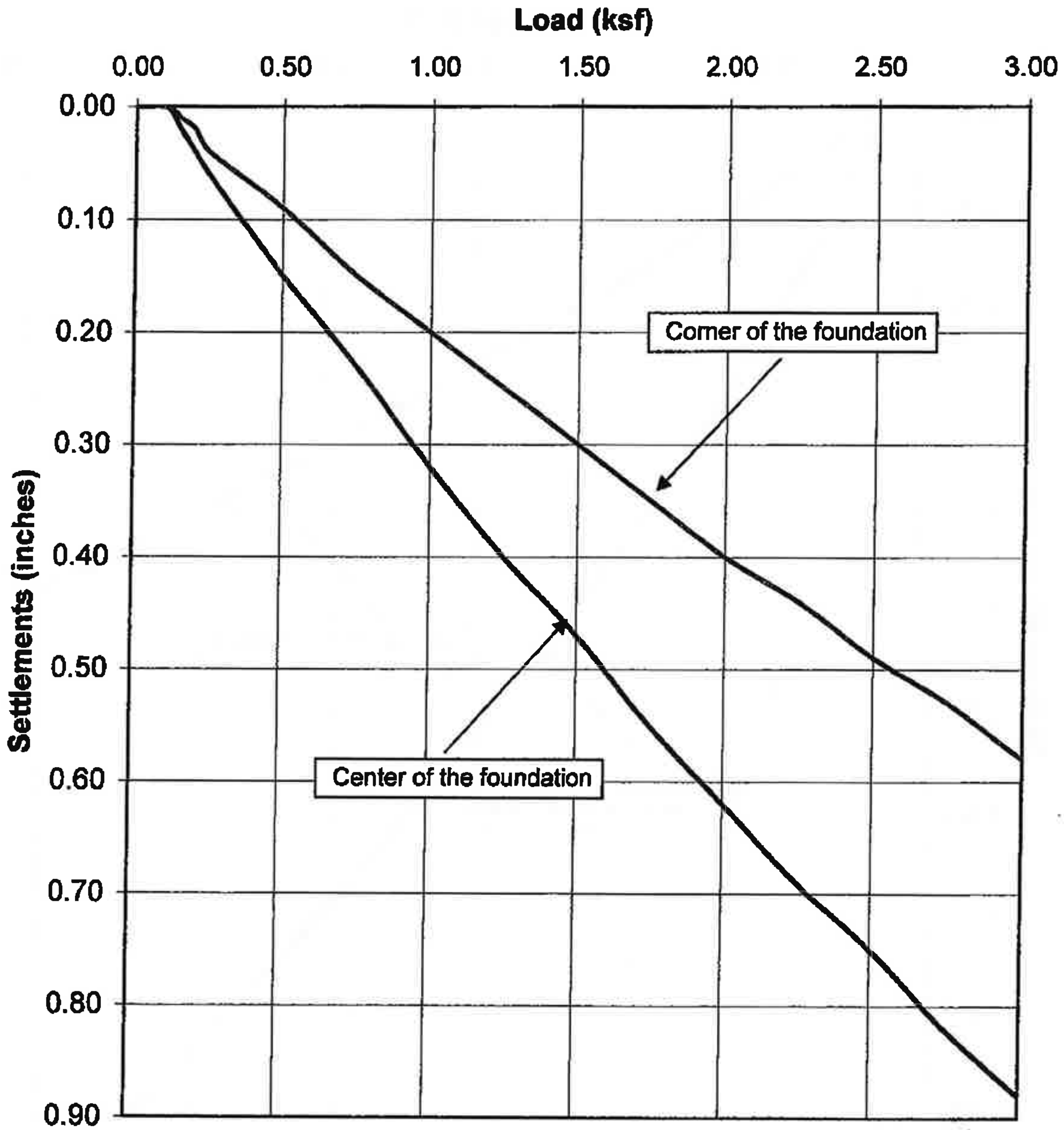
Notes:

1. A 30' x 60' foundation was used for settlement analysis

LANDMARK Geo-Engineers and Geologists
a DBE/MBE/SBE Company
Project No.: LE04354

Total Settlements for a Turbine Generator Foundation at Heber 2 Geothermal Plant

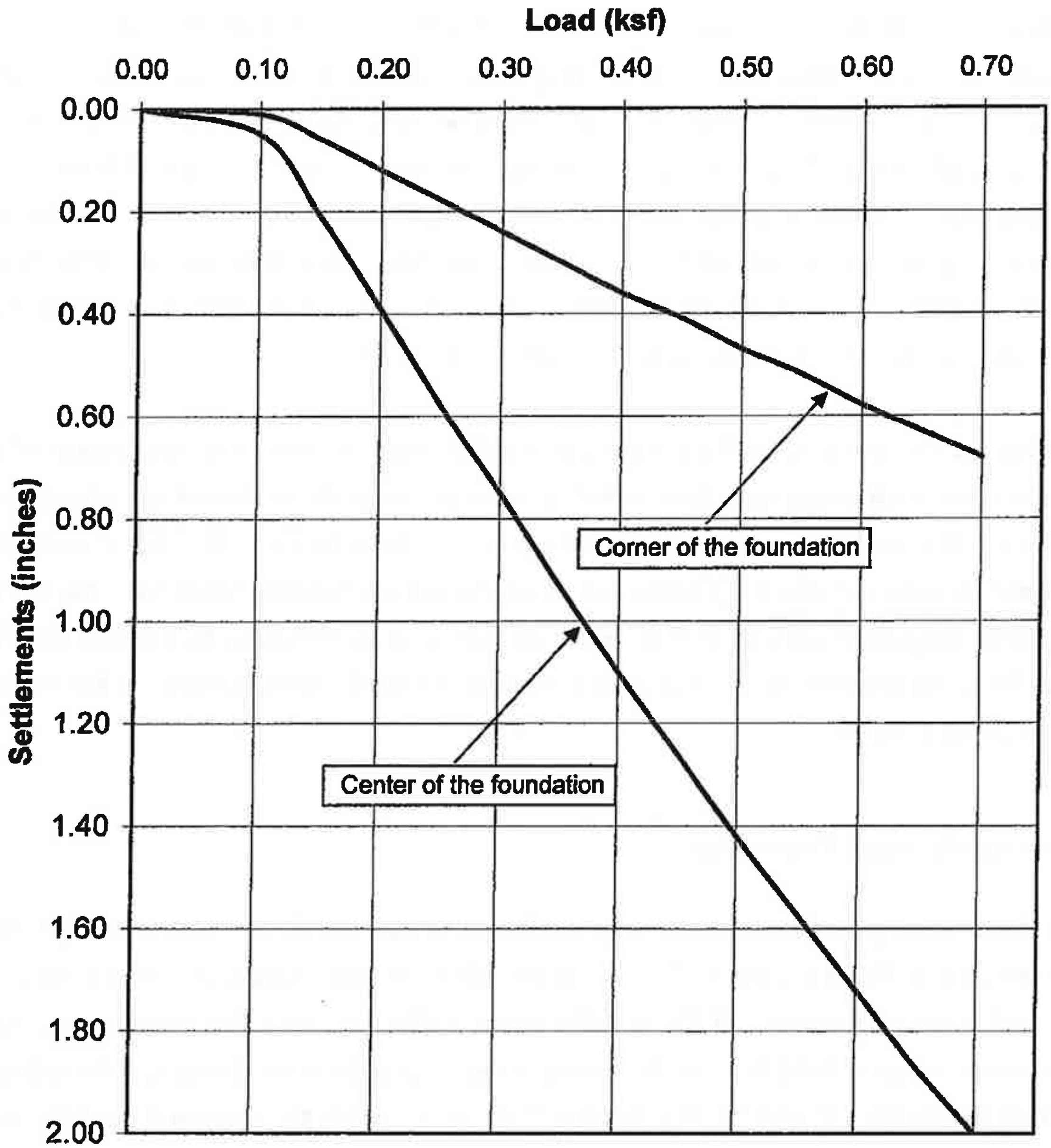
Figure 3



Notes:

1. A 5' x 5' foundation was used for settlement analysis

LANDMARK Geo-Engineers and Geologists *a DBE/MBE/SBE Company* **Project No.: LE04354**	**Total Settlements for a Cooling Tower Foundation at Heber 2 Geothermal Plant**	**Figure 4**



Notes:

1. A 60' x 180' foundation was used for settlement analysis

LANDMARK Geo-Engineers and Geologists *a DBE/MBE/SBE Company* **Project No.: LE04354**	**Total Settlements for a Cooling Tower Foundation at Heber 2 Geothermal Plant**	**Figure 5**

Control joints should be provided in all concrete slabs-on-grade at a maximum spacing (in feet) of 2 to 3 times the slab thickness (in inches) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce randomly oriented contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or sawcut (¼ of slab depth) within 6 to 8 hours of concrete placement. Construction (cold) joints in foundations and area flatwork should either be thickened butt-joints with dowels or a thickened keyed-joint designed to resist vertical deflection at the joint. All joints in flatwork should be sealed to prevent moisture, vermin, or foreign material intrusion. Precautions should be taken to prevent curling of slabs in this arid desert region (refer to ACI guidelines).

All independent flatwork (sidewalks, housekeeping slabs) should be placed on a minimum of 2 inches of concrete sand or aggregate base, dowelled to the perimeter foundations where adjacent to the structures and sloped 1% or more away from the structure. A minimum of 18 inches of moisture conditioned (3% minimum above optimum) and 8 inches of compacted subgrade (83 to 87%) and a 10-mil (minimum) polyethylene separation sheet should underlie the flatwork. All flatwork should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

4.4 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plates C-2 and C-3). The native soils were found to have moderate to severe levels of sulfate ion concentration (1,052 to 3,006 ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The California Building Code recommends that increased quantities of Type II Portland Cement be used at a low water/cement ratio when concrete is subjected to moderate sulfate concentrations. Type V Portland Cement and/or Type II/V cement with 25% flyash replacement is recommended when the concrete is subjected to soil with severe sulfate concentration.

A minimum of 6.25 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project. Admixtures may be required to allow placement of this low water/cement ratio concrete.

There are no special requirements for concrete mixes when foundations are placed on 2.5 feet of low sulfate content granular fill.

The native soil has moderate to very severe level of chloride ion concentration (210 to 3,040 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. Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 4 inches of densely consolidated concrete. ***No metallic pipes or conduits should be placed below foundations.***

Foundation designs shall provide a minimum concrete cover of four (4 inches around steel reinforcing or embedded components (anchor bolts, hold-downs, etc.) exposed to native soil or landscape water (to 18 inches above grade). If the 4-inch concrete edge distance cannot be achieved, all embedded steel components (anchor bolts, hold-downs, etc.) shall be epoxy dipped for corrosion protection or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings. Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete.

4.5 Excavations

All site excavations should conform to CalOSHA requirements for Type B soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type B soil. Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

4.6 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 Brawley, Superstition Hills, and Imperial 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 CBC for Seismic Zone 4 using the seismic coefficients given in Section 3.4 of this report. ***This site lies within 11.3 km of a Type A fault overlying S_D (stiff) soil.***

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The recommendations and conclusions within this report are based on current information regarding the proposed additions to the Ormat Heber 2 geothermal power plant located on Dogwood Road southwest of Heber, California. The conclusions and recommendations 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.

Findings and recommendations in this report are based on selected points of field exploration, geologic literature, laboratory testing, and our understanding of the proposed project. Our analysis of data and recommendations 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. If detected, these conditions may require additional studies, consultation, and possible design revisions.

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.

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. This report should be considered invalid for periods after two years from the report date without a review of the validity of the findings and recommendations by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice.

The client has responsibility to see that all parties to the project including, designer, contractor, and subcontractor are made aware of this entire report. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Additional Services

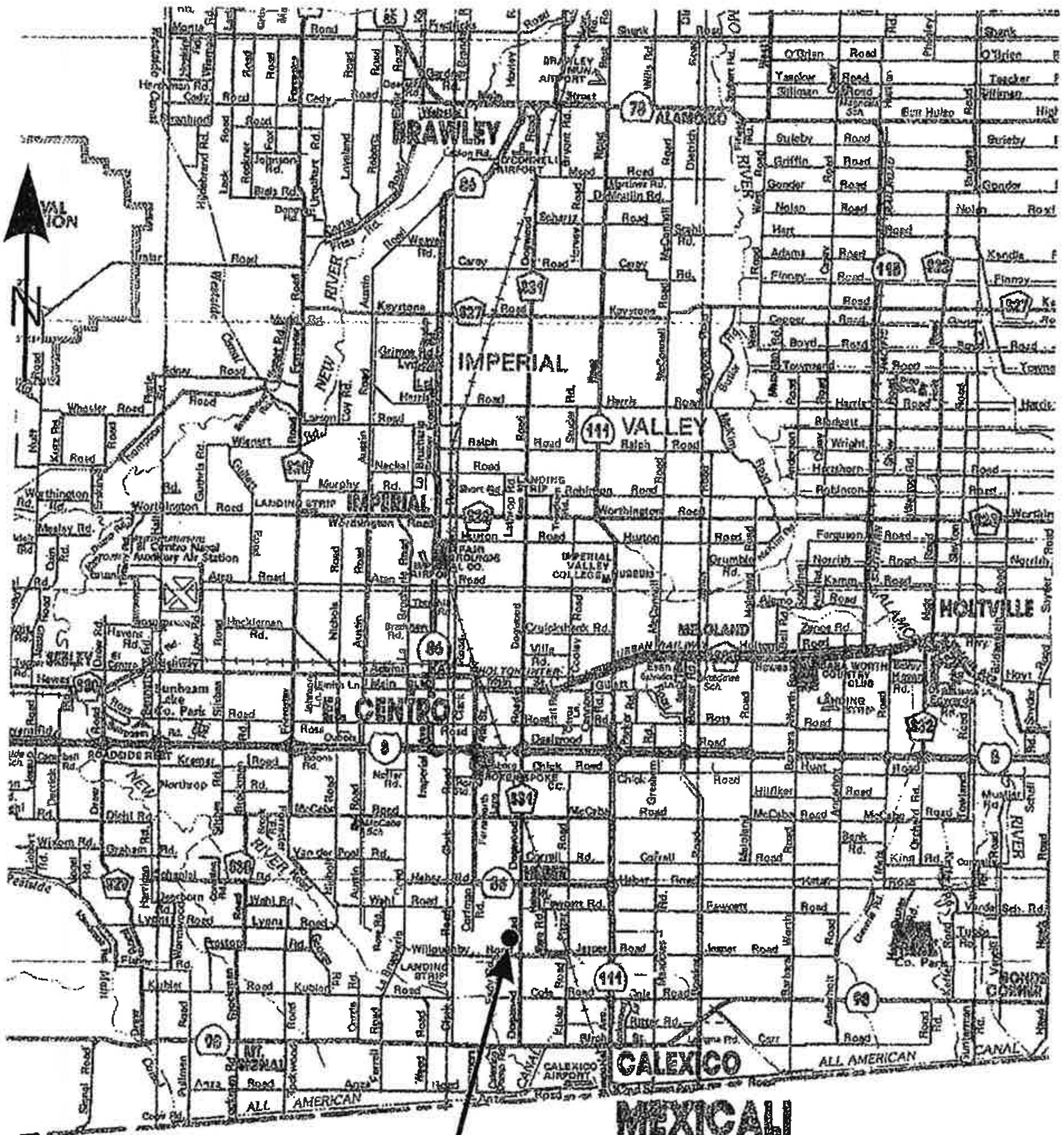
We recommend that Landmark Consultants, Inc. be retained as the geotechnical consultant to provide the tests and observations services during construction. If Landmark Consultants does not provide such services then *the geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

The recommendations presented in this report are based on the assumption that:

- Consultation during development of design and construction documents to check that the geotechnical recommendations are appropriate for the proposed project and that the geotechnical recommendations are properly interpreted and incorporated into the documents.
- Landmark Consultants will have the opportunity to review and comment on the plans and specifications for the project prior to the issuance of such for bidding.
- Continuous observation, inspection, and testing by the geotechnical consultant of record during site clearing, grading, excavation, placement of fills, building pad and subgrade preparation, and backfilling of utility trenches.
- Observation of foundation excavations and reinforcing steel before concrete placement.
- Other consultation as necessary during design and construction.

We emphasize our review of the project plans and specifications to check for compatibility with our recommendations and conclusions. Additional information concerning the scope and cost of these services can be obtained from our office.

APPENDIX A



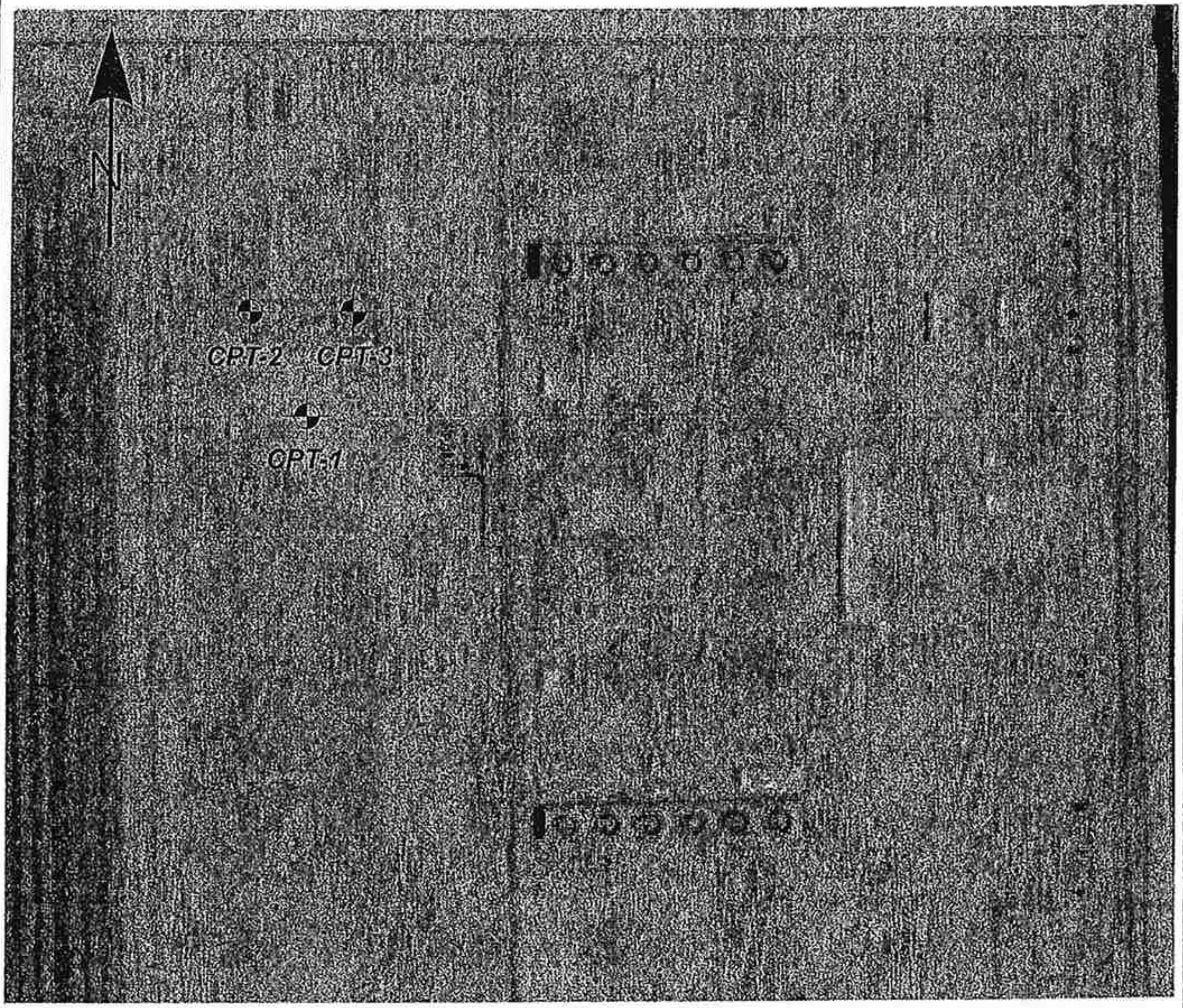
Project Site

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No.: LE04354

Vicinity Map

Plate A-1

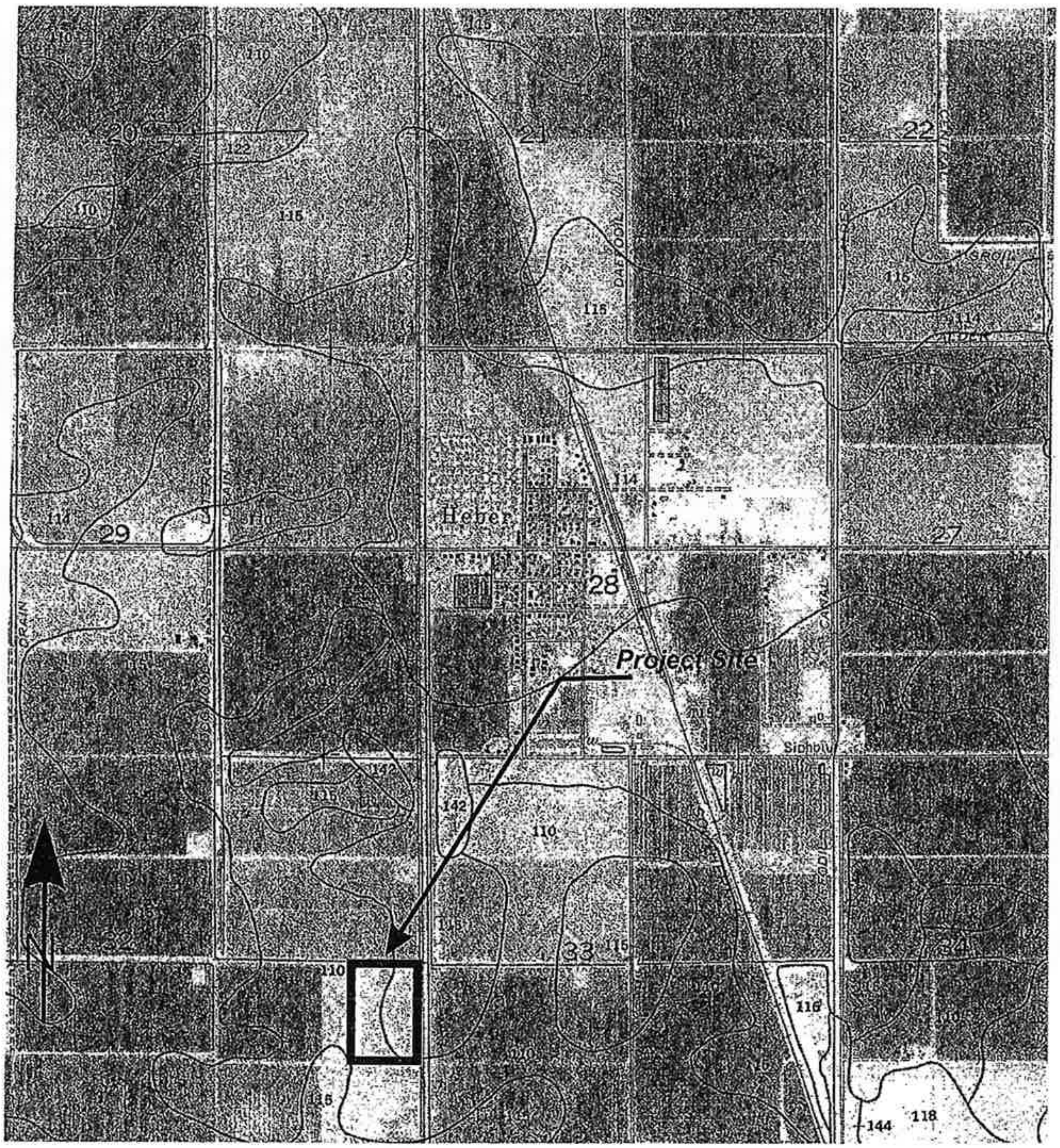


LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No.: LE04354

Site and Exploration Map

Plate A-2



LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No.: LE04354

Soil Survey Map

Plate A-3

Soil Survey of

IMPERIAL COUNTY CALIFORNIA IMPERIAL VALLEY AREA

United States Department of Agriculture Soil Conservation Service
in cooperation with
University of California Agricultural Experiment Station
and
Imperial Irrigation District

TABLE 11.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

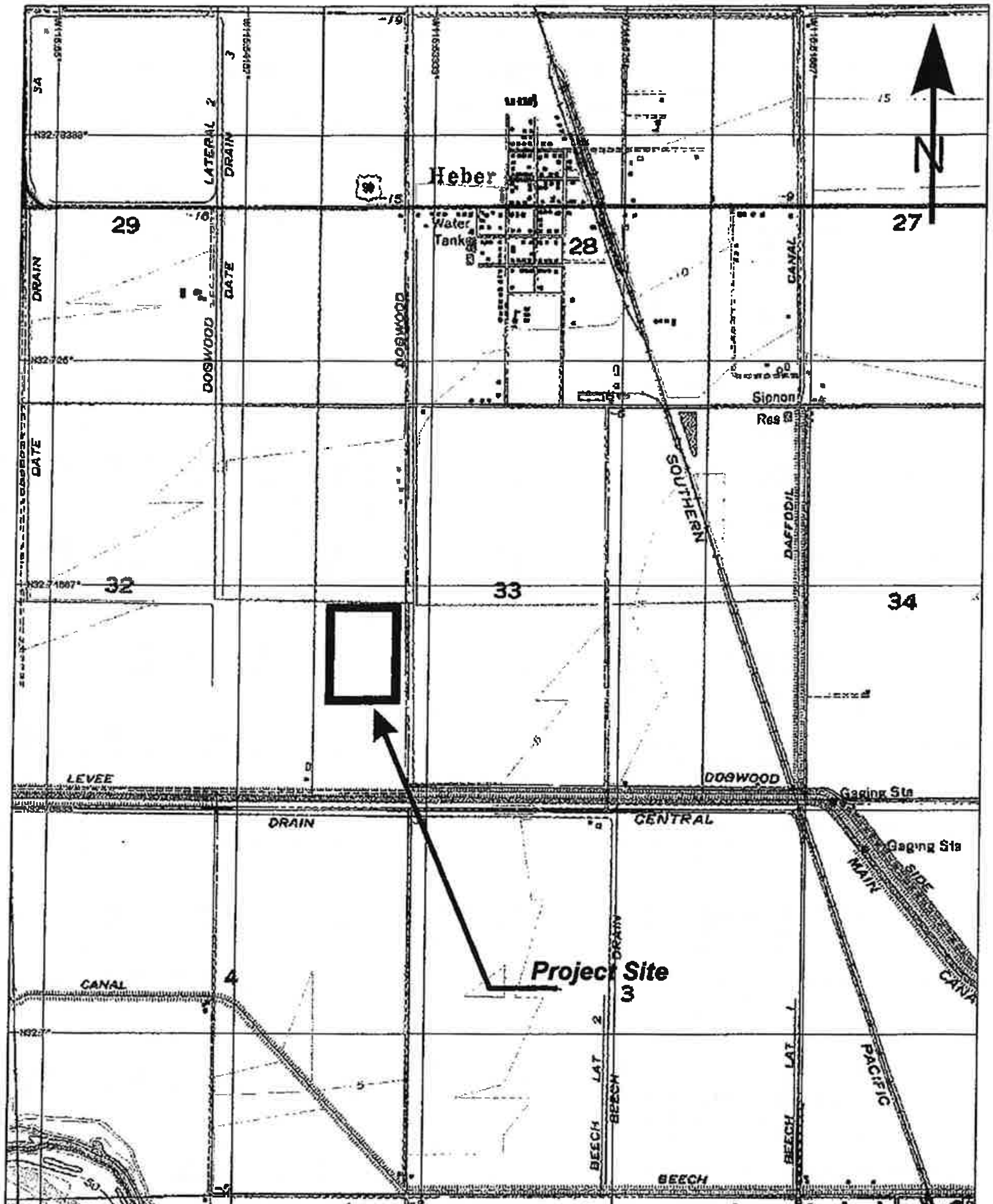
Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
100---------------- Antho	0-13	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	13-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
101*:											
Antho-------------	0-8	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	8-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
Superstition------	0-6	Fine sand--------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
102*. Badland											
103---------------- Carsitas	0-10	Gravelly sand---	SP, SP-SM	A-1, A-2	0-5	60-90	50-85	30-55	0-10	---	NP
	10-60	Gravelly sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-5	60-90	50-85	25-50	0-10	---	NP
104* Fluvaquents											
105---------------- Glenbar	0-13	Clay loam--------	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
106---------------- Glenbar	0-13	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
107*--------------- Glenbar	0-13	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	100	70-80	20-30	NP-10
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	75-95	35-45	15-30
108---------------- Holtville	0-14	Loam-------------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	14-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
109---------------- Holtville	0-17	Silty clay-------	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
110---------------- Holtville	0-17	Silty clay-------	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
111*:											
Holtville----------	0-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	10-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
Imperial----------	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
112---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
113---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	100	85-95	50-70	25-45
114---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
115*:											
Imperial----------	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar-----------	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
116*:											
Imperial----------	0-13	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	13-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar-----------	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
117, 118----------- Indio	0-12	Loam------------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
119*:											
Indio-------------	0-12	Loam------------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Vint--------------	0-10	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	10-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
120*--------------- Laveen	0-12	Loam------------	ML, CL-ML	A-4	0	100	95-100	75-85	55-65	20-30	NP-10
	12-60	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-95	70-80	55-65	15-25	NP-10

See footnote at end of table.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS

600 ft Scale: 1 : 20,800 Detail: 13-3 Datum: WGS84

LANDMARK Geo-Engineers and Geologists a DSE/MSE/SBE Company **Project No.: LE04354**	**Topographic Map**	**Plate A-4**

APPENDIX B

CLIENT: ORMAT
PROJECT: ORMAT Heber 2 Facilities, Heber, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight
DATE: 12/20/04

LOG OF CONE SOUNDING DATA CPT-1

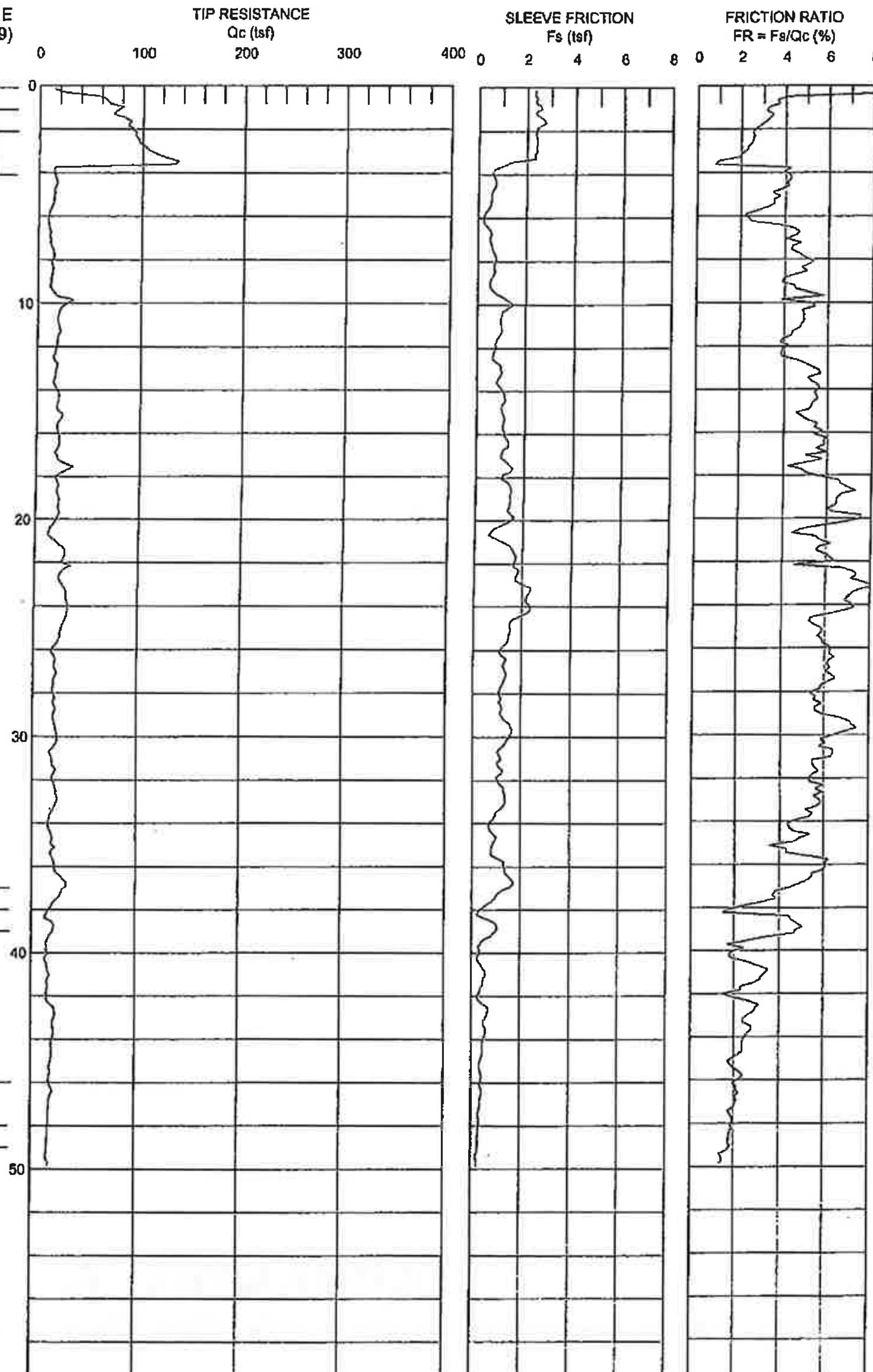
DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

Clay	CL/CH	hard
Sandy Silt to Clayey Silt	ML	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	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
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	" "	stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose
Clayey Silt to Silty Clay	ML/CL	stiff

End of Sounding @ 49.5 ft.



-10-
-20-
-30-
-40-
-50-

Project No:
LE04354

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate
B-1

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA   Project No: LE04354   Date: 12/20/04

CONE SOUNDING: CPT-1

Est. GWT (ft): 12.0   Phi Correlation: 0   0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
0.15	0.5	31.82	10.13 3	3	Clay	CL/CH	very stiff	125	1.3	25	2.00		95			1.87	>10
0.30	1.0	71.19	3.50 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	20	2.00	134.6	45	107	43		
0.45	1.5	76.38	3.27 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	22	2.00	144.4	40	102	42		
0.60	2.0	88.21	2.88 6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	25	2.00	166.8	35	101	42		
0.75	2.5	94.19	2.63 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	21	2.00	178.0	30	100	42		
0.93	3.0	101.94	2.35 7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	23	2.00	192.7	30	99	42		
1.08	3.5	123.24	1.66 8	8	Sand to Silty Sand	SP/SM	very dense	115	5.5	22	2.00	233.0	20	102	42		
1.23	4.0	53.93	2.99 6	6	Sandy Silt to Clayey Silt	ML	dense	115	3.5	15	2.00	101.9	45	76	39		
1.38	4.5	16.43	4.19 3	3	Clay	CL/CH	stiff	125	1.3	13	2.00		85			0.95	>10
1.53	5.0	15.53	3.80 4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	1.95		85			0.90	>10
1.68	5.5	13.99	3.48 4	4	Silty Clay to Clay	CL	stiff	125	1.8	8	1.85		85			0.80	>10
1.83	6.0	10.16	2.42 5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	4	1.76		85			0.58	>10
1.98	6.5	10.41	3.55 4	4	Silty Clay to Clay	CL	stiff	125	1.8	6	1.69		95			0.59	>10
2.13	7.0	11.62	4.38 3	3	Clay	CL/CH	stiff	125	1.3	9	1.62		100			0.66	>10
2.28	7.5	13.29	4.44 3	3	Clay	CL/CH	stiff	125	1.3	11	1.56		95			0.76	>10
2.45	8.0	14.55	4.93 3	3	Clay	CL/CH	stiff	125	1.3	12	1.51		95			0.83	>10
2.60	8.5	13.90	4.96 3	3	Clay	CL/CH	stiff	125	1.3	11	1.46		100			0.79	>10
2.75	9.0	13.23	4.08 3	3	Clay	CL/CH	stiff	125	1.3	11	1.42		95			0.75	>10
2.90	9.5	13.66	4.68 3	3	Clay	CL/CH	stiff	125	1.3	11	1.38		100			0.77	>10
3.05	10.0	26.88	5.00 3	3	Clay	CL/CH	very stiff	125	1.3	22	1.34		80			1.55	>10
3.20	10.5	21.69	5.01 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.32		90			1.24	>10
3.35	11.0	19.84	4.85 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.30		95			1.13	>10
3.50	11.5	21.31	4.45 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	1.29		90			1.22	>10
3.65	12.0	18.97	4.00 4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	1.27		90			1.08	>10
3.80	12.5	16.82	3.88 4	4	Silty Clay to Clay	CL	stiff	125	1.8	10	1.26		95			0.95	>10
3.95	13.0	18.18	4.91 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.24		100			1.03	>10
4.13	13.5	17.33	5.43 3	3	Clay	CL/CH	stiff	125	1.3	14	1.23		100			0.98	>10
4.28	14.0	17.04	5.46 3	3	Clay	CL/CH	stiff	125	1.3	14	1.22		100			0.96	>10
4.43	14.5	21.21	5.45 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.20		100			1.20	>10
4.58	15.0	19.96	5.21 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.19		100			1.13	>10
4.73	15.5	23.41	4.80 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.18		95			1.33	>10
4.88	16.0	20.50	5.51 3	3	Clay	CL/CH	very stiff	125	1.3	16	1.17		100			1.16	>10
5.03	16.5	21.94	5.88 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.15		100			1.24	>10
5.18	17.0	19.22	5.48 3	3	Clay	CL/CH	very stiff	125	1.3	15	1.14		100			1.08	>10
5.33	17.5	27.57	5.03 3	3	Clay	CL/CH	very stiff	125	1.3	22	1.13		95			1.57	>10
5.48	18.0	23.29	5.22 3	3	Clay	CL/CH	very stiff	125	1.3	19	1.12		100			1.32	>10
5.65	18.5	20.85	6.67 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.11		100			1.18	>10
5.80	19.0	21.33	6.77 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.10		100			1.20	>10
5.95	19.5	21.97	6.29 3	3	Clay	CL/CH	very stiff	125	1.3	18	1.09		100			1.24	>10
6.10	20.0	21.34	7.09 3	3	Clay	CL/CH	very stiff	125	1.3	17	1.08		100			1.20	>10
6.25	20.5	15.48	5.72 3	3	Clay	CL/CH	stiff	125	1.3	12	1.07		100			0.86	5.53
6.40	21.0	15.87	5.20 3	3	Clay	CL/CH	stiff	125	1.3	13	1.06		100			0.88	5.65
6.55	21.5	26.53	5.79 3	3	Clay	CL/CH	very stiff	125	1.3	21	1.05		100			1.50	>10
6.70	22.0	27.19	6.21 3	3	Clay	CL/CH	very stiff	125	1.3	22	1.05		100			1.54	>10
6.85	22.5	29.12	6.18 3	3	Clay	CL/CH	very stiff	125	1.3	23	1.04		100			1.65	>10
7.00	23.0	24.40	7.41 3	3	Clay	CL/CH	very stiff	125	1.3	20	1.03		100			1.38	>10
7.18	23.5	29.74	7.65 3	3	Clay	CL/CH	very stiff	125	1.3	24	1.02		100			1.69	>10
7.33	24.0	31.24	7.01 3	3	Clay	CL/CH	very stiff	125	1.3	25	1.01		100			1.78	>10
7.48	24.5	31.71	6.74 3	3	Clay	CL/CH	very stiff	125	1.3	25	1.01		100			1.80	>10
7.63	25.0	28.38	5.36 3	3	Clay	CL/CH	very stiff	125	1.3	23	1.00		100			1.61	>10
7.78	25.5	25.50	5.79 3	3	Clay	CL/CH	very stiff	125	1.3	20	0.99		100			1.44	>10
7.93	26.0	21.23	6.01 3	3	Clay	CL/CH	very stiff	125	1.3	17	0.98		100			1.18	7.00
8.08	26.5	19.41	6.26 3	3	Clay	CL/CH	very stiff	125	1.3	16	0.98		100			1.08	6.00
8.23	27.0	21.10	6.12 3	3	Clay	CL/CH	very stiff	125	1.3	17	0.97		100			1.17	6.65
8.38	27.5	20.13	6.30 3	3	Clay	CL/CH	very stiff	125	1.3	16	0.96		100			1.12	6.00
8.53	28.0	19.23	5.66 3	3	Clay	CL/CH	very stiff	125	1.3	15	0.96		100			1.06	5.42
8.68	28.5	20.08	5.65 3	3	Clay	CL/CH	very stiff	125	1.3	16	0.95		100			1.11	5.76
8.85	29.0	20.55	5.67 3	3	Clay	CL/CH	very stiff	125	1.3	16	0.94		100			1.14	5.88
9.00	29.5	20.76	7.00 3	3	Clay	CL/CH	very stiff	125	1.3	17	0.94		100			1.15	5.88
9.15	30.0	22.80	6.88 3	3	Clay	CL/CH	very stiff	125	1.3	18	0.93		100			1.27	6.65

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA   Project No: LE04354   Date: 12/20/04

CONE SOUNDING: CPT-1

Est. GWT (ft): 12.0   Phi Correlation: 0   0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
9.30	30.5	21.60	5.89	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.93		100			1.20	6.00
9.45	31.0	17.19	6.36	3	3	Clay	CL/CH	stiff	125	1.3	14	0.92		100			0.94	4.00
9.60	31.5	20.05	5.47	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.92		100			1.10	5.10
9.75	32.0	19.47	5.50	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.91		100			1.07	4.68
9.90	32.5	21.74	5.63	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.90		100			1.20	5.53
10.05	33.0	23.37	5.76	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.90		100			1.30	6.10
10.20	33.5	20.39	5.56	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.89		100			1.12	4.78
10.38	34.0	15.97	5.12	3	3	Clay	CL/CH	stiff	125	1.3	13	0.89		100			0.86	3.28
10.53	34.5	16.45	4.48	3	3	Clay	CL/CH	stiff	125	1.3	13	0.88		100			0.89	3.35
10.68	35.0	18.50	4.96	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.88		100			1.01	3.91
10.83	35.5	19.11	4.05	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.87		100			1.04	5.21
10.98	36.0	20.64	5.86	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.87		100			1.13	4.47
11.13	36.5	25.44	5.72	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.86		100			1.41	6.21
11.28	37.0	31.72	4.84	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	0.86		100			1.78	>10
11.43	37.5	25.49	3.77	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.85		100			1.41	>10
11.58	38.0	17.68	2.48	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.85		100			0.95	5.66
11.73	38.5	15.25	3.47	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	0.85		100			0.81	3.35
11.88	39.0	20.64	4.84	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.84		100			1.13	4.00
12.05	39.5	15.50	3.51	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	0.84		100			0.82	3.28
12.20	40.0	14.77	2.00	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.83		100			0.78	3.91
12.35	40.5	13.50	2.07	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	5	0.83		100			0.70	3.43
12.50	41.0	15.96	3.29	4	4	Silty Clay to Clay	CL	stiff	125	1.8	9	0.82		100			0.85	3.28
12.65	41.5	15.32	3.05	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.82		100			0.81	4.00
12.80	42.0	14.74	2.01	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.82		100			0.77	3.66
12.95	42.5	17.48	2.54	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.81		100			0.93	4.78
13.10	43.0	22.47	2.80	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.81		100			1.23	7.13
13.25	43.5	20.78	2.49	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.13	6.21
13.40	44.0	21.29	2.62	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.80		100			1.16	6.43
13.58	44.5	19.71	2.35	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.80		100			1.06	5.53
13.73	45.0	19.60	2.17	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.80		100			1.05	5.42
13.88	45.5	18.05	1.84	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.79	13.5	100	13	30		
14.03	46.0	17.42	2.29	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.79		100			0.92	4.28
14.18	46.5	19.49	2.03	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.79	14.5	100	15	30		
14.33	47.0	17.99	2.10	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.96	4.37
14.48	47.5	16.62	1.85	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.88	3.83
14.63	48.0	16.66	1.91	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.78		100			0.88	3.83
14.78	48.5	15.96	1.83	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.77		100			0.83	3.58
14.93	49.0	15.56	1.78	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.77		100			0.81	3.35
15.10	49.5	14.89	1.48	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	4	0.77	10.8	100	7	29		

CLIENT: ORMAT

PROJECT: ORMAT Heber 2 Facilities, Heber, CA

LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight

DATE: 12/20/04

LOG OF CONE SOUNDING DATA CPT-2

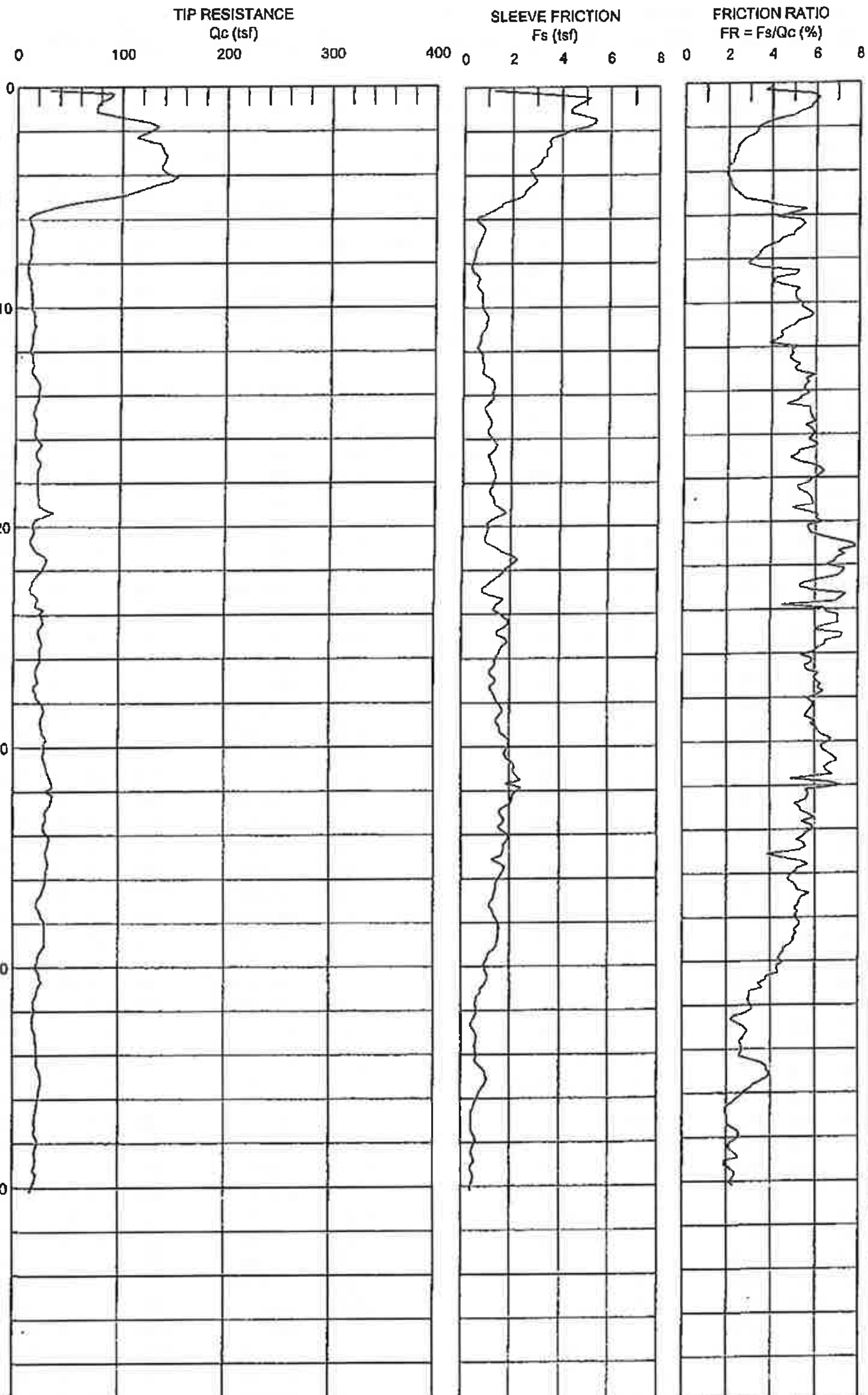
DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

Overconsolidated Soil	??	very dense
Overconsolidated Soil	" "	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Silty Sand to Sandy Silt	" "	very dense
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	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
Clayey Silt to Silty Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	very loose
Sandy Silt to Clayey Silt	" "	very loose

End of Sounding @ 50.0 ft.



Project No:
LE04354

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate
B-2

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA Project No: LE04354 Date: 12/20/04

CONE SOUNDING: CPT-2

Est. GWT (ft): 12.0

Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
0.15	0.5	70.28	4.52	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	28	2.00		50			4.13	>10
0.30	1.0	77.82	5.97	11	11	Overconsolidated Soil	??	very dense	120	1.0	78	2.00	147.1	55	110	43		
0.45	1.5	91.98	5.31	11	11	Overconsolidated Soil	??	very dense	120	1.0	92	2.00	173.9	50	107	43		
0.60	2.0	129.94	3.78	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	37	2.00	245.6	35	113	44		
0.75	2.5	119.62	3.11	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	34	2.00	226.1	30	107	43		
0.93	3.0	137.68	2.51	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	31	2.00	260.3	25	108	43		
1.08	3.5	140.87	2.30	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	31	2.00	266.3	25	106	43		
1.23	4.0	139.35	2.04	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	31	2.00	263.4	20	104	43		
1.38	4.5	144.85	2.01	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	32	2.00	273.8	20	103	42		
1.53	5.0	113.08	2.24	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	25	1.95	208.9	25	94	41		
1.68	5.5	52.70	3.38	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	1.86		50			3.08	>10
1.83	6.0	13.87	4.91	3	3	Clay	CL/CH	stiff	125	1.3	11	1.77		95			0.80	>10
1.98	6.5	15.08	5.36	3	3	Clay	CL/CH	stiff	125	1.3	12	1.70		95			0.87	>10
2.13	7.0	14.77	4.81	3	3	Clay	CL/CH	stiff	125	1.3	12	1.63		95			0.85	>10
2.28	7.5	13.38	3.90	3	3	Clay	CL/CH	stiff	125	1.3	11	1.57		90			0.76	>10
2.45	8.0	12.25	3.27	4	4	Silty Clay to Clay	CL	stiff	125	1.8	7	1.51		90			0.69	>10
2.60	8.5	11.34	3.86	3	3	Clay	CL/CH	stiff	125	1.3	9	1.46		100			0.64	9.79
2.75	9.0	13.62	4.43	3	3	Clay	CL/CH	stiff	125	1.3	11	1.42		95			0.77	>10
2.90	9.5	14.76	4.97	3	3	Clay	CL/CH	stiff	125	1.3	12	1.38		100			0.84	>10
3.05	10.0	15.04	5.19	3	3	Clay	CL/CH	stiff	125	1.3	12	1.34		100			0.85	>10
3.20	10.5	17.24	5.61	3	3	Clay	CL/CH	stiff	125	1.3	14	1.33		100			0.98	>10
3.35	11.0	17.82	5.31	3	3	Clay	CL/CH	very stiff	125	1.3	14	1.31		100			1.01	>10
3.50	11.5	16.22	4.53	3	3	Clay	CL/CH	stiff	125	1.3	13	1.29		100			0.92	>10
3.65	12.0	14.59	4.45	3	3	Clay	CL/CH	stiff	125	1.3	12	1.28		100			0.82	9.19
3.80	12.5	15.95	4.89	3	3	Clay	CL/CH	stiff	125	1.3	13	1.26		100			0.90	>10
3.95	13.0	16.10	5.07	3	3	Clay	CL/CH	stiff	125	1.3	13	1.25		100			0.91	>10
4.13	13.5	20.52	5.55	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.23		100			1.17	>10
4.28	14.0	22.48	5.55	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.22		100			1.28	>10
4.43	14.5	20.89	5.42	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.21		100			1.19	>10
4.58	15.0	17.79	5.37	3	3	Clay	CL/CH	very stiff	125	1.3	14	1.19		100			1.00	>10
4.73	15.5	19.47	5.86	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.18		100			1.10	>10
4.88	16.0	19.76	5.77	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.17		100			1.12	>10
5.03	16.5	22.53	5.91	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.16		100			1.28	>10
5.18	17.0	21.67	5.09	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.15		100			1.23	>10
5.33	17.5	22.15	5.77	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.13		100			1.25	>10
5.48	18.0	21.43	6.10	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.12		100			1.21	>10
5.65	18.5	21.56	5.34	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.11		100			1.22	>10
5.80	19.0	22.73	5.72	3	3	Clay	CL/CH	very stiff	125	1.3	18	1.10		100			1.29	>10
5.95	19.5	30.63	5.48	3	3	Clay	CL/CH	very stiff	125	1.3	25	1.09		95			1.75	>10
6.10	20.0	17.95	6.14	3	3	Clay	CL/CH	very stiff	125	1.3	14	1.08		100			1.00	7.41
6.25	20.5	17.30	5.70	3	3	Clay	CL/CH	stiff	125	1.3	14	1.07		100			0.96	6.65
6.40	21.0	16.60	6.99	3	3	Clay	CL/CH	stiff	125	1.3	13	1.07		100			0.92	6.10
6.55	21.5	26.75	7.44	3	3	Clay	CL/CH	very stiff	125	1.3	21	1.06		100			1.52	>10
6.70	22.0	28.17	6.81	3	3	Clay	CL/CH	very stiff	125	1.3	23	1.05		100			1.60	>10
6.85	22.5	20.17	7.24	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.04		100			1.13	7.85
7.00	23.0	16.15	5.62	3	3	Clay	CL/CH	stiff	125	1.3	13	1.03		100			0.89	5.21
7.18	23.5	21.37	6.84	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.02		100			1.20	8.27
7.33	24.0	24.23	5.98	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.02		100			1.36	>10
7.48	24.5	27.09	6.88	3	3	Clay	CL/CH	very stiff	125	1.3	22	1.01		100			1.53	>10
7.63	25.0	23.97	6.46	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.00		100			1.35	9.39
7.78	25.5	25.90	6.98	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.99		100			1.46	>10
7.93	26.0	24.80	6.17	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.99		100			1.39	9.59
8.08	26.5	22.94	5.66	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.98		100			1.28	8.00
8.23	27.0	22.28	5.92	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.97		100			1.24	7.27
8.38	27.5	20.15	6.14	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.97		100			1.12	6.10
8.53	28.0	24.13	6.05	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.96		100			1.35	8.14
8.68	28.5	28.28	5.86	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.95		100			1.59	>10
8.85	29.0	26.02	5.73	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.95		100			1.46	8.85
9.00	29.5	28.06	6.01	3	3	Clay	CL/CH	very stiff	125	1.3	22	0.94		100			1.58	>10
9.15	30.0	29.72	6.57	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.93		100			1.68	>10

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA Project No: LE04354 Date: 12/20/04

CONE SOUNDING: CPT-2

Est. GWT (ft): 12.0 Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
9.30	30.5	28.55	6.41	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.93		100			1.61	>10
9.45	31.0	31.07	6.84	3	3	Clay	CL/CH	very stiff	125	1.3	25	0.92		100			1.75	>10
9.60	31.5	34.71	6.59	3	3	Clay	CL/CH	very stiff	125	1.3	28	0.92		100			1.97	>10
9.75	32.0	35.27	6.25	3	3	Clay	CL/CH	very stiff	125	1.3	28	0.91		100			2.00	>10
9.90	32.5	37.01	5.65	3	3	Clay	CL/CH	hard	125	1.3	30	0.91		100			2.10	>10
10.05	33.0	32.37	5.31	3	3	Clay	CL/CH	very stiff	125	1.3	26	0.90		100			1.83	>10
10.20	33.5	30.28	5.70	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.89		100			1.70	9.59
10.38	34.0	29.97	5.71	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.89		100			1.68	9.19
10.53	34.5	34.16	5.42	3	3	Clay	CL/CH	very stiff	125	1.3	27	0.88		100			1.93	>10
10.68	35.0	31.53	5.44	3	3	Clay	CL/CH	very stiff	125	1.3	25	0.88		100			1.77	9.79
10.83	35.5	33.18	4.62	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	19	0.87		100			1.87	>10
10.98	36.0	31.41	5.32	3	3	Clay	CL/CH	very stiff	125	1.3	25	0.87		100			1.77	9.19
11.13	36.5	28.95	4.94	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.86		100			1.62	7.70
11.28	37.0	23.74	5.43	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.86		100			1.31	5.42
11.43	37.5	24.03	5.19	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.85		100			1.33	5.42
11.58	38.0	28.73	5.16	3	3	Clay	CL/CH	very stiff	125	1.3	23	0.85		100			1.60	7.13
11.73	38.5	29.89	5.19	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.85		100			1.67	7.56
11.88	39.0	29.55	5.05	3	3	Clay	CL/CH	very stiff	125	1.3	24	0.84		100			1.65	7.27
12.05	39.5	25.32	4.72	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.84		100			1.40	5.53
12.20	40.0	22.19	4.46	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.83		100			1.22	4.37
12.35	40.5	24.43	4.30	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	14	0.83		100			1.35	6.54
12.50	41.0	24.86	3.66	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.82		100			1.37	9.39
12.65	41.5	21.29	3.25	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.82		100			1.16	6.88
12.80	42.0	19.81	3.04	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.82		100			1.07	6.00
12.95	42.5	18.87	2.79	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.02	5.42
13.10	43.0	19.60	2.48	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.06	5.76
13.25	43.5	21.70	2.84	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.81		100			1.18	6.65
13.40	44.0	22.24	2.62	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.80		100			1.21	6.88
13.58	44.5	22.52	2.78	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.80		100			1.23	6.88
13.73	45.0	25.15	3.77	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.80		100			1.38	8.27
13.88	45.5	26.20	3.80	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.79		100			1.44	8.85
14.03	46.0	24.44	3.02	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.79		100			1.34	7.70
14.18	46.5	22.65	2.43	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.79		100			1.23	6.54
14.33	47.0	20.81	1.98	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.78	15.4	100	17	30		
14.48	47.5	20.51	2.12	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.78	15.1	100	17	30		
14.63	48.0	22.61	2.50	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.78		100			1.23	6.32
14.78	48.5	20.83	2.13	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.77	15.2	100	17	30		
14.93	49.0	20.93	2.27	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.77		100			1.13	5.42
15.10	49.5	20.67	2.11	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	6	0.77	15.0	100	16	30		
15.25	50.0	19.06	2.25	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.76		100			1.01	4.47

CLIENT: ORMAT

PROJECT: ORMAT Heber 2 Facilities, Heber, CA

LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: HOLGUIN, FAHAN & ASSC. Truck Mounted Electric Cone with 23 ton reaction weight

DATE: 12/20/04

LOG OF CONE SOUNDING DATA CPT-3

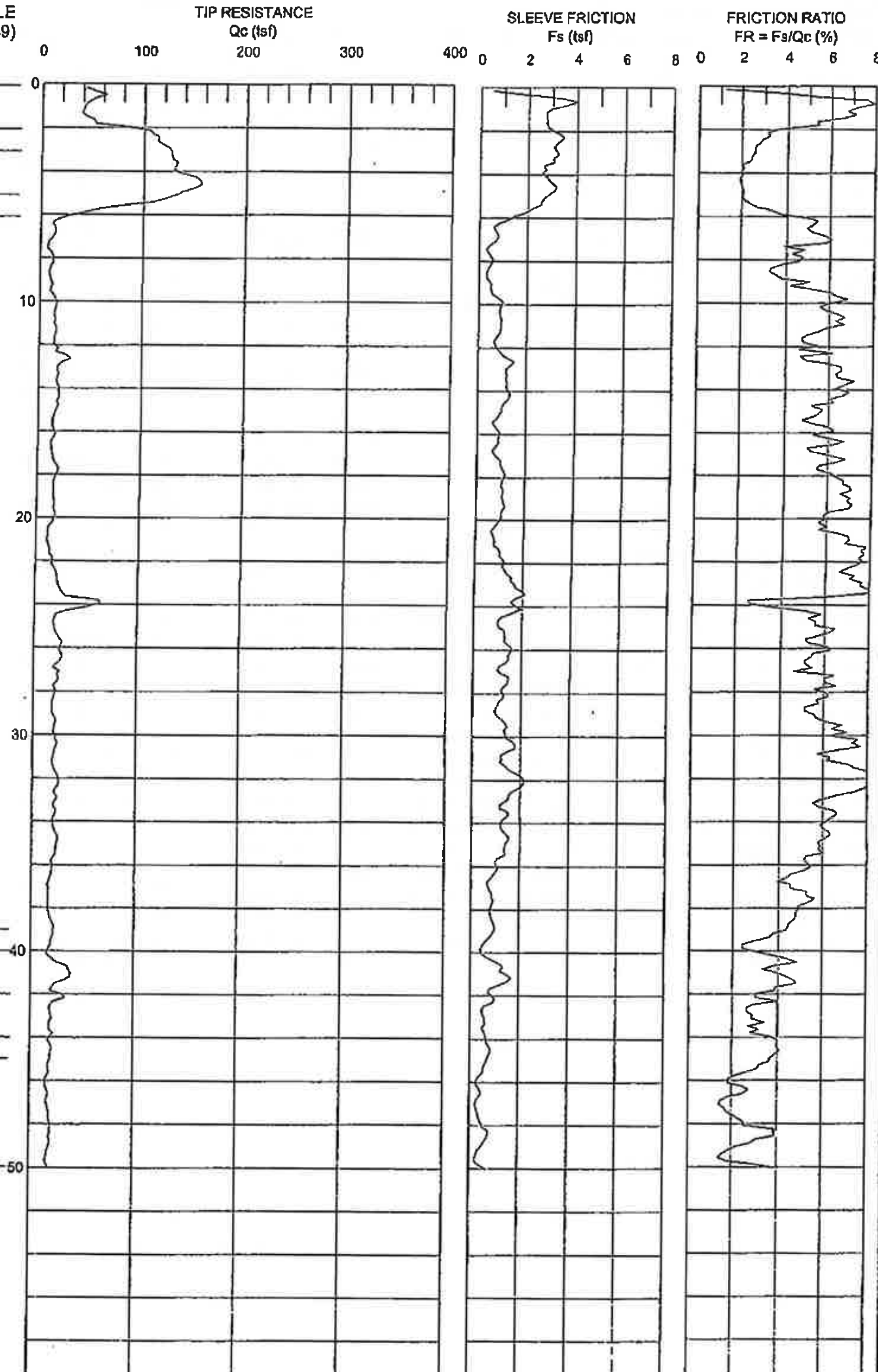
DEPTH (FEET)

INTERPRETED SOIL PROFILE
From Robertson & Campanella (1989)

GROUND EL. +/-

Clay	CL/CH	hard
Clay	" "	hard
Sandy Silt to Clayey Silt	ML	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Sandy Silt to Clayey Silt	ML	dense
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	hard
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	very stiff
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	stiff
Clayey Silt to Silty Clay	" "	stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	stiff

End of Sounding @ 50.0 ft.



Project No: LE04354

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Plate B-3

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA   Project No: LE04354   Date: 12/20/04

CONE SOUNDING: CPT-3

Est. GWT (ft): 12.0   Phi Correlation: 0   0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
0.15	0.5	51.76	3.36	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	2.00		50			3.04	>10
0.30	1.0	46.42	7.56	3	3	Clay	CL/CH	hard	125	1.3	37	2.00		75			2.73	>10
0.45	1.5	40.35	6.79	3	3	Clay	CL/CH	hard	125	1.3	32	2.00		75			2.37	>10
0.60	2.0	61.72	4.80	4	4	Silty Clay to Clay	CL	hard	125	1.8	35	2.00		55			3.62	>10
0.75	2.5	109.67	3.07	6	6	Sandy Silt to Clayey Silt	ML	very dense	115	3.5	31	2.00	207.3	35	104	43		
0.93	3.0	118.60	2.64	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	26	2.00	224.2	30	103	42		
1.08	3.5	127.70	2.43	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	28	2.00	241.4	25	103	42		
1.23	4.0	131.15	2.02	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	29	2.00	247.9	25	102	42		
1.38	4.5	147.55	1.96	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	33	2.00	278.9	20	103	42		
1.53	5.0	148.38	2.05	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	33	1.94	271.7	20	102	42		
1.68	5.5	111.44	2.28	7	7	Silty Sand to Sandy Silt	SM/ML	very dense	115	4.5	25	1.85	194.4	25	92	41		
1.83	6.0	40.17	4.02	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	16	1.76		60			2.34	>10
1.98	6.5	13.36	5.18	3	3	Clay	CL/CH	stiff	125	1.3	11	1.69		100			0.76	>10
2.13	7.0	13.22	5.65	3	3	Clay	CL/CH	stiff	125	1.3	11	1.62		100			0.75	>10
2.28	7.5	7.68	4.85	3	3	Clay	CL/CH	firm	125	1.3	6	1.56		100			0.43	6.10
2.45	8.0	11.50	4.55	3	3	Clay	CL/CH	stiff	125	1.3	9	1.51		100			0.65	>10
2.60	8.5	10.61	3.49	4	4	Silty Clay to Clay	CL	stiff	125	1.8	6	1.46		95			0.60	>10
2.75	9.0	9.81	4.10	3	3	Clay	CL/CH	stiff	125	1.3	8	1.42		100			0.55	6.54
2.90	9.5	10.85	5.09	3	3	Clay	CL/CH	stiff	125	1.3	9	1.38		100			0.61	7.00
3.05	10.0	14.61	6.36	3	3	Clay	CL/CH	stiff	125	1.3	12	1.34		100			0.82	>10
3.20	10.5	14.97	5.91	3	3	Clay	CL/CH	stiff	125	1.3	12	1.32		100			0.85	>10
3.35	11.0	14.49	6.53	3	3	Clay	CL/CH	stiff	125	1.3	12	1.31		100			0.82	>10
3.50	11.5	15.94	5.42	3	3	Clay	CL/CH	stiff	125	1.3	13	1.29		100			0.90	>10
3.65	12.0	14.15	5.01	3	3	Clay	CL/CH	stiff	125	1.3	11	1.27		100			0.79	8.56
3.80	12.5	20.31	5.15	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.26		95			1.16	>10
3.95	13.0	23.81	5.79	3	3	Clay	CL/CH	very stiff	125	1.3	19	1.24		95			1.36	>10
4.13	13.5	18.35	6.42	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.23		100			1.04	>10
4.28	14.0	18.13	6.73	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.22		100			1.02	>10
4.43	14.5	19.70	6.56	3	3	Clay	CL/CH	very stiff	125	1.3	16	1.20		100			1.12	>10
4.58	15.0	18.07	5.71	3	3	Clay	CL/CH	very stiff	125	1.3	14	1.19		100			1.02	>10
4.73	15.5	14.86	5.24	3	3	Clay	CL/CH	stiff	125	1.3	12	1.18		100			0.83	7.00
4.88	16.0	14.60	5.69	3	3	Clay	CL/CH	stiff	125	1.3	12	1.17		100			0.81	6.65
5.03	16.5	13.49	6.25	3	3	Clay	CL/CH	stiff	125	1.3	11	1.16		100			0.75	5.65
5.18	17.0	13.31	5.44	3	3	Clay	CL/CH	stiff	125	1.3	11	1.14		100			0.74	5.31
5.33	17.5	16.20	6.21	3	3	Clay	CL/CH	stiff	125	1.3	13	1.13		100			0.90	7.13
5.48	18.0	19.16	5.98	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.12		100			1.08	9.59
5.65	18.5	15.49	6.80	3	3	Clay	CL/CH	stiff	125	1.3	12	1.11		100			0.86	6.32
5.80	19.0	15.81	6.89	3	3	Clay	CL/CH	stiff	125	1.3	13	1.10		100			0.88	6.32
5.95	19.5	16.32	7.00	3	3	Clay	CL/CH	stiff	125	1.3	13	1.09		100			0.91	6.43
6.10	20.0	17.26	5.95	3	3	Clay	CL/CH	stiff	125	1.3	14	1.08		100			0.96	6.88
6.25	20.5	13.28	5.76	3	3	Clay	CL/CH	stiff	125	1.3	11	1.07		100			0.73	4.37
6.40	21.0	11.14	6.84	3	3	Clay	CL/CH	stiff	125	1.3	9	1.06		100			0.60	3.28
6.55	21.5	12.48	7.40	3	3	Clay	CL/CH	stiff	125	1.3	10	1.06		100			0.68	3.74
6.70	22.0	14.92	7.62	3	3	Clay	CL/CH	stiff	125	1.3	12	1.05		100			0.82	4.89
6.85	22.5	17.77	6.98	3	3	Clay	CL/CH	stiff	125	1.3	14	1.04		100			0.99	6.32
7.00	23.0	21.45	7.34	3	3	Clay	CL/CH	very stiff	125	1.3	17	1.03		100			1.20	8.41
7.18	23.5	24.58	7.84	3	3	Clay	CL/CH	very stiff	125	1.3	20	1.02		100			1.39	>10
7.33	24.0	51.65	3.68	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	21	1.02		70			2.98	>10
7.48	24.5	34.37	4.91	3	3	Clay	CL/CH	very stiff	125	1.3	27	1.01		95			1.96	>10
7.63	25.0	18.84	5.44	3	3	Clay	CL/CH	very stiff	125	1.3	15	1.00		100			1.05	6.10
7.78	25.5	21.09	6.11	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.99		100			1.18	7.13
7.93	26.0	26.12	5.49	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.99		100			1.47	>10
8.08	26.5	26.28	5.55	3	3	Clay	CL/CH	very stiff	125	1.3	21	0.98		100			1.48	>10
8.23	27.0	21.92	5.06	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.97		100			1.22	7.13
8.38	27.5	23.63	6.15	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.97		100			1.32	8.00
8.53	28.0	20.49	6.07	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.96		100			1.14	6.10
8.68	28.5	19.11	5.87	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.95		100			1.06	5.31
8.85	29.0	18.15	5.24	3	3	Clay	CL/CH	stiff	125	1.3	15	0.95		100			1.00	4.78
9.00	29.5	21.72	6.18	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.94		100			1.21	6.32
9.15	30.0	20.63	6.55	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.93		100			1.14	5.65

LANDMARK CONSULTANTS, INC.

CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: ORMAT Heber 2 Facilities, Heber, CA   Project No: LE04354   Date: 12/20/04

CONE SOUNDING: CPT-3

Est. GWT (ft): 12.0   Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %		1 Soil Type	Soil Classification	USC	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Cn or Cq	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17.0 Su (tsf)	OCR
9.30	30.5	22.90	7.51	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.93		100			1.27	6.54
9.45	31.0	20.57	6.23	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.92		100			1.14	5.42
9.60	31.5	19.55	6.90	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.92		100			1.08	4.89
9.75	32.0	23.76	8.37	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.91		100			1.32	6.54
9.90	32.5	24.30	8.05	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.90		100			1.35	6.65
10.05	33.0	22.78	6.54	3	3	Clay	CL/CH	very stiff	125	1.3	18	0.90		100			1.26	5.88
10.20	33.5	21.56	5.91	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.89		100			1.19	5.31
10.38	34.0	20.82	6.40	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.89		100			1.15	4.89
10.53	34.5	21.17	6.04	3	3	Clay	CL/CH	very stiff	125	1.3	17	0.88		100			1.17	4.89
10.68	35.0	24.71	6.05	3	3	Clay	CL/CH	very stiff	125	1.3	20	0.88		100			1.37	6.21
10.83	35.5	23.14	5.91	3	3	Clay	CL/CH	very stiff	125	1.3	19	0.87		100			1.28	5.53
10.98	36.0	19.96	5.21	3	3	Clay	CL/CH	very stiff	125	1.3	16	0.87		100			1.09	4.28
11.13	36.5	19.03	4.88	3	3	Clay	CL/CH	very stiff	125	1.3	15	0.86		100			1.04	3.91
11.28	37.0	16.19	4.33	3	3	Clay	CL/CH	stiff	125	1.3	13	0.86		100			0.87	3.07
11.43	37.5	16.02	5.36	3	3	Clay	CL/CH	stiff	125	1.3	13	0.85		100			0.86	3.00
11.58	38.0	16.15	5.06	3	3	Clay	CL/CH	stiff	125	1.3	13	0.85		100			0.86	3.00
11.73	38.5	17.81	4.75	3	3	Clay	CL/CH	stiff	125	1.3	14	0.85		100			0.96	3.35
11.88	39.0	21.66	4.41	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	0.84		100			1.19	5.65
12.05	39.5	20.18	3.42	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.84		100			1.10	6.65
12.20	40.0	17.00	2.62	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.83		100			0.91	5.00
12.35	40.5	20.64	4.32	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	12	0.83		100			1.12	5.00
12.50	41.0	36.57	3.70	5	5	Clayey Silt to Silty Clay	ML/CL	hard	120	2.5	15	0.82		95			2.06	>10
12.65	41.5	31.64	4.64	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	18	0.82		100			1.77	>10
12.80	42.0	23.58	3.56	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	9	0.82		100			1.29	8.14
12.95	42.5	24.97	3.28	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	10	0.81		100			1.37	8.85
13.10	43.0	19.07	2.71	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.03	5.42
13.25	43.5	18.86	2.98	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.81		100			1.01	5.31
13.40	44.0	19.54	3.20	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.80		100			1.05	5.53
13.58	44.5	19.29	3.97	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.80		100			1.04	3.91
13.73	45.0	19.79	3.86	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.80		100			1.07	4.00
13.88	45.5	17.66	3.31	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.79		100			0.94	4.47
14.03	46.0	16.42	2.18	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.79		100			0.87	3.91
14.18	46.5	15.61	2.35	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	6	0.78		100			0.82	3.58
14.33	47.0	16.68	1.80	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.78	12.3	100	11	29		
14.48	47.5	18.25	1.80	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.78	13.4	100	13	30		
14.63	48.0	19.39	2.43	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.78		100			1.04	4.89
14.78	48.5	19.39	3.87	4	4	Silty Clay to Clay	CL	very stiff	125	1.8	11	0.77		100			1.04	3.58
14.93	49.0	19.13	2.69	5	5	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.5	8	0.77		100			1.02	4.57
15.10	49.5	16.46	1.59	6	6	Sandy Silt to Clayey Silt	ML	very loose	115	3.5	5	0.77	11.9	100	10	29		
15.25	50.0	16.91	2.83	5	5	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.5	7	0.76		100			0.89	3.74

APPENDIX C

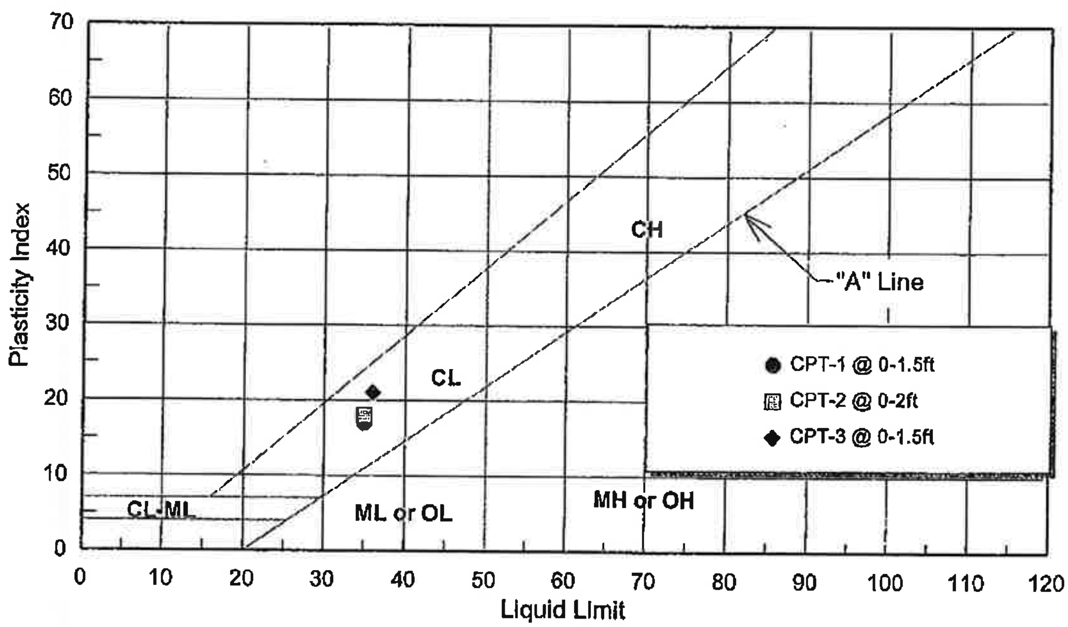
LANDMARK CONSULTANTS, INC.

CLIENT: ORMAT
PROJECT: ORMAT Heber 2 Facilities, Heber, CA
JOB NO: LE04354
DATE: 12/28/04

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classif-ation
CPT-1	0-1.5	35	18	17	CL
CPT-2	0-2	35	17	18	CL
CPT-3	0-1.5	36	15	21	CL

PLASTICITY CHART



LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No: LE04354

Atterberg Limits Test Results

Plate C-1

LANDMARK CONSULTANTS, INC.

CLIENT: ORMAT
PROJECT: ORMAT Heber 2 Facilities, Heber, CA
JOB NO: LE04354
DATE: 12/28/04

CHEMICAL ANALYSES

Boring:	CPT-1	CPT-1	CPT-2	CPT-2	CalTrans
Sample Depth, ft:	0-1.5	1.5-3	0-2	2-3	Method
pH:	7.9	7.9	7.8	7.9	643
Electrical Conductivity (mmhos):	2.5	1.7	1.8	0.9	424
Resistivity (ohm-cm):	260	1000	300	1000	643
Chloride (Cl), ppm:	3,040	230	1,490	220	422
Sulfate (SO4), ppm:	2,812	3,006	1,500	1,106	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble	0 -1000	Low
	Sulfates	1000 - 2000	Moderate
		2000 - 20,000	Severe
		> 20,000	Very Severe
Normal	Soluble	0 - 200	Low
Grade	Chlorides	200 - 700	Moderate
Steel		700 - 1500	Severe
		> 1500	Very Severe
Normal	Resistivity	1-1000	Very Severe
Grade		1000-2000	Severe
Steel		2000-10,000	Moderate
		10,000+	Low

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No: **LE04354**

Selected Chemical Analyses Results

Plate C-2

LANDMARK CONSULTANTS, INC.

CLIENT: ORMAT
PROJECT: ORMAT Heber 2 Facilities, Heber, CA
JOB NO: LE04354
DATE: 12/28/04

CHEMICAL ANALYSES

Boring:	CPT-3	CPT-3	CalTrans
Sample Depth, ft:	0-1.5	1.5-3	Method
pH:	7.9	7.8	643
Electrical Conductivity (mmhos):	1.5	1.3	424
Resistivity (ohm-cm):	450	1000	643
Chloride (Cl), ppm:	570	210	422
Sulfate (SO4), ppm:	1,785	1,052	417

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 -1000	Low
		1000 - 2000	Moderate
		2000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1500	Severe
		> 1500	Very Severe
Normal Grade Steel	Resistivity	1-1000	Very Severe
		1000-2000	Severe
		2000-10,000	Moderate
		10,000+	Low

LANDMARK
Geo-Engineers and Geologists
a DBE/MBE/SBE Company

Project No: LE04354

Selected Chemical Analyses Results

Plate C-3

APPENDIX D

REFERENCES

Arango I., 1996, Magnitude Scaling Factors for Soil Liquefaction Evaluations: ASCE Geotechnical Journal, Vol. 122, No. 11.

Bartlett, Steven F. and Youd, T. Leslie, 1995, Empirical Prediction of Liquefaction-Induced Lateral Spread: ASCE Geotechnical Journal, Vol. 121, No. 4.

Blake, T. F., 2000, FRISKSP - A computer program for the probabilistic estimation of seismic hazard using faults as earthquake sources.

Boore, D. M., Joyner, W. B., and Fumal, T. E., 1997, Empirical Near-Source Attenuation Relationships for Horizontal and Vertical Components of Peak Ground Acceleration, Peak Ground Velocity, and Pseudo-Absolute Acceleration Response Spectra: Seismological Research Letters, Vol. 68, No. 1, p. 154-179.

Building Seismic Safety Council (BSSC), 1991, NEHRP recommended provisions for the development of seismic regulations of new buildings, Parts 1, 2 and Maps: FEMA 222, January 1992

California Division of Mines and Geology (CDMG), 1996, California Fault Parameters: available at http://www.consrv.ca.gov/dmg/shezp/fltindex.html.

California Division of Mines and Geology (CDMG), 1962, Geologic Map of California – San Diego-El Centro Sheet: California Division of Mines and Geology, Scale 1:250,000.

Ellsworth, W. L., 1990, Earthquake History, 1769-1989 in: The San Andreas Fault System, California: U.S. Geological Survey Professional Paper 1515, 283 p.

International Conference of Building Officials (ICBO), 1997, Uniform Building Code, 1997 Edition.

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.

Jennings, C. W., 1994, Fault activity map of California and Adjacent Areas: California Division of Mines and Geology, DMG Geologic Map No. 6.

Jones, L. and Hauksson, E., 1994, Review of potential earthquake sources in Southern California: Applied Technology Council, Proceedings of ATC 35-1.

Maley, R. P. and Etheredge, E. C., 1981, Strong motion data from the Westmorland, California earthquake of April 26, 1981: U.S. Geological Survey Open File Report 81-1149, 18 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.

Mualchin, L. and Jones, A. L., 1992, Peak acceleration from maximum credible earthquakes in California (Rock and Stiff Soil Sites): California Division of Mines and Geology, DMG Open File Report 92-01.

Naeim, F. and Anderson, J. C., 1993, Classification and evaluation of earthquake records for design: Earthquake Engineering Research Institute, NEHRP Report.

National Research Council, Committee of Earthquake Engineering, 1985, Liquefaction of Soils during Earthquakes: National Academy Press, Washington, D.C.

Porcella, R., Etheredge, E., Maley, R., and Switzer, J., 1987, Strong motion data from the Superstition Hills earthquake of November 24, 1987: U.S. Geological Survey Open File Report 87-672, 56 p.

Robertson, P. K. and Wride, C. E., 1996, Cyclic Liquefaction and its Evaluation based on the SPT and CPT, Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils, NCEER Technical Report 97-0022, p. 41-88.

Seed, Harry B., Idriss, I. M., and Arango I., 1983, Evaluation of liquefaction potential using field performance data: ASCE Geotechnical Journal, Vol. 109, No. 3.

Seed, Harry B., et al, 1985, Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations: ASCE Geotechnical Journal, Vol. 113, No. 8.

Sharp, R. V., 1982, Tectonic setting of the Imperial Valley region: U.S. Geological Survey Professional Paper 1254, p. 5-14.

Sylvester, A. G., 1979, Earthquake damage in Imperial Valley, California May 18, 1940, as reported by T. A. Clark: Bulletin of the Seismological Society of America, v. 69, no. 2, p. 547-568.

Tokimatsu, K. and Seed H. B., 1987, Evaluation of settlements in sands due to earthquake shaking: ASCE Geotechnical Journal, v. 113, no. 8.

U.S. Geological Survey (USGS), 1982, The Imperial Valley California Earthquake of October 15, 1979: Professional Paper 1254, 451 p.

U.S. Geological Survey (USGS), 1990, The San Andreas Fault System, California, Professional Paper 1515.

U.S. Geological Survey (USGS), 1996, National Seismic Hazard Maps: available at http://gldage.cr.usgs.gov

Working Group on California Earthquake Probabilities (WGCEP), 1992, Future seismic hazards in southern California, Phase I Report: California Division of Mines and Geology.

Working Group on California Earthquake Probabilities (WGCEP), 1995, Seismic hazards in southern California, Probable Earthquakes, 1994-2014, Phase II Report: Southern California Earthquake Center.

Youd, T. Leslie and Garris, C. T., 1995, Liquefaction induced ground surface disruption: ASCE Geotechnical Journal, Vol. 121, No. 11.

Youd, T. L. et. al., 2001, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils: Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, p. 817-833.

Zimmerman, R. P., 1981, Soil survey of Imperial County, California, Imperial Valley Area: U.S. Dept. of Agriculture Soil Conservation Service, 112 p.

AIR SCIENCES INC.

TECHNICAL MEMORANDUM

DENVER • PORTLAND • LOS ANGELES

AIR QUALITY ANALYSIS SUMMARY FOR THE ORMAT HEBER 2 GEOTHERMAL REPOWER PROJECT

PREPARED FOR:	Ben Pogue, Catalyst Environmental Solutions
PREPARED BY:	Joel Firebaugh, Air Sciences Inc.
PROJECT NO.:	246-2-1
COPIES:	Melissa Wendt, ORMAT Nevada Inc.
DATE:	August 12, 2019

The Second Imperial Geothermal Company (SIGC), a wholly owned subsidiary of ORMAT Nevada Inc. (ORMAT), proposes to replace six existing water-cooled ORMAT Energy Converters (OECs) with two new water-cooled OECs at the Heber 2 Geothermal Energy Complex in Imperial County, CA. The project also entails installing three new 10,000 gallon above ground storage tanks to accommodate additional isopentane. The project will affect volatile organic compound (VOC) air emissions at the facility. The proposed changes are not expected to affect emission rates of other regulated pollutant emissions.

1.0 Project Description

The Heber 2 Complex is a geothermal power generation facility located on private lands owned by SIGC/ORMAT in southern Imperial County. The facility operates under Imperial County Air Pollution Control District (ICAPCD) Permit to Operate (PTO) #2217A-4. Heber 2 currently consists of six Integrated Two-Level Units (ITLU) which have a gross combined power output rating of 36 megawatts. PTO #2217A-4 also covers two adjacent, connected facilities to Heber 2: Goulds 2 and Heber South. These two facilities each consist of one ORMAT Energy Converter (OEC) with gross outputs of 10 and 12 megawatts, respectively. Ancillary equipment for the combined facilities includes cooling towers, an evacuation skid/vapor recovery maintenance unit (VRMU), motive fluid (MF) storage tanks, and diesel engines for emergency use.

The proposed development would occur entirely on Assessor's Parcel Number (APN) 054-250-031, which is a 39.99-acre property. The address for Heber 2 is 855 Dogwood Road, Heber, CA 92249.

1.1 Proposed Development

Development of the proposed project includes the installation of two new OEC units, manufactured by ORMAT, to replace the six existing ITLUs which were also manufactured by ORMAT in 1992. The total disturbance would be approximately 4 acres, entirely within the existing Heber 2 site. The existing ITLUs will either be demolished or abandoned in place. The development site is completely devoid of any vegetation and is actively disturbed as part of ongoing energy generation operations at the Heber 2 Complex. Considering its current condition, site preparation for the installation of the proposed facilities would be limited to light excavation and soil compaction.

ORMAT Energy Converter-1 (OEC-1)

The proposed OEC-1 unit is a two-turbine combined cycle binary unit, operating on a subcritical Rankine cycle, with isopentane as the motive fluid for the system. This system also consists of a generator, vaporizer, water cooled condensers, preheaters and recuperators, with the OEC served by the existing evacuation skid/vapor recovery maintenance unit for purging and maintenance events. The design capacity for the unit is 25.43 MW gross.

ORMAT Energy Converter-2 (OEC-2)

The proposed OEC-2 unit is a two-cycle binary unit, operating on a subcritical Rankine cycle, with isopentane as the motive fluid for the system. This system also consists of a generator, turbines, vaporizers, water cooled condensers and preheaters, with the OEC served by the existing evacuation skid/vapor recovery maintenance unit (VRMU) for purging and maintenance events. The design capacity for the unit is 14.01 MW gross.

Three Additional Isopentane Above Ground Storage Tanks

To support the new OEC units, three new storage tanks for additional isopentane supply would be installed. There are two existing storage tanks at Heber 2 and one at Goulds 2. The new tanks would be sited adjacent to the existing Heber 2 tanks. Each of the new and existing tanks has a capacity of 10,000 gallons.

2.0 Existing Air Emissions

The Heber 2 facility is a minor source of air pollution and operates in compliance with all applicable air quality requirements and its permit to operate (PTO #2217A-4). Air emission sources currently at the facility include the geothermal power generating units, cooling towers, VRMU, and emergency diesel equipment.

The existing power generating units (6 ITLUs and 2 OECs) have a combined gross power generating capacity of 58 megawatts. These units generate power by taking geothermal energy (e.g. heat) to vaporize liquid isopentane, which is the motive fluid that powers the turbines to create electricity.

The primary air pollutant from the facility is isopentane, which is a VOC. Isopentane emissions occur due to maintenance, purging, and fugitive leaks. During maintenance, the unit is shut down and the isopentane is evacuated before the system is opened for the necessary work to be performed. To evacuate the system, the liquid isopentane is transferred to storage tanks, and the remaining vapors are passed through the VRMU. The overall recovery rate of isopentane during evacuation is greater than 99.9%. However, trace quantities of vapors as well as liquid collected at low points in the system where the liquid cannot be completely drained result in VOC emissions when the unit is opened to the atmosphere.

Purging is the process by which impurities are removed from the isopentane closed circuit. Contamination of the isopentane causes operating efficiency losses, so purging is performed on a regular basis. Vapors are passed through the VRMU and the isopentane is collected and returned to the system while other gases are removed.

Fugitive losses of isopentane can occur due to failing seals, valves, flanges, etc.

Current permitted emission limits for the facility are provided in Table 1. In addition to isopentane emissions, there are particulate emissions from the cooling towers as well as particulates, NO_X, CO, SO_2, and VOC emissions from the emergency diesel engines. Potential emissions of PM_{10}, $PM_{2.5}$, NO_X, CO, SO_2 and VOCs from the cooling towers and diesel engines, combined, are less than 2 tons per year for each pollutant.

Table 1. Facility-wide Isopentane Emission Limits

Emission Source	Isopentane Emission Limit
1st Quarter (Jan – Mar)	185 lbs/day
2nd Quarter (Apr – Jun)	137 lbs/day
3rd Quarter (Jul – Sep)	137 lbs/day
4th Quarter (Oct – Dec)	218 lbs/day

Emissions are calculated on a quarterly average basis.

3.0 Method for Predicting Emissions for Proposed Development

The proposed changes to the facility do not include changes to the cooling towers or emergency diesel equipment. The only expected change to emissions from the proposed development is the isopentane emissions from the geothermal power generating units (OECs and ITLUs).

Future potential isopentane emissions were estimated based on actual emissions from the facility for the previous two years. Isopentane emissions are related to the size of the system, so emissions were estimated by scaling the previous actual emissions according to the change in MF volume at the facility. The existing six ITLUs and two OECs have a combined volume of 120,000 gallons, and the three MF storage tanks have a total capacity of 30,000 gallons. After the proposed development, the combined volume of the existing and new OECs will be 111,000 gallons, and the MF tanks will have 60,000 gallons total capacity.

Maintenance and fugitive emissions were also adjusted for the decreased complexity of the new units. By replacing six smaller units with two larger units, the number of seals, flanges, pumps valves, etc. is reduced significantly. A 50% emission reduction factor was applied to account for the approximately 50% fewer potential sites for leaks and equipment failure.

Isopentane emissions were estimated as follows:

- Maintenance and purging emissions were estimated based on the worst-case quarterly emissions for maintenance and purging from the previous two years. These emission rates were scaled based on the ratio of the future OEC volume (111,000 gallons) to the existing ITLU plus OEC volume (120,000 gallons). Maintenance emissions were then scaled using the 50% reduction factor described above.

- Fugitive emissions were estimated based on the worst-case quarterly emission rate over the last two years, scaled based on the total system capacity of the system including MF tanks (171,000 gallons proposed versus 150,000 existing). Emissions were then scaled with the 50% reduction factor described above.

This emission estimation method is a reasonably conservative estimate (e.g. an overestimation) of future emissions. The new units benefit from improvements in the design and technology that have occurred during the decades since the existing units were constructed. These improvements reduce fugitive leaks as well as emissions during MF evacuation for maintenance but are not accounted for in the emission estimate. Additionally, these new units are expected to have lower emissions because the units they are replacing have higher maintenance requirements due to their age.

4.0 Potential Emissions Summary for Proposed Development

Previous actual isopentane emissions, estimated potential emissions, as well as emission limits in PTO #2217A-4 for the Heber 2 Complex are given below in Table 2. Note that the estimated emissions for the facility after the proposed development remain below the current permitted emission limits. The estimated emissions are reasonably conservative for the reasons described above.

Table 2. Actual and Potential Emissions for Heber 2 Facility

	Facility Total Emissions	
Isopentane Emissions	**lbs / day**	**tons / year**
Actual Emissions (2017 – 2018)	117.5	14.9
Estimated Potential Emissions	64.5	11.8
Emissions Increase	-52.9	-3.1
Current Permit Limit (varies)	137 - 218	
Proposed Permit Limit (varies)	137 - 202	

The currently permitted isopentane emission limits vary by calendar quarter. In quarters two and three, the limit is 137 pounds per day. In quarters one and four, additional facility maintenance is typically performed, which potentially increase emissions. The current limit for the first quarter is 185 pounds per day and the fourth quarter limit is 218 pounds per day. The proposed reduction in OEC total size from 130,000 to 121,000 will reduce the volume of isopentane that needs to be evacuated for maintenance operations. SIGC is requesting to reduce the isopentane emission limits by an amount equivalent to the reduction in OEC volume (7.5%) for the two quarter with higher maintenance emissions. The proposed limits are 171 and 202 pounds per day for the first and fourth quarters, respectively.

The proposed changes are not expected to affect emissions of other regulated pollutants.

5.0 Air Quality Protection Measures

ORMAT has implemented measures to limit air emissions at Heber 2. These measures include but are not limited to the following:

- A water truck is used on site to control fugitive dust emissions.
- A five mile per hour speed limit at the site further reduces fugitive dust emissions.
- During windy conditions, additional watering is conducted to minimize wind-blown fugitive dust.
- Equipment is operated according to best practices and maintained according to design specifications.
- The OECs and ITLUs are inspected for leaks using specialized leak detection equipment during every shift, and leaks are repaired quickly.

- Any breakdown resulting in air emissions is reported to ICAPCD and corrected promptly (within 24 hours when possible).
- The VRMU is tested annually to confirm proper function and high isopentane recovery rates.

ORMAT

ORMAT, HEBER 2

GEOTHERMAL POWER GENERATION FACILITY

HEBER, CALIFORNIA

Hazard Assessment for Heber 2 Expansion Project

Revision	Date	Description
0.0	July 10, 2019	Initial Issue

RMP

Risk Management Professionals, Inc.

Two Venture Plaza, Suite 500, Irvine, California 92618

Phone: 949-282-0123 – E-mail: Client.Services@RMPCorp.com

TABLE OF CONTENTS

1.0 FACILITY OVERVIEW 1
2.0 COVERED PROCESS 2
3.0 LEVEL OF CONCERN 2
4.0 WORST-CASE SCENARIO 3
4.1 WORST-CASE SCENARIO SELECTION PROCESS 4
4.2 FLAMMABLE RELEASE POTENTIAL CONSEQUENCES 5
4.3 ENDPOINTS 6
4.4 MODELING ASSUMPTIONS 7
4.5 WORST-CASE RELEASE SCENARIO 8
4.6 WORST-CASE ANALYSIS CONSIDERATIONS 10
5.0 ALTERNATIVE RELEASE SCENARIO 10
5.1 ALTERNATIVE RELEASE SCENARIO SELECTION PROCESS 11
5.2 MODELING ASSUMPTIONS 13
5.3 ALTERNATIVE RELEASE SCENARIO 14
5.4 ALTERNATIVE RELEASE ANALYSIS CONSIDERATIONS 15
6.0 OFFSITE IMPACTS 15
6.1 IMPACTED POPULATION 15
6.2 OFFSITE SENSITIVE RECEPTOR DATA SOURCES 16
6.3 OFFSITE SENSITIVE RECEPTORS 17
7.0 WORST-CASE RELEASE AND ALTERNATIVE RELEASE SCENARIOS 19
7.1 WORST-CASE SCENARIO 19
7.2 ALTERNATIVE RELEASE SCENARIO 20
8.0 FIVE YEAR ACCIDENT HISTORY 22
9.0 REFERENCES 22

LIST OF TABLES

Table 1: Ormat—Heber 2 Geothermal Complex Facility Covered Process 2
Table 2: Worst Case Release Scenario Dispersion Modeling Parameters 8
Table 3: Worst-Case Scenario Results Summary 10
Table 4: Alternative Release Scenario Dispersion Modeling Parameters 13
Table 5: Alternative Release Scenario Result Summary 15

Table 6: Impacted Population for OCA Scenarios 16
Table 7: Websites and Software Used 16
Table 8: Summary of Sensitive and Environmental Receptors 17
Table 9: Worst-Case Scenario Parameter/Input Summary 19
Table 10: Worst-Case Scenario Parameter/Input Summary 20
Table 11: WCS Modeling Parameters A-3
Table 12: ARS Modeling Parameters B-4

LIST OF FIGURES

Figure 1: Aerial View of the Facility Location 1
Figure 2: Worst-Case Scenario Selection Process 5
Figure 3: Alternative Release Scenario Selection Process 12
Figure 4: WCS EPA RMP*Comp Modeling Results A-4
Figure 5: WCS MARPLOT 5.1.1 Population Estimates B-5
Figure 6: ARS EPA RMP*Comp Modeling Results B-5
Figure 7: ARS MARPLOT 5.1.1 Population Estimates B-6

LIST OF APPENDICES

Appendix A: Worst-Case Scenario Calculations
Appendix B: Alternative Case Scenario Calculations

1.0 FACILITY OVERVIEW

This technical assessment was conducted to fulfill the Hazard Assessments Offsite Consequence Analysis (OCA) requirements of the following regulations:

- 40 CFR §68.65 – Environmental Protection Agency (EPA) "Risk Management Plan (RMP)"[1]
- 19 CCR 2750.1 to 2750.9 – California Code of Regulation "California Accidental Release Prevention (CalARP) Program"[2]

This assessment is completed for the **Ormat – Heber 2 Geothermal Complex** Facility located in Heber, California. The facilitie's location at 885 Dogwood Road, Heber, CA 92249 is illustrated in Figure 1 below. The yellow marker depicts the location of the three 10,000 gallon isopentane vessels.

Figure 1: Aerial View of the Facility Location

COVERED PROCESS	FORMAT	LATITUDE	LONGITUDE
Isopentane Vessel 1	Degrees/Minutes/Seconds	32°42'51.20"N	115°32'10.47"W
Isopentane Vessel 2	Degrees/Minutes/Seconds	32°42'51.38"N	115°32'10.44"W

Isopentane Vessel 3	Degrees/Minutes/Seconds	32°42'51.56"N	115°32'10.43"W

2.0 COVERED PROCESS

The ***Ormat – Heber 2 Geothermal Complex*** has three geothermal electrical generating plants in Heber, CA operated by Ormat Nevada, Inc. Heber 2 consists of the H2, Gould-2 (G-2), and Heber South binary processes. The projects use the renewable geothermal resources of the Heber Known Geothermal Resource Area (KGRA) to generate electrical power.

The Heber 2 Geothermal Project produces electricity by using a vaporized motive fluid to spin a turbine connected to a generator. In the H2 binary processes, isopentane is the motive fluid.

The covered processes at the facility are listed below.

Table 1: Ormat—Heber 2 Geothermal Complex Facility Covered Process

PLANT	REGULATED SUBSTANCE	INVENTORY IN SINGLE VESSEL (LBS.)	TANK TYPE	LARGEST STORAGE INVENTORY
Heber 2	Isopentane	51,400	Storage	10,000 gallon tank

This hazard assessment will focus on the regulated substance, isopentane, in Heber 2. The facility is classified as Prevention Program 3 and is regulated by the Environmental Protection Agency's Risk Management Program (EPA RMP) for Chemical Accidental Release Prevention in accordance with the Code of Federal Regulations, Title 40, Chapter I, Subchapter C, Part 68, Subpart B Sections 68.20 to 68.42 (40 CFR §68.20 - 68.42)[1] for isopentane, because it is held on site in excess of 10,000 lbs. The unit is a geothermal power plant and utilizes isopentane as the motive fluid in the generation of electricity.

3.0 LEVEL OF CONCERN

To address potential health effects for the worst-case release scenario, the following are the key endpoints of concern for the EPA RMP as defined in Title 40 CFR Section 68.22(2):

(i) *Explosion. An overpressure of 1 psi.*

(ii) *Radiant heat/exposure time. A radiant heat of 5 kW/m^2 for 40 seconds.*

(iii) *Lower flammability limit. A lower flammability limit as provided in NFPA documents or other generally recognized sources.*

The distance from the point of release to the endpoint identified above defines a radius circle of concern for which consequences are reported in the Risk Management Plan.

4.0 WORST-CASE SCENARIO

The US EPA RMP determines the worst-case release quantity in Title 40 CFR Part 68.25(b) as follows:

The worst-case release quantity shall be the greater of the following:

(1) For substances in a vessel, the greatest amount held in a single vessel, taking into account administrative controls that limit the maximum quantity;

(2) For substances in pipes, the greatest amount in a pipe, taking into account administrative controls that limit the maximum quantity.

Given the substance released is a flammable, the US EPA RMP gives further guidelines in 68.25 (f):

Worst-Case scenario-flammable liquids. The owner or operator shall assume that the quantity of the substance, as determined under paragraph (b) of this section and the provisions below, vaporizes resulting in a vapor cloud explosion. A yield factor of 10 percent of the available energy released in the explosion shall be used to determine the distance to the explosion endpoint if the model used is based on TNT equivalent methods.

(1) For regulated flammable substances that are normally liquids at ambient temperature, the owner or operator shall assume that the entire quantity in the vessel or pipe as determined under paragraph (b) of this section, is spilled instantaneously to form a liquid pool. For liquids at temperatures below their atmospheric boiling point, the volatilization rate shall be calculated at the condition specified in paragraph (d) of this section.

(2) The owner or operator shall assume that the quantity which becomes vapor in the first 10 minutes is involved in the vapor cloud explosion.

Normally, to develop the worst-case scenario, the covered process is reviewed and a suitable worst-case release analysis is identified through a review of vessels and storage tanks to determine the single vessel with the largest quantity of the regulated substance. However, in this particular Hazard Assessment, the worst-case scenario instead analyzes a release from one of the three new 10,000 gallon isopentane storage vessels. This updated Hazard Assessment was performed to account for the modifications made to Heber 2 as part of the facility's expansion project, and thus, an exclusive examination of the three new 10,000 gallon storage vessels was performed rather than a review of the entire facility.

The 10,000 gallon isopentane storage vessel located closest to the residential neighborhood northeast of the plant was examined as a representative sample for the worst-case release scenario since this vessel has the largest potential to impact the community. EPA's RMP*Comp[3] modeling software was used to determine the distance to the endpoint for the worst-case release scenario analysis. The vulnerability zone resulting from this analysis was then reviewed. A vulnerability zone is defined as a circle whose center is the point of release and its radius is the length of the endpoint, which is predicted by the dispersion model (e.g., RMP*Comp).

4.1 Worst-Case Scenario Selection Process

The process of worst-case release scenario identification is summarized as follows. Figure 2 on the following page depicts the steps in this process.

- **Inventory Calculation**: The first step was to perform the inventory calculations for the 10,000 gallon storage vessels in the covered units and systems.
- **Screening Analysis**: The 10,000 gallon isopentane storage vessels' location was screened, and the single vessel that had the greatest potential to impact the community was selected for analysis. Once this vessel was identified, RMP*Comp was used to model the scenarios and determine the dispersion endpoints for the worst-case release scenarios. This was performed to determine the vulnerability zone associated with the worst-case release scenarios.
- **Review of the Vulnerability Zone**: The vulnerability zone resulting from the previous step was reviewed and is representative for the plant's worst-case scenario.
- **Worst-Case Analysis**: To document the worst-case scenario, the potential public receptors within the vulnerability zone were identified. All modeling inputs, calculations and assumptions are documented.

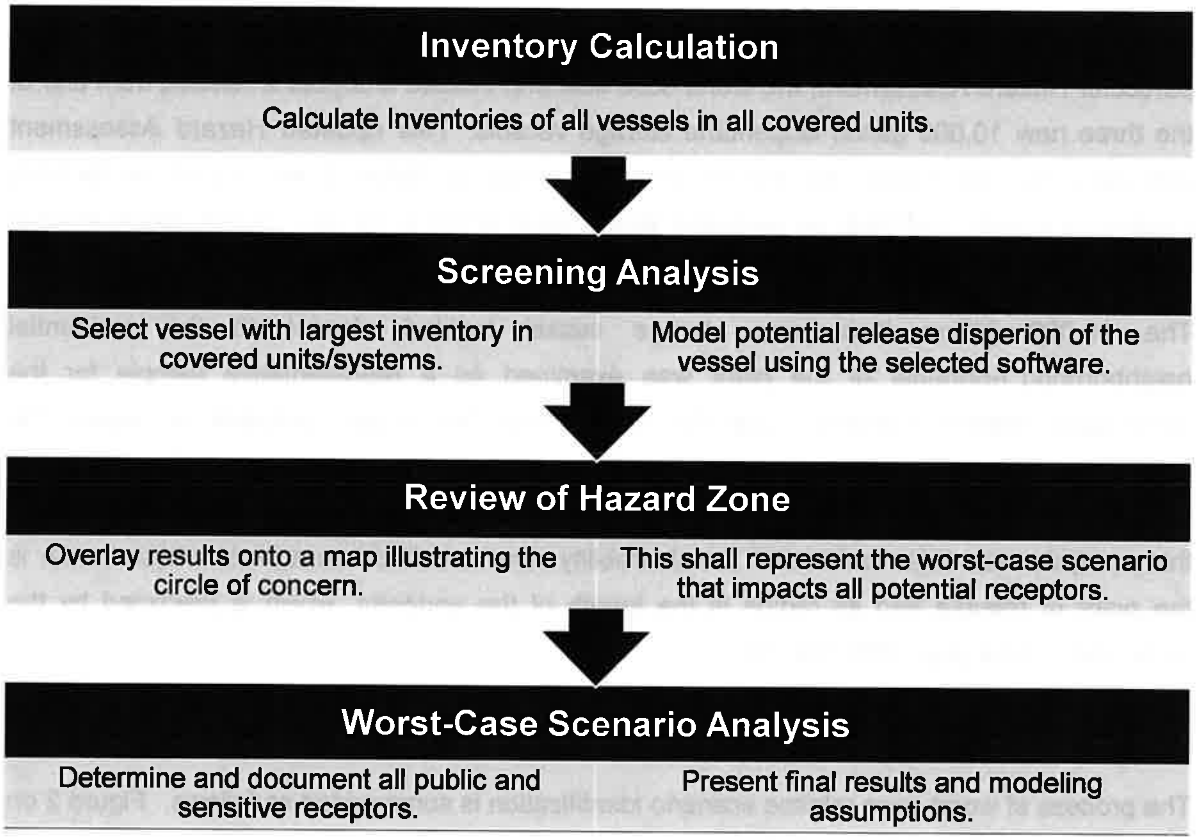


Figure 2: Worst-Case Scenario Selection Process

4.2 Flammable Release Potential Consequences

Several possible consequences of releases of flammable substances are discussed below. It should be noted that the following possible consequences apply to not only worst-case release analysis.

- **Flash Fire**. This event may result from dispersion of a flammable vapor cloud and ignition of the cloud following dispersion. Such a fire could flash back and could represent a severe heat radiation hazard to anyone in the area of the cloud. The lower flammability limit (LFL) endpoint, specified in the rule, would be appropriate for flash fires (vapor cloud fires).
- **Pool Fire**. Spill of a liquid whose boiling point is above ambient temperature may form a liquid pool, which could ignite and form a pool fire. The applicable endpoint specified in the rule is the heat radiation level of 5 kW/m^2.

- **BLEVE.** A BLEVE (Boiling Liquid Expanding Vapor Explosion) is a potential release scenario associated with a large quantity of flammable materials kept at below their boiling points. A BLEVE that may lead to a fireball could produce intense heat. This event may occur if a vessel containing flammable material ruptures as a result of exposure to fire. Heat radiation from the fireball is the primary hazard and vessel fragments and overpressure from the explosion are generally considered unlikely. To estimate the distance to a radiant heat level that can cause second degree burns (a heat "dose" equivalent to the specified radiant heat endpoint of 5 kW/m^2 for 40 seconds). Consistent with the EPA's "Risk Management Program Guidance for Offsite Consequence Analysis" published guidance, BLEVEs are generally considered unlikely events and were therefore not considered a probable event for the Offsite Consequence Analysis.
- **Vapor Cloud Explosion.** For a vapor cloud explosion to occur, rapid release of a large quantity, turbulent conditions (caused by a turbulent release or congested conditions in the area of the release, or both), and other factors are generally necessary. The endpoint for vapor cloud explosions is 1 psi.
- **Jet Fire.** This may result from the puncture or rupture of a tank or pipeline containing a compressed or liquefied gas under pressure. The gas discharging from the hole can form a jet that "blows" into the air in the direction away from the hole; the jet then may ignite. Jet fires could contribute to BLEVEs and fireballs if they impinge on tanks of flammable substances. A large horizontal jet fire may have the potential to pose an offsite hazard.

For the flammable worst-case release scenario, a vapor cloud explosion was the most appropriate consequence.

4.3 Endpoints

As mentioned previously, for flammable materials, the endpoints specified by the EPA RMP are:

- Overpressure of 1 pound per square inch (psi) for vapor cloud explosions
- Radiant heat of 5 kilowatts per square meter (kW/m^2) for jet fires
- Lower flammability limit (LFL) for flash fires

The rule specifies endpoints for fires based on the heat radiation level that may cause second degree burns from a 40-second exposure and the LFL, which is the lowest concentration in air at which a substance will burn. For a vapor cloud explosion, the endpoint is 1 psi, which is the force to cause partial demolition of houses with potential serious injuries to people, or shattering glass windows with potential skin laceration from flying glass.

4.4 Modeling Assumptions

The EPA RMP regulation imposes several assumptions that were adhered to when performing the offsite consequence analysis of the worst-case release scenario[4]. These are conservative assumptions for weather and release conditions. The distance to the endpoint estimated under worst-case conditions provides an estimate for the maximum possible area that might be affected by these unlikely conditions. It should be noted that EPA's intention for the vulnerability zone representing a worst-case release scenario is to provide a basis for discussion among the regulated industry, emergency responders, and the public, rather than a basis for any specific actions.

- **Meteorological Parameters:** For the worst-case release analysis, RMP*Comp uses the following assumptions. It should be noted that meteorological conditions could have little effect on some scenarios for flammable substances (e.g., vapor cloud explosions).
    - *Atmospheric stability*: F stability (very stable conditions)
    - *Wind speed:* 1.5 meters/second
    - *Ambient Temperature:* 77 °F
    - *Relative Humidity*: The typical relative humidity at the stationary source, which is 50%
- **Dispersion & Impact Modeling Parameters:**
    - *Height of Release:* Ground level, per EPA Rule requirement
    - *Vapor Cloud Explosion Impact:* A TNT-equivalent model has been used assuming that 10 percent of the energy in the cloud would contribute to the explosion
- **Mitigation Systems:** Once a release has occurred, mitigation systems are means (structures, equipment, or activities) that help minimize the transport of material to the atmosphere. Mitigation systems can be characterized as passive or active systems.
    - *Passive mitigation systems do not require activation, an energy source, or movement of components to perform their intended function*

- *Active mitigation systems do require activation, an energy source, and/or movement of components to perform their intended function*

It should be emphasized that the effectiveness of mitigation systems was taken into account when these systems were considered in the offsite consequence analysis. The effectiveness is determined based on how well the systems are designed and their abilities to respond reliably upon demand. The rule permits consideration of only passive mitigation systems for the worst-case release analysis provided that the systems are capable of withstanding the event triggering the release scenario and would still function as intended. For the worst-case release scenario, no passive mitigation measures were considered in the offsite consequence analysis.

4.5 Worst-Case Release Scenario

One worst-case scenario (WCS) was developed for the facility. For the worst-case release scenario, one of the new 10,000 gallon storage vessels containing isopentane at the Ormat – Heber 2 Geothermal Complex Facility was considered. The storage vessel is capable of storing a maximum of 10,000 gallons of isopentane. According to the Chevron Philips Chemical Company safety data sheet, the density of isopentane is 5.14 lbs/gal, which yields a total mass of 51,400 pounds of isopentane held in the storage vessel. The worst case scenario considers the catastrophic failure of one of the 10,000 gallon isopentane storage vessels, which would result in a release of the entire contents of the vessel. All dispersion modeling parameters utilized in the worst-case release scenario modeling is listed in Table 2 below. A summary of the scenario is presented in Table 3. Appendix A of this report provides a detailed description of the worst-case release scenario, RMP*Comp modeling output, MARPLOT 5.1.1[5] output with 2010 population estimates, and a map with the vulnerability zone denoted by a circle superimposed on the map.

Table 2: Worst Case Release Scenario Dispersion Modeling Parameters

PARAMETER	INPUT VALUE	NOTES
Isopentane Input Parameters		
Mass Released	51,400 lbs	Calculations shown in Appendix A.
Meteorological Parameters		

PARAMETER	INPUT VALUE	NOTES
Atmospheric Stability	F stability	As per 40 CFR §68.22 (b), "For the worst-case release analysis, the owner or operator shall use a wind speed of 1.5 meters per second and F atmospheric stability class"
Wind Speed	1.5 m/s	
Ambient Temperature	77°F	As per 40 CFR §68.22 (c), "An owner or operator using the RMP Offsite Consequence Analysis Guidance may use 25 °C and 50 percent humidity as values for these variables"
Relative Humidity	50%	
Dispersion and Impact Modeling Parameters		
Height of Release	Ground level	
Topography	N/A	Topography is not applicable to releases of flammable substances as it does not affect the radius impacted by a vapor cloud explosion.
Isopentane Mitigation System		
Passive Mitigation	None	
Active Mitigation	None	

Table 3: Worst-Case Scenario Results Summary

RELEASE SCENARIO	REGULATED SUBSTANCE	ENDPOINT	ENDPOINT DISTANCE
WCS: 10,000 gallon Isopentane Storage Vessel Rupture/Release	Isopentane	Overpressure of 1 psi	0.3 miles

4.6 Worst-Case Analysis Considerations

The worst-case distances to the flammable endpoints are based on a number of very conservative assumptions. The following summarizes the assumptions:

- The likelihood of a vessel rupture is extremely low. As a result, the release of entire inventory of a vessel is an unrealistic assumption.
- An overpressure of 1 psi is unlikely to have serious direct effects on people. This overpressure may cause property damage such as partial demolition of houses, which can result in injuries to people, and shattering of glass windows, which may cause skin laceration from flying glass.

5.0 ALTERNATIVE RELEASE SCENARIO

Alternative scenarios are potential releases that may result in consequences whose footprints represented by the endpoints could extend beyond the plant boundary. For a release case to be considered an alternative scenario, two conditions must be met:

1. The likelihood of the alternative release scenarios should be higher than that of the worst-case release scenarios.
2. The distance to endpoint from an alternative release scenario must go beyond the plant fence line.

As put forth in Title 40 CFR Section 68.28(a):

> *The owner or operator shall identify and analyze…at least one alternative release scenario to represent all flammable substances held in a covered process*

Title 40 CFR Section 68.28 (b)(2) defines the scenarios typically considered, but not limited to, the following:

> *(i) Transfer hose releases due to splits or sudden hose uncoupling;*

(ii) Process piping releases from failures at flanges, joints, welds, valves and valve seals, and drains or bleeds

(iii) Process vessel or pump release due to cracks, seal failure, or drain, bleed, or plug failure; and

(iv) Vessel overfilling and spill, or over pressurization and venting through relief valves or rupture disks.

(v) Shipping container mishandling and breakage or puncturing leading to a spill.

For alternative release scenarios, active mitigation systems, such as interlocks, shutdown systems, pressure relieving devices, flares, emergency isolation systems, and fire water and deluge systems, as well as passive mitigation systems are considered, if they were applicable. In order to be credited, the mitigation systems considered must be capable of withstanding the event that triggers the release while remaining functional.

5.1 Alternative Release Scenario Selection Process

The process of alternative release scenario identification is summarized as follows and depicted in Figure 3.

- **Selection of Candidate Alternative Release Scenario:** The process of alternative release scenario identification was initiated with the review of the worst-case release case. Additional vessels, containing various quantities of regulated substances, which considered having a higher likelihood of release, were then reviewed. In this process, all covered processes were reviewed and the candidate case for the alternative release scenario analysis was subsequently selected. The following criteria was utilized to identify the potential scenario:
  - Corrosion history and corrosive services
  - Past incidents and near misses
  - Potential equipment failure
  - Operating conditions
  - Potential for human error
  - Consequences considered in the unit Process Hazard Analysis
- **Analysis of the Selected Alternative Release Scenario:** Once the candidate scenario was selected, RMP*Comp was utilized to model the selected scenario. The vulnerability zone resulting from the analysis of the alternative release scenario was then reviewed. The size of release, which was estimated from a hole in the shaft seal on a vertical pump,

was calculated for this scenario. The release duration was primarily based on the length of time needed for operators to stop the release. In general, 10 minutes is a reasonable response time to stop the release based on the presence of monitoring equipment in the vicinity which notify operators of any substantial releases

- **Alternative Release Scenario**: The alternative release scenario for the flammable substance was selected and modeled to evaluate potential offsite impacts. Documentation of this scenario included modeling calculations, parameters and assumptions.

Criteria

Corrosion History and Corrosive Surfaces, Past Incidents and Near Misses, Potential Equipment Failure, Operating Conditions, Potential Human Error, Scenarios Considered in the Process Hazard Analysis.

↓

Select Alternative Release Scenario

Review process and facility characteristics to develop the candidate for an Alternative Release Scenario.

↓

Modeling of Alternative Release Scenario

Model potential release dispersion for the selected Alternative Release Scenario.

↓

Alternative Release Scenario Analysis

Present final results and modeling assumptions.

Figure 3: Alternative Release Scenario Selection Process

5.2 Modeling Assumptions

The EPA RMP regulation does not impose any mandatory assumptions for the OCA of the alternative release scenario. All dispersion modeling parameters utilized in the alternative release scenario modeling are listed in Table 4. For the alternative release scenario, a release due to a break in the product transfer hose connection during truck loading has been considered. Appendix B of this report provides a detailed description of the worst-case release scenario, RMP*Comp modeling output, MARPLOT 5.1.1 output with 2010 population estimates, and a map with the vulnerability zone denoted by a circle superimposed on the map.

Table 4: Alternative Release Scenario Dispersion Modeling Parameters

Parameter	Input Value	Notes
Isopentane Input Parameters		
Quantity Released	38,733 lbs	The most likely alternative release scenario involves the uncoupling of a transfer hose during truck loading operations. Calculations shown in Appendix B.
Release Rate	3,873.3 lbs/min	Calculations shown in Appendix B.
Release Duration	10 mins	The reasonable, assumed response time operators require to stop and isolate the leak.
Meteorological Parameters		
Atmospheric Stability	D stability	As per EPA RMP Offsite Consequence Analysis Guidance, for an alternative scenario, "this guidance assumes wind speed of 3 meters per second and D stability"
Wind Speed	3.0 m/s	
Ambient Temperature	77°F	

Parameter	Input Value	Notes
Relative Humidity	50%	As per EPA RMP Offsite Consequence Analysis Guidance, for an alternative scenario, "this guidance assumes 25ºC and 50 percent humidity"
Dispersion and Impact Modeling Parameters		
Height of Release	Ground Level	As per EPA RMP Offsite Consequence Analysis Guidance, for an alternative scenario, "this guidance assumes a ground-level release"
Topography	N/A	Topography is not applicable to releases of flammable substances as it does not affect the radius impacted by a vapor cloud explosion.
Isopentane Mitigation System		
Passive Mitigation	None	
Active Mitigation	None	

5.3 Alternative Release Scenario

A summary of the alternative release scenario is presented in Table 5. Appendix B of this report provides a detailed description of the alternative release scenarios, RMP*Comp modeling outputs, MARPLOT 5.1.1 outputs with 2010 population estimates, and a map with circles representing the vulnerability zones.

Table 5: Alternative Release Scenario Result Summary

RELEASE SCENARIO	REGULATED SUBSTANCE	ENDPOINT	ENDPOINT DISTANCE
ARS: Transfer Hose uncoupling from 10,000 gallon Isopentane Storage Vessel during Truck Loading Operations	Isopentane	Overpressure of 1 psi	0.1 miles

5.4 Alternative Release Analysis Considerations

Typically, the same conservative assumptions apply for the alternative release analysis as for the worst-case release analysis. Although the alternative release scenario is intended to be more likely than the worst-case release scenario, the analysis of the alternative release scenario should not be expected to provide a realistic estimate of an area in which off-site impact may occur. The same conservative endpoints have been used for both the worst-case and the alternative release analysis. These endpoints are intended to represent exposure levels below which most members of the public will not experience serious long-term health effects.

6.0 OFFSITE IMPACTS

A summary of the off-site impacts from an accidental release, including population and sensitive receptors, is discussed in the following sub-sections.

6.1 Impacted Population

In order to determine the impacted population around the facility, the potential for exposure within the endpoint was determined. The furthest endpoint distances reached by the worst-case scenario and alternative release scenario along with the estimated impacted population are summarized in Table 8:

Table 6: Impacted Population for OCA Scenarios

SCENARIO	ENDPOINT DISTANCE (MILES)	ESTIMATED IMPACTED POPULATION
WCS: 10,000 gallon Isopentane Storage Vessel Rupture/Release	0.3	0
ARS: Transfer Hose uncoupling from 10,000 gallon Isopentane Storage Vessel during Truck Loading Operations	0.1	0

The population was estimated using 2010 census tract data with the MARPLOT 5.1.1 software. When calculating population densities for large areas that encompass many tracts, the accuracy is rated as good; however, for small areas that encompass only two or three partial tracts, the population data may be skewed due to the unequal distribution within the tract. The use of MARPLOT 5.1.1 is pursuant to guidance endorsed by the US EPA. MARPLOT 5.1.1 requires the latitude and longitude of the facility in order to calculate the population. The latitude and longitude were estimated using Google Earth GPS[6] software and an aerial photo.

6.2 Offsite Sensitive Receptor Data Sources

Table 9 includes a list of websites and software used to locate offsite sensitive receptors. A few sites will perform a distance search in order to determine the eligibility of a possible receptor. For all other sites, a map interpolation determines whether the receptor falls within the circle of concern.

Table 7: Websites and Software Used

SOURCE	RECEPTORS THIS SOURCE IS USED TO IDENTIFY	METHOD OF DETERMINING ELIGIBILITY
maps.google.com[7]	Used to identify all receptors	Distance search in conjunction with a map interpolation
Google Earth	This mapping software is used to locate all receptors. It also	Software will map the location of the receptor.

	incorporates an internet search with the map to locate businesses.	

6.3 Offsite Sensitive Receptors

RMP requirements state that sensitive populations such as schools, hospitals, day-care centers, long-term health care facilities, prisons, residential areas, public use parks/recreational areas, and major commercial facilities, located within the "at risk" area must be identified. These sensitive populations include individuals who could not remove themselves from the exposure area without assistance. The sensitive populations also include industrial installations which may have a hazardous process that cannot be immediately left unattended. Table 8 shows a summary of offsite population receptors and offsite environmental receptors for isopentane, within the circle of concern as determined by the worst-case and alternative release scenarios.

Table 8: Summary of Sensitive and Environmental Receptors

RECEPTOR	WCS (0.3 MI)	ARS (0.1 MI)
Population Receptors		
Schools	No	No
Residences	No	No
Hospitals	No	No
Prisons/Correction Facilities	No	No
Recreation Areas	No	No
Major Commercial, Office, or Industrial Areas	No	No
Child Daycare	No	No
Long-term Health Care (e.g., convalescent homes)	No	No

RECEPTOR	WCS (0.3 MI)	ARS (0.1 MI)
Other (Government Buildings)	No	No
Environmental Receptors		
National or State Parks, Forests, or Monuments	No	No
Officially Designated Wildlife Sanctuaries, Preserves, or Refuges	No	No
Federal Wilderness Areas	No	No
Other (Landmark & Indian Reservations)	No	No

7.0 WORST-CASE RELEASE AND ALTERNATIVE RELEASE SCENARIOS

The following sections outlines a summary of the parameters used for the one worst case release scenario and the one alternative release scenario analyzed for the Heber 2 expansion project.

7.1 Worst-Case Scenario

The worst-case scenario evaluated the release of the entire contents of one of the new 10,000 gallon isopentane storage vessels, containing 51,400 pounds of isopentane. The following table provides a summary of the parameters used for the worst-case scenario and the corresponding inputs.

Table 9: Worst-Case Scenario Parameter/Input Summary

Worst-Case Scenario	
Chemical	Isopentane
Model Used	EPA's RMP*Comp™
Scenario	Vapor Cloud Explosion
Quantity Released (lbs)	51,400 lbs
Endpoint Used	Overpressure of 1 psi
Distance to Endpoint (miles)	0.3
Estimated Residential Population within Distance to Endpoint (numbers)	0
Public Receptors within Distance to Endpoint	
Schools	No
Residences	No
Hospitals	No
Prison/Correctional Facilities	No
Recreational Areas	No
Major Commercial, Office, or Industrial Areas	No

Worst-Case Scenario	
Other	Local Roads/Highways and Agricultural Land
Environmental Receptors within Distance to Endpoint	
National or State Parks, Forests, or Monuments	No
Officially Designated Wildlife Sanctuaries, Preserves or Refuges	No
Federal Wilderness Area	No
Other	No
Passive Mitigation Considered	
Blast Walls	No
Other	No

7.2 Alternative Release Scenario

It was determined that a release due to a break in the isopentane transfer hose connection during truck loading, was the most likely release scenario due to human factors associated with manned transfer operations, as well as reliability issues in industry related to hose degradation and coupling failures. The following table provides a summary of the parameters that were used for alternative release scenario and the corresponding inputs.

Table 10: Worst-Case Scenario Parameter/Input Summary

Alternative Release Scenario	
Chemical	Isopentane
Model Used	EPA's RMP*Comp™
Scenario	Vapor Cloud Explosion
Quantity Released (lbs)	38,733
Endpoint Used	1 psi
Distance to Endpoint (miles)	0.1

Alternative Release Scenario	
Estimated Residential Population within Distance to Endpoint (numbers)	0
Public Receptors within Distance to Endpoint	
Schools	No
Residences	No
Hospitals	No
Prison/Correctional Facilities	No
Recreational Areas	No
Major Commercial, Office, or Industrial Areas	No
Other	Local Roads/Highways and Agricultural Land
Environmental Receptors within Distance to Endpoint	
National or State Parks, Forests, or Monuments	No
Officially Designated Wildlife Sanctuaries, Preserves or Refuges	No
Federal Wilderness Area	No
Other	No
Passive Mitigation Considered	
Blast Walls	No
Other	No
Active Mitigation Considered	
Sprinkler Systems	No
Deluge Systems	No
Water Curtain	No
Excess Flow Valve	No
Other	No

Alternative Release Scenario

8.0 FIVE YEAR ACCIDENT HISTORY

There have been no applicable CalARP/RMP/PSM releases of isopentane at the facility within the last five years, therefore, this section is not applicable.

9.0 REFERENCES

1. Code of Federal Regulations (CFR), Title 40, Chapter I, Subchapter C, Part 68, Subpart B, Sections 68.20 to 68.42, "Hazard Assessment"; 2015, January 1.
2. California Code of Regulations (CCR), Title 19, Division 2, Chapter 4.5, Article 4, Sections 2750.1 to 2750.9, "Hazard Assessment"; 2015, January 1.
3. RMP*Comp™ Version 2.01, U.S. Environmental Protection Agency, February 2012. https://cdxnodengn.epa.gov/cdx-rmp-maintain/action/rmp-comp.
4. Risk Management Program Guidance for Offsite Consequence Analysis, U.S. Environmental Protection Agency, March 2009.
5. MARPLOT® 5.1.1 Mapping Software (internet download), National Oceanic and Atmospheric Administration and U.S. Environmental Protection Agency. http://www.epa.gov/osweroe1/content/cameo/marplot.htm. October 2015
6. Google ™ Earth, version 7.3.2.5776, Google, Inc. (2019)
7. Google ™ Maps, Google, Inc. (2019)

APPENDIX A
WORST-CASE SCENARIO CALCULATIONS

WORST-CASE SCENARIO (WCS)

The selected worst-case release scenario analyzes the hypothetical rupture of the 10,000 gallon isopentane vessel 3 introduced as part of the Heber 2 facility's expansion project. The vessel being analyzed can store up to 51,400 pounds of isopentane. Additionally, this vessel is located closest to the residential neighborhood northeast of the plant, and therefore the vessel with the largest potential to impact the community. Per requirement of the EPA rule for flammable substances, it was assumed that the whole quantity is instantaneously released.

The scenario also assumes that the cloud is ignited with a delay, under which the impact is higher than an immediate ignition. The delayed ignition would allow the air to get entrained in the cloud and form a larger and well-mixed explosive vapor cloud. If this vapor cloud ignited, the resultant blast could generate overpressure damage. A TNT-equivalent model has been used assuming that 10 percent of the energy in the cloud would contribute to the explosion, as required by the EPA Rule.

The RMP*Comp Model calculation predicts that the area impacted by the endpoint, which is an overpressure of 1 psi, is a circle with approximately 0.3 mile radius. According to MARPLOT 5.1.1 using 2010 census data, there are 0 residents in 0 housing units within this vulnerability zone for all three vessels and thus only one is shown below for representation. The table and figures on the following pages illustrate the scenario modeling parameter summary, scenario circle for the release, the RMP*Comp modeling output, as well as the MARPLOT results.

Table 11: WCS Modeling Parameters

WCS Modeling Parameters	
Regulated Substance	Isopentane
Vessel	Isopentane Storage Vessel
Latitude / Longitude	32°42'51.56"N / 115°32'10.43"W
Physical State	Liquefied Gas Under Pressure
Basis Of Results	RMP*Comp Version 1.07
Scenario	Vapor Cloud Explosion
Quantity Released	51,400 Pounds
Release Rate	Instantaneous
Release Duration	Instantaneous
Wind Speed & Stability Class	1.5 m/s & F Stability
Topography	N/A
Distance to Endpoint	0.3 Miles to 1 psi Overpressure
Public & Environmental Receptors	0 Residents, 0 Housing Units
Passive Mitigation Considered	None

Figure 4: WCS EPA RMP*Comp Modeling Results

Estimated Distance Calculation

Estimated distance to 1 psi overpressure: 0.3 miles (0.5 kilometers)

This is the distance to the overpressure endpoint of 1 pound per square inch specified for this regulated substance under the RMP Rule.

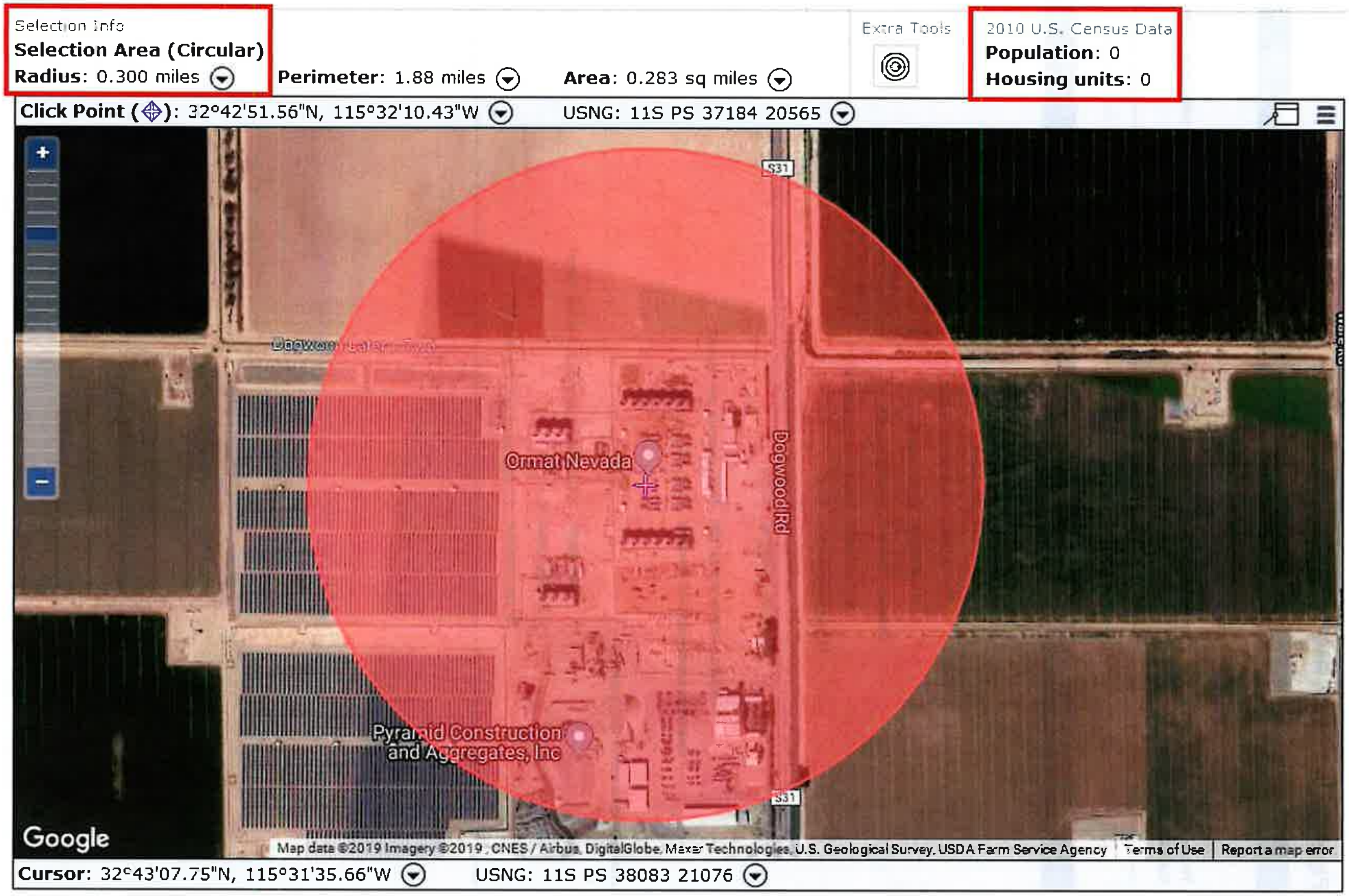
Scenario Summary

Chemical:	Isopentane [Butane, 2-methyl-]
CAS number:	78-78-4
Threat type:	Flammable Liquid
Scenario type:	Worst-case
Quantity released:	51400 pounds
Release type:	Vapor Cloud Explosion
Liquid temperature:	77 F
Mitigation measures:	NONE
Release rate to outside air:	7960 pounds per minute
Quantity evaporated in 10 minutes:	51400.0 pounds

Assumptions about this scenario

Wind speed:	1.5 meters/second (3.4 miles/hour)
Stability class:	F
Air temperature:	77 degrees F (25 degrees C)

Figure 5: WCS MARPLOT 5.1.1 Population Estimates



APPENDIX B
ALTERNATIVE SCENARIO CALCULATIONS

ALTERNATIVE RELEASE SCENARIO (ARS)

The selected alternative release scenario is a release due to a break in the product (isopentane) transfer hose connection during truck loading. This was considered the most likely release scenario due to human factors associated with manned transfer operations, as well as reliability issues in industry related to hose degradation and coupling failures. It is assumed that the transfer hose uncouples during isopentane transfer operations and that it is released through an area of 12.6 square inches. The release duration is assumed to be 10 minutes, which is a conservative assumption considering both the facility operator and truck drivers are in attendance during transfer operations. In the evaluations of this alternative release scenario, no mitigation measures were considered.

In order to calculate the release quantity for a transfer hose rupture, the release rate through the transfer hose must be calculated. The following equation, obtained from the EPA Risk Management Plan Guidance for Offsite Consequence Analysis, illustrates the calculation of the release rate for flammables liquefied under pressure through a transfer hose:

$$\mathrm{QR} = \mathrm{HA} \times 6.82\sqrt{\left(\frac{11.7}{DF^2} \times LH + \frac{669}{DF} + P_g\right)}$$

Where:

- QR = Release rate (lb/min)
- HA = Hole or puncture area (square inches)
- DF = Density Factor, dimensionless, obtained from the EPA Risk Management Plan Guidance for Offsite Consequence Analysis
- LH = Height of liquid level above hole (inches)
- P_g = Gauge pressure of the tank (psig)

To calculate the release rate utilizing the above equation, the values for each of the variables were calculated for isopentane:

Hole Area

The transfer hose used in isopentane filling operations at both plants is 4 inches in diameter. Thus, the hole area is based upon the transfer hose rupturing and calculated using the following:

$$HA = \pi r^2 = 12.6 \text{ in}^2$$

Density Factor

The Density Factors are obtained from Appendix C of the EPA Risk Management Plan Guidance for Offsite Consequence Analysis. The Density Factor value for isopentane is 0.79.

Liquid Height

The height of the liquid level above the hole is determined by the nominal liquid level in the vessel. The isopentane transfer point is taken to be at the bottom of the tank. Assuming that the isopentane storage vessel is full of liquid, the liquid height is 60 inches.

Pressure

The normal operating pressure of the isopentane motive fluid storage tank was identified to be 60 psig.

Modeling

Using these values, the release rate of 3873.3 lbs/min of isopentane is determined. Over the assumed 10 minute release period, this result in a total of 38,733 lbs of isopentane releasing that could potentially form a vapor cloud with the possibility of detonation.

The RMP*Comp Model calculation predicts that the area impacted by the endpoint, which is overpressure of 1 psi, is a circle with approximately a 0.10 mile radius. According to MARPLOT 5.1.1 using 2010 census data, there are 0 residents in 0 housing units within this vulnerability zone. This analysis was performed on the isopentane vessel 3 which is located closest to the residential neighborhood northeast of the plant, and therefore the vessel with the largest potential to impact the community. The table and figures on the following pages illustrate the scenario modeling parameter summary, scenario circle for the release, the RMP*Comp modeling output, as well as the MARPLOT results.

Table 12: ARS Modeling Parameters

ARS Modeling Parameters	
Regulated Substance	Isopentane
Vessel	Isopentane Storage Vessel
Unit & Location	Isopentane Tank
Latitude / Longitude	32°42'51.56"N / 115°32'10.43"W
Physical State	Liquefied Gas Under Pressure
Basis Of Results	RMP*Comp Version 1.07
Scenario	Vapor Cloud Explosion
Quantity Released	38,733 pounds
Release Rate	3873.3 lbs/min
Release Duration	10 minutes
Wind Speed & Stability Class	3 m/s & D Stabiltiy
Topography	N/A
Distance To Endpoint	0.1 Miles to 1 psi Overpressure
Public & Environmental Receptors	0 Residents, 0 Housing Units
Passive Mitigation Considered	None

Figure 6: ARS EPA RMP*Comp Modeling Results

Estimated Distance Calculation

Estimated distance to lower flammability limit: <0.1 miles (<0.16 kilometers)

This is the distance to the lower flammability limit specified for this regulated substance under the RMP Rule.

Scenario Summary

Chemical: Isopentane [Butane, 2-methyl-]

CAS number: 78-78-4

Threat type: Flammable Liquid

Scenario type: Alternative

Release duration: 10 minutes

Release type: Vapor Cloud Fire

Release rate: 3873 pounds per min

Liquid temperature: 77 F

Mitigation measures: NONE

Release rate to outside air: 3870 pounds per minute

Surrounding terrain type: Urban surroundings (many obstacles in the immediate area)

Lower flammability limit: 41 mg/L

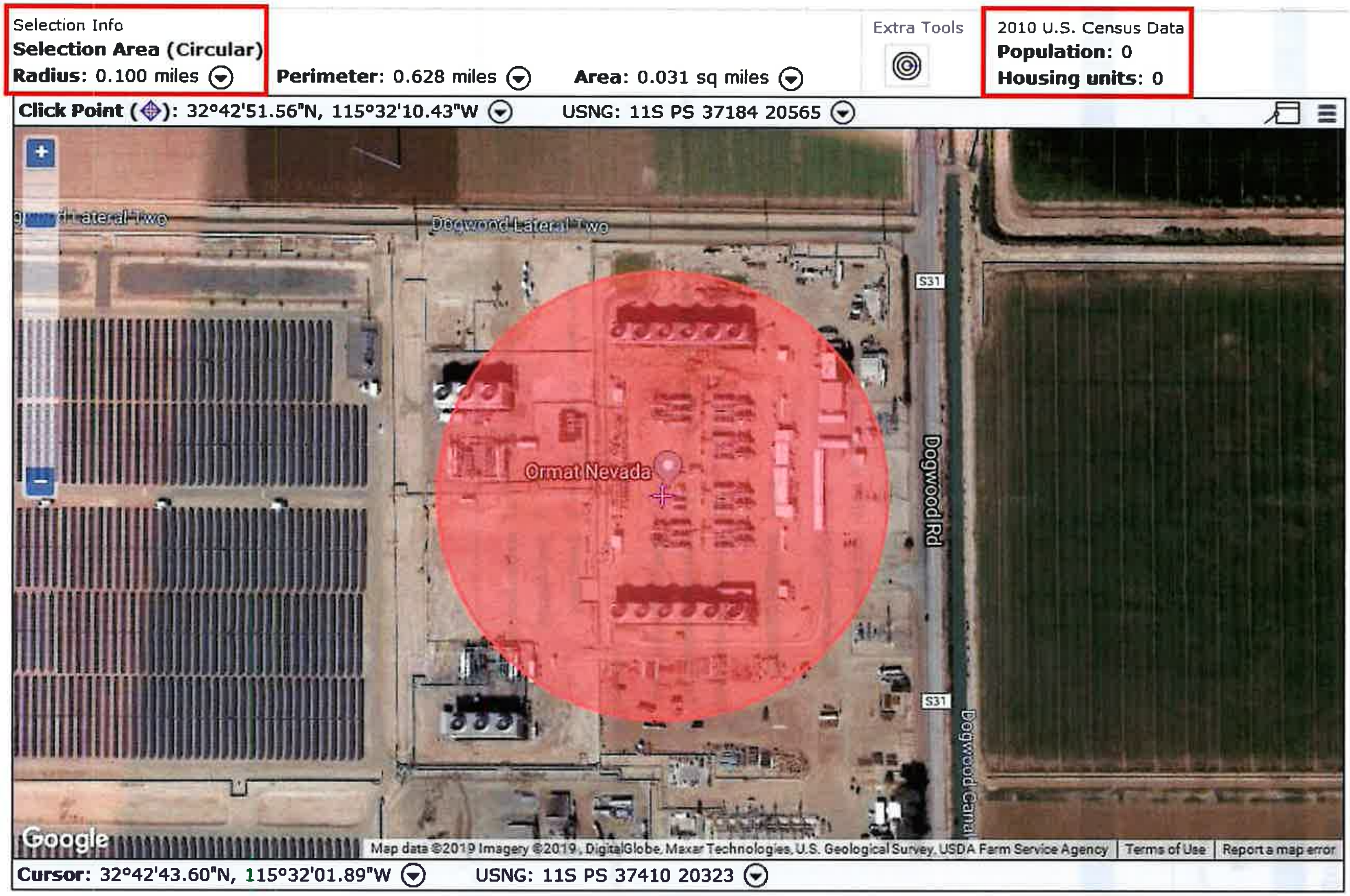
Assumptions about this scenario

Wind speed: 3 meters/second (6.7 miles/hour)

Stability class: D

Air temperature: 77 degrees F (25 degrees C)

Figure 7: ARS MARPLOT 5.1. Population Estimates



IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES DEPARTMENT

Reclamation Plan Application

OWNER, OPERATOR AND AGENT:

1. Applicant (Name, Mailing Address and Telephone Number):
Second Imperial Geothermal Company
a wholly owned subsidiary of ORMAT Nevada, Inc.
6140 Plumas Street
Reno, Nevada 89519
(775) 356-9029

2. Property Owner (s), or owner of Surface Rights (Name, Mailing Address and Telephone Number): [if different from applicant]
See 1.

3. Owner of Mineral Rights (Name, Mailing Address and Telephone Number): [if different than applicant]
See 1.

5. Lessee (Name, Mailing Address and Telephone Number):
See 1.

6. Operator (Name, Mailing Address and Telephone Number): [if different than applicant]
See 1.

7. Agent of Process (Name, Mailing Address and Telephone Number):
Melissa Wendt
Director, Project Development
6140 Plumas Street
Reno, Nevada 89519
(775) 356-9029

LOCATION:

8. Legal Description: (must be full legal)
855 Dogwood Road, Heber, CA (APN 054-250-031)
Tract 44, Township 16 South, Range 14 East, SBB&M

Assessor Parcel No.:	054-250-031
Longitude:	115º32'15.1W
Latitude:	32º42'52.2N
Elevation:	near zero

9. Size of the land(s) that will be affected by mining operation. Total acreage:
Heber 2 site is approximately 40 acres.

10. Describe existing and proposed access to the mine site: (please be specific)
Via existing ingress/egress. Primary highway access isprovided via Interstate-8. Dogwood Road stems off of I-8 and provides immediate access to the site.

GEOLOGICAL BACKGROUND:

11. Mineral commodity to be minded:
Geothermal fluids. However, no new wells are proposed.

12. General Geological description of the area:

The site is located within the Piliocene to Holocene, Q Geologic Unit. The Colorado Desert geomorphic province spans central Imperial County, where the site is located, often referred to as the Salton Trough. Low-lying barren desert located between alluvium-covered, active branches of the San Andreas Fault

13. Detailed description of the geology of the actual site in which surface mining is to be conducted:

Site is underlain by Cenozoic sedimentary rocks and alluvial, lacustrine, and eolian deposits. Surface sediments are about 275 feet below sea level. The site contains Holtville silty clays (wet) and Imperial-Glenbar silty clay loams (wet).

14. Brief description of the environmental setting of the site and the surrounding areas. Existing land uses, soil, vegetation, ground water elevation and surface water characteristics.

The site is completly devoid of any vegetation or water resources. Dry lean silty clays dominate the site, extending 4-5 ft. below the surface. The site is comprised of a graded, developed area that consists of exposed soils and gravel. Site within the active geothermal power plant area.

MINING OPERATION AND PRODUCTION:

15. Proposed starting date of operation: Plant in production since 1992

Estimated life of operation: 30 years, 2019-2049

Termination Date: 2049

Duration of first phase: ______

Second phase: ______

Third phase: ______

Fourth phase: ______

16. Operation will be (include days and hours of operation):

Continuous: Plant operates 24 hour per day, 7 days per week

Intermittent: ______

Seasonal: ______

17. Maximum anticipated annual production (Tons or Cubic Yards):
N/A

18. Total anticipated production:

Minerals:	N/A	cubic yards/tons	0
Tailings retained on site:		cubic yards/tons	0
Tailings disposed off site:		cubic yards/tons	0

Maximum anticipated depth (indicate on map location of benchmarks to verify mine depth):
N/A - Project does not propose drilling or extraction.

19. Describe mining method:
N/A - no mining is proposed as part of the Project.

20. Describe nature of processing and explain disposal of tailings or waste.
N/A - no tailings will be processed as part of the Project.

21. Do you plan to use cyanide or other toxic materials in your operations?
Three additional above ground storage tanks will be used for isopentane . storage Site will include two 10,000 gallon tanks and three 10,000 gallon tanks.

Do you plan to use or store petroleum products or other hazardous materials on the site?
Yes.

Describe refueling and maintenance of vehicles.
Construction equipment will be fueled on-site, as necessary. Fuel will be limited to diesel and gasoline, to fuel heavy and light equipment. Repairs to construction equipment will be performed on-site by certified mechanics. Spill prevention BMPs and safe handling techniques will be employed throughout the construction phase.

22. Indicate the quantity of water to be used, source of water, method of conveyance to the mine site, the quantity, quality and method of disposal of used and/or surplus water. Indicate if water well to be used for mine operation (drilling, reactivation, changing use or increasing volume of water well may require Conditional Use Permit approval).

No additional water will be required to support the proposed facilities. Water will be used for dust suppression during ground disturbing activities. A 5,000 gallon water truck is expected to be used. Approximately 20,000 gallons of water are expected to be used. The existing Heber 2 facility will provide the water via existing permits.

23. Describe phases of mining if applicable and concurrent reclamation including time schedule for concurrent activities.

No mining is proposed as part of the Project. Site reclamation would be performed at the end of the facilities' lifecycle (30 years).

24. Describe the types of equipment that will be used in the operation, including the estimated average daily trips (ADT) that will be generated by the operation.

Backhoes, excavators, heavy trucks, light vehicles, compactors, hand tools, welding equipment, water truck, crane.

25. Include the following maps: (NOTE: Without these the application is automatically incomplete.)

(1) Topographic Map with overlay showing proposed area to be mined.

(2) Site Plan showing mine layout and dimensions.

(3) General Vicinity Map showing the location of the mine site in Imperial County.

(4) Cross Section Map. (N/A - no subsurface activities proposed.)

RECLAMATION:

26. Indicate by overlay of map of Item No. 24, or by color or symbol on map those areas to be covered by the reclamation plan:

Total acreage: 39.99 acres
APN 054-250-031

27. Describe the ultimate physical condition of the site and specify the proposed use (s) or potential uses of the land after reclamation. Explain if utilities, haul or access roads will be removed or reclaimed.

The site is within a developed area used for geothermal energy generation. The site is completely devoid of any vegetation or water resources. The site consists of exposed soils and gravel. The site would likely be returned to a natural state or agricultural production after geothermal energy production has concluded. No roads would be developed for the Project and access will be provided via existing roads.

28. Describe relationship of the interim uses than mining and the ultimate physical condition to:

(a) Imperial County Zoning Ordinance

(b) Imperial County General Plan

The site is zoned as A-2-G-SPA and is within the Geothermal Overlay Zone, which allows for major geothermal energy projects. The proposed facilities and uses are consistent with the Imperial County Zoning Ordinance and General Plan.

29. Notarized statement that all owners of the possessory interest in the land have been notified of the proposed uses or potential uses identified in Item No. 25 (see Attachment "A").

N/A - The site owner is the applicant (ORMAT) and no other parties have an interest on the subject property.

30. Describe soil conditions and proposed topsoil salvage plan.

The site's soils are comprised of silty clays and loams. The site is arid and presently devoid of any vegetation or water resources. The site's topsoil is low quality. Approximately 18 inches of topsoil will be excavated from the 2.5 acre development site and piled. After gravel is deposited and compacted, the piled topsoil will be used as backfill material.

31. Describe the methods, their sequence and timing, to be used in bringing the reclamation of the land to its end state. Indicate on map (Items Nos. 24 and 25) or on diagrams as necessary. Include discussion of the pertinent items listed below.

(a) Backfilling and grading

(b) Stabilization of slopes

(c) Stabilization of permanent waste dumps, tailings, etc.

(d) Rehabilitation of pre-mining drainage

(e) Removal, disposal or utilization of residual equipment, structure, refuse, etc.

(f) Control and disposal of contaminants, especially with regard to surface runoff and ground water

(g) Treatment of streambeds and streambanks to control erosion and sedimentation

(h) Removal or minimization of residual hazards

(i) Resoiling, revegetation with evidence that selected plants can survive given the site's topography, soil and climate:

See Attachment D (Revegetation Plan)

32. If applicant has selected a short term phasing of his reclamation, describe in detail the specific reclamation to be accomplished during the first phase:

All reclamation activities would occur at the conclusion of the facilities' lifecycle (2049).

33. Describe how reclamation of this site in this manner may affect future mining at this site and in the surrounding area:

Reclamation of the site would remove all facilities from the entire Heber 2 site. Reclamation activities would likely return the land to a natural state or agricultural production. These activities would not affect any future mining or geothermal operations on the site or in the vicinity.

34. Notarized statement that the person submitting the plan accepts responsibility for reclaiming the mined lands in accordance with the Reclamation Plan (Attachment "B"):

Attached.

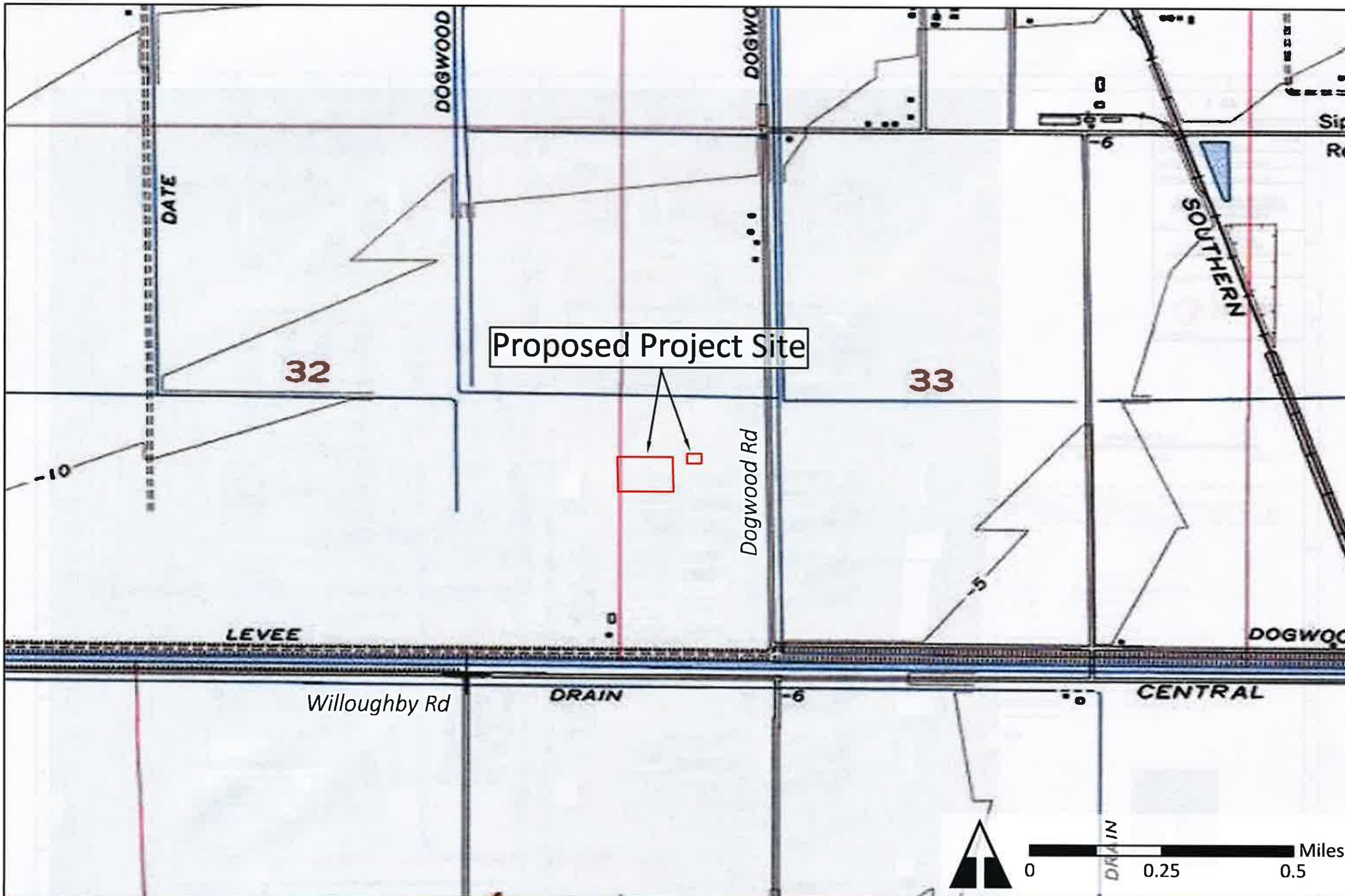
35. Include Reclamation Cost Calculations as Attachment "C":

Attached.

36. Describe proposed Revegetation Plan (attach as "Attachment D" if necessary):

The entire Heber 2 site would be dismantled and removed. All wells would abandoned per DOGGR requirements. Once free of facilities, the site would be disced and seeded with a native mix, per Imperial County's recommendation. See Attachment D.

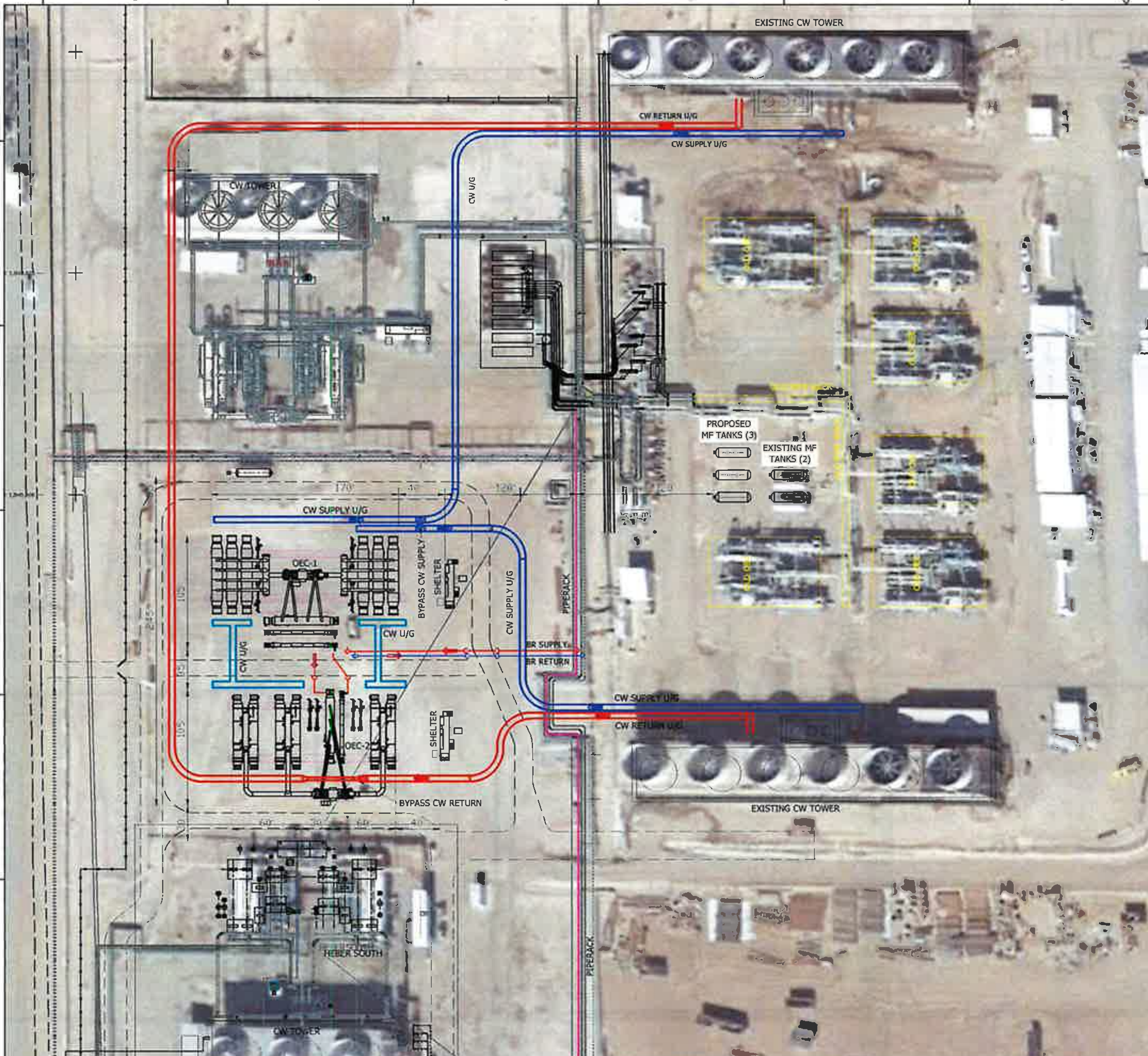
MAIN OFFICE: 801 Main Street El Centro, CA 92243 (760) 482-4236 FAX: (760) 353-8338 E-MAIL: planning@imperialcounty.net
ECON. DEV. OFFICE: 836 Main Street El Centro, CA 92243 (760) 482-4900 FAX: (760) 337-8907



TOPOGRAPHIC MAP OF PROJECT SITE

Catalyst ENVIRONMENTAL SOLUTIONS

Figure 1
ORMAT
Date: July 2019



REV	DESCRIPTION	DATE	BY	CHK	ENG	PRJ
P6	UPDATE MODELS DES-1 & DEC-2	5.APR.2019	A.S.	A.N.		S.H.
P7	UPDATE MODELS DES-1	17.APR.2019	A.S.	A.N.		S.H.
P8	UPDATE DEC-1 & DEC-2	27.MAY.2019	A.S.	A.N.		S.H.
P9	UPDATE LOCATION DEC-1	18.JULY.2019	A.S.	A.N.		S.H.

N

KEY:

- EXISTING FENCE LINE
- PROPOSED UNDERGROUND CW SUPPLY LINE
- PROPOSED UNDERGROUND CW RETURN LINE
- PROPOSED BR SUPPLY LINE
- PROPOSED BR RETURN LINE
- EQUIPMENT TO BE DECOMMISSIONED
- EXISTING EQUIPMENT TO REMAIN

CW — COOLING WATER
U/G — UNDERGROUND
BR — GEOTHERMAL BRINE
OEC — ORMAT ENERGY CONVERTOR
MF — MOTIVE FLUID

NOTE:

1. THE ARRANGEMENT AND SIZES PRESENTED ARE PRELIMINARY AND INDICATIVE ONLY AND SUBJECT TO CHANGED ON DESIGN OPTIMIZATION, DETAILED DESIGN AND ACTUAL EQUIPMENT PURCHASED (MANUFACTURED)
2. DIMENSIONS ARE IN MM (FEET), ELEVATIONS ARE IN MM FEET)

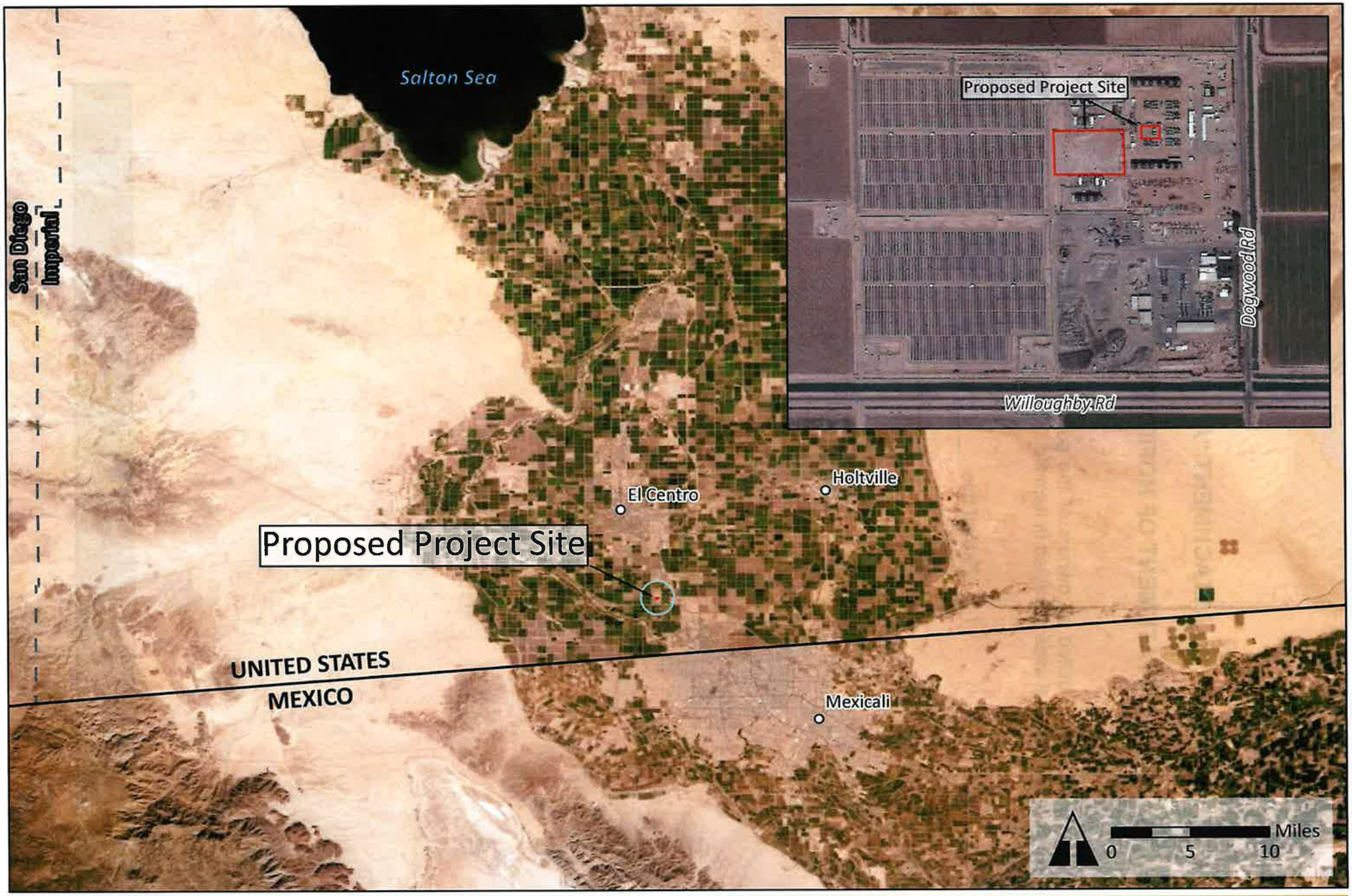
0 20' 100' 200'
GRAPHIC SCALE (FEET)

PREPARED BY:
Stantec
PHONE FAX

FOR
Second Imperial Geothermal Company
855 B Dogwood Road
Heber CA 92249

TITLE
HEBER2 REPOWER GENERAL ARRANGEMENT POWER PLANT ON MAP

DRAWN BY	KAM	DESIGNED BY	
CHECKED BY		APPROVED BY	
PROJECT NUMBER	0107 01234 01 0123	SCALE	AS SHOWN
DATE	04/01/04	FILE PATH	K:(CLIENT) OR JOB #
SHEET	**1 OF 1**		



Legend
United States/Mexico Border
County Line
Project Site
1-Mile Radius

PROPOSED PROJECT SITE - HEBER 2

Catalyst
ENVIRONMENTAL SOLUTIONS

Figure 1
ORMAT
Date: July 2019

ATTACHMENT "A"

STATEMENT OF NOFICATION

I, the undersigned, have notified all owners of the possessory interest in the land of the proposed use (s) or potential uses identified in Item No. 26 of the Reclamation Plan.

Signed this ________________ day

of ___________________, 2005.

____

Operator or Operator's Agent

MAIN OFFICE: 801 Main Street El Centro, CA 92243 (760) 482-4236 FAX: (760) 353-8338 E-MAIL: planning@imperialcounty.net
ECON. DEV. OFFICE: 836 Main Street El Centro, CA 92243 (760) 482-4900 FAX: (760) 337-8907

ATTACHMENT "B"

STATEMENT OF RESPONSIBILITY

I, the undersigned, hereby agree to accept full responsibility for reclaiming all mined lands as described and submitted herein with any modifications requested by the County of Imperial as conditions of approval.

Signed this 12th day

of August, 2019.

Connie Stechman

Operator or Operator's Agent

Connie Stechman, VP Finance

Ormat Nevada, Inc.

ATTACHMENT "C"

RECLAMATION COST ANALYSIS

Reclamation Cost Estimate for Heber 2 Geothermal Energy Complex

Date: July 31, 2019

RE: **Reclamation Cost Estimate for the Heber 2 Geothermal Energy Complex**

This cost estimate has been prepared for the Heber 2 Geothermal Repower Project and provides a general estimate to perform well abandonment and site reclamation/revegetation for the entire 40-acre Heber 2 Complex site.

Well Hole Abandonment

- Cost of Abandoning Two Injection Wells

  2 wells x 200 feet[1] x $16.10/foot[2] = **$6,440**

Site Reclamation and Revegetation

- Cost of Reclaiming 40 acres

  $10,235[2] (first acre) + 219,765 ($5,635/acre[2] for 39 acres) = **$230,000**

TOTAL COST ESTIMATE: $236,440

References

[1] California Department of Conservation Oil, Gas, and Geothermal Resources. April 2019. California Code of Regulations, Section 1723. Available online at: https://www.conservation.ca.gov/index/Documents/DOGGR-SR-1%20Web%20Copy.pdf

[2] New Mexico Energy, Minerals, and Natural Resources Department. 2013. Guidance for Estimating Reclamation Costs. Available online at: http://www.emnrd.state.nm.us/MMD/MARP/documents/MMD_Part3FAGuidelines_Sept2013.pdf

Reclamation estimates provided in this document were increased by 15% to account for six years of inflation and potential contingency costs.

ATTACHMENT "D"

REVEGATION PLAN

(REVISED MARCH 25, 2005)
JH/lh/S:/forms_lists/reclamation plan aplication

Revegetation Plan for Heber 2 Geothermal Energy Complex

Date: July 31, 2019

From: Catalyst Environmental Solutions

RE: **Revegetation Plan for the Heber 2 Geothermal Repower Project**

INTRODUCTION

The Second Imperial Geothermal Company (SIGC), a wholly owned subsidiary of ORMAT Nevada, Inc (ORMAT), owns and operates the Heber 2 Geothermal Energy Complex (Heber 2). ORMAT proposes to amend CUP No. 06-0006 to allow for the installation of two new air cooled ORMAT Energy Converters (OECs); three additional above ground storage tanks (ABSTs); and, additional pipes to connect the proposed facilities with the existing Heber 2 Geothermal Energy Complex (hereinafter, "Project"). All proposed facilities would be developed within the existing Heber 2 Complex and fence line. This application also proposes to renew the permitted life of the entire Heber 2 facility (including the Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049).

This Revegetation Plan has been prepared in support of the Reclamation Plan Application as part of the CUP amendment application for the Heber 2 Geothermal Repower Project.

Project Location

The Heber 2 Complex is located on private lands owned by ORMAT in southern Imperial County (**Figure 1**). The proposed development would occur entirely on Assessor's Parcel Number (APN) 054-250-031, which is a 39.99-acre property. The address for Heber 2 is 855 Dogwood Road, Heber, CA 92249.

Reclamation, Abandonment, and Revegetation Schedule

Reclamation, abandonment, and revegetation activities would commence at the closure of the Heber 2 Geothermal Energy Complex in 2049, if the CUP amendment application is approved by Imperial County. Activities would commence after two injection wells have been plugged and the dismantlement and removal/disposal of the energy facilities. If necessary, reseeding would be held off until the appropriate season (e.g. fall, spring). Activities would take approximately 6 months to complete.

Site Preparation

After all wells have been plugged and facilities are removed from the site, any soil piles or grades will be evened out by an excavator. The site is near zero elevation and is very flat and absent of topography. Reclamation activities will mimic the existing grade of the site and not introduce a new gradient/slope to the area. The site will then be rolled with a soil aerator/loosener. After site reclamation, topsoil will be transported to the site and deposited evenly across the site.

Selection of Plant Materials

The Heber 2 Complex site is completely devoid of vegetation, as the site is used for geothermal energy generation and contains industrial equipment that should not have vegetation under/around the facilities. See **Appendix A** of the CUP application for Site Photographs. The surrounding area is dominated by agricultural production and no natural areas are in the immediate vicinity of the Project Site. SIGC/ORMAT will reseed the entire 40-acre site with a seed mix approved by Imperial County.

Irrigation and Maintenance

Revegetation of the site will be maintained by a contractor every two weeks to conduct weeding, watering, and removing trash/debris. The site will be irrigated by water truck as necessary to establish the new vegetation.

4. The applicant shall provide a drainage letter that takes into account the prevention of storm event run-off and sedimentation of damage to off-site properties and county road right-of-way(s).

5. Dogwood Road is classified as Prime Arterial - Six (6) lanes divided, requiring one hundred sixty four feet (164) of right of way, being eighty two (82) feet from existing centerline. It is required that sufficient right of way be provided to meet this road classification. **As directed by Imperial County Board of Supervisors per Minute Order #6 dated 11/22/1994 per the Imperial County Circulation Element Plan of the General Plan).**

INFORMATIVE:

The following items are for informational purposes only. The Developer is responsible to determine if the enclosed items affect the subject project.

- All solid and hazardous waste shall be disposed of in approved solid waste disposal sites in accordance with existing County, State and Federal regulations (Per Imperial County Code of Ordinances, Chapter 8.72).

- All on-site traffic areas shall be hard surfaced to provide all weather access for emergency vehicles.

- The project may require a National Pollutant Discharge Elimination System (NPDES) permit and Notice of Intent (NOI) from the Regional Water Quality Control Board (RWQCB) prior to County approval of onsite grading plan (40 CFR 122.28).

- As this project proceeds through the planning and the approval process, additional comments and/or requirements may apply as more information is received.

- A Transportation Permit may be required from road agency(s) having jurisdiction over the haul route(s) for any hauls of heavy equipment and/or large vehicles which impose greater than legal loads on riding surfaces, including bridges. (Per Imperial County Code of Ordinances, Chapter 10.12 – Overweight Vehicles and Loads).

Should you have any questions, please do not hesitate to contact this office. Thank you for the opportunity to review and comment on this project.

Respectfully,

By:

John A. Gay, PE
Director of Public Works

CY/dm

RECEIVED

SEP 18 2019

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

COUNTY OF IMPERIAL
DEPARTMENT OF PUBLIC WORKS
155 S. 11th Street
El Centro, CA
92243
Tel: (442) 265-1818
Fax: (442) 265-1858
Follow Us:
www.facebook.com/ImperialCountyDPW/
https://twitter.com/CountyDpw/

ICDPW

Public Works works for the Public

September 18, 2019

RECEIVED
SEP 18 2019
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

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

Attention: David Black, Planner IV

SUBJECT: CUP 19-0017 for Second Imperial Geothermal Company / Ormat;
Located on 855 Dogwood Road, Heber, CA.
APN 054-250-031-000

Dear Mr. Minnick:

This letter is in response to your submittal received by this department on August 27, 2019 for the above mentioned project. The applicant is requesting a facility refurbishment, equipment installation and removal of existing facilities.

Department staff has reviewed the package information and the following comments shall be Conditions of Approval:

1. Prior to the issuance of grading, building, and encroachment permits, corner record is required to be filed with the county surveyor for monuments:

   8771. (b) When monuments exist that control the location of subdivisions, tracts, boundaries, roads, streets, or highways, or provide horizontal or vertical survey control, the monuments shall be located and referenced by or under the direction of a licensed land surveyor or licensed civil engineer legally authorized to practice land surveying, prior to the time when any streets, highways, other rights-of-way, or easements are improved, constructed, reconstructed, maintained, resurfaced, or relocated, and a corner record or record of survey of the references shall be filed with the county surveyor.

2. Prior to Certificate of Occupancy, a second corner record is required to be filed with the county surveyor for monuments:

   8771. (c) A permanent monument shall be reset in the surface of the new construction or a witness monument or monuments set to perpetuate the location if any monument could be destroyed, damaged, covered, disturbed, or otherwise obliterated, and a corner record or record of survey shall be filed with the county surveyor prior to the recording of a certificate of completion for the project. Sufficient controlling monuments shall be retained or replaced in their original positions to enable property, right-of-way and easement lines, property corners, and subdivision and tract boundaries to be reestablished without devious surveys necessarily originating on monuments differing from those that currently control the area.

3. An encroachment permit shall be secured from the Department of Public Works for any and all new, altered or unauthorized existing driveway(s) to access the property through surrounding County Roads.

150 SOUTH NINTH STREET
EL CENTRO, CA 92243-2850

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

AIR POLLUTION CONTROL DISTRICT

IMPERIAL COUNTY CALIFORNIA

September 25, 2019

RECEIVED

SEP 25 2019

IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

Mr. Jim Minnick
Planning & Development Services Director
801 Main St.
El Centro, CA 92243

SUBJECT: Condition Use Permit 19-0017—Second Imperial Geothermal Company (Ormat)

Dear Mr. Minnick:

The Imperial County Air Pollution Control District ("Air District") would like to thank you for the opportunity to review Conditional Use Permit (CUP) 19-0017 that would allow for the installation of two new water-cooled ORMAT Energy Converters; three 10,000 gallon isopentane above ground storage tanks; and, additional pipes to connect the proposed facilities with the existing Heber 2 Geothermal Energy complex ("Project"). The new energy converters will replace the existing six converters while the three new isopentane storage tanks will complement the existing two storage tanks. The Project location is located at 855 Dogwood Road in Heber (APN 054-250-031-000).

Upon review, the Air District reminds the applicant that it will need to submit an application for a Modification of a Permit to Operate to the Engineering & Permitting Division of the Air District. During this process the applicant can discuss the emissions from the equipment to be used in the construction and installation of the energy converters and storage tanks. The applicant must adhere to the Air District's Regulation VIII which is designed to mitigate PM10 emissions during construction. Additionally, the applicant needs to submit a Construction Dust Control Plan and notify the Air District 10 days prior to the start of any construction activities.

Finally, the Air District requests a copy of the Draft CUP prior to recording.

The Air District's rule book can be accessed via the internet at http://www.co.imperial.ca.us/AirPollution. Click on "Rules & Regulations" under "Resources" on the left side of the page. Should you have questions, please call our office at (442) 265-1800.

Sincerely,

Curtis Blondell

Curtis Blondell
APC Environmental Coordinator

Reviewed by Monica Soucier
APC Division Manager

ADMINISTRATION / TRAINING
1078 Dogwood Road
Heber, CA 92249

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

Training
Phone: (442) 265-6011

IMPERIAL COUNTY CRASH RESCUE FIRE

OPERATIONS/PREVENTION
2514 La Brucherie Road
Imperial, CA 92251

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

Prevention
Phone: (442) 265-3020

RECEIVED
SEP 19 2019
IMPERIAL COUNTY
PLANNING & DEVELOPMENT SERVICES

September 18, 2019

RE: Conditional Use Permit #19-0017
Ormat, 855 Dogwood Road, Heber CA 92249 APN: 054-250-031

Imperial County Fire Department would like to thank you for the chance to review and comment on CUP #19-0017 for Ormat Facility Refurbishment, equipment installation, removal of existing facilities.

Imperial County Fire Department has the following comments and/or requirements for the Ormat Geothermal facility.

Comment received is requesting 3 additional 10,000 gallon isopentane above ground storage tanks will be installed adjacent to the existing 2 10,000 gallon isopentane above ground storage tanks.
Isopentane is highly flammable liquid that fire behavior can be highly volatile and vapors may explode when mixed with air. The amount of propose storage and the location rises concerns for Imperial County Fire Department and the surrounding community of Heber. The Emergency Response Guide:
Excerpt from <u>ERG Guide 128</u> [Flammable Liquids (Water-Immiscible):
As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions.
LARGE SPILL: Consider initial downwind evacuation for at least 300 meters (1000 feet).
FIRE: If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2016)
Firefighting
Fire Extinguishing Agents Not to Be Used: Water may be ineffective
Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide (USCG, 1999)
These precautions are required to be followed for all incidents including fire involving hazardous materials. To adequately protect the Imperial County Fire Department staff, facility staff, and citizens of the community of Heber and Imperial County ICFD is requesting the following mitigations measures:

- A certified fire protection engineer survey and analysis of current and proposed fire suppression and detection equipment be performed to evaluate the current systems performance and coverage of protection. Evaluate propose fire suppression and detection equipment in conjunction with existing equipment. A full report of findings must be provided to Imperial County Fire Department for review
- Isopentane leak or fire will require a large scale evacuation area and create a large scale hazardous material incident with a large operational zone. To minimize potential extremely dangerous condition to firefighters and hazardous material teams Imperial County Fire Department is requiring that a Drone be purchase for Imperial County Fire

Department. The final cost, details, and equipment of the drone shall be determined prior the issuance of the building permit.

- Isopentane fire will require a large amount of dry chemical, foam or carbon dioxide to be effective in firefighting as water may be ineffective. For Imperial County Fire Department to be effective in our firefighting effort for the amount of storage Imperial County Fire Department is requiring a foam unit sized and equipment for the storage of isopentane be purchase for Imperial County Fire Department. The final cost, details, and equipment of the foam unit shall be determined prior the issuance of the building permits.
- All isopentane above ground storage tanks shall be protected by approved automatic fire suppression equipment. All automatic fire suppression shall be installed and maintained to the current adapted fire code and regulation.
- An approved automatic fire detection system shall be installed as per the California Fire Code. All fire detection systems shall be installed and maintained to the current adapted fire code and regulations.
- Fire department access roads and gates will be in accordance with the current adapted fire code and the facility will maintain a Knox Box for access on site.
- Compliance with all required sections of the fire code.
- Applicant shall provide product containment areas(s) for both product and water run-off in case of fire applications and retained for removal.

Imperial County Fire Department reserves the right to comment at a later time as we feel necessary.

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

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

Robert Malek
Deputy Chief
Imperial County Fire Department

ADMINISTRATION / TRAINING
1078 Dogwood Road
Heber, CA 92249

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

Training
Phone: (442) 265-6011

IMPERIAL COUNTY
CRASH RESCUE
FIRE

OPERATIONS/PREVENTION
2514 La Brucherie Road
Imperial, CA 92251

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

Prevention
Phone: (442) 265-3020

September 18, 2019

RE: Conditional Use Permit #19-0017
Ormat, 855 Dogwood Road, Heber CA 92249 APN: 054-250-031

Imperial County Fire Department would like to thank you for the chance to review and comment on CUP #19-0017 for Ormat Facility Refurbishment, equipment installation, removal of existing facilities.

Imperial County Fire Department has the following comments and/or requirements for the Ormat Geothermal facility.

Comment received is requesting 3 additional 10,000 gallon isopentane above ground storage tanks will be installed adjacent to the existing 2 10,000 gallon isopentane above ground storage tanks.
Isopentane is highly flammable liquid that fire behavior can be highly volatile and vapors may explode when mixed with air. The amount of propose storage and the location rises concerns for Imperial County Fire Department and the surrounding community of Heber. The Emergency Response Guide:
Excerpt from ERG Guide 128 [Flammable Liquids (Water-Immiscible):
As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions.
LARGE SPILL: Consider initial downwind evacuation for at least 300 meters (1000 feet).
FIRE: If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2016)
Firefighting
Fire Extinguishing Agents Not to Be Used: Water may be ineffective
Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide (USCG, 1999)
These precautions are required to be followed for all incidents including fire involving hazardous materials. To adequately protect the Imperial County Fire Department staff, facility staff, and citizens of the community of Heber and Imperial County ICFD is requesting the following mitigations measures:

- A certified fire protection engineer survey and analysis of current and proposed fire suppression and detection equipment be performed to evaluate the current systems performance and coverage of protection. Evaluate propose fire suppression and detection equipment in conjunction with existing equipment. A full report of findings must be provided to Imperial County Fire Department for review
- Isopentane leak or fire will require a large scale evacuation area and create a large scale hazardous material incident with a large operational zone. To minimize potential extremely dangerous condition to firefighters and hazardous material teams Imperial County Fire Department is requiring that a Drone be purchase for Imperial County Fire

Department. The final cost, details, and equipment of the drone shall be determined prior the issuance of the building permit.

- ~~Isopentane fire will require a large amount of dry chemical, foam or carbon dioxide to be effective in firefighting as water may be ineffective. For Imperial County Fire Department to be effective in our firefighting effort for the amount of storage Imperial County Fire Department is requiring a foam unit sized and equipment for the storage of isopentane be purchase for Imperial County Fire Department. The final cost, details, and equipment of the foam unit shall be determined prior the issuance of the building permits.~~ Revised by Imperial County Fire Department on 12/16/2019. ICFD will no longer required a foam unit to be purchase by Ormat for CUP #17-0017.
- All isopentane above ground storage tanks shall be protected by approved automatic fire suppression equipment. All automatic fire suppression shall be installed and maintained to the current adapted fire code and regulation.
- An approved automatic fire detection system shall be installed as per the California Fire Code. All fire detection systems shall be installed and maintained to the current adapted fire code and regulations.
- Fire department access roads and gates will be in accordance with the current adapted fire code and the facility will maintain a Knox Box for access on site.
- Compliance with all required sections of the fire code.
- Applicant shall provide product containment areas(s) for both product and water run-off in case of fire applications and retained for removal.

Imperial County Fire Department reserves the right to comment at a later time as we feel necessary.

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

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

Robert Malek
Deputy Chief
Imperial County Fire Department

Gabriela Robb

From: Krug, Robert@DTSC <Robert.Krug@dtsc.ca.gov>
Sent: Tuesday, August 27, 2019 3:23 PM
To: Gabriela Robb
Subject: RE: Request for Review and Comments for Ormat CUP19-0017

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

Hi Gabriela,
Regarding Heber 2 Geothermal Repower Project – Amendment to Conditional Use Permit No. 06-0006:
The DTSC Imperial CUPA requests that if Second Imperial Geothermal Company (SIGC) is currently regulated by the DTSC Imperial CUPA, that they update their California Environmental Reporting System (CERS) information when their activities and Haz Mat inventory changes. If they are just starting their business, then they need to evaluate their inventory for any Hazardous Materials (HM), if they will have any Hazardous Wastes (HW), if there will be any petroleum Aboveground Storage Tanks (ASTs) or Underground Storage Tanks (USTs), and lastly if they exceed the thresholds for the California Accidental Release Program (CalARP). If they determine they do have HM or HW as part of their business operation, then they need to notify the DTSC Imperial CUPA and we will evaluate and assist them in what they need to do, which will include creating a CERS account and the payment of annual CUPA fees. Any determination on their part is subject to validation by the DTSC Imperial CUPA, which may consist of an inspection of the facility and sampling wastes for HW criteria.
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

From: Gabriela Robb <GabrielaRobb@co.imperial.ca.us>
Sent: Tuesday, August 27, 2019 2:58 PM
Subject: Request for Review and Comments for Ormat CUP19-0017

Good afternoon commenting agencies,

Please see attached Request for Review and Comments regarding CUP19-0017 as submitted by Second Imperial Geothermal Company/Ormat.
Comments are due by Thursday, September 26, 2019.

Should you have further questions, feel free to contact assigned planner, David Black at (442) 265-1736 Ext. 1746.

Thank you,

Gabriela Robb
Office Assistant III

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 Second Imperial Geothermal Company	EMAIL ADDRESS Melissa Wendt - mwendt@ormat.com	
2. MAILING ADDRESS (Street / P O Box, City, State) 6140 Plumas St., Reno, NV	ZIP CODE 89519	PHONE NUMBER 775-356-9029
3. APPLICANT'S NAME Second Imperial Geothermal Company	EMAIL ADDRESS mwendt@ormat.com	
4. MAILING ADDRESS (Street / P O Box, City, State) 6140 Plumas St., Reno, NV	ZIP CODE 89519	PHONE NUMBER 775-356-9029
4. ENGINEER'S NAME Shlomi Huberman CA. LICENSE NO.	EMAIL ADDRESS shuberman@ormat.com	
5. MAILING ADDRESS (Street / P O Box, City, State) 6140 Plumas St., Reno, NV	ZIP CODE 89519	PHONE NUMBER 775-356-9029

6. ASSESSOR'S PARCEL NO. APN 054-250-031	SIZE OF PROPERTY (in acres or square foot) 39.99 acres	ZONING (existing) A-2-G-SPA

7. PROPERTY (site) ADDRESS
855 Dogwood Road, Heber, CA 92249

8. GENERAL LOCATION (i.e. city, town, cross street)
Slightly north of the intersection of Dogwood Road and Willoughby Road

9. LEGAL DESCRIPTION 855 Dogwood Road, Heber, CA
Tract 44, Township 16 South, Range 14 East, SBB&M

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

10. DESCRIBE PROPOSED USE OF PROPERTY (list and describe in detail)
Facility refurbishment, equipment installation, removal of existing facilities. See attached CUP Application for details.

11. DESCRIBE CURRENT USE OF PROPERTY: Major Geothermal Power Plant
12. DESCRIBE PROPOSED SEWER SYSTEM: No additional sewer service proposed
13. DESCRIBE PROPOSED WATER SYSTEM: No additional water service proposed
14. DESCRIBE PROPOSED FIRE PROTECTION SYSTEM: An existing fire protection system is in place.

15. IS PROPOSED USE A BUSINESS? ☒ Yes ☐ No
IF YES, HOW MANY EMPLOYEES WILL BE AT THIS SITE? Approximately 30, 10-15 more during construction.

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

Connie Stechman — Print Name
8-12-19 — Date
Connie Stechman — Signature

Print Name ______ Date ______
Signature ______

REQUIRED SUPPORT DOCUMENTS

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

APPLICATION RECEIVED BY:	D.R.	DATE	08/13/19
APPLICATION DEEMED COMPLETE BY:	DR	DATE	08/26/19
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 # 19-0017

IS 19-0020

HEBER 2 GEOTHERMAL REPOWER PROJECT

Application to Amend Conditional Use Permit No. 06-00~~06~~28

August 12, 2019

Submitted to:
County of Imperial
Planning & Development Services Department
801 Main Street
El Centro, CA 92243-2811

Submitted by:
Second Imperial Geothermal Company (ORMAT Nevada Inc.)
947 Dogwood Road
Heber, CA 92249

ORMAT

Prepared by:
Catalyst Environmental Solutions
315 Montana Ave., Suite 311
Santa Monica, CA 90403

Catalyst ENVIRONMENTAL SOLUTIONS

Table of Contents

INTRODUCTION....1
BACKGROUND....1
PROJECT DESCRIPTION....1
  Project Location, Access, and Zoning....1
  Proposed Development....2
    ORMAT Energy Converter-1 (OEC-1)....2
    ORMAT Energy Converter-2 (OEC-2)....2
    Three Additional Isopentane Above Ground Storage Tanks....3
  Construction Schedule....3
  Construction Equipment and Noise....3
  Abandonment....3
  Environmental Protection Measures....4
    Surface and Ground Water Quality....4
    Wildlife....4
    Vegetation....4
    Air Quality....4
    Cultural Resources....5
    Waste Management....5
    Fire Prevention....5
    Noise....6
    Geotechnical and Geologic Hazards....6
    Public Health and Safety....6
    Environmental Monitoring....6

Imperial County CEQA Checklist

Appendices

Appendix A: Site Photographs
Appendix B: Biological Resources Clearance Memorandum
Appendix C: Cultural Resources Clearance Memorandum (CONFIDENTIAL)

Appendix D: Water Quality Management Plan
Appendix E: Geo-Technical Site Conditions Memorandum and Technical Report
Appendix F: Air Emissions Memorandum
Appendix G: Isopentane Hazard Assessment
Appendix H: Imperial County Reclamation Plan Application

INTRODUCTION

The Second Imperial Geothermal Company (SIGC), a wholly owned subsidiary of ORMAT Nevada, Inc (ORMAT), owns and operates the Heber 2 Geothermal Energy Complex, which was originally constructed in 1992 and expanded in 2006. SIGC proposes to amend the existing Conditional Use Permit (CUP; No. 06-0006) to allow for the installation of two new water-cooled ORMAT Energy Converters (OECs) that will replace six old ORMAT units from 1992 (OEC-1 through OEC-6); three 10,000 gallon isopentane above ground storage tanks; and, additional pipes to connect the proposed facilities with the existing Heber 2 Geothermal Energy Complex (collectively, the "Project"). All proposed facilities would be developed within the existing Heber 2 Complex and fence line. This application also proposes to extend the permitted life of the entire Heber 2 Complex (including the Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049). The proposed facility upgrades would allow the Heber 2 Complex to run more efficiently and restore output to the net generation capacity (33 megawatts) without expanding the existing facility beyond the current footprint, and produce clean renewable energy in the Imperial Valley for the next three decades.

The land proposed for OEC development is zoned as General Agriculture (A-2) but the project site is entirely within the Imperial County Geothermal Overlay Area/Special Plan Area (G-SPA). "Major Geothermal Projects" in the overlay zone are permitted through the CUP process. The proposed use for the development site is the same as the existing use (geothermal energy generation), demonstrating consistency with the existing zoning and current uses; therefore, an amendment to the existing CUP is required pursuant to 1) County of Imperial's zoning code (Renewable Energy/Geothermal Energy Overlay), 2) the Renewable Energy and Transmission Element County of Imperial General Plan, and 3) condition G-14 (Amendments) of CUP No. 06-0006.

BACKGROUND

The existing Heber 2 Geothermal Energy Power Plant (Heber 2) was permitted for development under CUP No. 06-0006 (April 12, 2006) and consists of the following facilities:

- The Heber 2 Complex currently generates less than the 33 MW net generation capacity, the proposed improvements will restore the facility's generation capacity to 33 MW of renewable energy.
- The Heber 2 Complex currently includes one production well, two injection wells, two six-cell cooling towers, an electrical substation, emergency fire water pump, evacuation skid system-vapor recovery maintenance unit, control room, office space, maintenance facilities, two 10,000 gallons isopentane storage tanks, piping, and ancillary equipment/facilities.
- The parcel where the Heber 2 Complex site is located is approximately 40 acres and is enclosed by security fencing.
- Operations personnel are present at the Heber 2 Complex during routine working hours (8am-5pm), and the facility is monitored 24 hours per day from the control room at the Heber 1 geothermal power plant, approximately 1 mile to the east.

PROJECT DESCRIPTION

Project Location, Access, and Zoning

The Heber 2 Complex is located on private lands owned by ORMAT Nevada, Inc. in southern Imperial County, as observed on **Figure 1**. The proposed development would occur entirely on Assessor's Parcel Number (APN) 054-250-031, which is a 39.99-acre property. This parcel also includes geothermal facilities for the Goulds 2 and Heber South projects. The address for the Heber 2 Complex is 855 Dogwood Road, Heber, CA 92249.

Primary highway access to the Heber 2 site is provided via Interstate 8 (I-8; Kumeyaay Highway), which is located approximately 4.5 miles directly north of the Heber 2 Complex. Dogwood Road stems off of I-8 and provides immediate site access to the Heber 2 Complex. From the south, Willoughby Road runs west-east and is located approximately 1,700 feet from the site. Willoughby Road connects to Dogwood Road providing immediate site access.

APN 054-250-031 is zoned as A-2-G-SPA, for General Agriculture (A-2), Geothermal Overlay Zone (G), and in the Heber Specific Plan Area (SPA). The Project site is entirely within the Imperial County Geothermal Overlay Zone. "Major Geothermal Projects" in the overlay zone are permitted through the CUP process, as was the original Heber 2 Complex. The Heber SPA is intended "to allow for commercial, residential, industrial, renewable energy and other employment oriented development in a mixed used orientation" (Land Use Element of the Imperial County General Plan, 2015). Therefore, the proposed Project conforms to the standards and goals set forth in the Imperial County General Plan and the Renewable Energy and Transmission Element of County of Imperial General Plan (2015).

Proposed Development

SIGC proposes to install two new water-cooled ORMAT Energy Converters (OECs); three 10,000 gallon above ground storage tanks; and, additional pipeline to connect the proposed facilities with the existing Heber 2 Complex (hereinafter, "Project"). This application also proposes to extend the permitted life of the entire Heber 2 Complex (including the related Goulds 2 and Heber South geothermal energy facilities) to 30 years (2019-2049). The objective of the Project is to improve the efficiency of geothermal energy generation and refurbish the Heber 2 Complex to the original nameplate generation of 33 megawatts (MW). The total project disturbance from developing the new OECs is approximately 4 acres, all within the existing power plant footprint and fencing. **Figure 2** provides a site plan of the proposed and existing facilities. **Figure 3** provides a diagram of how the proposed facilities will be integrated with the existing Heber 2 Complex.

The existing air-cooled OEC units would be shut down, disassembled, and removed from the Heber 2 site likely immediately after the completion of the development of the proposed facilities, and no later than 5 years after issuance of the CUP.

The development site is completely devoid of any vegetation and is actively disturbed as part of ongoing energy generation operations at Heber 2. **Appendix A** provides photographs of the development site. Considering its current condition, site preparation for the installation of the proposed facilities would be limited to minor excavation and soil/gravel compaction.

ORMAT Energy Converter-1 (OEC-1)

The proposed OEC-1 unit is a two-turbine combined cycle binary unit, operating on a subcritical Rankine cycle, with isopentane as the motive fluid for the system. This system also consists of a generator, turbines, vaporizer, water cooled condensers, preheaters and recuperators, with the OEC served by the existing evacuation skid/vapor recovery maintenance unit (VRMU) for purging and maintenance events. The design capacity for the unit is 25.43 MW Gross. OEC-1 would be placed on small concrete footers. Example pictures of the proposed OEC unit are provided below in **Figure 4**.

ORMAT Energy Converter-2 (OEC-2)

The proposed OEC-2 unit is a two-cycle binary unit, operating on a subcritical Rankine cycle, with isopentane as the motive fluid for the system. This system also consists of a generator, turbines, vaporizers, water cooled condensers and preheaters, with the OEC served by the existing portable evacuation skid/vapor recovery maintenance unit (VRMU) for purging and maintenance events. The design capacity for the unit is 14.01 MW Gross. OEC-2 would be placed on small concrete footers.

Three Additional Isopentane Above Ground Storage Tanks

To support the new OEC units, three new double-walled ABSTs for additional isopentane supply would be installed. There are two existing ABSTs and the new ABSTs would be sited adjacent to the existing tanks. The new ABSTs would have a capacity of 10,000 gallons each. Example pictures of the proposed ABSTs are provided below in **Figure 5**.

Construction Schedule

The proposed developments are anticipated to take up to eight months to install, test, and become fully integrated with the existing system. Construction will initiate immediately after all permits are secured.

Construction Equipment and Noise

Heavy construction equipment, including semi-truck trailers, flatbed trucks, forklifts, excavators/bulldozers, roller, and cranes would be used to deliver and place the proposed facilities on the project site. Smaller powered hand tools, such as drills, compressors, and welding equipment will also be used. Employee vehicles will be used to transport workers to the project site and parked at the designated parking locations.

During construction, noise emissions would be periodic and temporary, depending on the use of the heavy equipment. Smaller hand tools would be used consistently during the construction phase (approximately eight months).

Construction activities would be limited to 7:00am through 7:00pm. Construction noise from the development of the proposed facilities would not exceed the County threshold of 75 decibels any time of the day (§90702.00 – Sound Level Limits). Further, there are no sensitive receptors in close proximity to the Heber 2 site and the closest resident is over 3,500 feet away from the development site.

Abandonment

The existing OEC units, as shown on **Figure 2**, would be safely disconnected from the Heber 2 Complex, dismantled, and removed from the site. Removal of the old air-cooled OEC units would likely occur immediately after development of the proposed facilities is complete, but no later than five years after issuance of the CUP amendment.

This application seeks to extend the permitted life of the Heber 2 Complex to 30 years, and if approved by the County, would operate between 2019 and 2049. As included in the enclosed Reclamation Plan Application (**Appendix H**), at the end of the useful life, all equipment and facilities would be properly abandoned and dismantled. The geothermal production well and injection wells would be abandoned in conformance with the well abandonment requirements of the California Division of Oil, gas, and Geothermal Resources (DOGGR). Abandonment of a geothermal well involves plugging the well bore with clean drilling mud and cement sufficient to ensure that fluids would not migrate to different aquifers. The well head (and any other equipment) would be removed, the casing cut off at least six feet below ground surface, and the well site reclaimed.

A Site Abandonment Plan (SAP), in conformance with Imperial County and DOGGR requirements, would be prepared and implemented. The SAP would describe the proposed approach to facility abandonment, equipment removal, disposal, and site restoration. All above-ground equipment will be dismantled and removed from the entire Heber 2 site. The surface of the site would be restored to conform to approximate pre-Project land uses (e.g., agriculture or open space).

Environmental Protection Measures

All SIGC and contractor personnel would be informed of SIGC/ORMAT's policy regarding environmental protection, safety plans, and emergency response protocols. Collectively, these measures minimize unintended impacts and events as result of facility construction and geothermal energy generation.

Surface and Ground Water Quality

- A Water Quality Management Plan (WQMP) has been prepared for both the construction and operations phases of the Project. The WQMP includes numerous "good housekeeping" and preventative maintenance, employee training, safe handling/storage, and spill response measures to minimize any accidental releases. The WQMP is attached as **Appendix D**.
- The site would be designed and prepared to provide adequate stormwater conveyance and/or infiltration.
- Any spills or accidental releases of the chemicals used during Project construction and/or operation would be cleaned up with the appropriate materials (i.e., absorbent pads, foams/gels) and the affected area remediated to prevent contact with groundwater resources.
- No vehicle fueling or maintenance would take place on exposed soil or vegetation.

Wildlife

- Speed limits of 5 mph would be observed on the project site in order to minimize dust and avoid collision and incidental mortality of local wildlife.
- Pre-construction surveys would occur to ensure the absence of any sensitive species, including burrowing owl.

Vegetation

- The site is void of any vegetation, however vegetation control, including invasive species eradication, will be controlled to prevent growth under/near the proposed facilities.

Air Quality

- The Project would comply with the Imperial County Air Pollution Control District (ICAPCD) Regulation VIII (Fugitive Dust Control), the Imperial County 2018 PM10 Plan, and the Imperial County 2018 PM2.5 Plan.
- Project equipment and worker vehicles would be turned off when not in use and not left idling to minimize unnecessary emissions.
- Water would be applied to the development site and during site preparation and construction to control fugitive dust.
- Earth moving work would be completed in phases (as necessary) to minimize the amount of disturbed area at one time.
- Construction vehicles and heavy equipment that use non-surfaced facility roads/areas will be restricted to 5 mph to control fugitive dust.
- During windy conditions, barriers would be constructed and/or additional watering is conducted to minimize wind-blown fugitive dust.
- Vehicle access would be restricted to the disturbance area via signage/fencing.
- Equipment would be operated according to best practices and maintained according to design specifications.

- The OECs would be inspected for leaks using specialized leak detection equipment during every shift, and leaks would be repaired quickly.
- Any breakdown resulting in air emissions would be reported to ICAPCD and corrected promptly (within 24 hours when possible).
- The VRMU would be tested annually to confirm proper function and high isopentane recovery rates.

Cultural Resources

- Project construction personnel will monitor areas during surface disturbing activities and if any potential cultural or archaeological resources (e.g., bones, ceramics) are discovered, all construction affecting the discovery site will be suspended immediately until a qualified archaeologist has reviewed the findings. An Unanticipated Discoveries Plan would be prepared prior to resuming construction.

Waste Management

- Workers would be required to properly dispose of all refuse and trash to prevent any litter on the site.
- During construction, portable chemical sanitary facilities would be used by all construction personnel. These facilities would be serviced by a local contractor.
- All construction wastes, liquid or solid, would be disposed of in compliance with all appropriate local, state, and federal disposal regulations.
- Solid wastes would be disposed of in an approved solid waste disposal site in accordance with Imperial County Environmental Health Department requirements. Waste would be routinely collected and disposed of at an authorized landfill by a licensed disposal contractor.

Fire Prevention

- The existing Heber 2 Emergency Response Plan (ERP) addresses Project construction and operations. The ERP would be reviewed and updated, if necessary, to specifically consider Project construction and operations.
- All construction equipment would be equipped with exhaust spark arresters.
- Safety Data Sheets for all known chemicals of concern would be maintained and available to workers and first responders.
- Personnel would be allowed to smoke only in designated areas.
- A list of emergency phone numbers would be available onsite so that the appropriate firefighters and first responders can be contacted in case of a fire or emergency.
- Adequate firefighting equipment (i.e., a shovel, a pulaski, standard fire extinguisher[s], and an ample water supply) would be kept readily available at each active construction site.
- Vehicle catalytic converters (on vehicles that would enter and leave the construction site on a regular basis) would be inspected often and cleaned of all flammable debris.
- All cutting/welding torch use, electric-arc welding, and grinding operations would be conducted in an area free from vegetation. An ample water supply and shovel would be on hand to extinguish any fires created from sparks. At least one person in addition to the cutter/welder/grinder would be at the work site to promptly detect fires created by sparks.
- Operations personnel are present at the Heber 2 site during routine working hours (8 am-5 pm), and the facility is monitored 24 hours per day from the control room at the Heber 1 geothermal power plant,

approximately 1 mile to the east. ORMAT would designate an employee to serve as the responsible agent/emergency manager who fully comprehends the ERP and would be prepared to enact the ERP in the event of a fire.

Noise

- Construction activities would be limited to 7:00am and 7:00pm.

Geotechnical and Geologic Hazards

- A formal geotechnical investigation of the site's soil characteristics, seismic conditions, stormwater infiltration, site stability, and potential for liquefaction has been developed. A summary memorandum and the full technical report are attached as **Appendix E.**

Public Health and Safety

- The existing Heber 2 ERP addresses Project construction and operations. The ERP would be reviewed and updated, if necessary, to specifically consider Project construction and operations.
- The Heber 2 site would be fenced to prevent:
    - Unauthorized people from accessing and tampering with the geothermal facilities.
    - Wildlife from entering the facility and damaging the geothermal facilities or being injured.
- Signage, such as "No Trespassing" and "Danger – High Voltage", is posted at the Heber 2 site to provide notice to unauthorized people to keep out.
- The existing Heber 2 Hazardous Materials Business Plan (HMBP) previously submitted to the California Department of Toxic Substances Control (CDTSC), as a Certified Unified Program Agency (CUPA) for Imperial County, would be updated and revised as necessary prior to Project construction and operation.
- Operations personnel are present at the Heber 2 site during routine working hours (8 am-5 pm), and the facility is monitored 24 hours per day from the control room at the Heber 1 geothermal power plant, approximately 1 mile to the east. ORMAT would designate an employee to serve as the responsible agent/emergency manager who fully comprehends the ERP and would be prepared to enact the ERP in the event of an emergency.
- Minor leaks or spills of fluids from construction equipment would be quickly contained and cleaned up.
- All hazardous materials would be used, transported, and disposed of in accordance with applicable safe handling and disposal regulations.
- Project personnel would coordinate that movement of any required oversized load on Imperial County roads with the Imperial County Department of Public Works (ICDPW) and/or on State highways with the California Department of Transportation (CalTrans) and the El Centro California Highway Patrol office. Transportation of oversized equipment would be minimized to the greatest extent feasible.

Environmental Monitoring

- Standard requirements for compliance with all applicable laws and regulations, with bonds, fees, and insurance requirements would be followed to ensure proper performance by operations personnel.
- Monitoring inspections and access/entry provisions would be put in place.
- ORMAT would designate a responsible agent to oversee all construction and operations activities at the Heber 2 site.