Geotechnical Engineering Report
CARSON ICE – GEN STEAM BOILER
WKA No. 10475.01
March 17, 2015

Prepared For:
Carson Energy Group
5000 83rd Street
Sacramento, California 95826
TABLE OF CONTENTS

INTRODUCTION .................................................................................................................. 1
  Scope of Services .............................................................................................................. 1
  Figures and Attachments ............................................................................................ 1
  Proposed Development ............................................................................................ 2

FINDINGS .......................................................................................................................... 2
  Site Description ......................................................................................................... 2
  Historical Aerial Photograph Review .................................................................... 2
  Soil Conditions ........................................................................................................ 3
  Groundwater .............................................................................................................. 3

CONCLUSIONS .................................................................................................................. 3
  Bearing Capacity ...................................................................................................... 3
  2013 CBC/ASCE 7-10 Seismic Design Criteria ....................................................... 4
  Liquefaction Potential ............................................................................................. 5
  Excavation Conditions ......................................................................................... 5
  Soil Expansion Potential ...................................................................................... 5
  Soil Suitability for Fill Construction ..................................................................... 6
  Preliminary Soil Corrosion Potential .................................................................... 6
  In-Situ Electrical Resistivity ................................................................................... 7
  Groundwater Conditions and Seasonal Moisture .............................................. 7

RECOMMENDATIONS ........................................................................................................ 8
  Site Clearing and Preparation .................................................................................. 8
  Engineered Fill Placement .................................................................................... 8
  Utility Trench Backfill ............................................................................................ 9
  Foundation Design .................................................................................................. 9
  Site Drainage ........................................................................................................... 10
  Geotechnical Engineering Observation and Testing During Earthwork ............ 11

LIMITATIONS ................................................................................................................... 11

FIGURES
  Vicinity Map ............................................................................................................... Figure 1
  Site Plan ..................................................................................................................... Figure 2
  Logs of Borings ........................................................................................................ Figures 3 and 4
  Unified Soil Classification System ........................................................................ Figure 5

APPENDIX A – General Project Information, Laboratory Testing and Results
  Expansion Index ......................................................................................................... Figure A1
  Corrosion Test Results ............................................................................................ Figure A2
INTRODUCTION

We have completed a geotechnical engineering study for the proposed steam boiler project to be constructed at the Carson Ice facility located at 8580 Laguna Station Road in Elk Grove, California. The purpose of our study has been to explore the existing site, soil and groundwater conditions, and to provide geotechnical engineering conclusions and recommendations for the design and construction of the proposed improvements. This report presents the results of our work.

Scope of Services

Our scope of services included the following tasks:

1. a site reconnaissance;
2. review of historic United States Geologic Survey (USGS) topographic maps and available groundwater data within the vicinity of the property;
3. subsurface exploration, including the drilling and sampling of two borings to a maximum depth of 15 feet below existing site grades;
4. in-situ electrical resistivity testing;
5. bulk sampling of the subgrade soils within the footprint of the proposed steam boiler;
6. laboratory testing of selected soil samples to determine engineering properties of the soil;
7. engineering analyses; and,
8. preparation of this report.

Supplemental information used in the preparation of this report included review of the Geotechnical Engineering Report (WKA No. 2515.01, dated September 21, 1993), prepared for the Carson Energy Systems Ice Gen facility.

Figures and Attachments

This report contains a Vicinity Map as Figure 1, a Site Plan showing the approximate boring locations as Figure 2, and the Logs of Soil Borings completed for this project as Figures 3 and 4.
An explanation of the symbols and classification system used on the logs is contained on Figure 5. Appendix A contains general information regarding project concepts, exploratory methods used during our field investigation, and laboratory test results not included on the boring logs.

**Proposed Development**

We understand the proposed steam boiler will be constructed to the southeast of the existing water treatment building. The steam boiler will be supported on a thick, reinforced mat-foundation. Structural loads for the steam boiler are anticipated to be on the order of 112,000 pounds for dead load conditions. Associated improvements will include construction of a deaerator, feed pumps, underground utilities, exterior flatwork, etc. Asphalt pavements are not being considered at this time. Grading plans were not available; however based on the existing site topography, we anticipate maximum excavations and fills on the order of one to three feet for the proposed improvements.

**FINDINGS**

**Site Description**

The project site is located at 8580 Laguna Station Road in Elk Grove, California (Figure 1), within the Sacramento Regional Wastewater Treatment Plant (SRWTP). At the time of our field explorations on February 26, 2015, the proposed steam boiler area was undeveloped and covered with a thin layer of gravel. An elevated pipe bridge was observed on the north side of the site and a storm drain was observed traversing east-west through the site. A switch yard was observed to the south of the site.

Topography of the site is relatively flat. According to the United States Geological Survey Topographic Map of the Florin Quadrangle, California (1980), the surface elevation of the site is about +15 feet relative to mean sea level (msl).

**Historical Aerial Photograph Review**

We reviewed available historical aerial photographs from the years 1961 through 2015. Review of historical aerial photographs taken in 1961, 1976, and 1991 show the planned steam boiler area to be vacant and undeveloped. By 1999, the Carson Energy Facility has been constructed and the surface of the steam boiler area appears to be covered with gravel. Historical aerial
photographs reviewed after 1999 up through 2015 indicate the site has remained essentially unchanged since at least 1999.

**Soil Conditions**

Two exploratory borings were drilled within the footprint of the steam boiler on February 26, 2015, at the approximate locations shown on Figure 2. The approximate footprint of the steam boiler was provided to us in the field by representatives of Carson Energy Group.

Borings D1 and D2 indicate the presence of undocumented fill materials consisting of sandy gravels to depths of up to about ½-foot below existing grade. The native subsurface profile encountered below the fill generally consists of very stiff, silty clay and clayey silt in the upper 2 to 3½ feet below existing grades underlain by dense, variably cemented silty sand to a depth up to about nine feet below the surface. Below a depth of nine feet, we encountered hard, silty clay to a depth of about 13½ feet underlain by very dense, sandy silt to the maximum depth explored of approximately 15 feet below existing site grade. These conditions are consistent with the subsurface soil encountered during our previous studies at the property.

For detailed soil conditions at the boring locations, please refer to the Logs of Soil Borings presented on Figures 3 and 4.

**Groundwater**

Groundwater was not encountered within the borings drilled on February 26, 2015, to the maximum depth explored of approximately 16½ feet below existing site grade. The Sacramento County Department of Public Works *Groundwater Elevations Map, Spring 2007* indicates that regional groundwater beneath the site is generally present at an elevation of approximately -20 feet msl, or at least 35 feet below the existing ground surface, consistent with the groundwater depth encountered in a previous boring drilled at the property in August of 1993.

**CONCLUSIONS**

**Bearing Capacity**

Based on our field and laboratory test results, it is our opinion that the undisturbed surface and near-surface soils are capable of supporting the proposed steam boiler provided the recommendations of this report are followed.
Clearing operations to remove existing underground utilities will disturb the surface soil and create loose and variable soil conditions. Disturbed soils must be excavated to expose a firm base and the excavations widened, as necessary to provide equipment access, and backfilled with engineered fill to provide uniform support for the planned steam boiler.

Our experience in the area also indicates that engineered fills composed of native soils or approved import soils that are placed and compacted in accordance with general engineering practices will be suitable for support of the proposed improvements.

2013 CBC/ASCE 7-10 Seismic Design Criteria

Section 1613 of the 2013 edition of the California Building Code (CBC) references ASCE Standard 7-10 for seismic design. The following seismic parameters were determined based on the site latitude and longitude using the public domain computer program developed by the USGS. The following parameters summarized in Table 1 may be used for seismic design of the planned steam boiler.

| TABLE 1 |
| 2013 CBC/ASCE 7-10 SEISMIC DESIGN PARAMETERS |
| Latitude: 38.5003° N | Longitude: 121.4014° W | ASCE 7-10 Table/Figure | 2013 CBC Table/Figure | Factor/Coefficient | Value |
| Short-Period MCE at 0.2 seconds | Figure 22-1 | Figure 1613.3.1(1) | | S_S | 0.709 g |
| 1.0 second Period MCE | Figure 22-2 | Figure 1613.3.1(2) | | S_1 | 0.300 g |
| Soil Class | Table 20.3-1 | Section 1613.3.2 | Site Class | D |
| Site Coefficient | Table 11.4-1 | Table 1613.3.3(1) | F_a | 1.233 |
| Site Coefficient | Table 11.4-2 | Table 1613.3.3(2) | F_v | 1.801 |
| Adjusted MCE Spectral Response Parameters | Equation 11.4-1 | Equation 16-37 | S_MS | 0.874 g |
| | Equation 11.4-2 | Equation 16-38 | S_M1 | 0.540 g |
| Design Spectral Acceleration Parameters | Equation 11.4-3 | Equation 16-39 | S_DS | 0.582 g |
| | Equation 11.4-4 | Equation 16-40 | S_D1 | 0.360 g |
| Seismic Design Category | Table 11.6-1 | Section 1613.3.5(1) | Risk Category | I to IV | D |
| | Table 11.6-2 | Section 1613.3.5(2) | Risk Category | I to IV | D |

Notes:  
MCE = Maximum Considered Earthquake  
g = gravity
Liquefaction Potential

A site-specific liquefaction analysis was beyond the scope of services for this evaluation. However, based upon the results of our subsurface exploration, the known site geologic, seismologic, groundwater and soil conditions, it is our opinion that the potential for liquefaction occurring at this site is relatively low. To our knowledge, there have been no reported instances of liquefaction having occurred within the Sacramento area during the major earthquake events of 1892 (Vacaville-Winters), 1906 (San Francisco), 1989 (Loma Prieta) and the 2014 (American Canyon).

Excavation Conditions

The surface and near-surface soils should be readily excavatable with conventional construction equipment. Soil sidewalls for the planned foundation excavations and shallow utility excavations likely will remain stable at near-vertical inclinations without significant caving, unless saturated or disturbed soils are encountered.

Excavations deeper than five feet that will be entered by workers should be sloped, braced or shored in accordance with current California Occupational Safety and Health Administration (Cal/OSHA) regulations. The contractor must provide an adequately constructed and braced shoring system in accordance with federal, state and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground.

Excavated materials should not be stockpiled directly adjacent to an open trench to prevent surcharge loading of the trench sidewalls. Excessive equipment traffic also should be avoided near open trenches. If material is stored or heavy equipment is operated near an excavation, stronger shoring would be needed to resist the extra pressure due to the superimposed loads.

Soil Expansion Potential

Laboratory test results on near-surface clays indicate these materials possess a medium expansion potential when tested in accordance with ASTM D4829 test method (Figure A1). Based on the laboratory test result, we conclude the native clays are capable of exerting moderate expansion pressures on foundations, interior floor slabs, and exterior flatwork. Specific recommendations to reduce the effects of expansive soils are presented in this report.
Soil Suitability for Fill Construction

The on-site soils encountered in our borings are considered suitable for use in engineered fill construction, provided these materials are free of significant organics and deleterious rubble, and are at moisture contents capable of achieving the desired degree of compaction. The near surface sandy gravel fill material may be used in engineered fill construction.

Preliminary Soil Corrosion Potential

One sample of near-surface soil was submitted to Sunland Analytical Lab for testing to determine pH, chloride and sulfate concentrations, and minimum resistivity to help evaluate the potential for corrosive attack upon buried concrete. The results of the corrosivity testing are summarized in the Table 2. A copy of the analytical test report is presented in Figure A2.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Test Method</th>
<th>(D2 (\frac{1}{2}'-2'))</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>CA DOT 643 Modified*</td>
<td>6.59</td>
</tr>
<tr>
<td>Minimum Resistivity</td>
<td>CA DOT 643 Modified*</td>
<td>999 (\Omega\text{-cm})</td>
</tr>
<tr>
<td>Chloride</td>
<td>CA DOT 417</td>
<td>31.1 ppm</td>
</tr>
<tr>
<td>Sulfate</td>
<td>CA DOT 422</td>
<td>103.5 ppm</td>
</tr>
</tbody>
</table>

Notes:
* = Small cell method
\(\Omega\text{-cm}\) = Ohm-centimeters
ppm = Parts per million

The California Department of Transportation Corrosion and Structural Concrete Field Investigation Branch, 2012 Corrosion Guidelines (Version 2.0), considers a site to be corrosive to foundation elements if one or more of the following conditions exists for the representative soil and/or water samples taken: has a chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 2000 ppm, or the pH is 5.5 or less. Based on this criterion, the on-site soils tested are not considered corrosive to steel reinforcement properly embedded within Portland cement concrete (PCC).

Table 4.2.1 – Exposure Categories and Classes, American Concrete Institute (ACI) 318, Section 4.2, as referenced in Section 1904.1 of the 2013 CBC, indicates the severity of sulfate exposure for the sample tested is Not Applicable. Ordinary Type I-II Portland cement is
considered suitable for use on this project, assuming a minimum concrete cover is maintained over the reinforcement.

Wallace-Kuhl & Associates are not corrosion engineers. Therefore, if it is desired to further define the soil corrosion potential at the site, a corrosion engineer should be consulted.

In-Situ Electrical Resistivity

An in-situ electrical resistivity test was performed using the Wenner 4-pin method (American Society of Testing and Materials [ASTM] G57) at the location shown in Figure 2. The results of the in-situ electrical resistivity testing indicates the soil resistivity of the upper 10 feet ranges from about 861 to 2202 ohm-centimeters and are summarized in Table 3. These results are consistent with previous in-situ electrical resistivity testing performed at the property.

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>IN-SITU ELECTRICAL RESISTIVITY TESTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Electrode Spacing (feet)</td>
</tr>
<tr>
<td>R1</td>
<td>2½</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td>R2</td>
<td>2½</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Notes:
Ω-cm = Ohm-centimeters

Groundwater Conditions and Seasonal Moisture

Available data from literature and our previous investigation indicates the permanent groundwater table is located at a depth of at least 35 feet below the existing ground surface. Therefore, groundwater should not adversely effect development of the project.

However, during the winter and spring months, infiltrating surface run-off water will create saturated surface soil conditions due to the impervious nature of the underlying cemented soils. It is probable that grading operations attempted following the onset of winter rains and prior to
prolonged drying periods will be hampered by high soil moisture contents. Such soils, intended for use as engineered fill, will require a prolonged period of dry weather and/or considerable aeration to reach a moisture content suitable to achieve proper compaction.

RECOMMENDATIONS

General

Based on existing site topography, we anticipate maximum excavations and fills on the order of one to three feet will be required for the proposed improvements. The recommendations contained in this report are based upon this assumption.

The on-site soils likely will be saturated by rainfall in the winter and early spring months, and will not be compactable without drying by aeration or the addition of lime (or a similar product) to dry the soils. Should the construction schedule require work to continue during the wet months, additional recommendations can be provided, as conditions warrant.

Site Clearing and Preparation

Prior to site grading, existing utilities to be abandoned should be completely removed from structural areas. Any excavations resulting from removal of underground utility lines should be backfilled with engineered fill. All loose fill materials should be removed from the pad area including a zone extending five feet beyond the foundation footprint.

Following site clearing, the construction areas should be scarified to a depth of 12 inches, thoroughly moisture conditioned to at least three percent above the optimum moisture content, and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density.

Compaction of the existing grade must be performed in the presence of our representative who will evaluate the performance of the subgrade under compactive loads and identify any loose or unstable soil conditions that could require additional excavation. Compaction should be achieved using a heavy, self-propelled, sheepsfoot compactor.

Engineered Fill Placement

On-site soils are suitable for engineered fill construction in structural areas provided the materials do not contain clay, rubbish, rubble greater than three inches, and significant organic
concentrations. Imported fill materials, if required, should be compactable, granular soils with an Expansion Index of 20 or less, Plastic Index of 15 or less, and contain no particles greater than three inches in maximum dimension. Imported soils should be approved by our office prior to being transported to the site. Also, if import fills are required (other than aggregate base), the contractor must provide appropriate documentation that the import is clean of known contamination and within acceptable corrosion limits.

Engineered fill composed of native or approved imported materials should be placed in lifts not exceeding six inches in compacted thickness with each lift being uniformly moisture conditioned to the optimum moisture content and compacted to 90 percent of the ASTM D1557 maximum dry density. Aggregate base, if used, should be uniformly compacted to at least 95 percent relative compaction and the optimum moisture content.

The upper 12 inches of final equipment pad subgrade should be moisture conditioned to at least three percent above the optimum moisture content and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density, for clay subgrades. Granular import soils should be moisture conditioned to the optimum moisture content and uniformly compacted to at least 95 percent relative compaction, regardless of whether final subgrade is achieved by excavation, filling, or left at-grade.

A representative from our office should be present during site clearing and preparation, and grading operations to observe and test the fill to verify compliance with our recommendations.

Utility Trench Backfill

Bedding of utilities and initial backfill should be in accordance with the manufacturer’s recommendations for the pipe materials selected, and the City of Elk Grove Standards, latest edition.

We recommend that native soil be used to backfill utility trenches, especially within building areas. Utility trench backfill should be placed in maximum 12-inch lifts (compacted thickness), moisture conditioned to at least two percent above the optimum moisture content, and mechanically compacted to at least 90 percent of the ASTM D1557 maximum dry density.

Foundation Design

We understand the proposed steam boiler will be supported on a thick mat-foundation. Alternative foundation systems such as isolated spread footings or drilled piers are suitable for
the project; however we understand that a thick, mat foundation will be utilized to support the proposed steam boiler. Recommendations for alternative foundation types can be provided upon request.

The proposed steam boiler may be supported on a mat foundation extending at least 18 inches below the lowest adjacent soil subgrade and bearing on properly placed and compacted engineered fill. Foundations so established may be sized for a maximum allowable “net” vertical bearing capacity of 2000 pounds per square foot (psf) for dead plus live load, with a one-third increase available for total load, including wind or seismic forces. The deflection of the slab can be evaluated using a modulus of subgrade reaction of 150 pounds per square inch per inch (pci) for native soil subgrades but may be increased to 300 pci for subgrades consisting of Class 2 aggregate base. The weight of foundation concrete extending below adjacent soil grade may be disregarded in bearing computations. The mat foundation should be reinforced to provide continuity and to allow the foundation the ability to span isolated soil irregularities. Foundation reinforcement should be determined by the project structural engineer.

Resistance to lateral foundation displacement may be computed using an allowable friction factor of 0.30, which may be multiplied by the effective vertical load on each foundation. Additional lateral resistance may be computed using an allowable passive earth pressure against the vertical projection of foundations equivalent to a fluid pressure of 300 psf per foot of depth. These two modes of resistance should not be added unless the frictional value is reduced by 50 percent since mobilization of these resistances may occur at different degrees of horizontal movement.

We estimate total settlement for the mat foundation using the recommended maximum net allowable bearing pressure presented above, should be one inch or less. Differential settlements are estimated to be about one-half the total settlement over a distance of 50 feet or the least dimension of the structure, whichever is less. These settlement estimates are based on the available boring information, our experience with similar structures and soil conditions, and field verification of suitable bearing soils by our firm during foundation construction.

Site Drainage

Final site grading should be accomplished to provide positive drainage of surface water away from the equipment pad and prevent ponding of water adjacent to foundations. The grade adjacent to the equipment pad should be sloped away from foundations at a minimum two percent slope for a distance of at least five feet, where possible. Ponding of surface water should not be allowed adjacent to foundations.
Geotechnical Engineering Report
CARSON ICE – GEN STEAM BOILER
WKA No. 10475.01
March 17, 2015

Geotechnical Engineering Observation and Testing During Earthwork

Site preparation should be accomplished in accordance with the recommendations of this report. Representatives of Wallace-Kuhl & Associates should be present during site preparation and all grading operations to observe and test the fill to verify compliance with our recommendations and the job specifications. Testing frequency will depend on how the site is graded and should be determined during the rough grading operations. These services are beyond the scope of work authorized for this investigation.

In the event that Wallace-Kuhl & Associates is not retained to provide geotechnical engineering observation and testing services during construction, the Geotechnical Engineer retained to provide these services should indicate in writing that they agree with the recommendations of this report, or prepare supplemental recommendations as necessary. A final report by the Geotechnical Engineer should be prepared upon completion of the project.

LIMITATIONS

Our recommendations are based upon the information provided regarding the proposed project, combined with our analysis of site conditions revealed by the field exploration and laboratory testing programs. We have used our engineering judgment based upon the information provided and the data generated from our investigation. This report has been prepared in substantial compliance with generally accepted geotechnical engineering practices that exist in the area of the project at the time the report was prepared. No warranty, either express or implied, is provided.

If the proposed construction is modified or re-sited; or, if it is found during construction that subsurface conditions differ from those we encountered at the boring location, we should be afforded the opportunity to review the new information or changed conditions to determine if our conclusions and recommendations must be modified.

We emphasize that this report is applicable only to the proposed construction and the investigated site, and should not be utilized for construction on any other site.
The conclusions and recommendations of this report are considered valid for a period of three years. If design is not completed and construction has not started within three years of the date of this report, the report must be reviewed and updated if necessary.

Wallace - Kuhl & Associates

Gerard J. Follettie
Staff Engineer

Michael M. Watari
Senior Engineer
Street data courtesy of Sacramento County.
Projection: NAD 83, California State Plane, Zone II
STORM DRAIN LINE

Legend
- Approximate Soil Boring Locations
- R1 Approximate in-site electrical resistivity line

SITE PLAN
CARSON ICE - GEN STEAM BOILER
Elk Grove, California

FIGURE 2

DRAWN BY
RWO
CHECKED BY
JP
PROJECT MGR
MMW
DATE
02/15

STREET DATA COURTESY OF SACRAMENTO COUNTY.
HYDROGRAPHY COURTESY OF THE U.S. GEOLOGICAL SURVEY
PROJECTION: NAD 83, CALIFORNIA STATE PLANE, ZONE II

WKA NO. 10475.01
Project: Carson Ice-Gen Steam Boiler
Project Location: Sacramento, California
WKA Number: 10475.01

LOG OF SOIL BORING D1

Sheet 1 of 1

Date(s) Drilled: 2/26/15
Logged By: GJF
Checked By: MMW

Drilling Method: Hollow Stem Augers
Drilling Contractor: V & W Drilling, Inc.
Total Depth of Drill Hole: 15.0 feet

Groundwater Depth [Elevation], feet: Groundwater was not encountered
Diameter(s) of Hole, inches: 8"
Approx. Surface Elevation, ft MSL

Drill Rig Type: CME 55

Groundwater was not encountered
Sampling Method(s): California Modified

Remarks: Driving Method and Drop
140 lb hammer, 30-inch drop

ENGINEERING CLASSIFICATION AND DESCRIPTION

<table>
<thead>
<tr>
<th>ELEVATION, feet</th>
<th>DEPTH, feet</th>
<th>GRAPHIC LOG</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>-5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>-10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>-15</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Gray brown, moist, silty, sandy GRAVEL (GM) - Fill
Red brown, moist, very stiff, sandy, clayey SILT (ML)

Brown, moist, dense, silty, fine SAND (SM)

Brown, moist, hard, silty CLAY (CL)

Brown, moist, very dense, sandy SILT (ML)

Boring terminated at 15 feet below existing site grade. Groundwater was not encountered.

SAMPLE DATA

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>SAMPLE NUMBER</th>
<th>NUMBER OF BLOWS</th>
<th>MOISTURE CONTENT, %</th>
<th>DRY UNIT WEIGHT,pcf</th>
<th>ADDITIONAL TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1-1I</td>
<td>20</td>
<td>11.5</td>
<td>118</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1-2I</td>
<td>45</td>
<td>10.4</td>
<td>118</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1-3I</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1-4I</td>
<td>50/4&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEST DATA

Sample Number: GJFCME 55
Approx. Surface Elevation, ft MSL: 15.0 feet

Driving Method and Drop: 140 lb hammer, 30-inch drop

FIGURE 3
**LOG OF SOIL BORING D2**

**Project Location:** Sacramento, California  
**Project:** Carson Ice-Gen Steam Boiler  
**WKA Number:** 10475.01

<table>
<thead>
<tr>
<th>Date(s) Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
<th>Drilling Method</th>
<th>Drilling Contractor</th>
<th>Total Depth of Drill Hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/26/15</td>
<td>GJF</td>
<td>MMW</td>
<td>Hollow Stem Augers</td>
<td>V &amp; W Drilling, Inc.</td>
<td>15.0 feet</td>
</tr>
</tbody>
</table>

**Drill Rig Type:** CME 55  
**Diameter(s) of Hole, inches:** 8"  
**Groundwater Depth (Elevation), feet:** Groundwater was not encountered  
**Sampling Method(s):** California Modified  
**Remarks:** Drilling Method and Drop  
**Driving Method and Drop:** 140 lb hammer, 30-inch drop

### GRAPHIC LOG

<table>
<thead>
<tr>
<th>ELEVATION, feet</th>
<th>DEPTH, feet</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>-15</td>
<td>Gray brown, moist, silty, sandy GRAVEL (GM) - Fill</td>
</tr>
<tr>
<td>10</td>
<td>-10</td>
<td>Brown, moist, very stiff, fine to medium sandy CLAY (CL)</td>
</tr>
<tr>
<td>5</td>
<td>-5</td>
<td>Brown, moist, medium dense, variably cemented, silty fine SAND (SM)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>very dense</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Brown, moist, hard, silty CLAY (CL)</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Brown, moist, very dense, fine sandy SILT (ML)</td>
</tr>
</tbody>
</table>

Boring terminated at 15 feet below existing site grade. Groundwater was not encountered.

### TEST DATA

<table>
<thead>
<tr>
<th>SAMPLE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAMPLE</strong></td>
</tr>
<tr>
<td>D2-1I</td>
</tr>
<tr>
<td>D2-2I</td>
</tr>
<tr>
<td>D2-3I</td>
</tr>
<tr>
<td>D2-4I</td>
</tr>
</tbody>
</table>

### ADDITIONAL TESTS

- **E1**
- **UCC=3.9 Tsf**

---

**Engineering Classification and Description**

- Gray brown, moist, silty, sandy GRAVEL (GM) - Fill
- Brown, moist, very stiff, fine to medium sandy CLAY (CL)
- Brown, moist, medium dense, variably cemented, silty fine SAND (SM)
- Very dense
- Brown, moist, hard, silty CLAY (CL)
- Brown, moist, very dense, fine sandy SILT (ML)
# Unified Soil Classification System

## Major Divisions

<table>
<thead>
<tr>
<th>Major Divisions</th>
<th>Symbol</th>
<th>Code</th>
<th>Typical Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels</td>
<td>GW</td>
<td>Well graded gravels or gravel - sand mixtures, little or no fines</td>
<td></td>
</tr>
<tr>
<td>Poorly graded gravels or gravel - sand mixtures, little or no fines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silty gravels, gravel - sand - silt mixtures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clayey gravels, gravel - sand - clay mixtures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sands</td>
<td>SW</td>
<td>Well graded sands or gravelly sands, little or no fines</td>
<td></td>
</tr>
<tr>
<td>Poorly graded sands or gravelly sands, little or no fines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silty sands, sand - silt mixtures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clayey sands, sand - clay mixtures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silts &amp; Clays</td>
<td>ML</td>
<td>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity</td>
<td></td>
</tr>
<tr>
<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic silts and organic silty clays of low plasticity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LL &lt; 50</td>
<td>CL</td>
<td>Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts</td>
<td></td>
</tr>
<tr>
<td>Inorganic clays of high plasticity, fat clays</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic clays of medium to high plasticity, organic silty clays, organic silts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LL ≥ 50</td>
<td>MH</td>
<td>Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts</td>
<td></td>
</tr>
<tr>
<td>Inorganic clays of high plasticity, fat clays</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic clays of medium to high plasticity, organic silty clays, organic silts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly Organic Soils</td>
<td>Pi</td>
<td>Peat and other highly organic soils</td>
<td></td>
</tr>
<tr>
<td>ROCK</td>
<td>RX</td>
<td>Rocks, weathered to fresh</td>
<td></td>
</tr>
<tr>
<td>FILL</td>
<td>FILL</td>
<td>Artificially placed fill material</td>
<td></td>
</tr>
</tbody>
</table>

### Other Symbols

- Drive Sample: 2-1/2" O.D. Modified California sampler
- Drive Sampler, no recovery
- SPT Sampler
- Initial Water Level
- Final Water Level
- Estimated or gradational material change line
- Observed material change line
- Laboratory Tests
- PI = Plasticity Index
- EI = Expansion Index
- UCC = Unconfined Compression Test
- TR = Triaxial Compression Test
- GR = Gradational Analysis (Sieve)
- K = Permeability Test

### Grain Size Classification

<table>
<thead>
<tr>
<th>Classification</th>
<th>Range of Grain Sizes</th>
<th>U.S. Standard Sieve Size</th>
<th>Grain Size in Millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulder</td>
<td>Above 12&quot;</td>
<td>Above 305</td>
<td></td>
</tr>
<tr>
<td>Cobble</td>
<td>12&quot; to 3&quot;</td>
<td>305 to 76.2</td>
<td></td>
</tr>
<tr>
<td>Gravel Coarse (c)</td>
<td>3&quot; to No. 4</td>
<td>76.2 to 4.76</td>
<td></td>
</tr>
<tr>
<td>Gravel Fine (f)</td>
<td>3/4&quot; to No. 4</td>
<td>76.2 to 19.1</td>
<td></td>
</tr>
<tr>
<td>Shale Coarse (c)</td>
<td>No. 4 to No. 200</td>
<td>19.1 to 4.76</td>
<td></td>
</tr>
<tr>
<td>Shale Fine (f)</td>
<td>No. 4 to No. 10</td>
<td>4.76 to 0.074</td>
<td></td>
</tr>
<tr>
<td>Clay (medium)</td>
<td>No. 10 to No. 40</td>
<td>2.00 to 0.0420</td>
<td></td>
</tr>
<tr>
<td>Clay (fine)</td>
<td>No. 40 to No. 200</td>
<td>0.420 to 0.074</td>
<td></td>
</tr>
<tr>
<td>Clayey (fine)</td>
<td>Below No. 200</td>
<td>Below 0.074</td>
<td></td>
</tr>
</tbody>
</table>

---

Wallace Kuhl & Associates

Carson Ice - Gen Steam Boiler
Elk Grove, California

FIGURE 5

DRAWN BY: RWO
CHECKED BY: JF
PROJECT MGR: MMW
DATE: 02/15
WKA NO. 10475.01
APPENDIX A
General Project Information, Laboratory Testing and Results
APPENDIX A

A. GENERAL INFORMATION

The performance of a geotechnical engineering study for the proposed steam boiler project to be constructed at 8580 Laguna Station Road in Elk Grove, California, was authorized by Mr. Jeffery White on February 20, 2015. Authorization was for an investigation as described in our proposal letter dated February 10, 2015, sent to our client Carson Energy Group, whose address is 5000 83rd Street in Sacramento, California; telephone (916) 379-2041.

In performing this investigation, we made reference to a site map titled Carson Ice-Gen Project, Equipment Locations Quadrant IV, provided by Carson Energy Group.

B. FIELD EXPLORATION

Two borings were drilled for the project on February 26, 2015, at the approximate locations indicated on Figure 2 utilizing a CME-75 truck-mounted drill rig. The borings were drilled to a maximum depth of approximately 16½ feet below existing site grades using six-inch (6") diameter, solid-stem helical augers. At various intervals, relatively undisturbed soil samples were recovered with a 2½-inch O.D., 2-inch I.D., modified California sampler driven by a 140-pound hammer freely falling 30 inches. The number of blows of the hammer required to drive the 18-inch long sampler each six-inch (6") interval was recorded. The sum of the blows required to drive the sampler the lower 12-inch interval, or portion thereof, is designated as the penetration resistance or "blow count" for that particular drive.

The samples were retained in two-inch (2") diameter by six-inch (6") long thin-walled brass tubes contained within the sampler. Immediately after recovery, the soils in the tubes were visually classified by the field engineer and the ends of the tubes were sealed to preserve the natural moisture contents. All samples were taken to our laboratory for soil classification and selection of samples for testing.

The Logs of Soil Borings, Figures 3 and 4, contain descriptions of the soils encountered at each boring location. The Unified Soil Classification System and the symbols used on the logs is contained on Figure 5.

C. LABORATORY TESTING

Selected undisturbed samples of the soils were tested to determine dry unit weight (ASTM D2937), natural moisture content (ASTM D2216) and unconfined compressive
strength (ASTM D2166). The results of these tests are included on the boring logs at the depth each sample was obtained.

One bulk sample of near-surface soil were subjected to Expansion Index testing (ASTM D4829); the results of the tests are presented in Figure A1.

One near-surface soil sample was submitted to Sunland Analytical to determine the soil pH and minimum resistivity (California Test 643), Sulfate concentration (California Test 417) and Chloride concentration (California Test 422). The results of the tests are presented in Figure A2.
EXPANSION INDEX TEST RESULTS
ASTM D4829

MATERIAL DESCRIPTION: Brown, fine to medium sandy clay
LOCATION: D2

<table>
<thead>
<tr>
<th>Sample Depth</th>
<th>Pre-Test Moisture (%)</th>
<th>Post-Test Moisture (%)</th>
<th>Dry Density (pcf)</th>
<th>Expansion Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5' - 2'</td>
<td>10.8</td>
<td>21.3</td>
<td>108</td>
<td>60</td>
</tr>
</tbody>
</table>

CLASSIFICATION OF EXPANSIVE SOIL *

<table>
<thead>
<tr>
<th>EXPANSION INDEX</th>
<th>POTENTIAL EXPANSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20</td>
<td>Very Low</td>
</tr>
<tr>
<td>21 - 50</td>
<td>Low</td>
</tr>
<tr>
<td><strong>51 - 90</strong></td>
<td><strong>Medium</strong></td>
</tr>
<tr>
<td>91 - 130</td>
<td>High</td>
</tr>
<tr>
<td>Above 130</td>
<td>Very High</td>
</tr>
</tbody>
</table>

* From ASTM D4829, Table 1
To: Joe Follettie  
Wallace-Kuhl & Assoc.  
3050 Industrial Blvd  
West Sacramento, CA, 95691

From: Gene Oliphant, Ph.D.  
\ Randy Horney  
General Manager  
\ Lab Manager

The reported analysis was requested for the following:  
Location: 10475.01-CARSON ICE  
Site ID: D2 @ 0.5-2 FT  
Your purchase order number is 3641.  
Thank you for your business.

* For future reference to this analysis please use SUN # 68872 - 143113

-----------------------------------------------------------------------------------
EVALUATION FOR SOIL CORROSION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil pH</td>
<td>6.59</td>
</tr>
<tr>
<td>Minimum Resistivity</td>
<td>0.99 ohm-cm (x1000)</td>
</tr>
<tr>
<td>Chloride</td>
<td>31.1 ppm</td>
</tr>
<tr>
<td>Sulfate-S</td>
<td>103.5 ppm</td>
</tr>
</tbody>
</table>

METHODS:  
P\H and Min Resistivity CA DOT Test #643 Mod.(Sm.Cell)  
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

-----------------------------------------------------------------------------------