APPENDIX A: DRAFT GEOTECHNICAL INVESTIGATION REPORT

TETRA TECH

Geotechnical Engineering ● Engineering Geology

Geotechnical Investigation Report

CARRIAGE CREST PARK
STORMWATER STORAGE FACILITIES
23800 S. Figueroa Street
Carson, California

Prepared for:

Los Angeles County Sanitation District
1955 Workman Mill Road.
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Prepared by:

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January 27, 2017 (Rev. April 19, 2017)
Project No. TET 16-101E

TETRA TECH

Project No. TET 16-101E
January 27, 2017 (Rev. April 19, 2017)

Ms. Kristen Ruffell
Los Angeles County Sanitation District
1955 Workman Mill Road.
Whittier, CA 90601

Subject: **GEOTECHNICAL INVESTIGATION REPORT, Revision No. 1**
CARRIAGE CREST PARK
STORMWATER STORAGE FACILITIES
23800 S. Figueroa Street
Carson, California

Dear Ms. Ruffell:

Presented herein is Tetra Tech's geotechnical investigation report for the proposed stormwater storage facilities at the Carriage Crest Park located at 23800 S Figueroa Street, in the City of Carson, California. This report summarizes the results of our geotechnical investigation to characterize the soils at the site and provides recommendations for the geotechnical design and construction of the proposed facilities including the storage tanks, diversion structures, pumping structures, pipelines, and temporary shoring. The appendices of the report include logs of borings from the current investigation, Cone Penetration Testing (CPT) logs, results of laboratory tests, and liquefaction analyses. This report addresses comments by the Los Angeles County Sanitation District and supersedes the draft report dated November 21, 2016. This revision includes a minor change to the original Section 3 – Project Background and Description.

We appreciate the opportunity to provide our professional services on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned.

Respectfully submitted,
Tetra Tech

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TABLE OF CONTENTS

Page

1. INTRODUCTION 1
2. SCOPE OF WORK 2
3. PROJECT BACKGROUND AND DESCRIPTION 3
4. SUBSURFACE EXPLORATIONS 4
5. LABORATORY TESTING 6
6. SUBSURFACE CONDITIONS 7
6.1. REGIONAL GEOLOGY 7
6.2.1. Artificial Fill 8
6.2.2. Native Alluvium 8
6.3. GROUNDWATER 8
7. ENGINEERING SEISMOLOGY AND GEOLOGIC HAZARDS 10
7.1. GENERAL SEISMIC SETTING 10
7.2. SURFACE FAULT RUPTURE 12
7.3. SEISMIC HAZARD ZONES 12
7.4. LIQUEFACTION POTENTIAL AND DYNAMIC SETTLEMENT 13
7.4.1. Soil Description 13
7.4.2. Groundwater Level for Liquefaction Analysis 13
7.4.3. Liquefaction Seismic Demand 13
7.4.4. Evaluation of Liquefaction Potential and Sensitivity Analyses 14
7.4.5. Dynamic Settlement 15
7.5. EARTHQUAKE-INDUCED LANDSLIDES 16
7.6. TSUNAMI RISK 16
7.7. SUBSIDENCE 16
8. DESIGN RECOMMENDATIONS 18
8.1. GENERAL 18
8.2. CLEARING AND GRUBBING 18
8.3. SITE PREPARATION 18
8.4. TEMPORARY SLOPES AND TRENCH EXCAVATIONS 20
8.5. TEMPORARY SHORED EXCAVATIONS 21
8.5.1. Soldier Pile and Lagging Wall System 22
8.5.2. Soil Nail Wall 26
8.5.3. Shoring Performance Monitoring 27
8.5.4. Irrigation Control 27
8.6. FOUNDATIONS 27
8.6.1. Design Parameters for At-Depth Foundations 27
8.6.2. Design Parameters for At Grade Shallow Foundations 29
8.6.3. Footings Adjacent to Trenches 29
8.6.4. Foundation Construction Observations 29
8.7. CONCRETE SLAB-ON-GRADE OR MATS 31
8.7.1. Structure Floor Slab-On-Grade or Mats 31
8.7.2. Exterior Slabs 32
8.8. UPLIFT OF BURIED STRUCTURES 32

8.9. SEISMIC DESIGN PARAMETERS 33
8.10. LATERAL EARTH PRESSURES ON UNDERGROUND WALLS AND TANKS 33
8.11. EMBEDDED POSTS AND POLES AT GRADE 36
8.11.1. Non-Constrained Case 36
8.11.2. Constrained Case 36
8.12. PIPELINE DESIGN AND CONSTRUCTION 36
8.12.1. Trench Excavation 36
8.12.2. Trench Bottom Preparation 36
8.12.3. Trench Backfill 36
8.13. PAVEMENT SECTIONS 37
8.13.1. Subgrade Preparation 37
8.13.2. Asphalt Concrete Pavement Design 37
8.13.3. Pavement Construction Observations 38
8.14. SOIL CORROSION 38
8.15. DRAINAGE CONTROL 39
9. GENERAL SITE GRADING RECOMMENDATIONS 40
12. LIMITATIONS 44
13. SELECTED REFERENCES 45

Figures

Figure 1 – Project Location Map
Figure 2 – Site Layout, Boring and CPT Location Map
Figure 3 – Geologic Map
Figure 4 – Historic High Groundwater Map
Figure 5 – Regional Faults and Seismicity Map
Figure 6 – Seismic Hazard Zones Map

Appendices

Appendix A – Logs of Exploratory Borings
Appendix B – Logs of Cone Penetration Tests (CPTs)
Appendix C – Laboratory Testing
Appendix D – Liquefaction Analyses

1. INTRODUCTION

This report presents the results of Tetra Tech's geotechnical engineering evaluation for the proposed stormwater capture, storage, and conveyance facilities at the Carriage Crest Park Project (see Figure 1) located at 23800 S Figueroa Street, in the City of Carson, California. The proposed facilities include:

- a 4.2 MG underground storage reservoir;
- two catch basin diversion structures;
- a pump station;
- a pre-treatment unit; and
- conveyance pipelines.

The purpose of this study was to evaluate the subsurface conditions at the site and to provide recommendations for the design and construction of the proposed improvements. This report summarizes the collected data and presents our findings, conclusions, and geotechnical design recommendations.

2. SCOPE OF WORK

Tetra Tech's scope of services for this project consisted of the following tasks:

- Review of readily available background data, including in-house geotechnical data from our soil explorations in the vicinity of the proposed facilities.

- Perform a reconnaissance site visit to observe ground conditions and mark boring locations.

- Coordinate with Los Angeles County Sanitation District (LACSD) engineering staff, City of Carson personnel, park staff, and Underground Service Alert (USA) for clearance of buried on-site utilities prior to drilling. Furthermore, utilities were also cleared using Ground Penetrating Radar (GPR) method.

- Conduct a subsurface investigation, including excavating, logging, and geotechnical sampling of 5 soil exploratory borings to a maximum depth of 51.5 feet. Contain soil cuttings in steel drums and dispose into an appropriate disposal facility.

- Conduct additional soil sampling for preliminary evaluation of environmental conditions at the site. The description of that process and the results of the evaluation are included in a separate letter report.

- Advance 7 Cone Penetration Tests (CPTs) to characterize the subsurface conditions at the site.

- Consult with LACSD regarding laboratory testing schedule and perform laboratory testing of selected samples recovered from the borings to evaluate geotechnical engineering properties of the on-site soils.

- Conduct an evaluation of the geotechnical data to develop geotechnical recommendations for the design and construction of the proposed structures including the following items:

    - An evaluation of general subsurface conditions and description of types, distribution, and engineering characteristics of subsurface materials.
    - An evaluation of the liquefaction potential and dynamic settlement of the on-site granular materials.
    - An evaluation of the suitability of on-site soils for the support of structures.
    - Recommendations for design of foundation systems including allowable bearing capacity, lateral resistance, and settlement estimates.
    - Determination of seismic design parameters in accordance with the 2013 California Building Code.
    - Evaluation of lateral earth pressure parameters for the design of the underground tanks and for the design of temporary shoring during construction.
    - An evaluation of the corrosion potential of the on-site soils to buried concrete.

- Prepare this written report documenting the work performed, physical data acquired, and geotechnical design recommendations.

3. PROJECT BACKGROUND AND DESCRIPTION

The Dominguez Channel Watershed Management Area Group (DCWMA Group) is comprised of the County of Los Angeles (County), Los Angeles County Flood Control District (LACFCD), and the cities of Carson, El Segundo, Hawthorne, Inglewood, Lawndale, Lomita, and Los Angeles (including the Port of Los Angeles). The DCWMA Group was formed in response to provisions of National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit Order No. R4-2012-0175 (Permit). The DCWMA Group, through a cooperative and collaborative process, developed an Enhanced Watershed Management Program (DCWMA Group EWMP). The Final DCWMA Group EWMP was subsequently approved by the Los Angeles Regional Water Quality Control Board on April 21, 2016.

The EWMP identified a suite of watershed control measures and structural Best Management Practices (BMPs). One of the regional structural BMPs identified in the Addendum to the DCWMA Group EWMP Carson was the Carriage Crest Park Project. It was identified as a high priority site for a regional stormwater capture project due to its proximity to two large storm drains with a total drainage area of 1,146 acres. This area discharges into Wilmington Drain which subsequently discharges into Machado Lake, and drains portions of unincorporated Los Angeles County and the Cities of Carson, Los Angeles, and Torrance.

In order to advance the development of the Carriage Crest Park Project, the City of Carson entered into a Cooperative Implementation Agreement with Caltrans to fund the Carson Water Capture Project. The City of Carson entered into a subsequent agreement with the Los Angeles County Sanitation Districts (LACSD) to manage the project, conduct engineering and geotechnical investigations, and assist with environmental clearance, permitting, design and construction management. The LACSD, pursuant to Senate Bill 485, is authorized to manage stormwater and dry weather runoff to assist local jurisdictions within the LACSD's service area to comply with stormwater-related regulatory requirements.

The Carson Water Capture Project consists of:

- a storm drain diversion structure;
- two catch basin diversion structures;
- pre-treatment unit;
- a 4.2 MG storage capacity underground storage reservoir about 20 feet deep and approximately 60,000 square feet in footprint located beneath the existing baseball fields;
- a pump station to convey flows to the sanitary sewer system and/or to an on-site treatment system where the water will undergo treatment and be used for on-site irrigation.

At this moment no specific information regarding the location. depth, and size of the diversion structures, pre-treatment unit, and pump station is available. Therefore the designer should verify with the Geotechnical Engineer the applicability of the recommendations contained herein once the final layout and preliminary design is completed.

4. SUBSURFACE EXPLORATIONS

The current subsurface soil and groundwater conditions beneath the site were explored on September 27 and 28, 2016 by Tetra Tech and included the drilling, logging, and sampling of 5 hollow stem auger exploratory borings B-1 through B-5, and 7 Cone Penetration Tests (CPTs).

Prior to starting the field exploration program, a field reconnaissance was conducted to observe surface conditions and to mark the locations of the planned boreholes and CPTs in agreement with LACSD engineering staff, the City of Carson Engineer, and park staff. A drilling permit was obtained from the Los Angeles County Department of Public Health (LACDPH) for all the subsurface explorations. Additionally, a GPR survey was conducted to identify buried utilities. Underground Service Alert, LACSD engineering staff, the LACDPH inspector, City of Carson personnel, and park staff were also notified of the drilling schedule at least 48 hours prior to drilling.

The hollow stem auger borings were excavated using a CME-75 truck-mounted drill rig equipped with an 8-inch diameter auger at the approximate locations indicated on Figure 2 – Site Layout, Boring and CPT Location Map. Borings B-1 and B-3 were advanced to a maximum depth of 51.5 feet and borings B-2, B-4, and B-5 were advanced to a maximum depth of approximately 31.5 feet. The CPTs were advanced to a maximum depth of approximately 50 feet using a standard electronic piezocone with a 15 cm^2 area and a 60-degree apex angle. The piezocone was pushed utilizing a 30-ton truck.

The approximate coordinates of the current soil explorations, the approximate elevations, and depths are included in Table 1. The approximate soil boring and CPT locations are also shown on Figure 2 – Site Layout, Boring and CPT Location Map.

Bulk, driven ring-type, and small bag samples were retrieved at selected depths during drilling of the exploratory borings. Standard Penetration Testing (SPT) was performed using an SPT sampler driven by an automatic 140-pound hammer with a drop of 30 inches in general accordance with ASTM D1586. The hammer calibration record indicated an energy transfer ratio of 81 percent. Ring-type samples were collected utilizing a California-type sampler driven by the same equipment used for the SPTs. Sampling was carried out at 2.5-foot intervals at all the borings between the depths of 2.5 and 20 feet. Otherwise sampling was carried out at 5-foot intervals. Selected soil samples for environmental screening were also taken at selected intervals as described in the environmental report.

The soil borings were surface-logged by a California Professional Geologist in general accordance with the visual-manual procedure for description and identification of soils, ASTM D2488. The Geologist prepared the recovered samples for subsequent reference and laboratory testing. The soil boring logs are presented in Appendix A.

CPT testing was carried out in accordance with ASTM D5778. The piezocone was pushed at a rate of 2 cm/sec and the soil tip resistance, soil-sleeve friction, and immediate dynamic pore water pressure response were recorded at 1-inch intervals. A copy of the Cone Penetration Test Data report is included in Appendix B.

At the completion of drilling, the borings and the CPTs were backfilled with a bentonite cement grout in accordance with LACDPH requirements. The exploratory boreholes and CPTs advanced through paved surfaces were capped with a cold asphalt patch.

Soil cuttings from the borehole explorations were stored in steel drums and disposed of at an appropriate facility.

Table 1
CPT and Borehole Information

Exploration Number	Northing	Easting	Approximate Depth (ft)	Approximate Top Elevation (ft MSL)*
B-1	33.80947	-118.28471	51.5	25
B-2	33.80901	-118.28451	31.5	25
B-3	33.80851	-118.28358	51.5	27
B-4	33.80823	-118.28423	31.5	26
B-5	33.80891	-118.28371	31.5	28
C-1	33.80944	-118.28475	50.0	25
C-2	33.80849	-118.28351	50.0	27
C-3	33.80854	-118.28382	50.0	27
C-4	33.80805	-118.28375	50.0	26
C-5	33.80846	-118.28424	50.0	26
C-6	33.80887	-118.28408	50.0	26
C-7	33.80907	-118.28468	50.0	25

*Estimated from Google Earth

5. LABORATORY TESTING

Laboratory tests were performed by Tetra Tech on selected samples recovered from the soil borings to aid in the classification of soils and to evaluate pertinent engineering properties of the soils at the site. The following tests were performed:

- Moisture Content of Soil, ASTM D2216;
- Density of Soil Specimens, ASTM D7263;
- Particle Size Analysis of Soils, ASTM D422;
- Atterberg Limits, ASTM D4318;
- Percent Passing #200 Sieve, ASTM D1140;
- Consolidation, ASTM D2435;
- Expansion Index, ASTM D 4829;
- Direct Shear Testing, ASTM D3080;
- Corrosion Testing in Soils: pH and resistivity, CTM 643; Sulphates, CTM 417; and Chlorides, CTM 422.

Results of all laboratory tests are presented in Appendix C. For ease of referral to the soil profile, most of the laboratory results have also been included on the boring logs in Appendix A.

6. SUBSURFACE CONDITIONS

6.1. Regional Geology

The subject site is located in the southwestern coastal plain of the greater Los Angeles Basin. The Los Angeles Basin is located within Peninsular Ranges geomorphic province which is characterized as a low-lying plain that rises gently inland to the surrounding mountains and hills including the Santa Monica and San Gabriel Mountains to the north, Puente Hills to the northeast, the Santa Ana Mountains to the Southeast, and the San Joaquin hills and Palos Verdes Peninsula to the south. The Peninsular Range is characterized by northwest-southeast trending structural blocks separated by northwest-southeast trending strike-slip faults.

Within the Los Angeles Basin there are 4 structural blocks: the southwestern block, the northwestern block, the central block, and the northeastern block (Norris and Webb, 1990). The subject site is located in the southwestern block, which is bounded by the Newport Inglewood - Rose Canyon fault zone to the east northeast and the Palos Verdes fault zone to the southwest. The main structural features of the southwestern block are the anticlinal Palos Verdes Hills that have been raised along the steeply dipping Palo Verdes reverse fault, several anticlinal ridges in the basement rocks over which younger sediments have been deposited, and intervening broad synclines. The anticlinal structures of the younger rocks have formed important traps for petroleum and natural gas within the region. The basement rocks of the southwestern block exposed in the Palos Verdes Hills, consist dominantly of green chlorite and blue glaucophane metamorphic rocks of the Catalina Schist that are late Jurassic to late Cretaceous in age. The overlying younger sediments are upper Pliocene to Holocene in age. The uppermost Holocene-age deposits are mapped as alluvial materials consisting of clay, silt, and sand (Dibblee, 1990).

6.2. Site Geology

The subject site is located within the southern portion of the northwest-trending coastal plain, locally recognized as the Torrance Plain (Poland and Piper, 1956). The Torrance Plain rests between the El Segundo Sand Hills and the Palos Verdes Hills in the west and southwest, the Rosecrans Hills and Dominguez Hills in the northeast, and the Dominguez gap to the east. The Torrance Plane consists of elevated older alluvium, which is covered, locally, with moderately dense silty sand of older eolian wind-blown deposits (Dibblee, 1990). Toward the San Pedro Shelf (Los Angeles Harbor), the Torrance Plain is incised and filled with younger alluvium deposits that are generally soft made of locally derived sand, silt, and clay, and with soft deposits associated with shallow marsh and bay sediments.

Based upon the findings from our subsurface investigation, the project site is mantled by artificial fill soils which were encountered across the entire site. Beneath the fill, mostly alluvium and some isolated shallow organic marsh sediments were encountered in the exploratory borings to the maximum explored depth of 51.5 feet. Locally, these alluvial deposits are classified as near shore alluvial and marsh type deposits. Generalized descriptions of the encountered deposits are provided below.

6.2.1. Artificial Fill

Artificial fill soils were encountered in all the borings to depths ranging from approximately 4 to 9 feet. The artificial fill soils were typically composed of medium dense, brown to dark olive gray silty sand and clayey sands, stiff, dark gray to black lean clay and, light yellowish brown very stiff silt, containing traces of roots, wood fragments, gravel and brick fragments.

6.2.2. Native Alluvium

Native alluvial (Qa) soils were encountered below the fill soils to the maximum explored depth of 51.5 feet below the ground surface. The native alluvium consisted of fine-grained (clay) and coarse-grained (sand) soils. The fine-grained materials consisted of light gray to olive brown to gray brown to black lean clay to silt and fat clay. The coarse-grained materials consisted of light yellowish brown to brown to olive brown to gray brown silty sand and poorly graded sand. The coarse-grained soils were generally found at a depth ranging from 22 to 25 feet below the ground surface throughout the subject site.

In addition, a 2.5 feet thick layer of dark brown to black organic lean clay was observed in B-5 a depth between 9.5 and 12 feet. Ring and SPT blow counts within the organic clay layer indicate firm to very stiff consistency. The organic clay layer was observed to have visible organic matter with a strong organic odor, suggesting deposits associated with shallow-water marsh or quagmire sediments.

SPT blowcounts in the native alluvium for the fine-grained (clay) soils generally varied from 8 to 19 indicating stiff to very stiff consistency. SPT blowcounts in the native alluvial coarse-grained (sandy) soils generally varied from 19 to greater than 50 indicating medium dense to very dense materials. Detailed descriptions of the soil conditions encountered in the borings are presented on the boring logs in Appendix A.

6.3. Groundwater

According to the State of California (CDMG, 1998), the historic high groundwater level near the site has been mapped at a depth of about 10 feet (Figure 4 – Historic High Groundwater Map). Groundwater was encountered in the Tetra Tech exploratory borings at a depth of approximately 42 to 44.1 feet.

A review of the database from the Los Angeles County Department of Public Works (LACDPW) for nearby wells (http://dpw.lacounty.gov/general/wells/) and Geotracker database is summarized in Table 2.

Table 2
Groundwater Wells in the Vicinity of the Site

Well Identification	Monitoring Period	Location relative to the site	Shallowest depth
Geotracker Well cluster WDR100001437–MW-7, MW-6, MW-10, and MW-12	July 2011 to April 2014	approximately within the site	37.2 feet in 2014
Geotracker Well cluster WDR100001437–MW-2 to MW-6, MW-8, MW-9, and MW-11, and MW-12	July 2011 to April 2014	across the street to the west	38 feet in 2013*
Inactive LACDPW Well ID 829M State # 4S13W19J06	April 1964 to October 1993	0.28 miles to the east	74.7 feet in April 1993
Inactive LACDPW Well ID 829 State # 4S13W19J02	August 1934 to April 1996	0.35 miles to the northeast	67.2 feet in March 1937
LACDPW Well ID 310C State # 4S13W30G01	September 1934 to January 2010	0.52 miles to the southeast	59.4 feet in February 1939

• Well data indicates a minimum groundwater depth of 33.5 feet in 2013 although this data point is likely to be anomalous since it is a single spike in one month in a sequence of measurements that indicate that the groundwater depth around that time was consistently at around 38 feet

Based on the assessment of the local stratigraphy and local topography, it is our opinion that the LACDPW and the Geotracker wells can be utilized for interpretation of the project groundwater conditions. Therefore, it is our conclusion that the groundwater at the site has been deeper than about 35 feet within the last 50 years.

Fluctuations of the groundwater level, localized zones of perched water, and increased soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or adjacent to the site can also cause a fluctuation of local groundwater levels. Evaluation of such factors is beyond the scope of our services.

Based on the research and observed conditions, groundwater is not expected to impact the construction of the proposed development, however the historic high groundwater depth of about 10 feet should be considered for the design process, and the proposed structures should be designed for the corresponding hydrostatic lateral and hydraulic uplift forces.

7. ENGINEERING SEISMOLOGY AND GEOLOGIC HAZARDS

7.1. General Seismic Setting

The Southern California region is known to be seismically active. Earthquakes occurring within approximately 60 miles of the site are generally capable of generating ground shaking of engineering significance to the proposed construction. The project area is located in the general proximity of several active and potentially active faults, as shown on Figure 5 – Regional Faults and Seismicity Map. Active faults are defined as those that have experienced surface displacement within the Holocene period (approximately the last 11,000 years).

Active faults within approximately 10 miles of the subject site include the Newport-Inglewood fault zone located 4.8 miles northeast of the site, the Palos Verdes fault located approximately 2.1 miles southwest of the site, the THUMS-Huntington Beach fault zone located approximately 5 miles southeast of the site, and the Redondo Canyon Fault located approximately 6.6 miles to the west of the site and the Los Alamitos fault located approximately 9.2 miles northeast of the site. The San Andreas Fault is located about 48.7 miles to the northeast of the site. An inferred trace of the potentially active Charnock fault, which trends sub-parallel to the northwest-trending Newport-Inglewood fault zone, is mapped approximately 9.5 miles to the north northwest of the subject site. The Charnock fault has no record of historic earthquakes but shows evidence of displacement during late Quaternary time (Jennings, 2010).

Table 3 lists selected principal known active faults that may affect the subject site and the maximum moment magnitude (M_{max}) as published by Cao et al. (2003) for the California Geological Survey (CGS). The approximate distance to the site were calculated from Jennings (2010).

Superimposed on the area map in Figure 5 are earthquake epicenters recorded by the USGS between 1900 to present day. A large amount of seismic activity and associated events with their epicenters have been recorded surrounding the project site. However, only relatively few earthquake epicenters have been recorded in the immediate area of the subject site. Notable historic earthquakes in Southern California of significance to the project include:

- 1994 magnitude M6.7 Northridge earthquake on a blind thrust fault (low angle fault that is not expressed at the ground surface) [Epicenter location: 34.21°N, 118.54°W];
- 1987 magnitude M5.9 Whittier Narrows earthquake on Puente Hills Blind Thrust Fault [Epicenter location: 34.06°N, 118.08°W];
- 1971 magnitude M6.4 San Fernando earthquake which occurred on the San Fernando Fault (of the Sierra Madre system) [Epicenter location: 34.42°N, 118.37°W];
- Two 1941 magnitude M4.8 Torrance-Gardena earthquakes which occurred on the Palos Verdes Fault [Epicenter locations: 33.82°N, 118.22°W and 33.78°N, 118.25°W];
- 1933 magnitude M6.4 Long Beach earthquake on the Newport-Inglewood Fault [Epicenter location: 33.63°N, 118.00°W];
- 1857 magnitude M7.9 Fort Tejon earthquake on the south central segment of the San Andreas Fault [Epicenter location: 35.43°N, 120.19°W].

The most significant historic earthquake near the project site was the 1933 Long Beach earthquake.

Table 3
Principal Active Faults

Fault Name	Approximate Fault Distance to Site[1] (miles)	Maximum Moment Magnitude[2] (M_{max})
Palos Verdes	2.1	7.3
Cabrillo	4.6	6.8
Newport-Inglewood	4.8	7.1
THUMS-Huntington Beach	5.0	7.0
Redondo Canyon	6.6	6.5
Los Alamitos	9.2	6.2
Charnock	9.5	6.5
Puente Hills Blind Thrust	12.5	7.1
Whittier	18.6	6.8
Santa Monica	18.8	6.6
Hollywood	20.2	6.4
Raymond	21.1	6.5
Verdugo	23.2	6.9
Malibu Coast	26.7	6.7
Anacapa-Dume	27.2	7.5
Sierra Madre	27.7	7.2
San Andreas	48.7	7.8

Notes:
[1] per Jennings, 2010
[2] per Cao, et al., 2003

Potential seismic sources of significance to the project include active faults previously described and faults that are not known to break the ground surface but are considered active. This latter group of faults includes buried or "blind" thrust faults. Current tectonic models for the Los Angeles basin include the presence of buried thrust faults, several of which are considered partly responsible for the north-to-south compression of the basin. Although these faults are not currently zoned by the State of California for surface rupture hazards (Earthquake Fault Zones), many are considered capable of generating seismic shaking of significance to structures.

Of these buried active faults the closest to the site is the Puente Hills Trust Fault (PHTF). The PHTF is currently defined as 3 separate but juxtaposed, generally east-west trending and north-dipping, fault surfaces that combined extend from Downtown Los Angeles to Brea. From west to east these include the Los Angeles, Santa Fe Springs, and Coyote Hills segments. Based upon recent studies by several researchers, including: Shaw et al., (2002), Olsen and Cooke (2005), and

Leon et al. (2007), the three fault surfaces are interpreted to extend from depths in excess of 9 miles on the north side of the Los Angeles basin to less than 1.2 miles at the southerly limits of the fault surfaces in the central portion of the basin. Fault surface geometries are interpreted from historical petroleum exploration data, limited geotechnical subsurface exploration data, and limited seismicity (i.e.; the 1987 magnitude 5.9 Whittier Narrows earthquake).

Leon et al. (2007) estimates that upwards of 60 percent of the total Los Angeles basin compression may be attributed to strain along the PHTF. Although ground rupture has not been officially attributed to the fault, the presence of youthful hills (e.g., Coyote Hills) and shallow folding at depth in the upper portion of the interpreted thrust ramp suggests recent activity. The PHTF is considered capable of generating earthquake magnitudes up to about M_w 7.0.

7.2. Surface Fault Rupture

Official Maps of Earthquake Fault Zones were reviewed to evaluate the location of the project site relative to active fault zones. Earthquake Fault Zones (known as Special Studies Zones prior to 1994) have been established in accordance with the Alquist-Priolo Special Studies Zones Act enacted in 1972. The Act directs the State Geologist to delineate the regulatory zones that encompass surface traces of active faults that have a potential for future surface fault rupture. The purpose of the Alquist-Priolo Act is to regulate development near active faults in order to mitigate the hazard of surface fault rupture.

The site is not located within a designated Earthquake Fault Zone for fault surface rupture hazard. Based on a review of State of California Earthquake Fault Zone maps, the closest zoned faults for surface rupture are both within the Newport-Inglewood Zone Fault: one zoned fault is located approximately 4.7 miles northeast of the site and is mapped within the Torrance Quadrangle (CDMG, 1986), and the other zoned fault is located approximately 5.4 miles east of the site and is mapped within the Long Beach Quadrangle (CDMG, 1986).

No surface traces of any active or potentially active faults are known to pass directly through or project towards the site. Neither our field exploration nor literature review disclosed an active fault trace projecting to the ground surface in the project area. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low.

7.3. Seismic Hazard Zones

Maps of seismic hazard zones are issued by the California Geological Survey (CGS, formerly California Department of Conservation, Division of Mines and Geology (CDMG)) in accordance with the Seismic Hazards Mapping Act enacted in April 1997. The intent of the Seismic Hazards Mapping Act is to provide for a statewide seismic hazard mapping and technical advisory program to assist cities and counties in developing compliance requirements to protect the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure and other seismic hazards caused by earthquakes.

Based on the review of the Torrance Quadrangle Official Map of Seismic Hazard Zones issued March 25, 1998 (see Figure 6), the proposed development is located within an area identified by the State of California as subject to the hazard of liquefaction. Because the site is located in a mapped area where the potential for liquefaction exists and due to the increase in the code-prescribed seismic demand since the Seismic Hazard Map was generated, a field investigation and analyses were performed to evaluate the site liquefaction potential per the 2013 CBC.

7.4. Liquefaction Potential and Dynamic Settlement

Liquefaction of soils can be caused by ground shaking during earthquakes. Research and historical data indicate that loose, relatively clean granular soils and low plasticity silts are susceptible to liquefaction and dynamic settlement, whereas the stability of the majority of clayey silts, silty clays and clays are not typically adversely affected by ground shaking. Liquefaction is generally known to occur in saturated or near-saturated cohesionless soils at depths shallower than about 50 feet.

7.4.1. Soil Description

Evaluation of liquefaction potential for the on-site materials was performed based on soil stratigraphy encountered in the field explorations. The encountered soil materials generally consisted of alluvial deposits made up of layers of medium dense to dense silty and clayey sands interspersed with layers of stiff to very stiff lean and fat clays.

Materials that are above the groundwater table are not considered susceptible to liquefaction according. Thus, the focus of this investigation was aimed at evaluating the liquefaction potential of the soils encountered at a depth between 10 and 50 feet. Fine grained soils as described in the following sections can undergo severe strength loss during ground shaking, and thus an evaluation of their sensitivity was performed.

7.4.2. Groundwater Level for Liquefaction Analysis

Groundwater was encountered during the field explorations at a depth ranging between 42 to 44 feet. The historic high groundwater at the site was mapped by CDMG (Torrance Quadrangle) at a depth of about 10 feet. Therefore, a groundwater depth of 10 feet was assumed for evaluation of liquefaction potential at the site.

7.4.3. Liquefaction Seismic Demand

Based on the USGS U.S. Seismic Design Maps website application (http://earthquake.usgs.gov/designmaps/us/application.php), for a site with coordinates 33.80847°N, -118.28369°W, the mapped Geometric Mean Peak Ground Acceleration (PGA_M) was estimated to be approximately 0.647g for a site class D (assumed v_s = 300 m/s), for a ground motion corresponding to the Maximum Considered Earthquake (MCE). From the Seismic Hazard Interactive Deaggregation website (https://geohazards.usgs.gov/deaggint/2008/) this ground motion approximately corresponds to a predominant earthquake magnitude of M_W 7.38 located at a distance of approximately 5 km (3.1 miles). These ground motion parameters were used in the liquefaction analyses.

7.4.4. Evaluation of Liquefaction Potential and Sensitivity Analyses

The liquefaction potential of cohesionless (sandy) soils was evaluated based on the SPT blowcounts and laboratory test results utilizing procedure published in Youd and Idriss (2001) consensus publication on liquefaction evaluation, and as recommended in the County of Los Angeles Administrative Manual, Liquefaction/Lateral Spreading/GS045.0 dated October 6, 2014.

The analyses based on standard penetration test (SPT) considered the energy ratio correction factor C_E of 1.35. This ratio is based on a calibrated hammer efficiency of approximately 81 percent as supplied by the drilling contractor, which is consistent with our experience with similar equipment. The blowcounts recorded for soils driven with the 3-inch O.D. California Sampler with brass rings were converted to an equivalent SPT blowcounts using a reduction factor of 0.67. Borehole diameter correction factor C_B of 1 based on the internal diameter of the hollow stem auger system used for the drilling was utilized in our liquefaction evaluation.

Results of liquefaction analyses of granular soils are summarized in Table 4 in the next section of this report and presented in Appendix F. The analyses based on SPT data indicated that the on-site granular soils found at depth intervals between 15 and 20 feet and between 30 and 35 feet are susceptible to liquefaction.

The liquefaction potential of the subsurface materials was also evaluated from the CPT data using the computer software CLiq v.2.0.6.97 by Geologismiki. The liquefaction susceptibility and the liquefaction induced settlements were evaluated using the NCEER Youd et al (2001) and Robertson (2009) method. The CPT analyses indicate that there are some layers of materials that behave like silty sands and sandy silts that are susceptible to liquefaction although these layers do not seem to be continuous throughout the site with the exception of a layer seemingly continuous between approximately 38 and 44 feet of depth which was observed in CPTs C-1 through C-5. Results of the liquefaction analysis using CPT data are summarized in Table 4 in the next section of this report and presented in Appendix F.

Seismic sensitivity of fine-grained soils was further evaluated per County of Los Angeles Administrative Manual GS045.0 where the fine-grained soils are classified in the following 3 categories:

1. Soils with Plasticity Index < 12 and moisture content > 85 percent of the liquid limit are classified as fine-grained soils susceptible to liquefaction (typically includes silts);

2. Soils with Plasticity Index > 18 and a degree of sensitivity $S_t > 6$ are classified as fine-grained soils potentially susceptible to significant loss of strength during seismic shaking and require additional evaluation. The sensitivity of the on-site fine-grained soils is evaluated based on the water content, Atterberg limits, and effective vertical stresses using the procedures suggested by Holtz and Kovacs (1981) and Terzaghi, Peck and Mesri (1996).

3. Fine-grained soils falling outside the two categories above are considered to behave like clays and are not considered susceptible to liquefaction or seismic sensitivity.

Analyses of the sensitivity of the saturated fine-grained soils indicated low sensitivity based on the estimated sensitivity ratios of 1.3 to 1.6 as evaluated from Terzagi, Peck and Mesri (1996). The sensitivity was also estimated from the CPT data and indicated that the fine-grained soils at the site ranged between 1 and 2 with most values in the order of 1.5, i.e., significantly less than the accepted sensitivity threshold value of 6. Therefore these soils are not considered to be susceptible to undergo seismically induced deformations. Consequently, the potential for significant loss of strength of fine-grained materials and ensuing bearing failure during seismic shaking is considered low. The results of the sensitivity analyses for the soil borings are included in Appendix F.

Table 4
Results of Liquefaction and Dry Dynamic Settlement Analyses

Boring No.	Assumed Groundwater Depth (feet)	Liquefiable Zone Depth Interval (feet)	FS_{liq}	Liquefaction Settlement (inches)[1]	Settlement of Dry Sands (inches)[1]	Combined Dynamic Settlement (inches)[1]
B-1	10	30-35	0.8	0.64	0.02	0.66
B-3		15-20	1.0	0.33	0.04	0.37
C-1		30.7-31.3 36.7-37.3 40.5-42 46-46.5	0.7 0.7 0.5 0.7	1.3	negligible	1.3
C-2		22.5-28 40.5-42	0.4 0.7	1.4	negligible	1.4
C-3		20.5-26 40.5-45	0.4 0.3	2.5	0.2	2.7
C-4		22-24.5 38.5-44 46.7-47.3	0.3 0.4 0.5	2.4	negligible	2.4
C-5		18-21.5 24-25 42-44 47-48	0.5 0.5 0.6 0.5	2.5	negligible	2.5
C-6		18-18.5	0.5	0.25	negligible	0.25
C-7		13-18 36.7-37.3 48-50	0.7 0.5 0.5	1.85	0.05	1.9

[1]Estimated settlements are mean values which can vary within +-50 percent.

7.4.5. Dynamic Settlement

Dynamic settlement can occur in both dry and saturated sands when loose to medium-dense granular soils undergo volumetric changes during ground shaking. Dynamic settlement can occur in saturated sands due to liquefaction or in dry sands due to densification of the soil matrix. The anticipated dynamic settlement of the saturated soils at the site was evaluated using SPT data from the current Tetra Tech exploration using procedures outlined by Tokimatsu and Seed (1987). The

potential for dry dynamic settlement using SPT data was calculated according to the procedure outlined in Pradel (1998a and 1998b). The potential for dry dynamic settlement using CPT data was evaluated using the computer software CLiq v.2.0.6.97 according to the procedure outlined in Robertson and Shao (2010). Table 4 above presents the results of liquefaction analyses and dry dynamic settlement. The details of dynamic settlement analyses are presented in Appendix F.

As shown in Table 4, the combined dynamic settlement of the on-site soils was estimated to be less than 2.5 inches at the ground surface. The seismic differential settlement is estimated to be no greater than 1.3 inches over a horizontal distance of 30 feet. Therefore structural mitigation of the total and differential settlement is acceptable at this site.

It is noted that although the magnitude of the estimated dynamic settlements corresponds to an mean estimated settlement which can vary in the order of +- 50 percent, the standard of practice uses mean estimated values in developing guidelines and evaluating potential damage to structures.

7.5. Earthquake-Induced Landslides

The site is not located in an Earthquake-induced Landslide Hazard Zone on the State of California Seismic Hazard Zones Map (see Figure 6). No evidence of landsliding was observed on or in the immediate vicinity of the site. Therefore the occurrence of an earthquake-induced landslide at the site is not considered to be hazard to the site.

7.6. Tsunami Risk

Based on the review of the Torrance Quadrangle/San Pedro Quadrangle, Tsunami Inundation Map issued March 1, 2009 by the California Geological Survey, the site is not located within an area that is mapped as tsunami inundation area. The nearest mapped tsunami inundation area is about 2.5 miles to the south of the site. Therefore a tsunami is not considered to be a potential seismic hazard to the site. Due to the lack of known occurrences of tsunamis in the historical records, the map does not include information about the probability of any tsunami affecting the site within a specific period of time.

7.7. Subsidence

Land subsidence is the lowering of the ground surface due to extraction or lowering of water levels or other stored fluids within the subsurface soil pores, or due to seismic activity. Groundwater withdrawal causes the alluvial sediments in the basin to compact. Fine-grained materials such as clays and silts that comprise the aquitard that separates the Upper and Lower aquifers in the east valley are more susceptible to compaction and subsidence than coarse-grained sediments, such as sands when groundwater is removed. Damage caused by subsidence can be visible cracks, fissures, or surface depression.

The historic withdrawal of oil has been known to cause subsidence in portions of the Torrance, Dominguez, and Wilmington oil fields, which are located within close proximity of the subject site. This subsidence region extended along the Newport-Inglewood structural zone between

Signal Hill and the Port of San Pedro on the south and Redondo Beach on the north. Total subsidence reached a maximum of 29 feet over the crest of the Wilmington anticline, where most of the oil had been withdrawn. There is no documented ground subsidence associated with oil fields prior to development of the region. By the early 1980s, water injection halted subsidence at the oil fields and, subsequently, no further subsidence has been since documented. Therefore subsidence is not considered a hazard at this site.

8. DESIGN RECOMMENDATIONS

8.1. General

Based on the results of the field exploration and engineering analyses, it is Tetra Tech's opinion that the proposed construction is feasible from a geotechnical standpoint, provided that the recommendations contained in this report are incorporated into the design plans and implemented during construction. It is expected that conventional foundation and construction methods will be suitable for the proposed improvements.

Observations and laboratory tests indicate that the on-site soils have negligible levels of water-soluble sulfates, therefore, the soils are not expected to cause injurious sulfate attack on concrete with a minimum 28-day compressive strength of 2,500 psi.

Observations and laboratory tests indicated that the on-site soils have a broad range of expansion potential ranging from medium for clays in boring B-3 to an extremely high expansion potential (EI value of 281) for a sample at 12.5 feet in boring B-5. Consequently, potential for some post-construction expansion-related effects does exist.

The key geotechnical design focus will be on:

- Mitigation of the effects of the on-site expansive soils;
- Excavation and shoring design;
- Foundation design of the subterranean structures.

The design recommendations presented below reflect these considerations.

The design recommendations presented below are based on Tetra Tech's current understanding of the project. Once the project configuration is finalized and the design is complete, Tetra Tech should review the plans and specifications to evaluate if the geotechnical design recommendations have been incorporated as intended.

8.2. Clearing and Grubbing

The construction area should be cleared of any pavement, structures, vegetation, trash and debris, prior to commencement of the earthwork. Any subterranean installations not to be preserved, such as pipes, utility collectors, tanks, older foundations, etc., should be abandoned and removed per Geotechnical Engineer's recommendations and in accordance with applicable regulations. All undocumented fills including the existing landscape fill mounds and other unsuitable materials within the construction areas should be removed.

8.3. Site Preparation

In order to create uniform bearing conditions for the proposed improvements the following is recommended:

- Underground storage tank and pump station vault should be founded on competent native soils. No need for overexcavation is expected for the foundations located at the anticipated invert depth of about 20 feet, unless loose/soft unsuitable conditions are encountered as discussed below.

- Pump station building foundation and floor slab area should be overexcavated and recompacted to a depth of at least 2.5 feet below the bottom of the foundation or floor slab, 3 feet below the existing grade, or to competent native soils, whichever is deeper. To the extent practicable, the zone of overexcavation should extend outside the perimeter of the building area for a horizontal distance of at least 3 feet, but not less than a distance equivalent to the depth of overexcavation below the foundation bottom.

- Lightly loaded ancillary structures areas should be overexcavated to a depth of at least 2 feet below the bottom of the proposed footing or floor slab or to competent native soils, whichever is deeper. The excavation should extend a horizontal distance of at least 2 feet beyond the outside perimeter of the structure.

- Pavement areas and flatwork areas should be overexcavated and recompacted to a depth of at least 1 foot below the proposed subgrade elevation, or to uniform acceptable soils, whichever is deeper. To the extent practicable, the zone of overexcavation should extend a horizontal distance of at least 2 feet beyond the outside perimeter of the pavement.

- In non-structural/landscaped areas, any existing fill may remain in place. However, depending on the future use of the area, existing fill may need to be excavated and replaced as compacted fill. This can be evaluated during grading.

- Disturbed soils at structural and non-structural areas will likely occur after demolition of existing site improvements. These soils should be overexcavated and recompacted to the total depth of the disturbed material.

The exposed overexcavation subgrade for all structures and slabs, should be probed and accepted by the Geotechnical Engineer. The soils should be scarified to a depth of 4 inches and compacted at a minimum of 125 percent of optimum moisture content to at least 90 percent of the maximum dry density, as evaluated by the latest version of ASTM D1557.

Localized zones of loose and/or unstable soils may be encountered during the grading operations at the subgrade level and should be overexcavated and recompacted. If loose/soft/wet areas are encountered that are not practical to be excavated and processed, Table 5 below provides options for stabilizing the subgrade. The objective is to produce at least 3 feet for foundations and 2 feet for pavements of competent fill to bridge over the impacted area. The specific type of remediation and associated area limits will need to be evaluated in the field by a representative of Tetra Tech.

All fill placement associated with the replacement of the overexcavated soils, fill placed to achieve finish grade or subgrade, or utility trench backfill should be moisture-conditioned to at least 125 percent of the optimum moisture content and compacted to at least 90 percent of the maximum dry density, as evaluated by the latest version of ASTM D1557. The upper 1 foot of soils below

pavements and any flatwork should be processed and compacted to at least 95 percent of the maximum dry density (per ASTM D1557).

Excavated on-site soils may be re-used as compacted fill provided they are free of organics, deleterious materials, debris and particles over 3 inches in largest dimension. Locally, particles up to 6 inches in largest dimension may be incorporated in the fill soils based on specific approval and placement recommendations provided by the Geotechnical Engineer of Record during grading.

Table 5
Conceptual Options for Handling Unstable Materials at the Excavated Subgrade

Areas where the soils are soft and/or unstable at the excavation subgrade	• Overexcavate at least 3 feet for foundations, 2 feet for pavement areas • Stabilize the soft subgrade by working open-graded aggregate material (typically 3/4" or 1.5" crushed rock, coarser for softer subgrade) at least 4 to 6 inches into the soil. • Place non-woven geotextile, Mirafi 180N or approved equivalent, over the stabilized subgrade. • Place and compact well-graded fill (e.g., AB, CMB) or general approved backfill material to specified compaction over the geotextile.
Larger areas where the soils are excessively soft and/or unstable	• Overexcavate at least 3 feet for foundations, 2 feet for pavement areas • Improve the soft subgrade by working in open-graded aggregate material as much as possible/practical into the subgrade. • Place non-woven geotextile, Mirafi 180N or approved equivalent, over the exposed soil. • Place at least 8 inches (12-18 inches preferred) of well graded aggregate material (e.g., AB, CMB); only reasonably achievable compaction is required. • Place non-woven geotextile, Mirafi 180N or approved equivalent, over the aggregate layer. • Place and compact fill to specified compaction over the geotextile.

In the event that any soil materials (including backfill or base course materials) are imported to the site, such soils should be sampled, tested, and approved by Tetra Tech prior to arrival on-site. In general, any soils imported to the site for use as fill should be predominantly granular and have an Expansion Index less than 30. Additional recommendations for site grading are provided in the "General Site Grading Recommendations" section of this report.

8.4. Temporary Slopes and Trench Excavations

The on-site soils are not expected to pose unusual excavation difficulties, and therefore, conventional earth-moving equipment may be used. Localized sloughing/raveling of exposed soil intervals should be anticipated. All trench excavations should be performed in accordance with

Cal-OSHA regulations. The on-site soils may be considered Type C soils to a depth of 8 feet, and Type B from 8 feet to a depth of 20 feet as defined by the current Cal-OSHA soil classification.

Unsurcharged excavations: Sides of temporary, unsurcharged excavations less than 8 feet deep should be sloped back at an inclination of 1.5(H):1(V) or flatter according to Cal-OSHA. For excavations that extend beyond a depth of 8 feet, the upper 8 feet should be sloped at 1.5(H):1(V) or flatter and the reminder of the excavation below a depth of 8 feet should be sloped at a 1(H):1(V) or flatter. For Type B soils below a depth of 8 feet, benching could be used as long as the overall slope below 8 feet is kept at an inclination of 1(H):1(V) or flatter, however the bottom vertical height of the trench must not exceed 4 feet and the subsequent benches cannot be higher than 5 feet. Where space for sloped sides is not available, shoring will be necessary. All excavations where the bottom vertical height of the trench exceeds 4 feet must be shielded to a height of at least 18 inches above the top of the vertical side.

This office can provide appropriate shoring recommendations, once the excavation layout is known.

Surcharge setback recommendations: Stockpiled (excavated) materials should be placed no closer than 4 feet from the top of the trench. A greater setback may be necessary when considering surcharge loads such as heavy vehicles, concrete trucks and cranes. Tetra Tech should be advised of such heavy vehicle loadings so that specific setback requirements can be established for the used equipment. Alternatively, a shoring system may be designed to allow reduction in the setback distance.

Personnel from Tetra Tech should observe the excavation progress so that appropriate modifications to the excavation design may be recommended, if necessary, due to encountered conditions differing from the design assumptions.

8.5. Temporary Shored Excavations

Significant excavation is required for the construction for the proposed 13-acre-foot storage tank with a footprint area of approximately 1.5 acre with foundations and associated piping anticipated at a depth of about 20 feet. At these depths the use of a simple cantilevered shoring is not likely to be feasible and a shoring system assisted by tiebacks and/or soil nail wall with shotcrete facing may be necessary for the temporary support of the excavation in areas where not enough space is available for slope cuts at the inclinations indicated above. Presented herein are preliminary design recommendations for the recommended shoring systems, including a cantilevered system, based on the information available at this time. We can furnish specific design recommendations as the design progresses, if requested. The designer will need to take into account the likelihood of encroaching outside the property limits and the need to account for the presence of utilities, conduits, and other underground structures that may affect the design and installation of the shoring system.

All components of the shoring system, including the penetration depth, should be designed by a specialist Registered Civil Engineer in the State of California and should further satisfy requirements of Cal-OSHA. It is recommended that all shoring designs be reviewed by the

Geotechnical Engineer of Record. The following recommendations are based on the assumption that groundwater remains below the excavation bottom, and the face of the shoring is not subject to hydrostatic forces within the retained soils.

8.5.1. Soldier Pile and Lagging Wall System

Temporary soldier pile and lagging shoring system may be used to facilitate the proposed excavation. Tiebacks are usually required for excavation depths greater than about 15 feet. Alternate measures may be considered that would allow for elimination of the tiebacks such as installation of rakers, partial lowering of the grade just outside the excavation, or use of oversized soldier pile beams. If there is not sufficient space to install the tieback anchors to the desired lengths on any side of the excavation, the soldier piles of the shoring system may require internal bracing.

The soldier pile and lagging system would consist of steel soldier piles placed in drilled holes, backfilled with concrete, and restrained with tiebacks. Continuous timber lagging or steel plates may be used between the soldier piles. Because groundwater fluctuations outside the underground storage tank are possible, the timber lagging should be removed at the time of backfilling.

8.5.1.1. Soldier Pile Wall Design

Table 6 below summarizes the governing geotechnical design parameters and loading diagrams for a cantilevered and tieback-supported soldier pile wall shoring system. These values are based on the assumption that (1) the shored soil grade is level at the ground surface, (2) there are no hydrostatic pressures above the bottom of excavation, and (3) the shoring is temporary.

Any surcharge (live or dead load) located within a 1(H):1(V) plane drawn up from the base of the shoring should be added to the lateral earth pressures. For the soldier pile wall systems, the lateral contribution of a uniform surcharge load beginning immediately behind the wall and extending a horizontal distance equal to at least the retained height, may be calculated by multiplying the surcharge by a factor of 0.42. This uniform lateral load, i.e., independent of depth, should be applied as a minimum throughout the whole exposed height of the soldier pile wall. As a minimum, a 2 feet of equivalent uniform soil surcharge, i.e., 240 psf, is recommended to be included to account for nominal construction surcharge. This office can provide recommendations for other surcharge configurations, if requested.

To resist the lateral loading on shoring, the necessary depth of penetration of isolated soldier piles below the excavation bottom can be calculated based on the passive soil resistance provided in Table 6. Passive resistance should be ignored for the upper 12 inches below excavation bottom to account for potential near-surface soil disturbance. The passive resistance of individual soldier piles in Table 6 was increased to account for soil arching and factored by a Factor of Safety of 1.5. The provided value is applicable for soldier piles that are spaced no closer than 1.9 pile widths/diameters. For closer spacing the passive resistance would need to be reduced.

Development of hydrostatic pressures is not anticipated based on the current groundwater conditions and if irrigation is limited as recommended later in this report.

Table 6
Temporary Soldier Pile Wall with Tieback Anchors with No Hydrostatic Pressure
Geotechnical Design Parameters

Excavation bottom depth	Up to ~20 feet	
Subsurface materials	**Alluvial Soils** Mostly very stiff lean and fat clays (materials to ~20 feet below existing grade)	
SHORING SYSTEM	**For cantilevered shoring systems**	**For restrained shoring systems** Soldier pile tieback wall – single level of tiebacks – multiple levels of tiebacks
Soil unit weight, γ	125 pcf	
Design friction angle, ϕ	24°	0°
Design cohesion, c	0 psf	1,800 psf
Stability number, Ns = $\frac{\gamma \cdot H}{c}$	n/a	1.3
ACTIVE PRESSURE		
Ka … coefficient of active lateral pressure	0.42	n/a
Equivalent fluid density, EFD	53 pcf	n/a
ALLOWABLE PASSIVE PRESSURE		
Arching capability *	1.9	
Kp … coefficient of passive lateral pressure	2.4	
Equivalent fluid density – includes Safety Factor of 1.5 – considers arching	380 pcf EFD	
LOADING DIAGRAMS		
Loading Diagram behind the shoring	53 pcf EFD (i.e., triangular distribution)	Trapezoidal load distribution (see Diagram 1 below) based on stability number Ns = 1.3
Allowable passive resistance for soldier piles below excavation bottom: – includes Safety Factor of 1.5 – considers arching – ignore resistance within the upper 12 inches	380 pcf EFD ** (i.e., triangular distribution)	

* Per Caltrans Trenching and Shoring Manual (2011)
** Valid without reduction for soldier pile spacing > 1.9 times the effective pile width. This office can provide recommendations for reduction of the allowable passive pressure for more closely spaced soldier piles

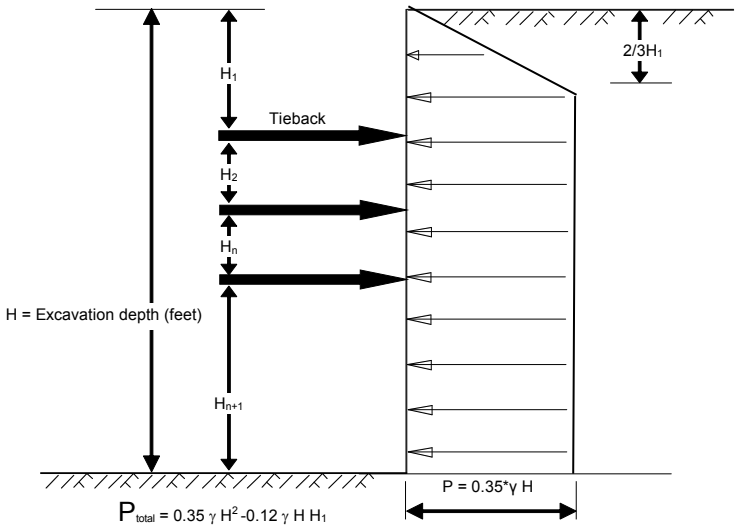

Diagram 1. Trapezoidal lateral pressures loading diagram for cohesive soils for a shoring wall with tiebacks

8.5.1.2. Tieback Design

Friction tieback anchors may be used to resist lateral loads. For design purposes, it may be assumed that the active wedge adjacent to the shoring is defined by a plane drawn at 33 degrees with the vertical through the bottom of the excavation. The tieback bonded zone must not encroach inside the active zone. The unbonded length of the anchor should extend either a minimum of distance of H/5, where H is the height of the wall, or 5 feet behind the surface defined by the active wedge. Only the frictional resistance developed beyond the active wedge would be effective in resisting lateral loads. If the anchors are spaced at least 6 feet on centers, no reduction due to group action in the capacity of the anchors needs to be considered.

It should be specified that all or at least the upper row of anchors be detensioned after completion of the storage tank construction.

Tiebacks are considered to assist with the lateral restraint of the shoring and to reduce soil movement behind the shoring wall. Straight shaft, pressure-grouted tiebacks may be initially designed for an allowable bond stress of 1,550 psf. The allowable bond stress includes a factor of Safety of 2. The allowable bod stress should be verified at the beginning of the construction.

The center of the anchor bond zone should be a minimum of 15 feet below the ground surface. The tieback bond stress may need to be adjusted depending on the tieback depth and grouting method.

8.5.1.3. Tieback Testing

The bond stress and capacities of anchors should be verified by testing during construction. The tieback proof and performance testing program should be in compliance with the latest (4th edition) Post-Tensioning Institute (PTI) guidelines "Recommendations For Prestressed Rock And Soil

Anchors". This office should review and approve the actual testing program and observe and interpret the execution of the testing program.

8.5.1.4. Tieback Installation

The anchors should be installed at angles of 15 to 30 degrees below the horizontal. Caving of the anchor holes at certain locations should be anticipated and provisions should be made available to minimize such caving. The anchors should be filled with grout placed by pumping from the tip out, and the grout should extend from the tip of the anchor to the active wedge. To minimize the potential for caving, we suggest that the portion of the anchor shaft within the active wedge be backfilled with sand before testing the anchor. This portion of the shaft should be filled tightly and flush with the face of the excavation. The sand backfill may contain a small amount of cement to allow the sand to be placed by pumping. For post-grouted anchors the anchor may be filled with grout to the face of the shoring provided the tieback strands are enclosed in plastic sheathing.

8.5.1.5. Deflection

It is difficult to accurately predict the amount of deflection of a shored excavation as it largely depends on the quality of construction. It should be realized, however, that some deflection will likely occur. We estimate that this deflection could be on the order of 1 inch at the top of the shored excavation. If greater deflection occurs during construction, additional bracing or restraint may be necessary to minimize settlement of the nearby improvements. If it is desired to reduce the deflection of the shoring, a greater lateral earth pressure could be used in the shoring design.

8.5.1.6. Construction Staging

The shoring should be constructed utilizing a top-down method of construction whereas the soil is first partially excavated to produce a bench for installation of the topmost row of tiebacks. Following the installation of the tiebacks, the excavation will proceed so that each row of tiebacks can be installed from the excavated bench. In order to continuously support the excavation, tieback installation bench should not be excavated more than 5 feet below the elevation of the centerline of the tieback row. The shoring designer should analyze each stage of tieback installation to ensure that the excavated bench level has an adequate factor of safety.

8.5.1.7. Internal Bracing

Locally, where tiebacks cannot be used, raker bracing may be used to internally brace the soldier pile wall. If used, raker bracing could be supported laterally by temporary concrete footings (deadmen). For design of such temporary footings, poured with the bearing surface normal to the rakers inclined at 45 to 60 degrees from the vertical, a bearing value of 2,000 psf may be used, provided the shallowest point of the footing is at least 1 foot below the lowest adjacent grade. To reduce the movement of the shoring, the rakers should be tightly wedged against the footings and/or shoring system.

8.5.2. Soil Nail Wall

A soil nail wall may be considered an option for support of the proposed excavation for the installation of the underground storage tank. The soil nail wall alternative may be more economical for the +/- 20 feet deep excavations than a soldier pile wall shoring system with tiebacks depending on the actual shoring configuration.

8.5.2.1. Soil Nail Wall Design

Parameters to be used for the initial soil nail wall design are summarized in Table 7 below for the prevailing on-site silty clays for solid bar nails.

Table 7
Summary of Soil Nail Design Parameters

Design Parameter	Design Value
Ultimate Bond Stress (for rotary drilled nails)	6 psi
Ultimate Bond Stress (for augered nails)	8 psi
Yield Strength of Reinforcement Steel	60 ksi
Soil Nail Diameter	6 inches

This office can provide the design of the soil nail wall, if requested.

8.5.2.2. Soil Nail Testing

Soil nail testing should be performed in accordance with the testing guidelines described in Chapter 9 of the FHWA Geotechnical Engineering Circular No.7 – Soil Nail Walls (FHWA-NHI-14-007) under the oversight of the Geotechnical Engineer.

8.5.2.3. Construction Staging

The soil nail wall construction should be performed using top-down method in multiple stages. In the first stage, the vertical excavation will be cut to allow for construction of the top row of soil nails and the shotcrete facing within the highest section of the wall. In the following stages, the soil will be excavated and soil nails installed and the shotcrete facing applied one row of soil nails at a time. In order to continuously support the excavation, the soil nail installation bench should not be excavated more than 5 feet below the elevation of the centerline of the soil nail row.

In general, it is expected that the conditions of the cut face encountered during construction will be favorable, i.e., no large scale or continuous caving will be encountered. However, this does not eliminate the potential for localized problems in cohesionless zones. If localized caving is encountered, it could be handled by reducing the unsupported height at that installation level and by flash coating the surface with shotcrete.

8.5.3. Shoring Performance Monitoring

Some means of monitoring the performance of the shoring system are recommended. The monitoring should consist of periodic visual inspections and lateral and vertical surveying of the tops of the soldier piles or survey monuments installed on top or behind the soil nail wall. This office can provide further recommendations of the monitoring when the design of the shoring system is being finalized.

8.5.4. Irrigation Control

It is recommended that while the shoring system is being installed and during its temporary operation no irrigation at the park be allowed within a horizontal distance of 20 feet measured from the top of the excavation to minimize possible buildup of pore water pressures.

8.6. Foundations

We anticipate that the proposed underground storage tank and pump station vault will be supported on either on mat foundations, or on pad footings with concrete slab on-grade established on subgrade prepared in accordance with recommendations provided in "Site Preparation" section of this report. Recommendations for the design and construction of shallow foundations are presented below.

8.6.1. Design Parameters for At-Depth Foundations

Foundations for the underground storage tank and the pump station vault located about 20 feet below the existing grade should be designed for the anticipated at-depth soil conditions using the geotechnical design parameters presented in Table 8. Footings should be designed and reinforced in accordance with the recommendations of the Structural Engineer and should conform to the 2013 California Building Code.

Table 8
Geotechnical Design Parameters
At-Depth Continuous and Isolated Spread Footing Foundations

Continuous Strip Footings			
Dimensions	• At least 1 foot wide but less than 4 feet wide • Minimize footing dimensions by maximizing the bearing pressure to confine and reduce the post-construction swelling of the expansive soils. • Embedded at least 2 feet below the lowest adjacent grade.		
Allowable Bearing Capacity	• 3,200 psf, foundation dimensions so that the bearing pressure is as close as practicable to 3,200 psf under dead loads. • The allowable bearing value may be increased by one-third for transient live loads from wind or seismicity.		
Spread Footings or Pads			
Dimensions (feet)	• Up to 4 feet x 4 feet	• Up to 8 x 8 feet	• Up to 15 x 15 feet (e.g., for the pump station vault)
Depth of Embedment	• At least 2 feet	• At least 2 feet	• At least 2 feet
Allowable Bearing Pressure	• 4,500 psf	• 4,000 psf	• 3,400 psf
	• The allowable bearing value may be increased by one-third for transient live loads from wind or seismicity.		
All Shallow Foundations			
Estimated Settlement	• Approximately 1-inch total settlement. • Approximately 0.5-inch differential settlement between supports or over a distance of 30 feet.		
Allowable Adhesion at the base (incorporates Factor of Safety of 1.5)	• 800 psf • Adhesion to be multiplied by the contact area as limited per 2013 CBC Section 1806.3.2.		
Allowable Lateral Passive Resistance (incorporates Factor of Safety of 2)	• 200 pcf (EFD) • The passive resistance derived of the upper 12 inches should be neglected.		
Allowable Combined Lateral Resistance	• The total allowable resistance to lateral loads can be calculated by combining the lateral resistance due to adhesion at the base and the lateral passive resistance. • The passive resistance values may be increased by one-third when considering transient wind or seismic loading		
Uplift Capacity	• The weight of the soil that contributes to the uplift capacity can be estimated as a zone defined by an angle of 30 degrees from the vertical projected from the top edge of the footing to the adjacent grade. • A total unit weight of 125 pcf may be used for the soil. • The lowest depth of embedment from the adjacent grade shall be used in the estimations		

8.6.2. Design Parameters for At Grade Shallow Foundations

Shallow foundations for at-grade structures should be designed for the anticipated near surface soil conditions using the geotechnical design parameters presented in Table 9. Footings should be designed and reinforced in accordance with the recommendations of the Structural Engineer and should conform to the 2013 California Building Code.

8.6.3. Footings Adjacent to Trenches

The bottom of any trenches that are required for any buried utilities and piping should be kept outside a zone defined by a 1(H): 1(V) plane projected from the outside bottom edge of any existing or proposed footings. Backfill materials and procedures shall conform to the recommendations provided in the "Site Preparation" and "General Site Grading" sections of this report. If any piping needs to be placed within the zone of influence, the pipes should be designed to account for the increased surcharge from the applied footing pressures and to withstand potential differential settlement between the surcharged and unsurcharged segments of the pipe. Generally, the pipes within the impacted zone should be protected with concrete encasement, utilidors, or other suitable form of protection. This office should be contacted to review any specific utility interaction configurations and their proposed mitigation.

8.6.4. Foundation Construction Observations

To evaluate the presence of satisfactory materials at foundation subgrade, foundation excavations should be observed by a representative of Tetra Tech, and be clean of loosened soil and debris before placing steel or concrete. If soft or loose soils or other unsatisfactory materials are encountered, such materials should be removed and replaced with compacted fill prior to pouring the footing.

Table 9
Geotechnical Design Parameters
Shallow Continuous and Isolated Spread Footing Foundations

Continuous Strip Footings		
Dimensions	• At least 1 foot wide but less than 4 feet wide • Minimize footing dimensions by maximizing the bearing pressure to confine and reduce the post-construction swelling of the expansive soils. • Embedded at least 2 feet below the lowest adjacent grade.	
Allowable Bearing Capacity	• 2,200 psf, foundation dimensions so that the bearing pressure is as close as practicable to 2,200 psf under dead loads. • The allowable bearing value may be increased by one-third for transient live loads from wind or seismicity.	
Spread Footings or Pads		
Dimensions (feet)	• Up to 4 feet x 4 feet	• Up to 8 x 8 feet
Depth of Embedment	• At least 2 feet	• At least 2 feet
Allowable Bearing Pressure	• 3,200 psf	• 2,600 psf
	• The allowable bearing value may be increased by one-third for transient live loads from wind or seismicity.	
All Shallow Foundations		
Estimated Settlement	• Approximately 1-inch total settlement. • Approximately 0.5-inch differential settlement between supports or over a distance of 30 feet.	
Allowable Adhesion along concrete – soil interface (incorporates Factor of Safety of 1.5)	• 800 psf • Adhesion to be multiplied by the contact area as limited per 2013 CBC Section 1806.3.2.	
Allowable Lateral Passive Resistance (incorporates Factor of Safety of 2)	• 160 pcf (EFD) • The passive resistance derived of the upper 12 inches should be neglected.	
Allowable Combined Lateral Resistance	• The total allowable resistance to lateral loads can be calculated by combining the lateral resistance due to adhesion at the base and the lateral passive resistance. • The passive resistance values may be increased by one-third when considering transient wind or seismic loading	
Uplift Capacity	• The weight of the soil that contributes to the uplift capacity can be estimated as a zone defined by an angle of 30 degrees from the vertical projected from the top edge of the footing to the adjacent grade. • A total unit weight of 120 pcf may be used for the soil. • The lowest depth of embedment from the adjacent grade shall be used in the estimations	

8.7. Concrete Slab-On-Grade or Mats

The recommendations provided in the "Site Preparation" section of this report and in this section are intended to provide a firm bearing subgrade to help reduce the occurrence of cracks in concrete and associated horizontal separation and vertical offset. However, it should be understood that concrete slabs may still crack due to structural design or detailing, curing, or construction execution even when these recommendations are implemented. If cracking of the concrete is desired to be minimized, the reinforcement, concrete mix, and curing specifications should be designed by the Structural Engineer and Concrete Specialist.

8.7.1. Structure Floor Slab-On-Grade or Mats

Structure floor slab-on-grade and mat foundations for the pump station vault or the underground storage tank, if considered, may be designed based on the reference modulus of subgrade reaction k_1 for a 1-foot by 1-foot square plate of 115 pounds per cubic inch. For the on-site silty and clayey soils, the design modulus of subgrade reaction k in pci for a concrete rectangular element can be determined as:

$$k = k_1 \frac{1 + 0.5 * \frac{B}{L}}{1.5 * B}$$

Where B and L are the width and length of the element in feet, respectively, while B is no more than 14 times the thickness of the element, i.e., floor slab, and k_1 is as defined above.

In order to assist with initiation of the floor slab design, the slab-on-ground should have a minimum thickness of 5 inches. The minimum reinforcement to reduce separation and offset of potential concrete cracks should consist of No. 4 reinforcing bars spaced at 18 inches on-center, each way, placed in the middle one-third of the section. The slab should be doweled into the perimeter building footings to reduce the potential for differential movement. Reinforcement should be properly placed and supported on blocks or "chairs." Welded wire mesh reinforcement is not recommended.

Control joints should be constructed in accordance with recommendations from the Structural Engineer and the Architect. For preliminary design considerations, control joints should be provided in all concrete slabs-on-grade as recommended by American Concrete Institute (ACI) guidelines and at a maximum spacing (in feet) of 2 to 3 times of the slab thickness (in inches), but generally no more than 10 feet,. All joints should form approximately square patterns to reduce potential for randomly oriented shrinkage cracks. The control joints should be tooled at the time of the pour or sawcut to ¼ of slab depth within 6 to 8 hours of concrete placement. 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 semi-arid region (refer to ACI guidelines).

An allowable adhesion of 700 psf (to be multiplied by the contact area) may be used to account for the lateral resistance generated in the contact between the slabs and the supporting soils. In no case, the lateral resistance can exceed 50 percent of the dead load.

8.7.2. Exterior Slabs

Exterior slabs should be placed on subgrade prepared in accordance with the recommendations provided in the "Site Preparation" section of this report. As indicated above, a Structural Engineer or an Engineer specialized in concrete design should be consulted if cracking of the exterior slabs is to be minimized. As a minimum for exterior walkways, it is recommended that narrow strip concrete slabs, such as sidewalks, be reinforced with at least No. 4 reinforcing bars placed longitudinally at 18 inches on center. Wide exterior slabs should be reinforced with at least No. 4 reinforcing bars placed 18 inches on center, each way. Placement of control joints within exterior flabs should follow the recommendations presented for floor slabs. Reinforcement should extend through the control joints to reduce the potential for differential movement. Control joints should be constructed in accordance with recommendations from the Structural Engineer and Architect.

8.8. Uplift of Buried Structures

Buried structures at a depth greater than 10 feet should be designed to resist uplift forces due to potential buoyancy forces exerted by a high groundwater depth of about 10 feet. These buoyant forces created by the groundwater need to be accounted to prevent buried structures and pipelines from floating or shifting upward. The designer must consider all the downward and upward forces on the structures and design for the worst-case scenario.

In accounting for the uplift resisting forces the designer may include the resistance of the soil adhesion acting against the buried walls of the considered structures, and/or the soil to soil adhesion acting on the vertical projections of foundation edges. These adhesive forces can be computed using the adhesion provided in Table 9.

Several options could be considered by the designer to resist the uplift forces, such as:

- Increase the thickness of the soil cover on top of the tanks by either raising the surface grade or lowering the tanks or combination thereof.
- Increase the weight of the concrete tanks by creating additional internal partitions or thickened walls.
- Place ballast concrete mass within the tank.
- Increase the lateral projection of the mat foundation beyond the tank footprint to increase the base area and the amount of overburden pressure at the foundation level due to the weight of the soil acting on the projection.
- Anchoring the tank foundation by the use of anchors, piles, or deadman.

Implementation of any these options may affect the hydraulic design of the system.

8.9. Seismic Design Parameters

The seismic design coefficients provided below in Table 10 are based on Chapter 16 of the 2013 California Building Code. According to the 2013 CBC, sites subject to liquefaction should be classified as Site Class F, which requires a site response analysis. However, ACSE7-10, Section 20.3.1, which is the basis for the 2013 CBC, states that for structures having a fundamental periods of vibration equal to or less than 0.5s, site response analysis is not required to determine spectral accelerations for liquefiable soils and the site class may be determined in accordance with Section 20.3, in which case this site may be classified as a class D. The structural engineer shall verify that the natural period of the structure meets this condition.

If a site specific response is required, Tetra Tech can provide such an analysis, although, by inspection, the site seismic response will be affected by the liquefaction only minimally because the maximum thickness of potentially liquefiable soils is only about 5 feet. The seismic design coefficients provided below in Table 10 are based on Chapter 16 of the 2013 California Building Code, and on the information provided by the USGS website http://earthquake.usgs.gov/hazards/designmaps/.

Table 10
Site Categorization and 2013 CBC Site Coefficients
Site coordinates N 33.80847, and W -118.28369°

Parameter	Design Value
Site Class (Table 20.3-1 ASCE 7)	D*
Short Period Spectral Acceleration Parameter S_s	1.647**
1-sec. Period Spectral Acceleration Parameter S_1	0.626**
Short Period Design Spectral Acceleration Parameter S_{DS}	1.098**
1-sec. Period Design Spectral Acceleration Parameter S_{D1}	0.626**

* Soil profile based on estimated v_{s30} of 300 m/s
** Values from USGS Earthquake Hazards Program website, http://earthquake.usgs.gov/hazards/designmaps/ based on the ASCE7-10 with July 2013 errata and 2012 International Building Code.

8.10. Lateral Earth Pressures on Underground Walls and Tanks

Based on the 2014 for the County of Los Angeles Building Code, which is based on the 2013 California Building Code (CBC) the design of retaining walls higher than 6 feet, as measured from the top of the footing, requires the inclusion of not only static lateral pressures but also of additional seismically induced lateral earth pressures.

The static lateral pressures acting on the proposed on-site underground structures storage and infiltration structures should be calculated based on the recommendations provided in Table 11.

According to the 2013 CBC the dynamic seismic lateral earth pressures on foundation walls and retaining walls should be determined using the design earthquake ground motions. Based on the USGS U.S. Seismic Design Maps website application (http://earthquake.usgs.gov/designmaps/us/application.php), the PGA from the Design Response Spectrum at the site is approximately 0.44g where the design PGA is calculated as $0.4*S_{DS}$, where S_{DS} is the risk-targeted, maximum rotated acceleration direction, design response spectrum parameter for short periods. The seismic induced earth pressure increments were estimated using the method recommended by Mikola and Sitar (2013). The seismic pore pressure increment was computed based on the recommendations from Ebeling (1993) for free water within the backfill applicable to free-draining materials like coarse sands, and gravels. These recommendations are provided in Table 11. Lateral earth pressures presented in this table are for a level backfill.

If a drainage system is not be installed or there is a potential for the underground storage tank to discharge into the surrounding soils, the wall should be designed to resist also the hydrostatic pressure.

Determination of whether the active or at-rest condition is appropriate for design will depend on the flexibility of the walls. In walls with stiff clay backfill that are free to rotate at least 0.01 radians (deflection at the top of the wall of at least 0.01 x H) may be designed for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The effect of any surcharge (dead or live load) located within a 1(H):1(V) plane drawn upward from the heel of the wall footing should be added to the lateral earth pressures.

Suitable backfill materials within a zone immediately the behind the subterranean walls, including the storage tank walls, should have a Sand Equivalent of about 30, an Expansion Index of less than 20, and fines content (passing #200 sieve) of less than 15 percent. It is expected that due to the expansive clayey nature of most of the on-site material, the on-site materials will not be generally suitable as a backfill immediately behind. Consequently, a select on-site material with an Expansion Index less than 20, or approved non-expansive import material should be used for the backfill within at least 5 feet behind the back of the underground wall or tank walls. It is expected that additional laboratory testing will be necessary to determine the suitability of the selected on site materials. The materials that are approved as backfill materials should be moisture-conditioned 110 percent of the optimum moisture content, and placed in horizontal lifts not more than 8 inches in uncompacted thickness, and compacted to at least 90 percent of the maximum dry density, as evaluated by the latest version of ASTM D1557.

Table 11
Geotechnical Design Parameters for Subterranean Walls
Lateral Pressures due to Static and Seismic Loads

Active Pressure for Yielding Walls		
Static *active* pressure (psf)	above groundwater	$51z + 0.42Q$
	below groundwater (at depth $z > z_w$)	$51z_w + 89(z - z_w) + 0.42Q$
Active seismic pressure increment (psf)	above groundwater	$14z$
	below groundwater (at depth $z > z_w$)	$14z_w + 7\,(z - z_w) + 24\sqrt{(z - z_w) * d_w}$
At rest Pressure for Non-yielding Walls		
Static *at-rest* pressure (psf)	above groundwater	$71z + 0.59Q$
	below groundwater (at depth $z > z_w$)	$71z_w + 99(z - z_w) + 0.59Q$
At-rest seismic pressure increment (psf)	above groundwater	$31z$
	below groundwater (at depth $z > z_w$)	$31z_w + 16(z - z_w) + 24\sqrt{(z - z_w) * d_w}$
Allowable Lateral Passive Pressure Resistance Includes a Factor of Safety of 2		
Lateral *passive* pressure (psf)	above groundwater	$142z_1$
	below groundwater at depth z_w	$142z_w + 74(z_1 - z_w)$

Notes:
- Lateral Pressures due to Seismic Loading are based on a PGA=0.44g for a design response spectrum taken as 2/3 MCE_R response spectrum. The appropriate total seismic force (active plus seismic increment for yielding walls and at rest plus seismic increment for non-yielding walls) should be calculated be assuming a downward increasing tringle equivalent fluid pressure distribution. The resulting force should be assumed to act at 1/3 of the height of the wall above the bottom of the wall.
- Pressure based on soil with $\phi = 24^o$, c = 0 psf, $\gamma_t = 120$ pcf (above groundwater), $\gamma_t = 125$ pcf (below groundwater)
- The 2013 CBC requires that basement walls be designed for at rest earth pressures for static conditions.

Legend:
- z … Depth (ft) below the grade behind the wall –depth measured from the ground surface to the depth where the soil lateral pressure is being evaluated;
- z_1 … Depth (ft) below the grade where passive conditions apply, i.e., usually in front of the wall – depth measured from the ground surface to the depth where the soil lateral pressure is being evaluated;
- z_w … Depth to groundwater (ft) – depth measured from the ground surface to the groundwater;
- d_w … Depth of water along the wall height (ft) – measured from the groundwater table to the bottom of the structure;
- Q … Uniform surcharge (psf) within a 1(H):1(V) plane drawn upward from the heel of the wall footing.

8.11. Embedded Posts and Poles at Grade

8.11.1. Non-Constrained Case

For the non-constrained case where the pole is not restricted to move at the ground level, the minimum depth of embedment required to resist lateral loads should be determined in accordance with the 2013 CBC Section 1807.3.2.1. The allowable static lateral soil bearing pressure can be assumed to be equal to 160 pcf equivalent fluid density (pcf EFD). Where bare ground (without concrete or asphalt cover) is present adjacent to the foundation, the lateral resistance should be ignored for the upper 12 inches below grade. Therefore, a trapezoidal pressure distribution should be used starting at 12 inches below grade. The allowable passive earth pressure value incorporates a Factor of Safety of 2. Vertical compressive loading can be resisted utilizing an allowable end bearing pressure of 2,800 psf.

8.11.2. Constrained Case

For the constrained case where the pole is restricted from movement at the ground level by encasement in surrounding concrete or similar, the minimum depth of embedment required to resist lateral loads should be determined in accordance with the 2013 CBC, Section 1807.3.2.2. The allowable static lateral soil bearing pressure can be assumed to be at least 160 pcf EFD. The constrained earth pressure value incorporates a Factor of Safety of 2. Vertical compressive loading can be resisted utilizing an allowable end bearing pressure of 2,800 psf.

8.12. Pipeline Design and Construction

Design recommendations for the proposed pipeline trenches and backfill are provided below.

8.12.1. Trench Excavation

Recommendations provided in the "Temporary Slopes and Trench Excavations" section of this report should be followed for design and construction of trenches for the proposed pipelines.

8.12.2. Trench Bottom Preparation

The bottom of pipeline trenches should be scarified to a depth of 6 inches. Any particle size greater than 3 inches should be removed. The scarified surface should be moisture conditioned to at least 125 percent of optimum moisture content and compacted to at least 90 percent of maximum dry density per the latest version of ASTM D1557.

8.12.3. Trench Backfill

Bedding and pipe zone backfill material for the pipelines should consist of clean sand or gravel The actual selection and suitability of the material should be determined based on the pipe design loading and requirements. The clayey materials found within the upper 20 feet at the site are not expected to be suitable for pipe bedding and pipe zone backfill. The bedding layer extending typically into the range between the pipe invert and the springline should be moisture-conditioned

to at least the optimum moisture content and compacted to at least 90 percent of maximum density per ASTM D1557. The pipe zone backfill extending typically 6 to 12 inches above the pipe should be moisture-conditioned to at least 110 percent of optimum moisture and hand tamped to achieve a density of at least 90 percent of maximum density per ASTM D1557. The use of mechanized compaction equipment within the pipe zone should be carefully controlled to avoid overstressing or damaging the pipe. Backfill should be placed on each side of the pipe simultaneously to avoid unbalanced loads on the pipe.

General trench backfill zone extends from the top of the pipe zone backfill to the finished grade. Approved excavated soil may be used for general trench backfill. If the excavated on-site material is used as the trench backfill, it should be moisture-conditioned to at least 125 percent of optimum moisture content and compacted to at least 90 percent of maximum dry density per the latest version of ASTM D1557. Within proposed pavement areas the upper 12 inches of backfill should be compacted to at least 95 percent of maximum.

Compaction by ponding or jetting of the trench backfill materials may be permitted by the Geotechnical Engineer only where select sand backfill is used and adequate drainage is available in the sandier surrounding soil intervals. If ponding or jetting are used for compaction, it will likely be necessary to supplement these methods by the use of vibrators to achieve the required compaction.

8.13. Pavement Sections

New pavements for driveways and parking lots are anticipated to be constructed on the native soils as well as on top of the underground storage tank. The recommendations presented below are for pavements constructed on native soils subgrade or on at least 2 feet of soil subgrade. For different conditions this office should be contacted. If pavements are to be constructed directly on the ceiling of the underground storage tank, the pavements should be designed as a part of the structural design.

8.13.1. Subgrade Preparation

The subgrade preparation and fill placement in the areas to be paved should conform to the recommendations provided in the "Site Preparation" and "General Site Grading" sections of this report.

8.13.2. Asphalt Concrete Pavement Design

Flexible pavement sections have been evaluated in general accordance with the Caltrans Highway Design Manual method for flexible pavement design using a 20-year design life period. It is estimated that the access roads may be designed for a Traffic Index of 5. If fire access is required, a Traffic Index of 5 or 6 is typically considered acceptable by regulatory agencies. Based on the prevailing on-site subgrade clayey sand soils R-value of 15 was assumed. The resulting recommended pavement sections are presented in Table 12.

Table 12
Flexible Pavement Sections

Location	R-Value	Assumed Traffic Index	Asphalt Concrete (inches)	Aggregate Base (inches)	Full Depth Asphalt Concrete Alternative
Parking / drive aisles	15	5.0 or less	3.0	8	7
Light / moderate traffic		6.0	3.5	10.5	8.5

Asphalt concrete and aggregate base should conform to the Specifications for Public Works Construction (Green Book) Sections 203-6 and 200-2, respectively. The aggregate base course should be compacted to 95 percent or more of the maximum dry density, as evaluated by the latest version of ASTM D1557.

8.13.3. Pavement Construction Observations

The preparation of the pavement subgrade and the placement of base course and pavement sections should be observed by Tetra Tech personnel. Careful observation is recommended to evaluate that the pavement subgrade is consistent with the design assumptions and that it is uniform and uniformly compacted and that the recommended pavement and base course thickness are achieved. Paved areas should be properly sloped, and surface drainage facilities should be established to reduce water infiltration into the pavement subgrade. Curbing located adjacent to paved areas should be founded in the soil subgrade in order to provide a cutoff to reduce water infiltration into the base course.

8.14. Soil Corrosion

The corrosion potential of the on-site materials to buried steel and concrete was evaluated based on laboratory testing on 2 representative soil samples. Table 13 below presents the results of the corrosivity testing.

Table 13
Corrosivity Test Results

Boring	Sample ID	Depth (feet)	pH	Resistivity (ohm-cm)	Chlorides (ppm/%)	Soluble Sulfate Content in Soil (ppm/%)
B-3	SK-1	0-5	7.1	680	69/0.0069	330/0.0330 Category S0 per 2013 CBC
B-4	SPT-7	17.5-19	7.4	480	213/0.0213	496/0.0496 Category S0 per 2013 CBC

Per 2013 CBC/ 2012 IBC, Section 1904.1, concrete subject to exposure to sulfates shall comply with the requirements set forth in ACI 318, Section 4.3. Based on the measured water soluble sulfate results the exposure of buried concrete to sulfate attack should be considered "not applicable", i.e., exposure class S0 per ACI 318, Table 4.2.1. Consequently, injurious sulfate

attack is not anticipated for concrete with a minimum 28-day compressive strength of 2,500 psi. Per 2013 CBC, Section 1904.1, concrete reinforcement should be protected from corrosion and exposure to chlorides in accordance with ACI 318, Section 4.3.

The evaluation of potential for corrosion of buried metals was based on the minimum resistivity and our experience with similar soils. The on-site soils are anticipated to likely have a "severe" corrosion potential to buried ferrous metals. A corrosion specialist should be consulted regarding suitable types of piping and necessary protection for underground metal conduits. The corrosion potential of the on-site soils should be verified during construction for each encountered soil type. Imported fill materials should be tested prior to placement to confirm that their corrosion potential is not more severe than the one assumed for the project.

8.15. Drainage Control

The intent of this section is to provide general information regarding the control of surface water. The control of surface water is essential to the satisfactory performance of the building construction and site improvements. Surface water should be controlled so that conditions of uniform moisture are maintained beneath and adjacent to the structure, even during periods of heavy rainfall. The following recommendations should be considered as minimal.

- Ponding and areas of low flow gradients should be avoided.
- Paved surfaces within 10 feet from the building foundation should be provided with a gradient of at least 2 percent sloping away from improvements.
- Bare soil, e.g., planters, within 10 feet of the structure should be sloped away from the improvement at a gradient of 5 percent.
- Positive drainage devices, such as graded swales, paved ditches, and/or catch basins should be employed to accumulate and convey water to appropriate discharge points.
- Concrete walks and flatwork should not obstruct the free flow of surface water.
- Area drains should be recessed below grade to allow free flow of water into the basin.
- Enclosed raised planters should be sealed at the bottom and provided with an ample flow gradient to a drainage device. Recessed planters and landscaped areas should be provided with area inlet and subsurface drain pipes.
- Planters should not be located immediately adjacent to structures. If planters are to be located adjacent to a structure, they should be positively sealed, should incorporate a subdrain, and should be provided with free discharge capacity to a drainage device.
- Planting areas at grade should be provided with positive drainage. Wherever possible, the grade of exposed soil areas should be established above adjacent paved grades. Drainage devices and curbing should be provided to prevent runoff from adjacent pavement or walks into planted areas.
- Gutter and downspout systems should be provided to capture discharge from roof areas. The accumulated roof water should be conveyed to an off-site disposal area by a pipe or concrete swale system.
- Landscape watering should be performed judiciously to preclude either soaking or desiccation of soils. The watering should be such that it just sustains plant growth without excessive infiltration. Sprinkler systems should be checked periodically to detect leakage and irrigation efforts should be reduced or halted during the rainy season.

9. GENERAL SITE GRADING RECOMMENDATIONS

The intent of this section is to provide general information regarding the site grading. Site grading operations should conform with applicable local building and safety codes and to the rules and regulations of those governmental agencies having jurisdiction over the subject construction.

The grading contractor is responsible for notifying governmental agencies, as required, and a representative of Tetra Tech at the start of site cleanup, at the initiation of grading, and any time that grading operations are resumed after an interruption. Each step of the grading should be accepted in a specific area by a representative of Tetra Tech, and where required, should be approved by the applicable governmental agencies prior to proceeding with subsequent work.

The following site grading recommendations should be regarded as minimal. The site grading recommendations should be incorporated into the project plans and specifications.

1. Prior to grading, existing vegetation, trash, surface structures and debris should be removed and disposed off-site at a legal dumpsite. Any existing utility lines, or other subsurface structures which are not to be utilized, should be removed, destroyed, or abandoned in compliance with current governmental regulations.

2. Subsequent to cleanup operations, and prior to initial grading, a reasonable search should be made for subsurface obstructions and/or possible loose fill or detrimental soil types. This search should be conducted by the contractor, with advice from and under the observation of a representative of Tetra Tech.

3. Prior to the placement of fill or foundations within the building area, the site should be prepared in accordance with the recommendations presented in the section "Site Preparation" of this report. All undocumented fill or disturbed soils within the building areas should be removed and processed as recommended by the representative of Tetra Tech.

4. The exposed subgrade and/or excavation bottom should be observed and approved by a representative of Tetra Tech BAS for conformance with the intent of the recommendations presented in this report and prior to any further processing or fill placement. <u>It should be understood that the actual encountered conditions may warrant excavation and/or subgrade preparation beyond the extent recommended and/or anticipated in this report.</u>

5. On-site inorganic granular soils that are free of debris or contamination are considered suitable for placement as compacted fill. Any rock or other soil fragments greater than 6 inches in size should not be placed within 5 feet of the foundation subgrade.

6. Any imported fill material required for backfill or grading should be tested and approved prior to delivery to the site.

7. Visual observations and field tests should be performed during grading by a representative of Tetra Tech. This is necessary to assist the contractor in obtaining the proper moisture content and required degree of compaction. Wherever, in the opinion of a representative of Tetra Tech,

an unsatisfactory condition is being created in any area, whether by cutting or filling, the work should not proceed in that area until the condition has been corrected.

10. DESIGN REVIEW AND CONSTRUCTION MONITORING

Geotechnical review of plans and specifications is of paramount importance in engineering practice. The poor performance of many structures has been attributed to inadequate geotechnical review of construction documents. Additionally, observation and testing of the subgrade will be important to the performance of the proposed development. The following sections present our recommendations relative to the review of construction documents and the monitoring of construction activities.

10.1. Plans and Specifications

The design plans and specifications should be reviewed and approved by Tetra Tech prior to bidding and construction, as the geotechnical recommendations may need to be re-evaluated in the light of the actual design configuration and loads. This review is necessary to evaluate whether the recommendations contained in this report have been incorporated into the project plans and specifications as intended.

10.2. Construction Monitoring

Site preparation, pile installation, assessment of imported fill materials, fill placement, and other site grading operations should be observed and tested. The subgrade soils exposed during the construction may differ from those anticipated in the preparation of this report. Continuous observation by a representative of Tetra Tech should be implemented during construction to allow for evaluation of the soil conditions as they are encountered, and to provide the opportunity to recommend appropriate revisions as needed.

11. STATEMENT 111

Based on the data and evaluations presented in the report, it is the opinion of Tetra Tech that the subject project site for the proposed Carriage Crest Park facilities will be safe against hazards from future landsliding, settlement or slippage and that the proposed grading construction will have no adverse impact on the geologic stability of property outside of the project site.

12. LIMITATIONS

The recommendations and opinions expressed in this report are based on Tetra Tech's review of background documents and on information obtained from the current geotechnical investigation. It should be noted that as part of this study the possible presence of hazardous materials at the site was evaluated and the findings have been summarized in a separate report.

Due to the limited nature of the field explorations, conditions not observed and described in this report may be present on the site. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation and laboratory testing can be performed upon request. It should be understood that conditions different from those anticipated in this report may be encountered during grading operations, for example, the extent of unsuitable soil and the associated additional effort required to mitigate them.

Site conditions, including groundwater level, can change with time as a result of natural processes or the activities of man at the subject site or at nearby sites. Changes to the applicable laws, regulations, codes, and standards of practice may occur as a result of government action or the broadening of knowledge. The findings of this document may, therefore, be invalidated over time, in part or in whole, by changes over which Tetra Tech has no control. Therefore, this report should reviewed and recertified if it were to be used for a project design commencing more than 1 year after the date of issuance of this report.

Tetra Tech's recommendations for this site are dependent upon appropriate quality control of the excavation for the construction of the underground storage tank and related facilities. Accordingly, the recommendations are made contingent upon the opportunity for Tetra Tech to observe grading operations, including installation of the temporary shoring. If parties other than Tetra Tech are engaged to provide such services, such parties must be notified that they will be required to assume complete responsibility as the Geotechnical Engineer of Record for the geotechnical phase of the project by concurring with the recommendations in this report and/or by providing alternative recommendations.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Tetra Tech should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. Reliance by others on the data presented herein or for purposes other than those stated in the text is authorized only if so permitted in writing by Tetra Tech. It should be understood that such an authorization may incur additional expenses and charges.

Tetra Tech has endeavored to perform its evaluation using the degree of care and skill ordinarily exercised under similar circumstances by reputable geotechnical professionals with experience in this area in similar soil conditions. No other warranty, either expressed or implied, is made as to the conclusions and recommendations contained in this report.

13. SELECTED REFERENCES

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Figures

Reference: Google Earth Pro (2016)

TETRA TECH BAS GEOSCIENCE
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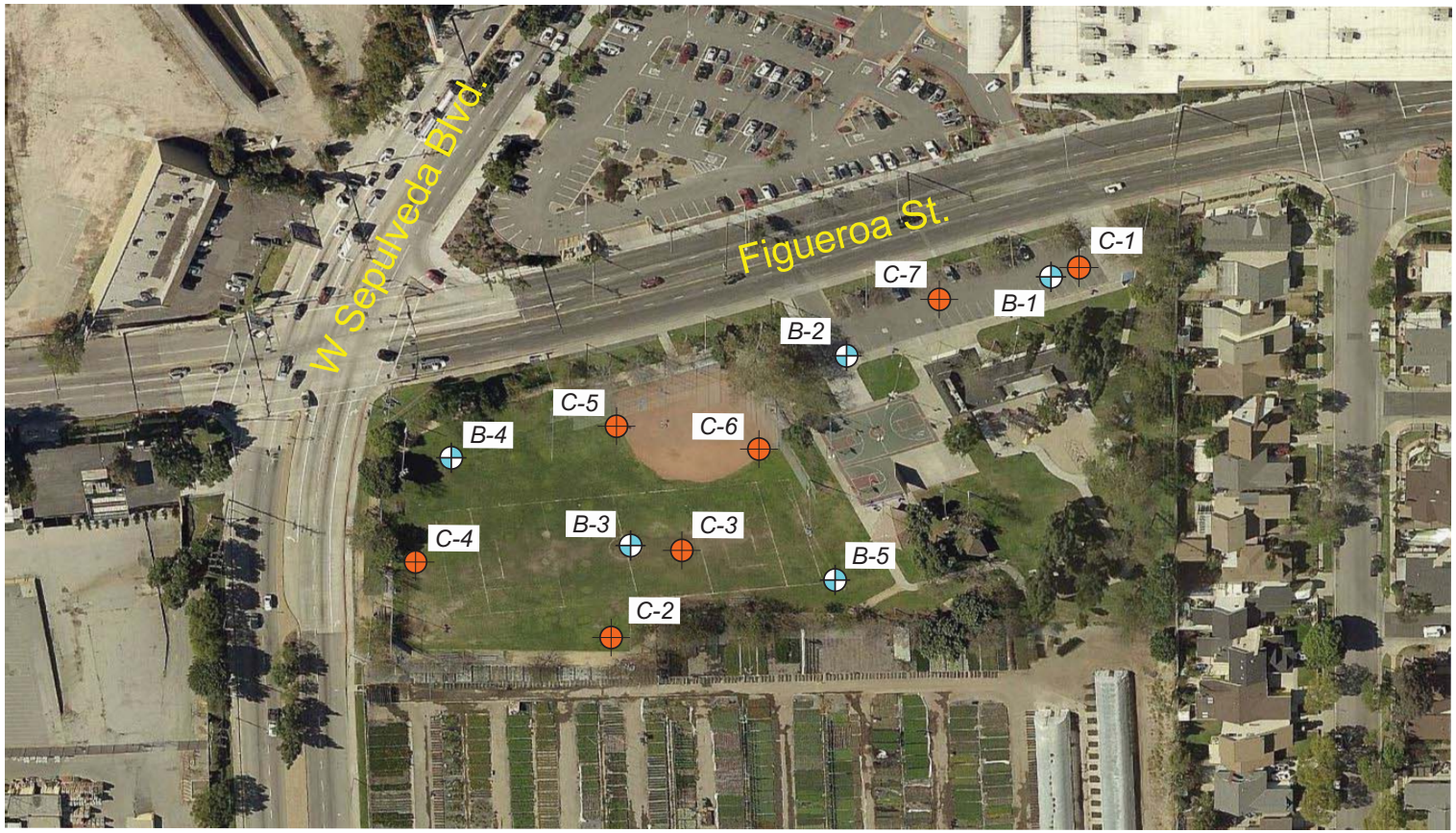
Project Location Map

Carriage Crest Park Water Capture
Carson, California

JOB NO	TET 16-101E
DATE	October 2016
DRAWN BY	YLI
	Figure 1



LEGEND

B-5 Boring No. and Location

C-7 CPT Sounding No. and Location

N

0 50 100 200 feet

Approximate Scale 1:2,400

Drawing References: Google Earth Pro (2016)

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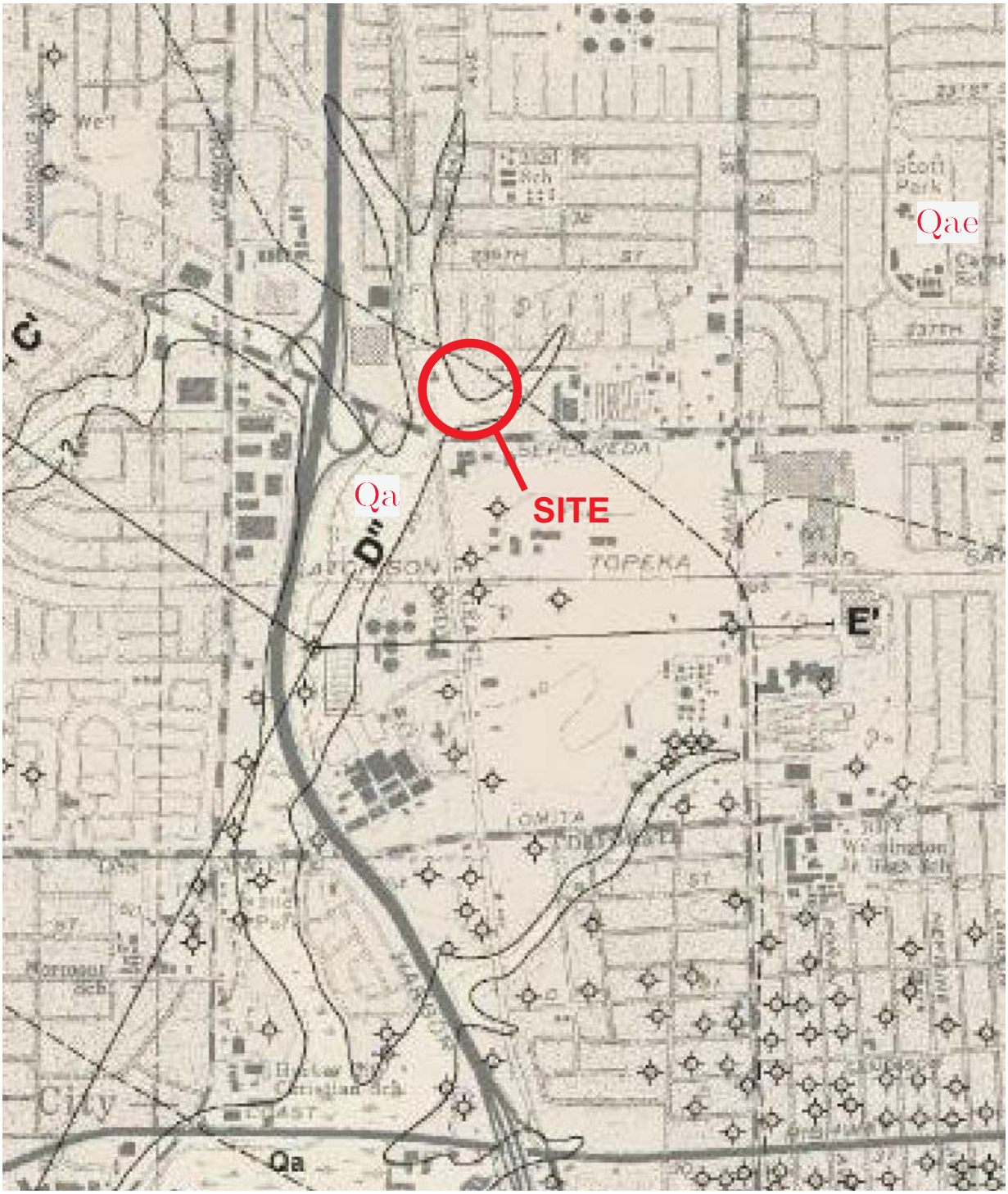
Project Layout, Boring and CPT Location Map

Carriage Crest Park Water Capture
Carson, California

JOB NO	TET 16-101E
DATE	October 2016
DRAWN BY	YLI
	Figure 2



LEGEND

Qa - Alluvium, mostly loamy clay of valley and flood plains; including fine sand near Palos Verdes Hills

Qae - Alluvium, similar to Qa but slightly elevated and locally dissected

Not to Scale

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE

Reference: Dibblee (1999)

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Phone (909) 860-7777

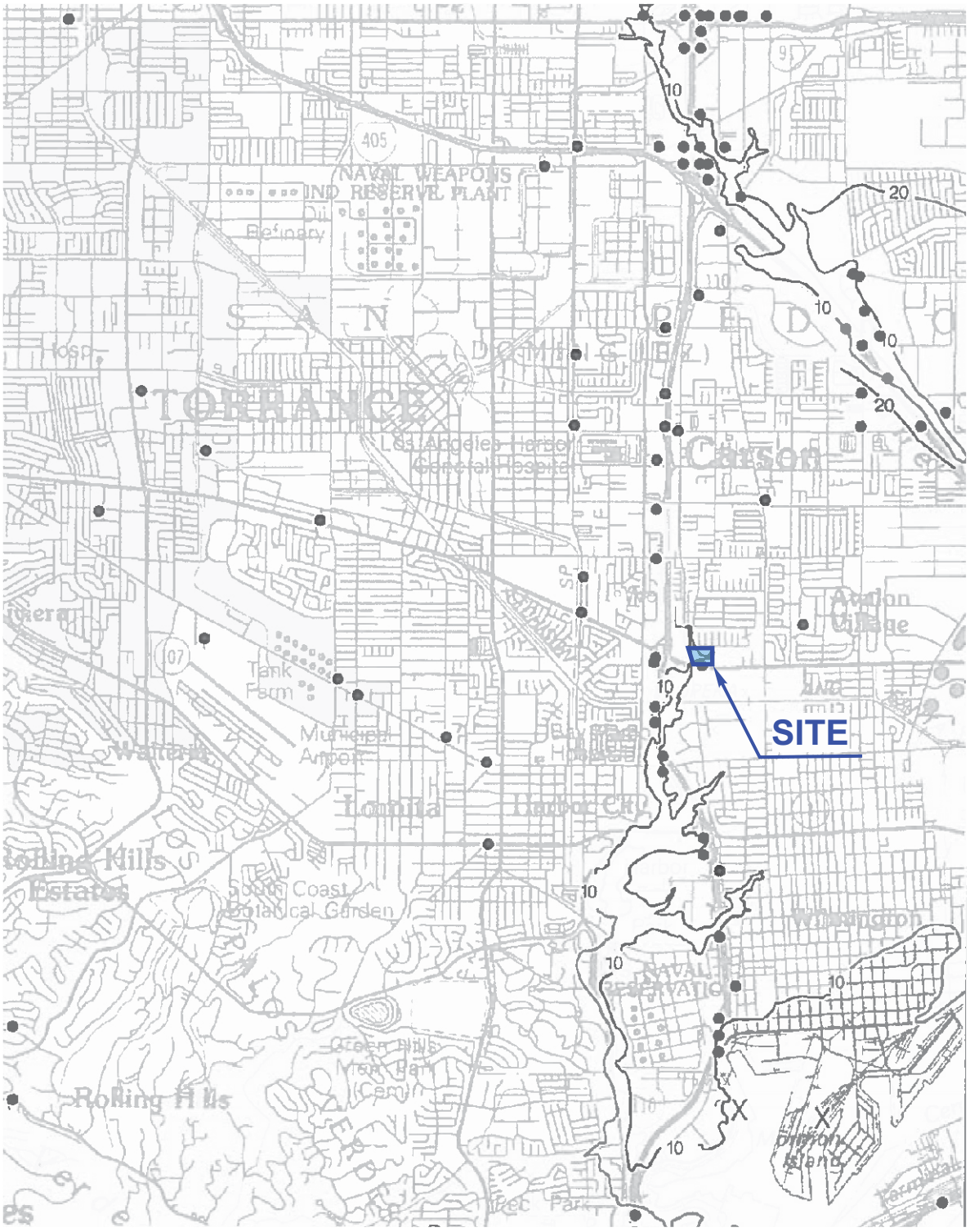
Project Name: Carriage Crest Park Water Capture - Carson

Project Number: TET 16-101E

DATE: October 2016

Geologic Map

Figure 3



Approx. Scale
1:24,000

Reference: Seismic Hazard Zone Report for the Torrance 7.5-Minute Quadrangle, Open-File Report 98-26, 1998

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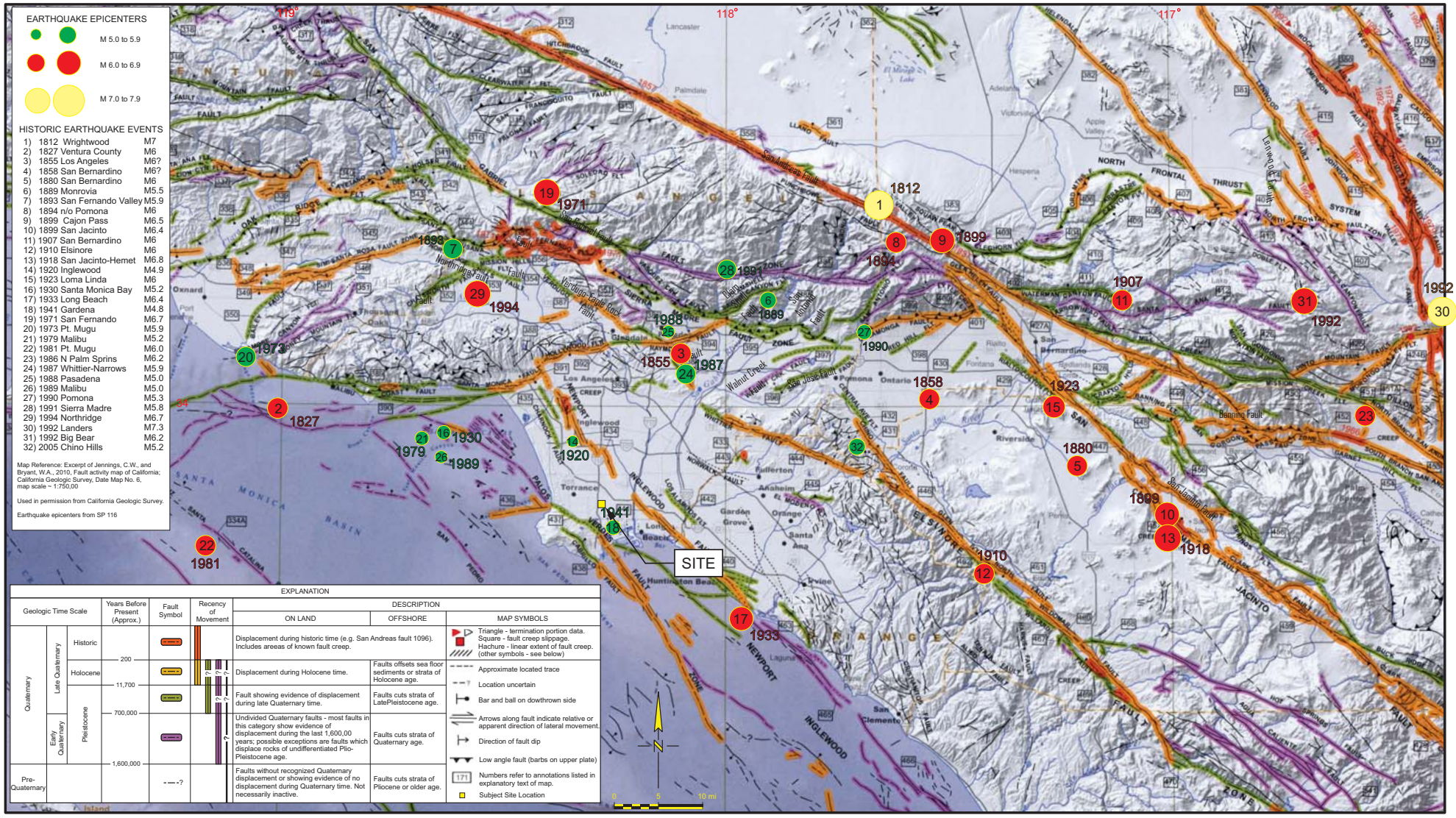
Historic High Groundwater

Carriage Crest Park Water Capture
Carson, California

JOB NO	TET 16-101E
DATE	October 2016
DRAWN BY	YLI
	Figure 4



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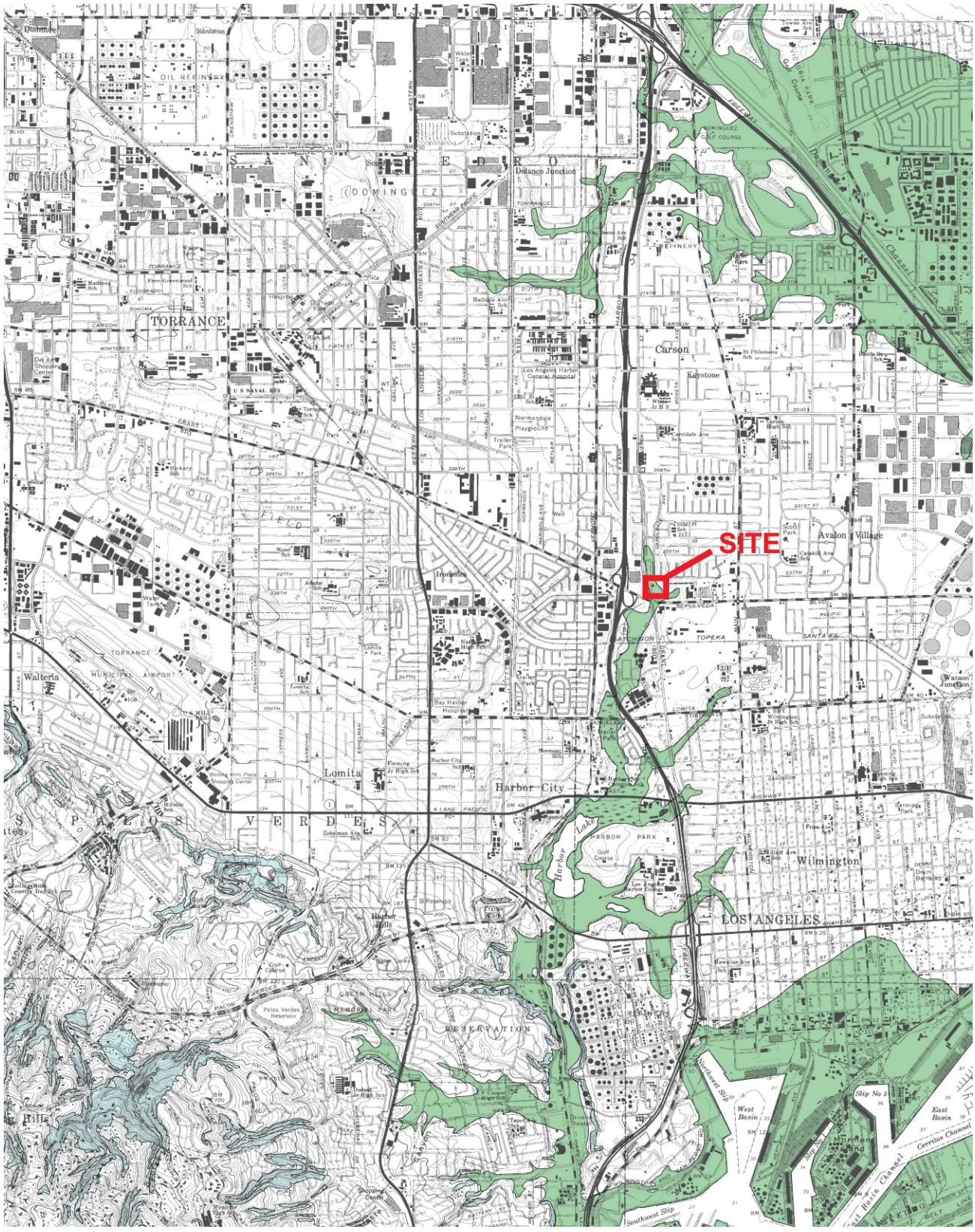
Regional Fault and Seismicity Map

Carriage Crest Park Water Capture
Carson, California

JOB NO	TET 16-101E
DATE	October 2016
DRAWN BY	YLI
	Figure 5



Reference: Torrance Quadrangle Map of Seismic Hazard Zones, dated March 25, 1999
Green areas indicate potential occurrences of liquefaction

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Seismic Hazard Zones Map

Project Name: Carriage Crest Park Water Capture - Carson

Project Number: TET 16-101E

DATE: October 2016

Figure 6

Appendix A

Logs of Exploratory Borings

Project: **Carriage Crest Park Water Capture**
Project Location: **Carson**
Project Number: **TET 16-101E**

Key to Log of Boring

Sheet 1 of 1

1 Elevation (feet)	2 Depth (feet)	3	4 Sample Number	5 Sampling Resistance	6 USCS Symbol	7 Graphic Log	8 MATERIAL DESCRIPTION	9 Water Content, %	10 Dry Unit Weight, pcf	11 REMARKS AND OTHER TESTS

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample Number: Sample identification number.
5. Sampling Resistance: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6. USCS Symbol: USCS symbol of the subsurface material.
7. Graphic Log: Graphic depiction of the subsurface material encountered.
8. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
9. Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.
10. Dry Unit Weight, pcf: Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.
11. REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

MATERIAL GRAPHIC SYMBOLS

- Asphaltic Concrete (AC)
- Crushed miscellaneous base material
- Fat CLAY, CLAY w/SAND, SANDY CLAY (CH)
- Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
- SILTY CLAY (CL-ML)
- SILT, SILT w/SAND, SANDY SILT (ML)
- Low plasticity PEAT (OL)
- Clayey SAND (SC)
- Silty SAND (SM)
- Poorly graded SAND (SP)
- Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Auger sampler
- Bulk Sample
- 2.5-inch-OD California w/ brass rings
- CME Sampler
- Grab Sample
- 3.0-inch-OD Modified California w/ brass liners
- Pitcher Sample
- 2-inch-OD unlined split spoon (SPT)
- Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)
- Water level (after waiting)
- Minor change in material properties within a stratum
- Inferred/gradational contact between strata
- Queried contact between strata

GENERAL NOTES

1: AD After drilling
2: ATD At time of drilling

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TETRA TECH

Figure A-1

Project: **Carriage Crest Park Water Capture**

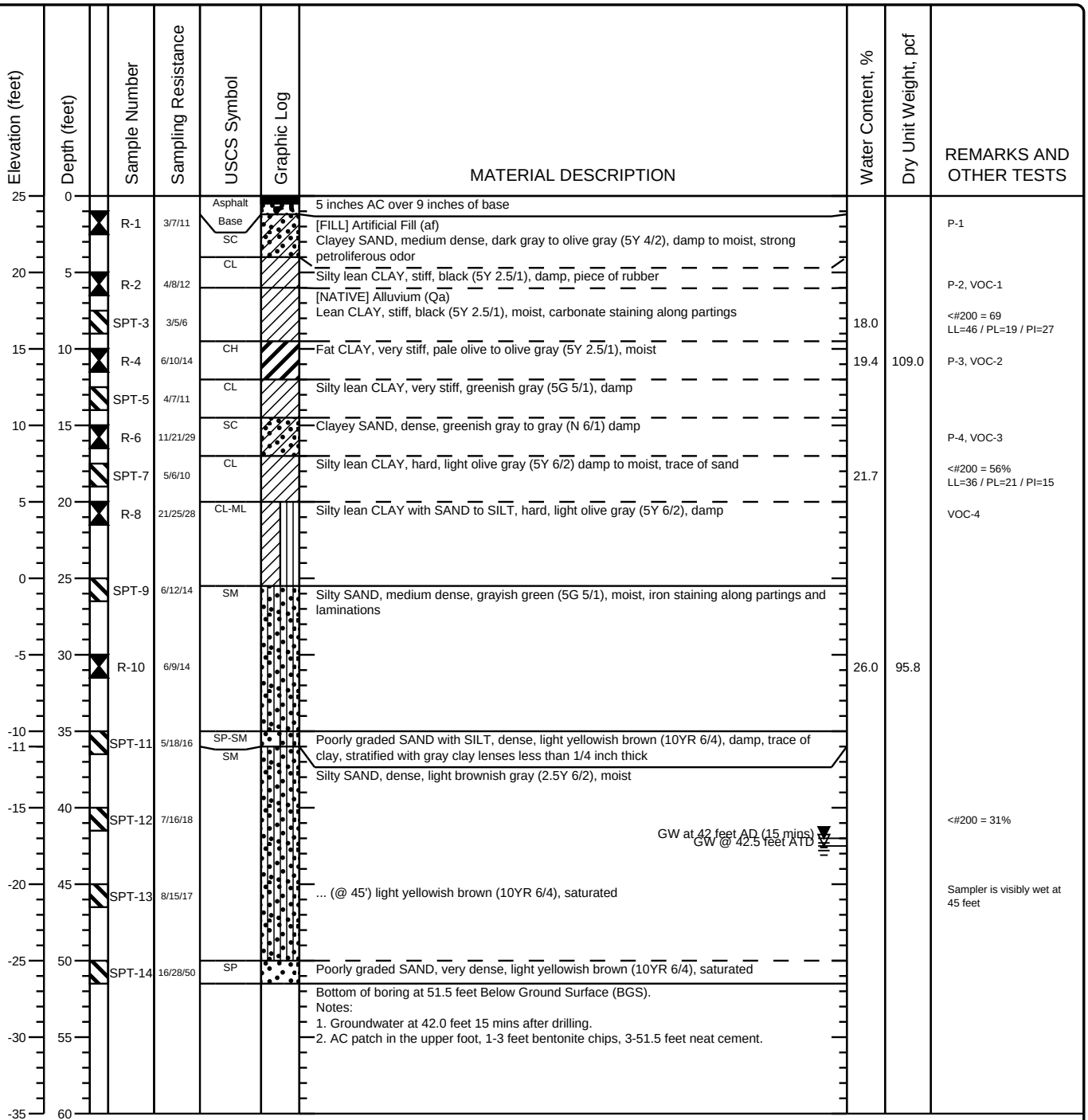
Project Location: **Carson**

Project Number: **TET 16-101E**

Log of Boring B-1

Sheet 1 of 1

Date(s) Drilled **9/27/2016**	Logged By **Andrew McLarty**	Checked By **Fernando Cuenca**
Drilling Method **HSA**	Drill Bit Size/Type **8-inch**	Total Depth of Borehole **51.5 feet bgs**
Drill Rig Type **CME 75**	Drilling Contractor **2R Drilling Inc.**	Approximate Surface Elevation **25.0 feet (Google Earth Pro)**
Groundwater Level and Date Measured **42.0 feet AD (15 mins)**	Sampling Method(s) **Modified California, SPT, Environmental**	Hammer Data **CME Auto-trip hammer 140 lbs with 30-inch drop**
Borehole Backfill **Neat-cement grout per LACDPH**	Location **Northern area of the parking lot. Lattitude: 33.80947 Longitude: -118.28471**	



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TETRA TECH

Project: **Carriage Crest Park Water Capture** Project Location: **Carson** Project Number: **TET 16-101E**	Log of Boring B-2 **Sheet 1 of 1**

Date(s) Drilled **9/27/2016**	Logged By **Andrew McLarty**	Checked By **Fernando Cuenca**
Drilling Method **HSA**	Drill Bit Size/Type **8-inch**	Total Depth of Borehole **31.5 feet bgs**
Drill Rig Type **CME 75**	Drilling Contractor **2R Drilling Inc.**	Approximate Surface Elevation **25.0 feet (GoogleEarth Pro)**
Groundwater Level and Date Measured **not encountered**	Sampling Method(s) **Bulk, Modified California, SPT, Environmental**	Hammer Data **CME Auto-trip hammer 140 lbs with a 30-inch drop**
Borehole Backfill **Neat-cement grout per LACDPH**	Location **Southern area of the parking lot. Lattitude: 33.80901 Longitude: -118.28451**	

Elevation (feet)	Depth (feet)	Sample Number	Sampling Resistance	USCS Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
25	0	SK-1A		Asphalt	4 inches of AC over 6 inches of base			
				Base				
		R-1B	4/6/7	SC	[FILL] Artificial Fill (af) Clayey SAND, medium dense, dark gray to black (5Y 2.5/1), damp to mosit, strong odor			P-1
20	5	R-2	8/9/11		[NATIVE] Alluvium (Qa) Fat CLAY, stiff, black (5Y 2.5/1) damp, strong odor			P-2, VOC-1
		SPT-3	4/7/8	CL	Silty lean CLAY, very stiff, gray to olive brown (5Y 4/2), moist			
15	10	R-4	6/10/13	CH	Fat CLAY, very stiff, black (5Y 2.5/1) damp, strong odor			P-3, VOC-2
		SPT-5	4/7/7	CL	Silty lean CLAY, stiff, greenish gray (5G 4/1), moist, caliche stringers and staining along partings			
10	15	R-6	10/15/23		... (@ 16ft) very stiff			P-4, VOC-3
		SPT-7	6/15/19	SP	Poorly graded SAND, dense, light olive gray (5Y 6/2), moist, trace of clay			
5	20	R-8	13/17/24	CL	Lean CLAY, hard, pale olive (5Y 6/4), damp, iron staining along partings, strong petroliferous			VOC-4
0	25	SPT-9	9/13/17	SM	Silty SAND, medium dense to dense, greenish gray (5G 5/1), moist			
-5	30	SPT-10	10/13/21		... (@ 30ft) dense			
					Bottom of boring at 31.5 feet BGS. Notes: 1. Groundwater not encountered. 2. Grass re-patched in upper 1 foot, 1-3 feet bentonite chips, 3-31.5 feet neat cement.			
-10	35							
-15	40							
-20	45							
-25	50							
-30	55							
-35	60							

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TETRA TECH

Project: **Carriage Crest Park Water Capture** Project Location: **Carson** Project Number: **TET 16-101E**	Log of Boring B-3 **Sheet 1 of 1**

Date(s) Drilled **9/28/2016**	Logged By **Andrew McLarty**	Checked By **Fernando Cuenca**
Drilling Method **HSA**	Drill Bit Size/Type **8-inch**	Total Depth of Borehole **51.5 feet bgs**
Drill Rig Type **CME 75**	Drilling Contractor **2R Drilling Inc.**	Approximate Surface Elevation **27.0 feet (Google Earth Pro)**
Groundwater Level and Date Measured **44.1 feet AD (15 mins)**	Sampling Method(s) **Bulk, Modified California, SPT, Environmental**	Hammer Data **CME Auto-trip hammer 140 lbs with a 30-inch drop**
Borehole Backfill **Neat-cement grout per LACDPH**	Location **Center of Field. Lattitude: 33.80851 Longitude: -118.28358**	

Elevation (feet)	Depth (feet)	Sample Number	Sampling Resistance	USCS Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
27	0	SK-1		SC	[FILL] Artificial Fill (af) Clayey SAND, medium dense, brown (10YR 4/3), damp, trace of red brick fragments	10.2	106.1	EI = 55 Res = 11600 ohm-cm pH = 7.1 SO4 = 0.0069% Cl = 0.0330%
		R-2	4/8/10			15.3	113.2	P-1
22	5	R-3	6/11/14	SM	[NATIVE] Alluvium (Qa) Silty SAND, medium dense, brown (10YR 5/3), damp			P-2, VOC-1 G / S / F = 2 / 56 / 42
		SPT-4	3/5/7	CL	Silty lean CLAY, stiff, dark gray (N 4/1) to brown (10YR 4/3), moist, carbonate staining along partings, stratified with dark brown clay	22.8		LL=48 / PL=23 / PI=25
17	10	R-5	5/9/10	CH	Fat CLAY with SAND, stiff, gray (N 6/1), moist	20.3	106.7	P-3, VOC-2 DS uu
		SPT-6	4/6/10	CL	Lean CLAY with SAND, stiff, light olive brown (5Y 6/2), moist, trace of carbonate stringers	21.4		LL=48 / PL=22 / PI=26
12	15	R-7	4/7/9			22.2	104.7	P-4, VOC-3 DS
		SPT-8	4/5/8					
7	20	R-9	8/17/23	SM	Silty SAND, dense, yellowish brown (10YR 5/6), moist	15.7	105.5	VOC-4 Consol
2	25	SPT-10	7/8/14	CL	Sandy lean CLAY, very stiff, gray (N 6/1), moist, a little silt	9.9	107.6	EI = 71
-3	30	SPT-11	13/18/23	SM	Silty SAND, very dense, olive brown (2.5Y 4/3), moist			
-8	35	SPT-12	10/21/29		... (@ 35ft) very dense silty fine SAND			G / S / F = 0 / 75 / 25
-13	40	SPT-13	9/10/13	SP-SM	Poorly-graded SAND with SILT, medium dense, light olive brown (5Y 6/2), moist to wet			
				ML	SILT to Sandy SILT, very stiff, pale olive (5Y 6/4), wet GW at 44.1 feet AD (15 mins)			
-18	45	SPT-14	5/6/13	SM	Silty SAND, medium dense, mottled dark brown (7.5YR 3/4) and gray (N 6/1), saturated			G / S / F = 0 / 40 / 60
				SP-SM	Poorly-graded SAND with SILT, very dense, light yellowish brown (10YR 6/4), saturated, trace of 1/4-inch stratified greenish brown (5G 5/1) clay layers			
-23	50	SPT-15	11/24/ 50/4"					<#200 = 10%
-28	55				Bottom of boring at 51.5 feet BGS. Notes: 1. Groundwater at 44.1 feet 15 mins after drilling. 2. Grass patch in the upper foot, 1-3 feet bentonite chips, 3-51.5 feet neat cement.			
-33	60							

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TETRA TECH

Project: **Carriage Crest Park Water Capture**

Project Location: **Carson**

Project Number: **TET 16-101E**

Log of Boring B-4

Sheet 1 of 1

Date(s) Drilled **9/28/2016**	Logged By **Andrew McLarty**	Checked By **Fernando Cuenca**
Drilling Method **HSA**	Drill Bit Size/Type **8-inch**	Total Depth of Borehole **31.5 feet bgs**
Drill Rig Type **CME 75**	Drilling Contractor **2R Drilling Inc.**	Approximate Surface Elevation **26.0 feet (GoogleEarth Pro)**
Groundwater Level and Date Measured **Not encountered**	Sampling Method(s) **Modified California, SPT, Environmental**	Hammer Data **CME Auto-trip hammer 140 lbs with a 30-inch drop**
Borehole Backfill **Neat-cement grout per LACDPH**	Location **SW portion of field. Lattitude: 33.80823 Longitude: -118.28423**	

Elevation (feet)	Depth (feet)	Sample Number	Sampling Resistance	USCS Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
26	0			ML	[FILL] Artificial Fill (af) Sandy SILT, very stiff, light yellowish brown (10YR 6/4), damp, rootlets			
		R-1	14/15/17			9.7	115.9	P-1
21	5			CL	[NATIVE] Alluvium (Qa) Sandy lean CLAY, very stiff, brown (10YR 4/3), damp			
		R-2	10/12/17			15.9	117.2	P-2, VOC-1 DS
		SPT-3	3/3/5	CH	Fat CLAY, firm, black (5Y 4/3), moist	28.9		LL=56 / PL=29 / PI=27
				OL	Organic lean CLAY, dark gray (N 4/1) to black (5Y 2.5/1), moist, 3-inch lens, visible organic material and organic odor			
16	10	R-4	10/13/17	CH	Fat CLAY with SAND, very stiff, dark gray (N 4/1) to black (5Y 2.5/1), moist, strong petroliferous odor	43.5	74.2	P-3, VOC-2 DS
		SPT-5	3/3/5		Fat CLAY, firm, dark gray (N 4/1), moist, porous, visible oil along partings and root casts, strong petroliferous odor	12.9	98.2	EI = 281
11	15	R-6	8/10/12		...very stiff, dark brown to black (5Y 2.5/1), not porous, no oil, no odor	20.0	100.3	P-4, VOC-3 DS uu Res = 1080 ohm-cm pH = 7.4 SO4 = 0.0496% Cl = 0.0213%
		SPT-7	4/6/8		Fat CLAY with SAND, very stiff, dark gray (N 4/1), moist, porous, visible oil along partings and root casts, strong petroliferous odor			
6	20	R-8	7/7/10	CL	... (@18.2 ft) interbedded with black silty sand, sands are saturated with oil Lean CLAY with SAND, stiff, greenish gray (5G 5/1), moist, visible oil within pores , strong petroliferous odor	22.7	106.4	VOC-4 Consol
1	25	SPT-9	8/10/25	SM	Silty SAND, dense, light olive gray (5Y 6/2), dry to damp, iron staining along laminations			
-4	30	SPT-10	10/15/23	SM	Silty SAND, dense, light olive gray (5Y 6/2), dry to damp, iron staining along laminations			
					Bottom of boring at 31.5 feet BGS. Notes: 1. Groundwater not encountered. 2. Grass re-patched in upper 1 foot, 1-3 feet bentonite chips, 3-31.5 feet neat cement.			
-9	35							
-14	40							
-19	45							
-24	50							
-29	55							
-34	60							

L:\02 - PROJECTS\2016 Projects\TET 16-101E (4552-0101) Carriage Crest Park Water Capture - Carson\03 Field & Lab\Boring Logs\Boring Logs B-1 thru B-5.bg4[60-65 with 2 lab Tt LOGO.tpl]

TETRA TECH

Project: **Carriage Crest Park Water Capture**

Project Location: **Carson**

Project Number: **TET 16-101E**

Log of Boring B-5

Sheet 1 of 1

Date(s) Drilled **9/28/2016**	Logged By **Andrew McLarty**	Checked By **Fernando Cuenca**
Drilling Method **HSA**	Drill Bit Size/Type **8-inch**	Total Depth of Borehole **31.5 feet bgs**
Drill Rig Type **CME 75**	Drilling Contractor **2R Drilling Inc.**	Approximate Surface Elevation **28.0 feet (Google Earth Pro)**
Groundwater Level and Date Measured **Not encountered**	Sampling Method(s) **Modified California, SPT, Environmental**	Hammer Data **CME Auto-trip hammer 140 lbs with a 30-inch drop**
Borehole Backfill **Neat-cement grout per LACDPH**	Location **NE portion of Field. Lattitude: 33.80891 Longitude: -118.28371**	

Elevation (feet)	Depth (feet)	Sample Number	Sampling Resistance	USCS Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
28	0			SM	[FILL] Artificial Fill (af) Silty SAND, medium dense, brown (10YR 4/3), dry to damp			
		R-1	9/15/16		... (@2.5 ft) mottled with fat CLAY, trace of gravel, visible fill bands	8.7	113.9	P-1
23	5	R-2	4/11/15	CL	Silty lean CLAY, very stiff, dark brown (7.5YR 3/4) to brown (7.5YR 5/4), moist, trace of sandy silt	15.8	109.5	P-2, VOC-1
		SPT-3	4/4/5		... (@8 ft) stiff, dark gray to black (5Y 2.5/1), trace of red brick fragments, organic odor			
18	10	R-4	6/8/11	OL	[NATIVE] Alluvium (Qa) Organic lean CLAY, stiff, dark brown to greenish gray (5G 5/1), moist, visible orgainc matter, possible marsh or quagmire?			P-3, VOC-2
		SPT-5	3/7/9	CL	Lean CLAY with SAND, very stiff, olive gray (5Y 6/2), moist, carbonate staining along laminations	19.7		LL=37 / PL=20 / PI=17 <#200 = 51%
13	15	R-6	11/25/30		Lean CLAY, hard, yellowish brown (10YR 6/4), damp, iron staining along partings	21.5	105.2	P-4, VOC-3
		SPT-7	5/11/25	ML SM	Sandy SILT, very stiff, olive gray (5Y 6/2), moist Silty SAND, dense, light yellowish brown (10YR 6/3), damp			G / S / F = 0 / 71 / 29
8	20	R-8	24/ 50/6"		... (@21 ft) very dense, moist	8.6	98.4	VOC-4
3	25	SPT-9	8/13/17		Silty fine SAND, medium dense, light yellowish brown (10YR 6/4), damp, iron staining along partings			<#200 = 42
-2	30	SPT-10	10/12/17		...medium dense to dense, gray (N 6/1), iron-stained nodules	NP		LL=NP / PL=NP / PI=NP
					Bottom of boring at 31.5 feet BGS. Notes: 1. Groundwater not encountered. 2. Grass re-patched in upper 1 foot, 1-3 feet bentonite chips, 3-31.5 feet neat cement.			
-7	35							
-12	40							
-17	45							
-22	50							
-27	55							
-32	60							

L:\02 - PROJECTS\2016 Projects\TET 16-101E (4552-0101) Carriage Crest Park Water Capture - Carson\03 Field & Lab\Boring Logs\Boring Logs B-1 thru B-5.bg4[60-65 with 2 lab Tt LOGO.tpl]

TETRA TECH

Appendix B

Logs of Cone Penetration Tests (CPTs)

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

Carriage Crest Park
23800 S. Figueroa Street
Carson, CA
September 27, 2016

Prepared for:

Mr. Fernando Cuenca
Tetra Tech BAS
1360 Valley Vista Drive
Diamond Bar, CA 91765
Office (909) 860-5096 / Fax (909) 860-5094

Prepared by:

KEHOE TESTING & ENGINEERING
5415 Industrial Drive
Huntington Beach, CA 92649-1518
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www.kehoetesting.com

TABLE OF CONTENTS

1. **INTRODUCTION**
2. **SUMMARY OF FIELD WORK**
3. **FIELD EQUIPMENT & PROCEDURES**
4. **CONE PENETRATION TEST DATA & INTERPRETATION**

APPENDIX

- CPT Plots
- CPT Classification/Soil Behavior Chart
- Interpretation Output (CPeT-IT)
- CPeT-IT Calculation Formulas

SUMMARY

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Carriage Crest Park project located at 23800 S. Figueroa Street in Carson, California. The work was performed by Kehoe Testing & Engineering (KTE) on September 27, 2016. The scope of work was performed as directed by Tetra Tech BAS personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at seven locations to determine the soil lithology. Groundwater measurements and hole collapse depths provided in **TABLE 2.1** are for information only. The readings indicate the apparent depth to which the hole is open and the apparent water level (if encountered) in the CPT probe hole at the time of measurement upon completion of the CPT. KTE does not warranty the accuracy of the measurements and the reported water levels may not represent the true or stabilized groundwater levels.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	50	Hole open to 38.6 ft (dry)
CPT-2	50	Hole open to 39.0 ft (dry)
CPT-3	50	Hole open to 39.0 ft (dry)
CPT-4	50	Hole open to 38.6 ft (dry)
CPT-5	50	Hole open to 23 ft (dry)
CPT-6	50	Hole open to 39.0 ft (dry)
CPT-7	50	Hole open to 20.0 ft (dry)

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil classification on the CPT plots is derived from the attached CPT Classification Chart (Robertson) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

Tables of basic CPT output from the interpretation program CPeT-IT are provided for CPT data averaged over one foot intervals in the Appendix. Spreadsheet files of the averaged basic CPT output and averaged estimated geotechnical parameters are also included for use in further geotechnical analysis. We recommend a geotechnical engineer review the assumed input parameters and the calculated output from the CPeT-IT program. A summary of the equations used for the tabulated parameters is provided in the Appendix.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

KEHOE TESTING & ENGINEERING

Richard W. Koester, Jr.
General Manager

10/06/16-ms-7525-1

APPENDIX

Kehoe Testing and Engineering
714-901-7270
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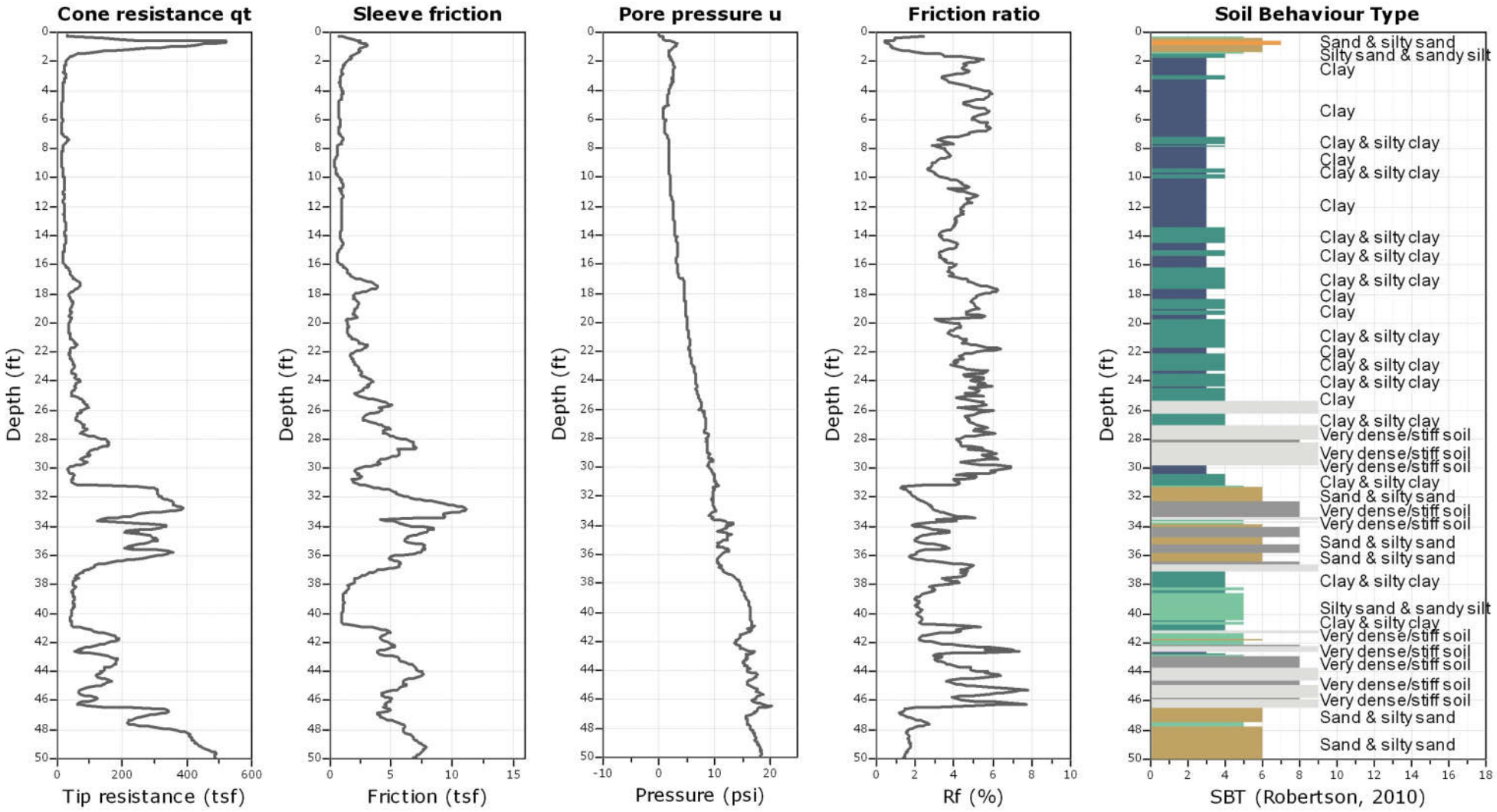
www.kehoetesting.com

CPT: CPT-1

Project: **Tetra Tech BAS/Carriage Crest Park**
Location: **23800 S. Figueroa St Carson, CA**

Total depth: 50.33 ft, Date: 9/27/2016
Cone Type: Vertek



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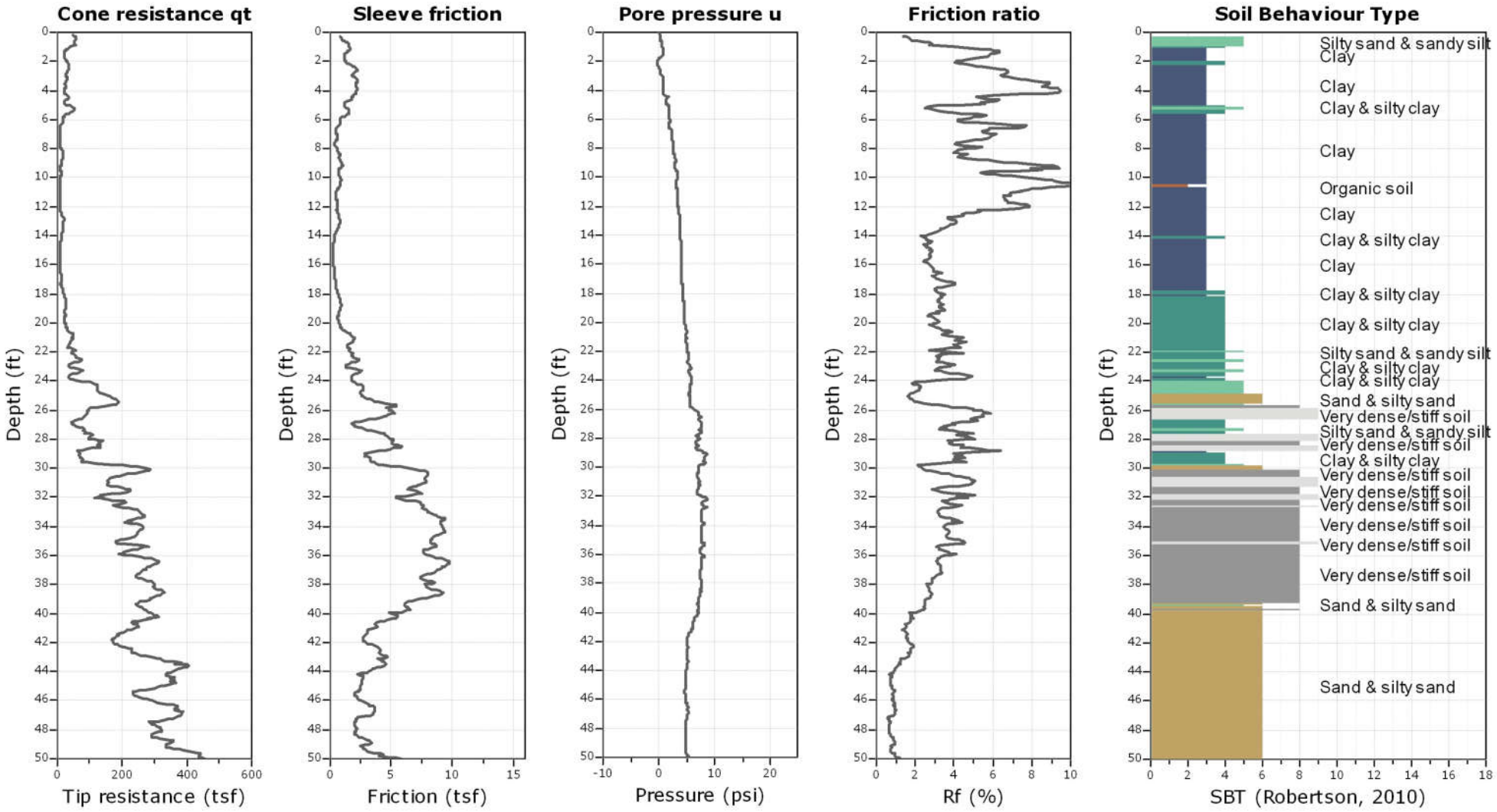
CPT: CPT-2

Project: **Tetra Tech BAS/Carriage Crest Park**
Location: **23800 S. Figueroa St Carson, CA**

Total depth: 50.48 ft, Date: 9/27/2016
Cone Type: Vertek



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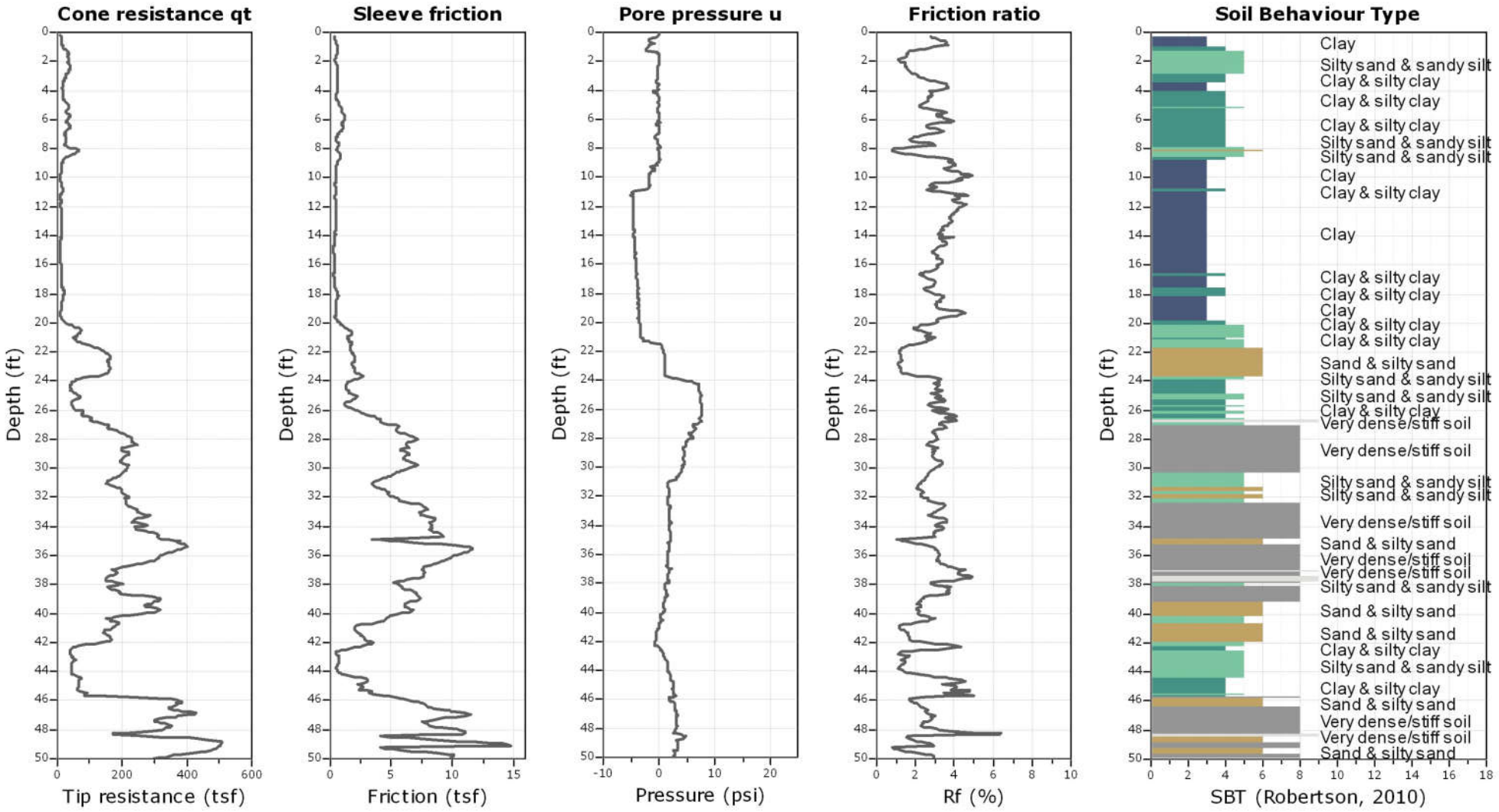
CPT: CPT-3

Project: **Tetra Tech BAS/Carriage Crest Park**
Location: **23800 S. Figueroa St Carson, CA**

Total depth: 50.27 ft, Date: 9/27/2016
Cone Type: Vertek



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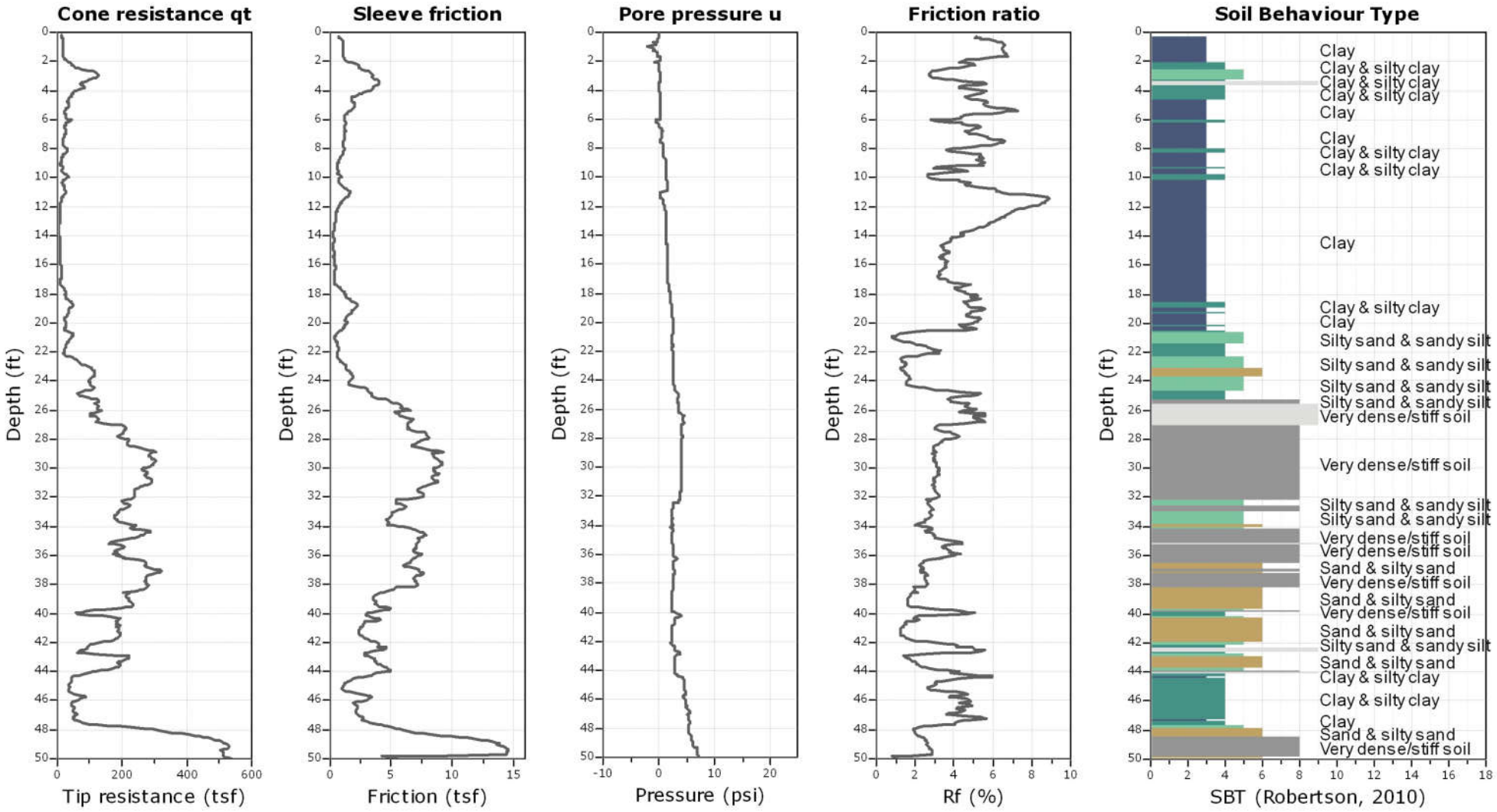
CPT: CPT-4

Project: **Tetra Tech BAS/Carriage Crest Park**
Location: **23800 S. Figueroa St Carson, CA**

Total depth: 50.27 ft, Date: 9/27/2016
Cone Type: Vertek



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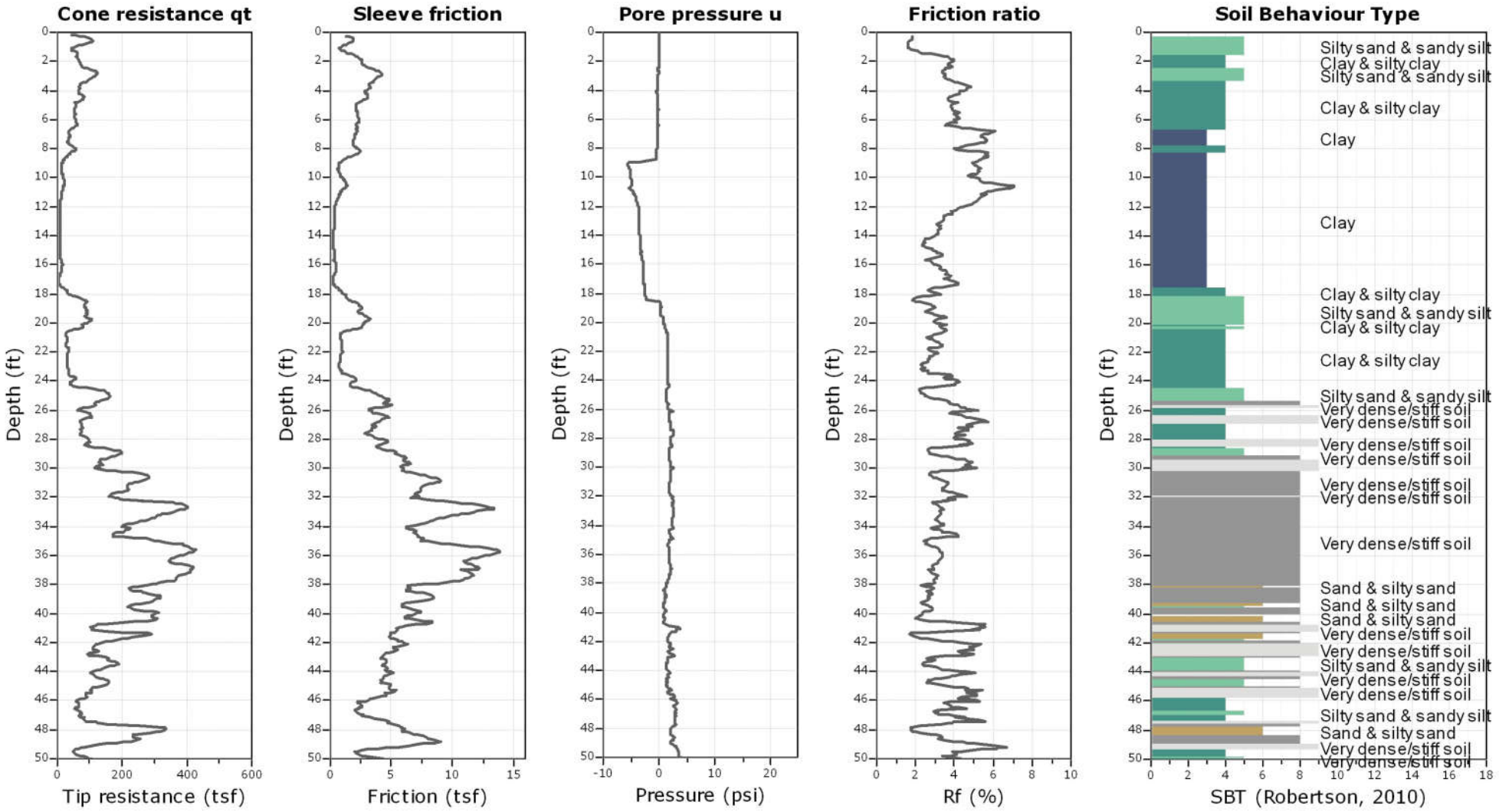
CPT: CPT-5

Project: **Tetra Tech BAS/Carriage Crest Park**
Total depth: 50.42 ft, Date: 9/27/2016

Location: **23800 S. Figueroa St Carson, CA**
Cone Type: Vertek



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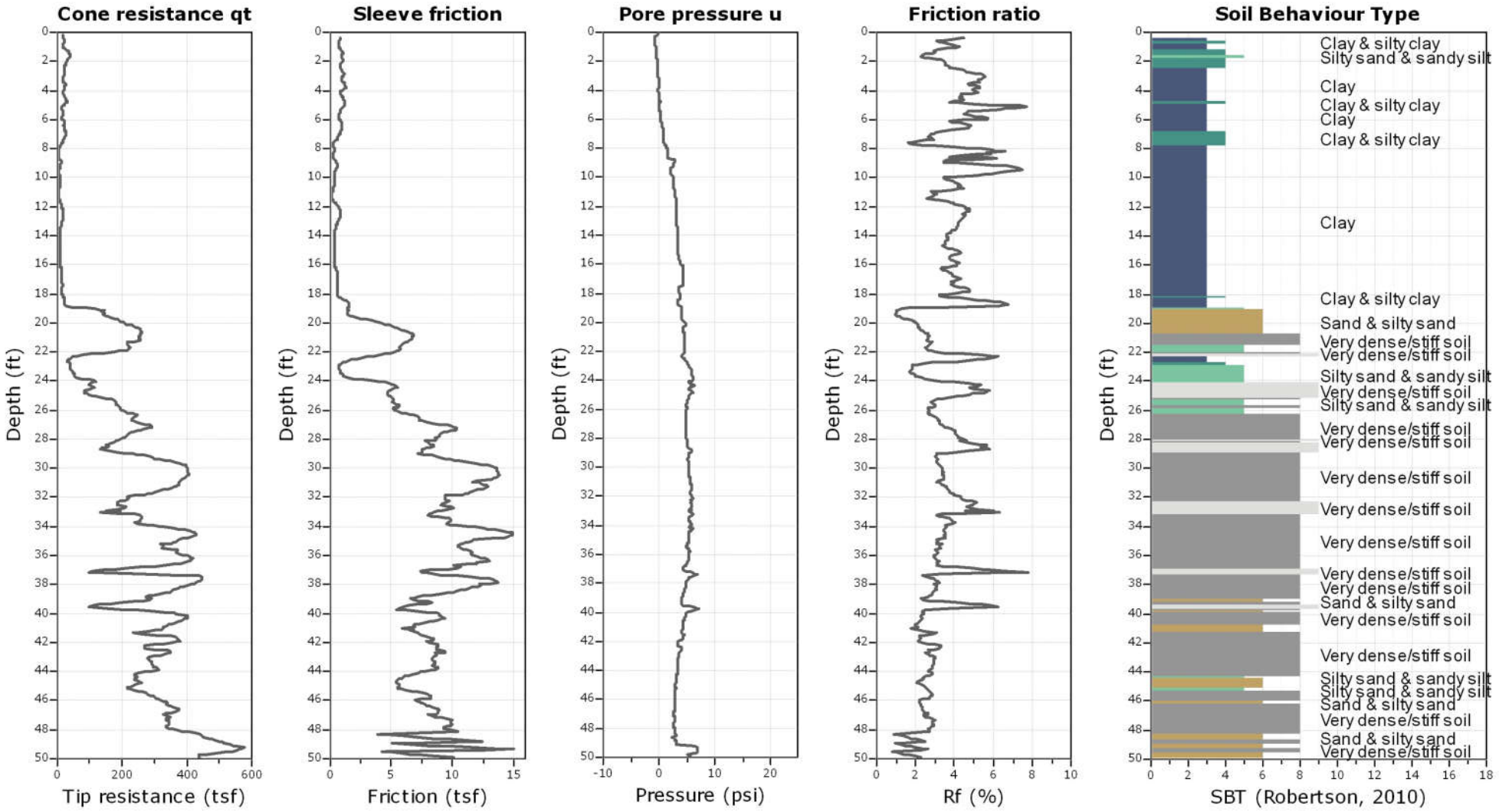
CPT: CPT-6

Project: **Tetra Tech BAS/Carriage Crest Park**
Location: **23800 S. Figueroa St Carson, CA**

Total depth: 50.27 ft, Date: 9/27/2016
Cone Type: Vertek



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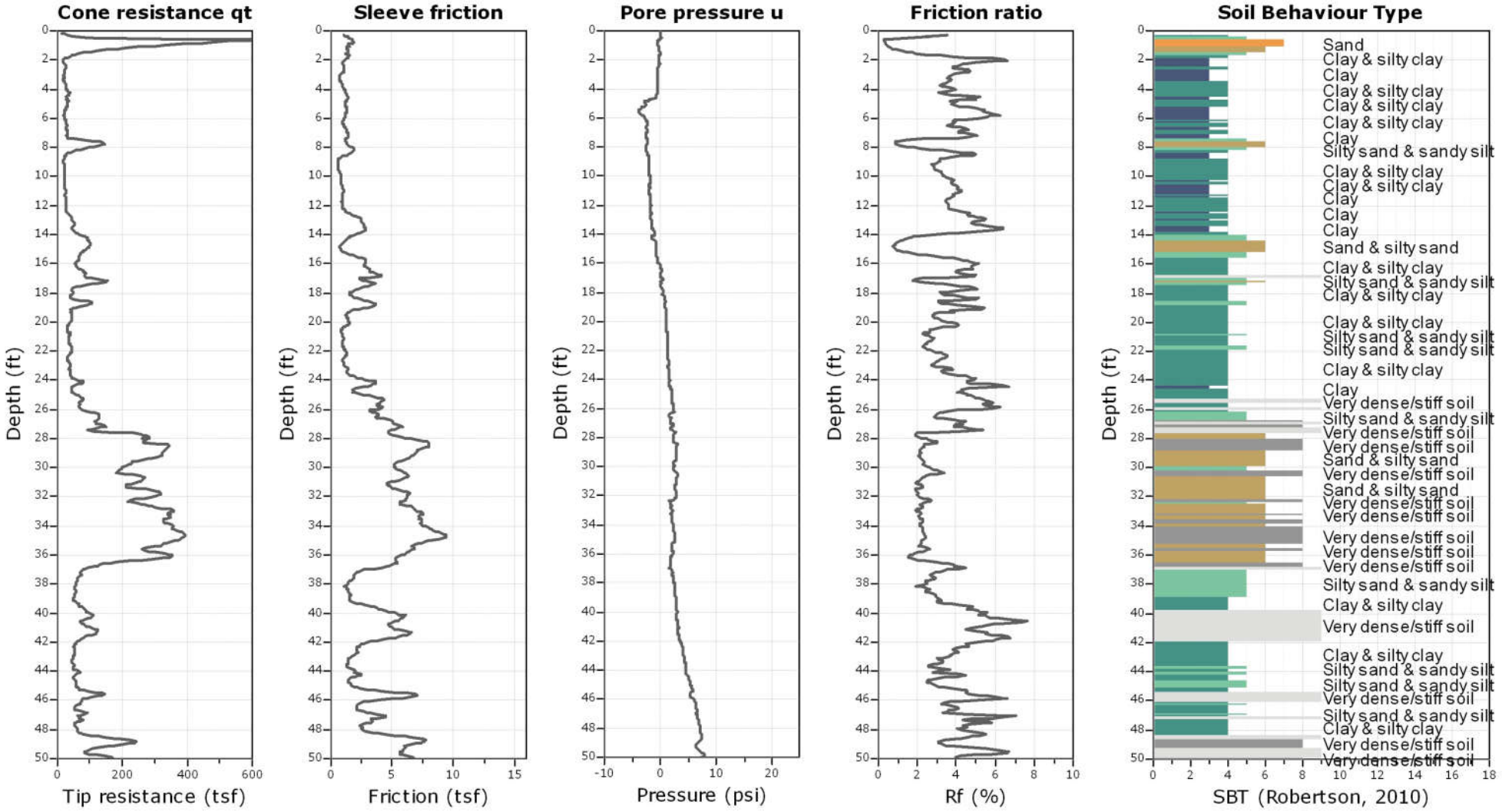
CPT: CPT-7

Project: **Tetra Tech BAS/Carriage Crest Park**
Location: **23800 S. Figueroa St Carson, CA**

Total depth: 50.33 ft, Date: 9/27/2016
Cone Type: Vertek



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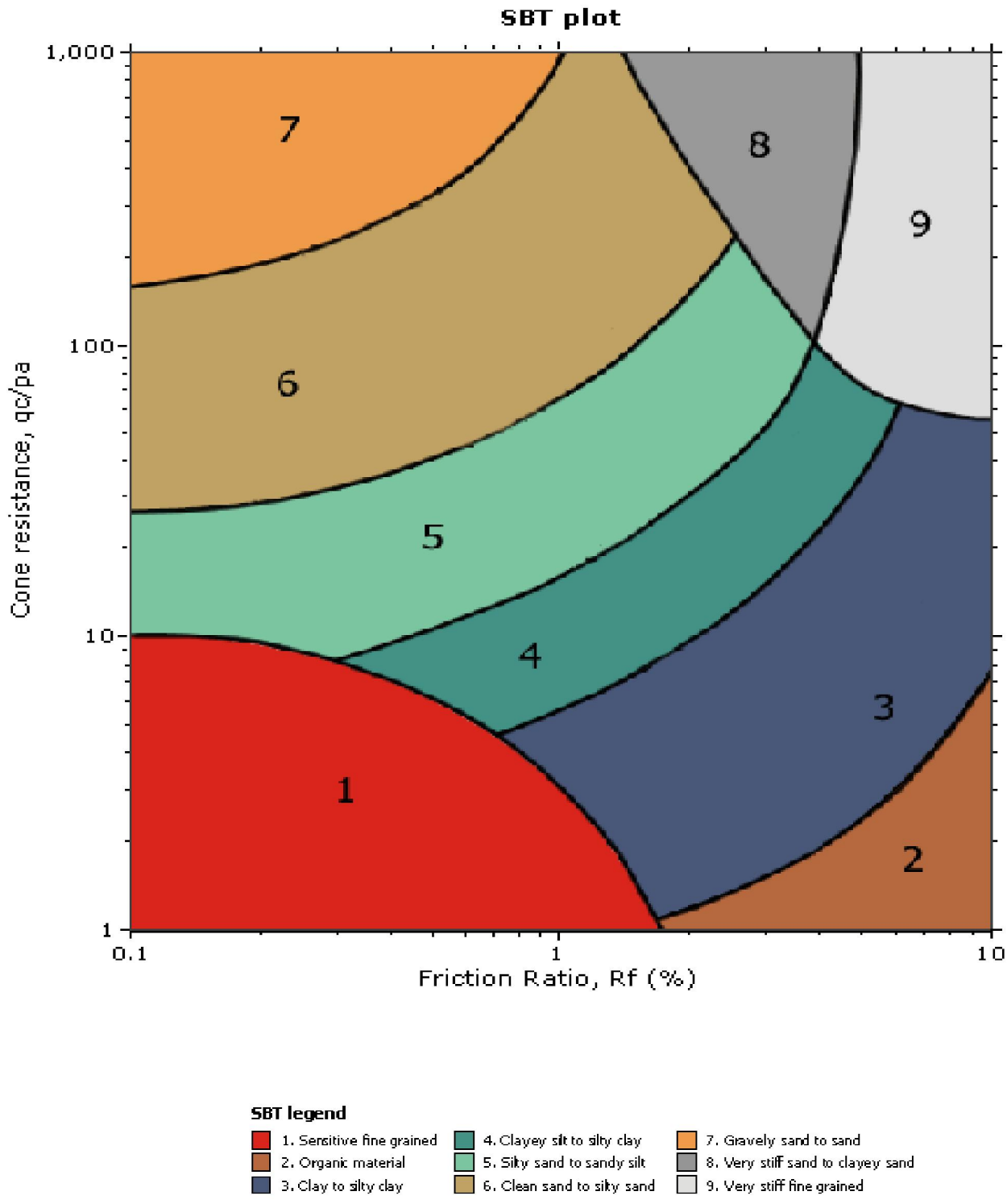


	CPT-1	In situ data						Basic output data												
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	352.1	2.79	2.88	1.08	352.135	0.7923	6	1.46639	132.0812	0.06604	0	0.066	5331.1	0.7925	0.0006	7	0.3269	2.4765	1.2486	824.0258
2	26.1	1.37	2.42	0.79	26.1296	5.2431	3	2.84211	120.5334	0.12631	0	0.1263	205.87	5.2686	0.0067	9	0.763	5.0617	2.3794	124.3932
3	26	0.92	2.53	0.82	26.031	3.5343	4	2.72934	117.6107	0.18511	0	0.1851	139.62	3.5596	0.0071	5	0.7475	3.6806	2.3317	89.90307
4	17.8	0.98	1.93	0.86	17.8236	5.4983	3	2.97925	117.1491	0.24369	0	0.2437	72.141	5.5745	0.0079	4	0.8526	3.497	2.603	58.10107
5	14	0.66	1.65	0.87	14.0202	4.7075	3	3.01574	113.6712	0.30052	0	0.3005	45.653	4.8106	0.0087	4	0.8815	3.033	2.6712	39.32664
6	15.8	0.78	1.17	0.91	15.8143	4.9322	3	2.98814	115.1872	0.35812	0	0.3581	43.16	5.0465	0.0055	4	0.8927	2.6305	2.6931	38.42494
7	15.5	0.73	1.29	0.99	15.5158	4.7049	3	2.98145	114.656	0.41544	0	0.4154	36.347	4.8343	0.0062	3	0.9072	2.3353	2.7236	33.32672
8	15.8	0.56	1.91	1	15.8234	3.5391	3	2.89777	112.7641	0.47183	0	0.4718	32.536	3.6478	0.009	4	0.8916	2.0545	2.6755	29.80783
9	12.3	0.35	1.81	1.04	12.3222	2.8404	3	2.92894	108.7151	0.52618	0	0.5262	22.418	2.9671	0.0111	4	0.9165	1.897	2.732	21.14789
10	20.6	0.71	2.1	1.1	20.6257	3.4423	4	2.7999	115.1471	0.58376	0	0.5838	34.333	3.5426	0.0075	4	0.8854	1.6931	2.6434	32.06994
11	19.8	0.9	2.22	1.11	19.8272	4.5392	3	2.88982	116.7859	0.64215	0	0.6422	29.876	4.6912	0.0083	3	0.932	1.5927	2.7595	28.8782
12	20.8	0.93	2.58	1.2	20.8316	4.4644	3	2.86882	117.1463	0.70072	0	0.7007	28.729	4.6198	0.0092	3	0.9367	1.4711	2.7649	27.98873
13	23.8	0.99	2.74	1.21	23.8335	4.1538	3	2.80411	117.9321	0.75969	0	0.7597	30.373	4.2906	0.0086	4	0.9242	1.3583	2.725	29.61983
14	24.2	0.8	2.96	1.22	24.2362	3.3008	4	2.73408	116.4138	0.8179	0	0.8179	28.632	3.4161	0.0091	4	0.9089	1.2637	2.6775	27.96823
15	21.4	0.75	3.34	1.26	21.4409	3.498	4	2.79121	115.6427	0.87572	0	0.8757	23.484	3.6469	0.0117	4	0.9419	1.1951	2.7572	23.22708
16	21.8	0.89	3.34	1.32	21.8409	4.0749	3	2.82745	116.94	0.93419	0	0.9342	22.38	4.257	0.0115	3	0.9665	1.1279	2.8146	22.28638
17	52.1	2.4	4.36	1.33	52.1534	4.6018	4	2.58921	126.3214	0.99735	0	0.9974	51.292	4.6915	0.0061	4	0.8822	1.0536	2.5856	50.93604
18	37.8	2.14	4.67	1.37	37.8572	5.6528	3	2.74997	124.7011	1.0597	0	1.0597	34.724	5.8156	0.0091	3	0.9546	0.9986	2.7678	34.72681
19	39.7	2.11	4.96	1.45	39.7607	5.3068	3	2.71545	124.7174	1.12206	0	1.1221	34.436	5.4609	0.0092	3	0.9508	0.9457	2.75	34.53515
20	35.1	1.44	5.15	1.51	35.163	4.0952	4	2.67463	121.6223	1.18287	0	1.1829	28.727	4.2378	0.0109	4	0.9457	0.9	2.7292	28.90124
21	40	1.71	5.53	1.59	40.0677	4.2678	4	2.64611	123.1982	1.24447	0	1.2445	31.197	4.4046	0.0103	4	0.9426	0.8582	2.7134	31.4884
22	37.6	1.95	5.72	1.68	37.67	5.1765	3	2.7242	124.0087	1.30647	0	1.3065	27.833	5.3625	0.0113	3	0.9823	0.8129	2.81	27.9372
23	54.2	2.33	6.1	1.81	54.2747	4.293	4	2.5554	126.2021	1.36957	0	1.3696	38.629	4.4041	0.0083	4	0.9219	0.7883	2.6433	39.4153
24	68.9	3.49	6.82	1.84	68.9835	5.0592	4	2.53845	129.7433	1.43445	0	1.4345	47.091	5.1666	0.0073	4	0.9208	0.7556	2.6323	48.23946
25	42.8	2.3	7.19	1.84	42.888	5.3628	3	2.6959	125.5329	1.49721	0	1.4972	27.645	5.5568	0.0125	3	0.9967	0.7075	2.8236	27.67708
26	73.9	4.19	7.36	1.91	73.9901	5.6629	9	2.5563	131.2517	1.56284	0	1.5628	46.343	5.7851	0.0073	3	0.9427	0.6924	2.6738	47.39149
27	78.9	4.04	8.58	1.99	79.005	5.1136	9	2.504	131.1449	1.62841	0	1.6284	47.517	5.2212	0.008	4	0.9296	0.6698	2.6312	48.98103
28	146.4	6.09	8.72	2.18	146.507	4.1568	8	2.26857	135.654	1.69624	0	1.6962	85.372	4.2055	0.0043	9	0.8374	0.6735	2.3803	92.17947
29	93.1	5.68	9.05	2.22	93.2108	6.0937	9	2.519	134.0411	1.76326	0	1.7633	51.863	6.2112	0.0071	3	0.9482	0.6162	2.6633	53.25329
30	34.8	2.39	9.16	2.11	34.9121	6.8458	3	2.83431	125.312	1.82591	0	1.8259	18.12	7.2236	0.0199	3	1	0.5795	3.0354	18.12036
31	45.6	1.95	10.3	1.99	45.7261	4.2645	4	2.60517	124.4813	1.88815	0	1.8882	23.217	4.4482	0.0169	3	1	0.5604	2.8138	23.21734
32	320.8	6.52	9.86	1.93	320.921	2.0317	6	1.81954	137.28	1.95679	0	1.9568	163	2.0441	0.0022	6	0.6769	0.6596	1.9274	198.826
33	326.9	10.64	10.32	2.01	327.026	3.2536	8	1.99032	137.28	2.02543	0	2.0254	160.46	3.2738	0.0023	8	0.7481	0.6152	2.106	188.9677
34	334	6.85	12.72	2.01	334.156	2.0499	6	1.81336	137.28	2.09407	0	2.0941	158.57	2.0629	0.0028	6	0.6858	0.6262	1.9337	196.509
35	301.8	6.09	12.11	1.95	301.948	2.0169	6	1.83141	137.28	2.16271	0	2.1627	138.62	2.0315	0.0029	6	0.7009	0.6059	1.9647	171.6639
36	317.7	5.69	11.4	2.03	317.84	1.7902	6	1.77599	137.0459	2.23124	0	2.2312	141.45	1.8029	0.0026	6	0.6845	0.6001	1.9131	178.9943
37	93.9	4.03	11.25	2.03	94.0377	4.2855	9	2.39667	131.5516	2.29701	0	2.297	39.939	4.3928	0.0088	4	0.9605	0.475	2.6291	41.18042
38	46.7	1.75	14.59	2.01	46.8786	3.7331	4	2.55673	123.7503	2.35889	0	2.3589	18.873	3.9308	0.0236	3	1	0.4486	2.8472	18.87317
39	52.8	1.07	15.74	2.01	52.9927	2.0192	5	2.3367	120.4496	2.41911	0	2.4191	20.906	2.1157	0.0224	4	0.9701	0.4484	2.6389	21.42991
40	44.6	0.95	16.5	2.09	44.802	2.1204	5	2.40602	119.1697	2.4787	0	2.4787	17.075	2.2446	0.0281	4	1	0.4269	2.7341	17.0748
41	77	3.67	17.12	2.09	77.2096	4.7533	4	2.48608	130.386	2.54389	0	2.5439	29.351	4.9152	0.0165	3	1	0.4159	2.7683	29.35097
42	157.6	4.75	13.87	2.01	157.77	3.0107	5	2.13692	134.0164	2.6109	0	2.6109	59.427	3.0614	0.0064	5	0.8772	0.4528	2.3718	66.40054
43	162.7	5.46	15.91	1.97	162.895	3.3519	8	2.1659	135.1137	2.67846	0	2.6785	59.817	3.4079	0.0072	4	0.8939	0.436	2.4073	66.01459
44	136.9	7.41	15.93	2.02	137.095	5.405	9	2.37829	136.9276	2.74692	0	2.7469	48.909	5.5155	0.0085	4	0.988	0.3896	2.6459	49.47128
45	125.9	6.17	16.09	2.05	126.097	4.8931	9	2.36416	135.3836	2.81461	0	2.8146	43.801	5.0048	0.0094	4	0.993	0.3785	2.6489	44.1013
46	100.8	4.97	16.93	2.18	101.007	4.9204	9	2.42413	133.26	2.88124	0	2.8812	34.057	5.0649	0.0124	3	1	0.3672	2.7311	34.05684
47	285.6	3.96	16.93	2.28	285.807	1.3856	6	1.71243	134.1346	2.94831	0	2.9483	95.939	1.4	0.0043	6	0.7258	0.4753	1.9319	127.0663
48	352.6	6.02	16.59	2.34	352.803	1.7063	6	1.73358	137.28	3.01695	0	3.017	115.94	1.7211	0.0034	6	0.7325	0.4642	1.9412	153.4442
49	429.8	7.38	17.8	2.33	430.018	1.7162	6	1.69032	137.28	3.08559	0	3.0856	138.36	1.7286	0.003	6	0.7147	0.4654	1.8858	187.7803
50	487.9	0	18.22	2.3	488.123	0	0	0	120.9	3.14604	0	3.146	154.15	0	0.0027	0	1	0.3363	0	0

	CPT-2	In situ data						Basic output data											
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	40.5	1.57	0.57	-0.06	40.507	3.8759	4	2.61361	122.5998	0.0613	0	0.0613	659.8	3.8818	0.001	8	0.6561	6.4808	2.1049	247.7252
2	30.5	1.26	-0.29	0.15	30.4965	4.1316	4	2.7226	120.2979	0.12145	0	0.1215	250.11	4.1482	-7E-04	8	0.7215	4.768	2.2708	136.8736
3	28.2	1.81	0.63	-0.02	28.2077	6.4167	3	2.87899	122.758	0.18283	0	0.1828	153.29	6.4586	0.0016	9	0.8045	4.106	2.4853	108.7501
4	23	2.17	0.67	0.03	23.0082	9.4314	3	3.06012	123.5884	0.24462	0	0.2446	93.056	9.5328	0.0021	9	0.8909	3.6866	2.7025	79.31152
5	26.9	1.2	1.68	0.04	26.9206	4.4576	3	2.78486	119.6368	0.30444	0	0.3044	87.426	4.5086	0.0045	4	0.8104	2.7444	2.4843	69.03394
6	19.3	0.82	2.1	0.02	19.3257	4.2431	3	2.8794	116.0422	0.36246	0	0.3625	52.318	4.3242	0.008	4	0.8567	2.5037	2.598	44.8705
7	8.2	0.49	2.39	0	8.22925	5.9544	3	3.2606	110.1924	0.41756	0	0.4176	18.708	6.2727	0.022	3	1	2.534	2.9835	18.70806
8	11.3	0.55	2.58	0.01	11.3316	4.8537	3	3.09643	111.8179	0.47347	0	0.4735	22.933	5.0653	0.0171	3	0.9643	2.1715	2.8648	22.28326
9	13.1	0.95	2.96	0.08	13.1362	7.2319	3	3.15736	116.1774	0.53156	0	0.5316	23.713	7.5369	0.0169	3	1	1.9906	2.9643	23.71282
10	10.7	0.83	3.38	0.04	10.7414	7.7271	3	3.24229	114.6984	0.5889	0	0.5889	17.24	8.1754	0.024	3	1	1.7967	3.088	17.23958
11	6.6	0.48	3.44	0.04	6.64211	7.2266	3	3.38567	109.519	0.64366	0	0.6437	9.3192	8.0021	0.0413	3	1	1.6439	3.2804	9.31921
12	7.7	0.62	3.53	0.06	7.74321	8.007	3	3.3613	111.7658	0.69955	0	0.6996	10.069	8.8022	0.0361	3	1	1.5126	3.282	10.06889
13	19.9	0.81	3.92	0.06	19.948	4.0606	3	2.85659	116.0297	0.75756	0	0.7576	25.332	4.2209	0.0147	3	0.9438	1.3707	2.7765	24.86016
14	13.5	0.34	3.92	0.06	13.548	2.5096	4	2.86448	108.7343	0.81193	0	0.8119	15.686	2.6696	0.0222	4	0.9597	1.2894	2.8116	15.51942
15	9	0.25	4.01	0.18	9.04908	2.7627	3	3.03333	105.5001	0.86468	0	0.8647	9.4653	3.0546	0.0353	3	1	1.2237	3.021	9.46525
16	10.1	0.28	4.11	0.26	10.1503	2.7585	3	2.99136	106.6095	0.91798	0	0.918	10.057	3.0328	0.0321	3	1	1.1526	2.9975	10.05717
17	13	0.41	4.2	0.27	13.0514	3.1414	3	2.93386	110.0131	0.97299	0	0.973	12.414	3.3945	0.025	3	1	1.0875	2.9515	12.41371
18	19.6	0.65	4.39	0.23	19.6537	3.3073	4	2.80545	114.3833	1.03018	0	1.0302	18.078	3.4902	0.017	3	0.9767	1.0265	2.8294	18.06665
19	25.6	0.86	4.68	0.33	25.6573	3.3519	4	2.7193	117.0819	1.08872	0	1.0887	22.566	3.5004	0.0137	4	0.9511	0.9732	2.7549	22.59793
20	24.8	0.74	4.78	0.35	24.8585	2.9769	4	2.69719	115.9052	1.14668	0	1.1467	20.679	3.1208	0.0145	4	0.9527	0.9263	2.752	20.75755
21	45.3	1.93	5.06	0.41	45.3619	4.2547	4	2.60691	124.3864	1.20887	0	1.2089	36.524	4.3712	0.0083	4	0.9211	0.8845	2.6613	36.91012
22	44.8	1.71	5.16	0.37	44.8632	3.8116	4	2.57669	123.4739	1.27061	0	1.2706	34.308	3.9227	0.0085	4	0.9186	0.8453	2.647	34.82342
23	35.7	1.28	5.67	0.37	35.7694	3.5785	4	2.62936	120.8022	1.33101	0	1.331	25.874	3.7168	0.0119	4	0.9505	0.8041	2.7233	26.16947
24	70.7	1.85	6.02	0.38	70.7737	2.614	5	2.3207	125.1615	1.39359	0	1.3936	49.785	2.6665	0.0063	5	0.8321	0.7952	2.4045	52.14081
25	157	2.58	5.62	0.37	157.069	1.6426	6	1.93564	129.5396	1.45836	0	1.4584	106.7	1.658	0.0026	6	0.6834	0.8031	2.0065	118.1103
26	96.5	4.87	6.41	0.44	96.5785	5.0425	9	2.44451	133.0019	1.52486	0	1.5249	62.336	5.1234	0.0049	4	0.8915	0.722	2.5441	64.85692
27	46.9	1.91	7.74	0.52	46.9947	4.0643	4	2.58198	124.3964	1.58706	0	1.5871	28.611	4.2063	0.0123	4	0.9635	0.6767	2.7255	29.03797
28	106.7	5.09	7.41	0.56	106.791	4.7663	9	2.39838	133.5704	1.65384	0	1.6538	63.571	4.8413	0.0051	4	0.8873	0.6728	2.5169	66.85233
29	71.2	2.92	8.41	0.64	71.3029	4.0952	4	2.45998	128.5192	1.7181	0	1.7181	40.501	4.1963	0.0087	4	0.9255	0.6385	2.609	41.99133
30	272.3	6.42	7.16	0.73	272.388	2.3569	6	1.91253	137.28	1.78674	0	1.7867	151.45	2.3725	0.0019	5	0.7	0.693	2.0091	177.2299
31	157.2	7.72	7.26	0.84	157.289	4.9082	9	2.30997	137.28	1.85538	0	1.8554	83.774	4.9668	0.0034	9	0.8687	0.6139	2.4426	90.18486
32	125.6	5.45	7.79	0.76	125.695	4.3359	9	2.32279	134.4679	1.92262	0	1.9226	64.377	4.4032	0.0045	4	0.885	0.5895	2.477	68.95281
33	253.8	8.03	7.74	0.68	253.895	3.1627	8	2.03628	137.28	1.99126	0	1.9913	126.5	3.1877	0.0022	5	0.7676	0.6155	2.1613	146.5303
34	264.4	9.22	7.84	0.71	264.496	3.4859	8	2.06281	137.28	2.0599	0	2.0599	127.4	3.5132	0.0022	8	0.7833	0.5935	2.1939	147.1906
35	187.7	8.27	7.64	0.73	187.794	4.4038	9	2.22807	137.28	2.12854	0	2.1285	87.227	4.4543	0.003	9	0.8612	0.5477	2.3883	96.11189
36	216.4	8.02	7.72	0.71	216.494	3.7045	8	2.13144	137.28	2.19718	0	2.1972	97.533	3.7425	0.0026	8	0.8268	0.5466	2.291	110.6954
37	267.3	8.91	7.64	0.77	267.394	3.3322	8	2.04362	137.28	2.26582	0	2.2658	117.01	3.3606	0.0021	8	0.7944	0.5461	2.1975	136.8428
38	301.9	7.75	7.74	0.81	301.995	2.5663	8	1.91935	137.28	2.33446	0	2.3345	128.36	2.5863	0.0019	5	0.7498	0.5525	2.0719	156.465
39	286.9	7.44	7.35	0.85	286.99	2.5924	8	1.93486	137.28	2.4031	0	2.4031	118.43	2.6143	0.0019	5	0.7631	0.5347	2.0983	143.8221
40	291.5	4.97	7.1	0.75	291.587	1.7045	6	1.77975	135.8457	2.47102	0	2.471	117	1.719	0.0018	6	0.7091	0.548	1.9478	149.7431
41	240.7	3.86	6.15	0.77	240.775	1.6032	6	1.80808	133.5293	2.53778	0	2.5378	93.876	1.6202	0.0019	6	0.7313	0.5274	1.9977	118.7532
42	172.4	2.91	5.16	0.89	172.463	1.6873	6	1.91743	130.6483	2.60311	0	2.6031	65.253	1.7132	0.0022	5	0.7893	0.4914	2.142	78.87831
43	292.7	4.66	5.25	0.93	292.764	1.5917	6	1.75457	135.3843	2.6708	0	2.6708	108.62	1.6064	0.0013	6	0.7169	0.5149	1.9432	141.1717
44	354.4	3.11	5.06	0.93	354.462	0.8774	6	1.49865	132.8918	2.73724	0	2.7372	128.5	0.8842	0.001	6	0.6185	0.5555	1.6762	184.6618
45	326.3	2.5	4.91	0.93	326.36	0.766	6	1.47695	131.0928	2.80279	0	2.8028	115.44	0.7727	0.0011	6	0.6184	0.5475	1.6675	167.4215
46	292.9	2.49	4.87	0.87	292.96	0.85	6	1.54185	130.8001	2.86819	0	2.8682	101.14	0.8584	0.0012	6	0.6525	0.5217	1.749	143.027
47	381.4	3.33	5.25	0.81	381.464	0.873	6	1.47703	133.5709	2.93498	0	2.935	128.97	0.8797	0.001	6	0.6245	0.5288	1.6671	189.1854
48	319.1	2.17	4.87	0.71	319.16	0.6799	6	1.44526	130.0025	2.99998	0	3	105.39	0.6864	0.0011	6	0.624	0.5219	1.6575	155.9344
49	335.5	3.03	5.06	0.64	335.562	0.903	6	1.52338	132.5674	3.06626	0	3.0663	108.44	0.9113	0.0011	6	0.6578	0.4966	1.7383	156.0562
50	452.5	5.7	5.43	0.75	452.566	1.2595	6	1.56415	137.28	3.1349	0	3.1349	143.36	1.2683	0.0009	6	0.6684	0.4839	1.7578	205.5284

	CPT-3	In situ data						Basic output data											
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	18	0.56	-1.69	-0.38	17.9793	3.1147	4	2.81998	113.0756	0.05654	0	0.0565	317.01	3.1245	-0.007	5	0.6872	7.4866	2.1929	126.8111
2	33.7	0.4	0	-0.38	33.7	1.1869	5	2.35462	112.146	0.11261	0	0.1126	298.26	1.1909	0	6	0.5847	3.706	1.9073	117.6385
3	26.9	0.56	-0.1	-0.41	26.8988	2.0819	4	2.57492	114.0582	0.16964	0	0.1696	157.56	2.0951	-3E-04	5	0.6844	3.5004	2.1671	88.42455
4	17.1	0.55	-0.06	-0.41	17.0993	3.2165	3	2.84578	112.8214	0.22605	0	0.2261	74.644	3.2596	-3E-04	4	0.7937	3.4044	2.4526	54.28872
5	32.7	0.73	0	-0.44	32.7	2.2324	4	2.52614	116.4743	0.28429	0	0.2843	114.02	2.252	0	5	0.711	2.5458	2.2278	77.99326
6	30.2	1.13	-0.01	-0.41	30.1999	3.7417	4	2.69693	119.4773	0.34403	0	0.344	86.784	3.7849	-2E-05	4	0.7913	2.4329	2.4292	68.64625
7	23.4	0.62	-0.08	-0.35	23.399	2.6497	4	2.68647	114.463	0.40126	0	0.4013	57.314	2.6959	-3E-04	5	0.7982	2.1683	2.4399	47.12792
8	53.6	0.53	-0.12	-0.31	53.5985	0.9888	5	2.14315	115.3369	0.45893	0	0.4589	115.79	0.9974	-2E-04	6	0.6206	1.6794	1.9671	84.34135
9	14.6	0.57	-0.16	-0.33	14.598	3.9046	3	2.95158	112.697	0.51527	0	0.5153	27.331	4.0475	-8E-04	4	0.9234	1.9433	2.7516	25.86423
10	9.6	0.44	-1.63	-0.39	9.58005	4.5929	3	3.13978	109.7756	0.57016	0	0.5702	15.802	4.8835	-0.013	3	1	1.8558	2.9668	15.80231
11	14.9	0.51	-4.69	-0.41	14.8426	3.4361	3	2.91207	111.9237	0.62612	0	0.6261	22.706	3.5874	-0.024	4	0.9358	1.6339	2.7714	21.95312
12	10.7	0.47	-4.58	-0.31	10.6439	4.4157	3	3.09296	110.5151	0.68138	0	0.6814	14.621	4.7177	-0.033	3	1	1.5529	2.9832	14.6211
13	12.4	0.48	-4.68	-0.29	12.3427	3.8889	3	3.0084	111.0303	0.7369	0	0.7369	15.75	4.1359	-0.029	3	0.9981	1.4349	2.9223	15.73885
14	12.3	0.41	-4.58	-0.36	12.2439	3.3486	3	2.97259	109.8573	0.79183	0	0.7918	14.463	3.5801	-0.029	3	0.997	1.3351	2.9126	14.4504
15	8.9	0.26	-4.4	-0.41	8.84614	2.9391	3	3.05635	105.7318	0.84469	0	0.8447	9.4726	3.2494	-0.04	3	1	1.2527	3.0359	9.47263
16	11.9	0.38	-4.11	-0.44	11.8497	3.2068	3	2.97317	109.2215	0.8993	0	0.8993	12.177	3.4702	-0.027	3	1	1.1766	2.9639	12.17654
17	11.5	0.32	-3.96	-0.52	11.4515	2.7944	3	2.9511	107.8807	0.95324	0	0.9532	11.013	3.0481	-0.027	3	1	1.11	2.9664	11.01323
18	20.1	0.61	-3.63	-0.56	20.0556	3.0416	4	2.77609	113.9679	1.01023	0	1.0102	18.853	3.2029	-0.014	4	0.9616	1.0455	2.7924	18.81907
19	13.8	0.44	-3.58	-0.52	13.7562	3.1986	3	2.91999	110.6581	1.06556	0	1.0656	11.91	3.4671	-0.02	3	1	0.993	2.9714	11.90986
20	26	0.8	-3.44	-0.58	25.9579	3.0819	4	2.69213	116.5812	1.12385	0	1.1239	22.097	3.2214	-0.01	4	0.9464	0.9446	2.7384	22.16884
21	49.7	1.47	-3.15	-0.64	49.6614	2.96	4	2.46883	122.6152	1.18515	0	1.1852	40.903	3.0324	-0.005	4	0.8642	0.9067	2.5148	41.53777
22	144.6	1.74	0.86	-0.68	144.611	1.2032	6	1.86315	126.4558	1.24838	0	1.2484	114.84	1.2137	0.0004	6	0.6335	0.9005	1.9013	122.0128
23	160.9	1.9	1.15	-0.69	160.914	1.1808	6	1.82441	127.36	1.31206	0	1.3121	121.64	1.1905	0.0005	6	0.6251	0.8742	1.8711	131.8576
24	51.6	1.65	4.71	-0.73	51.6577	3.1941	4	2.47926	123.5565	1.37384	0	1.3738	36.601	3.2814	0.0067	4	0.8941	0.7918	2.5696	37.62765
25	66.1	2.2	7.62	-0.68	66.1933	3.3236	4	2.41548	126.2662	1.43697	0	1.437	45.064	3.3974	0.0085	4	0.8747	0.7651	2.5109	46.82574
26	60.5	2.08	7.73	-0.65	60.5946	3.4327	4	2.45225	125.6402	1.49979	0	1.4998	39.402	3.5198	0.0094	4	0.8981	0.731	2.5645	40.82759
27	152.3	5.02	6.85	-0.64	152.384	3.2943	8	2.17718	134.3362	1.56696	0	1.567	96.248	3.3285	0.0033	5	0.7881	0.7338	2.267	104.5975
28	228.5	7.16	5.89	-0.64	228.572	3.1325	8	2.05758	137.28	1.6356	0	1.6356	138.75	3.1551	0.0019	8	0.7437	0.7233	2.1428	155.1324
29	220.3	6.43	4.58	-0.65	220.356	2.918	8	2.04089	137.0471	1.70413	0	1.7041	128.31	2.9408	0.0015	5	0.7445	0.7013	2.1364	144.9211
30	214.8	6.56	4.28	-0.82	214.852	3.0533	8	2.06334	137.1319	1.77269	0	1.7727	120.2	3.0787	0.0015	5	0.7602	0.6755	2.1689	136.0367
31	152.5	3.48	1.89	-0.94	152.523	2.2816	5	2.05185	131.6575	1.83852	0	1.8385	81.96	2.3095	0.0009	5	0.7682	0.6542	2.1817	93.15963
32	222.2	5.25	1.81	-0.86	222.222	2.3625	6	1.96371	135.5842	1.90631	0	1.9063	115.57	2.3829	0.0006	5	0.7343	0.6491	2.0843	135.1428
33	246.8	7.44	1.83	-0.93	246.822	3.0143	8	2.02533	137.28	1.97495	0	1.975	123.98	3.0386	0.0005	5	0.7624	0.6214	2.1497	143.791
34	263.7	8.19	2.01	-1.02	263.725	3.1055	8	2.02078	137.28	2.04359	0	2.0436	128.05	3.1298	0.0006	5	0.7657	0.6041	2.1498	149.401
35	367.4	5.02	2.2	-1.08	367.427	1.3663	6	1.64353	136.4828	2.11183	0	2.1118	172.98	1.3742	0.0004	6	0.6201	0.6515	1.759	224.9169
36	319.5	10.28	1.69	-1.02	319.521	3.2173	8	1.99108	137.28	2.18047	0	2.1805	145.54	3.2394	0.0004	8	0.7625	0.5762	2.1245	172.7987
37	169	7.57	2.29	-0.97	169.028	4.4786	9	2.2595	137.28	2.24911	0	2.2491	74.153	4.5389	0.001	9	0.8876	0.5121	2.4426	80.71439
38	195.6	5.47	1.35	-0.97	195.617	2.7963	5	2.05548	135.5735	2.3169	0	2.3169	83.43	2.8298	0.0005	5	0.8114	0.5294	2.2357	96.72018
39	316.1	7.39	1.05	-0.93	316.113	2.3378	8	1.87449	137.28	2.38554	0	2.3855	131.51	2.3556	0.0002	5	0.7359	0.5498	2.029	163.0054
40	268.7	5.75	0.73	-0.85	268.709	2.1399	6	1.88108	136.7131	2.4539	0	2.4539	108.5	2.1596	0.0002	5	0.7487	0.5327	2.054	134.0419
41	169	1.96	0	-0.9	169	1.1598	6	1.80388	127.7071	2.51775	0	2.5178	66.123	1.1773	0	6	0.7381	0.5274	2.018	82.9742
42	138.4	3.56	-0.65	-0.95	138.392	2.5724	5	2.1189	131.5867	2.58354	0	2.5835	52.567	2.6213	-3E-04	5	0.8717	0.4593	2.3608	58.94707
43	46.1	0.74	0.76	-0.73	46.1093	1.6049	5	2.32024	117.412	2.64225	0	2.6423	16.451	1.7024	0.0013	4	0.9961	0.4019	2.6793	16.50896
44	43.9	0.62	1.72	-0.64	43.9211	1.4116	5	2.30337	115.9988	2.70025	0	2.7003	15.266	1.5041	0.003	4	0.9985	0.3924	2.6789	15.28744
45	65	2.76	2.58	-0.86	65.0316	4.2441	4	2.49829	127.8823	2.76419	0	2.7642	22.526	4.4325	0.003	3	1	0.3828	2.8227	22.52645
46	378.8	6.75	2.01	-0.95	378.825	1.7818	6	1.73282	137.28	2.83283	0	2.8328	132.73	1.7953	0.0004	6	0.7144	0.4948	1.9166	175.837
47	405.7	11.47	3.17	-0.95	405.739	2.8269	8	1.89177	137.28	2.90147	0	2.9015	138.84	2.8473	0.0006	5	0.779	0.4557	2.0781	173.504
48	328.1	10.43	3.25	-0.92	328.14	3.1785	8	1.98077	137.28	2.97011	0	2.9701	109.48	3.2076	0.0007	5	0.8261	0.4263	2.1931	131.006
49	506.7	14.32	3.44	-0.87	506.742	2.8259	8	1.84837	137.28	3.03875	0	3.0388	165.76	2.8429	0.0005	8	0.7661	0.4457	2.027	212.1528
50	299.6	0	2.67	-0.87	299.633	0	0	0	120.9	3.0992	0	3.0992	95.681	0	0.0007	0	1	0.3414	0	0

	CPT-4	In situ data						Basic output data												
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	16.6	1.08	-1.81	-0.39	16.5779	6.5147	3	3.05162	117.6834	0.05884	0	0.0588	280.74	6.5379	-0.008	9	0.775	9.3857	2.4174	146.528
2	32.2	1.41	-0.07	-0.22	32.1991	4.379	4	2.72243	121.2535	0.11947	0	0.1195	268.52	4.3953	-2E-04	9	0.7226	4.836	2.2739	146.6173
3	126.3	3.47	0.38	-0.21	126.305	2.7473	5	2.16627	131.1764	0.18506	0	0.1851	681.52	2.7514	0.0002	8	0.5861	2.7784	1.9122	331.1653
4	61.1	3.34	0.19	-0.07	61.1023	5.4662	4	2.59835	129.1259	0.24962	0	0.2496	243.78	5.4887	0.0002	9	0.7453	2.9341	2.3204	168.7419
5	36.3	2.04	0.38	-0.1	36.3047	5.6191	3	2.76082	124.2488	0.31174	0	0.3117	115.46	5.6678	0.0008	9	0.8106	2.6929	2.4837	91.60389
6	34.7	1.2	0.09	-0.18	34.7011	3.4581	4	2.62914	120.256	0.37187	0	0.3719	92.315	3.4956	0.0002	5	0.7761	2.2513	2.3855	73.04172
7	23.3	1.17	0.57	-0.15	23.307	5.02	3	2.8659	119.1	0.43142	0	0.4314	53.024	5.1146	0.0018	4	0.874	2.1905	2.6346	47.35685
8	29.7	1.18	0.76	-0.19	29.7093	3.9718	4	2.71951	119.7542	0.4913	0	0.4913	59.471	4.0386	0.0019	4	0.8368	1.9002	2.5294	52.47211
9	11.1	0.61	1.34	-0.12	11.1164	5.4874	3	3.13601	112.5287	0.54756	0	0.5476	19.302	5.7717	0.0091	3	0.9995	1.9317	2.9492	19.29499
10	30	0.8	1.34	-0.02	30.0164	2.6652	4	2.60335	116.9355	0.60603	0	0.606	48.529	2.7201	0.0033	4	0.818	1.5776	2.4657	43.84825
11	25.6	1.65	0.85	0.05	25.6104	6.4427	3	2.91015	121.8452	0.66695	0	0.667	37.399	6.615	0.0025	3	0.946	1.5475	2.7936	36.47892
12	8.7	0.68	1.05	0.06	8.71285	7.8046	3	3.31464	112.7294	0.72332	0	0.7233	11.046	8.5111	0.0095	3	1	1.4629	3.2422	11.04567
13	6.9	0.41	1.24	0.12	6.91518	5.929	3	3.31957	108.4639	0.77755	0	0.7776	7.8935	6.6801	0.0146	3	1	1.3608	3.2864	7.89354
14	6.5	0.29	1.34	0.17	6.5164	4.4503	3	3.26743	105.7853	0.83044	0	0.8304	6.8469	5.1003	0.017	3	1	1.2742	3.2644	6.8469
15	8.3	0.3	1.53	0.16	8.31873	3.6063	3	3.12824	106.6289	0.88376	0	0.8838	8.4129	4.035	0.0148	3	1	1.1973	3.1323	8.41291
16	11.4	0.41	1.62	0.16	11.4198	3.5903	3	3.01486	109.6874	0.9386	0	0.9386	11.167	3.9118	0.0111	3	1	1.1273	3.0251	11.16686
17	10.6	0.37	1.72	0.18	10.6211	3.4837	3	3.03275	108.7594	0.99298	0	0.993	9.6961	3.8429	0.0129	3	1	1.0656	3.0699	9.69613
18	24.7	1.18	2.1	0.29	24.7257	4.7724	3	2.83214	119.3064	1.05263	0	1.0526	22.489	4.9846	0.0064	3	0.9883	1.0051	2.8572	22.488
19	37.5	2.04	2.29	0.34	37.528	5.4359	3	2.74047	124.3296	1.1148	0	1.1148	32.664	5.6024	0.0045	3	0.9597	0.9512	2.7743	32.73231
20	27.6	1.39	2.48	0.39	27.6304	5.0307	3	2.81213	120.7757	1.17519	0	1.1752	22.511	5.2542	0.0068	3	0.9999	0.9004	2.8722	22.5118
21	44.6	0.36	2.39	0.52	44.6293	0.8067	5	2.16174	112.0602	1.23122	0	1.2312	35.248	0.8295	0.004	5	0.7545	0.892	2.2209	36.58417
22	21.2	0.63	2.48	0.6	21.2304	2.9675	4	2.75001	114.3428	1.28839	0	1.2884	15.478	3.1592	0.009	3	0.999	0.8214	2.8559	15.48125
23	94.1	1.31	2.58	0.68	94.1316	1.3917	5	2.04256	123.3316	1.35005	0	1.3501	68.724	1.4119	0.002	5	0.7174	0.8396	2.1085	73.62318
24	98.9	1.58	2.67	0.73	98.9327	1.5971	5	2.06722	124.8242	1.41247	0	1.4125	69.043	1.6202	0.002	5	0.7338	0.809	2.1437	74.56002
25	69.4	3.33	3.73	0.81	69.4457	4.7951	4	2.51894	129.4162	1.47717	0	1.4772	46.013	4.8993	0.004	4	0.9187	0.736	2.6214	47.27805
26	130.5	6.62	3.63	0.85	130.544	5.0711	9	2.36791	135.9833	1.54517	0	1.5452	83.486	5.1318	0.002	9	0.8606	0.7219	2.4603	88.01124
27	178.1	6.34	4.36	0.92	178.153	3.5587	8	2.16434	136.4254	1.61338	0	1.6134	109.42	3.5913	0.0018	8	0.7861	0.7178	2.2557	119.7575
28	215.3	7.86	4.11	1.02	215.35	3.6499	8	2.12728	137.28	1.68202	0	1.682	127.03	3.6786	0.0014	8	0.7762	0.6978	2.2212	140.9149
29	289.7	8.37	4.2	1.1	289.751	2.8887	8	1.97252	137.28	1.75066	0	1.7507	164.51	2.9062	0.0011	8	0.7187	0.6964	2.0628	189.543
30	266	8.55	4.12	1.14	266.05	3.2137	8	2.03138	137.28	1.8193	0	1.8193	145.24	3.2358	0.0011	8	0.7489	0.6664	2.1336	166.4094
31	289.4	8.66	4.2	1.2	289.451	2.9919	8	1.98575	137.28	1.88794	0	1.8879	152.32	3.0115	0.0011	8	0.7363	0.6529	2.092	177.4395
32	235.8	7.39	3.92	1.35	235.848	3.1334	8	2.05021	137.28	1.95658	0	1.9566	119.54	3.1596	0.0012	5	0.7711	0.6225	2.1748	137.6022
33	189.2	5.22	2.39	1.33	189.229	2.7586	5	2.05919	135.1502	2.02415	0	2.0242	92.486	2.7884	0.0009	5	0.7854	0.6008	2.2039	106.2998
34	239.1	5.59	2.56	1.29	239.131	2.3376	6	1.9415	136.2222	2.09226	0	2.0923	113.29	2.3583	0.0008	5	0.7418	0.6031	2.0809	135.1003
35	183.5	7.29	2.39	1.29	183.529	3.9721	8	2.19631	137.28	2.1609	0	2.1609	83.932	4.0194	0.001	4	0.852	0.5442	2.3618	93.28583
36	186.6	7.35	2.53	1.33	186.631	3.9383	8	2.18915	137.28	2.22954	0	2.2295	82.708	3.9859	0.001	4	0.8555	0.5285	2.3625	92.11069
37	314.1	7.27	2.65	1.43	314.132	2.3143	8	1.87223	137.28	2.29818	0	2.2982	135.69	2.3314	0.0006	5	0.7276	0.5687	2.018	167.6121
38	276.9	7.24	2.67	1.49	276.933	2.6144	8	1.94628	137.28	2.36682	0	2.3668	116.01	2.6369	0.0007	5	0.7652	0.5401	2.1082	140.1433
39	219.6	3.52	2.39	1.58	219.629	1.6027	6	1.83282	132.6304	2.43314	0	2.4331	89.266	1.6207	0.0008	5	0.7338	0.5428	2.0172	111.4222
40	60.3	2.95	3.01	1.65	60.3368	4.8892	4	2.5657	128.1867	2.49723	0	2.4972	23.161	5.1003	0.0038	3	1	0.4237	2.8544	23.16148
41	189.7	2.46	2.39	1.64	189.729	1.2966	6	1.80443	129.6518	2.56206	0	2.5621	73.053	1.3143	0.0009	6	0.7391	0.5202	2.0151	92.00848
42	129	3.94	2.29	1.68	129.028	3.0536	5	2.19577	132.1579	2.62814	0	2.6281	48.095	3.1171	0.0013	4	0.9089	0.4374	2.4507	52.25201
43	222.3	3.3	3.05	1.77	222.337	1.4842	6	1.80363	132.1881	2.69423	0	2.6942	81.523	1.5024	0.001	6	0.7463	0.4978	2.0175	103.339
44	115.6	4.8	2.77	1.92	115.634	4.151	9	2.32978	133.3352	2.7609	0	2.7609	40.883	4.2526	0.0018	4	0.9769	0.3919	2.6145	41.8004
45	37.9	1.08	4.73	2.05	37.9579	2.8453	4	2.54377	119.7038	2.82075	0	2.8208	12.457	3.0737	0.0097	3	1	0.3751	2.9249	12.45666
46	55.6	2.67	4.89	2.09	55.6599	4.797	4	2.58315	127.2602	2.88438	0	2.8844	18.297	5.0592	0.0067	3	1	0.3668	2.9284	18.29698
47	59	2.24	5.49	2.22	59.0672	3.7923	4	2.49107	126.1202	2.94744	0	2.9474	19.04	3.9915	0.007	3	1	0.359	2.8485	19.04016
48	296	5.75	5.45	2.25	296.067	1.9421	6	1.82256	136.9496	3.01592	0	3.0159	97.168	1.9621	0.0013	5	0.7728	0.4451	2.047	123.2808
49	522.5	13.53	6.18	2.4	522.576	2.5891	8	1.8083	137.28	3.08456	0	3.0846	168.42	2.6045	0.0009	5	0.7532	0.4467	1.9875	219.3071
50	536.1	0	7.34	2.59	536.19	0	0	0	120.9	3.14501	0	3.145	169.49	0	0.001	0	1	0.3364	0	0

	CPT-5	In situ data						Basic output data											
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	55.7	0.91	0	-0.33	55.7	1.6338	5	2.26095	119.386	0.05969	0	0.0597	932.11	1.6355	0	6	0.5358	4.6665	1.795	245.3867
2	67.5	2.64	0.1	-0.26	67.5012	3.911	4	2.46117	127.648	0.12352	0	0.1235	545.49	3.9182	0.0001	8	0.6554	4.0863	2.0975	260.2042
3	117.3	4.11	-0.1	-0.13	117.299	3.5039	5	2.26824	132.2345	0.18963	0	0.1896	617.55	3.5096	-6E-05	8	0.6237	2.9216	2.0096	323.3598
4	65.4	2.94	-0.1	-0.02	65.3988	4.4955	4	2.51519	128.3583	0.25381	0	0.2538	256.66	4.513	-1E-04	9	0.7168	2.7825	2.2454	171.3137
5	55.2	2.12	-0.1	0	55.1988	3.8407	4	2.51545	125.5521	0.31659	0	0.3166	173.35	3.8628	-1E-04	8	0.7291	2.4103	2.2694	125.0155
6	56.4	2.31	-0.1	0.19	56.3988	4.0958	4	2.52912	126.2326	0.37971	0	0.3797	147.53	4.1236	-1E-04	9	0.75	2.1568	2.3158	114.1848
7	36.6	2.06	-0.16	0.27	36.598	5.6287	3	2.7589	124.3398	0.44188	0	0.4419	81.824	5.6975	-3E-04	9	0.8434	2.0884	2.5527	71.36317
8	54.7	2.22	-0.23	0.27	54.6972	4.0587	4	2.53545	125.8671	0.50481	0	0.5048	107.35	4.0965	-3E-04	4	0.7785	1.7791	2.3747	91.12055
9	15.3	0.76	-5.24	0.21	15.2359	4.9882	3	3.00372	114.9063	0.56226	0	0.5623	26.097	5.1794	-0.026	3	0.9551	1.8292	2.83	25.36648
10	18.7	0.95	-4.97	0.28	18.6392	5.0968	3	2.94298	117.0308	0.62078	0	0.6208	29.026	5.2724	-0.02	3	0.947	1.657	2.8017	28.21701
11	14.9	0.84	-4.77	0.34	14.8416	5.6598	3	3.0477	115.5747	0.67857	0	0.6786	20.872	5.9309	-0.024	3	0.9992	1.5588	2.9322	20.86441
12	8.4	0.37	-3.66	0.41	8.3552	4.4284	3	3.17821	108.1741	0.73265	0	0.7327	10.404	4.854	-0.035	3	1	1.4442	3.1064	10.40405
13	9.9	0.33	-3.53	0.44	9.85679	3.3479	3	3.0493	107.7401	0.78652	0	0.7865	11.532	3.6383	-0.028	3	1	1.3453	2.9951	11.53212
14	9.4	0.28	-3.34	0.44	9.35912	2.9917	3	3.04026	106.4115	0.83973	0	0.8397	10.145	3.2866	-0.028	3	1	1.2601	3.0143	10.14542
15	10.4	0.31	-3.11	0.45	10.3619	2.9917	3	3.00367	107.4045	0.89343	0	0.8934	10.598	3.274	-0.024	3	1	1.1843	2.9979	10.59792
16	15.8	0.48	-2.96	0.44	15.7638	3.045	3	2.85969	111.627	0.94924	0	0.9492	15.607	3.2401	-0.014	3	0.9846	1.1128	2.8603	15.58066
17	6.4	0.23	-2.86	0.44	6.36499	3.6135	3	3.22507	104.0319	1.00126	0	1.0013	5.357	4.2881	-0.038	3	1	1.0568	3.3082	5.35699
18	34.9	1.15	-2.58	0.48	34.8684	3.2981	4	2.61386	119.9563	1.06124	0	1.0612	31.856	3.4016	-0.005	4	0.9036	0.9973	2.6337	31.86544
19	88	2.62	0.53	0.53	88.0065	2.9771	5	2.29597	128.2393	1.12536	0	1.1254	77.203	3.0156	0.0004	5	0.7864	0.9527	2.3181	78.22601
20	88.5	2.77	0.76	0.56	88.5093	3.1296	5	2.31037	128.6605	1.18969	0	1.1897	73.397	3.1723	0.0006	5	0.8001	0.9105	2.3462	75.13678
21	30.3	0.77	1.56	0.6	30.3191	2.5397	4	2.58676	116.6803	1.24803	0	1.248	23.294	2.6487	0.0039	4	0.9241	0.8585	2.6643	23.58733
22	33.4	1.02	1.61	0.7	33.4197	3.0521	4	2.6055	118.9751	1.30752	0	1.3075	24.56	3.1764	0.0036	4	0.9389	0.8198	2.6958	24.87927
23	30.4	0.71	1.72	0.74	30.4211	2.3339	4	2.56273	116.0949	1.36556	0	1.3656	21.277	2.4436	0.0043	4	0.9328	0.7882	2.6725	21.64495
24	48.6	2.05	1.56	0.79	48.6191	4.2165	4	2.58296	124.9969	1.42806	0	1.4281	33.046	4.3441	0.0024	4	0.9419	0.754	2.6885	33.62635
25	161.8	4.08	1.34	0.79	161.816	2.5214	5	2.06936	132.9656	1.49454	0	1.4945	107.27	2.5449	0.0006	5	0.7385	0.7749	2.1456	117.4115
26	61.7	3.21	1.94	0.87	61.7238	5.2006	4	2.57918	128.8601	1.55897	0	1.559	38.593	5.3354	0.0023	3	0.9539	0.691	2.7037	39.28896
27	74.5	3.44	2.2	0.93	74.5269	4.6158	4	2.48636	129.8262	1.62389	0	1.6239	44.894	4.7186	0.0022	4	0.9233	0.6734	2.6152	46.39352
28	98.3	4.22	2.1	1	98.3257	4.2919	9	2.38493	131.9974	1.68989	0	1.6899	57.185	4.3669	0.0016	4	0.8877	0.66	2.5132	60.27308
29	193.9	5.21	1.91	1.12	193.923	2.6866	5	2.04365	135.196	1.75748	0	1.7575	109.34	2.7112	0.0007	5	0.7528	0.6825	2.1514	123.9564
30	119.3	5.94	2.52	1.24	119.331	4.9778	9	2.38435	134.9712	1.82497	0	1.825	64.388	5.0551	0.0015	4	0.899	0.6126	2.5262	68.0309
31	236.2	8.66	2.08	1.33	236.225	3.666	8	2.10723	137.28	1.89361	0	1.8936	123.75	3.6956	0.0006	8	0.787	0.6325	2.2244	140.0807
32	173	6.68	2.43	1.43	173.03	3.8606	8	2.20058	136.7365	1.96198	0	1.962	87.191	3.9049	0.001	4	0.8353	0.597	2.3427	96.5239
33	357.6	11.78	2.48	1.6	357.63	3.2939	8	1.97618	137.28	2.03062	0	2.0306	175.12	3.3127	0.0005	8	0.7414	0.6167	2.0878	207.267
34	198.9	6.35	2.39	1.62	198.929	3.1921	8	2.0982	136.706	2.09897	0	2.099	93.775	3.2261	0.0009	5	0.8066	0.5755	2.2501	107.0615
35	303.2	7.52	2.08	1.66	303.225	2.48	8	1.90582	137.28	2.16761	0	2.1676	138.89	2.4979	0.0005	5	0.7298	0.5925	2.0401	168.5859
36	382.4	12.92	1.81	1.74	382.422	3.3785	8	1.97224	137.28	2.23625	0	2.2363	170.01	3.3983	0.0003	8	0.7561	0.5679	2.1008	204.0468
37	412.1	10.74	2.3	1.85	412.128	2.606	8	1.8574	137.28	2.30489	0	2.3049	177.81	2.6206	0.0004	8	0.716	0.5727	1.9869	221.7992
38	293.5	7.81	1.43	1.99	293.518	2.6608	8	1.93923	137.28	2.37353	0	2.3735	122.66	2.6825	0.0004	5	0.7616	0.5405	2.098	148.7139
39	308.6	8.43	1.13	2.2	308.614	2.7316	8	1.93751	137.28	2.44217	0	2.4422	125.37	2.7534	0.0003	5	0.7657	0.5271	2.1002	152.5091
40	305.5	7.12	1.11	2.33	305.514	2.3305	8	1.88125	137.28	2.51081	0	2.5108	120.68	2.3498	0.0003	5	0.7503	0.5229	2.0512	149.7362
41	103.9	5.42	3.1	2.39	103.938	5.2147	9	2.43651	133.964	2.57779	0	2.5778	39.321	5.3473	0.0022	3	1	0.4105	2.7041	39.32052
42	136	5.97	1.55	2.49	136.019	4.3891	9	2.30664	135.3273	2.64546	0	2.6455	50.416	4.4762	0.0008	4	0.951	0.4183	2.5604	52.73192
43	150.7	4.23	2.66	2.59	150.733	2.8063	5	2.12494	133.0568	2.71198	0	2.712	54.58	2.8577	0.0013	5	0.8839	0.4352	2.377	60.88124
44	109.8	4.8	1.63	2.74	109.82	4.3708	9	2.36122	133.2094	2.77859	0	2.7786	38.524	4.4843	0.0011	4	0.9932	0.3833	2.6539	38.77773
45	132.2	4.88	1.48	2.78	132.218	3.6909	8	2.2538	133.783	2.84548	0	2.8455	45.466	3.7721	0.0008	4	0.9517	0.3901	2.5372	47.69038
46	56.6	3	2.79	2.84	56.6342	5.2972	4	2.60997	128.1552	2.90956	0	2.9096	18.465	5.584	0.0037	3	1	0.3637	2.9538	18.46486
47	71.6	2.66	2.86	2.84	71.635	3.7133	4	2.42711	127.8481	2.97348	0	2.9735	23.091	3.8741	0.003	4	1	0.3559	2.7762	23.09128
48	331.5	5.94	2.35	2.95	331.529	1.7917	6	1.76613	137.28	3.04212	0	3.0421	107.98	1.8083	0.0005	6	0.7493	0.4532	1.9822	140.7038
49	137.6	7.3	2.26	2.98	137.628	5.3042	9	2.37061	136.8276	3.11054	0	3.1105	43.246	5.4268	0.0012	3	1	0.3402	2.6803	43.24564
50	104.4	4.35	3.95	3.08	104.448	4.1647	9	2.3583	132.3668	3.17672	0	3.1767	31.879	4.2954	0.0028	4	1	0.3331	2.702	31.87931

	CPT-6	In situ data						Basic output data											
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	16.5	0.69	-0.57	-0.01	16.493	4.1836	3	2.92866	114.3926	0.0572	0	0.0572	287.36	4.1982	-0.003	9	0.727	8.3417	2.289	129.5741
2	29.6	1.02	-0.19	-0.05	29.5977	3.4462	4	2.6799	118.6788	0.11654	0	0.1165	252.98	3.4598	-5E-04	8	0.7018	4.7028	2.219	131.0298
3	19.6	1.08	-0.1	-0.02	19.5988	5.5106	3	2.94897	118.0916	0.17558	0	0.1756	110.62	5.5604	-4E-04	9	0.8153	4.325	2.5154	79.39165
4	19.6	0.99	-0.1	-0.06	19.5988	5.0513	3	2.92397	117.455	0.23431	0	0.2343	82.645	5.1125	-4E-04	4	0.8307	3.4984	2.547	64.02378
5	20.2	1.21	0.1	-0.08	20.2012	5.9897	3	2.96345	118.9971	0.29381	0	0.2938	67.757	6.0781	0.0004	3	0.8678	3.0402	2.6359	57.19791
6	14.1	0.77	0.32	0.04	14.1039	5.4595	3	3.05456	114.8136	0.35121	0	0.3512	39.158	5.5989	0.0017	3	0.9136	2.7388	2.7485	35.59797
7	26.2	0.75	0.81	-0.02	26.2099	2.8615	4	2.66852	116.1325	0.40928	0	0.4093	63.039	2.9069	0.0023	5	0.7955	2.1289	2.4317	51.90927
8	6.2	0.33	1.5	0	6.21836	5.3069	3	3.32821	106.6166	0.46259	0	0.4626	12.443	5.7334	0.0188	3	1	2.2874	3.0911	12.44252
9	12.4	0.51	2.87	0.04	12.4351	4.1013	3	3.01977	111.4921	0.51833	0	0.5183	22.991	4.2797	0.0173	3	0.9486	1.9678	2.8179	22.16209
10	9.2	0.32	2.58	0.06	9.23158	3.4664	3	3.08128	107.3551	0.57201	0	0.572	15.139	3.6953	0.0215	3	0.9852	1.833	2.9082	15.00116
11	5.9	0.17	2.87	0.06	5.93513	2.8643	3	3.19637	101.6495	0.62284	0	0.6228	8.5292	3.2001	0.0389	3	1	1.6989	3.0697	8.52918
12	14.3	0.65	3.15	0	14.3386	4.5332	3	2.99788	113.6143	0.67964	0	0.6796	20.097	4.7588	0.0166	3	0.9806	1.5436	2.8831	19.92546
13	14.9	0.63	3.25	0.04	14.9398	4.2169	3	2.96433	113.4858	0.73639	0	0.7364	19.288	4.4356	0.0165	3	0.9806	1.4268	2.8761	19.15295
14	10.4	0.38	3.34	0.12	10.4409	3.6395	3	3.04987	108.9128	0.79084	0	0.7908	12.202	3.9378	0.0249	3	1	1.338	2.9961	12.20221
15	9.2	0.38	3.44	0.1	9.24211	4.1116	3	3.12382	108.6153	0.84515	0	0.8452	9.9354	4.5255	0.0295	3	1	1.252	3.1037	9.93544
16	8.9	0.37	3.97	0.15	8.94859	4.1347	3	3.1366	108.3415	0.89932	0	0.8993	8.9504	4.5967	0.0355	3	1	1.1766	3.144	8.95038
17	13.8	0.6	4.3	0.23	13.8526	4.3313	3	2.99727	112.9445	0.95579	0	0.9558	13.493	4.6523	0.024	3	1	1.1071	3.0064	13.49332
18	15.1	0.56	3.82	0.19	15.1468	3.6972	3	2.92439	112.6575	1.01212	0	1.0121	13.965	3.9619	0.0195	3	1	1.0454	2.9513	13.96533
19	91.9	1.48	4.18	0.53	91.9512	1.6096	5	2.09269	124.1673	1.07421	0	1.0742	84.599	1.6286	0.0033	5	0.7021	0.9895	2.1033	84.98053
20	203.9	4.07	4.61	0.97	203.956	1.9955	6	1.92738	133.5122	1.14096	0	1.141	177.76	2.0068	0.0016	6	0.6445	0.9526	1.9439	182.5861
21	250.5	6.68	4.59	1.25	250.556	2.6661	8	1.97719	137.28	1.2096	0	1.2096	206.14	2.679	0.0013	8	0.67	0.9143	2.002	215.447
22	169	5.26	4.68	1.5	169.057	3.1114	8	2.13031	134.9312	1.27707	0	1.2771	131.38	3.1351	0.002	5	0.7377	0.8704	2.1713	138.0232
23	40.3	0.74	5.42	1.61	40.3663	1.8332	5	2.40133	117.0876	1.33561	0	1.3356	29.223	1.8959	0.01	5	0.8623	0.8181	2.491	30.17551
24	116.7	3.9	5.97	1.34	116.773	3.3398	5	2.25332	131.8398	1.40153	0	1.4015	82.318	3.3804	0.0037	5	0.8018	0.7982	2.324	87.03348
25	107.6	4.73	5.56	1.1	107.668	4.3931	9	2.36826	133.0536	1.46806	0	1.4681	72.34	4.4539	0.0038	4	0.8544	0.756	2.4536	75.87415
26	197	5.33	5.07	1.18	197.062	2.7047	5	2.0419	135.4018	1.53576	0	1.5358	127.32	2.726	0.0019	5	0.7296	0.762	2.1182	140.808
27	275.6	9.23	4.97	1.2	275.661	3.3483	8	2.03854	137.28	1.6044	0	1.6044	170.82	3.3679	0.0013	8	0.7311	0.7376	2.1134	191.0507
28	196.8	8.71	4.97	1.29	196.861	4.4245	9	2.21863	137.28	1.67304	0	1.673	116.67	4.4624	0.0018	9	0.8115	0.6895	2.3152	127.1901
29	229.1	7.02	5.41	1.27	229.166	3.0633	8	2.04888	137.28	1.74168	0	1.7417	130.58	3.0867	0.0017	5	0.7506	0.6879	2.1477	147.8578
30	402.6	13.61	5.35	1.29	402.665	3.38	8	1.96216	137.28	1.81032	0	1.8103	221.43	3.3952	0.001	8	0.7151	0.6811	2.0459	258.042
31	374.6	12.24	5.64	1.43	374.669	3.2669	8	1.96348	137.28	1.87896	0	1.879	198.4	3.2834	0.0011	8	0.7226	0.6604	2.0572	232.6612
32	216.7	9.44	5.83	1.51	216.771	4.3548	8	2.19042	137.28	1.9476	0	1.9476	110.3	4.3943	0.002	9	0.8262	0.6041	2.3192	122.638
33	154.5	8.57	5.64	1.64	154.569	5.5445	9	2.35814	137.28	2.01624	0	2.0162	75.662	5.6177	0.0027	9	0.904	0.5583	2.5152	80.496
34	315.6	11.41	5.82	1.85	315.671	3.6145	8	2.03766	137.28	2.08488	0	2.0849	150.41	3.6386	0.0013	8	0.7723	0.5923	2.1619	175.5314
35	367.5	11.58	5.35	2.14	367.565	3.1505	8	1.95351	137.28	2.15352	0	2.1535	169.68	3.169	0.0011	8	0.7428	0.5899	2.0759	203.7151
36	394.9	11.74	5.45	2.32	394.967	2.9724	8	1.9165	137.28	2.22216	0	2.2222	176.74	2.9892	0.001	8	0.7328	0.5806	2.0413	215.4953
37	150.3	8.46	4.3	2.51	150.353	5.6268	9	2.37013	137.28	2.2908	0	2.2908	64.633	5.7138	0.0021	9	0.9369	0.485	2.5676	67.86197
38	414.8	12.18	4.98	2.7	414.861	2.9359	8	1.90183	137.28	2.35944	0	2.3594	174.83	2.9527	0.0009	8	0.7375	0.5535	2.0365	215.7954
39	290.3	6.63	4.2	2.93	290.351	2.2834	6	1.88578	137.28	2.42808	0	2.4281	118.58	2.3027	0.0011	5	0.7462	0.5381	2.0506	146.4119
40	363.5	8.86	5.16	3.01	363.563	2.437	8	1.85856	137.28	2.49672	0	2.4967	144.62	2.4538	0.001	5	0.7357	0.5317	2.0146	181.4496
41	326.8	5.84	4.3	3.09	326.853	1.7867	6	1.76853	137.28	2.56536	0	2.5654	126.41	1.8009	0.001	6	0.7099	0.5333	1.9381	163.4455
42	352.8	8.1	3.58	3.26	352.844	2.2956	8	1.84281	137.28	2.634	0	2.634	132.96	2.3129	0.0007	5	0.7421	0.5082	2.0143	168.2122
43	279.7	8.42	3.63	3.36	279.744	3.0099	8	1.99572	137.28	2.70264	0	2.7026	102.51	3.0393	0.0009	5	0.8138	0.4662	2.1939	122.0705
44	285.6	7.6	3.53	3.6	285.643	2.6607	8	1.94548	137.28	2.77128	0	2.7713	102.07	2.6867	0.0009	5	0.7998	0.463	2.1488	123.7693
45	227.6	5.62	2.96	3.81	227.636	2.4689	5	1.97321	136.1412	2.83935	0	2.8394	79.172	2.5	0.001	5	0.8239	0.4434	2.2036	94.19899
46	323.3	7.14	2.96	3.97	323.336	2.2082	6	1.8483	137.28	2.90799	0	2.908	110.19	2.2283	0.0007	5	0.7703	0.459	2.0541	138.9914
47	330.1	8.07	2.58	4.21	330.132	2.4445	8	1.8811	137.28	2.97663	0	2.9766	109.91	2.4667	0.0006	5	0.7881	0.4426	2.0924	136.841
48	357.5	9.53	2.77	4.26	357.534	2.6655	8	1.89591	137.28	3.04527	0	3.0453	116.41	2.6884	0.0006	5	0.7969	0.4307	2.1069	144.2903
49	527	6.09	3.19	4.4	527.039	1.1555	6	1.49752	137.28	3.11391	0	3.1139	168.25	1.1624	0.0004	6	0.6356	0.5035	1.6745	249.3257
50	436.5	0	5.73	4.48	436.57	0	0	0	120.9	3.17436	0	3.1744	136.53	0	0.001	0	1	0.3333	0	0

	CPT-7	In situ data			Basic output data														
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	334.6	1.45	-0.38	-1.38	334.595	0.4334	7	1.29426	127.1678	0.06358	0	0.0636	5261.3	0.4334	-8E-05	7	0.2642	2.1022	1.074	664.634
2	17.6	1.15	-0.24	-1.15	17.5971	6.5352	3	3.03326	118.2884	0.12273	0	0.1227	142.38	6.5811	-1E-03	9	0.8156	5.7948	2.5243	95.69897
3	19.5	0.74	-0.57	-1.11	19.493	3.7962	3	2.84573	115.3121	0.18038	0	0.1804	107.06	3.8317	-0.002	4	0.7779	3.9602	2.4182	72.28144
4	26.7	1.05	-0.48	-1.08	26.6941	3.9335	4	2.75145	118.6391	0.2397	0	0.2397	110.36	3.9691	-0.001	4	0.7761	3.1656	2.4036	79.14437
5	31.1	1.16	-2.49	-1.06	31.0695	3.7336	4	2.6871	119.7383	0.29957	0	0.2996	102.71	3.7699	-0.006	4	0.7754	2.6602	2.3933	77.35883
6	21.8	1.09	-2.69	-1.06	21.7671	5.0076	3	2.88729	118.415	0.35878	0	0.3588	59.67	5.0915	-0.009	4	0.8609	2.5372	2.6094	51.33335
7	31.6	1.35	-2.41	-1.1	31.5705	4.2761	4	2.72166	120.8872	0.41922	0	0.4192	74.307	4.3337	-0.006	4	0.8213	2.1391	2.4979	62.97663
8	103.3	1.77	-2.48	-1.1	103.27	1.714	5	2.07513	125.7597	0.4821	0	0.4821	213.21	1.722	-0.002	6	0.6098	1.615	1.935	156.8824
9	18.6	0.58	-1.91	-1.08	18.5766	3.1222	4	2.80936	113.4121	0.53881	0	0.5388	33.477	3.2155	-0.008	4	0.8769	1.8072	2.6285	30.80725
10	23.8	0.81	-1.82	-1.14	23.7777	3.4066	4	2.74919	116.4581	0.59704	0	0.597	38.826	3.4943	-0.006	4	0.8702	1.6454	2.6018	36.04633
11	24.3	1.06	-1.96	-1.18	24.276	4.3665	3	2.81237	118.4769	0.65628	0	0.6563	35.99	4.4878	-0.006	4	0.9066	1.542	2.691	34.4204
12	25.8	0.93	-1.62	-1.14	25.7802	3.6074	4	2.73831	117.6661	0.71511	0	0.7151	35.051	3.7103	-0.005	4	0.8907	1.4176	2.6421	33.58127
13	45.4	2.47	-1.48	-1.17	45.3819	5.4427	3	2.68368	126.1926	0.77821	0	0.7782	57.316	5.5377	-0.002	4	0.8832	1.3118	2.615	55.29602
14	67.6	1.98	-1.05	-1.1	67.5872	2.9296	5	2.3699	125.5461	0.84098	0	0.841	79.367	2.9665	-0.001	5	0.7753	1.1949	2.3239	75.3753
15	85.7	0.79	-0.76	-1.17	85.6907	0.9219	6	1.96012	119.4019	0.90068	0	0.9007	94.14	0.9317	-7E-04	6	0.6287	1.1066	1.9317	88.67447
16	54	2.76	-0.22	-1.29	53.9973	5.1114	4	2.61237	127.4288	0.9644	0	0.9644	54.991	5.2043	-3E-04	4	0.886	1.0856	2.5995	54.41249
17	100.8	2.33	0.39	-0.99	100.805	2.3114	5	2.17529	127.7121	1.02825	0	1.0283	97.035	2.3352	0.0003	5	0.7274	1.021	2.1754	96.28104
18	49.1	1.56	0.57	-0.58	49.107	3.1767	4	2.49348	123.0226	1.08976	0	1.0898	44.062	3.2488	0.0009	4	0.8598	0.975	2.5152	44.24457
19	54.5	2.96	0.71	-0.33	54.5087	5.4303	4	2.62909	127.9637	1.15374	0	1.1537	46.245	5.5478	0.001	3	0.9201	0.9235	2.6655	46.566
20	40.2	1.46	1.15	-0.37	40.2141	3.6306	4	2.59634	122.0506	1.21477	0	1.2148	32.104	3.7437	0.0021	4	0.9192	0.8808	2.6556	32.46448
21	37.2	0.98	1.25	-0.37	37.2153	2.6333	4	2.5283	118.9447	1.27424	0	1.2742	28.206	2.7267	0.0025	4	0.903	0.8455	2.6055	28.7192
22	42.8	1.2	1.43	-0.39	42.8175	2.8026	4	2.50024	120.7686	1.33463	0	1.3346	31.082	2.8928	0.0025	4	0.8991	0.8116	2.5879	31.81848
23	38.9	1.09	1.49	-0.31	38.9182	2.8007	4	2.5311	119.8322	1.39454	0	1.3945	26.908	2.9048	0.0029	4	0.9209	0.7755	2.6375	27.50177
24	64.6	3	1.79	-0.26	64.6219	4.6424	4	2.52906	128.477	1.45878	0	1.4588	43.299	4.7496	0.002	4	0.9212	0.7439	2.6304	44.40796
25	58.9	2.66	2.2	-0.15	58.9269	4.5141	4	2.54694	127.3718	1.52247	0	1.5225	37.705	4.6338	0.0028	4	0.9376	0.711	2.6656	38.57029
26	74.3	3.84	2.29	-0.12	74.328	5.1663	9	2.52439	130.6246	1.58778	0	1.5878	45.813	5.2791	0.0023	4	0.9335	0.6847	2.6465	47.06655
27	122.7	5.11	2.1	0.03	122.726	4.1638	9	2.31504	133.9383	1.65475	0	1.6548	73.166	4.2207	0.0013	4	0.8534	0.6828	2.4276	78.12211
28	271.8	6.28	2.34	0.22	271.829	2.3103	6	1.9058	137.28	1.72339	0	1.7234	156.73	2.325	0.0006	5	0.6915	0.7137	1.9949	182.1798
29	320.8	6.93	2.77	0.33	320.834	2.16	6	1.842	137.28	1.79203	0	1.792	178.03	2.1721	0.0006	6	0.6709	0.7023	1.9321	211.746
30	197.5	5.3	2.39	0.4	197.529	2.6832	5	2.03848	135.3662	1.85971	0	1.8597	105.22	2.7087	0.0009	5	0.7605	0.6512	2.1591	120.4272
31	247.6	4.89	2.87	0.4	247.635	1.9747	6	1.87305	135.3285	1.92738	0	1.9274	127.48	1.9902	0.0008	6	0.6995	0.6574	1.9904	152.6577
32	294.1	6.2	2.77	0.42	294.134	2.1079	6	1.85367	137.28	1.99602	0	1.996	146.36	2.1223	0.0007	6	0.6951	0.6433	1.9704	177.6081
33	355.9	7.07	2.28	0.54	355.928	1.9864	6	1.78719	137.28	2.06466	0	2.0647	171.39	1.998	0.0005	6	0.6719	0.6382	1.9009	213.4218
34	356.6	7.54	2.39	0.62	356.629	2.1142	6	1.80982	137.28	2.1333	0	2.1333	166.17	2.127	0.0005	6	0.6865	0.618	1.9306	207.0327
35	368.6	8.09	2.48	0.73	368.63	2.1946	8	1.81629	137.28	2.20194	0	2.2019	166.41	2.2078	0.0005	6	0.6941	0.6013	1.9421	208.2298
36	350.3	5.88	2.29	0.79	350.328	1.6784	6	1.72926	137.28	2.27058	0	2.2706	153.29	1.6894	0.0005	6	0.6677	0.6006	1.8641	197.5679
37	80	2.78	1.86	0.81	80.0228	3.474	5	2.37336	128.4411	2.3348	0	2.3348	33.274	3.5784	0.0017	4	0.9606	0.4676	2.6244	34.3286
38	55.6	1.4	2.47	0.99	55.6302	2.5166	5	2.3847	122.535	2.39606	0	2.3961	22.217	2.6299	0.0033	4	0.9838	0.4475	2.6783	22.51278
39	49.6	1.51	2.77	1.14	49.6339	3.0423	4	2.47717	122.8103	2.45747	0	2.4575	19.197	3.2008	0.0042	4	1	0.4306	2.7854	19.19717
40	96	5.32	3.11	1.2	96.0381	5.5395	9	2.47823	133.6349	2.52429	0	2.5243	37.046	5.689	0.0024	3	1	0.4192	2.7415	37.04563
41	103.5	5.09	3.38	1.14	103.541	4.9159	9	2.41721	133.495	2.59103	0	2.591	38.961	5.0421	0.0024	4	0.9968	0.4096	2.6877	39.07377
42	59.1	2.97	3.72	1.06	59.1455	5.0215	4	2.58011	128.1875	2.65513	0	2.6551	21.276	5.2575	0.0047	3	1	0.3985	2.8906	21.27597
43	46.5	1.67	4.21	1.02	46.5515	3.5874	4	2.54682	123.3908	2.71682	0	2.7168	16.135	3.8098	0.0069	3	1	0.3895	2.8915	16.13455
44	66.5	2.06	4.78	1	66.5585	3.095	5	2.39159	125.7985	2.77972	0	2.7797	22.944	3.2299	0.0054	4	1	0.3807	2.7275	22.9443
45	58	1.71	5.54	0.98	58.0678	2.9448	5	2.41824	124.1031	2.84177	0	2.8418	19.434	3.0964	0.0072	4	1	0.3723	2.7723	19.43365
46	75	3.3	6.07	1.05	75.0743	4.3957	4	2.46823	129.54	2.90654	0	2.9065	24.829	4.5727	0.0061	3	1	0.364	2.8001	24.82941
47	69.7	4.33	6.68	1.08	69.7818	6.2051	9	2.60312	131.3494	2.97222	0	2.9722	22.478	6.4811	0.0072	3	1	0.356	2.9351	22.47801
48	61	2.54	7.16	1.1	61.0876	4.158	4	2.51012	127.1219	3.03578	0	3.0358	19.123	4.3754	0.0089	3	1	0.3486	2.8728	19.12256
49	209.1	6.79	6.75	1.2	209.183	3.246	8	2.09185	137.28	3.10442	0	3.1044	66.382	3.2949	0.0024	5	0.8968	0.3809	2.362	74.18209
50	169.9	0	7.35	1.29	169.99	0	0	0	120.9	3.16487	0	3.1649	52.712	0	0.0032	0	1	0.3343	0	0

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236 \right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \cdot I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a} \right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$ (applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$

:: Peak drained friction angle, φ (°) ::

$\varphi = 17.60 + 11 \cdot \log(Q_{tn})$

(applicable only to SBT_n: 5, 6, 7 and 8)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$

$\alpha = 14$ for $Q_{tn} > 14$

$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

$M_{CPT} = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$

:: Small strain shear Modulus, Go (MPa) ::

$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho} \right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot +7 \cdot \log(F_r))} \right]^{1.25}$$ or user defined

$OCR = k_{OCR} \cdot Q_{tn}$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Effective Stress Friction Angle, φ' (°) ::

$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$

(applicable for $0.10 < B_q < 1.00$)

References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Appendix C

Laboratory Testing

TETRA TECH BAS GEOSCIENCE

MOISTURE CONTENT AND DENSITY

ASTM D2937

Job Name:	Carriage Crest Park Water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET 16-101E	**Date Completed:**	10/19/2016
Tested By:	MG	**Note:**	Page 1 of 1

Boring / Test Pit / Trench		**B-1**	**B-1**	**B-3**	**B-4**	**B-5**	**B-5**	**B-5**	**B-5**
Sample Number		**R-4**	**R-10**	**R-2**	**R-1**	**R-1**	**R-2**	**R-6**	**R-8**
Sample Depth	*feet*	**11-11.5**	**31-31.5**	**2-2.5**	**2-2.5**	**2-2.5**	**6-6.5**	**16-16.5**	**21-21.5**
USCS Soil Description		Olive Brown Native (CH)	Olive Brown Native (SM)	Olive Brown Fill (SC)	Yellowish Brown Fill (ML)	Brown Fill (SM)	Dark Brown Fill (CL)	Olive Brown Native (CL)	Pale Olive Native (SM)
Number of Rings		6	6	6	6	6	6	6	6
Total Weight Rings + Soil	*grams*	1208.70	1140.50	1211.10	1187.60	1162.40	1184.80	1192.50	1040.70
* Volume of Rings	ft^3	0.0159	0.0159	0.0159	0.0159	0.0159	0.0159	0.0159	0.0159
* Weight of Rings	*grams*	267.54	267.54	267.54	267.54	267.54	267.54	267.54	267.54
* Weight of Soil	*grams*	941.16	872.96	943.56	920.06	894.86	917.26	924.96	773.16
* Wet Density	*pcf*	130.13	120.70	130.46	127.21	123.73	126.83	127.89	106.90
	Container ID	P34	Z10	Z27	P20	P12	Z20	Z29	Z6
Tare	*grams*	9.2	4	4	8.8	9.3	4	4	4
Wet Soil + Tare	*grams*	306.9	285.9	292.1	285.3	304.4	289.1	255.9	258.3
Dry Soil + Tare	*grams*	258.6	227.8	253.9	260.8	280.9	250.2	211.3	238.1
* Weight of Water	*grams*	48.3	58.1	38.2	24.5	23.5	38.9	44.6	20.2

*** Dry Density**	***pcf***	**109.0**	**95.8**	**113.2**	**115.9**	**113.9**	**109.5**	**105.2**	**98.4**
*** Moisture Content**	***%***	**19.4**	**26.0**	**15.3**	**9.7**	**8.7**	**15.8**	**21.5**	**8.6**

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

MOISTURE CONTENT AND DRY DENSITY OF TUBE SAMPLES

Client: Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project No.: TET 16-101E

HAI Project No.: TRT-16-017
Performed by: KL
Checked by: MZ
Date: 10/24/2016

Boring No.		**B-3**	**B-4**
Sample No.		**R-5**	**R-6**
Depth (ft)		**11-11.5**	**16-16.5**
Total wt of tube and soil	gr	775.66	725.14
Height of sample	in	5.07	5.04
Diameter of sample	in	2.4055	2.4065
Volume of sample	cu.ft	0.0133	0.0133
Weight of tube	gr	0.00	0.00
Weight of soil	lbs.	1.710	1.599
Wet Density	pcf	128.3	120.4
Container No.		42	35
Weight of cont.+ wet soil	gr	74.41	78.85
Weight of cont.+ dry soil	gr	62.71	66.53
Weight of container	gr	4.99	4.94
Weight of water	gr	11.70	12.32
Weight of dry soil	gr	57.72	61.59
Moisture Content	**%**	**20.3**	**20.0**
Dry Density	**pcf**	**106.7**	**100.3**

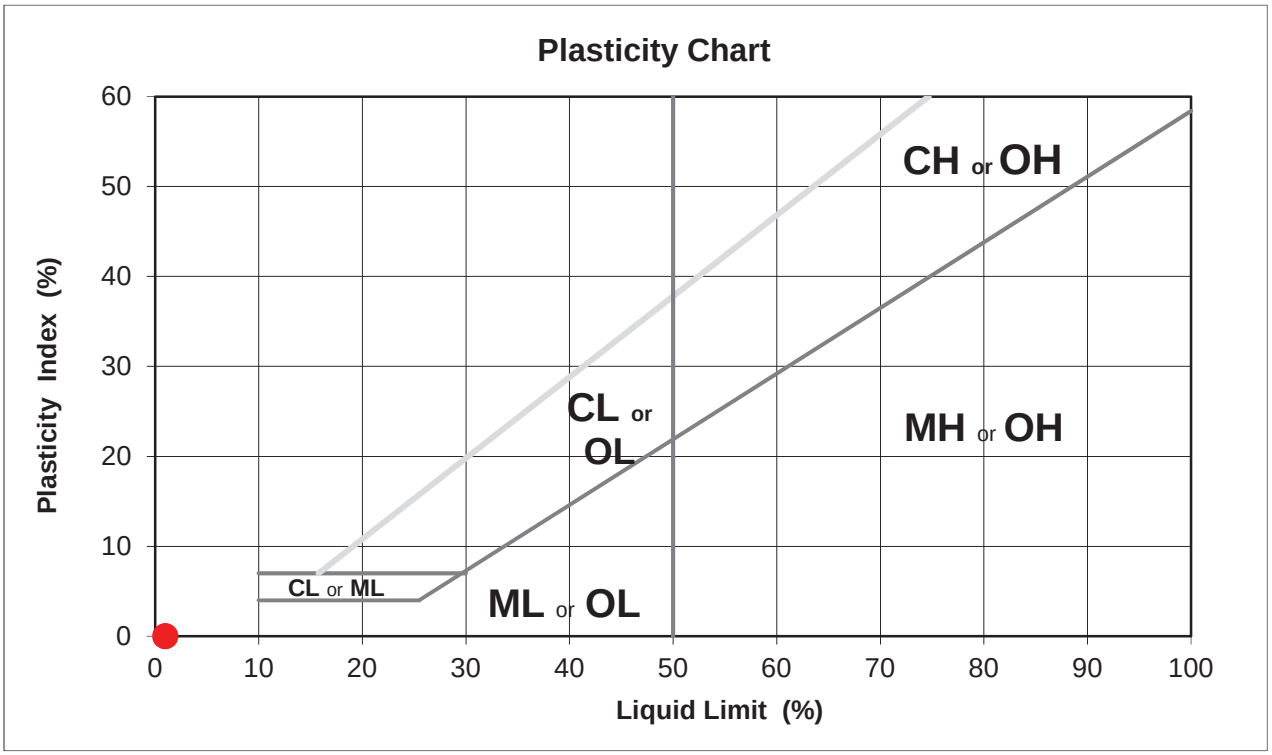
TETRA TECH BAS GEOSCIENCE

ATTERBERG LIMITS

ASTM D4318

Job Name:	Carriage Crest Park Water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET-16-101E	**Date Completed:**	10/30/2016
Tested By:	MG	**Sample Identification:**	B-5 , SPT-10
Note:		**Sample Depth:**	25-26.5ft
Sample Description:	Olive Brownish Gray Native (SM)		

		PLASTIC LIMIT		LIQUID LIMIT			
Test No.		**1**	**2**	**1**	**2**	**3**	**4**
Number of Blows							
Container ID							
Wet Weight of Soil + Cont.	*grams*	NP	NP	NP	NP	NP	
Dry Weight of Soil + Cont.	*grams*						
Weight of Container	*grams*						
* Moisture Weight	*grams*	0.00	0.00	0.00	0.00	0.00	
* Weight of Dry Soil	*grams*	0.00	0.00	0.00	0.00	0.00	
*** Moisture Content**	*%*	**NP**	**NP**	**NP**	**NP**	**NP**	



Plastic Limit	**NP**
Liquid Limit	**NP**
Plasticity Inde	**NP**

USCS Classification	**SM**

TETRA TECH BAS GEOSCIENCE

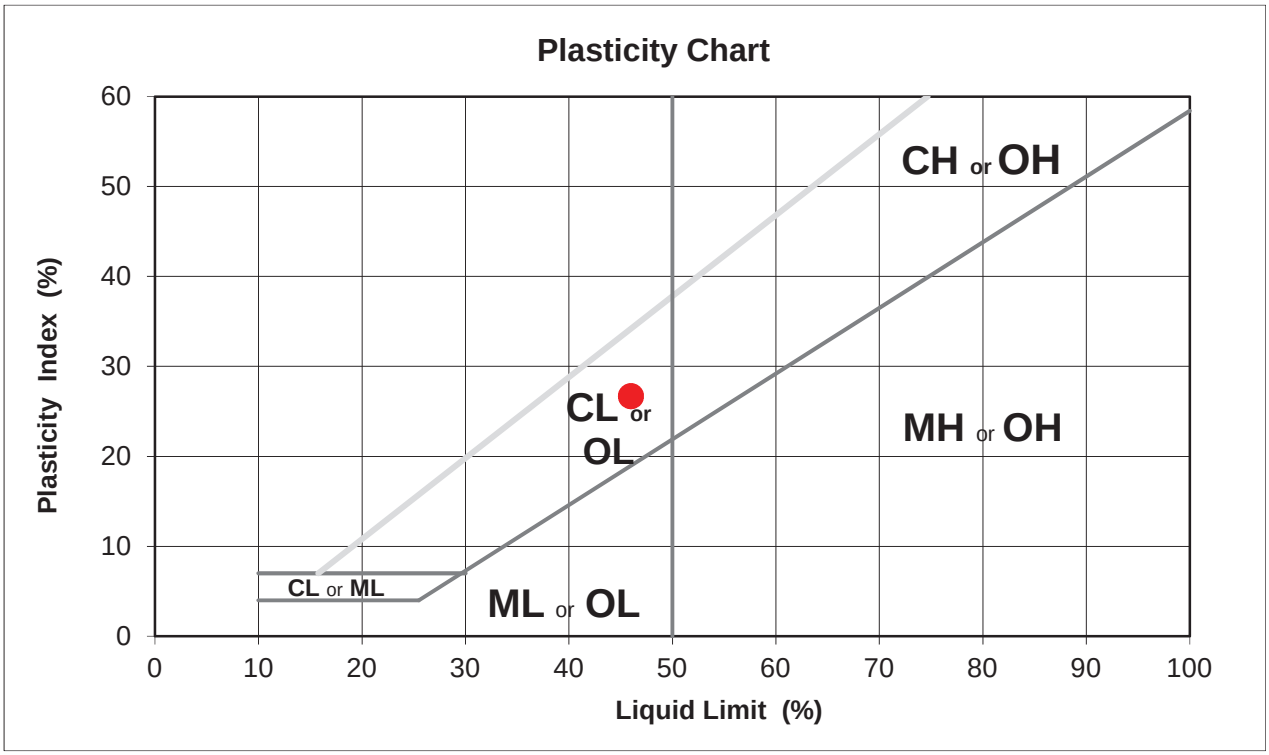
ATTERBERG LIMITS

ASTM D4318

Job Name:	Carriage Crest Park water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET-16-101E	**Date Completed:**	10/27/2016
Tested By:	MG	**Sample Identification:**	B-1, SPT-3
Note:		**Sample Depth:**	7.5-9 ft
Sample Description:	Dark Gray Native (CL)		

		PLASTIC LIMIT	
Test No.		**1**	**2**
Number of Blows			
Container ID		F7	F6
Wet Weight of Soil + Cont.	*grams*	24.20	24.70
Dry Weight of Soil + Cont.	*grams*	22.40	22.60
Weight of Container	*grams*	12.40	12.40
* Moisture Weight	*grams*	1.80	2.10
* Weight of Dry Soil	*grams*	10.00	10.20
*** Moisture Content**	*%*	**18.0**	**20.6**

LIQUID LIMIT			
1	**2**	**3**	**4**
36	27	17	
N10	T18	T16	
46.60	47.90	47.20	
40.10	40.88	40.10	
25.50	25.60	25.30	
6.50	7.02	7.10	
14.60	15.28	14.80	
44.5	**45.9**	**48.0**	



Plastic Limit	**19**
Liquid Limit	**46**
Plasticity Index	**27**

USCS Classification	**CL**

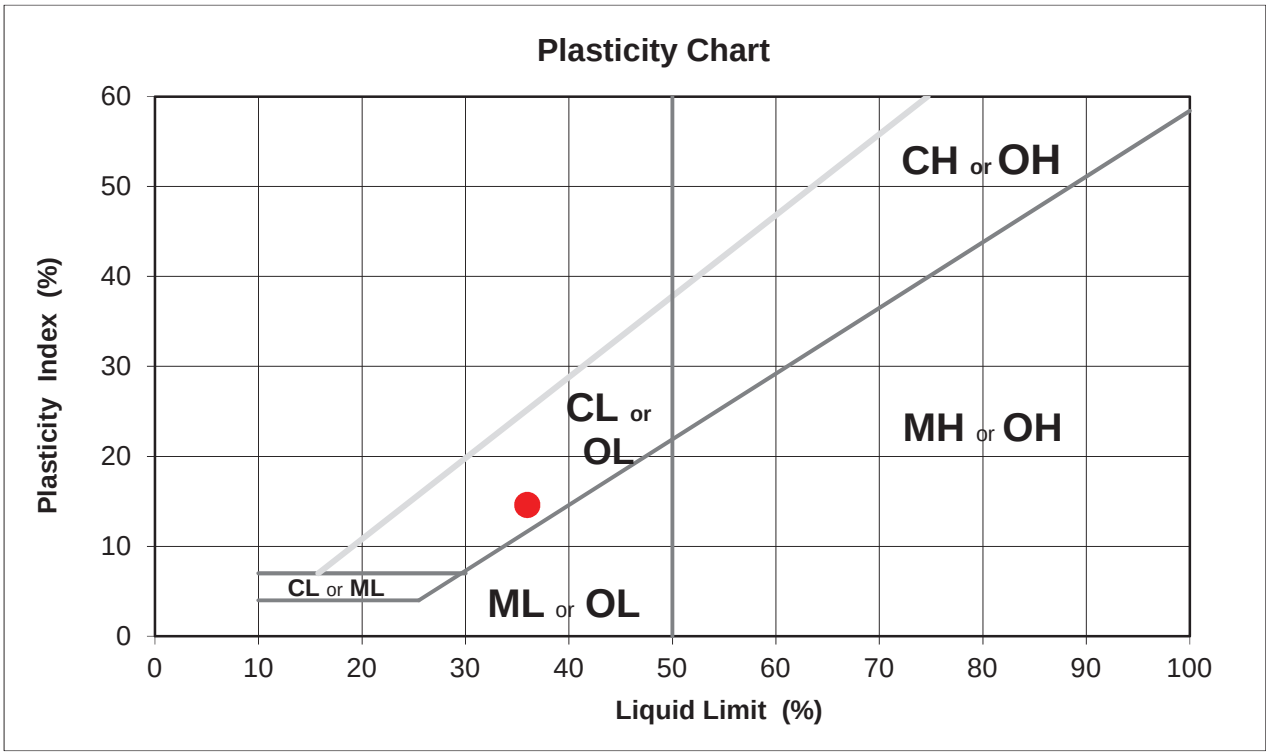
TETRA TECH BAS GEOSCIENCE

ATTERBERG LIMITS

ASTM D4318

Job Name:	Carriage Crest Park water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET-16-101E	**Date Completed:**	10/27/2016
Tested By:	MG	**Sample Identification:**	B-1, SPT-7
Note:		**Sample Depth:**	17.5-19 ft
Sample Description:	Olive Brownish Gray Native (CL)		

		PLASTIC LIMIT		LIQUID LIMIT			
Test No.		**1**	**2**	**1**	**2**	**3**	**4**
Number of Blows				15	26	35	
Container ID		P3	P5	N11	M14	S19	
Wet Weight of Soil + Cont.	*grams*	25.30	25.60	53.30	50.40	53.40	
Dry Weight of Soil + Cont.	*grams*	23.00	23.30	45.80	43.80	46.30	
Weight of Container	*grams*	12.40	12.40	25.50	25.30	25.40	
* Moisture Weight	*grams*	2.30	2.30	7.50	6.60	7.10	
* Weight of Dry Soil	*grams*	10.60	10.90	20.30	18.50	20.90	
*** Moisture Content**	*%*	**21.7**	**21.1**	**36.9**	**35.7**	**34.0**	



Plastic Limit	**21**
Liquid Limit	**36**
Plasticity Index	**15**

USCS Classification	**CL**

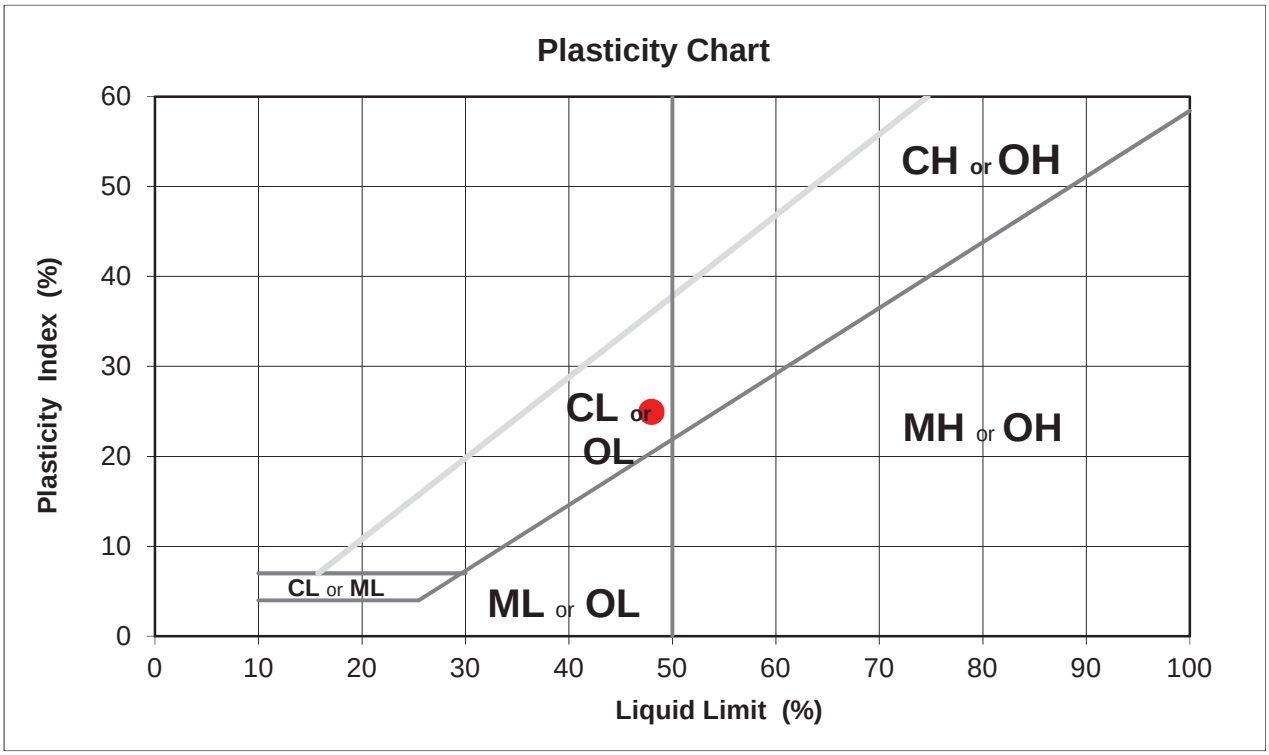
TETRA TECH BAS GEOSCIENCE

ATTERBERG LIMITS

ASTM D4318

Job Name:	Carriage Crest Park water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET-16-101E	**Date Completed:**	10/27/2016
Tested By:	MG	**Sample Identification:**	B-3, SPT-4
Note:		**Sample Depth:**	7.5-9 ft
Sample Description:	Light Brownish Gray Native (CL)		

		PLASTIC LIMIT		LIQUID LIMIT			
Test No.		**1**	**2**	**1**	**2**	**3**	**4**
Number of Blows				36	24	15	
Container ID		F5	M1	P36	P8	S1	
Wet Weight of Soil + Cont.	*grams*	22.10	21.40	47.30	46.80	46.00	
Dry Weight of Soil + Cont.	*grams*	20.30	19.70	40.60	39.70	39.00	
Weight of Container	*grams*	12.40	12.40	25.80	25.10	25.10	
* Moisture Weight	*grams*	1.80	1.70	6.70	7.10	7.00	
* Weight of Dry Soil	*grams*	7.90	7.30	14.80	14.60	13.90	
*** Moisture Content**	*%*	**22.8**	**23.3**	**45.3**	**48.6**	**50.4**	



Plastic Limit	**23**
Liquid Limit	**48**
Plasticity Index	**25**

USCS Classification	**CL**

TETRA TECH BAS GEOSCIENCE

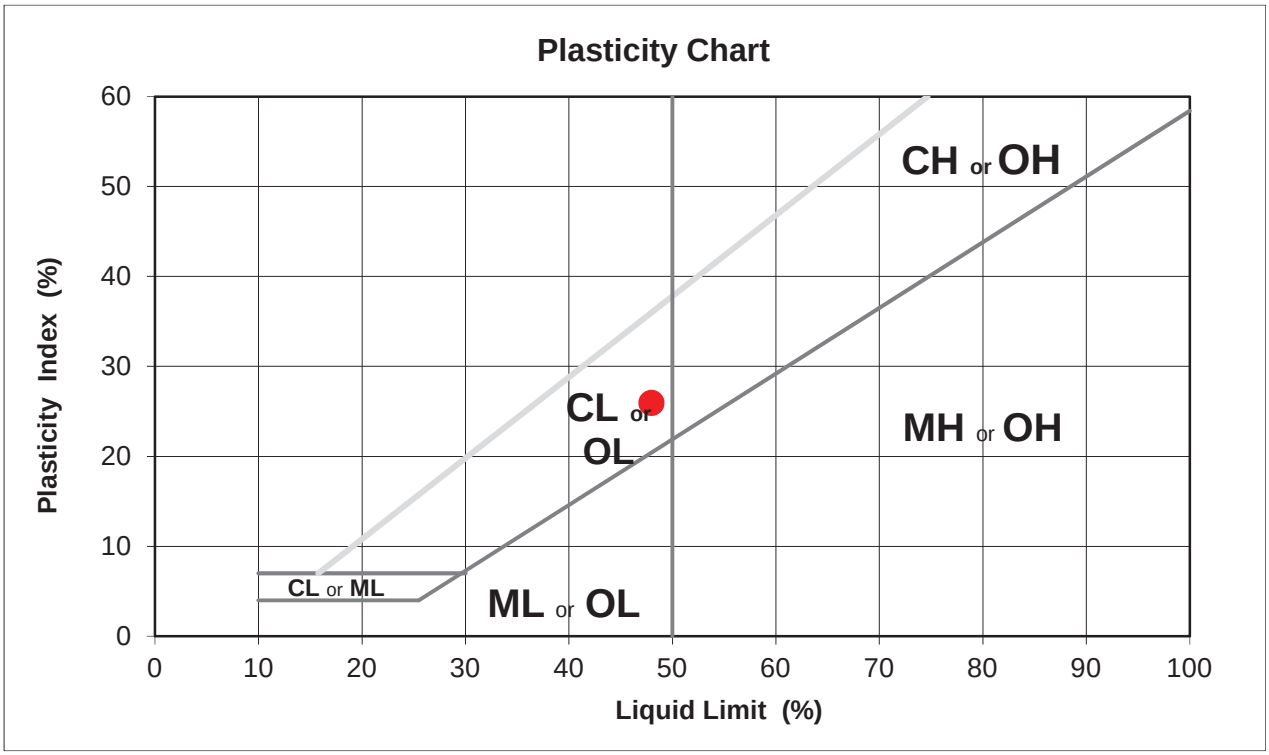
ATTERBERG LIMITS

ASTM D4318

Job Name:	Carriage Crest Park water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET-16-101E	**Date Completed:**	10/27/2016
Tested By:	MG	**Sample Identification:**	B-3, SPT-6
Note:		**Sample Depth:**	12.5-14 ft
Sample Description:	Dark Gray (CL)		

		PLASTIC LIMIT	
Test No.		**1**	**2**
Number of Blows			
Container ID		F8	A
Wet Weight of Soil + Cont.	*grams*	20.90	21.60
Dry Weight of Soil + Cont.	*grams*	19.40	19.90
Weight of Container	*grams*	12.40	12.40
* Moisture Weight	*grams*	1.50	1.70
* Weight of Dry Soil	*grams*	7.00	7.50
*** Moisture Content**	*%*	**21.4**	**22.7**

LIQUID LIMIT			
1	**2**	**3**	**4**
34	27	17	
T38	MP39	N6	
47.30	46.80	46.00	
40.60	39.70	39.00	
25.80	25.10	25.10	
6.70	7.10	7.00	
14.80	14.60	13.90	
45.3	**48.6**	**50.4**	



Plastic Limit	**22**
Liquid Limit	**48**
Plasticity Index	**26**

USCS Classification	**CL**

TETRA TECH BAS GEOSCIENCE

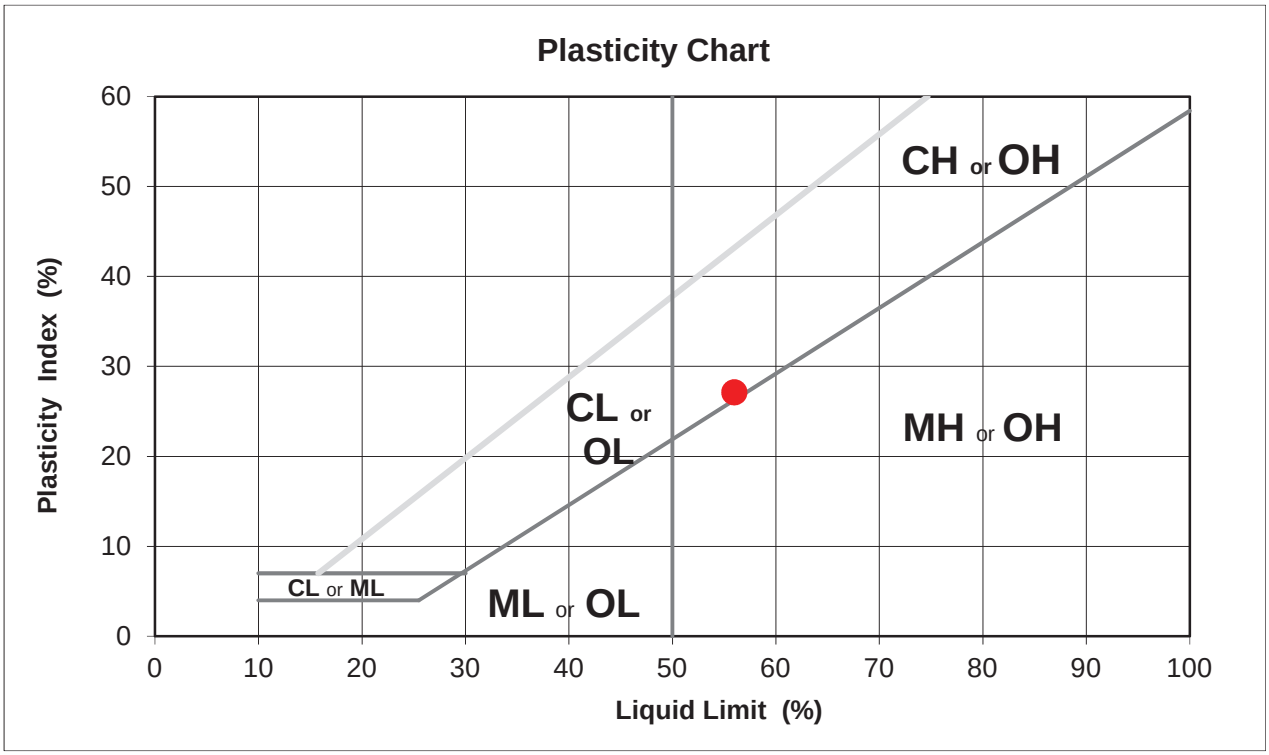
ATTERBERG LIMITS

ASTM D4318

Job Name:	Carriage Crest Park water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET-16-101E	**Date Completed:**	10/30/2016
Tested By:	MG	**Sample Identification:**	B-4, SPT-3
Note:		**Sample Depth:**	7.5-9 ft
Sample Description:	Dark Gray (CH)		

		PLASTIC LIMIT	
Test No.		**1**	**2**
Number of Blows			
Container ID		N4	P6
Wet Weight of Soil + Cont.	*grams*	24.00	24.00
Dry Weight of Soil + Cont.	*grams*	21.40	21.40
Weight of Container	*grams*	12.40	12.40
* Moisture Weight	*grams*	2.60	2.60
* Weight of Dry Soil	*grams*	9.00	9.00
*** Moisture Content**	*%*	**28.9**	**28.9**

LIQUID LIMIT			
1	**2**	**3**	**4**
34	23	18	
T38	M14	N10	
48.60	49.20	44.30	
40.70	40.70	37.30	
25.70	25.40	25.50	
7.90	8.50	7.00	
15.00	15.30	11.80	
52.7	**55.6**	**59.3**	



Plastic Limit	**29**
Liquid Limit	**56**
Plasticity Index	**27**

USCS Classification	**CH**

TETRA TECH BAS GEOSCIENCE

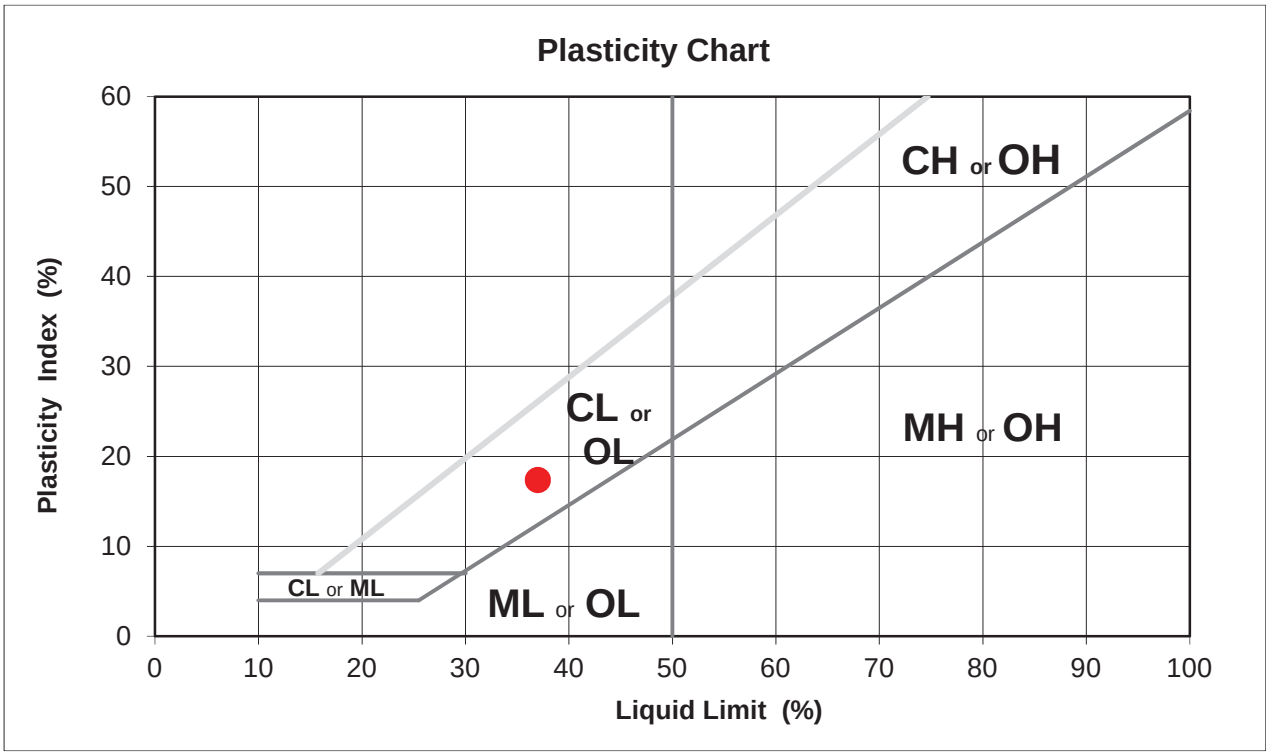
ATTERBERG LIMITS

ASTM D4318

Job Name:	Carriage Crest Park water Capture	**Date Sampled:**	9/30/2016
Job Number:	TET-16-101E	**Date Completed:**	10/30/2016
Tested By:	MG	**Sample Identification:**	B-5, SPT-5
Note:		**Sample Depth:**	12.5-14 ft
Sample Description:	Pale Olive Native (CL)		

		PLASTIC LIMIT	
Test No.		**1**	**2**
Number of Blows			
Container ID		F5	A
Wet Weight of Soil + Cont.	*grams*	21.50	22.20
Dry Weight of Soil + Cont.	*grams*	20.00	20.60
Weight of Container	*grams*	12.40	12.40
* Moisture Weight	*grams*	1.50	1.60
* Weight of Dry Soil	*grams*	7.60	8.20
*** Moisture Content**	*%*	**19.7**	**19.5**

LIQUID LIMIT			
1	**2**	**3**	**4**
35	26	15	
M39	P8	T16	
48.80	46.80	45.50	
42.70	41.10	39.80	
25.10	25.70	25.30	
6.10	5.70	5.70	
17.60	15.40	14.50	
34.7	**37.0**	**39.3**	



Plastic Limit	**20**
Liquid Limit	**37**
Plasticity Index	**17**

USCS Classification	**CL**

TETRA TECH BAS GEOSCIENCE

PERCENT PASSING # 200 SIEVE

ASTM D1140

Job Name:	Carriage Crest Park Water Capture	**Tested By :**	MG
Job Number:	TET-16-101E	**Date Completed:**	October 19, 2016
Address:			
Date Sampled:	September 30, 2016		

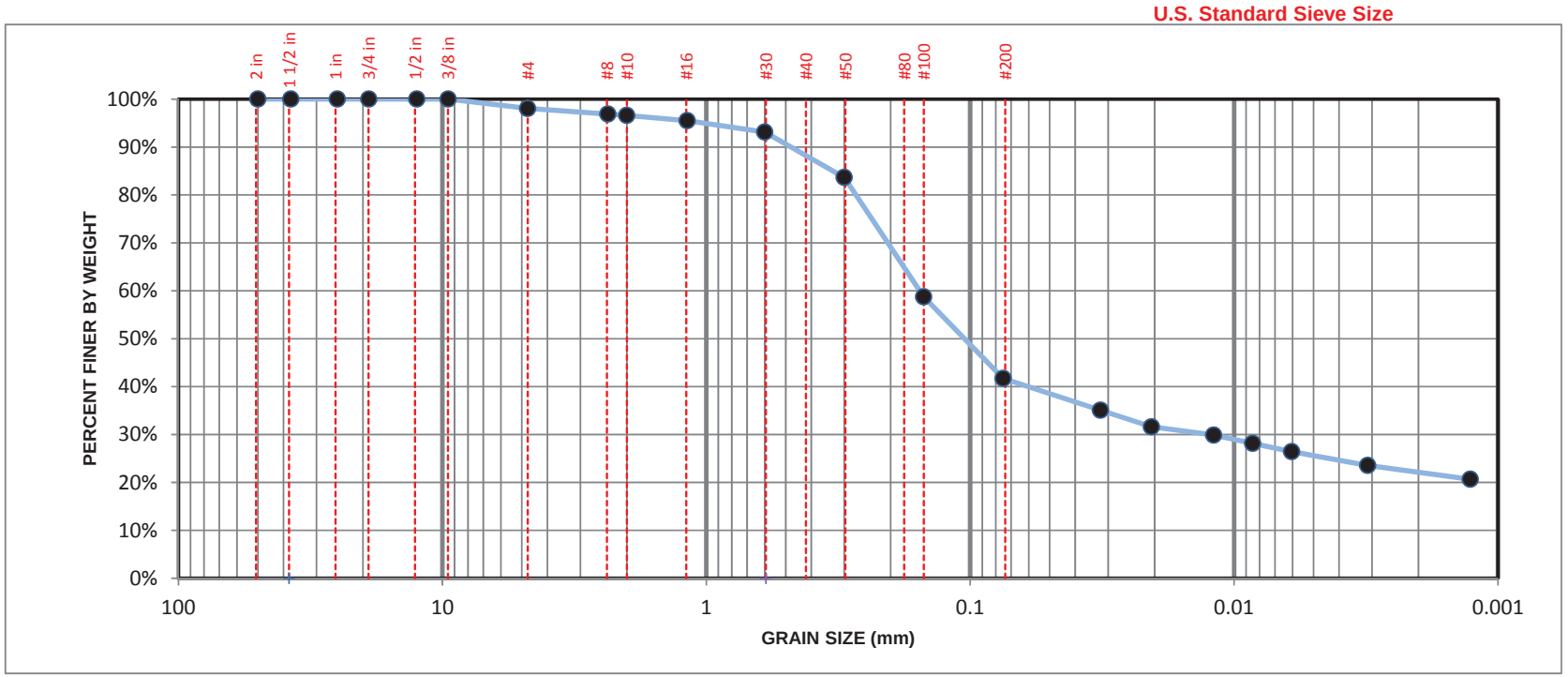
Boring Number	Sample Number	Depth (ft)	Percent Passing # 200 Sieve	USCS Classification
B-1	**SPT-3**	7.5-9	69	CL
B-1	**SPT-7**	17.5-19	56	CL
B-1	**SPT-12**	40-41.5	31	SM
B-3	**SPT-15**	50-51.5	10	SP-SM
B-5	**SPT-5**	12.5-14	51	ML
B-5	**SPT-9**	25-26.5	42	SM

TETRA TECH BAS GEOSCIENCE

GRAIN SIZE DISTRIBUTION ANALYSIS

ASTM C136/C117/D422

Job Name:	Carriage Crest Park Water Capture	**Tested By :**	MG
Job Number:	TET 16-101E	**Date Completed:**	October 19, 2016
Address:			
Date Sampled:	September 30, 2016		



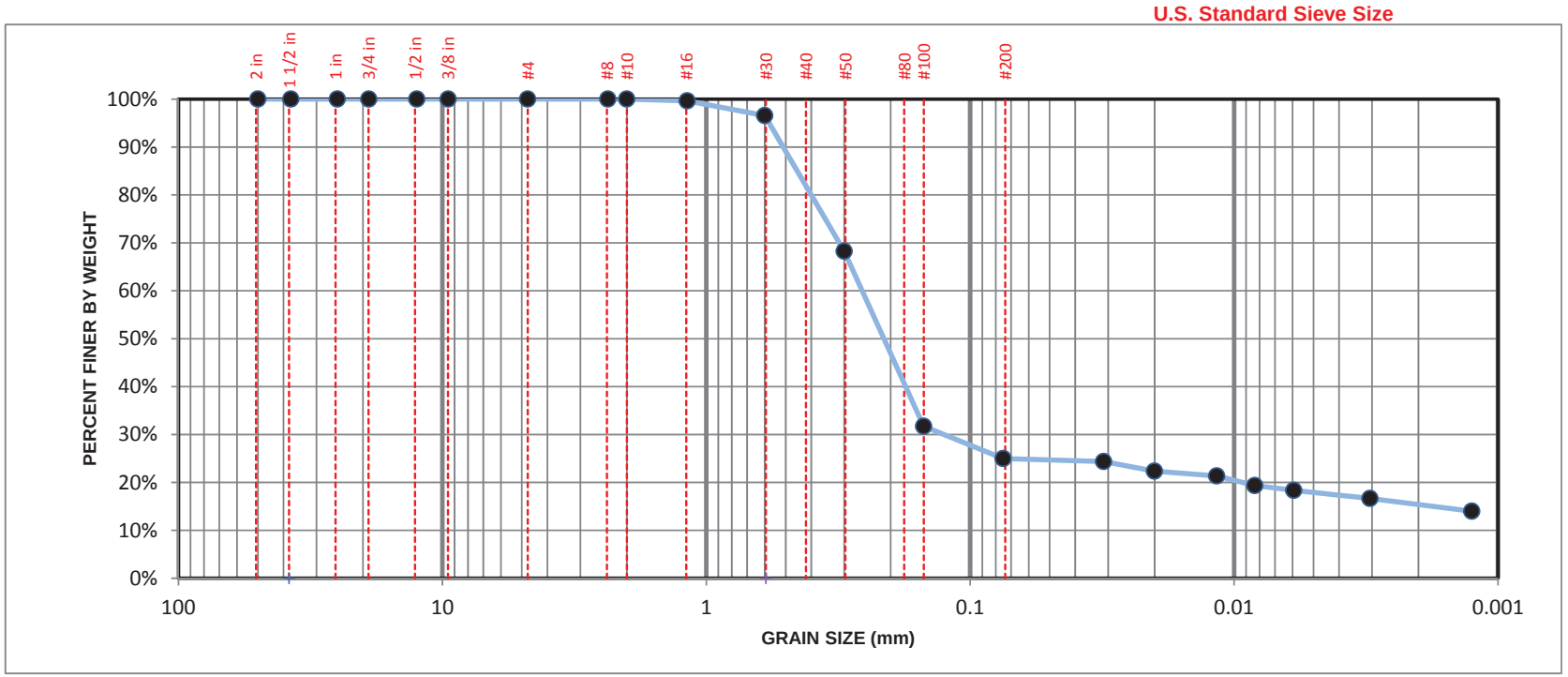
Symbol	Boring No.	Sample #	Deph (feet)	LL	PI	USCS	Gravel	Sand	Fines	2μ
●	B-3	R-3	6-6.5ft			**SM**	**2%**	**56%**	**42%**	**22%**

TETRA TECH BAS GEOSCIENCE

GRAIN SIZE DISTRIBUTION ANALYSIS

ASTM C136/C117/D422

Job Name:	Carriage Crest Park Water Capture	**Tested By :**	MG
Job Number:	TET 16-101E	**Date Completed:**	October 19, 2016
Address:			
Date Sampled:	September 30, 2016		



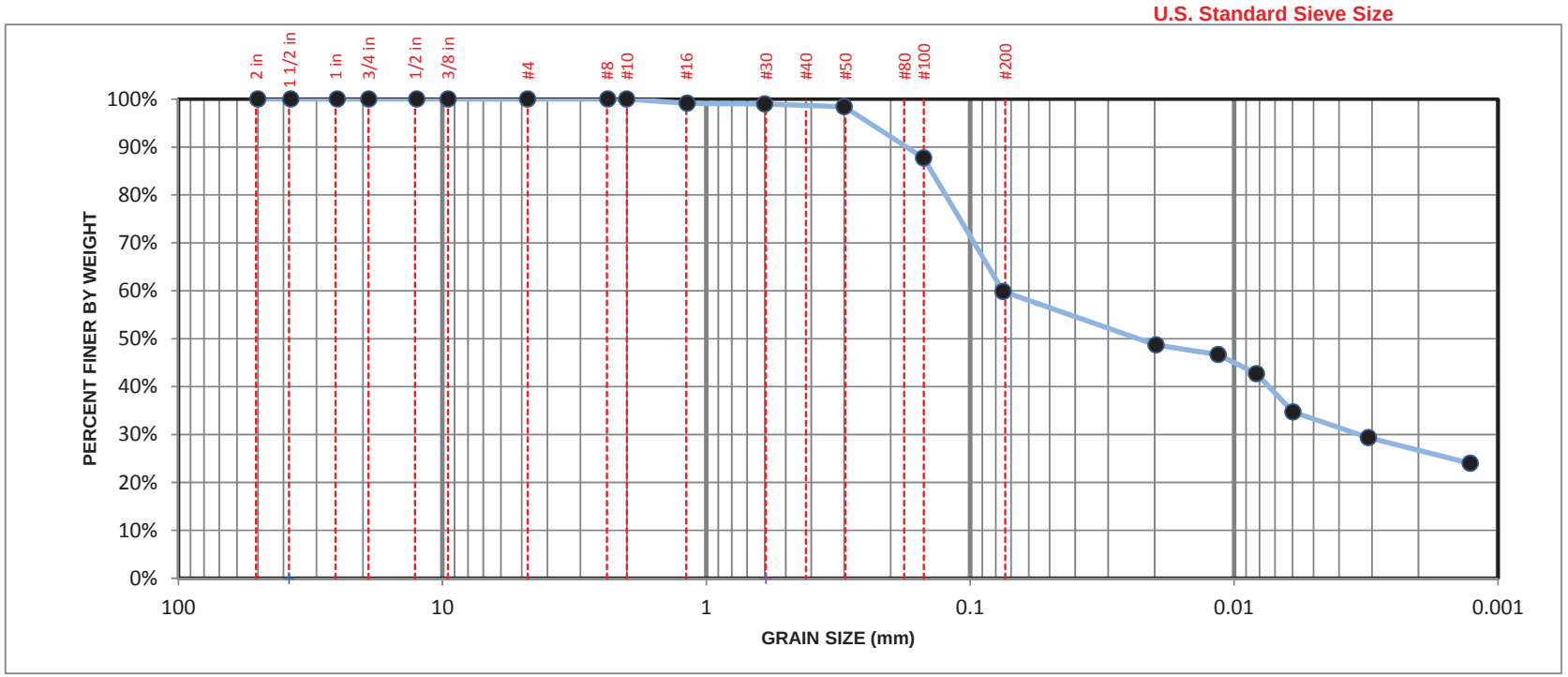
Symbol	Boring No.	Sample #	Deph (feet)	LL	PI	USCS	Gravel	Sand	Fines	2μ
●	B-3	SPT-12	35-36.5ft			**SM**	**0%**	**75%**	**25%**	**15%**

TETRA TECH BAS GEOSCIENCE

GRAIN SIZE DISTRIBUTION ANALYSIS

ASTM C136/C117/D422

Job Name:	Carriage Crest Park Water Capture	**Tested By :**	MG
Job Number:	TET 16-101E	**Date Completed:**	October 19, 2016
Address:			
Date Sampled:	September 30, 2016		



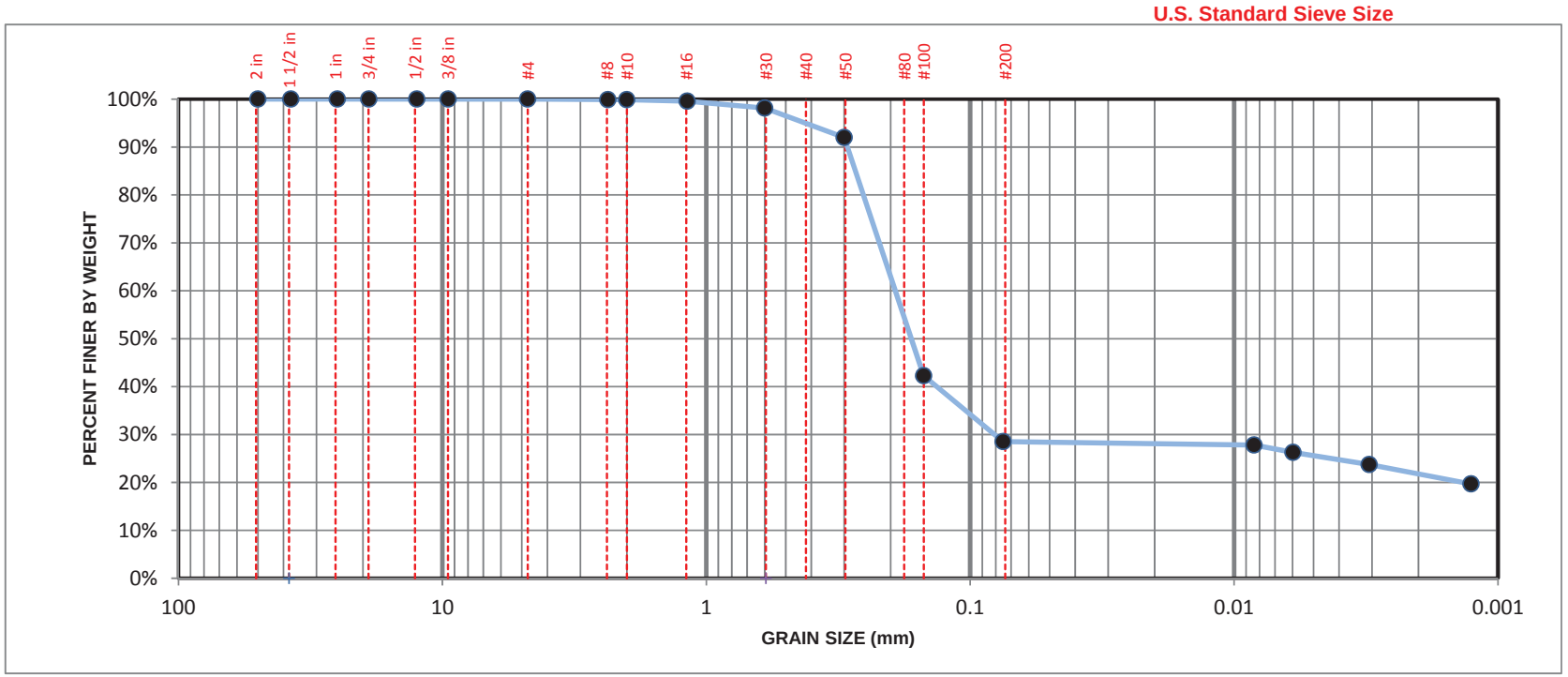
Symbol	Boring No.	Sample #	Deph (feet)	LL	PI	USCS	Gravel	Sand	Fines	2µ
●	B-3	SPT-14	45-46.5ft			**ML**	**0%**	**40%**	**60%**	**26%**

TETRA TECH BAS GEOSCIENCE

GRAIN SIZE DISTRIBUTION ANALYSIS

ASTM C136/C117/D422

Job Name:	Carriage Crest Park Water Capture	**Tested By :**	MG
Job Number:	TET 16-101E	**Date Completed:**	October 19, 2016
Address:			
Date Sampled:	September 30, 2016		



Symbol	Boring No.	Sample #	Deph (feet)	LL	PI	USCS	Gravel	Sand	Fines	2µ
●	B-5	SPT-7	17.5-19ft			**SM**	**0%**	**71%**	**29%**	**22%**

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

EXPANSION INDEX
(ASTM D4829)

Client: Tetra Tech ***HAI Project No.:*** TRT-16-017

Project Name: Carriage Crest Park Water Capture ***Tested by:*** KL

Project No.: TET 16-101E ***Checked by:*** MZ

Boring No.: B-3 ***Sample No.:*** SK-1 ***Depth:*** 0-5' ***Date:*** 10/24/2016

Soil Description: Dark Brown, Clayey Sand (SC)

MOLDED SPECIMEN		
Wt. of wet soil + cont.	**170.46**	g
Wt. of dry soil + cont.	**155.81**	g
Wt. of container	**12.08**	g
Wt. of water	**14.65**	g
Wt. of dry soil	**143.73**	g
Moisture Content	**10.2**	%
Wt. of wet soil + ring	**587.88**	g
Wt. of ring	**201.99**	g
Wt. of wet soil	**385.89**	g
Wet density of soil	**116.9**	pcf
Dry density of soil	**106.1**	pcf
Specific gravity of soil	**2.65**	pcf
Saturation	**48.4**	%

MOISTURE CONTENT AFTER TEST		
Wt. of wet soil + cont.	**634.42**	g
Wt. of dry soil + cont.	**551.70**	g
Wt. of container	**201.99**	g
Wt. of water	**82.72**	g
Wt. of dry soil	**349.71**	g
Moisture Content	**23.7**	%

Date & time	Elapsed time (min)	Dial Reading	Δh, Expansion
10/12/2016 13:38	0	0	
10/12/2016 13:48	10	-0.0008	
Add distilled water to sample			
10/14/2016 13:38	2880	0.0543	0.0551

Expansion Index = 55

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

EXPANSION INDEX
(ASTM D4829)

Client: Tetra Tech ***HAI Project No.:*** TRT-16-017

Project Name: Carriage Crest Park Water Capture ***Tested by:*** KL

Project No.: TET 16-101E ***Checked by:*** MZ

Boring No.: B-3 ***Sample No.:*** SPT-10 ***Depth:*** 25-26.5' ***Date:*** 10/24/2016

Soil Description: Olive, Sandy Lean Clay (CL)

MOLDED SPECIMEN		
Wt. of wet soil + cont.	**72.39**	g
Wt. of dry soil + cont.	**66.88**	g
Wt. of container	**11.04**	g
Wt. of water	**5.51**	g
Wt. of dry soil	**55.84**	g
Moisture Content	**9.9**	%
Wt. of wet soil + ring	**596.95**	g
Wt. of ring	**206.94**	g
Wt. of wet soil	**390.01**	g
Wet density of soil	**118.2**	pcf
Dry density of soil	**107.6**	pcf
Specific gravity of soil	**2.65**	pcf
Saturation	**48.7**	%

MOISTURE CONTENT AFTER TEST		
Wt. of wet soil + cont.	**649.64**	g
Wt. of dry soil + cont.	**557.64**	g
Wt. of container	**206.94**	g
Wt. of water	**92.00**	g
Wt. of dry soil	**350.70**	g
Moisture Content	**26.2**	%

Date & time	Elapsed time (min)	Dial Reading	Δh, Expansion
10/12/2016 14:23	0	0	
10/12/2016 14:33	10	-0.0013	
Add distilled water to sample			
10/14/2016 14:23	2880	0.0695	0.0708

Expansion Index = 71

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

EXPANSION INDEX
(ASTM D4829)

Client: Tetra Tech ***HAI Project No.:*** TRT-16-017

Project Name: Carriage Crest Park Water Capture ***Tested by:*** KL

Project No.: TET 16-101E ***Checked by:*** MZ

Boring No.: B-4 ***Sample No.:*** SPT-5 ***Depth:*** 12.5-14' ***Date:*** 10/24/2016

Soil Description: Dark Brown, Fat Clay (CH)

MOLDED SPECIMEN		
Wt. of wet soil + cont.	**141.23**	g
Wt. of dry soil + cont.	**126.37**	g
Wt. of container	**11.60**	g
Wt. of water	**14.86**	g
Wt. of dry soil	**114.77**	g
Moisture Content	**12.9**	%
Wt. of wet soil + ring	**556.99**	g
Wt. of ring	**190.87**	g
Wt. of wet soil	**366.12**	g
Wet density of soil	**110.9**	pcf
Dry density of soil	**98.2**	pcf
Specific gravity of soil	**2.65**	pcf
Saturation	**50.2**	%

MOISTURE CONTENT AFTER TEST		
Wt. of wet soil + cont.	**656.56**	g
Wt. of dry soil + cont.	**511.65**	g
Wt. of container	**190.87**	g
Wt. of water	**144.91**	g
Wt. of dry soil	**320.78**	g
Moisture Content	**45.2**	%

Date & time	Elapsed time (min)	Dial Reading	Δh, Expansion
10/12/2016 14:01	0	0	
10/12/2016 14:11	10	-0.0014	
Add distilled water to sample			
10/21/2016 14:01	12960	0.2793	0.2807

Expansion Index = 281

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST
(ASTM D2435)

Client : Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project No.: TET 16-101E

HAI Project No.: TRT-16-017
Tested by: KL
Checked by: MZ
Date: 10/24/2016

Boring No.: B-3 ***Sample No.:*** R-9 ***Depth:*** 21-21.5'
Soil Description: Yellowish Brown, Silty Sand (SM)
Type of Sample: Undisturbed Ring

Initial Total Weight (g)	Final Total Weight (g)	Final Dry Weight (g)
147.32	150.71	127.36

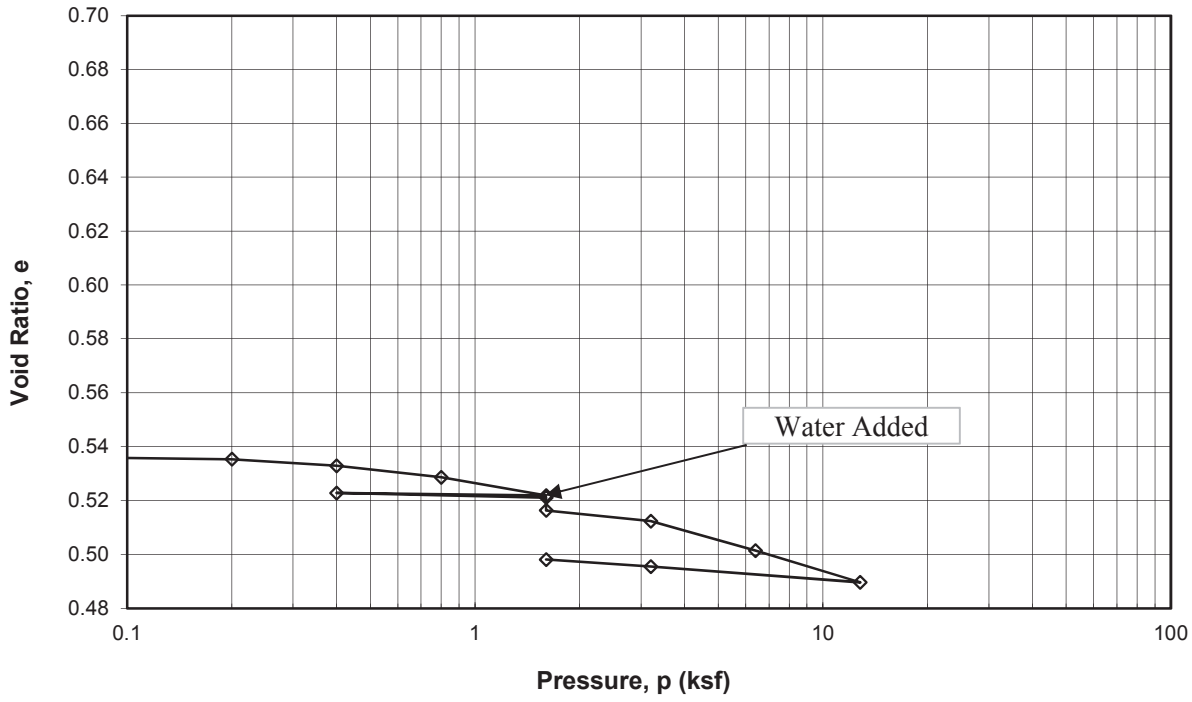
			Initial Conditions	Final Conditions
Height	**H**	**(in)**	1.0025	0.9768
Height of Solids	**Hs**	**(in)**	0.652	0.652
Height of Water	**Hw**	**(in)**	0.266	0.311
Height of Air	**Ha**	**(in)**	0.085	0.014
Dry Density		**(pcf)**	**105.5**	**108.3**
Water Content		**(%)**	**15.7**	**18.3**
Saturation		**(%)**	**75.8**	**95.7**

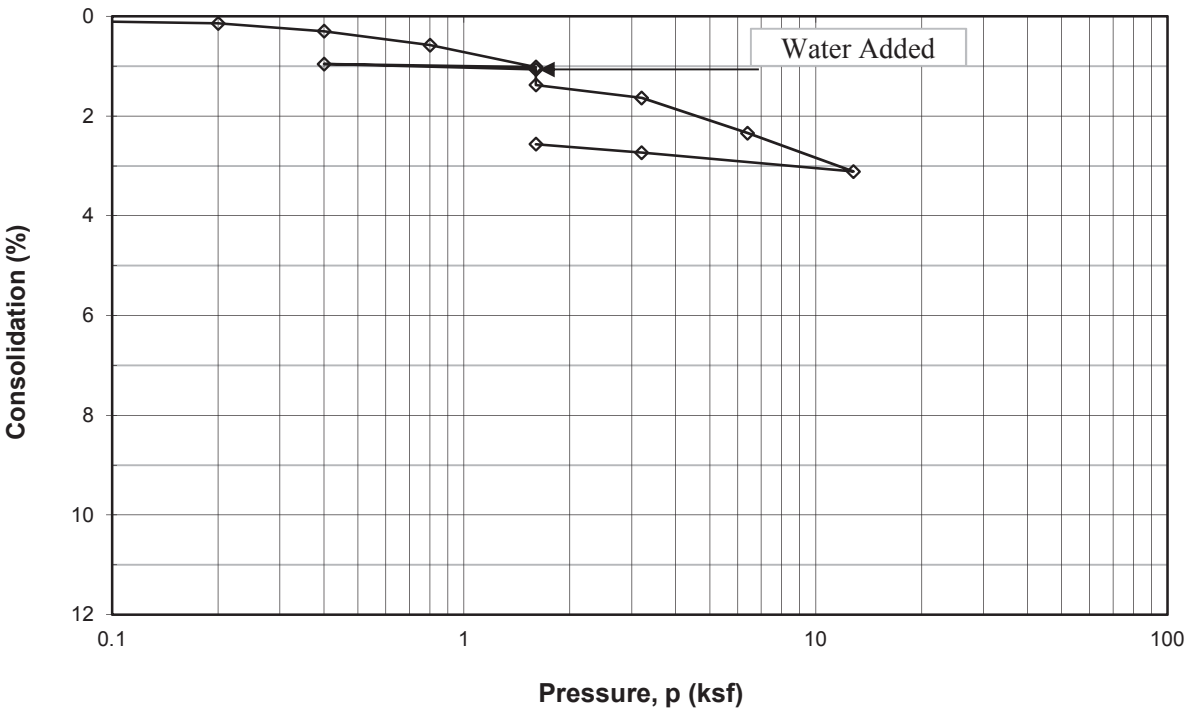
Load (ksf)	δH (in)	H (in)	Voids (in)	e	Consol. (%)	t_{50} (sec)	a_v $(ksf)^{-1}$	M_v $(ksf)^{-1}$	
0.01	-------	1.0025	0.350	0.537	0				
0.2	0.0014	1.0011	0.349	0.535	0.1		1.1E-02	7.4E-03	
0.4	0.0030	0.9995	0.347	0.533	0.3		1.2E-02	8.0E-03	
0.8	0.0058	0.9967	0.345	0.529	0.6		1.1E-02	7.0E-03	
1.6	0.0102	0.9923	0.340	0.522	1.0		8.4E-03	5.5E-03	
0.4	0.0096	0.9929	0.341	0.523	1.0	**UNLOAD**			
1.6	0.0107	0.9918	0.340	0.521	1.1		1.4E-03	9.2E-04	
1.6	0.0138	0.9887	0.337	0.516	1.4	**Water Added**			
3.2	0.0164	0.9861	0.334	0.512	1.6		2.5E-03	1.6E-03	
6.4	0.0235	0.9790	0.327	0.501	2.3		3.4E-03	2.3E-03	
12.8	0.0312	0.9713	0.319	0.490	3.1		1.8E-03	1.2E-03	
3.2	0.0274	0.9751	0.323	0.495	2.7	**UNLOAD**			
1.6	0.0257	0.9768	0.325	0.498	2.6				

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST
(ASTM D2435)

Client: Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project No.: TET 16-101E
Boring No.: B-3 ***Sample No.:*** R-9 ***Depth:*** 21-21.5'
Soil Description: Yellowish Brown, Silty Sand (SM)
Type of Sample: Undisturbed Ring





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST
(ASTM D2435)

Client : Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project No.: TET 16-101E

HAI Project No.: TRT-16-017
Tested by: KL
Checked by: MZ
Date: 10/24/2016

Boring No.: B-4 ***Sample No.:*** R-8 ***Depth:*** 21-21.5'
Soil Description: Olive, Lean Clay with Sand (CL)
Type of Sample: Undisturbed Ring

Initial Total Weight (g)	Final Total Weight (g)	Final Dry Weight (g)
156.95	152.07	127.96

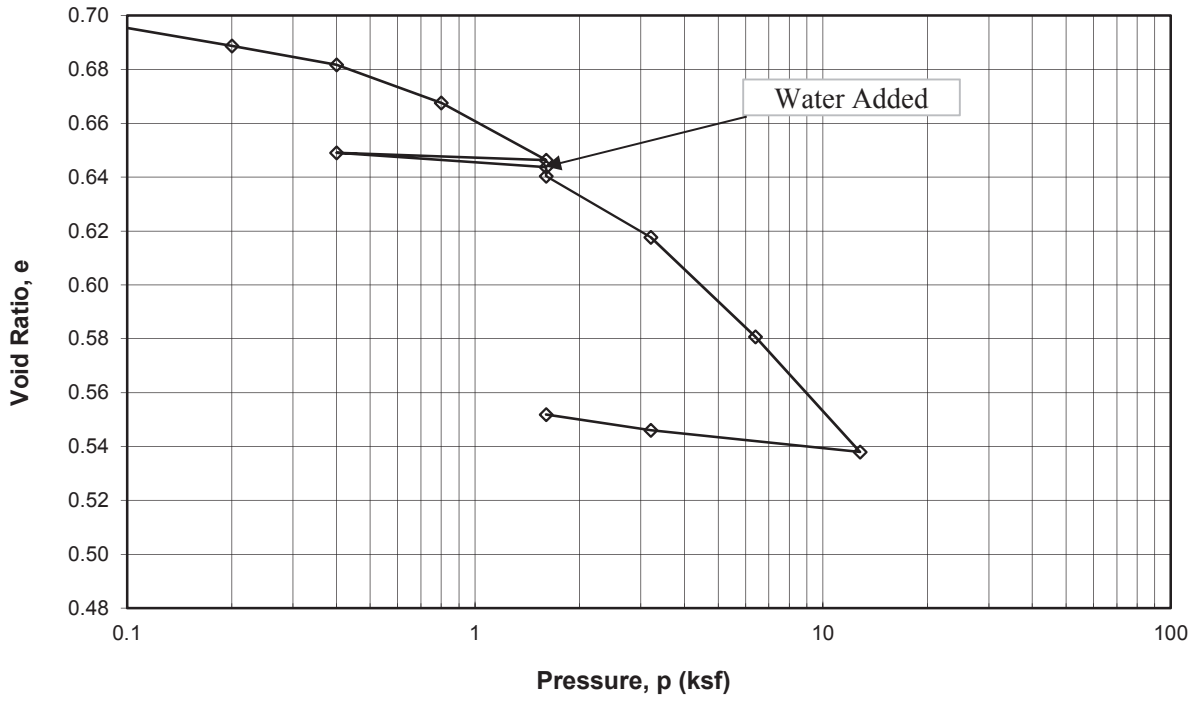
			Initial Conditions	Final Conditions
Height	**H**	**(in)**	0.9988	0.9025
Height of Solids	**Hs**	**(in)**	0.582	0.582
Height of Water	**Hw**	**(in)**	0.386	0.321
Height of Air	**Ha**	**(in)**	0.031	0.000
Dry Density		**(pcf)**	**106.4**	**117.8**
Water Content		**(%)**	**22.7**	**18.8**
Saturation		**(%)**	**92.5**	**100.0**

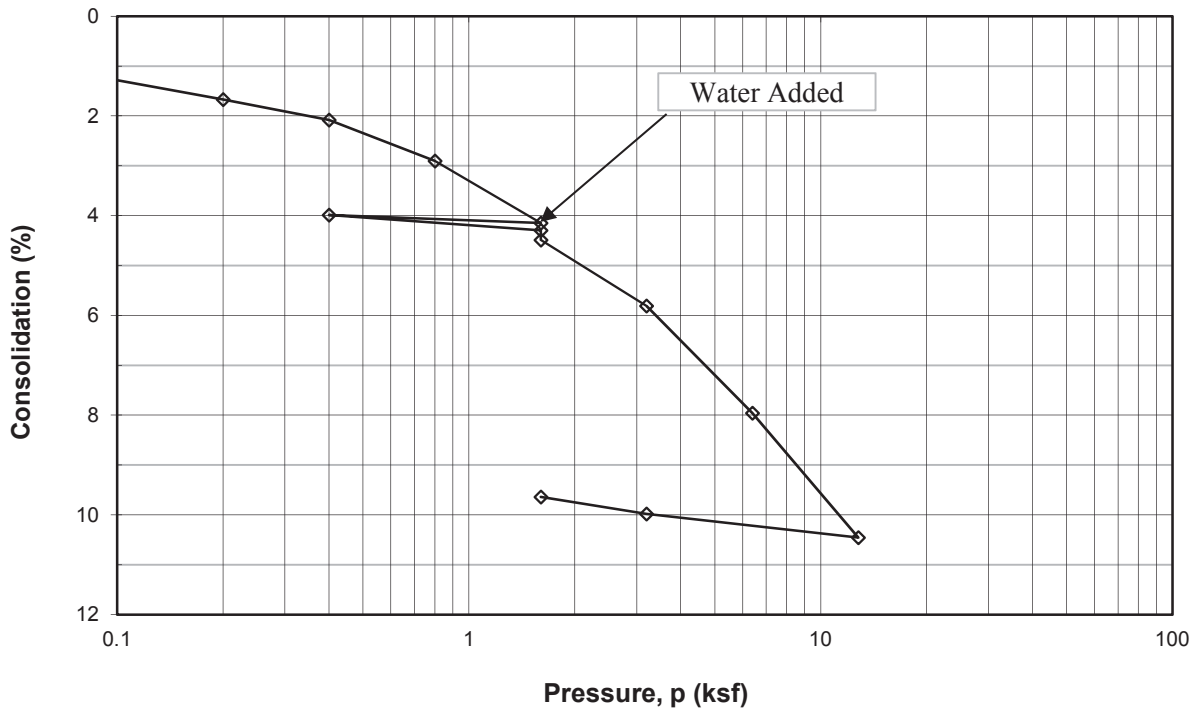
Load (ksf)	δH (in)	H (in)	Voids (in)	e	Consol. (%)	t_{50} (sec)	a_v $(ksf)^{-1}$	M_v $(ksf)^{-1}$	
0.01	-------	0.9988	0.417	0.717	0				
0.2	0.0167	0.9821	0.401	0.689	1.7		1.5E-01	9.0E-02	
0.4	0.0208	0.9780	0.396	0.682	2.1		3.5E-02	2.1E-02	
0.8	0.0290	0.9698	0.388	0.668	2.9		3.5E-02	2.1E-02	
1.6	0.0414	0.9574	0.376	0.646	4.1		2.7E-02	1.6E-02	
0.4	0.0398	0.9590	0.377	0.649	4.0	**UNLOAD**			
1.6	0.0429	0.9559	0.374	0.644	4.3		4.4E-03	2.7E-03	
1.6	0.0448	0.9540	0.372	0.640	4.5	**Water Added**			
3.2	0.0580	0.9408	0.359	0.618	5.8		1.4E-02	8.8E-03	
6.4	0.0795	0.9193	0.338	0.581	8.0		1.2E-02	7.3E-03	
12.8	0.1044	0.8944	0.313	0.538	10.5		6.7E-03	4.4E-03	
3.2	0.0997	0.8991	0.318	0.546	10.0	**UNLOAD**			
1.6	0.0963	0.9025	0.321	0.552	9.6				

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

CONSOLIDATION TEST
(ASTM D2435)

Client: Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project No.: TET 16-101E
Boring No.: B-4 ***Sample No.:*** R-8 ***Depth:*** 21-21.5'
Soil Description: Olive, Lean Clay with Sand (CL)
Type of Sample: Undisturbed Ring





HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

(ASTM D3080)

HAI Pr No.: TRT-16-017
Tested by: KL
Checked by: MZ
Date: 10/24/2016

Client: Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project Number: TET 16-101E

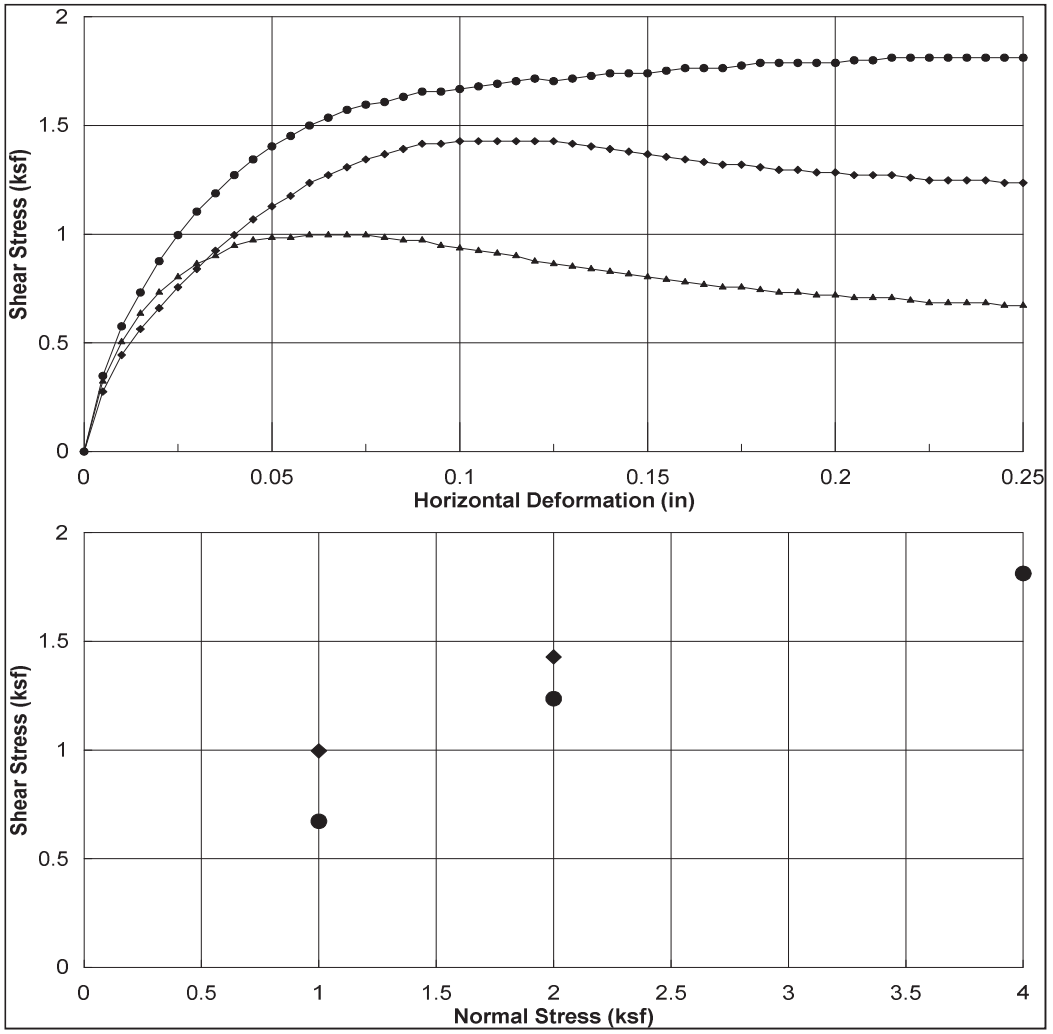
Boring No.: B-3

Sample No.: R-7

Depth (ft): 16-16.5'

Soil description: Brown, Lean Clay with Sand (CL)
Sample type: Undisturbed Ring

Type of test: Consolidated, Drained



	▲	◆	●
Normal Stress (ksf)	**1**	**2**	**4**
Deformation Rate (in/min)	**0.002**		

Peak Shear Stress (ksf) ◆	**1.00**	**1.43**	**1.81**
Shear stress @ end of test (ksf) ●	**0.67**	**1.24**	**1.81**

Initial height of sample (in)	**1**	**1**	**1**
Height of sample before shear (in)	**0.9967**	**0.9880**	**0.9642**
Diameter of sample (in)	**2.42**	**2.42**	**2.42**
Initial Moisture Content (%)	**22.2**	**22.2**	**22.2**
Final Moisture Content (%)	**24.4**	**23.3**	**22.1**
Dry Density (pcf)	**104.4**	**105.7**	**106.3**

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

DIRECT SHEAR TEST

(ASTM D3080)

HAI Pr No.: TRT-16-017
Tested by: KL
Checked by: MZ
Date: 10/24/2016

Client: Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project Number: TET 16-101E

Boring No.: B-4

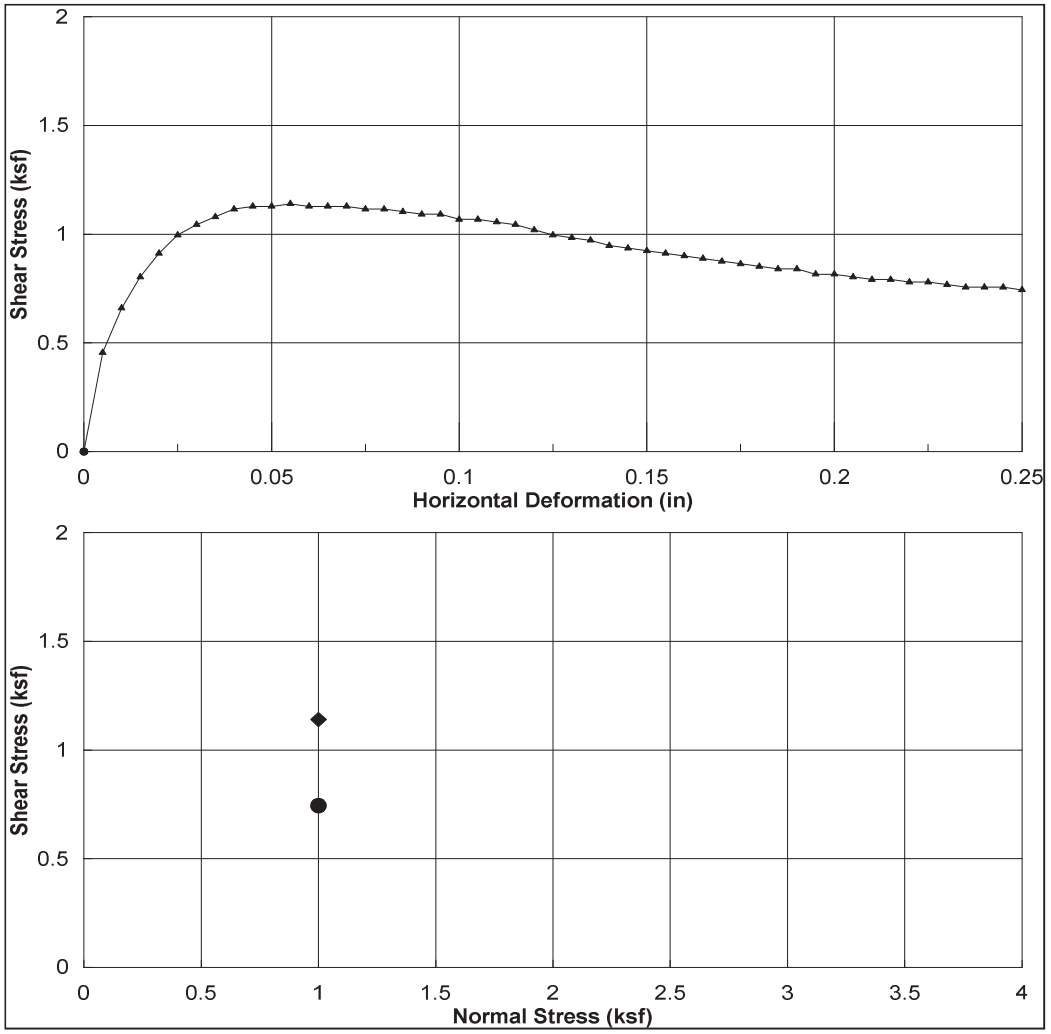
Sample No.: R-2

Depth (ft): 6-6.5'

Soil description: Brown, Sandy Lean Clay (CL)
Sample type: Undisturbed Ring

Type of test: Consolidated, Drained

	▲
Normal Stress (ksf)	**1**
Deformation Rate (in/min)	**0.002**
Peak Shear Stress (ksf) ◆	**1.14**
Shear stress @ end of test (ksf) ●	**0.74**
Initial height of sample (in)	**1**
Height of sample before shear (in)	**0.9937**
Diameter of sample (in)	**2.42**
Initial Moisture Content (%)	**15.9**
Final Moisture Content (%)	**18.3**
Dry Density (pcf)	**117.2**



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DIRECT SHEAR TEST

(ASTM D3080)

HAI Pr No.: TRT-16-017
Tested by: KL
Checked by: MZ
Date: 10/24/2016

Client: Tetra Tech
Project Name: Carriage Crest Park Water Capture
Project Number: TET 16-101E

Boring No.: B-4

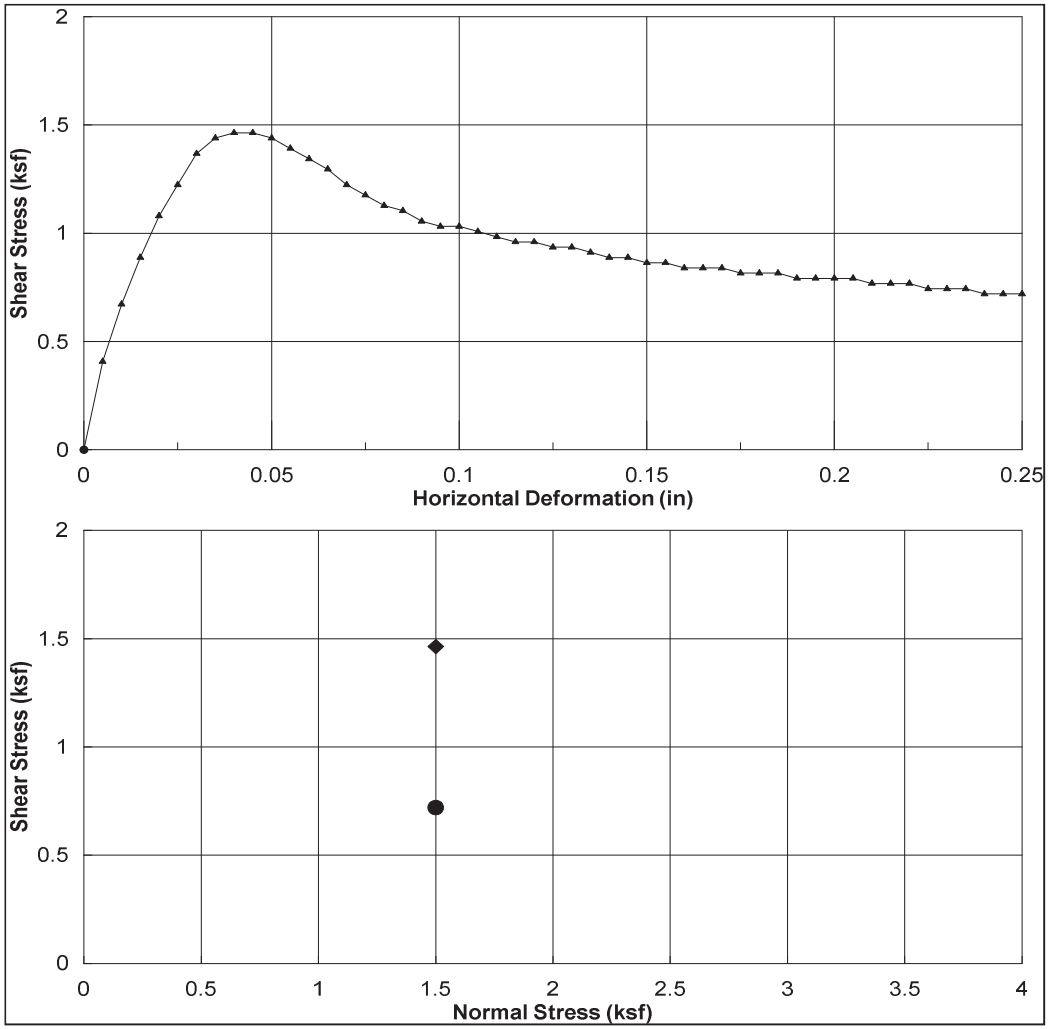
Sample No.: R-4

Depth (ft): 11-11.5'

Soil description: Olive Brown, Fat Clay with Sand (CH)
Sample type: Undisturbed Ring

Type of test: Consolidated, Drained

	▲
Normal Stress (ksf)	**1.5**
Deformation Rate (in/min)	**0.002**
Peak Shear Stress (ksf) ◆	**1.46**
Shear stress @ end of test (ksf) ●	**0.72**
Initial height of sample (in)	**1**
Height of sample before shear (in)	**0.9862**
Diameter of sample (in)	**2.42**
Initial Moisture Content (%)	**43.5**
Final Moisture Content (%)	**47.4**
Dry Density (pcf)	**74.2**



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Geotechnical and Earthquake Engineers

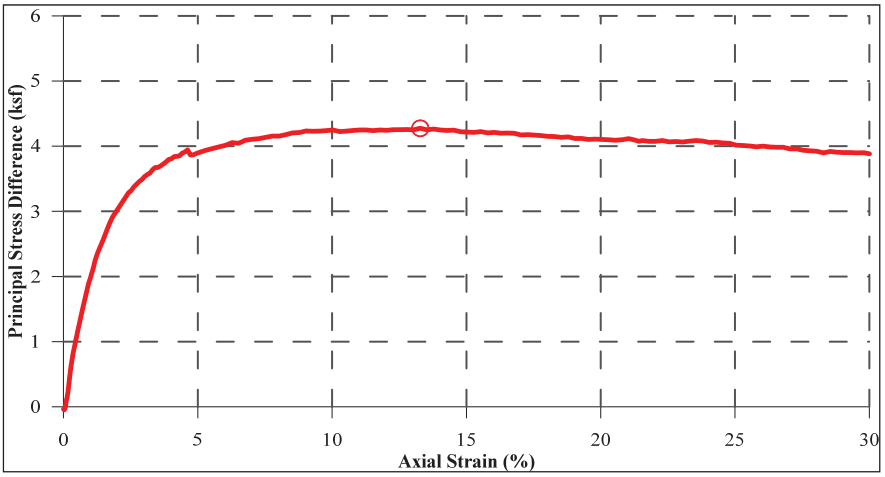
UNCONSOLIDATED UNDRAINED (UU) TRIAXIAL COMPRESSION TEST

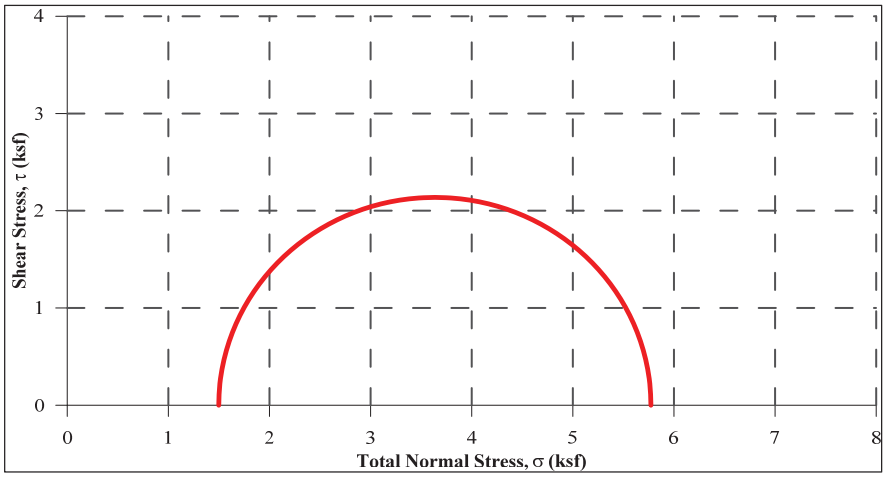
Project Name: Carriage Crest Park Water Capture
Project No.: TRT-16-017
Sample Type: Extruded from a 5" ring

Client: Tetra Tech
Project Location: ---
Tested By: KL
Checked by: MZ

Boring No.	Sample No.	Sample Description	Depth (ft)	Symbol	$\sigma_{d,f}$ (ksf)	ε_f (%)	$\sigma_{1,f}$ (ksf)	$\sigma_{3,f}$ (ksf)
B-3	R-5	Dark Olive, Fat Clay with Sand (CH)	11-11.5	○	4.27	13.28	5.77	1.50

Symbol		○
Sample		1
		Initial
Height	**(in.)**	5.07
Diameter	**(in.)**	2.41
Dry Density	**(pcf)**	106.4
Moisture Content	**(%)**	20.3





Tested in general accordance with
ASTM D2850

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

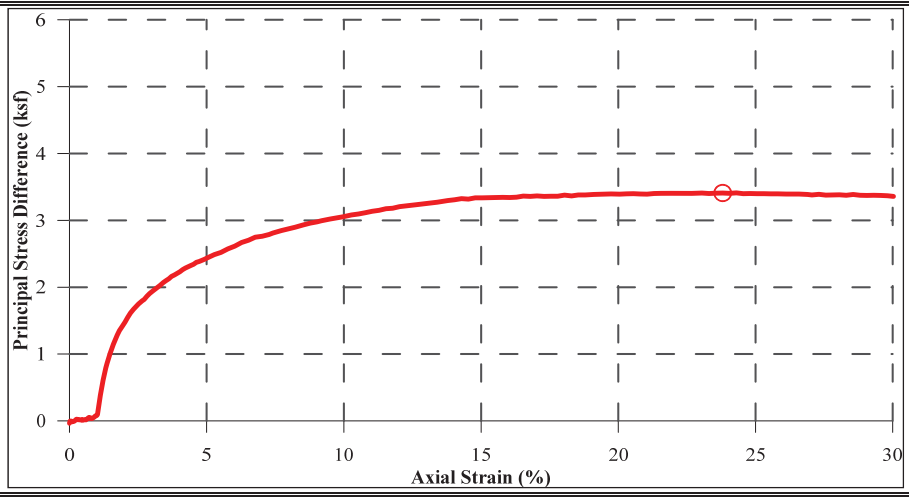
UNCONSOLIDATED UNDRAINED (UU) TRIAXIAL COMPRESSION TEST

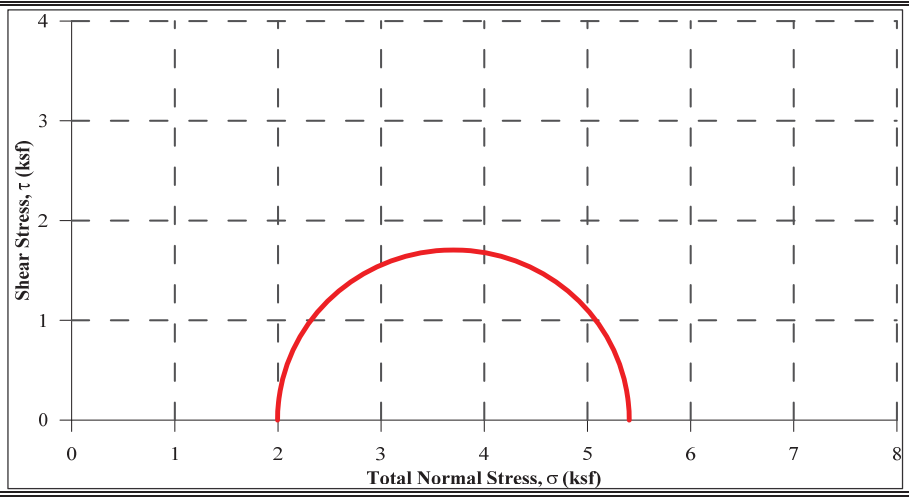
Project Name: Carriage Crest Park Water Capture
Project No.: TRT-16-017
Sample Type: Extruded from a 5" ring

Client: Tetra Tech
Project Location: ---
Tested By: KL
Checked by: MZ

Boring No.	Sample No.	Sample Description	Depth (ft)	Symbol	$\sigma_{d,f}$ (ksf)	ε_f (%)	$\sigma_{1,f}$ (ksf)	$\sigma_{3,f}$ (ksf)
B-4	R-6	Dark Olive, Fat Clay with Sand (CH)	16-16.5'	○	3.41	24.30	5.41	2.00

Symbol		○
Sample		1
		Initial
Height	**(in.)**	5.04
Diameter	**(in.)**	2.41
Dry Density	**(pcf)**	100.3
Moisture Content	**(%)**	20.0





Tested in general accordance with
ASTM D2850

Table 1 - Laboratory Tests on Soil Samples

Hushmand Associates
Carriage Crest Park Water Capture
Your #TRT-16-016, HDR Lab #16-0759LAB
21-Oct-16

Sample ID			B-3 SK-1 @ 0-5'	B-4 SPT-7 @ 17.5-19
Resistivity		**Units**		
as-received		ohm-cm	11,600	1,080
minimum		ohm-cm	680	480
pH			7.1	7.4
Electrical Conductivity		mS/cm	0.30	0.43
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	73	ND
magnesium	Mg^{2+}	mg/kg	23	21
sodium	Na^{1+}	mg/kg	263	460
potassium	K^{1+}	mg/kg	20	12
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	259	85
fluoride	F^{1-}	mg/kg	6.0	1.3
chloride	Cl^{1-}	mg/kg	69	213
sulfate	SO_4^{2-}	mg/kg	330	496
phosphate	PO_4^{3-}	mg/kg	6.3	4.2
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	ND	ND
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Minimum resistivity per CTM 643, Chlorides per CTM 422, Sulfates per CTM 417

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

Appendix D

Liquefaction Analyses

SPT LIQUEFACTION SUSCEPTIBILITY AND EARTHQUAKE INDUCED SETTLEMENT

You must input all fields highlighted in blue | Insert or delete rows only immediately above the red row.

This spreadsheet is suitable only for evaluation of liquefaction of SANDs.

If fines content greater than 50% is input, sensitivity of the fine-grained soils will be evaluated.

P_{atm} = 100 kPa = 2088.54 psf
σ_{ref} = 2000 psf
M_{base} = 7.5

Boring: B-1 | M 7.38 | PGA 0.65 | ==> | MSF 1.042 g

Boring Data

Depth to Layer Top	Depth to Layer Bottom	Groundwater present ? yes / no	Layer Thickness	Depth to layer middle	SPT - N	Fines % If NF > 50% NO LIQUEFACTION is present	Dry Unit Wt	Moisture Content	Total Unit Wt	Total Stress @ layer middle	Pore Pressure @ layer middle	Pore Pressure @ layer bottom	Effective Stress @ layer middle	Test for first groundwater
feet	feet		feet	feet	meters		%	pcf	%	pcf	psf	psf	psf	psf	
0	4	no	4.0	2.0	0.6	12	30.0	110	16.0	127.6	255	0.0	0.0	255	n/a
4	10	no	6.0	7.0	2.1	11	70.0	110	16.0	127.6	893	0.0	0.0	893	n/a
10	14.5	yes	4.5	12.3	3.7	18	70.0	109	19.0	129.7	1568	140.4	280.8	1427	10
14.5	17	yes	2.5	15.8	4.8	32	30.0	113	15.0	130.0	2022	358.8	436.8	1663	n/a
17	20	yes	3.0	18.5	5.6	16	56.0	110	16.0	127.6	2376	530.4	624.0	1846	n/a
20	25	yes	5.0	22.5	6.9	34	70.0	110	16.0	127.6	2886	780.0	936.0	2106	n/a
25	30	yes	5.0	27.5	8.4	26	31.0	96	26.0	121.0	3508	1092.0	1248.0	2416	n/a
30	35	yes	5.0	32.5	9.9	15	20.0	96	26.0	121.0	4113	1404.0	1560.0	2709	n/a
35	40	yes	5.0	37.5	11.4	34	20.0	96	26.0	121.0	4717	1716.0	1872.0	3001	n/a
40	45	yes	5.0	42.5	13.0	34	31.0	96	26.0	121.0	5322	2028.0	2184.0	3294	n/a
45	51.5	yes	6.5	48.3	14.7	32	5.0	110	10.0	121.0	6018	2386.8	2589.6	3631	n/a

Earthquake Loading — Cyclic Stress Ratio CSR

r_d	CSR	$CSR_{7.5}$
0.997	0.421	0.404
0.986	0.416	0.400
0.974	0.452	0.434
0.967	0.497	0.477
0.961	0.523	0.502
0.950	0.550	0.528
0.932	0.572	0.549
0.907	0.582	0.558
0.872	0.579	0.556
0.828	0.565	0.543
0.796	0.540	0.518
0.771	0.540	0.518

Derivation of $(N_1)_{60,CS}$

SPT Readings and Corrections (convert California sampler blowcounts into SPT and use SPT blowcounts only)

Correction for borehole diameter	D_B (in)	8	C_B 1.15
Correction for sampling method		no liner	C_S 1.2
Correction for energy ratio			C_E 1.35
Correction for rod length	$r_{stickup}$ (ft)	3	see C_R
Correction for effective overburden pressure			see C_N
Correction for % fines			see α, β

C_N	rod length	C_R	$(N_1)_{60}$	α	β	$(N_1)_{60,CS}$
2.000	1.5	0.75	33.5	4.706	1.154	43.4
1.529	3.0	0.75	23.5	5.000	1.200	33.2
1.210	4.6	0.85	34.5	5.000	1.200	46.4
1.121	5.7	0.85	56.8	4.706	1.154	70.3
1.064	6.6	0.95	30.1	5.000	1.200	41.1
0.996	7.8	0.95	59.9	5.000	1.200	76.9
0.930	9.3	0.95	43	4.770	1.163	54.5
0.878	10.8	1.00	25	3.615	1.079	30.1
0.834	12.3	1.00	53	3.615	1.079	60.7
0.796	13.9	1.00	50	4.770	1.163	63.4
0.758	15.6	1.00	45	0.000	1.000	45.2

Soil Earthquake Resistance — Cyclic Resistance Ratio CRR

K_σ	$CRR_{SPT,CS}$ Idriss	$CRR_{SPT,CS}$ Rauch	$CRR_{SPT,CS,K\sigma}$
1.000	no liq	no liq	no liq
1.000	no liq	no liq	no liq
1.000	no liq	no liq	no liq
1.000	no liq	no liq	no liq
1.000	no liq	no liq	no liq
0.994	no liq	no liq	no liq
0.971	no liq	no liq	no liq
0.951	no liq	0.475	0.452
0.932	no liq	no liq	no liq
0.914	no liq	no liq	no liq
0.894	no liq	no liq	no liq

Factor of Safety

Factor of Safety against Liquefaction

Total evaluated profile thickness 51.50 feet
Profile thickness susceptible to liquefaction 5.00 feet

not interpreted

$FS_{SPT,cs,K\sigma}$	Interpreted Factor of Safety against liquefaction	Liquefiable thickness	for plotting only
		ft	
no liq	Not liquefiable - no groundwater	0.00	5.00
no liq	Not liquefiable - no groundwater	0.00	5.00
no liq	Not liquefiable - fines > 50%	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
no liq	Not liquefiable - fines > 50%	0.00	5.00
no liq	Not liquefiable - fines > 50%	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
0.81	0.81 - liquefieable - FS < 1.3	5.00	0.81
no liq	Not liquefiable - too dense	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00

EARTHQUAKE-INDUCED SETTLEMENT OF SATURATED SAND

Earthquake-induced Settlement of Saturated Sand (fines < 50%) by Tokimatsu and Seed

Total liquefaction settlement 0.64 inches

Fines% Correction by Tokimatsu & Seed	$(N_1)_{60,CS,stlmnt}$	$CSR_{7.5}$	ε_v	Δz	$S_i = \varepsilon_{vi} \Delta z_i$	S_{cumul}
			%	feet	in	inches
8.00	41.5	0.404	0.00	4.00	no GW	0.00
9.00	32.5	0.400	0.00	6.00	no GW	0.00
9.00	43.5	0.434	0.00	4.50	not sand (%f > 50%)	0.00
8.00	64.8	0.477	0.00	2.50	0.00	0.00
9.00	39.1	0.502	0.00	3.00	not sand (%f > 50%)	0.00
9.00	68.9	0.528	0.00	5.00	not sand (%f > 50%)	0.00
8.00	50.8	0.549	0.00	5.00	0.00	0.00
2.00	26.5	0.558	1.07	5.00	0.64	0.64
5.00	57.8	0.556	0.00	5.00	0.00	0.64
8.00	58.4	0.543	0.00	5.00	0.00	0.64
3.00	48.2	0.518	0.00	6.50	0.00	0.64

EARTHQUAKE-INDUCED SETTLEMENT OF DRY SAND

Earthquake-induced Settlement of Dry Sand (fines < 50%) by Daniel Pradel

Total settlement of dry sand 0.02 inches

Multidirectional effect coefficient B = 2
Equivalent number of cycles N_c = 14.05

K_σ	σ_m	G_{max}	r_d	τ_{av}	a	b	γ	ε_{15}	ε_{Nc}	Δz	$S_i = \varepsilon_{vi} \Delta z_i$	S_{cumul}
		psf		psf						feet	in	in
0.50	170	916749	1.000	108	0.127	28075	0.046%	0.018%	0.018%	4.00	0.02	0.02
0.50	595	1568437	0.995	376	0.136	13240	0.089%	0.049%	0.047%	6.00	not sand (%f > 50%)	0.02
0.50	952	2216326	0.985	594	0.143	9993	0.072%	0.026%	0.026%	4.50	below GW	0.02
0.50	1109	2747662	0.976	686	0.146	9117	0.053%	0.012%	0.011%	2.50	below GW	0.02
0.50	1230	2421669	0.967	754	0.148	8566	0.085%	0.036%	0.035%	3.00	below GW	0.02
0.50	1404	3186675	0.952	847	0.151	7913	0.052%	0.010%	0.010%	5.00	below GW	0.02
0.50	1611	3042899	0.930	949	0.155	7288	0.068%	0.020%	0.020%	5.00	below GW	0.02
0.50	1806	2643475	0.905	1035	0.159	6805	0.111%	0.068%	0.066%	5.00	below GW	0.02
1.50	4002	4970264	0.877	1112	0.202	4221	0.028%	0.007%	0.007%	5.00	below GW	0.02
2.50	6588	6472460	0.847	1179	0.252	3130	0.021%	0.005%	0.005%	5.00	below GW	0.02
3.50	9683	7010196	0.811	1245	0.312	2484	0.020%	0.008%	0.007%	6.50	below GW	0.02

Settlement Distribution

Layer settlement (compression) both liquefied and dry sand	Distribution of Earthquake-induced settlement (top of layer)
	Surface settlement 0.66
S_{layer}	S_{cumul}
in	in
0.02	0.66
0.00	0.64
0.00	0.64
0.00	0.64
0.00	0.64
0.00	0.64
0.00	0.64
0.64	0.64
0.00	0.00
0.00	0.00
0.00	0.00

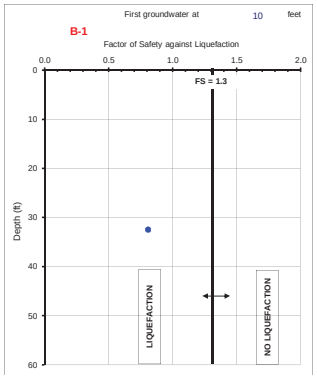
Summary of analysis

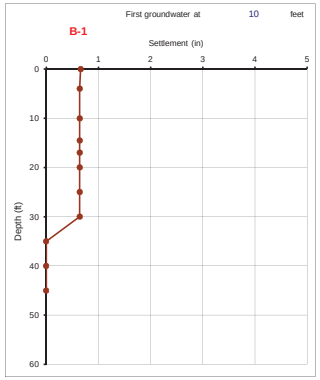
Boring B-1

Total liquefaction settlement	0.64 inches
Total dry sand settlement	0.02 inches
Total earthquake-induced settlement	0.66 inches
Number of evaluated intervals	11
Number of potentially liquefiable intervals	1
Average Factor of Safety	0.81
Depth to first groundwater	10.00 feet
Total thickness of evaluated profile	51.50 feet
Profile thickness susceptible to liquefaction	5.00 feet

Earthquake loading: M 7.38 | PGA 0.65

Depth to Layer Top	Depth to Layer Bottom	SPT - N	Fines %	$FS_{SPT,cs,K\sigma}$	Interpreted Factor of Safety against liquefaction		Settlement
feet	feet						in
0	4	12	30	no liq	Not liquefiable	- no groundwater	0.02
4	10	11	70	no liq	Not liquefiable	- no groundwater	0.00
10	14.5	18	70	no liq	Not liquefiable	- fines > 50%	0.00
14.5	17	32	30	no liq	Not liquefiable	- too dense	0.00
17	20	16	56	no liq	Not liquefiable	- fines > 50%	0.00
20	25	34	70	no liq	Not liquefiable	- fines > 50%	0.00
25	30	26	31	no liq	Not liquefiable	- too dense	0.00
30	35	15	20	0.81	0.81	- liquefieable - FS < 1.3	0.64
35	40	34	20	no liq	Not liquefiable	- too dense	0.00
40	45	34	31	no liq	Not liquefiable	- too dense	0.00
45	51.5	32	5	no liq	Not liquefiable	- too dense	0.00





SPT LIQUEFACTION SUSCEPTIBILITY AND EARTHQUAKE INDUCED SETTLEMENT

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P_{atm} = 100 kPa = 2088.54 psf
σ_{ref} = 2000 psf
M_{base} = 7.5

Boring: B-3 | M 7.38 | PGA 0.65 | ==> | MSF 1.042 g

Boring Data

Depth to Layer Top	Depth to Layer Bottom	Groundwater present ? yes / no	Layer Thickness	Depth to layer middle	SPT - N	Fines % If NF > 50% NO LIQUEFACTION is present	Dry Unit Wt	Moisture Content	Total Unit Wt	Total Stress @ layer middle	Pore Pressure @ layer middle	Pore Pressure @ layer bottom	Effective Stress @ layer middle	Test for first groundwater
feet	feet		feet	feet	meters		%	pcf	%	pcf	psf	psf	psf	psf	
0	7	no	7.0	3.5	1.1	12	30.0	113	15.0	130.0	455	0.0	0.0	455	n/a
7	10	no	3.0	8.5	2.6	12	70.0	96	15.0	110.4	1075	0.0	0.0	1075	n/a
10	15	yes	5.0	12.5	3.8	16	70.0	109	19.0	129.7	1565	156.0	312.0	1409	10
15	20	yes	5.0	17.5	5.3	11	70.0	105	22.0	128.1	2210	468.0	624.0	1742	n/a
20	25	yes	5.0	22.5	6.9	27	20.0	105	22.0	128.1	2850	780.0	936.0	2070	n/a
25	30	yes	5.0	27.5	8.4	22	65.0	116	10.0	127.6	3489	1092.0	1248.0	2397	n/a
30	35	yes	5.0	32.5	9.9	41	25.0	96	16.0	111.4	4087	1404.0	1560.0	2683	n/a
35	40	yes	5.0	37.5	11.4	50	25.0	96	16.0	111.4	4644	1716.0	1872.0	2928	n/a
40	45	yes	5.0	42.5	13.0	23	7.0	110	8.0	118.8	5219	2028.0	2184.0	3191	n/a
45	50	yes	5.0	47.5	14.5	19	20.0	116	10.0	127.6	5835	2340.0	2496.0	3495	n/a
50	51.5	yes	1.5	50.8	15.5	50	10.0	98	9.0	106.8	6234	2542.8	2589.6	3691	n/a

Earthquake Loading — Cyclic Stress Ratio CSR

r_d	CSR	$CSR_{7.5}$
0.994	0.420	0.403
0.982	0.415	0.398
0.974	0.457	0.439
0.963	0.516	0.495
0.950	0.553	0.530
0.933	0.573	0.550
0.907	0.584	0.560
0.872	0.584	0.561
0.828	0.572	0.549
0.778	0.549	0.527
0.745	0.532	0.510

Derivation of $(N_1)_{60,CS}$

SPT Readings and Corrections (convert California sampler blowcounts into SPT and use SPT blowcounts only)

Correction for borehole diameter	D_B (in)	8	C_B 1.15
Correction for sampling method		no liner	C_S 1.2
Correction for energy ratio			C_E 1.35
Correction for rod length	$r_{stickup}$ (ft)	3	see C_R
Correction for effective overburden pressure			see C_N
Correction for % fines			see α, β

C_N	rod length	C_R	$(N_1)_{60}$	α	β	$(N_1)_{60,CS}$
2.000	2.0	0.75	33.5	4.706	1.154	43.4
1.394	3.5	0.75	23.4	5.000	1.200	33.0
1.217	4.7	0.85	30.8	5.000	1.200	42.0
1.095	6.2	0.95	21.3	5.000	1.200	30.6
1.004	7.8	0.95	48.0	3.615	1.079	55.4
0.933	9.3	0.95	36.3	5.000	1.200	48.6
0.882	10.8	1.00	67	4.289	1.115	79.4
0.845	12.3	1.00	79	4.289	1.115	92.0
0.809	13.9	1.00	35	0.120	1.009	35.1
0.773	15.4	1.00	27	3.615	1.079	33.2
0.752	16.4	1.00	70	0.869	1.022	72.5

Soil Earthquake Resistance — Cyclic Resistance Ratio CRR

K_σ	$CRR_{SPT,CS}$ Idriss	$CRR_{SPT,CS}$ Rauch	$CRR_{SPT,CS,K\sigma}$
1.000	no liq	no liq	no liq
1.000	no liq	no liq	no liq
1.000	no liq	no liq	no liq
1.000	no liq	0.515	0.515
0.997	no liq	no liq	no liq
0.972	no liq	no liq	no liq
0.953	no liq	no liq	no liq
0.936	no liq	no liq	no liq
0.920	no liq	no liq	no liq
0.902	no liq	no liq	no liq
0.891	no liq	no liq	no liq

Factor of Safety

Factor of Safety against Liquefaction

Total evaluated profile thickness 51.50 feet
Profile thickness susceptible to liquefaction 0.00 feet

not interpreted

$FS_{SPT,cs,K\sigma}$	Interpreted Factor of Safety against liquefaction	Liquefiable thickness	for plotting only
		ft	
no liq	Not liquefiable - no groundwater	0.00	5.00
no liq	Not liquefiable - no groundwater	0.00	5.00
no liq	Not liquefiable - fines > 50%	0.00	5.00
1.04	Not liquefiable - fines > 50%	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
0.972	Not liquefiable - fines > 50%	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00
no liq	Not liquefiable - too dense	0.00	5.00

EARTHQUAKE-INDUCED SETTLEMENT OF SATURATED SAND

Earthquake-induced Settlement of Saturated Sand (fines < 50%) by Tokimatsu and Seed

Total liquefaction settlement 0.33 inches

Fines% Correction by Tokimatsu & Seed	$(N_1)_{60,CS,stlmnt}$	$CSR_{7.5}$	ε_v	Δz	$S_i = \varepsilon_{vi} \Delta z_i$	S_{cumul}
			%	feet	in	inches
8.00	41.5	0.403	0.00	7.00	no GW	0.00
9.00	32.4	0.398	0.16	3.00	no GW	0.00
9.00	39.8	0.439	0.00	5.00	not sand (%f > 50%)	0.00
9.00	30.3	0.495	0.78	5.00	not sand (%f > 50%)	0.00
5.00	53.0	0.530	0.00	5.00	0.00	0.00
9.00	45.3	0.550	0.00	5.00	not sand (%f > 50%)	0.00
7.00	74.4	0.560	0.00	5.00	0.00	0.00
7.00	85.7	0.561	0.00	5.00	0.00	0.00
3.00	37.7	0.549	0.00	5.00	0.00	0.00
5.00	32.4	0.527	0.56	5.00	0.33	0.33
3.00	73.1	0.510	0.00	1.50	0.00	0.33

EARTHQUAKE-INDUCED SETTLEMENT OF DRY SAND

Earthquake-induced Settlement of Dry Sand (fines < 50%) by Daniel Pradel

Total settlement of dry sand 0.04 inches

Multidirectional effect coefficient B = 2
Equivalent number of cycles N_c = 14.05

K_σ	σ_m	G_{max}	r_d	τ_{av}	a	b	γ	ε_{15}	ε_{Nc}	Δz	$S_i = \varepsilon_{vi} \Delta z_i$	S_{cumul}
		psf		psf						feet	in	in
0.50	303	1223861	0.999	192	0.130	19849	0.054%	0.021%	0.021%	7.00	0.04	0.04
0.50	717	1718076	0.993	451	0.138	11845	0.094%	0.052%	0.050%	3.00	not sand (%f > 50%)	0.04
0.50	939	2130789	0.985	586	0.142	10071	0.079%	0.032%	0.031%	5.00	below GW	0.04
0.50	1161	2130960	0.970	714	0.147	8869	0.113%	0.068%	0.066%	5.00	below GW	0.04
0.50	1380	2832459	0.952	833	0.151	7996	0.066%	0.019%	0.019%	5.00	below GW	0.04
0.50	1598	2917708	0.930	942	0.155	7322	0.074%	0.025%	0.025%	5.00	below GW	0.04
0.50	1789	3635380	0.905	1025	0.159	6844	0.051%	0.010%	0.009%	5.00	below GW	0.04
0.50	1952	3988342	0.877	1085	0.162	6494	0.046%	0.007%	0.007%	5.00	below GW	0.04
1.50	4255	4270084	0.847	1142	0.207	4069	0.036%	0.018%	0.018%	5.00	below GW	0.04
2.50	6990	5370964	0.816	1205	0.260	3021	0.027%	0.015%	0.014%	5.00	below GW	0.04
3.50	9844	8271010	0.795	1241	0.315	2460	0.017%	0.004%	0.003%	1.50	below GW	0.04

Settlement Distribution

Layer settlement (compression) both liquefied and dry sand	Distribution of Earthquake-induced settlement (top of layer)
	Surface settlement 0.37
S_{layer}	S_{cumul}
in	in
0.04	0.37
0.00	0.33
0.00	0.33
0.00	0.33
0.00	0.33
0.00	0.33
0.00	0.33
0.00	0.33
0.00	0.33
0.33	0.33
0.00	0.00

0.65
25.00 16.25

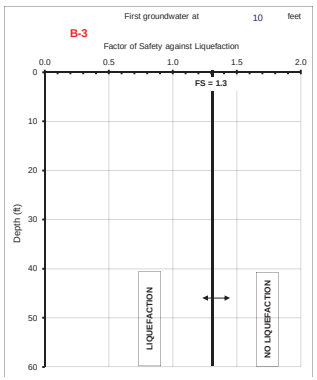
Summary of analysis

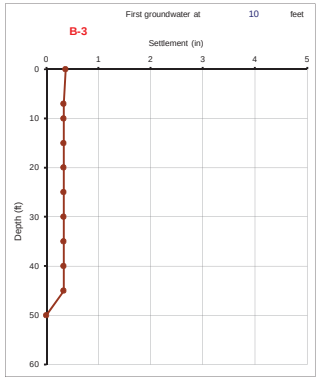
Boring B-3

Total liquefaction settlement	0.33 inches
Total dry sand settlement	0.04 inches
Total earthquake-induced settlement	0.37 inches
Number of evaluated intervals	11
Number of potentially liquefiable intervals	0
Average Factor of Safety	no liquefaction
Depth to first groundwater	10.00 feet
Total thickness of evaluated profile	51.50 feet
Profile thickness susceptible to liquefaction	0.00 feet

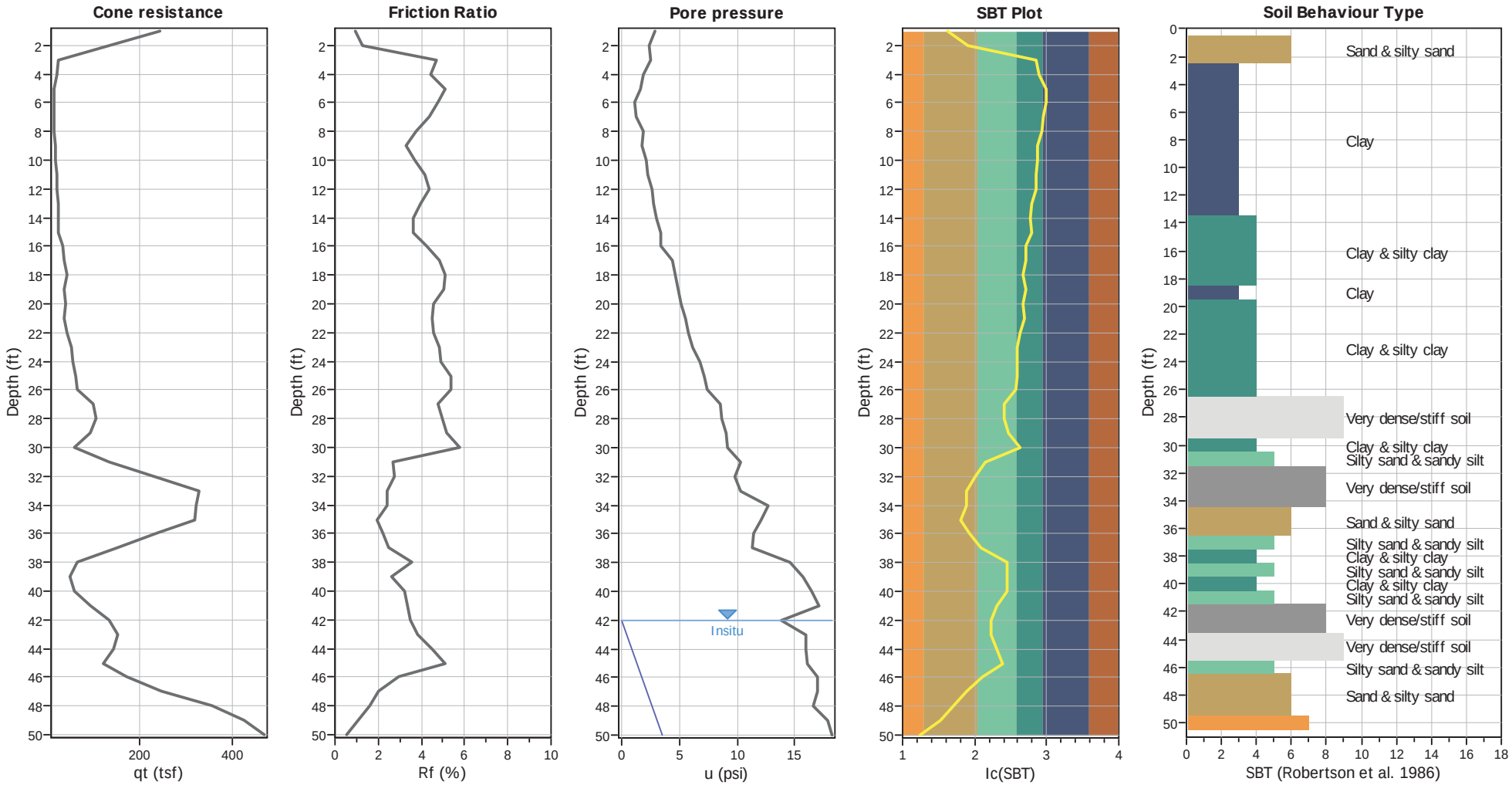
Earthquake loading: M 7.38 | PGA 0.65

Depth to Layer Top	Depth to Layer Bottom	SPT - N	Fines %	$FS_{SPT,cs,K\sigma}$	Interpreted Factor of Safety against liquefaction		Settlement
feet	feet						in
0	7	12	30	no liq	Not liquefiable	- no groundwater	0.04
7	10	12	70	no liq	Not liquefiable	- no groundwater	0.00
10	15	16	70	no liq	Not liquefiable	- fines > 50%	0.00
15	20	11	70	1.04	Not liquefiable	- fines > 50%	0.00
20	25	27	20	no liq	Not liquefiable	- too dense	0.00
25	30	22	65	no liq	Not liquefiable	- fines > 50%	0.00
30	35	41	25	no liq	Not liquefiable	- too dense	0.00
35	40	50	25	no liq	Not liquefiable	- too dense	0.00
40	45	23	7	no liq	Not liquefiable	- too dense	0.00
45	50	19	20	no liq	Not liquefiable	- too dense	0.33
50	51.5	50	10	no liq	Not liquefiable	- too dense	0.00





CPT basic interpretation plots



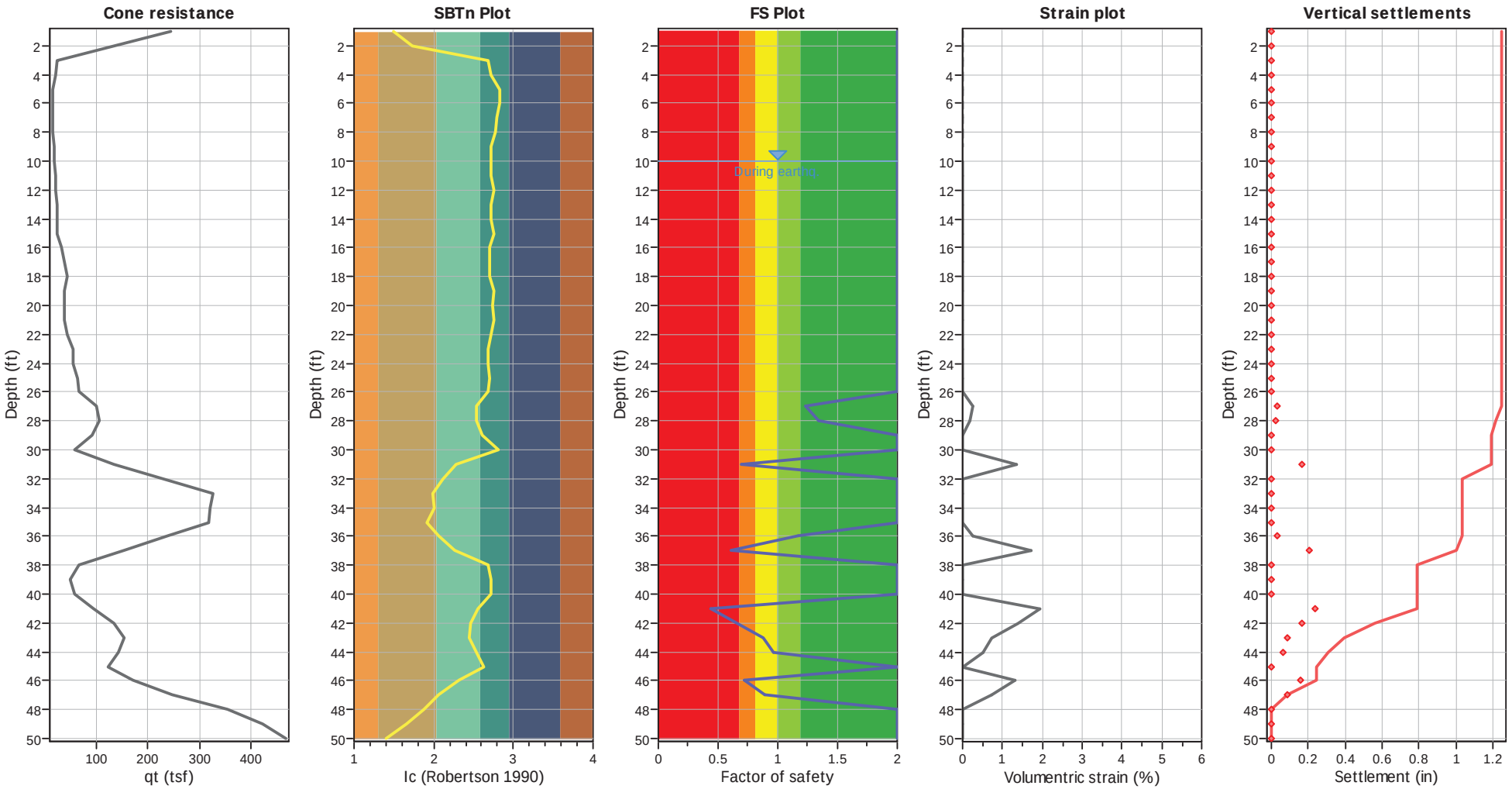
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	10.00 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:	7.38	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	42.00 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

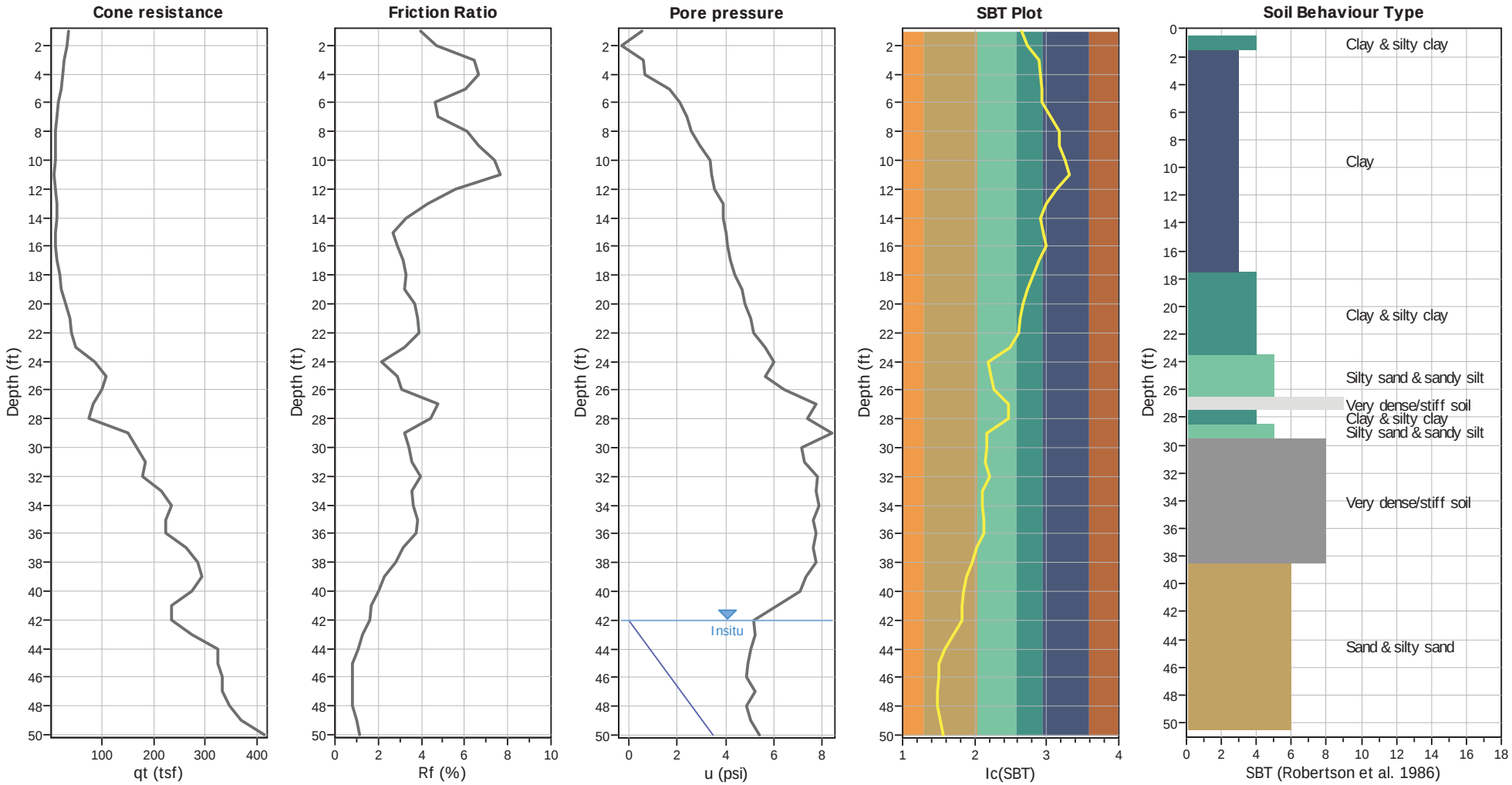
Estimation of post-earthquake settlements



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

CPT basic interpretation plots



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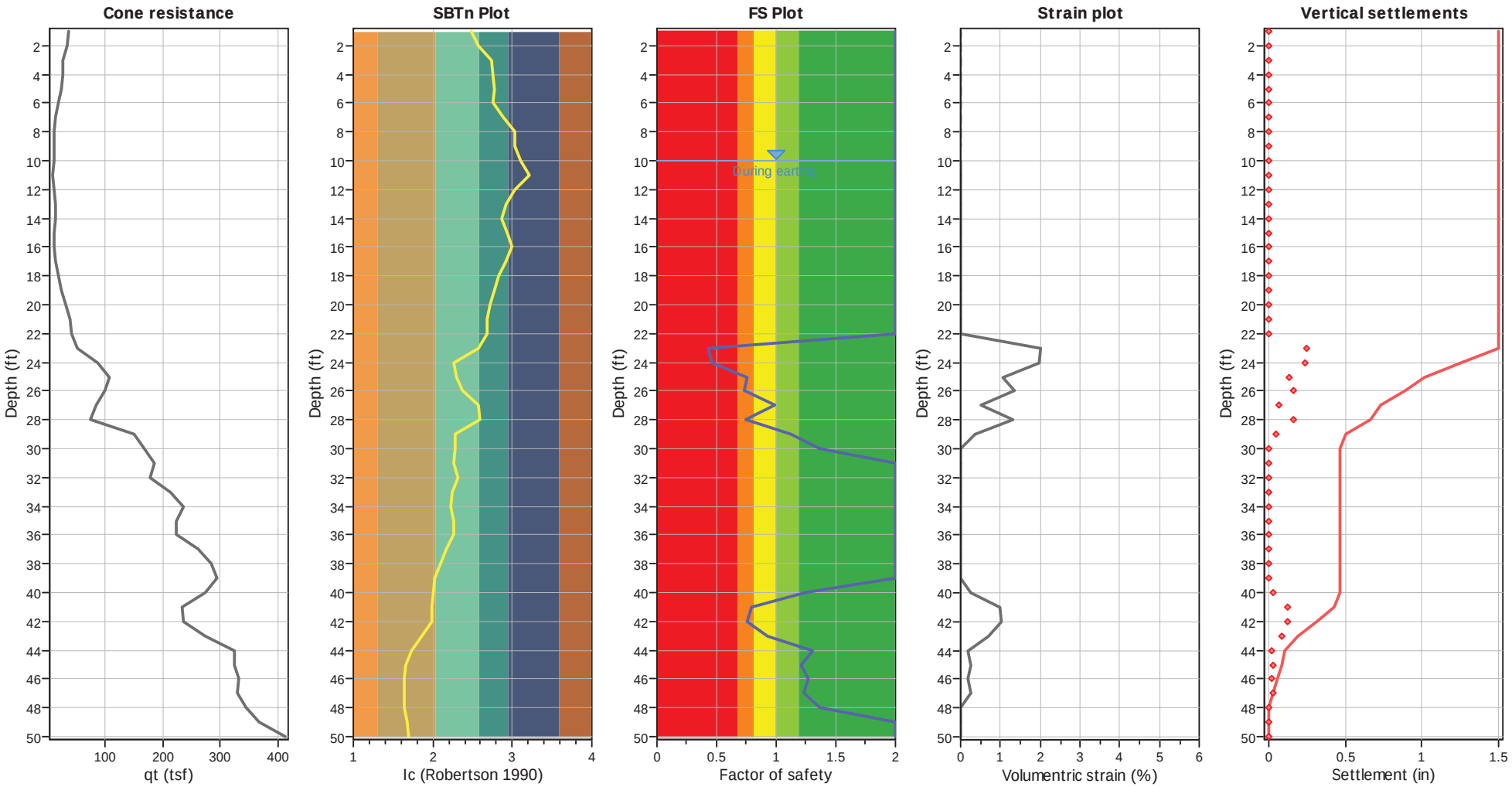
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	42.00 ft	Fill height:	N/A	Limit depth:	N/A

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



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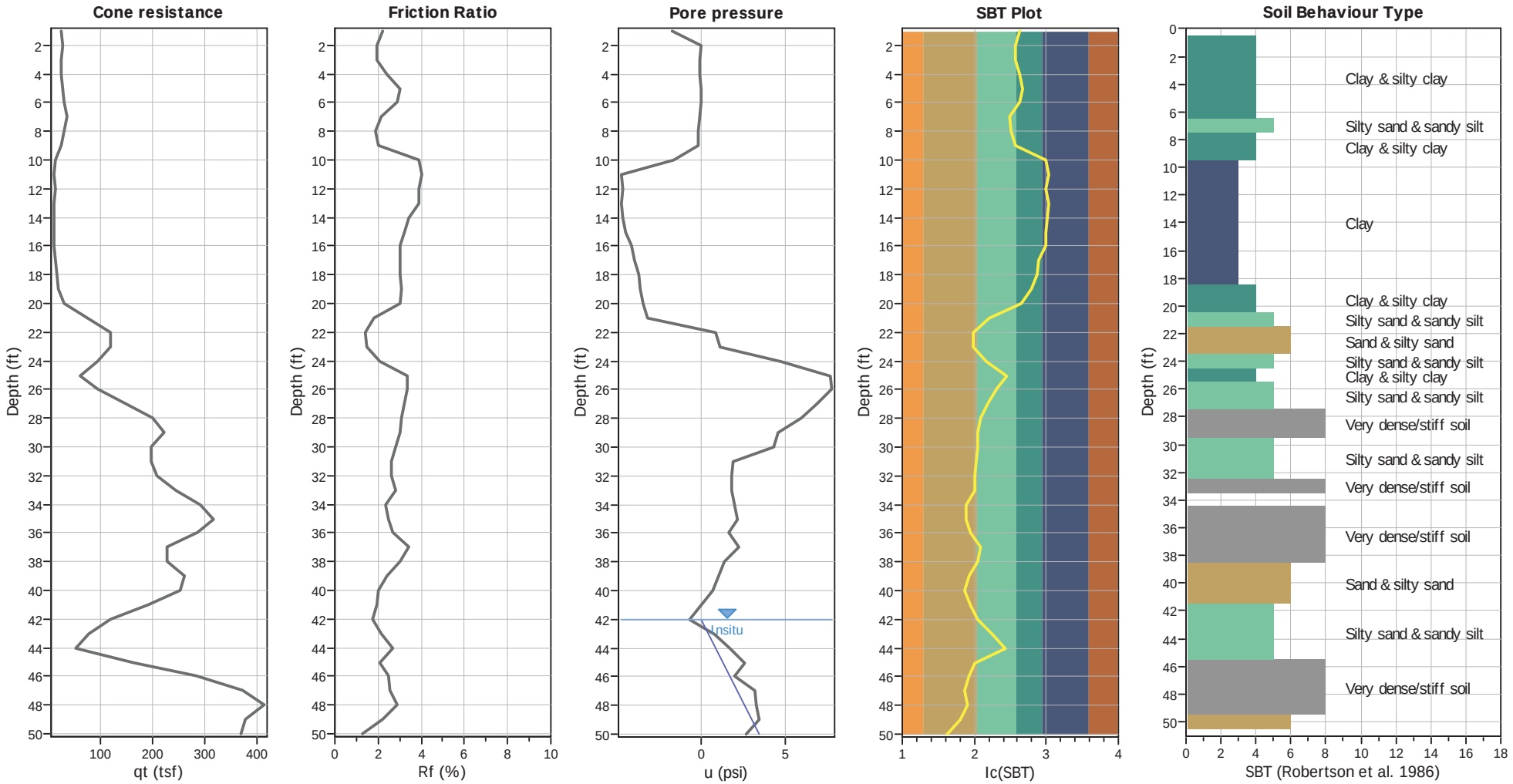
CPT basic interpretation plots



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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:	7.38	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	42.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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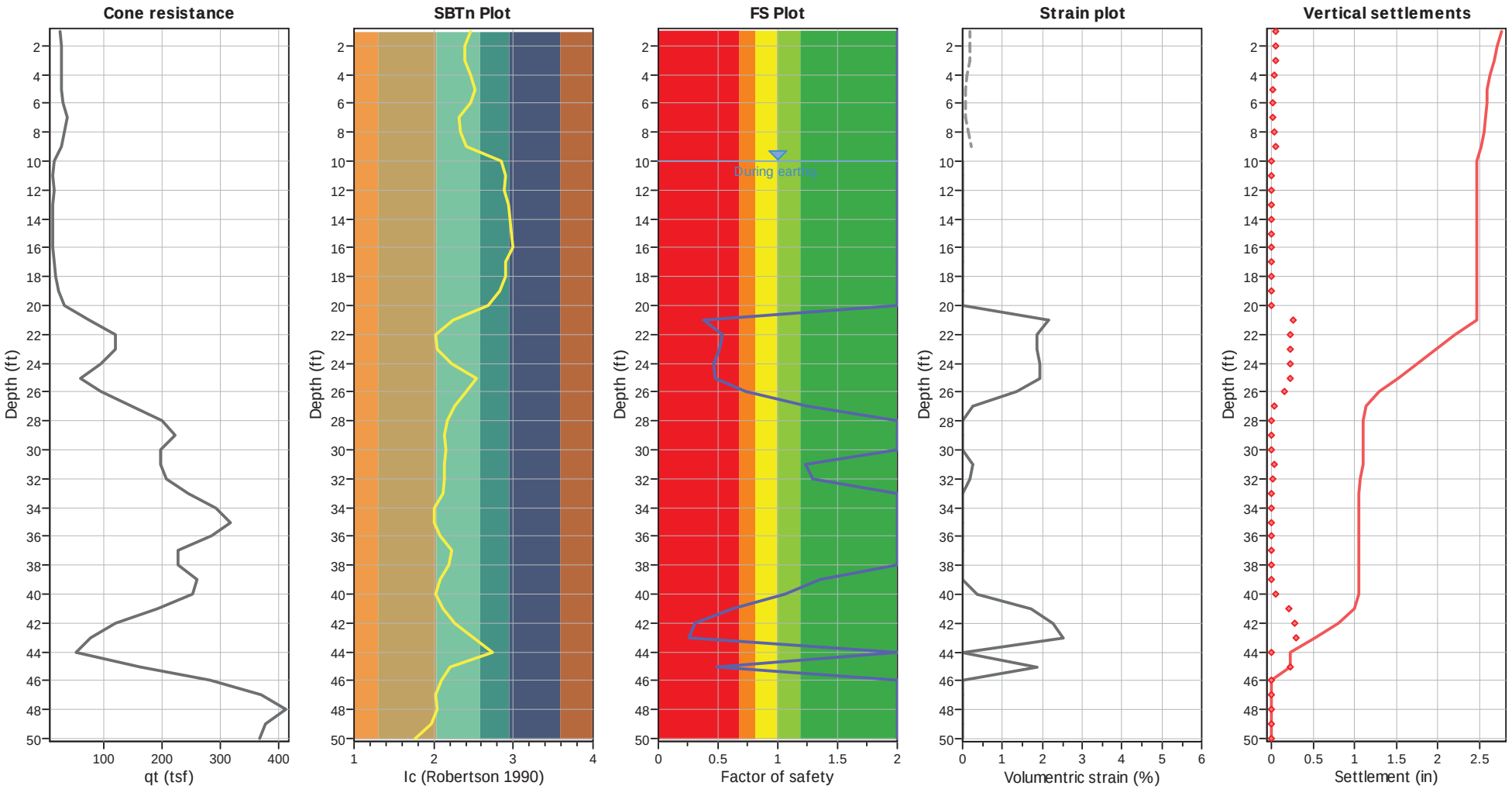
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



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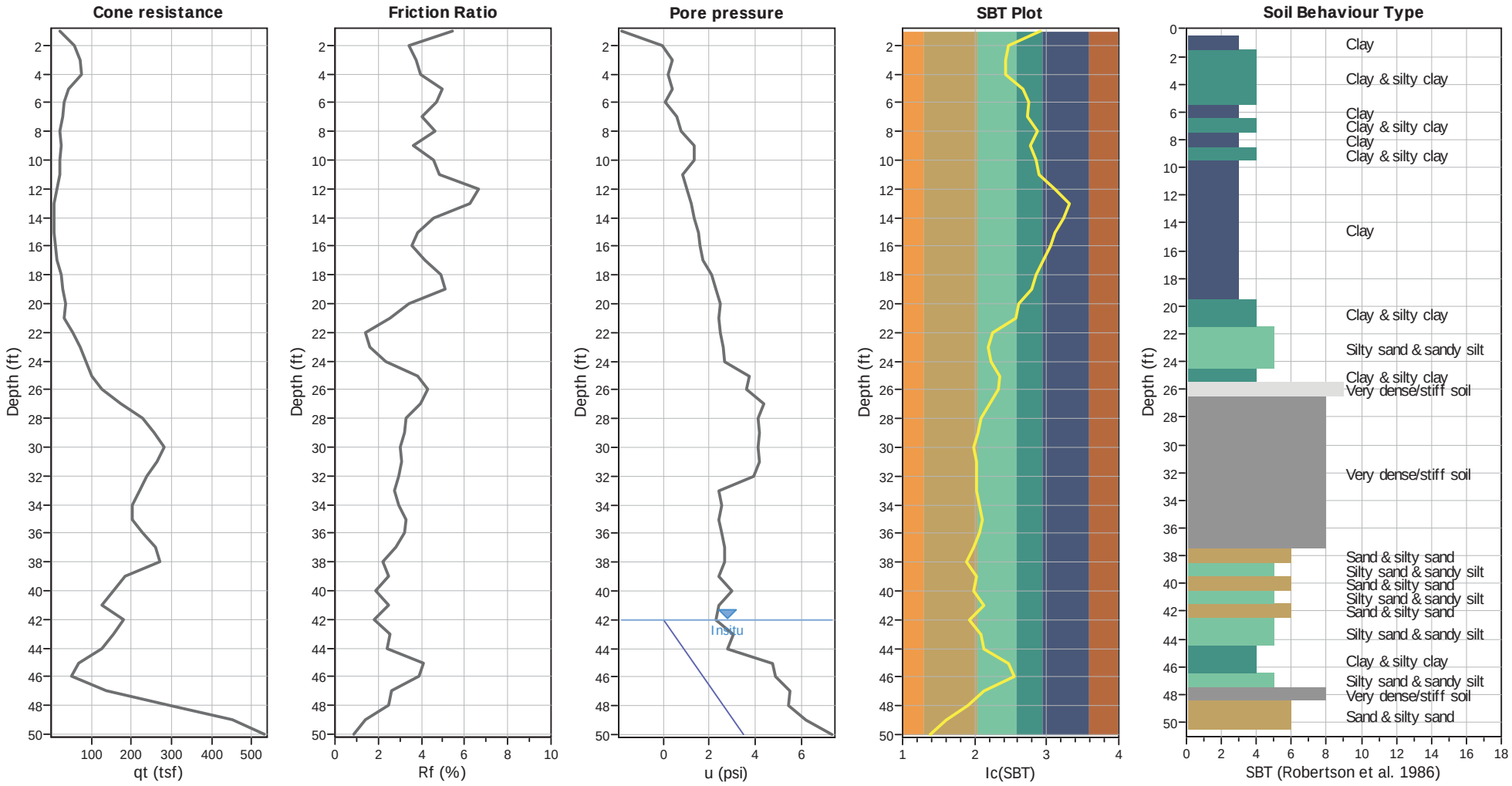
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	10.00 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:	7.38	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	42.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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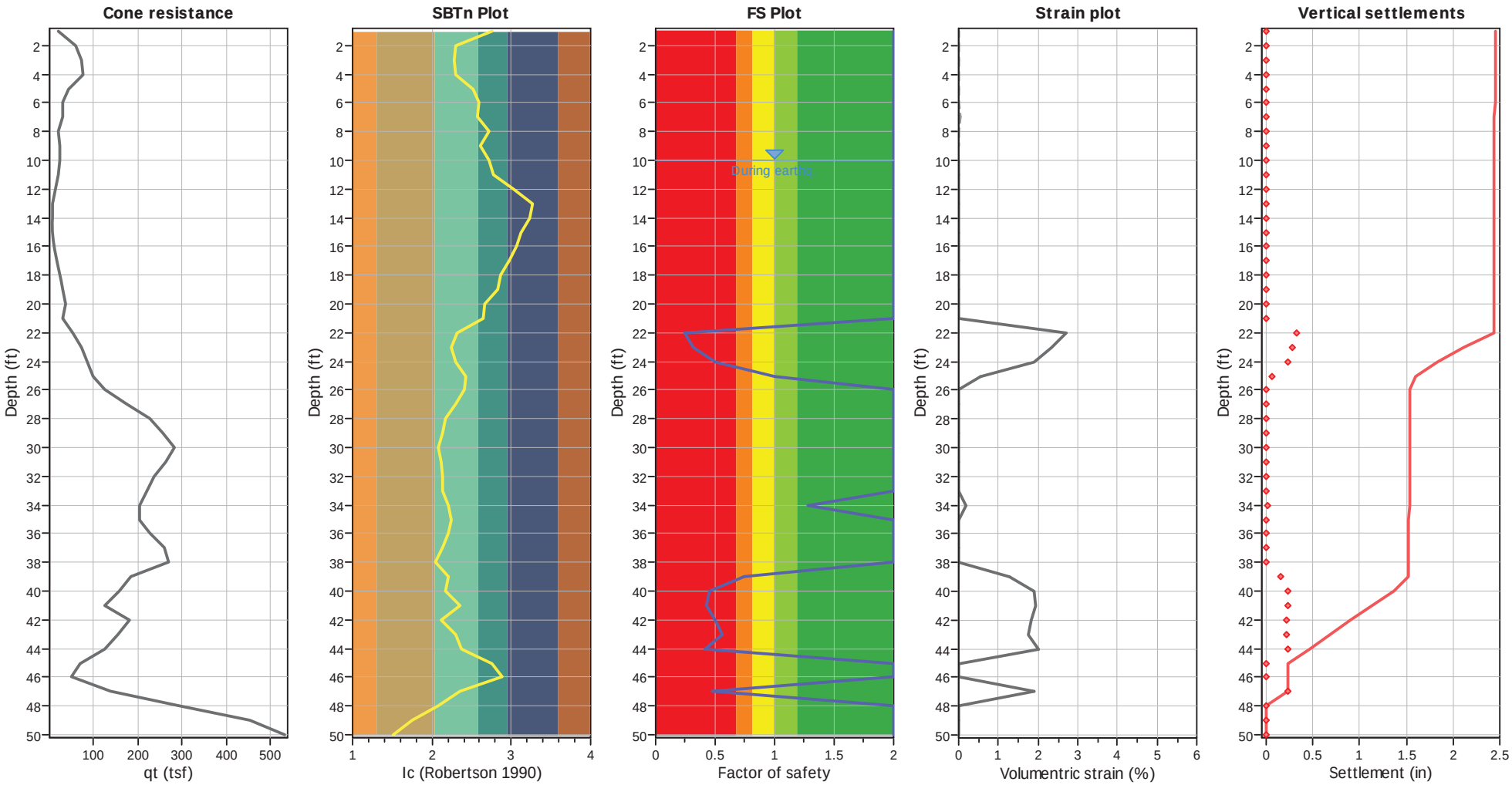
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



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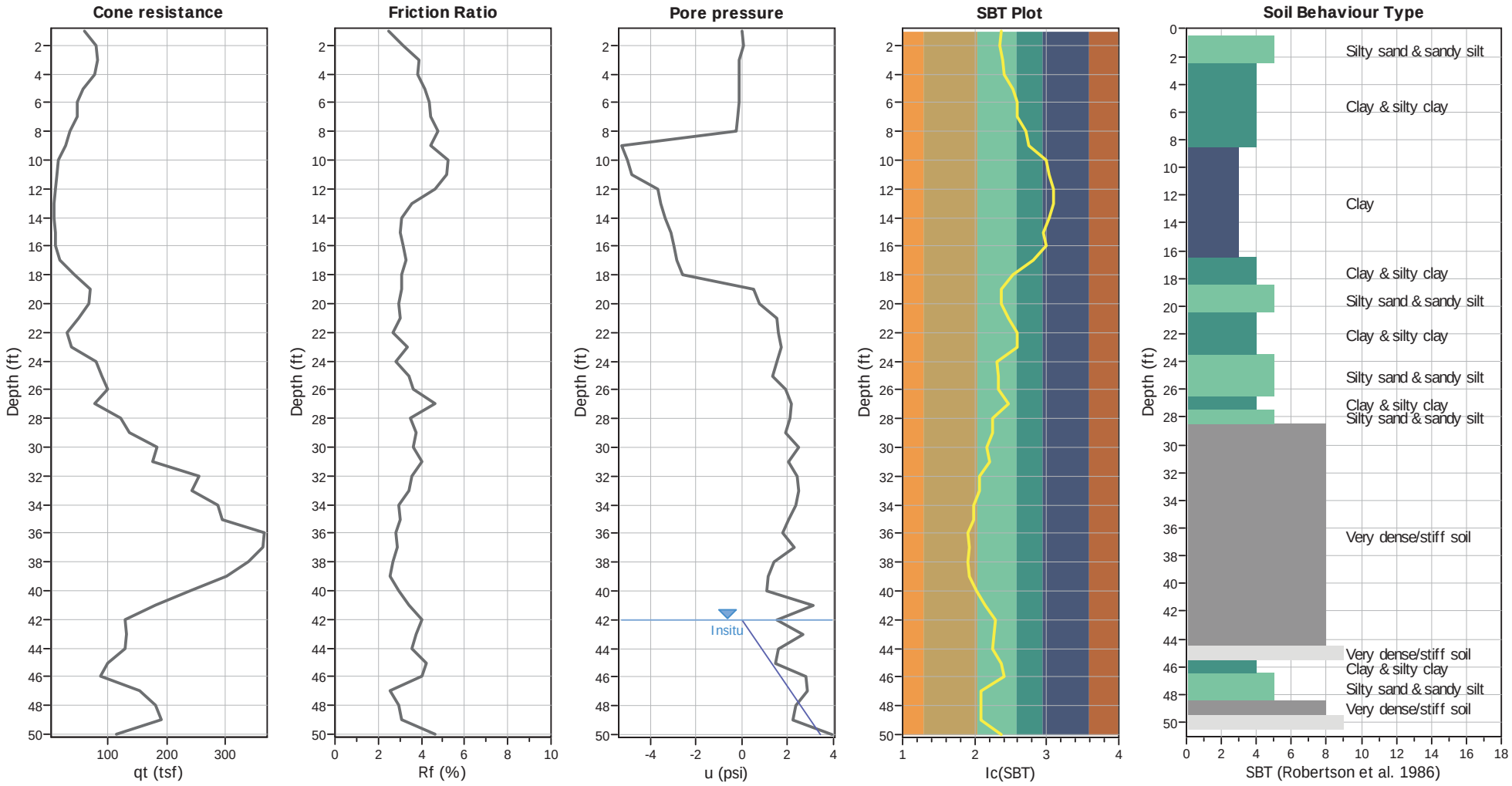
CPT basic interpretation plots



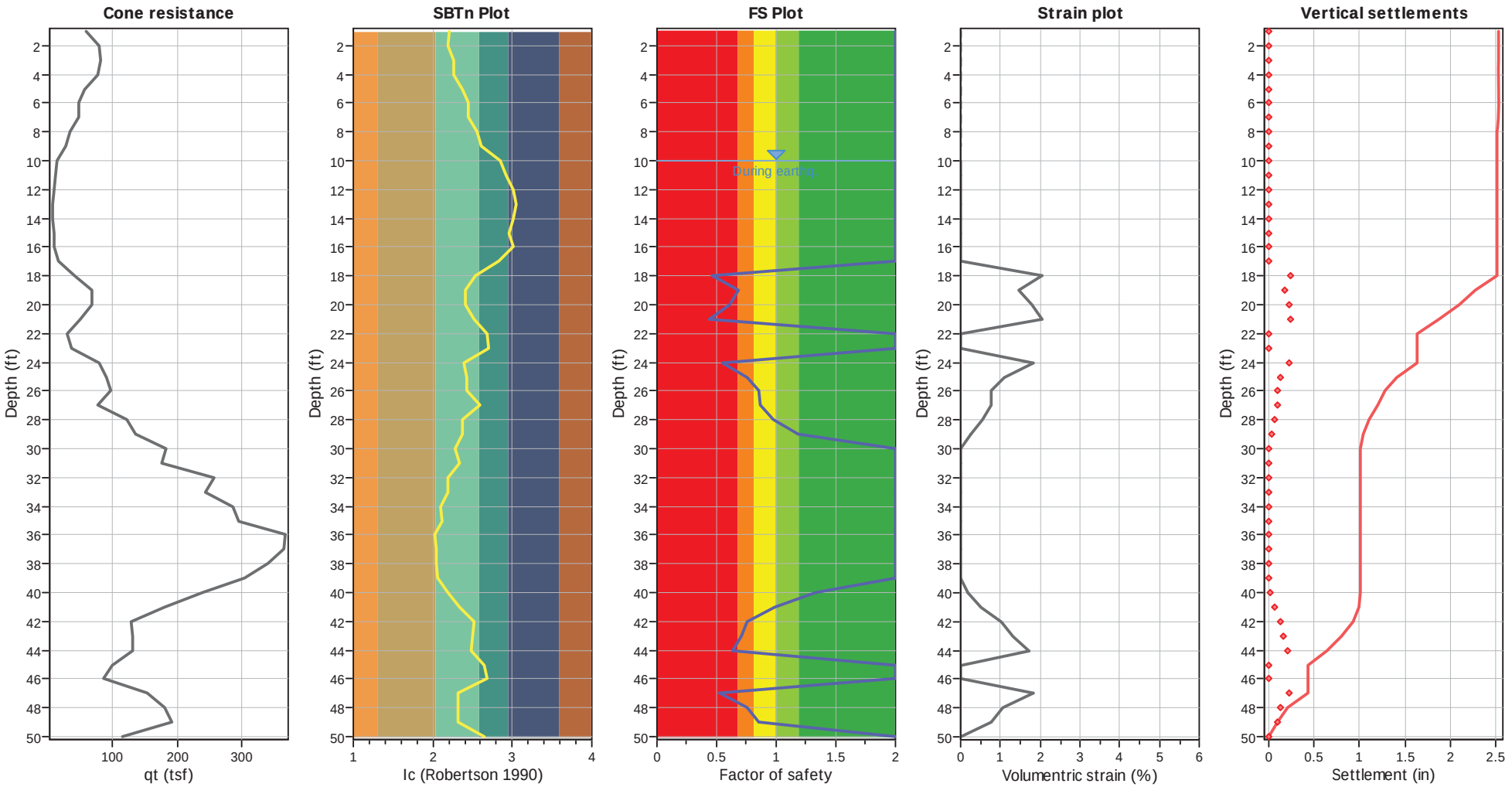
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	10.00 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:	7.38	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	42.00 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



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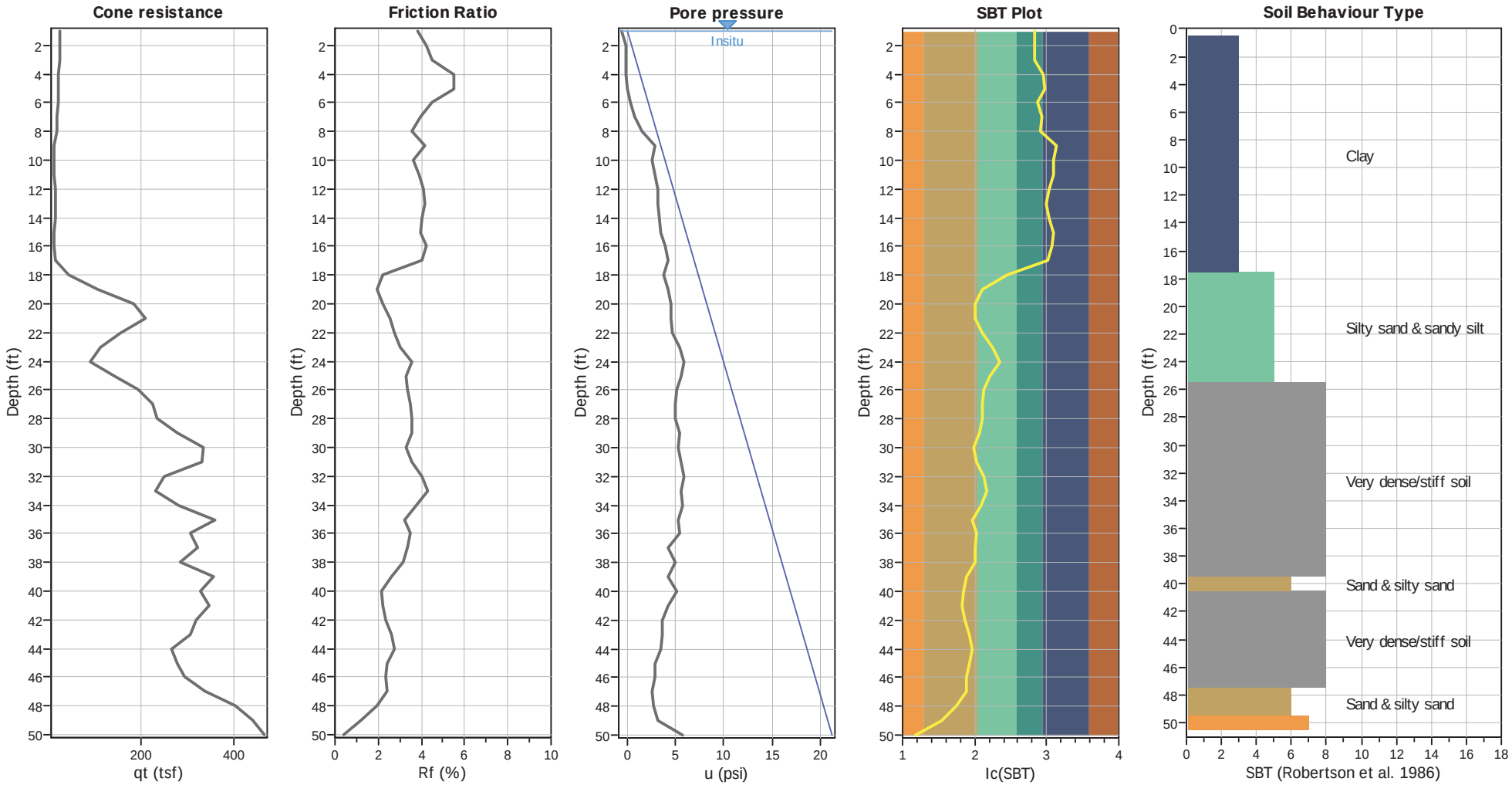
CPT basic interpretation plots



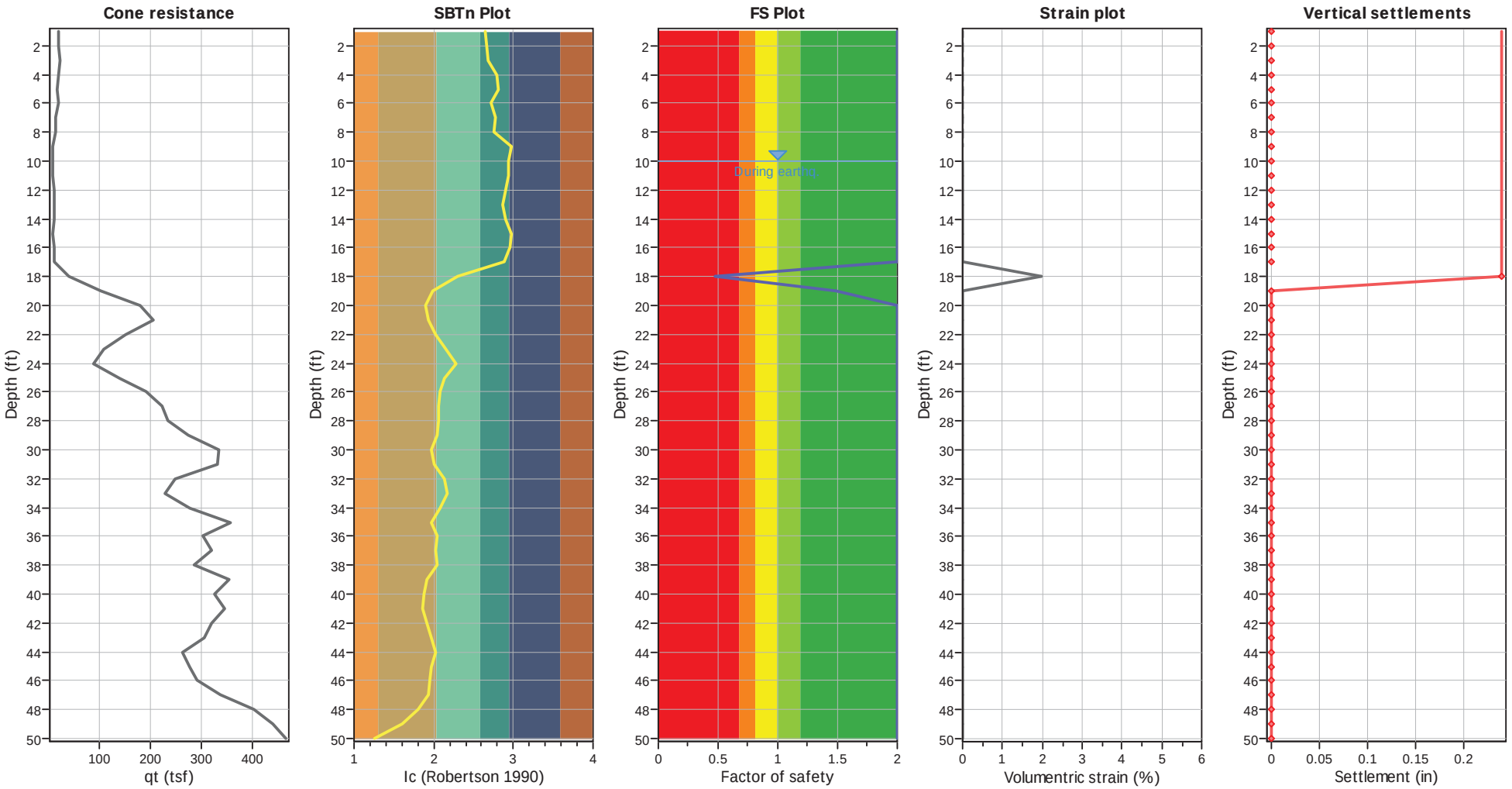
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	10.00 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:	7.38	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 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

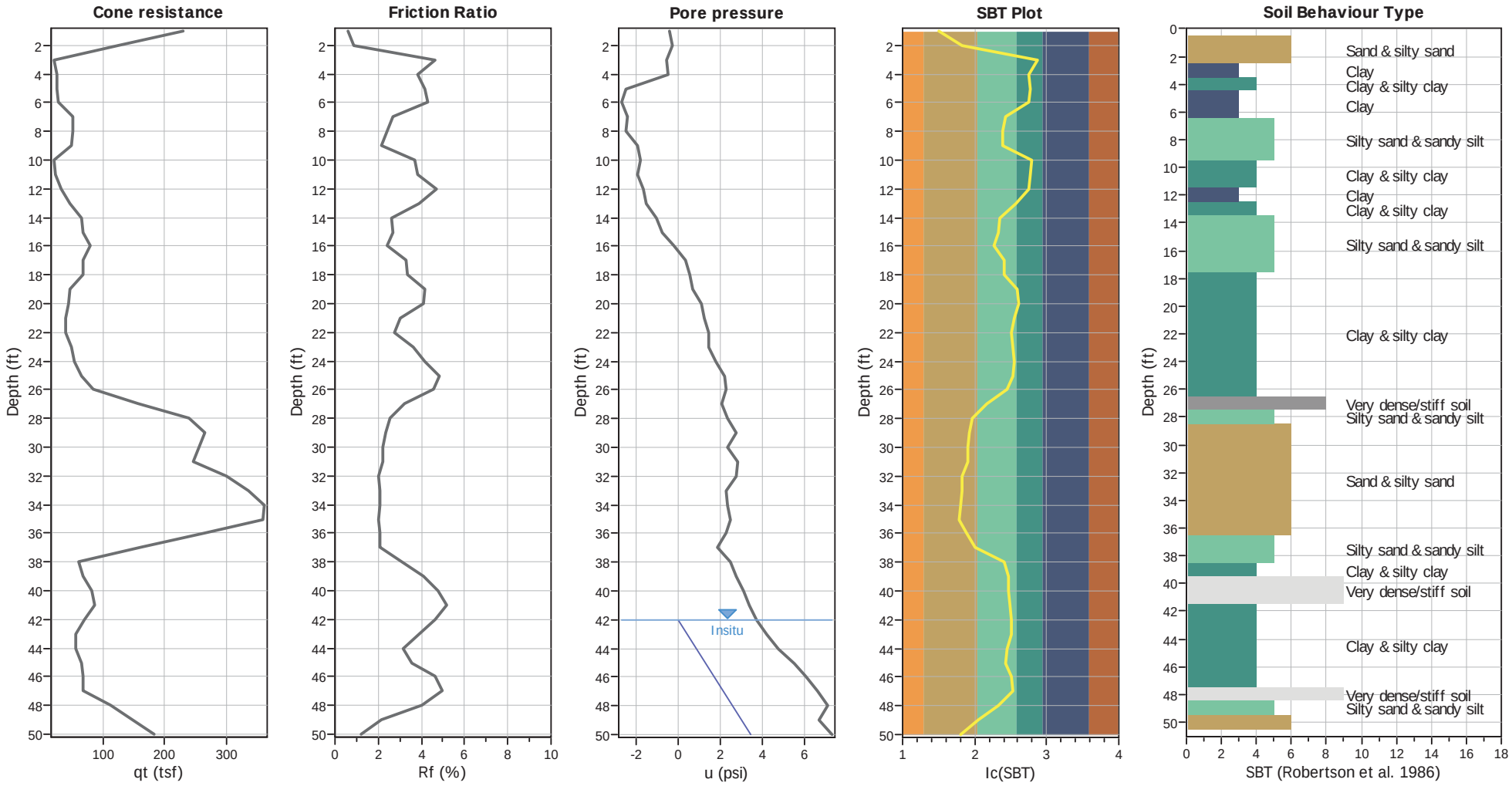
Estimation of post-earthquake settlements



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

CPT basic interpretation plots



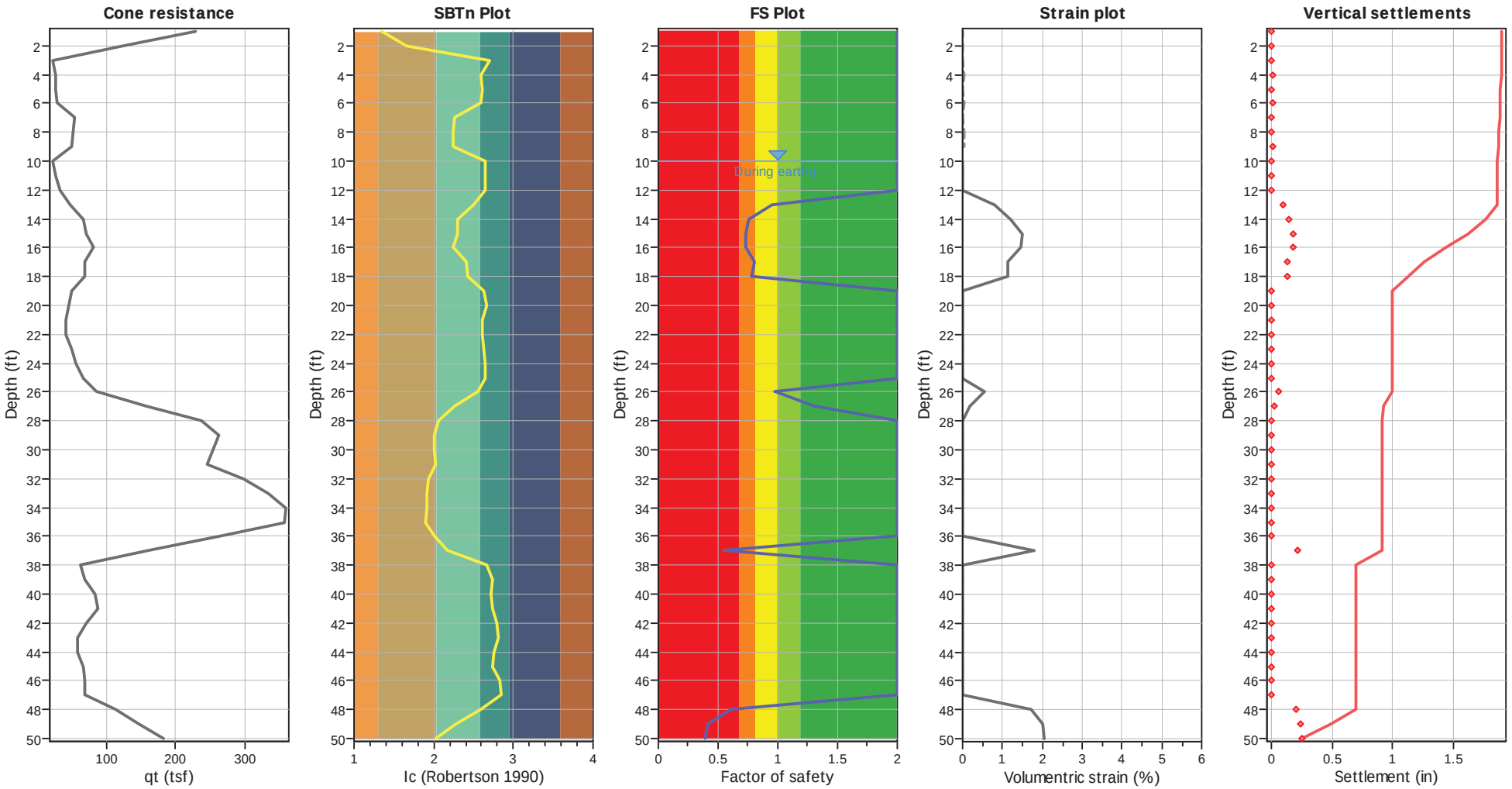
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	10.00 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:	7.38	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	42.00 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

Sensitivity Analyses of Fine-Grained Materials

Sample No.	Sample Depth (ft)	Groundwater Depth (ft)	Assumed Total Unit Weight above GWT (pcf)	assumed Total Unit Weight below GWT (pcf)	USCS Classification	Sample Moisture Content (%)	Dry Unit Weight at this depth (pcf)	Liquid Limit	Plastic Limit	Assumed Specific Gravity	Plasticity Index	Total Unit Weight (pcf)	Saturated Moisture Content (%)	Liquidity Index	Approximate Effective Vertical Stress (atm)	Sensitivity from Peck, Mesri (1996)	Sensitivity from Mitchell and Soga (2005)
B-1 R-4	10	10	120	125	CH	19	109	36	21	2.65	15	129.7	19.5	-0.10	0.57	1.35	-1.05
B-3 R-5	10	10	120	125	CH	20.3	107	48	22	2.65	26	128.7	20.6	-0.05	0.57	1.45	-0.73
B-3 R-7	15	10	120	125	CL	22	105	48	22	2.65	26	128.1	21.7	-0.01	0.72	1.55	-0.23

APPENDIX B: SOIL TESTING REPORT

TETRA TECH BAS

November 11, 2016

Oliver Galang
Tetra Tech
3475 E. Foothill Blvd
Pasadena, CA 91107

RE: ANALYTICAL SOIL TESTING REPORT
CARRIAGE CREST PARK WATER CAPTURE PROJECT
CARSON, CA

Dear Mr. Galang,

Tetra Tech BAS (Tetra Tech) has prepared this letter report to present the results of analytical testing of soil samples collected during drilling operations at the Carriage Crest Park Site. The purpose of the testing was to determine whether material proposed to be excavated during site development would require special handling and/or disposal. The sampling program was developed based our understanding of the previous site (and adjacent site) uses. Sample locations are shown on the attached Project Layout and Boring Location Map. Although there is no known on-site contaminant source, adjacent properties to the east have been utilized as nurseries and one adjacent site to the west (across Figueroa Avenue) was the location of an underground storage tank that could potentially be the source of a petroleum hydrocarbon release.

The adjacent nurseries may have impacted the subject site with pesticides and/or herbicides through surface water run-on, airborne particulate deposition or over-spraying of these chemicals. Because these impacts are primarily associated with near-surfaces impacts and because pesticides and herbicide are not typically highly mobile, only samples from the upper five feet were analyzed initially for these contaminants.

Potential underground storage tank impacts, would by definition occur only at depths greater than the depth at which the tank and/or piping are buried and would be evidenced by the presence of more mobile contaminants such as Total Petroleum Hydrocarbons (TPH) and Volatile Organic Compounds (VOCs). As a result, samples to the entire twenty-foot depth of the borings were analyzed for these compounds.

All samples were collected in accordance with industry standard sample collection protocols and were delivered to Eurofins, Calscience Labs in Garden Grove, California, a State certified analytical testing laboratory. A copy of the laboratory analytical results is attached to this report and are summarized in Table 1 (also attached).

These results identified no detectable levels of herbicides in any of the samples collected. Furthermore, TPH and VOCs were detected in only isolated, relatively random samples at low concentrations. As a result, it does not appear that these compounds are of significant concern. However, it should be noted that during drilling operations at the site, petroleum

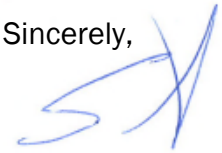
odors were observed. It is possible that the source of the observed odors were subsurface vapors from the adjacent site that may have migrated beneath the subject site.

Analyses for pesticides identified several samples with concentrations of 4,4'-DDD, 4,4'-DDE and/or 4,4'-DDT exceeding the California Total Threshold Limit Concentration (TTLC), which is used to define a hazardous waste. These exceedances are noted as highlighted cells in Table 1 (attached). No discernable trend in the compound specific impacts was evident across all of the locations and depth intervals. Initially, only samples collected from 1 foot and 5 feet below ground surface were analyzed for these constituents. However, at four of the five locations concentrations of at least one of these compounds exceeded the TTLC at the deepest depth tested (i.e. 5 feet below ground surface – bgs); and at each of these four locations, the concentration of at least one of the compounds increased between the 1-foot and the 5-foot deep samples. Subsequent testing of deeper samples taken at depths of 10 and 15 feet showed a significant drop in concentrations indicating that the impacts are limited to the upper 5 to 8 feet.

Given the fact that these pesticide impacts were identified at all five of the locations sampled, the soil cuttings from these borings within the upper 8 feet should be considered a California Hazardous Waste and managed accordingly. In addition, any soil excavated as part of any construction activities at the subject site should be tested for pesticides (at a minimum) in accordance with the waste profiling and in conformance with the acceptance criteria of the licensed disposal facility identified for the project.

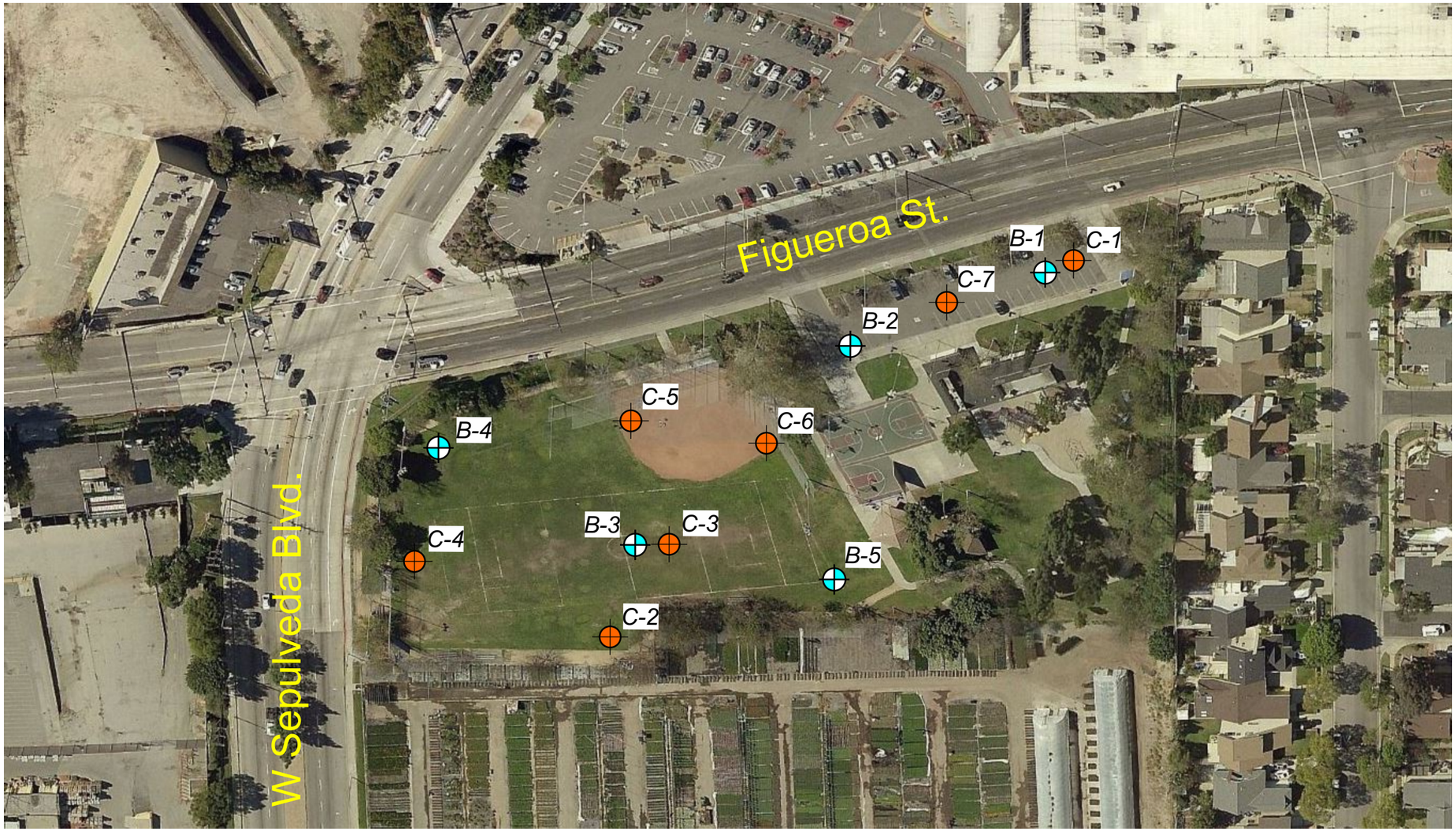
Should you have any questions, feel free to contact the undersigned at (909) 860-7777.

Sincerely,



Greg Acosta, PE
Vice President, Environmental Services

Attachments: Project Layout and Boring Location Map
Table 1 – Soil Analytical Results
Attachment A – Laboratory Analytical Reports



LEGEND

B-3 Boring No. and Location

C-4 CPT No. and Location

N

0 50 100 200 feet

Approximate Scale 1:2,400

Drawing References: Google Earth Pro (2016)

TETRA TECH BAS GEOSCIENCE
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

Project Layout and Boring Location Map

Carriage Crest Park Water Capture
Carson, California

JOB NO	TET 16-101E
DATE	October 2016
DRAWN BY	YLI
	Figure 2

TABLE 1
SOIL ANALYTICAL RESULTS
CARRIAGE CREST SITE
CARSON, CALIFORNIA

Boring	Depth	Date	Pesticides			TPH-g	VOCs	
			4,4'-DDD	4,4'-DDE	4,4'-DDT		Benzene	Xylenes
			(ug/Kg)			(mg/Kg)	(ug/Kg)	
B-1	1'	9/27/16	**2,600**	**20,000**	780	ND	*NA*	*NA*
	5'	9/27/16	**6,200**	**7,500**	**2,500**	ND	ND	ND
	10'	9/27/16	ND	ND	ND	ND	ND	ND
	15'	9/27/16	ND	ND	ND	ND	ND	ND
	20'	9/27/16	*NA*	*NA*	*NA*	ND	ND	ND
B-2	1'	9/27/16	16	24	ND	ND	*NA*	*NA*
	5'	9/27/16	**1,600**	**3,200**	390	1.8	ND	ND
	10'	9/27/16	*NA*	*NA*	*NA*	330	ND	ND
	15'	9/27/16	*NA*	*NA*	*NA*	ND	ND	ND
	20'	9/27/16	*NA*	*NA*	*NA*	ND	ND	ND
B-3	1'	9/28/16	ND	**3,700**	ND	ND	*NA*	*NA*
	5'	9/28/16	830	250	**1,100**	ND	ND	ND
	10'	9/28/16	8.0	8.0	ND	ND	ND	ND
	15'	9/28/16	ND	ND	ND	ND	ND	ND
	20'	9/28/16	*NA*	*NA*	*NA*	ND	ND	ND
B-4	1'	9/28/16	400	**3,200**	**1,400**	ND	*NA*	*NA*
	5'	9/28/16	ND	12	ND	ND	1.1	ND
	10'	9/28/16	ND	ND	ND	290	ND	ND
	15'	9/28/16	ND	ND	ND	170	ND	49
	20'	9/28/16	*NA*	*NA*	*NA*	ND	ND	ND
B-5	1'	9/28/16	ND	ND	ND	ND	*NA*	*NA*
	5'	9/28/16	**1,500**	**2,700**	320	ND	ND	ND
	10'	9/28/16	ND	ND	ND	ND	ND	ND
	15'	9/28/16	ND	ND	ND	ND	ND	ND
	20'	9/28/16	*NA*	*NA*	*NA*	ND	ND	ND
		TTLC	1,000	1,000	1,000			
		STLC	100	100	100			
		TCLP					500	

NOTES:

mg/kg = Milligrams per kilogram

ug/kg = Micrograms per kilogram

9.3 = Concentration exceeds the California TTLC level.

ND = Analyte not detected at or above the laboratory detection limit

NA = Not Analyzed (i.e. compound was not anaylized for in the indicated sample)

TTLC = California Total Threshold Limit Concentration

STLC = California Soluble Threshold Limit Concentration

TCLP = USEPA Toxicity Characteristic Leaching Potential

No Herbicides were detected above laboratory detection limits in any of the samples analyzed.

No Pesticides were detected other than those listed. All others were not detected above the laboratory detection limit.

No VOCs were detected other than those listed. All others were not detected above the laboratory detection limit.

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WORK ORDER NUMBER: 16-09-2276

The difference is service

AIR | SOIL | WATER | MARINE CHEMISTRY

Analytical Report For

Client: Tetra Tech, Inc.

Client Project Name: Carriage Crest Park

Attention: Fernando Cuenca
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Vikas Patel

Approved for release on 10/17/2016 by:
Vikas Patel
Project Manager

ResultLink

Email your PM

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Contents

Client Project Name: Carriage Crest Park
Work Order Number: 16-09-2276

1 Work Order Narrative. 3

2 Sample Summary. 4

3 Detections Summary. 5

4 Client Sample Data. 7
4.1 EPA 8015B (M) TPH Gasoline (Solid). 7
4.2 EPA 8081A Organochlorine Pesticides (Solid). 12
4.3 EPA 8151A Chlorinated Herbicides (Solid). 25
4.4 EPA 8260B BTEX + Oxygenates (Aqueous). 31
4.5 EPA 8260B BTEX + Oxygenates Prep 5035 (Solid). 33

5 Quality Control Sample Data. 56
5.1 MS/MSD. 56
5.2 LCS/LCSD. 60

6 Sample Analysis Summary. 69

7 Glossary of Terms and Qualifiers. 70

8 Chain-of-Custody/Sample Receipt Form. 71

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Work Order Narrative

Work Order: 16-09-2276 Page 1 of 1

Condition Upon Receipt:

Samples were received under Chain-of-Custody (COC) on 09/30/16. They were assigned to Work Order 16-09-2276.

Unless otherwise noted on the Sample Receiving forms all samples were received in good condition and within the recommended EPA temperature criteria for the methods noted on the COC. The COC and Sample Receiving Documents are integral elements of the analytical report and are presented at the back of the report.

Holding Times:

All samples were analyzed within prescribed holding times (HT) and/or in accordance with the Calscience Sample Acceptance Policy unless otherwise noted in the analytical report and/or comprehensive case narrative, if required.

Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.

Quality Control:

All quality control parameters (QC) were within established control limits except where noted in the QC summary forms or described further within this report.

Subcontractor Information:

Unless otherwise noted below (or on the subcontract form), no samples were subcontracted.

Additional Comments:

Air - Sorbent-extracted air methods (EPA TO-4A, EPA TO-10, EPA TO-13A, EPA TO-17): Analytical results are converted from mass/sample basis to mass/volume basis using client-supplied air volumes.

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are always reported on a wet weight basis.

Return to Contents

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Sample Summary

Client:	Tetra Tech, Inc. 1360 Valley Vista Drive Diamond Bar, CA 91765-1111	Work Order:	16-09-2276
		Project Name:	Carriage Crest Park
		PO Number:	
		Date/Time Received:	09/30/16 14:00
		Number of Containers:	92
Attn:	Fernando Cuenca		

Sample Identification	Lab Number	Collection Date and Time	Number of Containers	Matrix
B-1,P-1@1'	16-09-2276-1	09/27/16 09:00	1	Solid
B-1,P-2@5'	16-09-2276-2	09/27/16 09:15	1	Solid
B-1,P-3@10'	16-09-2276-3	09/27/16 09:30	1	Solid
B-1,P-4@15'	16-09-2276-4	09/27/16 09:45	1	Solid
B-1,VOC-1@5'	16-09-2276-5	09/27/16 09:15	4	Solid
B-1,VOC-2@10'	16-09-2276-6	09/27/16 09:30	4	Solid
B-1,VOC-3@15'	16-09-2276-7	09/27/16 09:45	4	Solid
B-1,VOC-4@20'	16-09-2276-8	09/27/16 10:20	4	Solid
B-2,P-1@1'	16-09-2276-9	09/27/16 12:00	1	Solid
B-2,P-2@5'	16-09-2276-10	09/27/16 12:20	1	Solid
B-2,P-3@10'	16-09-2276-11	09/27/16 12:35	1	Solid
B-2,P-4@15'	16-09-2276-12	09/27/16 13:15	1	Solid
B-2,VOC-1@5'	16-09-2276-13	09/27/16 12:20	1	Solid
B-2,VOC-2@10'	16-09-2276-14	09/27/16 12:35	1	Solid
B-2,VOC-3@15'	16-09-2276-15	09/27/16 13:15	1	Solid
B-2,VOC-4@20'	16-09-2276-16	09/27/16 13:45	1	Solid
B-3,P-1@1'	16-09-2276-17	09/28/16 07:15	1	Solid
B-3,P-2@5'	16-09-2276-18	09/28/16 07:30	1	Solid
B-3,P-3@10'	16-09-2276-19	09/28/16 08:00	1	Solid
B-3,P-4@15'	16-09-2276-20	09/28/16 08:30	1	Solid
B-3,VOC-1@5'	16-09-2276-21	09/28/16 07:30	4	Solid
B-3,VOC-2@10'	16-09-2276-22	09/28/16 08:00	4	Solid
B-3,VOC-3@15'	16-09-2276-23	09/28/16 08:30	4	Solid
B-3,VOC-4@20'	16-09-2276-24	09/28/16 09:00	4	Solid
B-4,P-1@1'	16-09-2276-25	09/28/16 11:00	1	Solid
B-4,P-2@5'	16-09-2276-26	09/28/16 11:20	1	Solid
B-4,P-3@10'	16-09-2276-27	09/28/16 11:40	1	Solid
B-4,P-4@15'	16-09-2276-28	09/28/16 12:10	1	Solid
B-4,VOC-1@5'	16-09-2276-29	09/28/16 11:20	4	Solid
B-4,VOC-2@10'	16-09-2276-30	09/28/16 11:40	4	Solid
B-4,VOC-3@15'	16-09-2276-31	09/28/16 12:10	4	Solid
B-4,VOC-4@20'	16-09-2276-32	09/28/16 12:30	4	Solid
B-5,P-1@1'	16-09-2276-33	09/28/16 13:10	1	Solid
B-5,P-2@5'	16-09-2276-34	09/28/16 13:30	1	Solid
B-5,P-3@10'	16-09-2276-35	09/28/16 13:45	1	Solid
B-5,P-4@15'	16-09-2276-36	09/28/16 14:10	1	Solid
B-5,VOC-1@5'	16-09-2276-37	09/28/16 13:30	4	Solid
B-5,VOC-2@10'	16-09-2276-38	09/28/16 13:45	4	Solid
B-5,VOC-3@15'	16-09-2276-39	09/28/16 14:10	4	Solid
B-5,VOC-4@20'	16-09-2276-40	09/28/16 14:45	4	Solid
TB	16-09-2276-41	09/28/16 00:00	4	Aqueous

Return to Contents

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Detections Summary

Client:	Tetra Tech, Inc.	Work Order:	16-09-2276
	1360 Valley Vista Drive	Project Name:	Carriage Crest Park
	Diamond Bar, CA 91765-1111	Received:	09/30/16
Attn:	Fernando Cuenca		

Client SampleID / Analyte	Result	Qualifiers	RL	Units	Method	Extraction
B-1,P-1@1' (16-09-2276-1)						
4,4'-DDD	2600		2500	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	20000		2500	ug/kg	EPA 8081A	EPA 3545
4,4'-DDT	780		250	ug/kg	EPA 8081A	EPA 3545
B-1,P-2@5' (16-09-2276-2)						
4,4'-DDD	6200		1000	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	7500		1000	ug/kg	EPA 8081A	EPA 3545
4,4'-DDT	2500		1000	ug/kg	EPA 8081A	EPA 3545
B-2,P-1@1' (16-09-2276-9)						
4,4'-DDD	16		5.0	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	24		5.0	ug/kg	EPA 8081A	EPA 3545
B-2,P-2@5' (16-09-2276-10)						
TPH as Gasoline	1.8	HD	0.50	mg/kg	EPA 8015B (M)	EPA 5030C
4,4'-DDD	1600		250	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	3200		2500	ug/kg	EPA 8081A	EPA 3545
4,4'-DDT	390		50	ug/kg	EPA 8081A	EPA 3545
B-2,P-3@10' (16-09-2276-11)						
TPH as Gasoline	330	HD	19	mg/kg	EPA 8015B (M)	EPA 5030C
B-3,P-1@1' (16-09-2276-17)						
4,4'-DDE	3700		2500	ug/kg	EPA 8081A	EPA 3545
B-3,P-2@5' (16-09-2276-18)						
4,4'-DDD	830		250	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	250		50	ug/kg	EPA 8081A	EPA 3545
4,4'-DDT	1100		250	ug/kg	EPA 8081A	EPA 3545
B-4,P-1@1' (16-09-2276-25)						
4,4'-DDD	400		250	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	3200		2500	ug/kg	EPA 8081A	EPA 3545
4,4'-DDT	1400		250	ug/kg	EPA 8081A	EPA 3545
B-4,P-2@5' (16-09-2276-26)						
4,4'-DDE	12		5.0	ug/kg	EPA 8081A	EPA 3545
B-4,P-3@10' (16-09-2276-27)						
TPH as Gasoline	290	HD	20	mg/kg	EPA 8015B (M)	EPA 5030C
B-4,P-4@15' (16-09-2276-28)						
TPH as Gasoline	170	HD	4.0	mg/kg	EPA 8015B (M)	EPA 5030C
B-4,VOC-1@5' (16-09-2276-29)						
Benzene	1.1		0.76	ug/kg	EPA 8260B	EPA 5035
B-4,VOC-3@15' (16-09-2276-31)						
o-Xylene	49		37	ug/kg	EPA 8260B	EPA 5035

Return to Contents

* MDL is shown

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Detections Summary

Client:	Tetra Tech, Inc.	Work Order:	16-09-2276
	1360 Valley Vista Drive	Project Name:	Carriage Crest Park
	Diamond Bar, CA 91765-1111	Received:	09/30/16
Attn:	Fernando Cuenca		

Client SampleID

Analyte	Result	Qualifiers	RL	Units	Method	Extraction
B-5,P-2@5' (16-09-2276-34)						
4,4'-DDD	1500		250	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	2700		2500	ug/kg	EPA 8081A	EPA 3545
4,4'-DDT	320		50	ug/kg	EPA 8081A	EPA 3545

Subcontracted analyses, if any, are not included in this summary.

Return to Contents

* MDL is shown

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5030C
Method: EPA 8015B (M)
Units: mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-1@1'	**16-09-2276-1-A**	**09/27/16 09:00**	**Solid**	**GC 1**	**10/04/16**	**10/04/16 23:49**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.48	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	89	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-2@5'	**16-09-2276-2-A**	**09/27/16 09:15**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 00:25**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.52	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	94	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-3@10'	**16-09-2276-3-A**	**09/27/16 09:30**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 19:58**	**161004L050**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.48	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	89	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-4@15'	**16-09-2276-4-A**	**09/27/16 09:45**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 01:00**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.51	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	96	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-1@1'	**16-09-2276-9-A**	**09/27/16 12:00**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 01:36**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.48	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	95	42-126	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5030C
Method: EPA 8015B (M)
Units: mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-2@5'	**16-09-2276-10-A**	**09/27/16 12:20**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 02:11**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	1.8	0.50	1.00	HD

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	96	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-3@10'	**16-09-2276-11-A**	**09/27/16 12:35**	**Solid**	**GC 1**	**10/04/16**	**10/06/16 18:46**	**161006L049**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	330	19	38.9	HD

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	146	42-126	2,7

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-4@15'	**16-09-2276-12-A**	**09/27/16 13:15**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 02:47**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.51	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	101	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-1@1'	**16-09-2276-17-A**	**09/28/16 07:15**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 03:23**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.48	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	92	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-2@5'	**16-09-2276-18-A**	**09/28/16 07:30**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 03:58**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.51	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	95	42-126	

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

Return to Contents

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5030C
Method: EPA 8015B (M)
Units: mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-3@10'	**16-09-2276-19-A**	**09/28/16 08:00**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 05:45**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	93	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-4@15'	**16-09-2276-20-A**	**09/28/16 08:30**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 06:20**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.52	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	99	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-1@1'	**16-09-2276-25-A**	**09/28/16 11:00**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 06:56**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.48	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	92	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-2@5'	**16-09-2276-26-A**	**09/28/16 11:20**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 07:31**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.49	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	94	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-3@10'	**16-09-2276-27-A**	**09/28/16 11:40**	**Solid**	**GC 1**	**10/04/16**	**10/06/16 19:58**	**161006L049**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	290	20	39.2	HD

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	124	42-126	

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

Return to Contents

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8015B (M)
		Units:	mg/kg
Project: Carriage Crest Park			Page 4 of 5

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-4@15'	**16-09-2276-28-A**	**09/28/16 12:10**	**Solid**	**GC 1**	**10/04/16**	**10/06/16 19:22**	**161006L049**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	170	4.0	7.92	HD

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	225	42-126	2,7

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-1@1'	**16-09-2276-33-A**	**09/28/16 13:10**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 08:07**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.53	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	93	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-2@5'	**16-09-2276-34-A**	**09/28/16 13:30**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 20:34**	**161004L050**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	86	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-3@10'	**16-09-2276-35-A**	**09/28/16 13:45**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 21:10**	**161004L050**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.51	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	95	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-4@15'	**16-09-2276-36-A**	**09/28/16 14:10**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 21:45**	**161004L050**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.49	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	94	42-126	

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

Return to Contents

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5030C
Method: EPA 8015B (M)
Units: mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-14-571-3312**	**N/A**	**Solid**	**GC 1**	**10/04/16**	**10/04/16 20:15**	**161004L046**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	91	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-14-571-3313**	**N/A**	**Solid**	**GC 1**	**10/03/16**	**10/05/16 14:02**	**161004L050**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	0.50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	88	42-126	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-14-571-3314**	**N/A**	**Solid**	**GC 1**	**10/06/16**	**10/06/16 12:50**	**161006L049**

Parameter	Result	RL	DF	Qualifiers
TPH as Gasoline	ND	4.0	8.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene - FID	82	42-126	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-1@1'	**16-09-2276-1-A**	**09/27/16 09:00**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 17:07**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	50	10.0	
Alpha-BHC	ND	100	10.0	
Beta-BHC	ND	50	10.0	
Chlordane	ND	500	10.0	
Delta-BHC	ND	100	10.0	
Dieldrin	ND	50	10.0	
Endosulfan I	ND	50	10.0	
Endosulfan II	ND	50	10.0	
Endosulfan Sulfate	ND	50	10.0	
Endrin	ND	50	10.0	
Endrin Aldehyde	ND	50	10.0	
Endrin Ketone	ND	50	10.0	
Gamma-BHC	ND	50	10.0	
Heptachlor	ND	50	10.0	
Heptachlor Epoxide	ND	100	10.0	
Methoxychlor	ND	50	10.0	
Toxaphene	ND	1000	10.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	104	24-168	
2,4,5,6-Tetrachloro-m-Xylene	110	25-145	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-1@1'	**16-09-2276-1-A**	**09/27/16 09:00**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 18:54**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDT	780	250	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	204	24-168	1,2,7
2,4,5,6-Tetrachloro-m-Xylene	156	25-145	1,2,7

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-1@1'	**16-09-2276-1-A**	**09/27/16 09:00**	**Solid**	**GC 41**	**10/03/16**	**10/06/16 13:57**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDD	2600	2500	500	
4,4'-DDE	20000	2500	500	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	192	24-168	1,2,7
2,4,5,6-Tetrachloro-m-Xylene	346	25-145	1,2,7

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-2@5'	**16-09-2276-2-A**	**09/27/16 09:15**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 17:22**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	50	10.0	
Alpha-BHC	ND	100	10.0	
Beta-BHC	ND	50	10.0	
Chlordane	ND	500	10.0	
Delta-BHC	ND	100	10.0	
Dieldrin	ND	50	10.0	
Endosulfan I	ND	50	10.0	
Endosulfan II	ND	50	10.0	
Endosulfan Sulfate	ND	50	10.0	
Endrin	ND	50	10.0	
Endrin Aldehyde	ND	50	10.0	
Endrin Ketone	ND	50	10.0	
Gamma-BHC	ND	50	10.0	
Heptachlor	ND	50	10.0	
Heptachlor Epoxide	ND	100	10.0	
Methoxychlor	ND	50	10.0	
Toxaphene	ND	1000	10.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	67	24-168	
2,4,5,6-Tetrachloro-m-Xylene	76	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-2@5'	**16-09-2276-2-A**	**09/27/16 09:15**	**Solid**	**GC 41**	**10/03/16**	**10/07/16 12:08**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDD	6200	1000	200	
4,4'-DDE	7500	1000	200	
4,4'-DDT	2500	1000	200	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	100	24-168	
2,4,5,6-Tetrachloro-m-Xylene	58	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-1@1'	**16-09-2276-9-A**	**09/27/16 12:00**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 16:50**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	
Alpha-BHC	ND	10	1.00	
Beta-BHC	ND	5.0	1.00	
Chlordane	ND	50	1.00	
4,4'-DDD	16	5.0	1.00	
4,4'-DDE	24	5.0	1.00	
4,4'-DDT	ND	5.0	1.00	
Delta-BHC	ND	10	1.00	
Dieldrin	ND	5.0	1.00	
Endosulfan I	ND	5.0	1.00	
Endosulfan II	ND	5.0	1.00	
Endosulfan Sulfate	ND	5.0	1.00	
Endrin	ND	5.0	1.00	
Endrin Aldehyde	ND	5.0	1.00	
Endrin Ketone	ND	5.0	1.00	
Gamma-BHC	ND	5.0	1.00	
Heptachlor	ND	5.0	1.00	
Heptachlor Epoxide	ND	10	1.00	
Methoxychlor	ND	5.0	1.00	
Toxaphene	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	102	24-168	
2,4,5,6-Tetrachloro-m-Xylene	93	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 3545
		Method:	EPA 8081A
		Units:	ug/kg
Project: Carriage Crest Park			Page 5 of 13

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-2@5'	**16-09-2276-10-A**	**09/27/16 12:20**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 17:37**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	50	10.0	
Alpha-BHC	ND	100	10.0	
Beta-BHC	ND	50	10.0	
Chlordane	ND	500	10.0	
4,4'-DDT	390	50	10.0	
Delta-BHC	ND	100	10.0	
Dieldrin	ND	50	10.0	
Endosulfan I	ND	50	10.0	
Endosulfan II	ND	50	10.0	
Endosulfan Sulfate	ND	50	10.0	
Endrin	ND	50	10.0	
Endrin Aldehyde	ND	50	10.0	
Endrin Ketone	ND	50	10.0	
Gamma-BHC	ND	50	10.0	
Heptachlor	ND	50	10.0	
Heptachlor Epoxide	ND	100	10.0	
Methoxychlor	ND	50	10.0	
Toxaphene	ND	1000	10.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	113	24-168	
2,4,5,6-Tetrachloro-m-Xylene	102	25-145	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-2@5'	**16-09-2276-10-A**	**09/27/16 12:20**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 19:24**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDD	1600	250	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	92	24-168	
2,4,5,6-Tetrachloro-m-Xylene	117	25-145	

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

Return to Contents

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-2@5'	**16-09-2276-10-A**	**09/27/16 12:20**	**Solid**	**GC 41**	**10/03/16**	**10/06/16 14:27**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDE	3200	2500	500	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	155	24-168	
2,4,5,6-Tetrachloro-m-Xylene	146	25-145	1,2,7

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-1@1'	**16-09-2276-17-A**	**09/28/16 07:15**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 17:52**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	50	10.0	
Alpha-BHC	ND	100	10.0	
Beta-BHC	ND	50	10.0	
Chlordane	ND	500	10.0	
4,4'-DDD	ND	50	10.0	
4,4'-DDT	ND	50	10.0	
Delta-BHC	ND	100	10.0	
Dieldrin	ND	50	10.0	
Endosulfan I	ND	50	10.0	
Endosulfan II	ND	50	10.0	
Endosulfan Sulfate	ND	50	10.0	
Endrin	ND	50	10.0	
Endrin Aldehyde	ND	50	10.0	
Endrin Ketone	ND	50	10.0	
Gamma-BHC	ND	50	10.0	
Heptachlor	ND	50	10.0	
Heptachlor Epoxide	ND	100	10.0	
Methoxychlor	ND	50	10.0	
Toxaphene	ND	1000	10.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	91	24-168	
2,4,5,6-Tetrachloro-m-Xylene	93	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-1@1'	**16-09-2276-17-A**	**09/28/16 07:15**	**Solid**	**GC 41**	**10/03/16**	**10/06/16 14:42**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDE	3700	2500	500	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	146	24-168	
2,4,5,6-Tetrachloro-m-Xylene	186	25-145	1,2,7

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-2@5'	**16-09-2276-18-A**	**09/28/16 07:30**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 13:07**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	
Alpha-BHC	ND	10	1.00	
Beta-BHC	ND	5.0	1.00	
Chlordane	ND	50	1.00	
Delta-BHC	ND	10	1.00	
Dieldrin	ND	5.0	1.00	
Endosulfan I	ND	5.0	1.00	
Endosulfan II	ND	5.0	1.00	
Endosulfan Sulfate	ND	5.0	1.00	
Endrin	ND	5.0	1.00	
Endrin Aldehyde	ND	5.0	1.00	
Endrin Ketone	ND	5.0	1.00	
Gamma-BHC	ND	5.0	1.00	
Heptachlor	ND	5.0	1.00	
Heptachlor Epoxide	ND	10	1.00	
Methoxychlor	ND	5.0	1.00	
Toxaphene	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	60	24-168	
2,4,5,6-Tetrachloro-m-Xylene	61	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-2@5'	**16-09-2276-18-A**	**09/28/16 07:30**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 14:07**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDE	250	50	10.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	58	24-168	
2,4,5,6-Tetrachloro-m-Xylene	131	25-145	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-2@5'	**16-09-2276-18-A**	**09/28/16 07:30**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 14:22**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDD	830	250	50.0	
4,4'-DDT	1100	250	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	62	24-168	
2,4,5,6-Tetrachloro-m-Xylene	108	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-1@1'	**16-09-2276-25-A**	**09/28/16 11:00**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 18:07**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	50	10.0	
Alpha-BHC	ND	100	10.0	
Beta-BHC	ND	50	10.0	
Chlordane	ND	500	10.0	
Delta-BHC	ND	100	10.0	
Dieldrin	ND	50	10.0	
Endosulfan I	ND	50	10.0	
Endosulfan II	ND	50	10.0	
Endosulfan Sulfate	ND	50	10.0	
Endrin	ND	50	10.0	
Endrin Aldehyde	ND	50	10.0	
Endrin Ketone	ND	50	10.0	
Gamma-BHC	ND	50	10.0	
Heptachlor	ND	50	10.0	
Heptachlor Epoxide	ND	100	10.0	
Methoxychlor	ND	50	10.0	
Toxaphene	ND	1000	10.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	104	24-168	
2,4,5,6-Tetrachloro-m-Xylene	89	25-145	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-1@1'	**16-09-2276-25-A**	**09/28/16 11:00**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 19:54**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDD	400	250	50.0	
4,4'-DDT	1400	250	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	101	24-168	
2,4,5,6-Tetrachloro-m-Xylene	94	25-145	

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

Return to Contents

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-1@1'	**16-09-2276-25-A**	**09/28/16 11:00**	**Solid**	**GC 41**	**10/03/16**	**10/06/16 14:57**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDE	3200	2500	500	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	138	24-168	
2,4,5,6-Tetrachloro-m-Xylene	153	25-145	1,2,7

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-2@5'	**16-09-2276-26-A**	**09/28/16 11:20**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 17:47**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	
Alpha-BHC	ND	10	1.00	
Beta-BHC	ND	5.0	1.00	
Chlordane	ND	50	1.00	
4,4'-DDD	ND	5.0	1.00	
4,4'-DDE	12	5.0	1.00	
4,4'-DDT	ND	5.0	1.00	
Delta-BHC	ND	10	1.00	
Dieldrin	ND	5.0	1.00	
Endosulfan I	ND	5.0	1.00	
Endosulfan II	ND	5.0	1.00	
Endosulfan Sulfate	ND	5.0	1.00	
Endrin	ND	5.0	1.00	
Endrin Aldehyde	ND	5.0	1.00	
Endrin Ketone	ND	5.0	1.00	
Gamma-BHC	ND	5.0	1.00	
Heptachlor	ND	5.0	1.00	
Heptachlor Epoxide	ND	10	1.00	
Methoxychlor	ND	5.0	1.00	
Toxaphene	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	94	24-168	
2,4,5,6-Tetrachloro-m-Xylene	83	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-1@1'	**16-09-2276-33-A**	**09/28/16 13:10**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 18:01**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	
Alpha-BHC	ND	10	1.00	
Beta-BHC	ND	5.0	1.00	
Chlordane	ND	50	1.00	
4,4'-DDD	ND	5.0	1.00	
4,4'-DDE	ND	5.0	1.00	
4,4'-DDT	ND	5.0	1.00	
Delta-BHC	ND	10	1.00	
Dieldrin	ND	5.0	1.00	
Endosulfan I	ND	5.0	1.00	
Endosulfan II	ND	5.0	1.00	
Endosulfan Sulfate	ND	5.0	1.00	
Endrin	ND	5.0	1.00	
Endrin Aldehyde	ND	5.0	1.00	
Endrin Ketone	ND	5.0	1.00	
Gamma-BHC	ND	5.0	1.00	
Heptachlor	ND	5.0	1.00	
Heptachlor Epoxide	ND	10	1.00	
Methoxychlor	ND	5.0	1.00	
Toxaphene	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	40	24-168	
2,4,5,6-Tetrachloro-m-Xylene	40	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-2@5'	**16-09-2276-34-A**	**09/28/16 13:30**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 18:22**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	50	10.0	
Alpha-BHC	ND	100	10.0	
Beta-BHC	ND	50	10.0	
Chlordane	ND	500	10.0	
4,4'-DDT	320	50	10.0	
Delta-BHC	ND	100	10.0	
Dieldrin	ND	50	10.0	
Endosulfan I	ND	50	10.0	
Endosulfan II	ND	50	10.0	
Endosulfan Sulfate	ND	50	10.0	
Endrin	ND	50	10.0	
Endrin Aldehyde	ND	50	10.0	
Endrin Ketone	ND	50	10.0	
Gamma-BHC	ND	50	10.0	
Heptachlor	ND	50	10.0	
Heptachlor Epoxide	ND	100	10.0	
Methoxychlor	ND	50	10.0	
Toxaphene	ND	1000	10.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	104	24-168	
2,4,5,6-Tetrachloro-m-Xylene	89	25-145	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-2@5'	**16-09-2276-34-A**	**09/28/16 13:30**	**Solid**	**GC 41**	**10/03/16**	**10/05/16 20:09**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDD	1500	250	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	121	24-168	
2,4,5,6-Tetrachloro-m-Xylene	94	25-145	

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

Return to Contents

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-2@5'	**16-09-2276-34-A**	**09/28/16 13:30**	**Solid**	**GC 41**	**10/03/16**	**10/06/16 15:12**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
4,4'-DDE	2700	2500	500	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	122	24-168	
2,4,5,6-Tetrachloro-m-Xylene	163	25-145	1,2,7

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-537-2530**	**N/A**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 12:05**	**161003L02A**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	
Alpha-BHC	ND	10	1.00	
Beta-BHC	ND	5.0	1.00	
Chlordane	ND	50	1.00	
4,4'-DDD	ND	5.0	1.00	
4,4'-DDE	ND	5.0	1.00	
4,4'-DDT	ND	5.0	1.00	
Delta-BHC	ND	10	1.00	
Dieldrin	ND	5.0	1.00	
Endosulfan I	ND	5.0	1.00	
Endosulfan II	ND	5.0	1.00	
Endosulfan Sulfate	ND	5.0	1.00	
Endrin	ND	5.0	1.00	
Endrin Aldehyde	ND	5.0	1.00	
Endrin Ketone	ND	5.0	1.00	
Gamma-BHC	ND	5.0	1.00	
Heptachlor	ND	5.0	1.00	
Heptachlor Epoxide	ND	10	1.00	
Methoxychlor	ND	5.0	1.00	
Toxaphene	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	95	24-168	
2,4,5,6-Tetrachloro-m-Xylene	97	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 8151A
Method: EPA 8151A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-1@1'	**16-09-2276-1-A**	**09/27/16 09:00**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 18:28**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	112	30-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-2@5'	**16-09-2276-2-A**	**09/27/16 09:15**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 18:51**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	97	30-130	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 8151A
Method: EPA 8151A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-1@1'	**16-09-2276-9-A**	**09/27/16 12:00**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 19:14**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	72	30-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,P-2@5'	**16-09-2276-10-A**	**09/27/16 12:20**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 19:38**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	88	30-130	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 8151A
Method: EPA 8151A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-1@1'	**16-09-2276-17-A**	**09/28/16 07:15**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 20:01**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	78	30-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-2@5'	**16-09-2276-18-A**	**09/28/16 07:30**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 20:24**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	84	30-130	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 8151A
Method: EPA 8151A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-1@1'	**16-09-2276-25-A**	**09/28/16 11:00**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 20:47**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	98	30-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-2@5'	**16-09-2276-26-A**	**09/28/16 11:20**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 21:10**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	92	30-130	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 8151A
Method: EPA 8151A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-1@1'	**16-09-2276-33-A**	**09/28/16 13:10**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 21:33**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	105	30-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-2@5'	**16-09-2276-34-A**	**09/28/16 13:30**	**Solid**	**GC 40**	**10/01/16**	**10/10/16 21:56**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	88	30-130	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 8151A
Method: EPA 8151A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**095-01-033-1405**	**N/A**	**Solid**	**GC 40**	**10/01/16**	**10/07/16 19:39**	**161001L01**

Parameter	Result	RL	DF	Qualifiers
Dalapon	ND	250	1.00	
Dicamba	ND	10	1.00	
MCPP	ND	10000	1.00	
MCPA	ND	10000	1.00	
Dichlorprop	ND	100	1.00	
2,4-D	ND	100	1.00	
2,4,5-TP (Silvex)	ND	10	1.00	
2,4,5-T	ND	10	1.00	
2,4-DB	ND	100	1.00	
Dinoseb	ND	50	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
2,4-Dichlorophenylacetic acid	94	30-130	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5030C
Method: EPA 8260B
Units: ug/L

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
TB	**16-09-2276-41-b**	**09/28/16 00:00**	**Aqueous**	**GC/MS WW**	**10/04/16**	**10/04/16 13:17**	**161004L002**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.50	1.00	
Ethylbenzene	ND	1.0	1.00	
Toluene	ND	1.0	1.00	
p/m-Xylene	ND	1.0	1.00	
o-Xylene	ND	1.0	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.0	1.00	
Tert-Butyl Alcohol (TBA)	ND	10	1.00	
Diisopropyl Ether (DIPE)	ND	2.0	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	2.0	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	2.0	1.00	
Ethanol	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	90	80-120	
Dibromofluoromethane	97	78-126	
1,2-Dichloroethane-d4	102	75-135	
Toluene-d8	94	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5030C
Method: EPA 8260B
Units: ug/L

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-14-001-21504**	**N/A**	**Aqueous**	**GC/MS WW**	**10/04/16**	**10/04/16 12:07**	**161004L002**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.50	1.00	
Ethylbenzene	ND	1.0	1.00	
Toluene	ND	1.0	1.00	
p/m-Xylene	ND	1.0	1.00	
o-Xylene	ND	1.0	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.0	1.00	
Tert-Butyl Alcohol (TBA)	ND	10	1.00	
Diisopropyl Ether (DIPE)	ND	2.0	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	2.0	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	2.0	1.00	
Ethanol	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	93	80-120	
Dibromofluoromethane	97	78-126	
1,2-Dichloroethane-d4	103	75-135	
Toluene-d8	94	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,VOC-1@5'	**16-09-2276-5-D**	**09/27/16 09:15**	**Solid**	**GC/MS QQ**	**09/27/16**	**10/05/16 14:51**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.69	1.00	
Ethylbenzene	ND	0.69	1.00	
Toluene	ND	0.69	1.00	
p/m-Xylene	ND	1.4	1.00	
o-Xylene	ND	0.69	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.4	1.00	
Tert-Butyl Alcohol (TBA)	ND	14	1.00	
Diisopropyl Ether (DIPE)	ND	0.69	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.69	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.69	1.00	
Ethanol	ND	350	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	94	80-120	
Dibromofluoromethane	95	79-133	
1,2-Dichloroethane-d4	103	71-155	
Toluene-d8	97	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,VOC-2@10'	**16-09-2276-6-D**	**09/27/16 09:30**	**Solid**	**GC/MS QQ**	**09/27/16**	**10/05/16 15:19**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.69	1.00	
Ethylbenzene	ND	0.69	1.00	
Toluene	ND	0.69	1.00	
p/m-Xylene	ND	1.4	1.00	
o-Xylene	ND	0.69	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.4	1.00	
Tert-Butyl Alcohol (TBA)	ND	14	1.00	
Diisopropyl Ether (DIPE)	ND	0.69	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.69	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.69	1.00	
Ethanol	ND	350	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	93	80-120	
Dibromofluoromethane	95	79-133	
1,2-Dichloroethane-d4	101	71-155	
Toluene-d8	98	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,VOC-3@15'	**16-09-2276-7-D**	**09/27/16 09:45**	**Solid**	**GC/MS QQ**	**09/27/16**	**10/05/16 15:48**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.77	1.00	
Ethylbenzene	ND	0.77	1.00	
Toluene	ND	0.77	1.00	
p/m-Xylene	ND	1.5	1.00	
o-Xylene	ND	0.77	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.5	1.00	
Tert-Butyl Alcohol (TBA)	ND	15	1.00	
Diisopropyl Ether (DIPE)	ND	0.77	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.77	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.77	1.00	
Ethanol	ND	390	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	95	80-120	
Dibromofluoromethane	97	79-133	
1,2-Dichloroethane-d4	103	71-155	
Toluene-d8	99	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,VOC-4@20'	**16-09-2276-8-C**	**09/27/16 10:20**	**Solid**	**GC/MS W**	**09/27/16**	**10/04/16 13:51**	**161004L008**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.70	1.00	
Ethylbenzene	ND	0.70	1.00	
Toluene	ND	0.70	1.00	
p/m-Xylene	ND	1.4	1.00	
o-Xylene	ND	0.70	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.4	1.00	
Tert-Butyl Alcohol (TBA)	ND	14	1.00	
Diisopropyl Ether (DIPE)	ND	0.70	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.70	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.70	1.00	
Ethanol	ND	350	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	94	80-120	
Dibromofluoromethane	99	79-133	
1,2-Dichloroethane-d4	109	71-155	
Toluene-d8	99	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,VOC-1@5'	**16-09-2276-13-E**	**09/27/16 12:20**	**Solid**	**GC/MS W**	**09/27/16**	**10/04/16 18:17**	**161004L009**

Comment(s): - Reporting limit is elevated due to high levels of non-target hydrocarbons.

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	39	50.0	
Ethylbenzene	ND	39	50.0	
Toluene	ND	39	50.0	
p/m-Xylene	ND	78	50.0	
o-Xylene	ND	39	50.0	
Methyl-t-Butyl Ether (MTBE)	ND	78	50.0	
Tert-Butyl Alcohol (TBA)	ND	780	50.0	
Diisopropyl Ether (DIPE)	ND	39	50.0	
Ethyl-t-Butyl Ether (ETBE)	ND	39	50.0	
Tert-Amyl-Methyl Ether (TAME)	ND	39	50.0	
Ethanol	ND	19000	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	104	80-120	
Dibromofluoromethane	98	79-133	
1,2-Dichloroethane-d4	102	71-155	
Toluene-d8	100	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,VOC-2@10'	**16-09-2276-14-E**	**09/27/16 12:35**	**Solid**	**GC/MS W**	**09/27/16**	**10/04/16 18:44**	**161004L009**

Comment(s): - Reporting limit is elevated due to high levels of non-target hydrocarbons.

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	37	50.0	
Ethylbenzene	ND	37	50.0	
Toluene	ND	37	50.0	
p/m-Xylene	ND	75	50.0	
o-Xylene	ND	37	50.0	
Methyl-t-Butyl Ether (MTBE)	ND	75	50.0	
Tert-Butyl Alcohol (TBA)	ND	750	50.0	
Diisopropyl Ether (DIPE)	ND	37	50.0	
Ethyl-t-Butyl Ether (ETBE)	ND	37	50.0	
Tert-Amyl-Methyl Ether (TAME)	ND	37	50.0	
Ethanol	ND	19000	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	104	80-120	
Dibromofluoromethane	94	79-133	
1,2-Dichloroethane-d4	97	71-155	
Toluene-d8	103	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,VOC-3@15'	**16-09-2276-15-D**	**09/27/16 13:15**	**Solid**	**GC/MS QQ**	**09/27/16**	**10/05/16 16:17**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.71	1.00	
Ethylbenzene	ND	0.71	1.00	
Toluene	ND	0.71	1.00	
p/m-Xylene	ND	1.4	1.00	
o-Xylene	ND	0.71	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.4	1.00	
Tert-Butyl Alcohol (TBA)	ND	14	1.00	
Diisopropyl Ether (DIPE)	ND	0.71	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.71	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.71	1.00	
Ethanol	ND	350	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	95	80-120	
Dibromofluoromethane	99	79-133	
1,2-Dichloroethane-d4	104	71-155	
Toluene-d8	100	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5035
		Method:	EPA 8260B
		Units:	ug/kg
Project: Carriage Crest Park			Page 8 of 23

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-2,VOC-4@20'	**16-09-2276-16-D**	**09/27/16 13:45**	**Solid**	**GC/MS QQ**	**09/27/16**	**10/05/16 16:46**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.76	1.00	
Ethylbenzene	ND	0.76	1.00	
Toluene	ND	0.76	1.00	
p/m-Xylene	ND	1.5	1.00	
o-Xylene	ND	0.76	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.5	1.00	
Tert-Butyl Alcohol (TBA)	ND	15	1.00	
Diisopropyl Ether (DIPE)	ND	0.76	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.76	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.76	1.00	
Ethanol	ND	380	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	96	80-120	
Dibromofluoromethane	99	79-133	
1,2-Dichloroethane-d4	105	71-155	
Toluene-d8	96	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,VOC-1@5'	**16-09-2276-21-C**	**09/28/16 07:30**	**Solid**	**GC/MS W**	**09/28/16**	**10/04/16 15:11**	**161004L008**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.75	1.00	
Ethylbenzene	ND	0.75	1.00	
Toluene	ND	0.75	1.00	
p/m-Xylene	ND	1.5	1.00	
o-Xylene	ND	0.75	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.5	1.00	
Tert-Butyl Alcohol (TBA)	ND	15	1.00	
Diisopropyl Ether (DIPE)	ND	0.75	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.75	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.75	1.00	
Ethanol	ND	370	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	93	80-120	
Dibromofluoromethane	99	79-133	
1,2-Dichloroethane-d4	115	71-155	
Toluene-d8	99	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,VOC-2@10'	**16-09-2276-22-C**	**09/28/16 08:00**	**Solid**	**GC/MS W**	**09/28/16**	**10/04/16 15:38**	**161004L008**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.91	1.00	
Ethylbenzene	ND	0.91	1.00	
Toluene	ND	0.91	1.00	
p/m-Xylene	ND	1.8	1.00	
o-Xylene	ND	0.91	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.8	1.00	
Tert-Butyl Alcohol (TBA)	ND	18	1.00	
Diisopropyl Ether (DIPE)	ND	0.91	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.91	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.91	1.00	
Ethanol	ND	460	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	94	80-120	
Dibromofluoromethane	105	79-133	
1,2-Dichloroethane-d4	117	71-155	
Toluene-d8	101	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,VOC-3@15'	**16-09-2276-23-C**	**09/28/16 08:30**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 17:15**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	1.3	1.00	
Ethylbenzene	ND	1.3	1.00	
Toluene	ND	1.3	1.00	
p/m-Xylene	ND	2.6	1.00	
o-Xylene	ND	1.3	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	2.6	1.00	
Tert-Butyl Alcohol (TBA)	ND	26	1.00	
Diisopropyl Ether (DIPE)	ND	1.3	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	1.3	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	1.3	1.00	
Ethanol	ND	640	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	90	80-120	
Dibromofluoromethane	91	79-133	
1,2-Dichloroethane-d4	93	71-155	
Toluene-d8	98	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,VOC-4@20'	**16-09-2276-24-C**	**09/28/16 09:00**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 17:44**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.93	1.00	
Ethylbenzene	ND	0.93	1.00	
Toluene	ND	0.93	1.00	
p/m-Xylene	ND	1.9	1.00	
o-Xylene	ND	0.93	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.9	1.00	
Tert-Butyl Alcohol (TBA)	ND	19	1.00	
Diisopropyl Ether (DIPE)	ND	0.93	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.93	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.93	1.00	
Ethanol	ND	460	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	93	80-120	
Dibromofluoromethane	102	79-133	
1,2-Dichloroethane-d4	108	71-155	
Toluene-d8	101	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,VOC-1@5'	**16-09-2276-29-C**	**09/28/16 11:20**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 18:13**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	1.1	0.76	1.00	
Ethylbenzene	ND	0.76	1.00	
Toluene	ND	0.76	1.00	
p/m-Xylene	ND	1.5	1.00	
o-Xylene	ND	0.76	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.5	1.00	
Tert-Butyl Alcohol (TBA)	ND	15	1.00	
Diisopropyl Ether (DIPE)	ND	0.76	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.76	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.76	1.00	
Ethanol	ND	380	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	94	80-120	
Dibromofluoromethane	100	79-133	
1,2-Dichloroethane-d4	107	71-155	
Toluene-d8	98	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,VOC-2@10'	**16-09-2276-30-E**	**09/28/16 11:40**	**Solid**	**GC/MS W**	**09/28/16**	**10/04/16 19:10**	**161004L009**

Comment(s): - Reporting limit is elevated due to high levels of non-target hydrocarbons.

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	42	50.0	
Ethylbenzene	ND	42	50.0	
Toluene	ND	42	50.0	
p/m-Xylene	ND	84	50.0	
o-Xylene	ND	42	50.0	
Methyl-t-Butyl Ether (MTBE)	ND	84	50.0	
Tert-Butyl Alcohol (TBA)	ND	840	50.0	
Diisopropyl Ether (DIPE)	ND	42	50.0	
Ethyl-t-Butyl Ether (ETBE)	ND	42	50.0	
Tert-Amyl-Methyl Ether (TAME)	ND	42	50.0	
Ethanol	ND	21000	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	100	80-120	
Dibromofluoromethane	88	79-133	
1,2-Dichloroethane-d4	86	71-155	
Toluene-d8	99	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,VOC-3@15'	**16-09-2276-31-E**	**09/28/16 12:10**	**Solid**	**GC/MS W**	**09/28/16**	**10/04/16 19:37**	**161004L009**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	37	50.0	
Ethylbenzene	ND	37	50.0	
Toluene	ND	37	50.0	
p/m-Xylene	ND	74	50.0	
o-Xylene	49	37	50.0	
Methyl-t-Butyl Ether (MTBE)	ND	74	50.0	
Tert-Butyl Alcohol (TBA)	ND	740	50.0	
Diisopropyl Ether (DIPE)	ND	37	50.0	
Ethyl-t-Butyl Ether (ETBE)	ND	37	50.0	
Tert-Amyl-Methyl Ether (TAME)	ND	37	50.0	
Ethanol	ND	18000	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	99	80-120	
Dibromofluoromethane	88	79-133	
1,2-Dichloroethane-d4	81	71-155	
Toluene-d8	99	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,VOC-4@20'	**16-09-2276-32-C**	**09/28/16 12:30**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 18:41**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.70	1.00	
Ethylbenzene	ND	0.70	1.00	
Toluene	ND	0.70	1.00	
p/m-Xylene	ND	1.4	1.00	
o-Xylene	ND	0.70	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.4	1.00	
Tert-Butyl Alcohol (TBA)	ND	14	1.00	
Diisopropyl Ether (DIPE)	ND	0.70	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.70	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.70	1.00	
Ethanol	ND	350	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	97	80-120	
Dibromofluoromethane	97	79-133	
1,2-Dichloroethane-d4	106	71-155	
Toluene-d8	99	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,VOC-1@5'	**16-09-2276-37-C**	**09/28/16 13:30**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 19:10**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.79	1.00	
Ethylbenzene	ND	0.79	1.00	
Toluene	ND	0.79	1.00	
p/m-Xylene	ND	1.6	1.00	
o-Xylene	ND	0.79	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.6	1.00	
Tert-Butyl Alcohol (TBA)	ND	16	1.00	
Diisopropyl Ether (DIPE)	ND	0.79	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.79	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.79	1.00	
Ethanol	ND	400	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	101	80-120	
Dibromofluoromethane	101	79-133	
1,2-Dichloroethane-d4	108	71-155	
Toluene-d8	100	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5035
		Method:	EPA 8260B
		Units:	ug/kg
Project: Carriage Crest Park			Page 18 of 23

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,VOC-2@10'	**16-09-2276-38-C**	**09/28/16 13:45**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 19:39**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.67	1.00	
Ethylbenzene	ND	0.67	1.00	
Toluene	ND	0.67	1.00	
p/m-Xylene	ND	1.3	1.00	
o-Xylene	ND	0.67	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.3	1.00	
Tert-Butyl Alcohol (TBA)	ND	13	1.00	
Diisopropyl Ether (DIPE)	ND	0.67	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.67	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.67	1.00	
Ethanol	ND	340	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	96	80-120	
Dibromofluoromethane	94	79-133	
1,2-Dichloroethane-d4	104	71-155	
Toluene-d8	100	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,VOC-3@15'	**16-09-2276-39-C**	**09/28/16 14:10**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 20:08**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.81	1.00	
Ethylbenzene	ND	0.81	1.00	
Toluene	ND	0.81	1.00	
p/m-Xylene	ND	1.6	1.00	
o-Xylene	ND	0.81	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.6	1.00	
Tert-Butyl Alcohol (TBA)	ND	16	1.00	
Diisopropyl Ether (DIPE)	ND	0.81	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.81	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.81	1.00	
Ethanol	ND	410	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	96	80-120	
Dibromofluoromethane	101	79-133	
1,2-Dichloroethane-d4	105	71-155	
Toluene-d8	97	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5035
		Method:	EPA 8260B
		Units:	ug/kg
Project: Carriage Crest Park			Page 20 of 23

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,VOC-4@20'	**16-09-2276-40-C**	**09/28/16 14:45**	**Solid**	**GC/MS QQ**	**09/28/16**	**10/05/16 20:37**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	0.89	1.00	
Ethylbenzene	ND	0.89	1.00	
Toluene	ND	0.89	1.00	
p/m-Xylene	ND	1.8	1.00	
o-Xylene	ND	0.89	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	1.8	1.00	
Tert-Butyl Alcohol (TBA)	ND	18	1.00	
Diisopropyl Ether (DIPE)	ND	0.89	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	0.89	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	0.89	1.00	
Ethanol	ND	450	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	96	80-120	
Dibromofluoromethane	99	79-133	
1,2-Dichloroethane-d4	105	71-155	
Toluene-d8	97	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**095-01-025-28074**	**N/A**	**Solid**	**GC/MS W**	**10/04/16**	**10/04/16 12:58**	**161004L008**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	1.0	1.00	
Ethylbenzene	ND	1.0	1.00	
Toluene	ND	1.0	1.00	
p/m-Xylene	ND	2.0	1.00	
o-Xylene	ND	1.0	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	2.0	1.00	
Tert-Butyl Alcohol (TBA)	ND	20	1.00	
Diisopropyl Ether (DIPE)	ND	1.0	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	1.0	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	1.0	1.00	
Ethanol	ND	500	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	96	80-120	
Dibromofluoromethane	99	79-133	
1,2-Dichloroethane-d4	104	71-155	
Toluene-d8	100	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**095-01-025-28083**	**N/A**	**Solid**	**GC/MS W**	**10/04/16**	**10/04/16 13:25**	**161004L009**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	100	50.0	
Ethylbenzene	ND	100	50.0	
Toluene	ND	100	50.0	
p/m-Xylene	ND	200	50.0	
o-Xylene	ND	100	50.0	
Methyl-t-Butyl Ether (MTBE)	ND	200	50.0	
Tert-Butyl Alcohol (TBA)	ND	2000	50.0	
Diisopropyl Ether (DIPE)	ND	100	50.0	
Ethyl-t-Butyl Ether (ETBE)	ND	100	50.0	
Tert-Amyl-Methyl Ether (TAME)	ND	100	50.0	
Ethanol	ND	50000	50.0	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	97	80-120	
Dibromofluoromethane	95	79-133	
1,2-Dichloroethane-d4	99	71-155	
Toluene-d8	98	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**095-01-025-28085**	**N/A**	**Solid**	**GC/MS QQ**	**10/05/16**	**10/05/16 11:28**	**161005L016**

Parameter	Result	RL	DF	Qualifiers
Benzene	ND	1.0	1.00	
Ethylbenzene	ND	1.0	1.00	
Toluene	ND	1.0	1.00	
p/m-Xylene	ND	2.0	1.00	
o-Xylene	ND	1.0	1.00	
Methyl-t-Butyl Ether (MTBE)	ND	2.0	1.00	
Tert-Butyl Alcohol (TBA)	ND	20	1.00	
Diisopropyl Ether (DIPE)	ND	1.0	1.00	
Ethyl-t-Butyl Ether (ETBE)	ND	1.0	1.00	
Tert-Amyl-Methyl Ether (TAME)	ND	1.0	1.00	
Ethanol	ND	500	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
1,4-Bromofluorobenzene	97	80-120	
Dibromofluoromethane	93	79-133	
1,2-Dichloroethane-d4	90	71-155	
Toluene-d8	97	80-120	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Quality Control - Spike/Spike Duplicate

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8015B (M)
Project: Carriage Crest Park			Page 1 of 4

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
16-10-0163-1	**Sample**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 08:42**	**161004S018**
16-10-0163-1	**Matrix Spike**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 11:40**	**161004S018**
16-10-0163-1	**Matrix Spike Duplicate**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 12:16**	**161004S018**

Parameter	Sample Conc.	Spike Added	MS Conc.	MS %Rec.	MSD Conc.	MSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
TPH as Gasoline	ND	10.00	9.424	94	8.359	84	48-114	12	0-23	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - Spike/Spike Duplicate

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8015B (M)
Project: Carriage Crest Park			Page 2 of 4

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
16-10-0013-6	**Sample**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 15:14**	**161004S021**
16-10-0013-6	**Matrix Spike**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 16:25**	**161004S021**
16-10-0013-6	**Matrix Spike Duplicate**	**Solid**	**GC 1**	**10/04/16**	**10/05/16 17:00**	**161004S021**

Parameter	Sample Conc.	Spike Added	MS Conc.	MS %Rec.	MSD Conc.	MSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
TPH as Gasoline	ND	10.00	6.972	70	5.106	51	48-114	31	0-23	4

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - Spike/Spike Duplicate

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8015B (M)
Project: Carriage Crest Park			Page 3 of 4

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
16-10-0046-2	**Sample**	**Solid**	**GC 1**	**10/04/16**	**10/06/16 15:13**	**161006S023**
16-10-0046-2	**Matrix Spike**	**Solid**	**GC 1**	**10/04/16**	**10/06/16 15:48**	**161006S023**
16-10-0046-2	**Matrix Spike Duplicate**	**Solid**	**GC 1**	**10/04/16**	**10/06/16 16:24**	**161006S023**

Parameter	Sample Conc.	Spike Added	MS Conc.	MS %Rec.	MSD Conc.	MSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
TPH as Gasoline	ND	10.00	7.458	75	6.394	64	48-114	15	0-23	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - Spike/Spike Duplicate

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 3545
		Method:	EPA 8081A
Project: Carriage Crest Park			Page 4 of 4

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
B-3,P-2@5'	**Sample**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 14:22**	**161003S02A**
B-3,P-2@5'	**Matrix Spike**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 12:34**	**161003S02A**
B-3,P-2@5'	**Matrix Spike Duplicate**	**Solid**	**GC 44**	**10/03/16**	**10/04/16 12:48**	**161003S02A**

Parameter	Sample Conc.	Spike Added	MS Conc.	MS %Rec.	MSD Conc.	MSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
Aldrin	ND	25.00	21.14	85	17.81	71	50-135	17	0-25	
Alpha-BHC	ND	25.00	21.73	87	18.21	73	50-135	18	0-25	
Beta-BHC	ND	25.00	22.12	88	19.74	79	50-135	11	0-25	
4,4'-DDD	827.5	25.00	248.1	0	176.7	0	50-135	34	0-25	3,4
4,4'-DDE	247.5	25.00	274.4	108	236.1	0	50-135	15	0-25	3
4,4'-DDT	1058	25.00	516.2	0	338.6	0	50-135	42	0-25	3,4
Delta-BHC	ND	25.00	25.12	100	21.54	86	50-135	15	0-25	
Dieldrin	ND	25.00	23.76	95	20.74	83	50-135	14	0-25	
Endosulfan I	ND	25.00	26.18	105	21.01	84	50-135	22	0-25	
Endosulfan II	ND	25.00	24.83	99	21.78	87	50-135	13	0-25	
Endosulfan Sulfate	ND	25.00	22.79	91	19.74	79	50-135	14	0-25	
Endrin	ND	25.00	21.33	85	18.72	75	50-135	13	0-25	
Endrin Aldehyde	ND	25.00	21.92	88	18.97	76	50-135	14	0-25	
Gamma-BHC	ND	25.00	22.40	90	19.08	76	50-135	16	0-25	
Heptachlor	ND	25.00	22.61	90	19.16	77	50-135	17	0-25	
Heptachlor Epoxide	ND	25.00	33.48	134	27.94	112	50-135	18	0-25	
Methoxychlor	ND	25.00	24.17	97	20.95	84	50-135	14	0-25	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

eurofins | Calscience

Quality Control - LCS

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8015B (M)
Project: Carriage Crest Park			Page 1 of 9

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS Batch Number
099-14-571-3312	**LCS**	**Solid**	**GC 1**	**10/04/16**	**10/04/16 19:40**	**161004L046**

Parameter	Spike Added	Conc. Recovered	LCS %Rec.	%Rec. CL	Qualifiers
TPH as Gasoline	10.00	11.23	112	70-124	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8015B (M)
Project: Carriage Crest Park			Page 2 of 9

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS Batch Number
099-14-571-3313	**LCS**	**Solid**	**GC 1**	**10/03/16**	**10/05/16 13:27**	**161004L050**

Parameter	Spike Added	Conc. Recovered	LCS %Rec.	%Rec. CL	Qualifiers
TPH as Gasoline	10.00	11.42	114	70-124	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8015B (M)
Project: Carriage Crest Park			Page 3 of 9

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS Batch Number
099-14-571-3314	**LCS**	**Solid**	**GC 1**	**10/06/16**	**10/06/16 11:39**	**161006L049**

Parameter	Spike Added	Conc. Recovered	LCS %Rec.	%Rec. CL	Qualifiers
TPH as Gasoline	10.00	10.12	101	70-124	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 3545
		Method:	EPA 8081A
Project: Carriage Crest Park			Page 4 of 9

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS Batch Number
099-12-537-2530	**LCS**	**Solid**	**GC 41**	**10/03/16**	**10/06/16 11:19**	**161003L02A**

Parameter	Spike Added	Conc. Recovered	LCS %Rec.	%Rec. CL	ME CL	Qualifiers
Aldrin	25.00	26.86	107	50-135	36-149	
Alpha-BHC	25.00	27.06	108	50-135	36-149	
Beta-BHC	25.00	24.93	100	50-135	36-149	
4,4'-DDD	25.00	28.43	114	50-135	36-149	
4,4'-DDE	25.00	29.63	119	50-135	36-149	
4,4'-DDT	25.00	32.29	129	50-135	36-149	
Delta-BHC	25.00	28.99	116	50-135	36-149	
Dieldrin	25.00	28.79	115	50-135	36-149	
Endosulfan I	25.00	26.94	108	50-135	36-149	
Endosulfan II	25.00	29.53	118	50-135	36-149	
Endosulfan Sulfate	25.00	27.70	111	50-135	36-149	
Endrin	25.00	20.13	81	50-135	36-149	
Endrin Aldehyde	25.00	33.98	136	50-135	36-149	ME
Gamma-BHC	25.00	27.79	111	50-135	36-149	
Heptachlor	25.00	28.97	116	50-135	36-149	
Heptachlor Epoxide	25.00	27.72	111	50-135	36-149	
Methoxychlor	25.00	30.64	123	50-135	36-149	

Total number of LCS compounds: 17
Total number of ME compounds: 1
Total number of ME compounds allowed: 1
LCS ME CL validation result: Pass

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

eurofins | Calscience

Quality Control - LCS/LCSD

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 8151A
Method: EPA 8151A

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
095-01-033-1405	**LCS**	**Solid**	**GC 40**	**10/01/16**	**10/07/16 21:12**	**161001L01**
095-01-033-1405	**LCSD**	**Solid**	**GC 40**	**10/01/16**	**10/07/16 21:35**	**161001L01**

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
2,4-D	400.0	378.0	94	389.0	97	30-130	3	0-30	
2,4,5-T	40.00	41.00	102	43.00	108	30-130	5	0-30	
2,4-DB	400.0	427.0	107	452.0	113	30-130	6	0-30	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS/LCSD

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5030C
		Method:	EPA 8260B
Project: Carriage Crest Park			Page 6 of 9

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-14-001-21504	**LCS**	**Aqueous**	**GC/MS WW**	**10/04/16**	**10/04/16 09:46**	**161004L002**
099-14-001-21504	**LCSD**	**Aqueous**	**GC/MS WW**	**10/04/16**	**10/04/16 10:20**	**161004L002**

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	ME CL	RPD	RPD CL	Qualifiers
Benzene	50.00	48.42	97	46.78	94	80-120	73-127	3	0-20	
Ethylbenzene	50.00	56.28	113	52.84	106	80-123	73-130	6	0-20	
Toluene	50.00	48.94	98	52.07	104	80-120	73-127	6	0-20	
p/m-Xylene	100.0	114.6	115	105.3	105	75-123	67-131	8	0-20	
o-Xylene	50.00	59.23	118	56.44	113	74-122	66-130	5	0-20	
Methyl-t-Butyl Ether (MTBE)	50.00	53.53	107	52.77	106	69-129	59-139	1	0-20	
Tert-Butyl Alcohol (TBA)	250.0	275.4	110	274.6	110	69-129	59-139	0	0-20	
Diisopropyl Ether (DIPE)	50.00	50.54	101	49.34	99	68-128	58-138	2	0-20	
Ethyl-t-Butyl Ether (ETBE)	50.00	56.62	113	55.90	112	63-135	51-147	1	0-20	
Tert-Amyl-Methyl Ether (TAME)	50.00	56.76	114	56.59	113	67-133	56-144	0	0-20	
Ethanol	500.0	451.8	90	447.7	90	42-168	21-189	1	0-20	

Total number of LCS compounds: 11
Total number of ME compounds: 0
Total number of ME compounds allowed: 1
LCS ME CL validation result: Pass

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

eurofins | Calscience

Quality Control - LCS/LCSD

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 5035
		Method:	EPA 8260B
Project: Carriage Crest Park			Page 7 of 9

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
095-01-025-28074	**LCS**	**Solid**	**GC/MS W**	**10/04/16**	**10/04/16 10:18**	**161004L008**
095-01-025-28074	**LCSD**	**Solid**	**GC/MS W**	**10/04/16**	**10/04/16 10:45**	**161004L008**

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	ME CL	RPD	RPD CL	Qualifiers
Benzene	50.00	43.06	86	40.69	81	80-120	73-127	6	0-20	
Ethylbenzene	50.00	43.74	87	42.30	85	80-120	73-127	3	0-20	
Toluene	50.00	43.80	88	41.35	83	80-120	73-127	6	0-20	
p/m-Xylene	100.0	85.30	85	82.99	83	75-125	67-133	3	0-25	
o-Xylene	50.00	44.49	89	42.83	86	75-125	67-133	4	0-25	
Methyl-t-Butyl Ether (MTBE)	50.00	50.17	100	43.10	86	70-124	61-133	15	0-20	
Tert-Butyl Alcohol (TBA)	250.0	233.8	94	220.8	88	73-121	65-129	6	0-20	
Diisopropyl Ether (DIPE)	50.00	45.73	91	43.57	87	69-129	59-139	5	0-20	
Ethyl-t-Butyl Ether (ETBE)	50.00	46.11	92	44.18	88	70-124	61-133	4	0-20	
Tert-Amyl-Methyl Ether (TAME)	50.00	45.50	91	43.08	86	74-122	66-130	5	0-20	
Ethanol	500.0	460.2	92	448.0	90	51-135	37-149	3	0-27	

Total number of LCS compounds: 11
Total number of ME compounds: 0
Total number of ME compounds allowed: 1
LCS ME CL validation result: Pass

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS/LCSD

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
095-01-025-28083	**LCS**	**Solid**	**GC/MS W**	**10/04/16**	**10/04/16 10:18**	**161004L009**
095-01-025-28083	**LCSD**	**Solid**	**GC/MS W**	**10/04/16**	**10/04/16 10:45**	**161004L009**

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	ME CL	RPD	RPD CL	Qualifiers
Benzene	50.00	43.06	86	40.69	81	80-120	73-127	6	0-20	
Ethylbenzene	50.00	43.74	87	42.30	85	80-120	73-127	3	0-20	
Toluene	50.00	43.80	88	41.35	83	80-120	73-127	6	0-20	
p/m-Xylene	100.0	85.30	85	82.99	83	75-125	67-133	3	0-25	
o-Xylene	50.00	44.49	89	42.83	86	75-125	67-133	4	0-25	
Methyl-t-Butyl Ether (MTBE)	50.00	50.17	100	43.10	86	70-124	61-133	15	0-20	
Tert-Butyl Alcohol (TBA)	250.0	233.8	94	220.8	88	73-121	65-129	6	0-20	
Diisopropyl Ether (DIPE)	50.00	45.73	91	43.57	87	69-129	59-139	5	0-20	
Ethyl-t-Butyl Ether (ETBE)	50.00	46.11	92	44.18	88	70-124	61-133	4	0-20	
Tert-Amyl-Methyl Ether (TAME)	50.00	45.50	91	43.08	86	74-122	66-130	5	0-20	
Ethanol	500.0	460.2	92	448.0	90	51-135	37-149	3	0-27	

Total number of LCS compounds: 11
Total number of ME compounds: 0
Total number of ME compounds allowed: 1
LCS ME CL validation result: Pass

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS/LCSD

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 5035
Method: EPA 8260B

Project: Carriage Crest Park

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
095-01-025-28085	**LCS**	**Solid**	**GC/MS QQ**	**10/05/16**	**10/05/16 09:44**	**161005L016**
095-01-025-28085	**LCSD**	**Solid**	**GC/MS QQ**	**10/05/16**	**10/05/16 10:12**	**161005L016**

Parameter	Spike Added	LCS Conc.	LCS %Rec.	LCSD Conc.	LCSD %Rec.	%Rec. CL	ME CL	RPD	RPD CL	Qualifiers
Benzene	50.00	46.70	93	43.19	86	80-120	73-127	8	0-20	
Ethylbenzene	50.00	49.32	99	45.13	90	80-120	73-127	9	0-20	
Toluene	50.00	47.89	96	44.64	89	80-120	73-127	7	0-20	
p/m-Xylene	100.0	101.5	101	92.87	93	75-125	67-133	9	0-25	
o-Xylene	50.00	53.18	106	48.36	97	75-125	67-133	9	0-25	
Methyl-t-Butyl Ether (MTBE)	50.00	45.13	90	43.19	86	70-124	61-133	4	0-20	
Tert-Butyl Alcohol (TBA)	250.0	210.2	84	202.0	81	73-121	65-129	4	0-20	
Diisopropyl Ether (DIPE)	50.00	40.21	80	37.45	75	69-129	59-139	7	0-20	
Ethyl-t-Butyl Ether (ETBE)	50.00	45.45	91	42.43	85	70-124	61-133	7	0-20	
Tert-Amyl-Methyl Ether (TAME)	50.00	47.92	96	44.58	89	74-122	66-130	7	0-20	
Ethanol	500.0	377.4	75	331.3	66	51-135	37-149	13	0-27	

Total number of LCS compounds: 11
Total number of ME compounds: 0
Total number of ME compounds allowed: 1
LCS ME CL validation result: Pass

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Sample Analysis Summary Report

Work Order: 16-09-2276 Page 1 of 1

Method	Extraction	Chemist ID	Instrument	Analytical Location
EPA 8015B (M)	EPA 5030C	1083	GC 1	2
EPA 8081A	EPA 3545	669	GC 41	1
EPA 8081A	EPA 3545	669	GC 44	1
EPA 8151A	EPA 8151A	944	GC 40	1
EPA 8260B	EPA 5035	486	GC/MS QQ	2
EPA 8260B	EPA 5035	867	GC/MS W	2
EPA 8260B	EPA 5030C	1073	GC/MS WW	2

Return to Contents

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Glossary of Terms and Qualifiers

Work Order: 16-09-2276 Page 1 of 1

Qualifiers	Definition
*	See applicable analysis comment.
<	Less than the indicated value.
>	Greater than the indicated value.
1	Surrogate compound recovery was out of control due to a required sample dilution. Therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to suspected matrix interference. The associated LCS recovery was in control.
4	The MS/MSD RPD was out of control due to suspected matrix interference.
5	The PDS/PDSD or PES/PESD associated with this batch of samples was out of control due to suspected matrix interference.
6	Surrogate recovery below the acceptance limit.
7	Surrogate recovery above the acceptance limit.
B	Analyte was present in the associated method blank.
BU	Sample analyzed after holding time expired.
BV	Sample received after holding time expired.
CI	See case narrative.
E	Concentration exceeds the calibration range.
ET	Sample was extracted past end of recommended max. holding time.
HD	The chromatographic pattern was inconsistent with the profile of the reference fuel standard.
HDH	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but heavier hydrocarbons were also present (or detected).
HDL	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but lighter hydrocarbons were also present (or detected).
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
JA	Analyte positively identified but quantitation is an estimate.
ME	LCS Recovery Percentage is within Marginal Exceedance (ME) Control Limit range (+/- 4 SD from the mean).
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
SG	The sample extract was subjected to Silica Gel treatment prior to analysis.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.
	Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are reported on a wet weight basis.
	Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.
	A calculated total result (Example: Total Pesticides) is the summation of each component concentration and/or, if "J" flags are reported, estimated concentration. Component concentrations showing not detected (ND) are summed into the calculated total result as zero concentrations.

Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

16-09-2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: Calscience
SHIPMENT METHOD: Courier
TURNAROUND TIME: 5-day

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOCs (BTEX + Oxys) 8260	TPHg	Pesticides (8081)	Herbicides (8151)	HOLD FOR FUTURE ANALYSIS
B-1, P-1@1'	1	9/27/16	0900	Soil	1		X	X	X	
B-1, P-2@5'	2		0915				X	X	X	
B-1, P-3@10'	3		0930				X			X
B-1, P-4@15'	4		0945				X			X
B-1, VOC-1@5'	5		0915		4	X	X			
B-1, VOC-2@10'	6		0930				X	@		
B-1, VOC-3@15'	7		0945				X			
B-1, VOC-4@20'	8		1020				X			

RELINQUISHED BY: (Signature)	9/30/16 1030 DATE/TIME	RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature)	9/30/16 1400 DATE/TIME	RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

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Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: CARRIAGE CREST PARK
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: FERNANDO CUENCA
LABORATORY: CALSCIENCE
SHIPMENT METHOD: COURIER
TURNAROUND TIME: 5 DAY

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOC (BTEX + OXYS)(8260)	TPHg	Pesticides (8081)	Herbicides (8151)	HOLD FOR FUTURE ANALYSIS
B-2, P-1 @ 1'	9	9/27/16	1200	Soil	1		X	X	X	
B-2, P-2 @ 5'	10		1220				X	X	X	
B-2, P-3 @ 10'	11		1235				X			X
B-2, P-4 @ 15'	12		1315				X			X
B-2, VOC-1 @ 5'	13		1220		4	X				
B-2, VOC-2 @ 10'	14		1235							
B-2, VOC-3 @ 15'	15		1315							
B-2, VOC-4 @ 20'	16		1345							

RELINQUISHED BY: (Signature) — DATE/TIME: 9/30/16 1030 — RECEIVED BY: (Signature) ECO

RELINQUISHED BY: (Signature) — DATE/TIME: 9/30/16 1400 — RECEIVED BY: (Signature) CEC

RELINQUISHED BY: (Signature) — DATE/TIME — RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

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Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4592-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: Calscience
SHIPMENT METHOD: Courier
TURNAROUND TIME: Sday

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOC's (BTEX + 60xys) 8260	TPH	Pesticides (8081)	Herbicides (8151)	HOLD FOR FUTURE ANALYSIS
B-3, P-1 @1'	17	9/29/16	0715	Soil	1		X	X	X	
B-3, P-2 @5'	18		0730		1		X	X	X	
B-3, P-3 @10'	19		0800		1		X			X
B-3, P-4 @15'	20		0830		1		X			X
B-3, VOC-1 @5'	21		0730		4	X	X			
B-3, VOC-2 @10'	22		0800		4			(60)		
B-3, VOC-3 @15'	23		0830		4					
B-3, VOC-4 @20'	24		0900		4					

RELINQUISHED BY: (Signature) DATE/TIME: 9/30/16 1030 RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME: 9/30/16 1400 RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

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Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: CalScience
SHIPMENT METHOD: Courier
TURNAROUND TIME: 5-day

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOCs (8260 + 6 OXYS)	TPHd	Pesticides (8081)	Herbicides (8151)	HOLD
B-4, P-1@1'	25	9/28/14	1100	Soil	1		X	X	X	
B-4, P-2@5'	26		1120				X	X	X	
B-4, P-3@10'	27		1140				X			X
B-4, P-4@15'	28		1210				X			X
B-4, VOC-1@5'	29		1120		4	X				
B-4, VOC-2@10'	30		1140							
B-4, VOC-3@15'	31		1210						(24)	
B-4, VOC-4@20'	32		1230							

RELINQUISHED BY: (Signature) DATE/TIME 9/30/14 1030 RECEIVED BY: (Signature) EGS

RELINQUISHED BY: (Signature) DATE/TIME 9/30/14 1400 RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

Original to accompany lab report Copy 1 – Lab Copy 2 – Originator

Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: Calscience
SHIPMENT METHOD: Courier
TURNAROUND TIME: 5-day

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOCs (BTEX + GROS) 8260	TPHd	Pesticides (8081)	Herbicides (8151)	HOLD
B-5, P-1@1'	33	9/28/16	1310	Soil	1		X	X	X	
B-5, P-2@5'	34	"	1330	"	"		X	X	X	
B-5, P-3@10'	35	"	1345	"	"		X			X
B-5, P-4@15'	36	"	1410	"	"		X			X
B-5, VOC-1@5'	37	"	1330	"	4	X				
B-5, VOC-2@10'	38	"	1345	"	"	"		(2)		
B-5, VOC-3@15'	39	"	1410	"	"	"				
B-5, VOC-4@20'	40	"	1445	"	"	"				
TB	41	—	—	DI	2	X				

RELINQUISHED BY: (Signature) DATE/TIME 9/30/16 1030 RECEIVED BY: (Signature) Alycia Ees

RELINQUISHED BY: (Signature) DATE/TIME 9/30/16 1400 RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

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Return to Contents

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WORK ORDER NUMBER: 16-09- 2276

SAMPLE RECEIPT CHECKLIST

COOLER 1 OF 2

CLIENT: TETRA TECH

DATE: 09 / 20 / 2016

TEMPERATURE: (Criteria: 0.0°C – 6.0°C, not frozen except sediment/tissue)

Thermometer ID: SC2A (CF: 0.0°C); Temperature (w/o CF): 3.7 °C (w/ CF): 3.7 °C; ☐ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____)

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling

☐ Sample(s) received at ambient temperature; placed on ice for transport by courier

Ambient Temperature: ☐ Air ☐ Filter Checked by: 658

CUSTODY SEAL:

Cooler ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 658

Sample(s) ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 1069

SAMPLE CONDITION:	Yes	No	N/A
Chain-of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Sampling date ☐ Sampling time ☐ Matrix ☐ Number of containers			
☐ No analysis requested ☐ Not relinquished ☐ No relinquished date ☐ No relinquished time			
Sampler's name indicated on COC	☐	☐	☑
Sample container label(s) consistent with COC 1069	☑	☑	☐
Sample container(s) intact and in good condition 9/30/16	☑	☐	☐
Proper containers for analyses requested	☑	☐	☐
Sufficient volume/mass for analyses requested	☑	☐	☐
Samples received within holding time	☑	☐	☐
Aqueous samples for certain analyses received within 15-minute holding time			
☐ pH ☐ Residual Chlorine ☐ Dissolved Sulfide ☐ Dissolved Oxygen	☐	☐	☑
Proper preservation chemical(s) noted on COC and/or sample container	☑	☐	☐
Unpreserved aqueous sample(s) received for certain analyses			
☐ Volatile Organics ☐ Total Metals ☐ Dissolved Metals			
Container(s) for certain analysis free of headspace	☐	☑	☐
☑ Volatile Organics ☐ Dissolved Gases (RSK-175) ☐ Dissolved Oxygen (SM 4500)			
☐ Carbon Dioxide (SM 4500) ☐ Ferrous Iron (SM 3500) ☐ Hydrogen Sulfide (Hach)			
Tedlar™ bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE: (Trip Blank Lot Number: 160920B)

Aqueous: ☐ VOA ☑ VOA**h** ☐ VOA**na$_2$** ☐ 100PJ ☐ 100PJ**na$_2$** ☐ 125AGB ☐ 125AGB**h** ☐ 125AGB**p** ☐ 125PB

☐ 125PB**znna** ☐ 250AGB ☐ 250CGB ☐ 250CGB**s** ☐ 250PB ☐ 250PB**n** ☐ 500AGB ☐ 500AGJ ☐ 500AGJ**s**

☐ 500PB ☐ 1AGB ☐ 1AGB**na$_2$** ☐ 1AGB**s** ☐ 1PB ☐ 1PB**na** ☐ _____ ☐ _____ ☐ _____ ☐ _____

Solid: ☑ 4ozCGJ ☐ 8ozCGJ ☐ 16ozCGJ ☐ Sleeve (_____) ☐ EnCores® (_____) ☑ TerraCores® (3) ☑ 2ozPJ

Air: ☐ Tedlar™ ☐ Canister ☐ Sorbent Tube ☐ PUF ☐ _____ **Other Matrix** (_____): ☐ _____ ☐ _____

Container: **A** = Amber, **B** = Bottle, **C** = Clear, **E** = Envelope, **G** = Glass, **J** = Jar, **P** = Plastic, and **Z** = Ziploc/Resealable Bag

Preservative: **b** = buffered, **f** = filtered, **h** = HCl, **n** = HNO_3, **na** = NaOH, **na$_2$** = $Na_2S_2O_3$, **p** = H_3PO_4, **s** = H_2SO_4, **u** = ultra-pure, **x** = Na_2SO_3+$NaHSO_4.H_2O$, **znna** = Zn $(CH_3CO_2)_2$ + NaOH

Labeled/Checked by: 1069

Reviewed by: 1017

Return to Contents

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WORK ORDER NUMBER: 16-09- 2276

SAMPLE RECEIPT CHECKLIST

COOLER 2 OF 2

CLIENT: TETRA TECH

DATE: 09 / 30 / 2016

TEMPERATURE: (Criteria: 0.0°C – 6.0°C, not frozen except sediment/tissue)

Thermometer ID: SC2A (CF: 0.0°C); Temperature (w/o CF): 3.9 °C (w/ CF): 3.9 °C; ☑ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____)

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling

☐ Sample(s) received at ambient temperature; placed on ice for transport by courier

Ambient Temperature: ☐ Air ☐ Filter Checked by: 678

CUSTODY SEAL:

Cooler ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 678

Sample(s) ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 1069

SAMPLE CONDITION:	Yes	No	N/A
Chain-of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Sampling date ☐ Sampling time ☐ Matrix ☐ Number of containers			
☐ No analysis requested ☐ Not relinquished ☐ No relinquished date ☐ No relinquished time			
Sampler's name indicated on COC	☐	☐	☑
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and in good condition	☑	☐	☐
Proper containers for analyses requested	☑	☐	☐
Sufficient volume/mass for analyses requested	☑	☐	☐
Samples received within holding time	☑	☐	☐
Aqueous samples for certain analyses received within 15-minute holding time			
☐ pH ☐ Residual Chlorine ☐ Dissolved Sulfide ☐ Dissolved Oxygen	☐	☐	☑
Proper preservation chemical(s) noted on COC and/or sample container	☑	☐	☐
Unpreserved aqueous sample(s) received for certain analyses			
☐ Volatile Organics ☐ Total Metals ☐ Dissolved Metals			
Container(s) for certain analysis free of headspace	☐	☐	☑
☐ Volatile Organics ☐ Dissolved Gases (RSK-175) ☐ Dissolved Oxygen (SM 4500)			
☐ Carbon Dioxide (SM 4500) ☐ Ferrous Iron (SM 3500) ☐ Hydrogen Sulfide (Hach)			
Tedlar™ bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE: (Trip Blank Lot Number: _____)

Aqueous: ☐ VOA ☐ VOA**h** ☐ VOA**na$_2$** ☐ 100PJ ☐ 100PJ**na$_2$** ☐ 125AGB ☐ 125AGB**h** ☐ 125AGB**p** ☐ 125PB

☐ 125PB**znna** ☐ 250AGB ☐ 250CGB ☐ 250CGB**s** ☐ 250PB ☐ 250PB**n** ☐ 500AGB ☐ 500AGJ ☐ 500AGJ**s**

☐ 500PB ☐ 1AGB ☐ 1AGB**na$_2$** ☐ 1AGB**s** ☐ 1PB ☐ 1PB**na** ☐ _____ ☐ _____ ☐ _____ ☐ _____

Solid: ☐ 4ozCGJ ☐ 8ozCGJ ☐ 16ozCGJ ☐ Sleeve (_____) ☐ EnCores® (_____) ☑ TerraCores® (3) ☑ 2oz PJ

Air: ☐ Tedlar™ ☐ Canister ☐ Sorbent Tube ☐ PUF ☐ _____ **Other Matrix** (_____): ☐ _____ ☐ _____

Container: **A** = Amber, **B** = Bottle, **C** = Clear, **E** = Envelope, **G** = Glass, **J** = Jar, **P** = Plastic, and **Z** = Ziploc/Resealable Bag

Preservative: **b** = buffered, **f** = filtered, **h** = HCl, **n** = HNO_3, **na** = NaOH, **na$_2$** = $Na_2S_2O_3$, **p** = H_3PO_4, **s** = H_2SO_4, **u** = ultra-pure, **znna** = Zn $(CH_3CO_2)_2$ + NaOH

Labeled/Checked by: 1069

Reviewed by: 1017

Return to Contents

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WORK ORDER NUMBER: 16-09- 2276

SAMPLE ANOMALY REPORT

DATE: 09 / 30 / 2016

SAMPLES, CONTAINERS, AND LABELS:

- ☐ Sample(s) NOT RECEIVED but listed on COC
- ☐ Sample(s) received but NOT LISTED on COC
- ☐ Holding time expired (list client or ECI sample ID and analysis)
- ☐ Insufficient sample amount for requested analysis (list analysis)
- ☐ Improper container(s) used (list analysis)
- ☐ Improper preservative used (list analysis)
- ☐ No preservative noted on COC or label (list analysis and notify lab)
- ☐ Sample container(s) not labeled
- ☐ Client sample label(s) illegible (list container type and analysis)
- ☒ Client sample label(s) do not match COC (comment)
  - ☐ Project information
  - ☐ Client sample ID
  - ☐ Sampling date and/or time
  - ☒ Number of container(s)
  - ☐ Requested analysis
- ☐ Sample container(s) compromised (comment)
  - ☐ Broken
  - ☐ Water present in sample container
- ☐ Air sample container(s) compromised (comment)
  - ☐ Flat
  - ☐ Very low in volume
  - ☐ Leaking (not transferred; duplicate bag submitted)
  - ☐ Leaking (transferred into ECI Tedlar™ bags*)
  - ☐ Leaking (transferred into client's Tedlar™ bags*)

* Transferred at client's request.

Comments

(-41) Received 4 vials w. HCl instead of 2

MISCELLANEOUS: (Describe)

Comments

HEADSPACE:

(Containers with bubble > 6 mm or ¼ inch for volatile organic or dissolved gas analysis)

ECI Sample ID	ECI Container ID	Total Number**	ECI Sample ID	ECI Container ID	Total Number**
41	D	4			

(Containers with bubble for other analysis)

ECI Sample ID	ECI Container ID	Total Number**	Requested Analysis

Comments:

Reported by: 1069

Reviewed by: 1017

** Record the total number of containers (i.e., vials or bottles) for the affected sample.

Return to Contents

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Supplemental Report 1

Additional requested analyses are reported as a stand-alone report.

WORK ORDER NUMBER: 16-09-2276

The difference is service

AIR | SOIL | WATER | MARINE CHEMISTRY

Analytical Report For

Client: Tetra Tech, Inc.

Client Project Name: Carriage Crest Park

Attention: Fernando Cuenca
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Vikas Patel

Approved for release on 11/09/2016 by:
Vikas Patel
Project Manager

ResultLink

Email your PM

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Contents

Client Project Name: Carriage Crest Park
Work Order Number: 16-09-2276

1 Work Order Narrative. 3

2 Sample Summary. 4

3 Detections Summary. 5

4 Client Sample Data. 6
4.1 EPA 8081A Organochlorine Pesticides (Solid). 6

5 Quality Control Sample Data. 15
5.1 MS/MSD. 15
5.2 LCS/LCSD. 16

6 Sample Analysis Summary. 17

7 Glossary of Terms and Qualifiers. 18

8 Chain-of-Custody/Sample Receipt Form. 19

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Work Order Narrative

Work Order: 16-09-2276 Page 1 of 1

Condition Upon Receipt:

Samples were received under Chain-of-Custody (COC) on 09/30/16. They were assigned to Work Order 16-09-2276.

Unless otherwise noted on the Sample Receiving forms all samples were received in good condition and within the recommended EPA temperature criteria for the methods noted on the COC. The COC and Sample Receiving Documents are integral elements of the analytical report and are presented at the back of the report.

Holding Times:

All samples were analyzed within prescribed holding times (HT) and/or in accordance with the Calscience Sample Acceptance Policy unless otherwise noted in the analytical report and/or comprehensive case narrative, if required.

Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.

Quality Control:

All quality control parameters (QC) were within established control limits except where noted in the QC summary forms or described further within this report.

Subcontractor Information:

Unless otherwise noted below (or on the subcontract form), no samples were subcontracted.

Additional Comments:

Air - Sorbent-extracted air methods (EPA TO-4A, EPA TO-10, EPA TO-13A, EPA TO-17): Analytical results are converted from mass/sample basis to mass/volume basis using client-supplied air volumes.

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are always reported on a wet weight basis.

Return to Contents

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Sample Summary

Client:	Tetra Tech, Inc.	Work Order:	16-09-2276
	1360 Valley Vista Drive	Project Name:	Carriage Crest Park
	Diamond Bar, CA 91765-1111	PO Number:	197-4552-0101
		Date/Time Received:	09/30/16 14:00
		Number of Containers:	92
Attn:	Fernando Cuenca		

Sample Identification	Lab Number	Collection Date and Time	Number of Containers	Matrix
B-1,P-3@10'	16-09-2276-3	09/27/16 09:30	1	Solid
B-1,P-4@15'	16-09-2276-4	09/27/16 09:45	1	Solid
B-3,P-3@10'	16-09-2276-19	09/28/16 08:00	1	Solid
B-3,P-4@15'	16-09-2276-20	09/28/16 08:30	1	Solid
B-4,P-3@10'	16-09-2276-27	09/28/16 11:40	1	Solid
B-4,P-4@15'	16-09-2276-28	09/28/16 12:10	1	Solid
B-5,P-3@10'	16-09-2276-35	09/28/16 13:45	1	Solid
B-5,P-4@15'	16-09-2276-36	09/28/16 14:10	1	Solid

Return to Contents

eurofins | Calscience

Detections Summary

Client:	Tetra Tech, Inc.	Work Order:	16-09-2276
	1360 Valley Vista Drive	Project Name:	Carriage Crest Park
	Diamond Bar, CA 91765-1111	Received:	09/30/16
Attn:	Fernando Cuenca		

Client SampleID

Analyte	Result	Qualifiers	RL	Units	Method	Extraction
B-3,P-3@10' (16-09-2276-19)						
4,4'-DDD	8.0	ET	4.9	ug/kg	EPA 8081A	EPA 3545
4,4'-DDE	6.0	ET	4.9	ug/kg	EPA 8081A	EPA 3545

Subcontracted analyses, if any, are not included in this summary.

Return to Contents

* MDL is shown

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-3@10'	**16-09-2276-3-A**	**09/27/16 09:30**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 12:52**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	ET
Alpha-BHC	ND	10	1.00	ET
Beta-BHC	ND	5.0	1.00	ET
Chlordane	ND	50	1.00	ET
4,4'-DDD	ND	5.0	1.00	ET
4,4'-DDE	ND	5.0	1.00	ET
4,4'-DDT	ND	5.0	1.00	ET
Delta-BHC	ND	10	1.00	ET
Dieldrin	ND	5.0	1.00	ET
Endosulfan I	ND	5.0	1.00	ET
Endosulfan II	ND	5.0	1.00	ET
Endosulfan Sulfate	ND	5.0	1.00	ET
Endrin	ND	5.0	1.00	ET
Endrin Aldehyde	ND	5.0	1.00	ET
Endrin Ketone	ND	5.0	1.00	ET
Gamma-BHC	ND	5.0	1.00	ET
Heptachlor	ND	5.0	1.00	ET
Heptachlor Epoxide	ND	10	1.00	ET
Methoxychlor	ND	5.0	1.00	ET
Toxaphene	ND	100	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	97	24-168	
2,4,5,6-Tetrachloro-m-Xylene	83	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-1,P-4@15'	**16-09-2276-4-A**	**09/27/16 09:45**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 13:07**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	ET
Alpha-BHC	ND	10	1.00	ET
Beta-BHC	ND	5.0	1.00	ET
Chlordane	ND	50	1.00	ET
4,4'-DDD	ND	5.0	1.00	ET
4,4'-DDE	ND	5.0	1.00	ET
4,4'-DDT	ND	5.0	1.00	ET
Delta-BHC	ND	10	1.00	ET
Dieldrin	ND	5.0	1.00	ET
Endosulfan I	ND	5.0	1.00	ET
Endosulfan II	ND	5.0	1.00	ET
Endosulfan Sulfate	ND	5.0	1.00	ET
Endrin	ND	5.0	1.00	ET
Endrin Aldehyde	ND	5.0	1.00	ET
Endrin Ketone	ND	5.0	1.00	ET
Gamma-BHC	ND	5.0	1.00	ET
Heptachlor	ND	5.0	1.00	ET
Heptachlor Epoxide	ND	10	1.00	ET
Methoxychlor	ND	5.0	1.00	ET
Toxaphene	ND	100	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	106	24-168	
2,4,5,6-Tetrachloro-m-Xylene	92	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-3@10'	**16-09-2276-19-A**	**09/28/16 08:00**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 13:22**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	4.9	1.00	ET
Alpha-BHC	ND	9.9	1.00	ET
Beta-BHC	ND	4.9	1.00	ET
Chlordane	ND	49	1.00	ET
4,4'-DDD	8.0	4.9	1.00	ET
4,4'-DDE	6.0	4.9	1.00	ET
4,4'-DDT	ND	4.9	1.00	ET
Delta-BHC	ND	9.9	1.00	ET
Dieldrin	ND	4.9	1.00	ET
Endosulfan I	ND	4.9	1.00	ET
Endosulfan II	ND	4.9	1.00	ET
Endosulfan Sulfate	ND	4.9	1.00	ET
Endrin	ND	4.9	1.00	ET
Endrin Aldehyde	ND	4.9	1.00	ET
Endrin Ketone	ND	4.9	1.00	ET
Gamma-BHC	ND	4.9	1.00	ET
Heptachlor	ND	4.9	1.00	ET
Heptachlor Epoxide	ND	9.9	1.00	ET
Methoxychlor	ND	4.9	1.00	ET
Toxaphene	ND	99	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	106	24-168	
2,4,5,6-Tetrachloro-m-Xylene	90	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-3,P-4@15'	**16-09-2276-20-A**	**09/28/16 08:30**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 13:37**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	ET
Alpha-BHC	ND	10	1.00	ET
Beta-BHC	ND	5.0	1.00	ET
Chlordane	ND	50	1.00	ET
4,4'-DDD	ND	5.0	1.00	ET
4,4'-DDE	ND	5.0	1.00	ET
4,4'-DDT	ND	5.0	1.00	ET
Delta-BHC	ND	10	1.00	ET
Dieldrin	ND	5.0	1.00	ET
Endosulfan I	ND	5.0	1.00	ET
Endosulfan II	ND	5.0	1.00	ET
Endosulfan Sulfate	ND	5.0	1.00	ET
Endrin	ND	5.0	1.00	ET
Endrin Aldehyde	ND	5.0	1.00	ET
Endrin Ketone	ND	5.0	1.00	ET
Gamma-BHC	ND	5.0	1.00	ET
Heptachlor	ND	5.0	1.00	ET
Heptachlor Epoxide	ND	10	1.00	ET
Methoxychlor	ND	5.0	1.00	ET
Toxaphene	ND	100	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	101	24-168	
2,4,5,6-Tetrachloro-m-Xylene	93	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Project: Carriage Crest Park

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-3@10'	**16-09-2276-27-A**	**09/28/16 11:40**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 13:52**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	ET
Alpha-BHC	ND	10	1.00	ET
Beta-BHC	ND	5.0	1.00	ET
Chlordane	ND	50	1.00	ET
4,4'-DDD	ND	5.0	1.00	ET
4,4'-DDE	ND	5.0	1.00	ET
4,4'-DDT	ND	5.0	1.00	ET
Delta-BHC	ND	10	1.00	ET
Dieldrin	ND	5.0	1.00	ET
Endosulfan I	ND	5.0	1.00	ET
Endosulfan II	ND	5.0	1.00	ET
Endosulfan Sulfate	ND	5.0	1.00	ET
Endrin	ND	5.0	1.00	ET
Endrin Aldehyde	ND	5.0	1.00	ET
Endrin Ketone	ND	5.0	1.00	ET
Gamma-BHC	ND	5.0	1.00	ET
Heptachlor	ND	5.0	1.00	ET
Heptachlor Epoxide	ND	10	1.00	ET
Methoxychlor	ND	5.0	1.00	ET
Toxaphene	ND	100	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	122	24-168	
2,4,5,6-Tetrachloro-m-Xylene	73	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

eurofins | Calscience

Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-4,P-4@15'	**16-09-2276-28-A**	**09/28/16 12:10**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 14:07**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	ET
Alpha-BHC	ND	9.9	1.00	ET
Beta-BHC	ND	5.0	1.00	ET
Chlordane	ND	50	1.00	ET
4,4'-DDD	ND	5.0	1.00	ET
4,4'-DDE	ND	5.0	1.00	ET
4,4'-DDT	ND	5.0	1.00	ET
Delta-BHC	ND	9.9	1.00	ET
Dieldrin	ND	5.0	1.00	ET
Endosulfan I	ND	5.0	1.00	ET
Endosulfan II	ND	5.0	1.00	ET
Endosulfan Sulfate	ND	5.0	1.00	ET
Endrin	ND	5.0	1.00	ET
Endrin Aldehyde	ND	5.0	1.00	ET
Endrin Ketone	ND	5.0	1.00	ET
Gamma-BHC	ND	5.0	1.00	ET
Heptachlor	ND	5.0	1.00	ET
Heptachlor Epoxide	ND	9.9	1.00	ET
Methoxychlor	ND	5.0	1.00	ET
Toxaphene	ND	99	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	87	24-168	
2,4,5,6-Tetrachloro-m-Xylene	50	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-3@10'	**16-09-2276-35-A**	**09/28/16 13:45**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 14:22**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	ET
Alpha-BHC	ND	10	1.00	ET
Beta-BHC	ND	5.0	1.00	ET
Chlordane	ND	50	1.00	ET
4,4'-DDD	ND	5.0	1.00	ET
4,4'-DDE	ND	5.0	1.00	ET
4,4'-DDT	ND	5.0	1.00	ET
Delta-BHC	ND	10	1.00	ET
Dieldrin	ND	5.0	1.00	ET
Endosulfan I	ND	5.0	1.00	ET
Endosulfan II	ND	5.0	1.00	ET
Endosulfan Sulfate	ND	5.0	1.00	ET
Endrin	ND	5.0	1.00	ET
Endrin Aldehyde	ND	5.0	1.00	ET
Endrin Ketone	ND	5.0	1.00	ET
Gamma-BHC	ND	5.0	1.00	ET
Heptachlor	ND	5.0	1.00	ET
Heptachlor Epoxide	ND	10	1.00	ET
Methoxychlor	ND	5.0	1.00	ET
Toxaphene	ND	100	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	104	24-168	
2,4,5,6-Tetrachloro-m-Xylene	67	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
B-5,P-4@15'	**16-09-2276-36-A**	**09/28/16 14:10**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 14:37**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	ET
Alpha-BHC	ND	10	1.00	ET
Beta-BHC	ND	5.0	1.00	ET
Chlordane	ND	50	1.00	ET
4,4'-DDD	ND	5.0	1.00	ET
4,4'-DDE	ND	5.0	1.00	ET
4,4'-DDT	ND	5.0	1.00	ET
Delta-BHC	ND	10	1.00	ET
Dieldrin	ND	5.0	1.00	ET
Endosulfan I	ND	5.0	1.00	ET
Endosulfan II	ND	5.0	1.00	ET
Endosulfan Sulfate	ND	5.0	1.00	ET
Endrin	ND	5.0	1.00	ET
Endrin Aldehyde	ND	5.0	1.00	ET
Endrin Ketone	ND	5.0	1.00	ET
Gamma-BHC	ND	5.0	1.00	ET
Heptachlor	ND	5.0	1.00	ET
Heptachlor Epoxide	ND	10	1.00	ET
Methoxychlor	ND	5.0	1.00	ET
Toxaphene	ND	100	1.00	ET

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	133	24-168	
2,4,5,6-Tetrachloro-m-Xylene	94	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Analytical Report

Tetra Tech, Inc.
1360 Valley Vista Drive
Diamond Bar, CA 91765-1111

Project: Carriage Crest Park

Date Received: 09/30/16
Work Order: 16-09-2276
Preparation: EPA 3545
Method: EPA 8081A
Units: ug/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-537-2550**	**N/A**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 12:07**	**161104L09**

Parameter	Result	RL	DF	Qualifiers
Aldrin	ND	5.0	1.00	
Alpha-BHC	ND	10	1.00	
Beta-BHC	ND	5.0	1.00	
Chlordane	ND	50	1.00	
4,4'-DDD	ND	5.0	1.00	
4,4'-DDE	ND	5.0	1.00	
4,4'-DDT	ND	5.0	1.00	
Delta-BHC	ND	10	1.00	
Dieldrin	ND	5.0	1.00	
Endosulfan I	ND	5.0	1.00	
Endosulfan II	ND	5.0	1.00	
Endosulfan Sulfate	ND	5.0	1.00	
Endrin	ND	5.0	1.00	
Endrin Aldehyde	ND	5.0	1.00	
Endrin Ketone	ND	5.0	1.00	
Gamma-BHC	ND	5.0	1.00	
Heptachlor	ND	5.0	1.00	
Heptachlor Epoxide	ND	10	1.00	
Methoxychlor	ND	5.0	1.00	
Toxaphene	ND	100	1.00	

Surrogate	Rec. (%)	Control Limits	Qualifiers
Decachlorobiphenyl	110	24-168	
2,4,5,6-Tetrachloro-m-Xylene	95	25-145	

Return to Contents

RL: Reporting Limit. DF: Dilution Factor. MDL: Method Detection Limit.

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Quality Control - Spike/Spike Duplicate

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 3545
		Method:	EPA 8081A
Project: Carriage Crest Park			Page 1 of 1

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
B-5,P-4@15'	**Sample**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 14:37**	**161104S09**
B-5,P-4@15'	**Matrix Spike**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 12:22**	**161104S09**
B-5,P-4@15'	**Matrix Spike Duplicate**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 12:37**	**161104S09**

Parameter	Sample Conc.	Spike Added	MS Conc.	MS %Rec.	MSD Conc.	MSD %Rec.	%Rec. CL	RPD	RPD CL	Qualifiers
Aldrin	ND	25.00	23.06	92	23.84	95	50-135	3	0-25	
Alpha-BHC	ND	25.00	22.20	89	22.92	92	50-135	3	0-25	
Beta-BHC	ND	25.00	24.82	99	25.01	100	50-135	1	0-25	
4,4'-DDD	ND	25.00	31.29	125	30.88	124	50-135	1	0-25	
4,4'-DDE	ND	25.00	34.38	138	35.04	140	50-135	2	0-25	3
4,4'-DDT	ND	25.00	31.40	126	32.52	130	50-135	4	0-25	
Delta-BHC	ND	25.00	25.34	101	25.47	102	50-135	1	0-25	
Dieldrin	ND	25.00	27.15	109	26.95	108	50-135	1	0-25	
Endosulfan I	ND	25.00	23.64	95	23.52	94	50-135	1	0-25	
Endosulfan II	ND	25.00	31.48	126	30.65	123	50-135	3	0-25	
Endosulfan Sulfate	ND	25.00	30.80	123	29.75	119	50-135	3	0-25	
Endrin	ND	25.00	29.53	118	29.22	117	50-135	1	0-25	
Endrin Aldehyde	ND	25.00	28.41	114	27.29	109	50-135	4	0-25	
Gamma-BHC	ND	25.00	24.10	96	24.57	98	50-135	2	0-25	
Heptachlor	ND	25.00	23.40	94	24.30	97	50-135	4	0-25	
Heptachlor Epoxide	ND	25.00	24.89	100	24.96	100	50-135	0	0-25	
Methoxychlor	ND	25.00	31.77	127	30.95	124	50-135	3	0-25	

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Quality Control - LCS

Tetra Tech, Inc.		Date Received:	09/30/16
1360 Valley Vista Drive		Work Order:	16-09-2276
Diamond Bar, CA 91765-1111		Preparation:	EPA 3545
		Method:	EPA 8081A
Project: Carriage Crest Park			Page 1 of 1

Quality Control Sample ID	Type	Matrix	Instrument	Date Prepared	Date Analyzed	LCS Batch Number
099-12-537-2550	**LCS**	**Solid**	**GC 41**	**11/04/16**	**11/07/16 11:52**	**161104L09**

Parameter	Spike Added	Conc. Recovered	LCS %Rec.	%Rec. CL	ME CL	Qualifiers
Aldrin	25.00	21.85	87	50-135	36-149	
Alpha-BHC	25.00	22.67	91	50-135	36-149	
Beta-BHC	25.00	21.53	86	50-135	36-149	
4,4'-DDD	25.00	22.11	88	50-135	36-149	
4,4'-DDE	25.00	24.14	97	50-135	36-149	
4,4'-DDT	25.00	23.79	95	50-135	36-149	
Delta-BHC	25.00	22.76	91	50-135	36-149	
Dieldrin	25.00	23.36	93	50-135	36-149	
Endosulfan I	25.00	22.42	90	50-135	36-149	
Endosulfan II	25.00	24.76	99	50-135	36-149	
Endosulfan Sulfate	25.00	23.64	95	50-135	36-149	
Endrin	25.00	24.10	96	50-135	36-149	
Endrin Aldehyde	25.00	23.30	93	50-135	36-149	
Gamma-BHC	25.00	23.41	94	50-135	36-149	
Heptachlor	25.00	23.40	94	50-135	36-149	
Heptachlor Epoxide	25.00	22.59	90	50-135	36-149	
Methoxychlor	25.00	22.99	92	50-135	36-149	

Total number of LCS compounds: 17
Total number of ME compounds: 0
Total number of ME compounds allowed: 1
LCS ME CL validation result: Pass

Return to Contents

RPD: Relative Percent Difference. CL: Control Limits

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Sample Analysis Summary Report

Work Order: 16-09-2276 Page 1 of 1

Method	Extraction	Chemist ID	Instrument	Analytical Location
EPA 8081A	EPA 3545	669	GC 41	1

Return to Contents

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Glossary of Terms and Qualifiers

Work Order: 16-09-2276 Page 1 of 1

Qualifiers	Definition
*	See applicable analysis comment.
<	Less than the indicated value.
>	Greater than the indicated value.
1	Surrogate compound recovery was out of control due to a required sample dilution. Therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to suspected matrix interference. The associated LCS recovery was in control.
4	The MS/MSD RPD was out of control due to suspected matrix interference.
5	The PDS/PDSD or PES/PESD associated with this batch of samples was out of control due to suspected matrix interference.
6	Surrogate recovery below the acceptance limit.
7	Surrogate recovery above the acceptance limit.
B	Analyte was present in the associated method blank.
BU	Sample analyzed after holding time expired.
BV	Sample received after holding time expired.
CI	See case narrative.
E	Concentration exceeds the calibration range.
ET	Sample was extracted past end of recommended max. holding time.
HD	The chromatographic pattern was inconsistent with the profile of the reference fuel standard.
HDH	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but heavier hydrocarbons were also present (or detected).
HDL	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but lighter hydrocarbons were also present (or detected).
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
JA	Analyte positively identified but quantitation is an estimate.
ME	LCS Recovery Percentage is within Marginal Exceedance (ME) Control Limit range (+/- 4 SD from the mean).
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
SG	The sample extract was subjected to Silica Gel treatment prior to analysis.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.
	Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are reported on a wet weight basis.
	Any parameter identified in 40CFR Part 136.3 Table II that is designated as "analyze immediately" with a holding time of <= 15 minutes (40CFR-136.3 Table II, footnote 4), is considered a "field" test and the reported results will be qualified as being received outside of the stated holding time unless received at the laboratory within 15 minutes of the collection time.
	A calculated total result (Example: Total Pesticides) is the summation of each component concentration and/or, if "J" flags are reported, estimated concentration. Component concentrations showing not detected (ND) are summed into the calculated total result as zero concentrations.

Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

16-09-2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: Calscience
SHIPMENT METHOD: Courier
TURNAROUND TIME: 5-day

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOCs (BTEX + 6 oxys) 8260	TPHg	Pesticides (8081)	Herbicides (8151)	HOLD FOR FUTURE ANALYSIS
B-1, P-1@1'	1	9/27/16	0900	Soil	1		X	X	X	
B-1, P-2@5'	2		0915				X	X	X	
B-1, P-3@10'	3		0930				X			X
B-1, P-4@15'	4		0945				X			X
B-1, VOC-1@5'	5		0915		4	X	X	@		
B-1, VOC-2@10'	6		0930				X			
B-1, VOC-3@15'	7		0945				X			
B-1, VOC-4@20'	8		1020				X			

RELINQUISHED BY: (Signature)	9/30/16 1030 DATE/TIME	RECEIVED BY: (Signature)	
RELINQUISHED BY: (Signature)	9/30/16 1400 DATE/TIME	RECEIVED BY: (Signature)	
RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)	

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

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Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: CARRIAGE CREST PARK
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: FERNANDO CUENCA
LABORATORY: CALSCIENCE
SHIPMENT METHOD: COURIER
TURNAROUND TIME: 5 DAY

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOC (BTEX + OXYS)(8260)	TPHg	PESTICIDES (8081)	HERBICIDES (8151)	HOLD FOR FUTURE ANALYSIS
B-2, P-1 @ 1'	9	9/27/16	1200	SOIL	1		X	X	X	
B-2, P-2 @ 5'	10		1220				X	X	X	
B-2, P-3 @ 10'	11		1235				X			X
B-2, P-4 @ 15'	12		1315				X			X
B-2, VOC-1 @ 5'	13		1220		4	X				
B-2, VOC-2 @ 10'	14		1235							
B-2, VOC-3 @ 15'	15		1315							
B-2, VOC-4 @ 20'	16		1345							

RELINQUISHED BY: (Signature) — DATE/TIME: 9/30/16 1030 — RECEIVED BY: (Signature) ECO

RELINQUISHED BY: (Signature) — DATE/TIME: 9/30/16 1400 — RECEIVED BY: (Signature) CCG

RELINQUISHED BY: (Signature) — DATE/TIME — RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

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TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4592-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: Calscience
SHIPMENT METHOD: Courier
TURNAROUND TIME: Sday

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOC's (BTEX + 60xys) 8260	TPH	Pesticides (8081)	Herbicides (8151)	HOLD FOR FUTURE ANALYSIS
B-3, P-1 @1'	17	9/29/16	0715	Soil	1		X	X	X	
B-3, P-2 @5'	18		0730		1		X	X	X	
B-3, P-3 @10'	19		0800		1		X			X
B-3, P-4 @15'	20		0830		1		X			X
B-3, VOC-1 @5'	21		0730		4	X	X			
B-3, VOC-2 @10'	22		0800		4			(60)		
B-3, VOC-3 @15'	23		0830		4					
B-3, VOC-4 @20'	24		0900		4					

RELINQUISHED BY: (Signature) 9/30/16 1030 DATE/TIME RECEIVED BY: (Signature) EET

RELINQUISHED BY: (Signature) 9/30/16 1400 DATE/TIME RECEIVED BY: (Signature) LM

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

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TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: CalScience
SHIPMENT METHOD: Courier
TURNAROUND TIME: 5-day
DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOCs (BTEX + G OXYS) 8260	TPHg	Pesticides (8081)	Herbicides (8151)	HOLD
B-4, P-1@1'	25	9/28/14	1100	Soil	1		X	X	X	
B-4, P-2@5'	26	"	1120	"	"		X	X	X	
B-4, P-3@10'	27	"	1140	"	"		X			X
B-4, P-4@15'	28	"	1210	"	"		X			X
B-4, VOC-1@5'	29	"	1120	"	4	X				
B-4, VOC-2@10'	30	"	1140	"	"	"				
B-4, VOC-3@15'	31	"	1210	"	"	"			(24)	
B-4, VOC-4@20'	32	"	1230	"	"	"				

RELINQUISHED BY: (Signature) — DATE/TIME: 9/30/14 1030 — RECEIVED BY: (Signature) EES

RELINQUISHED BY: (Signature) — DATE/TIME: 9/30/14 1400 — RECEIVED BY: (Signature) by

RELINQUISHED BY: (Signature) — DATE/TIME — RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

Original to accompany lab report Copy 1 – Lab Copy 2 – Originator

Return to Contents

TETRA TECH BAS

CHAIN OF CUSTODY

2276

PROJECT INFORMATION

PROJECT NAME: Carriage Crest Park
JOB NUMBER: 197-4552-0101
PROJECT MANAGER: Fernando Cuenca
LABORATORY: Calscience
SHIPMENT METHOD: Courier
TURNAROUND TIME: 5-day

DISPOSAL: Lab Disposal [X] Return [ ] Pick Up [ ]

BAS Sample I.D.	LAB I.D.	DATE	TIME	MATRIX	NUMBER OF CONTAINERS	VOCs (BTEX + GCMS) 8260	TPHd	Pesticides (8081)	Herbicides (8151)	HOLD
B-5, P-1@1'	33	9/28/16	1310	Soil	1		X	X	X	
B-5, P-2@5'	34	"	1330	"	"		X	X	X	
B-5, P-3@10'	35	"	1345	"	"		X			X
B-5, P-4@15'	36	"	1410	"	"		X			X
B-5, VOC-1@5'	37	"	1330	"	4	X				
B-5, VOC-2@10'	38	"	1345	"	"	"		(2)		
B-5, VOC-3@15'	39	"	1410	"	"	"				
B-5, VOC-4@20'	40	"	1445	"	"	"				
TB	41	—	—	DI	2	X				

RELINQUISHED BY: (Signature) DATE/TIME 9/30/16 1030 RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME 9/30/16 1400 RECEIVED BY: (Signature)

RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

SAMPLE CONDITION (Lab Initials)

Shipping Container:
Sealed _____
Sample(s):
Integrity _____
Chilled _____
Sealed _____

COMMENTS:

1360 Valley Vista Drive, Diamond Bar, CA 91765 (909) 860-7777 FAX (909) 860-8017

Original to accompany lab report Copy 1 – Lab Copy 2 – Originator

Return to Contents

eurofins | Calscience

WORK ORDER NUMBER: 16-09- 2276

SAMPLE RECEIPT CHECKLIST

COOLER 1 OF 2

CLIENT: TETRA TECH

DATE: 09 / 20 / 2016

TEMPERATURE: (Criteria: 0.0°C – 6.0°C, not frozen except sediment/tissue)

Thermometer ID: SC2A (CF: 0.0°C); Temperature (w/o CF): 3.7 °C (w/ CF): 3.7 °C; ☐ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____)

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling

☐ Sample(s) received at ambient temperature; placed on ice for transport by courier

Ambient Temperature: ☐ Air ☐ Filter Checked by: 658

CUSTODY SEAL:

Cooler ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 658

Sample(s) ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 1069

SAMPLE CONDITION:	Yes	No	N/A
Chain-of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Sampling date ☐ Sampling time ☐ Matrix ☐ Number of containers			
☐ No analysis requested ☐ Not relinquished ☐ No relinquished date ☐ No relinquished time			
Sampler's name indicated on COC	☐	☐	☑
Sample container label(s) consistent with COC 1069	☑	☑	☐
Sample container(s) intact and in good condition 9/30/16	☑	☐	☐
Proper containers for analyses requested	☑	☐	☐
Sufficient volume/mass for analyses requested	☑	☐	☐
Samples received within holding time	☑	☐	☐
Aqueous samples for certain analyses received within 15-minute holding time			
☐ pH ☐ Residual Chlorine ☐ Dissolved Sulfide ☐ Dissolved Oxygen	☐	☐	☑
Proper preservation chemical(s) noted on COC and/or sample container	☑	☐	☐
Unpreserved aqueous sample(s) received for certain analyses			
☐ Volatile Organics ☐ Total Metals ☐ Dissolved Metals			
Container(s) for certain analysis free of headspace	☐	☑	☐
☑ Volatile Organics ☐ Dissolved Gases (RSK-175) ☐ Dissolved Oxygen (SM 4500)			
☐ Carbon Dioxide (SM 4500) ☐ Ferrous Iron (SM 3500) ☐ Hydrogen Sulfide (Hach)			
Tedlar™ bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE: (Trip Blank Lot Number: 1609208)

Aqueous: ☐ VOA ☑ VOA**h** ☐ VOA**na$_2$** ☐ 100PJ ☐ 100PJ**na$_2$** ☐ 125AGB ☐ 125AGB**h** ☐ 125AGB**p** ☐ 125PB

☐ 125PB**znna** ☐ 250AGB ☐ 250CGB ☐ 250CGB**s** ☐ 250PB ☐ 250PB**n** ☐ 500AGB ☐ 500AGJ ☐ 500AGJ**s**

☐ 500PB ☐ 1AGB ☐ 1AGB**na$_2$** ☐ 1AGB**s** ☐ 1PB ☐ 1PB**na** ☐ _____ ☐ _____ ☐ _____ ☐ _____

Solid: ☑ 4ozCGJ ☐ 8ozCGJ ☐ 16ozCGJ ☐ Sleeve (_____) ☐ EnCores® (_____) ☑ TerraCores® (3) ☑ 2ozPJ

Air: ☐ Tedlar™ ☐ Canister ☐ Sorbent Tube ☐ PUF ☐ _____ **Other Matrix** (_____): ☐ _____ ☐ _____

Container: **A** = Amber, **B** = Bottle, **C** = Clear, **E** = Envelope, **G** = Glass, **J** = Jar, **P** = Plastic, and **Z** = Ziploc/Resealable Bag

Preservative: **b** = buffered, **f** = filtered, **h** = HCl, **n** = HNO_3, **na** = NaOH, **na$_2$** = $Na_2S_2O_3$, **p** = H_3PO_4, **s** = H_2SO_4, **u** = ultra-pure, **x** = Na_2SO_3+$NaHSO_4.H_2O$, **znna** = Zn $(CH_3CO_2)_2$ + NaOH

Labeled/Checked by: 1069

Reviewed by: 1017

Return to Contents

eurofins | Calscience

WORK ORDER NUMBER: 16-09- 2276

SAMPLE RECEIPT CHECKLIST

COOLER 2 OF 2

CLIENT: TETRA TECH

DATE: 09 / 30 / 2016

TEMPERATURE: (Criteria: 0.0°C – 6.0°C, not frozen except sediment/tissue)

Thermometer ID: SC2A (CF: 0.0°C); Temperature (w/o CF): 3.9 °C (w/ CF): 3.9 °C; ☑ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____)

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling

☐ Sample(s) received at ambient temperature; placed on ice for transport by courier

Ambient Temperature: ☐ Air ☐ Filter Checked by: 678

CUSTODY SEAL:

Cooler ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 678

Sample(s) ☐ Present and Intact ☐ Present but Not Intact ☑ Not Present ☐ N/A Checked by: 1069

SAMPLE CONDITION:	Yes	No	N/A
Chain-of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Sampling date ☐ Sampling time ☐ Matrix ☐ Number of containers			
☐ No analysis requested ☐ Not relinquished ☐ No relinquished date ☐ No relinquished time			
Sampler's name indicated on COC	☐	☐	☑
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and in good condition	☑	☐	☐
Proper containers for analyses requested	☑	☐	☐
Sufficient volume/mass for analyses requested	☑	☐	☐
Samples received within holding time	☑	☐	☐
Aqueous samples for certain analyses received within 15-minute holding time			
☐ pH ☐ Residual Chlorine ☐ Dissolved Sulfide ☐ Dissolved Oxygen	☐	☐	☑
Proper preservation chemical(s) noted on COC and/or sample container	☑	☐	☐
Unpreserved aqueous sample(s) received for certain analyses			
☐ Volatile Organics ☐ Total Metals ☐ Dissolved Metals			
Container(s) for certain analysis free of headspace	☐	☐	☑
☐ Volatile Organics ☐ Dissolved Gases (RSK-175) ☐ Dissolved Oxygen (SM 4500)			
☐ Carbon Dioxide (SM 4500) ☐ Ferrous Iron (SM 3500) ☐ Hydrogen Sulfide (Hach)			
Tedlar™ bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE: (Trip Blank Lot Number: _____)

Aqueous: ☐ VOA ☐ VOA**h** ☐ VOA**na$_2$** ☐ 100PJ ☐ 100PJ**na$_2$** ☐ 125AGB ☐ 125AGB**h** ☐ 125AGB**p** ☐ 125PB

☐ 125PB**znna** ☐ 250AGB ☐ 250CGB ☐ 250CGB**s** ☐ 250PB ☐ 250PB**n** ☐ 500AGB ☐ 500AGJ ☐ 500AGJ**s**

☐ 500PB ☐ 1AGB ☐ 1AGB**na$_2$** ☐ 1AGB**s** ☐ 1PB ☐ 1PB**na** ☐ _____ ☐ _____ ☐ _____ ☐ _____

Solid: ☐ 4ozCGJ ☐ 8ozCGJ ☐ 16ozCGJ ☐ Sleeve (_____) ☐ EnCores® (_____) ☑ TerraCores® (3) ☑ 2oz PJ

Air: ☐ Tedlar™ ☐ Canister ☐ Sorbent Tube ☐ PUF ☐ _____ **Other Matrix** (_____): ☐ _____ ☐ _____

Container: **A** = Amber, **B** = Bottle, **C** = Clear, **E** = Envelope, **G** = Glass, **J** = Jar, **P** = Plastic, and **Z** = Ziploc/Resealable Bag

Preservative: **b** = buffered, **f** = filtered, **h** = HCl, **n** = HNO_3, **na** = NaOH, **na$_2$** = $Na_2S_2O_3$, **p** = H_3PO_4, **s** = H_2SO_4, **u** = ultra-pure, **znna** = Zn $(CH_3CO_2)_2$ + NaOH

Labeled/Checked by: 1069

Reviewed by: 1017

Return to Contents

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WORK ORDER NUMBER: 16-09- 2276

SAMPLE ANOMALY REPORT

DATE: 09 / 30 / 2016

SAMPLES, CONTAINERS, AND LABELS:

- ☐ Sample(s) NOT RECEIVED but listed on COC
- ☐ Sample(s) received but NOT LISTED on COC
- ☐ Holding time expired (list client or ECI sample ID and analysis)
- ☐ Insufficient sample amount for requested analysis (list analysis)
- ☐ Improper container(s) used (list analysis)
- ☐ Improper preservative used (list analysis)
- ☐ No preservative noted on COC or label (list analysis and notify lab)
- ☐ Sample container(s) not labeled
- ☐ Client sample label(s) illegible (list container type and analysis)
- ☒ Client sample label(s) do not match COC (comment)
  - ☐ Project information
  - ☐ Client sample ID
  - ☐ Sampling date and/or time
  - ☒ Number of container(s)
  - ☐ Requested analysis
- ☐ Sample container(s) compromised (comment)
  - ☐ Broken
  - ☐ Water present in sample container
- ☐ Air sample container(s) compromised (comment)
  - ☐ Flat
  - ☐ Very low in volume
  - ☐ Leaking (not transferred; duplicate bag submitted)
  - ☐ Leaking (transferred into ECI Tedlar™ bags*)
  - ☐ Leaking (transferred into client's Tedlar™ bags*)

* Transferred at client's request.

Comments

(-41) Received 4 vials w. HCl instead of 2

MISCELLANEOUS: (Describe)

Comments

HEADSPACE:

(Containers with bubble > 6 mm or ¼ inch for volatile organic or dissolved gas analysis)

ECI Sample ID	ECI Container ID	Total Number**	ECI Sample ID	ECI Container ID	Total Number**
41	D	4			

(Containers with bubble for other analysis)

ECI Sample ID	ECI Container ID	Total Number**	Requested Analysis

Comments:

Reported by: 1069

Reviewed by: 1017

** Record the total number of containers (i.e., vials or bottles) for the affected sample.

Return to Contents

Vikas Patel

From: Acosta, Greg <gacosta@bas.com>
Sent: Thursday, November 03, 2016 3:05 PM
To: Vikas Patel
Subject: RE: Additional Testing - Work Order 16-09-2276

I think the data will be useful regardless. It is just for planning purposes and not for submittal to an agency. When would the data be available?

Greg Acosta, P.E. | **Vice President, Environmental Services Division**
Office: 909.860.7777 x258 | Fax: 909.396.1768 | Cell: 951.836.2709
greg.acosta@tetratech.com

From: Vikas Patel [mailto:VikasPatel@eurofinsUS.com]
Sent: Thursday, November 03, 2016 3:02 PM
To: Acosta, Greg <gacosta@bas.com>
Cc: Erick Ovalle <ErickOvalle@eurofinsUS.com>; Vikas Patel <VikasPatel@eurofinsUS.com>
Subject: RE: Additional Testing - Work Order 16-09-2276

Hi Greg – Samples would be extracted and analyze past the recommended holding time (14 days). Please confirm this is acceptable.

Vik Patel
Eurofins Calscience, Inc.
Phone: +1 714 895 5494

From: Acosta, Greg [mailto:gacosta@bas.com]
Sent: Thursday, November 03, 2016 2:29 PM
To: Virendra Patel
Cc: 'Bob Stearns' (BStearns@calscience.com)
Subject: Additional Testing - Work Order 16-09-2276

Hi Vik,

I need some additional testing run on some of the samples under Calscience Work Order 16-09-2276 as follows

Sample ID	Lab Number	Analyses
B-1,P-3@10’	16-09-2276-3	EPA 8081A (Pesticides)
B-1,P-4@15’	16-09-2276-4	
B-2,P-3@10’	16-09-2276-19	
B-2,P-4@15’	16-09-2276-20	
B-3,P-3@10’	16-09-2276-27	
B-3,P-4@15’	16-09-2276-28	
B-4,P-3@10’	16-09-2276-35	
B-4,P-4@15’	16-09-2276-36	

Please respond to this email confirming receipt and whether there are any issues with this request. Thanks.

- Greg

Return to Contents

APPENDIX C: RUBBER DAM IMPOUNDMENT DELINEATION

B.M.S.Y. 5811 – Elev. = 20.456 – F.B. 3309-7
Int. Sepulveda Blvd. & Figueroa St. Std.
L.A.C.E. Br. Cp. Mon. in H.H.
B.M.S.Y. 5812 – Elev. = 22.402 – F.B. 3309-7
Figueroa St. 52' E.Ɇ Sepulveda Blvd. 6'S.
L.E.T. in S. cb. of Service Island.
B.M.S.D. 2244 – Elev. = 23.672 – F.B. 3309-7
Figueroa St. E.Side & 600' N of Sepulveda Bl.
Bt. Spk. & 7/17 in W side of P.P.# 1621701E Spk.
PROFILE
HORIZ. SCALE: 1" = 40'
VERT. SCALE: 1" = 4'
Exist Ground Line
SECTION A-A
NO SCALE
3-3" Oil Lines
Exist. Ground Surface
Grade to daylight
Note "A":
Reconst. fencing with 20' Dble. Drive Gate for access road in accordance with Std. Dwg. 2-D179 except as modified by the "Detail of Gate Post Anchorage" at right.
6' high chain link fabric
3" Std. Galv. Pipe by 8'-9"
12" min. diameter
17" long lightweight metal inserts. Grout around posts.
8-#7 bars spaced equally around gate post
Top Slab of R.C. Box
DETAIL OF GATE POST ANCHORAGE
Scale: 1" = 1'-0"
RUBBER DAM
INV ELEV = 13.30
STA: 5+40
3' BACKUP
WSE = 16.30
2' BACKUP
WSE = 15.30
DBLE. 10'-9"W X 6'-7"H R.C. BOX
12" Sewer (W) (Encased)
Invert S = .0005
TOTAL VOLUME
3' BACKUP = 80,162 CF
2' BACKUP = 43,926 CF
TOTAL LENGTH
3' BACKUP = 1922 FT
2' BACKUP = 1642 FT
609' - Sec. #1
200' - Sec. #10
36" R.C. Pipe
S = .0069
Exist. Street Surface
Construct upstream end of M.H. Solid, T = 6"
Proposed 60" Trunk Sewer Invert El. = 10.10 ±
126' - 36" R.C.P. 1000-D
SEPULVEDA BLVD. LATERAL
Notes:
1. Elevations of Access Road are at 20' Intervals.
2. Pave Road with 2" A.C.
R/W Curve Data
Δ = 107°10'23"
R = 82'
L = 153.38'
T = 111.17'
12'-Wide Access Road
S.D. Ease. - As Shown
Curve Data:
Δ = 55°
R = 80'
L = 86.39'
T = 46.85'
B.C. = 1+91.63
E.C. = 2+78.02
SEPULVEDA BLVD.
FIGUEROA ST.
CURVE DATA 2
Δ = 84°00'00"
R = 90.00'
T = 81.04'
L = 131.95'
B.C. 4+11.02
E.C. 5+42.97
Break out wall of Exist. C.B. and connect to Storm Drain with 18" Pipe. Seal Exist. outlet with 8" of Brick & cement Mortar and remodel floor of C.B. to drain to new outlet.
4+25.00 – Proj. #1201 – A = 1+00
Sepulveda Blvd. Lateral
Sewer Reconstruction See Sht. No. 19
RUBBER DAM
STA: 5+40
CROSS SECTION
STA. 7+50
SCALE – HORZ. 1" = 10'
VERT. – 1" = 4'
Typ. Pay Lines for Box Excav.
Seal existing C.B. with 8" brick & cement or concrete and remove interfering portion of existing pipe.
Remove interfering portion of 18" C.M.P. and seal end with 8" of brick & cement mortar or 6" Concrete
Remodel Exist. C.B. – Raise Elev. of bottom of C.B. from 13.83 to 16.50 – Break out wall of Exist. C.B. and connect to Storm Drain with 48 - 18" Pipe. Seal Exist. outlet with 8" of Brick & Cement Mortar.
CURVE DATA 3
Δ = 22°30'10"
R = 2010.00'
L = 789.42'
B.C. 8+28.10
E.C. 16+17.52
PLAN
SCALE: 1" = 40'
REVISIONS
MARK	DATE	DESCRIPTION
■	12-14-71	As Built
①	5-29-79	Permit 78151A
DRAWN BY County of L.A.
CHECKED BY County of L.A.
DESIGNED BY County of L.A.
SUBMITTED BY C.W.H.
PREPARED BY
JOHN A. LAMBIE
COUNTY ENGINEER
RECOMMENDED BY
DIVISION ENGINEER – DESIGN DIVISION
DRAWN BY M. AMEZQUITA
TRACED BY E. MOORE
CHECKED BY H. HARGIS
DESIGNED BY M. AMEZQUITA
SUBMITTED BY
DATE 1-23-68
1964 STORM DRAIN BOND ISSUE
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
COUNTY PROJECT NO. 1201
LINE A
STA. 1+46.63 TO STA. 10+00
PLAN AND PROFILE
APPROVED BY
CHIEF ENGINEER
SCALE AS SHOWN
DATE OCT '68
DWG. NO. 364-1201-D6.3
SHEET 3 OF 20


B.M.S.D. 2245 ~ Elev. = 25.453 ~ F.B. 3309-7 Figueroa St. W. Side ℄ 1200' N. of Sepulveda Blvd. Bt. Spk. in cb. at prod. of S. side of large Brick Building.
B.M.S.D. 2246 ~ Elev. = 23.813 ~ F.B. 3309-7 Figueroa St. W. Side ℄ 205' N. of 235th St. - Bt. Spk. in cb.
PROFILE
HORIZ. SCALE: 1" = 40'
VERT. SCALE: 1" = 4'
℄ CARRIAGEDALE DR.
℄ 235th ST. 18+87.21
Exist. Street Surface
DBLE. 10'-9"w X 6'-7"h R.C. BOX
DBLE. 10'-0"w X 7'-1"h R.C. BOX
DBLE. 9'-9"w X 7'-1"h R.C. BOX
3' BACKUP WSE = 16.30
2' BACKUP WSE=15.30
Invert
S=.00177
S=.0005
S=.0009
12" Sewer Inv. El.=18.15 To be abandoned. Remove Interfering Portions and Seal Ends.
10" Sewer Inv. El. 19.13 To be abandoned. Remove Interfering Portions and Seal Ends.
TOTAL VOLUME
3' BACKUP = 81,013 CF
2' BACKUP = 44,202 CF
TOTAL LENGTH
3' BACKUP = 1992 FT
2' BACKUP = 1713 FT
Grade Change 12+85
17+55 Grade Change
75' Sec# 10
675' - Sec# 2
290' - Sec.# 5
CROSS SECTION
STA. 19+50
SCALE ~ HORZ ~ 1" = 10' VERT ~ 1" = 4'
Figueroa St
Typical Pay Lines for Box Conduit Excavation
DBLE. 9'-9"W X 7'-1"H R.C. Box Storm Drain
PLAN
SCALE: 1" = 40'
FIGUEROA ST.
CARRIAGEDALE DR.
235th ST.
SERVICE RD.
GUNITE CHANNEL
CURVE DATA-3
Δ= 22°30'10"
R= 2010.00'
T= 399.86'
L= 789.42
B.C.= 8+28.10
E.C.= 16+17.52
Break out wall of existing Catch Basin and connect to storm drain with 18" pipe. Seal existing outlet with 8" of Brick & Cement Mortar. Remodel floor of catch basin to drain to new outlet. ~ Exist. V=4.5' New = 4.0' 44'-18" Pipe
Constructed 2'x2' Blockout For Future Connection F.L. Elev. 19.94'
4'-18" Pipe-End Inv. El.=17.50 Δ=70° ~ Seal end with 18" of Brick & Cement Mortar or 6" of Concrete
Deleted See Sketch on This Sheet
J.S.N. 1 ℄ 4' of 42" RCP 1400D
A = 55° B = 42" C = 42" S = 16.25' R = 16.31'
Sketch For C.O. # 10
1964 STORM DRAIN BOND ISSUE
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
COUNTY PROJECT NO. 1201 LINE A
STA. 10+00 TO STA. 20+50
PLAN AND PROFILE
PREPARED BY JOHN A. LAMBIE COUNTY ENGINEER
SCALE AS SHOWN
DATE OCT '68
DWG. NO. 364-1201-D6.4
SHEET 4 OF 20
REVISIONS
12-14-71 As Built
10-18-72 PERMIT Nº 69637
5-29-79 Permit 78151 A

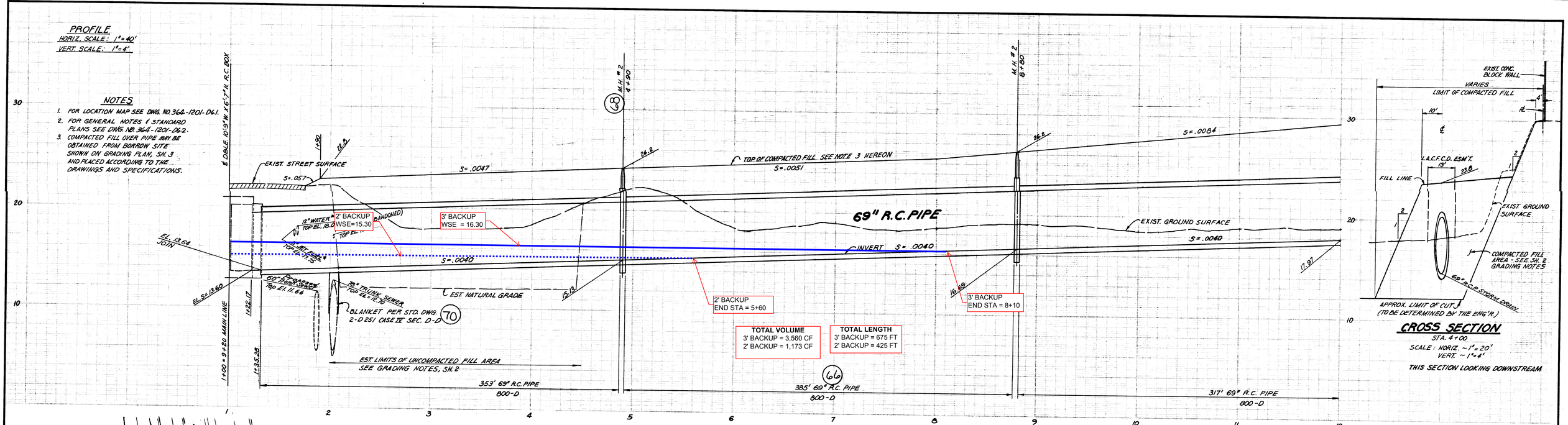
PROFILE
HORIZ. SCALE: 1" = 40'
VERT. SCALE: 1" = 4'
B.M.S.D. 2247, El.=28.355, Figueroa St. E. Side @ 335' N. of 234th St. Bt. Spk. in cb.
DBLE. 9'-9"W x 7'-1"H R.C. BOX
DBLE. 8'-0"W X 7'-1"H
R. C. BOX
2' BACKUP
WSE=15.30
3' BACKUP
WSE = 16.30
2' BACKUP
END STA = 21+82
3' BACKUP
END STA = 24+62
TOTAL VOLUME
3' BACKUP = 80,162 CF
2' BACKUP = 43,926 CF
TOTAL LENGTH
3' BACKUP = 1922 FT
2' BACKUP = 1642 FT
Surface Left Bank of Ditch
Surface Right Bank of Ditch
Fill Line
Ground Surface ℄ S.D.
Invert S=.00358
Top of Wall
Headwall
Exist. Inv. of Conc. Drain - S=.0012
70' - Sec.# 5
140' - Sec.# 6
762.49' - Sec.# 7
CROSS SECTION
STA. 21+00
SCALE - HORZ. - 1" = 10'
VERT. - 1" = 4'
Typical Pay Lines for Box Conduit Excavation
HARBOR FREEWAY
FIGUEROA ST.
Boundary City of Carson
Inlet #1, Case I
Riser = 3.0', C.M.P. 16 Ga.
Elev. A = 24.0
CURVE DATA - 4
CURVE DATA - 5
CURVE DATA - 6
CURVE DATA - 7
Note: See sheet #13 for cross sections on the portion of Line A within Flood Control R/W.
PLAN
SCALE: 1" = 40'
REVISIONS
MARK | DATE | DESCRIPTION
■ 12-14-71 As Built PERMIT Nº 70009
Ⓙ 10-17-72 DWG. Nº 364-1201-F9
1964 STORM DRAIN BOND ISSUE
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
PREPARED BY
JOHN A. LAMBIE
COUNTY ENGINEER
COUNTY PROJECT NO. 1201
LINE A
STA. 20+50 TO STA. 30+67.49
PLAN AND PROFILE
SCALE AS SHOWN
DATE OCT '68
DWG. NO. 364-1201-D6.5
SHEET 5 OF 20

PROFILE

HORIZ. SCALE: 1"=40'
VERT. SCALE: 1"=4'

NOTES

1. FOR LOCATION MAP SEE DWG. NO. 364-1201-D6.1.
2. FOR GENERAL NOTES & STANDARD PLANS SEE DWG. NO. 364-1201-D6.2.
3. COMPACTED FILL OVER PIPE MAY BE OBTAINED FROM BORROW SITE SHOWN ON GRADING PLAN, SH. 3 AND PLACED ACCORDING TO THE DRAWINGS AND SPECIFICATIONS.

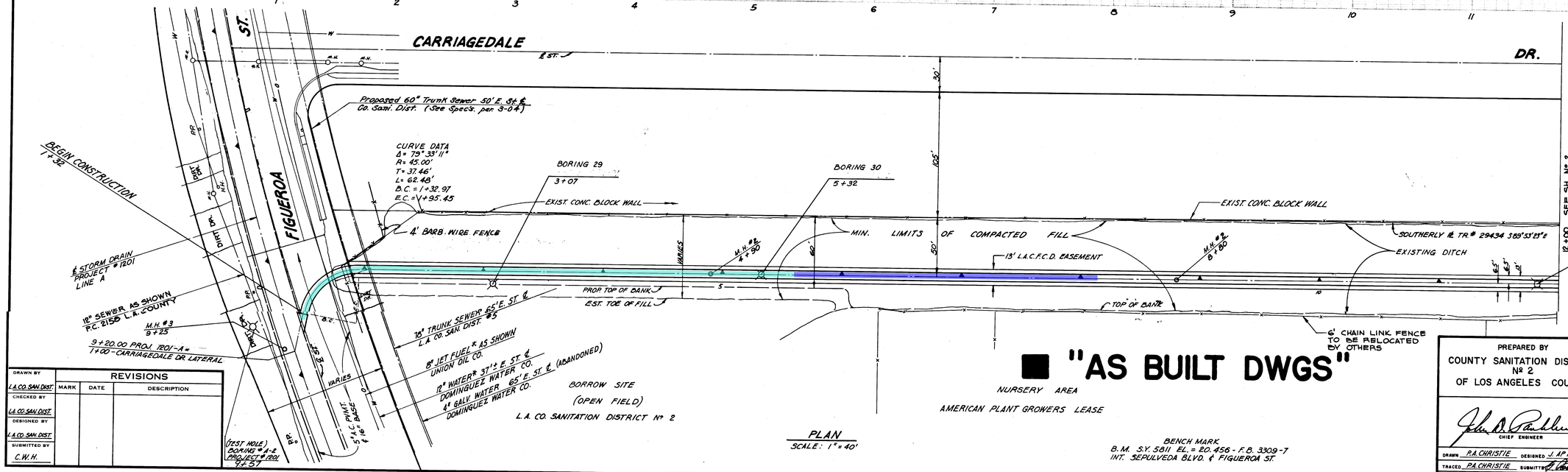


CROSS SECTION

STA. 4+00
SCALE: HORIZ. - 1"=20'
VERT. - 1"=4'

THIS SECTION LOOKING DOWNSTREAM

CARRIAGEDALE DR. LATERAL IS INCLUDED IN PROPOSAL 2 ONLY



PLAN

SCALE: 1"=40'

"AS BUILT DWGS"

NURSERY AREA
AMERICAN PLANT GROWERS LEASE

BENCH MARK
B.M. S.Y. 5611 EL. = 20.456 - F.B. 3309-7
INT. SEPULVEDA BLVD. & FIGUEROA ST.

DRAWN BY	REVISIONS		
L.A. CO. SAN. DIST.	MARK	DATE	DESCRIPTION
CHECKED BY			
L.A. CO. SAN. DIST.			
DESIGNED BY			
L.A. CO. SAN. DIST.			
SUBMITTED BY			
C.W.H.			

PREPARED BY
COUNTY SANITATION DISTRICT Nº 2 OF LOS ANGELES COUNTY

CHIEF ENGINEER

DRAWN P.A. CHRISTIE DESIGNED J. A.P. ROBERTS
TRACED P.A. CHRISTIE SUBMITTED
CHECKED R.A. BEEKEN DATE JUNE, 1968

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

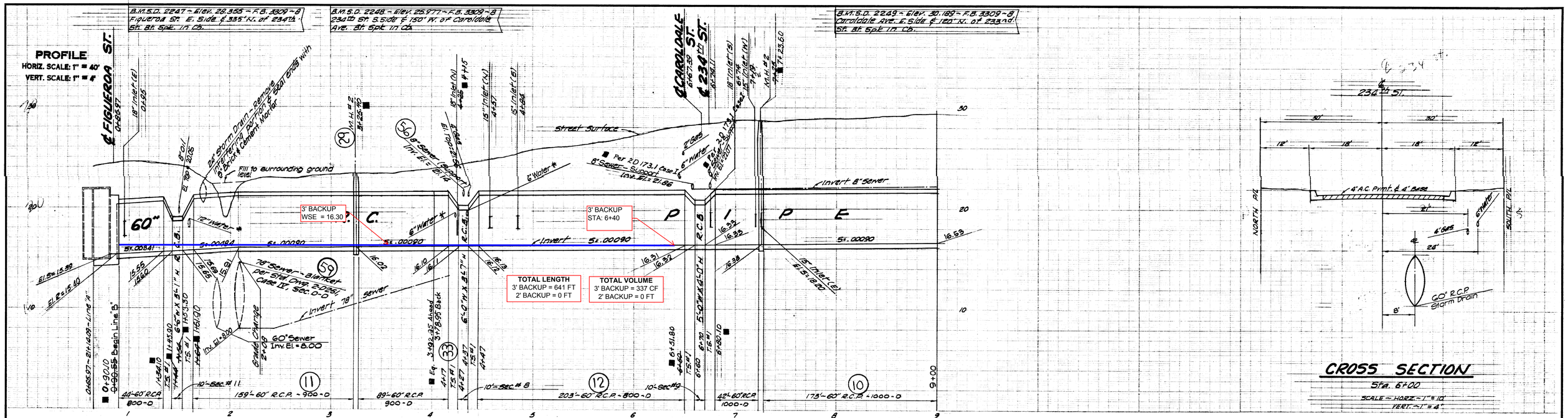
CARRIAGEDALE DRIVE LATERAL

STA. 1+35.28 TO STA. 12+00

PLAN AND PROFILE

RECOMMENDED BY: DIVISION ENGINEER (DESIGN)
APPROVAL RECOMMENDED BY: ASST. CHIEF DEPUTY ENGINEER
APPROVED BY: CHIEF ENGINEER
10-21-68

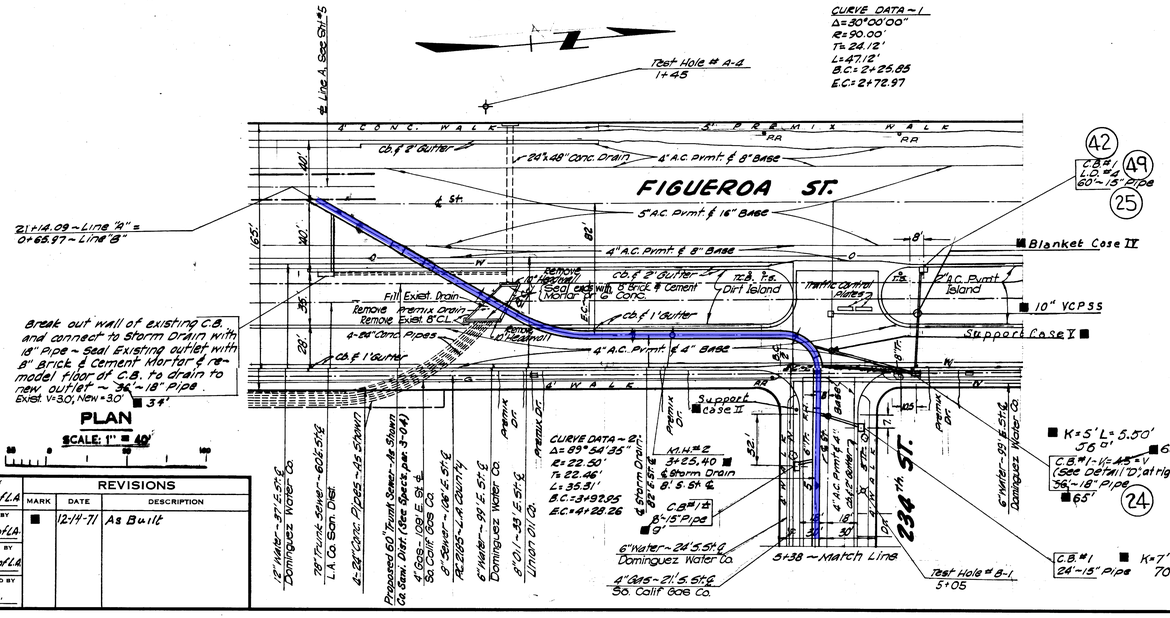
SCALE	DATE	DWG. NO. 364-1201-D4.1
AS SHOWN	OCT '68	SHEET 1 OF 3



CROSS SECTION

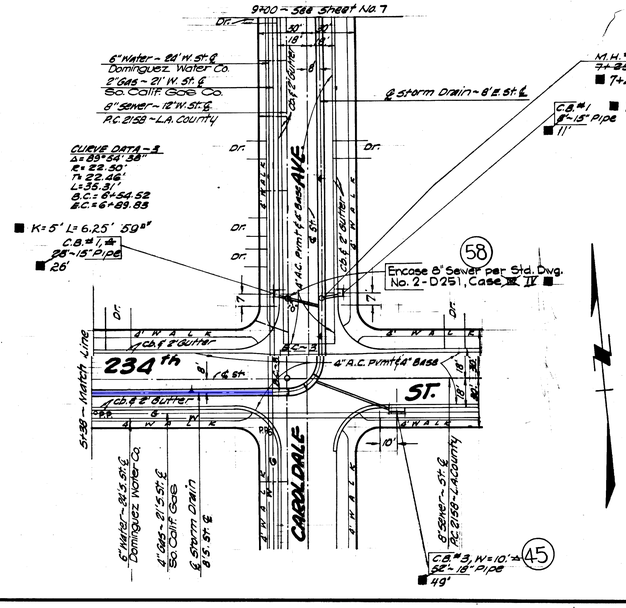
Sta. 6+00

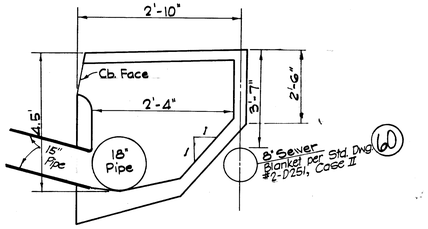
SCALE ~ HORIZ. ~ 1" = 10'
VERT. ~ 1" = 4'



PLAN

SCALE: 1" = 40'





DETAIL "D" MODIFIED C.B. # 1

No Scale

REVISIONS			
MARK	DATE	DESCRIPTION
■	12-14-71	As Built

DRAWN BY: County of L.A.
CHECKED BY: County of L.A.
DESIGNED BY: County of L.A.
SUBMITTED BY: C.I.V.H.

P-0034808

PREPARED BY
JOHN A. LAMBIE
COUNTY ENGINEER

RECOMMENDED BY
Division Engineer ~ Design Division

DRAWN BY M. AMEROUITH DESIGNED BY M. AMEROUITH
TRACED BY E. MOORE SUBMITTED BY K. KAYANAMBU
CHECKED BY H. HARRIS DATE 1-23-68

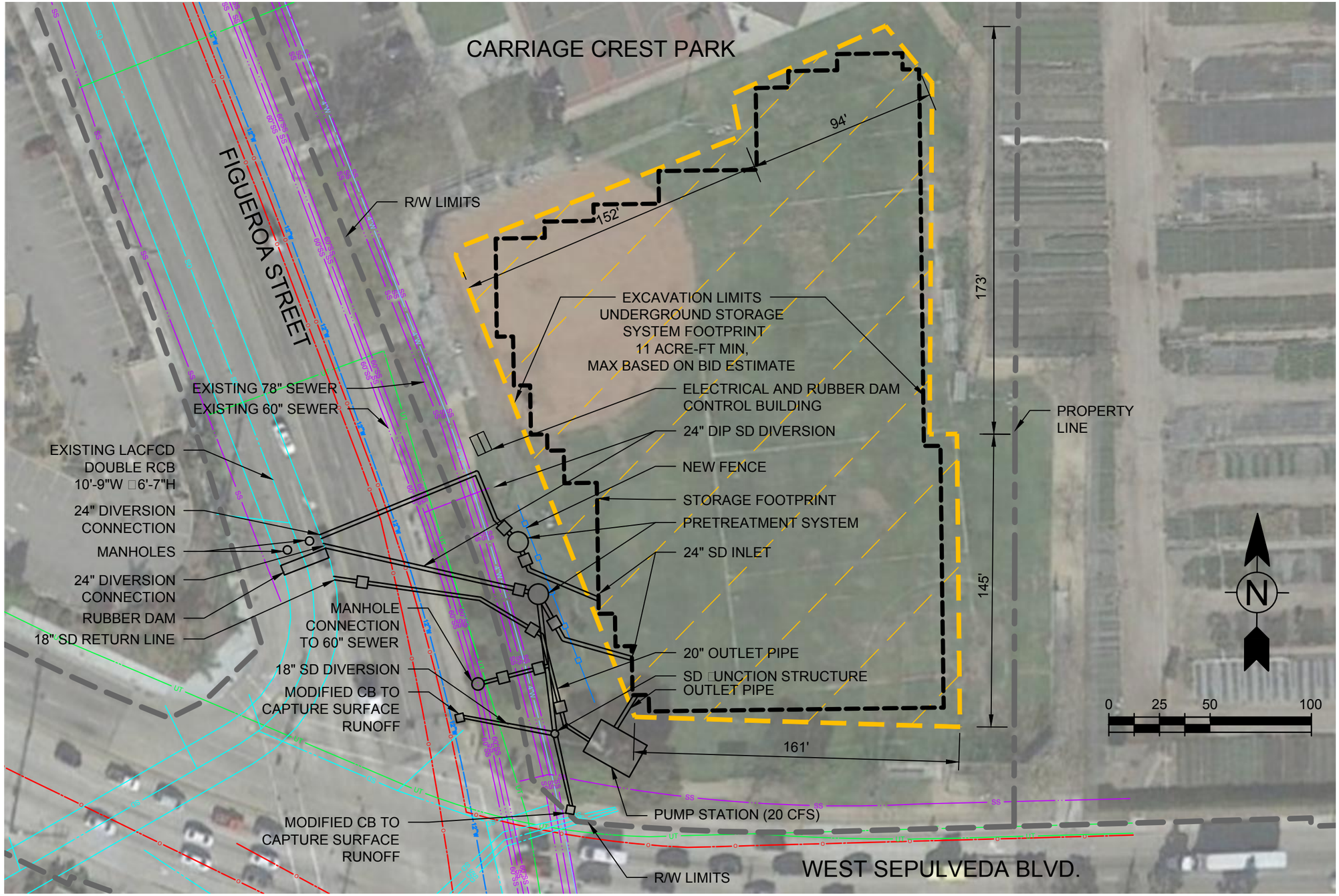
1964 STORM DRAIN BOND ISSUE
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
COUNTY PROJECT NO. 1201
LINE B
STA. 0+65.97 TO STA. 9+00
PLAN AND PROFILE

RECOMMENDED BY: Division Engineer ~ Design Division
APPROVAL RECOMMENDED BY: Asst. Chief Deputy Engineer
APPROVED BY: Walter E. Wood, Chief Engineer

SCALE: AS SHOWN
DATE: OCT '68
DWG. NO. 364-1201-D6.6
SHEET 6 OF 20

APPENDIX D: DETAILED DRAWINGS AND SITE LAYOUTS

Note: The site configuration may be modified during final design.



APPROXIMATE ELEVATIONS FOR UNDERGROUND STORAGE SYSTEM
(ELEVATIONS BASED ON AS-BUILTS USING NGVD 1927):
FINISHED SURFACE 23.5
TOP OF SYSTEM 13.0
INVERT OF SYSTEM 0.0

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CITY OF CARSON

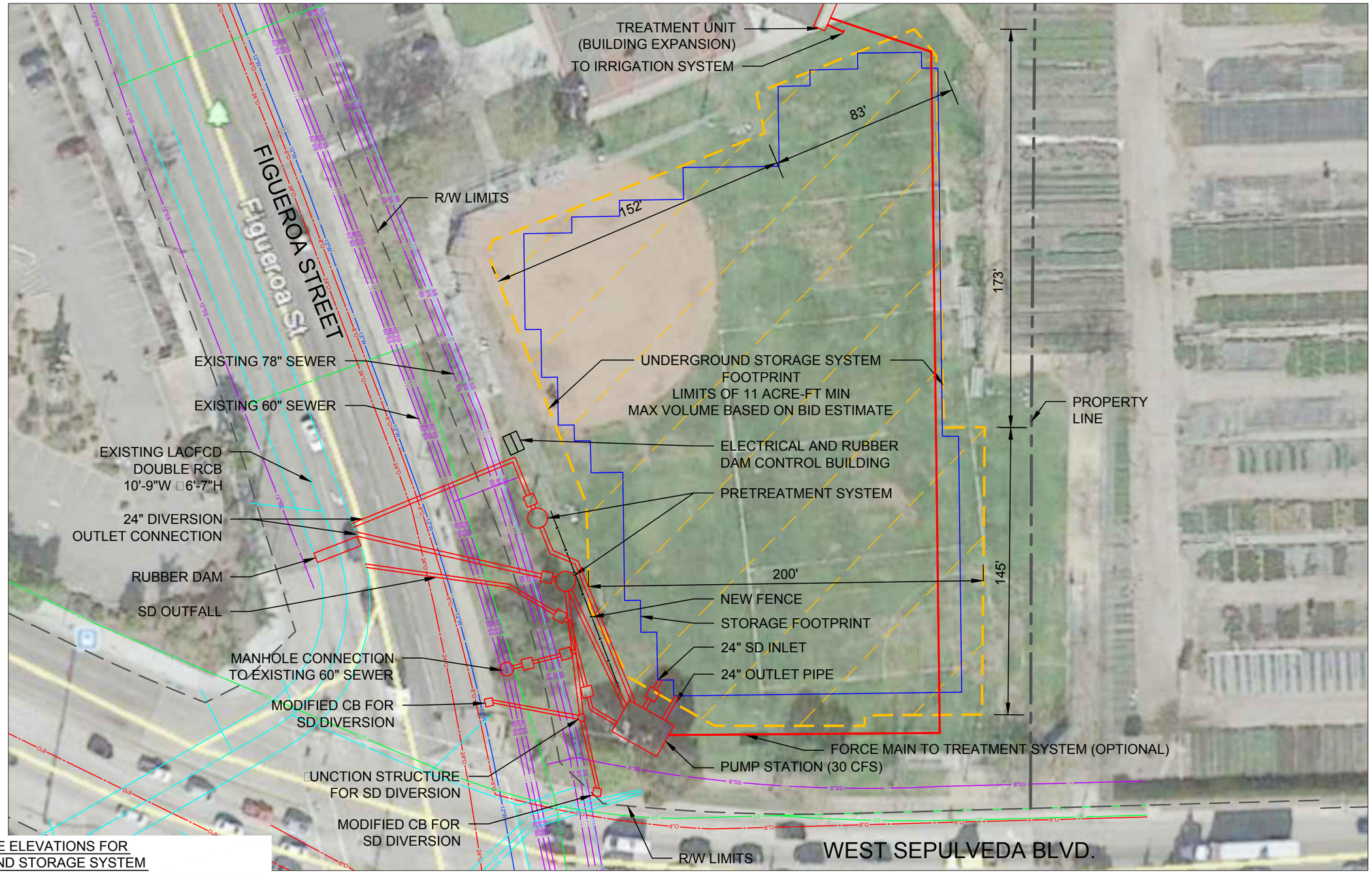
CARRAIGE CREST PARK

STORMWATER CAPTURE PROJECT
CONCEPTUAL SITE PLAN
ALTERNATIVE 1 (GRAVITY SYSTEM)

Project No.:	135-01297-16021
Date:	2/16/17
Designed By:	JLF

Supplemental
EH-1

Bar Measure 1 Inch



APPROXIMATE ELEVATIONS FOR
UNDERGROUND STORAGE SYSTEM
(ELEVATIONS BASED ON AS-BUILTS USING NAD1927):
FINISHED SURFACE □ 23.5
TOP OF SYSTEM □ 20.5
INVERT OF SYSTEM □ 7.5

0 25' 50'
SCALE: 1" □ 50'

N

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Pa□ade□a, CA 91107
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CITY OF CARSON

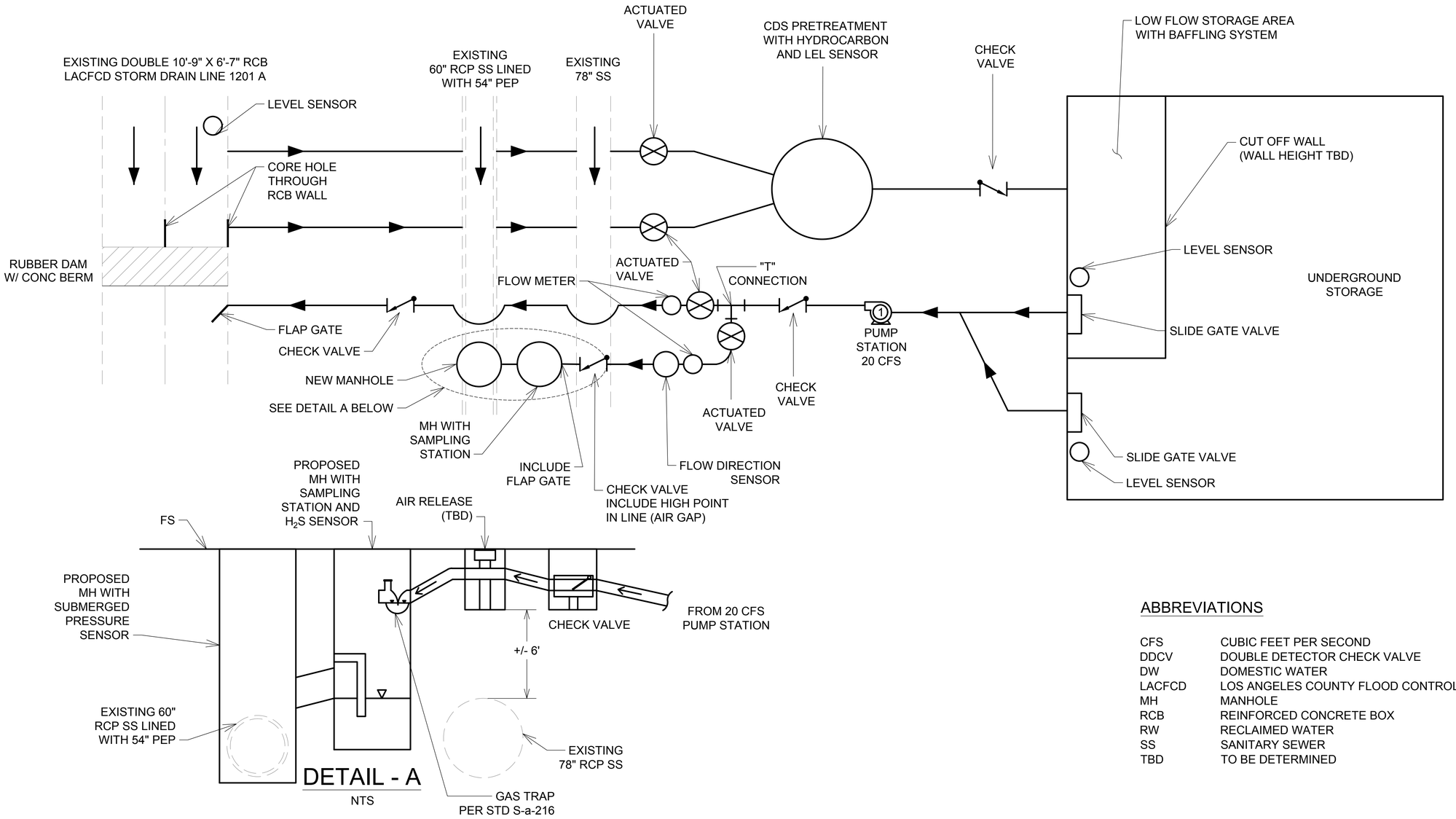
CARRAIGE CREST PARK

STORMWATER CAPTURE PRO□ECT
CONCEPTUAL SITE PLAN
ALTERNATIVE 2 (PUMP SYSTEM)

Project No.:	135-01297-16021
Date:	12/9/16
Designed By:	JLF

Supplemental
EH-2

Bar Mea□re□1 □ch



DETAIL - A

NTS

ABBREVIATIONS

CFS	CUBIC FEET PER SECOND
DDCV	DOUBLE DETECTOR CHECK VALVE
DW	DOMESTIC WATER
LACFCD	LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
MH	MANHOLE
RCB	REINFORCED CONCRETE BOX
RW	RECLAIMED WATER
SS	SANITARY SEWER
TBD	TO BE DETERMINED

NOTES:

1. 30 CFS GRAVITY FLOW TO STORAGE AND 20 CFS MAX TO SEWER.

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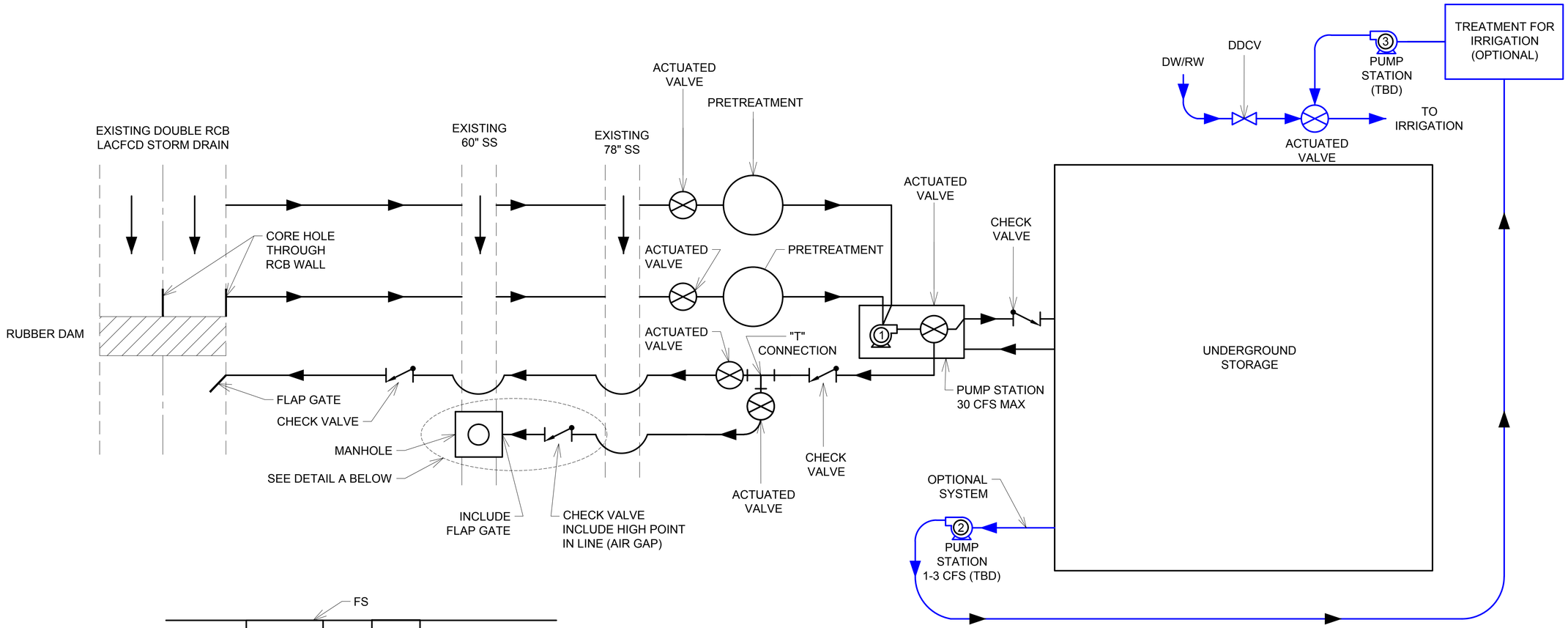
CITY OF CARSON

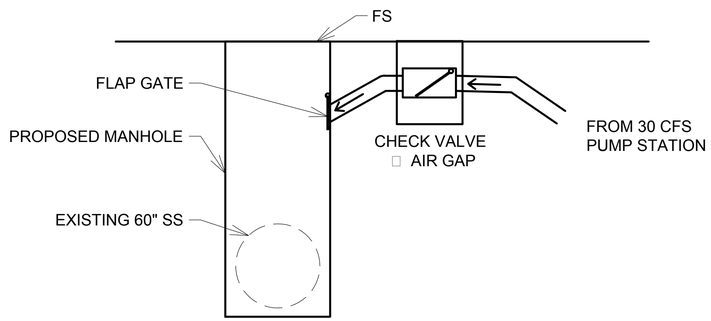
PROCESS FLOW DIAGRAM
ALTERNATIVE - 1

DEPARTMENT OF PUBLIC WORKS

DRAWING NO.
REV.
PFD -1

SHEET 1 OF 1





DETAIL - A

NTS

ABBREVIATIONS

CFS	CUBIC FEET PER SECOND
DDCV	DOUBLE DETECTOR CHECK VALVE
DW	DOMESTIC WATER
LACFCD	LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
MH	MANHOLE
RCB	REINFORCED CONCRETE BOX
RW	RECLAIMED WATER
SS	SANITARY SEWER
TBD	TO BE DETERMINED

NOTES:

1. PUMP STATION 1 SHALL BE TIED TO TELEMETRY FOR LACSD MHD225.
2. IMPROVEMENTS SHOWN IN BLUE INDICATE AN OPTIONAL TREATMENT SYSTEM FOR ON-SITE IRRIGATION USE. IMPLEMENTATION OF THIS OPTIONAL SYSTEM WILL BE DETERMINED DURING FINAL DESIGN.
3. 20 CFS MAX PUMPED TO STORAGE OR 20 CFS MAX PUMPED TO SEWER.

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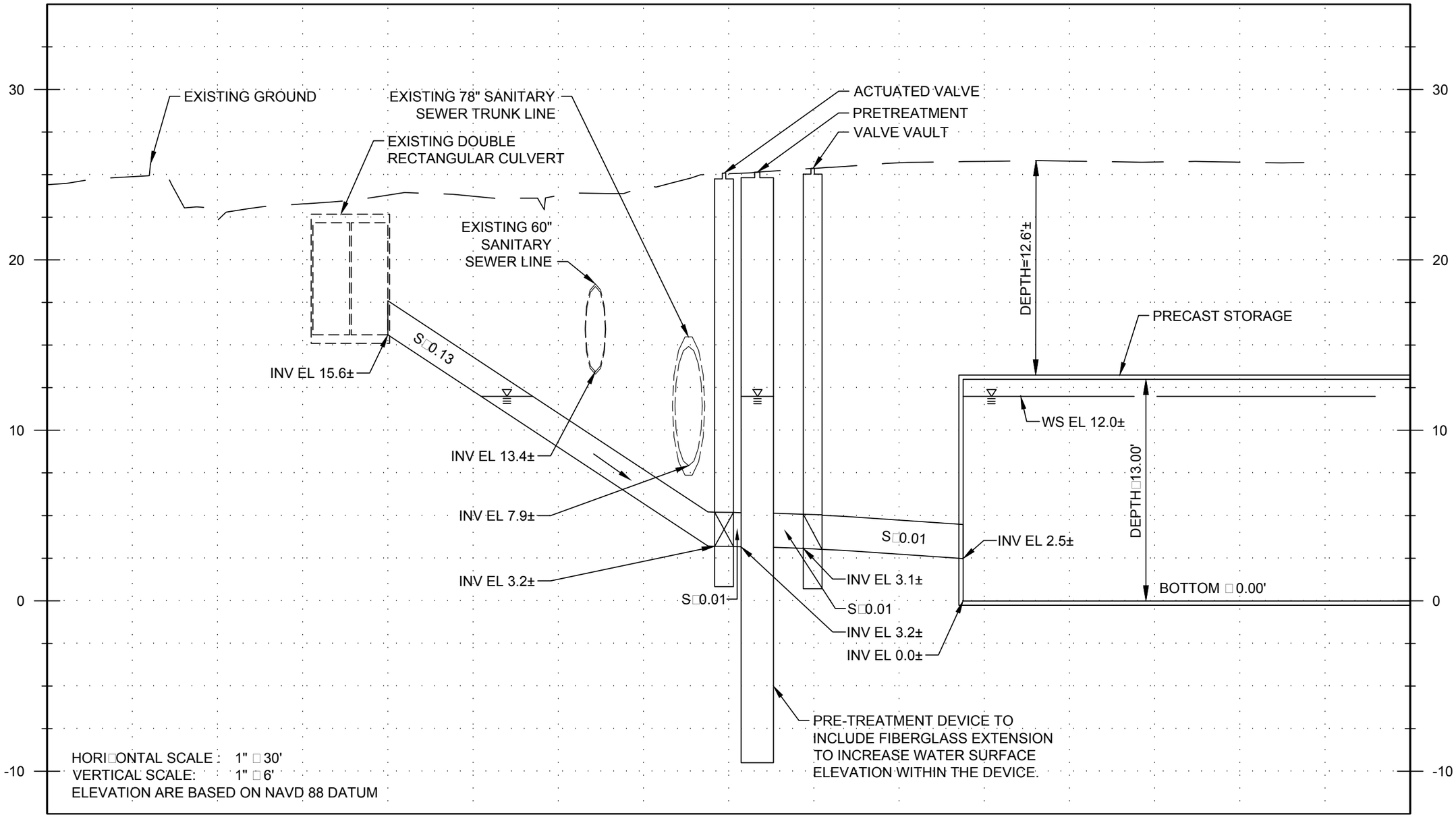
CITY OF CARSON

PROCESS FLOW DIAGRAM
ALTERNATIVE - 2

DEPARTMENT OF PUBLIC WORKS

DRAWING NO. PFD -2 REV.

SHEET 2 OF 2



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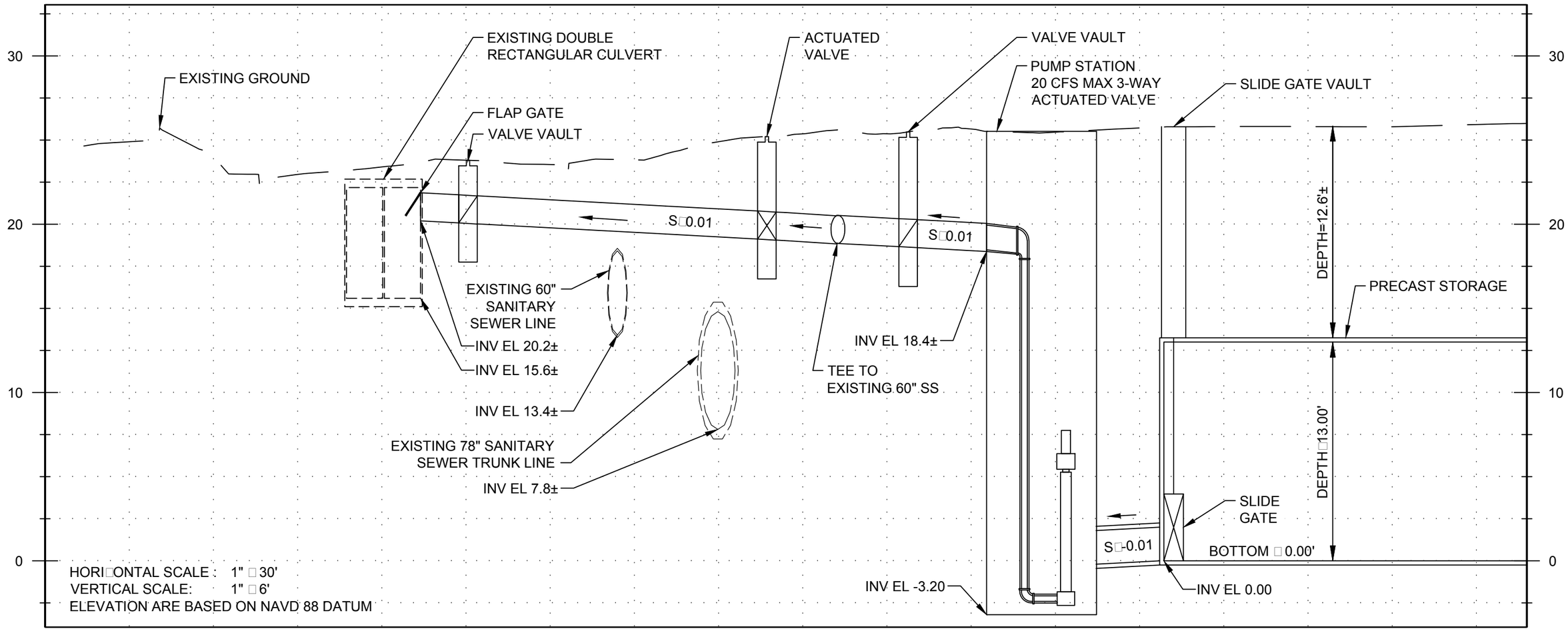
CITY OF CARSON
CARRAIGE CREST PARK
STORMWATER CAPTURE PROJECT
CONCEPTUAL PROFILE
INFLOW ALTERNATIVE 1 (GRAVITY SYSTEM)

Project No.:	135-01297-16021
Date:	2/16/17
Designed By:	JLF
Supplemental	
PROF-1	

Bar Measure 1 Inch

2/16/2017 1:44:10 PM - P:\01297\135-01297-16021\CAD\CONCEPTUALEH-CONCEPTUALPROFILE_ALT1-FACTSHEET.DWG - PANGILINAN, ELVA

Copyright: Tetra Tech



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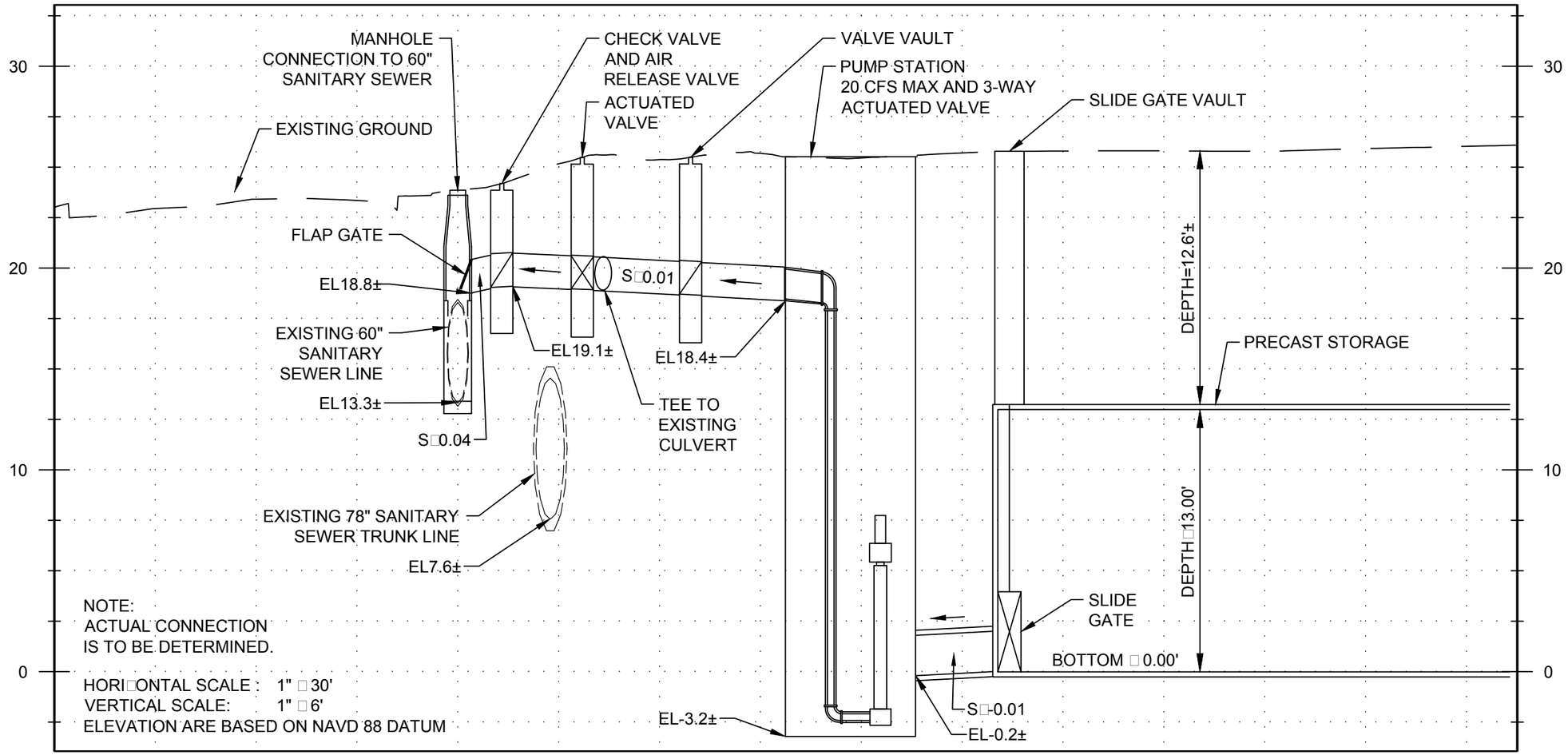
CITY OF CARSON
CARRAIGE CREST PARK
STORMWATER CAPTURE PROJECT
CONCEPTUAL PROFILE
OUTFLOW ALTERNATIVE 1 (TO STORM DRAIN)

Project No.:	135-01297-16021
Date:	2/16/17
Designed By:	JLF
Supplemental	
PROF-2	

Bar Measure 1 inch



NOTE:
ACTUAL CONNECTION
IS TO BE DETERMINED.

HORI ONTAL SCALE : 1" 30'
VERTICAL SCALE: 1" 6'
ELEVATION ARE BASED ON NAVD 88 DATUM

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CITY OF CARSON

CARRAIGE CREST PARK

STORMWATER CAPTURE PRO ECT
CONCEPTUAL PROFILE
OUTFLOW ALTERNATIVE 1 (TO SANITARY SEWER)

Project No.:	135-01297-16021
Date:	2/16/17
Designed By:	JLF

Supplemental

PROF-3

Bar Mea re 1 ch

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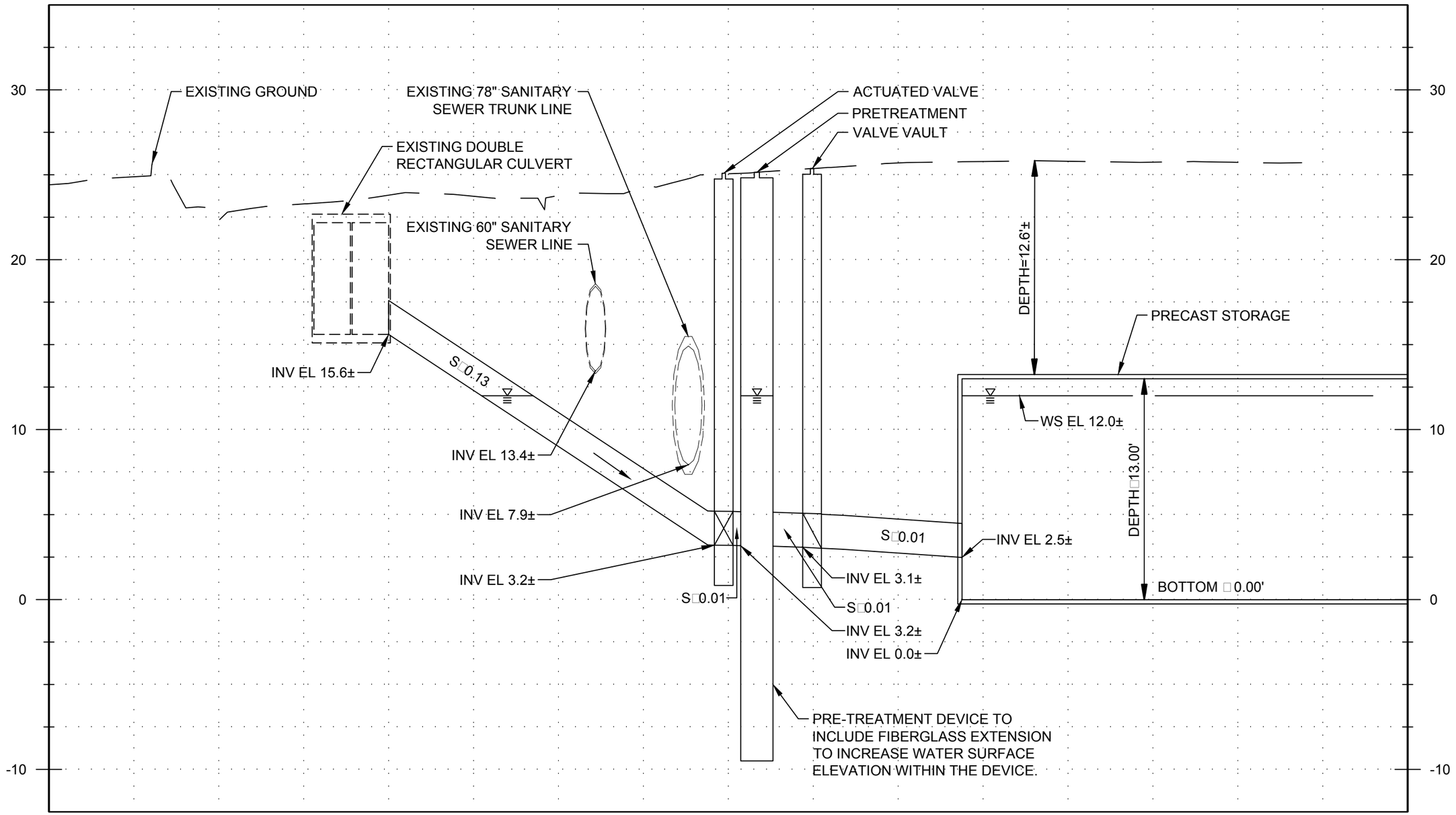

HORIZONTAL SCALE : 1" = 30'
VERTICAL SCALE: 1" = 6'

ELEVATION ARE BASED ON NAVD 88 DATUM

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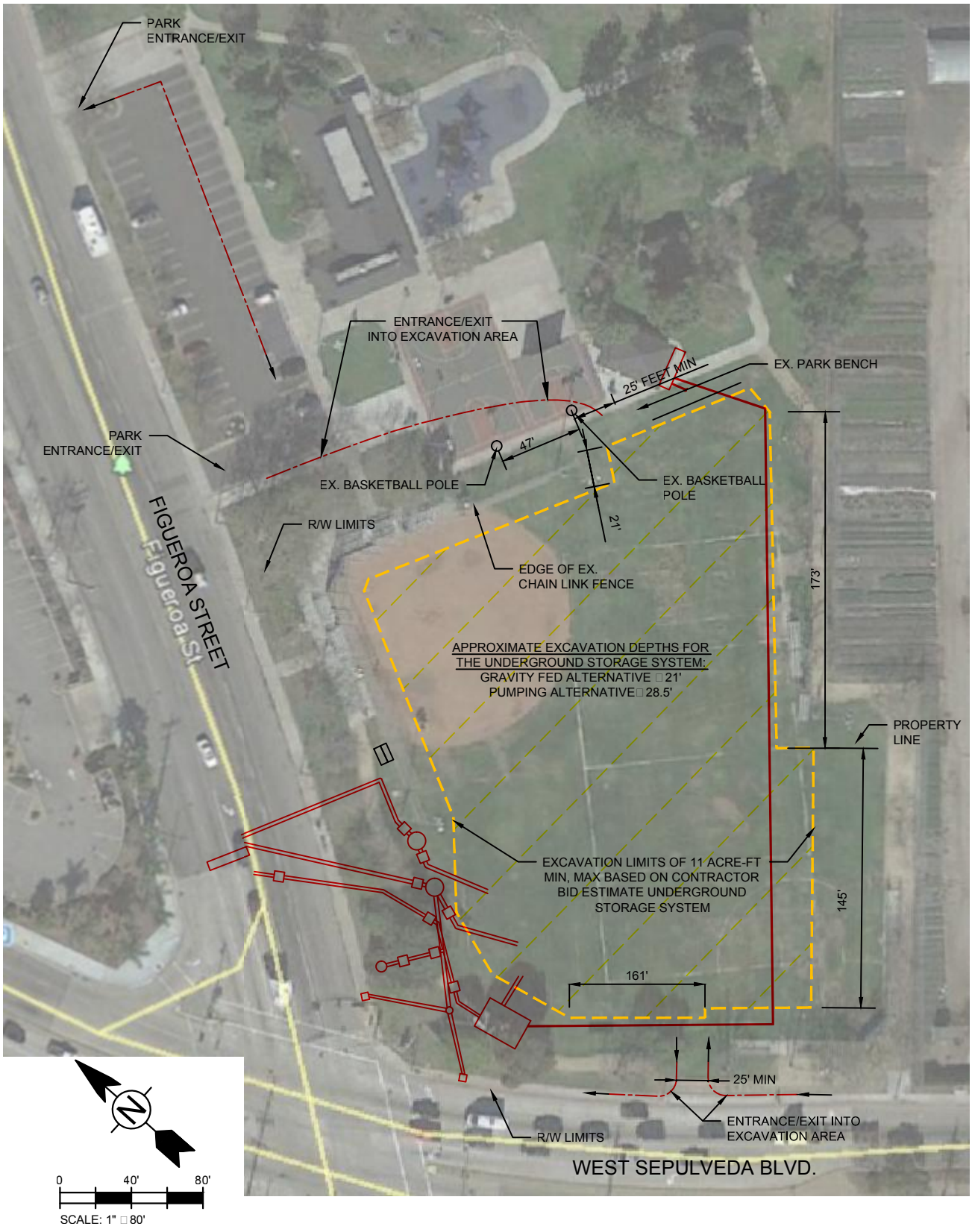
CITY OF CARSON

CARRAIGE CREST PARK

STORMWATER CAPTURE PROJECT
CONCEPTUAL PROFILE
INFLOW ALTERNATIVE 1 (GRAVITY SYSTEM)

Project No.:	135-01297-16021
Date:	12/9/16
Designed By:	JLF
Supplemental	
PROF-1	

Bar Measure 1 Inch



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CITY OF CARSON

CARRIAGE CREST PARK

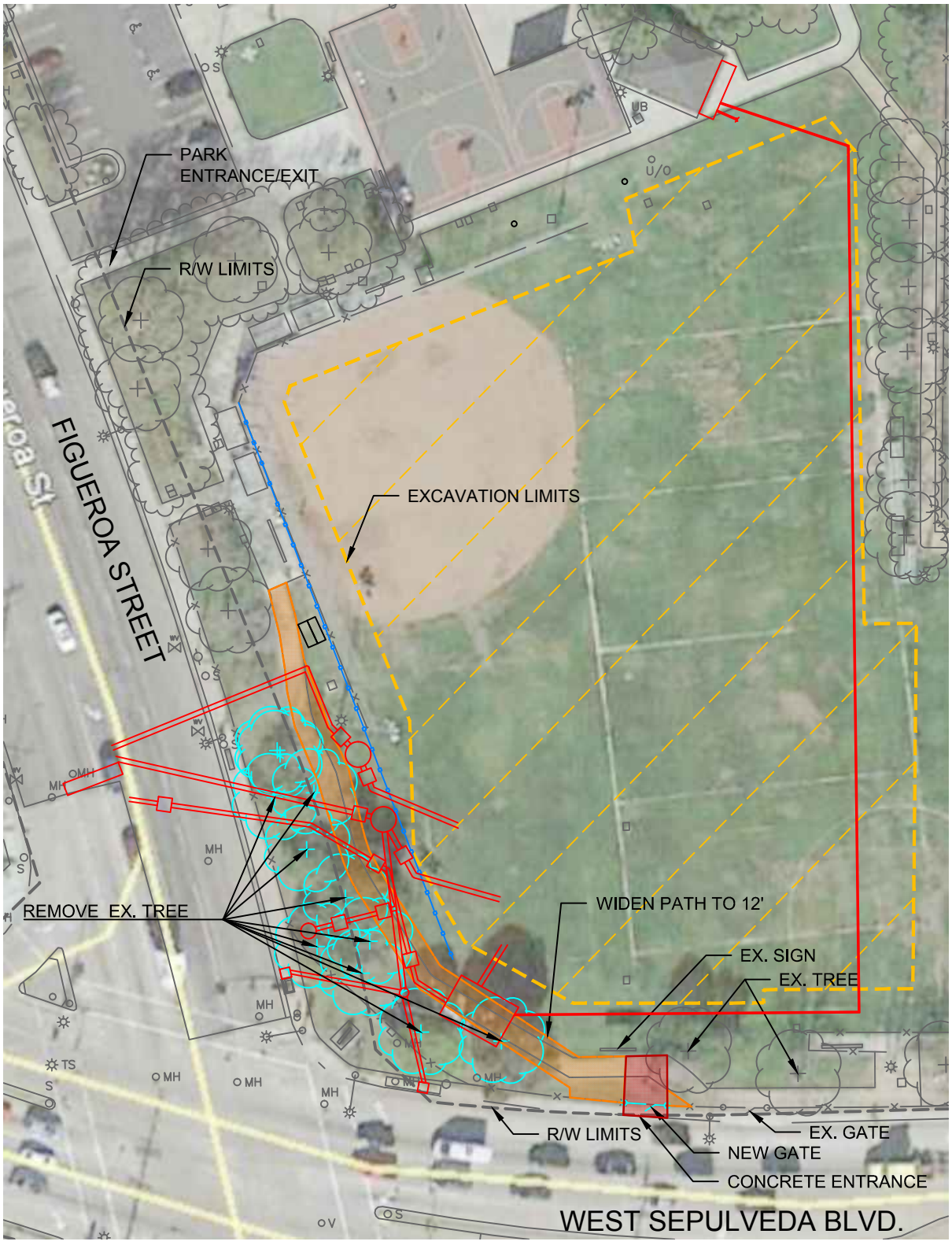
STORMWATER CAPTURE PROJECT - CONSTRUCTION TRAFFIC FLOW AND CONCEPTUAL SITE PLAN

Project No.:	135-01297-16021
Date:	12/9/2016
Designed By:	JH

Supplemental

EH-3

Bar Measure 1 Inch



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CITY OF CARSON

CARRIAGE CREST PARK

STORMWATER CAPTURE PROJECT - MAINTENANCE ACCESS AND CONCEPTUAL SITE PLAN

Project No.:	135-01297-16021
Date:	12/9/2016
Designed By:	JH

Supplemental

EH-4

Bar Measure 1 inch

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CITY OF CARSON

CARRIAGE CREST PARK

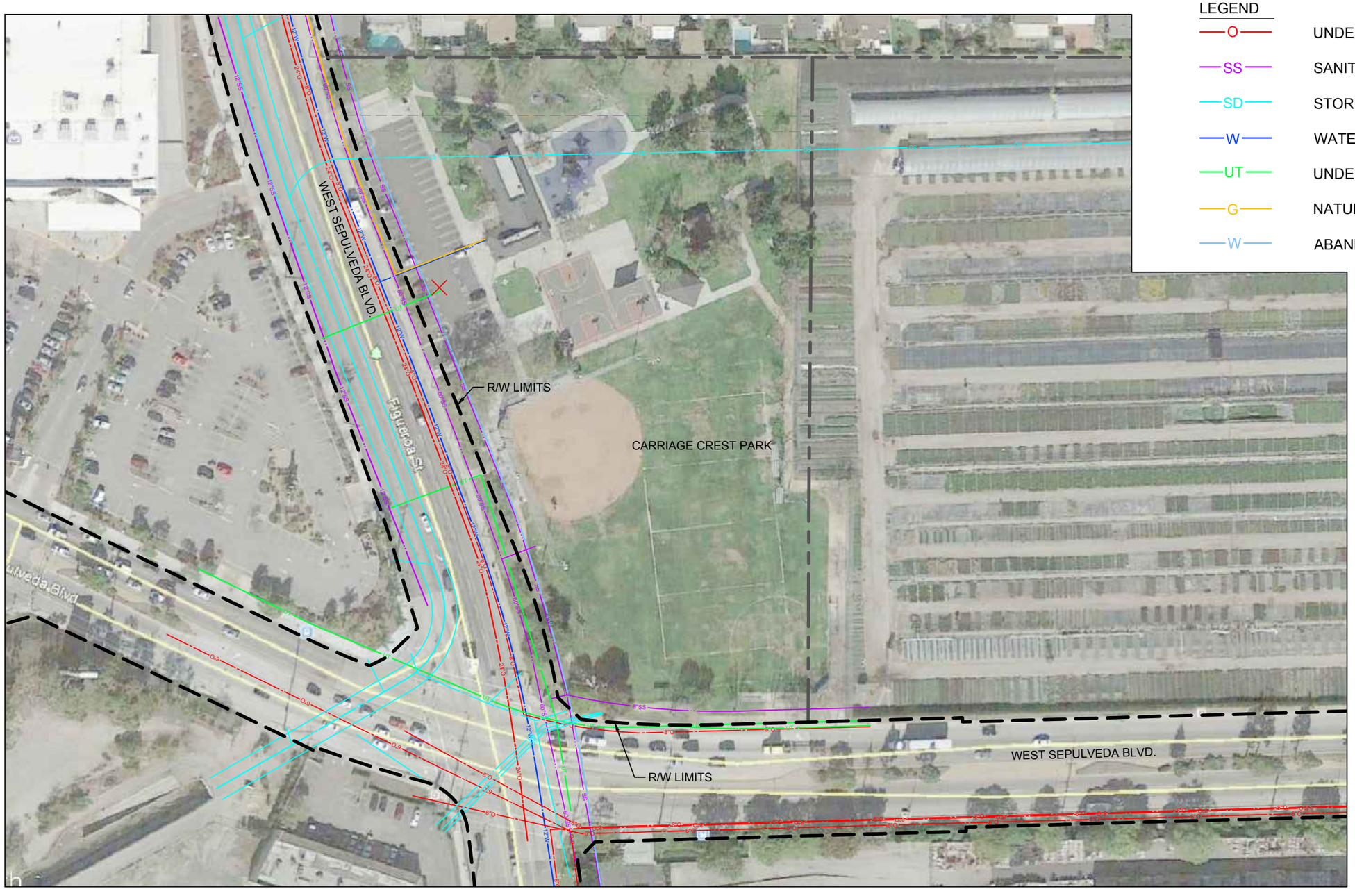
CARRIAGE CREST PARK SURFACE IMPROVEMENTS CONCEPTUAL SITE PLAN

Project No.:	135-01297-16021
Date:	10/12/2016
Designed By:	JH

Supplemental

EH-5

BAR MEASURES 1 INCH



LEGEND

- O — UNDERGROUND OIL LINE
- SS — SANITARY SEWER
- SD — STORM DRAIN
- W — WATER LINE
- UT — UNDERGROUND TELEPHONE LINE
- G — NATURAL GAS
- W — ABANDONED WATER

0 50' 100'

SCALE: 1" = 100'

N

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CITY OF CARSON

CARRAIGE CREST PARK

STORMWATER CAPTURE PROJECT
EXISTING UTILITIES

Project No.: 135-01297-16021
Date: 12/9/2016
Designed By: JLF

Supplemental
EH-1

Bar Measure 1 Inch

APPENDIX E: DETAILED PRELIMINARY COST ESTIMATES

CARRIAGE CREST 10% DESIGN COST ESTIMATE

Client: **County of Los Angeles Sanitation District**
Project: **Carson Stormwater and Runoff Capture Project - Carriage Crest Park**
Status: **Preliminary Engineering Design - Alternative 1**

Prepared by: **JH**
Checked by: **JLF**
Date: **Dec. 8, 2016**

Description	Qty	Unit	Unit Price	Total
Miscellaneous				**$369,293**
Mobilization / Demobilization (3% of Costs)	1	LS	$229,293.00	$229,293
Traffic Control	1	LS	$40,000.00	$40,000
SCADA and Telemetry Upgrades	1	LS	$50,000.00	$50,000
Active Controls	1	LS	$50,000.00	$50,000
Channel Diversion and Pretreatment				**$641,139**
Pneumatic Gate (Rubber Dam) System	1	LS	$100,000.00	$100,000
Concrete Pad (Rubber Dam Controls)	200	SF	$10.00	$2,000
Fiberglass Shelter (Rubber Dam Controls)	1	LS	$100,000.00	$100,000
Actuated Valves and Vault	2	EA	$25,000.00	$50,000
Check Valves and Vault	2	EA	$10,000.00	$20,000
Pretreatment Device (15 cfs)	2	EA	$100,000.00	$200,000
60" Junction Structure	1	LS	$45,000.00	$45,000
CB Junction Structures (with Pretreatment)	2	LS	$9,000.00	$18,000
Piping to Pretreatment (24" DIP)	220	LF	$175.00	$38,500
Piping to Pretreatment (18" DIP)	150	LF	$150.00	$22,500
Piping to Storage (24" DIP)	110	LF	$175.00	$19,250
Excavation for Piping	1,294	CY	$20.00	$25,889
Site Preparation and Demolition - Existing Park Area				**$16,085**
Concrete Walkway and Sidewalk Removal	250	SF	$3.50	$875
Concrete Curb and Gutter Removal	50	LF	$5.00	$250
AC Pavement Removal	560	SF	$3.50	$1,960
Tree Removal	8	EA	$1,000.00	$8,000
Irrigation Removal	1	LS	$3,000.00	$3,000
Water Line Relocation	1	LS	$2,000.00	$2,000
Storage				**$5,300,799**
Excavation	39,438	CY	$9.00	$354,942
Shoring	25,000	SF	$20.00	$500,000
Backfill of Sides (Aggregate)	900	CY	$30.00	$27,000
Backfill and Compaction (On-site Materials)	13,890	CY	$9.00	$125,008
Hauling - Non-hazardous Material	12,928	CY	$30.00	$387,847
Hauling - Hazardous Material	12,620	CY	$79.00	$996,980
Underground Storage (11 Acre-Ft)	479,160	CF	$6.00	$2,874,960
Subgrade (6" Stone Base)	789	CY	$30.00	$23,662
Maintenance Hole	2	EA	$5,000.00	$10,000
Flap Gate Valve	2	EA	$200.00	$400
Pump Station and Conveyance				**$1,041,062**
Excavation	220	CY	$9.00	$1,980
Shoring	1,800	SF	$15.00	$27,000
Pump Station (3-pump, 20 CFS)	1	LS	$508,500.00	$508,500
Pump Station Structure	1	LS	$380,360.00	$380,360
20" DIP Force Main	225	LF	$140.00	$31,500
24" DIP to Pump Station	20	LF	$175.00	$3,500
Maintenance Hole	1	EA	$5,000.00	$5,000
Excavation for Piping	61	CY	$20.00	$1,222
Actuated Valves and Vault	2	EA	$25,000.00	$50,000
Check Valves and Vault	3	EA	$10,000.00	$30,000
Chain Link Fence	100	LF	$20.00	$2,000

CARRIAGE CREST 10% DESIGN COST ESTIMATE

Client: **County of Los Angeles Sanitation District**
Project: **Carson Stormwater and Runoff Capture Project - Carriage Crest Park**
Status: **Preliminary Engineering Design - Alternative 1**

Prepared by: **JH**
Checked by: **JLF**
Date: **Dec. 8, 2016**

Description	Qty	Unit	Unit Price	Total
Electrical Service, Controls, Instrumentation				**$274,200**
Electrical Service	1	LS	$110,000.00	$110,000
Control Panel and PLC Programming	1	LS	$70,000.00	$70,000
Conduit & Wiring	1	LS	$25,000.00	$25,000
NEMA 4 Junction Box, 6"x6"x6" (3 each for 480V and 120V conduits)	6	EA	$200.00	$1,200
Misc. Conduit Fittings, Elbows, Core Drilling and Sealing, etc.	1	LS	$8,000.00	$8,000
Instrumentation	1	LS	$60,000.00	$60,000
Landscape and Irrigation Modifications				**$228,250**
Re-Planting/Seeding Excavation Areas	75,000	SF	$0.50	$37,500
Irrigation System (including all components and mainline)	75,000	SF	$2.15	$161,250
90-Day Plant Establishment Period	1	LS	$20,000.00	$20,000
Tree Planting	19	EA	$500.00	$9,500
Site Amenities and Improvements				**$66,550**
Baseball Infield	13,000	SF	$3.00	$39,000
Concrete Paving	400	SF	$10.00	$4,000
Concrete Walkway and Sidewalk	250	SF	$10.00	$2,500
Concrete Curb and Gutter	50	LF	$26.00	$1,300
AC Paving (Figueroa Street)	600	SF	$7.00	$4,200
AC Overlay (Laydown Area)	15,550	SF	$1.00	$15,550
Start-up, Testing, Prepare Operations & Maintenance Manuals, and Prepare Record Drawings				**$75,000**
SWPPP Implementation	1	LS	$15,000.00	$15,000
Start-up and Testing	1	LS	$50,000.00	$50,000
O&M Manuals	1	LS	$5,000.00	$5,000
Record Drawings	1	LS	$5,000.00	$5,000
SUBTOTAL				**$8,012,378**

20% Contingency = $1,602,475.68

TOTAL **$9,614,854**

Notes:
Cost for optional water treatment and re-use has not been included.
A 13' depth was chosed based on an average height from multiple precast concrete vendors. Extending the height will decrease the required footprint and lower hazardous export quantities.

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CARRIAGE CREST 10% DESIGN COST ESTIMATE

Client: **County of Los Angeles Sanitation District**
Project: **Carson Stormwater and Runoff Capture Project - Carriage Crest Park**
Status: **Preliminary Engineering Design - Alternative 2**

Prepared by: **JH**
Checked by: **JLF**
Date: **Dec. 8, 2016**

Description	Qty	Unit	Unit Price	Total
Miscellaneous				**$381,601**
Mobilization / Demobilization (3% of Costs)	1	LS	$241,601.00	$241,601
Traffic Control	1	LS	$40,000.00	$40,000
SCADA and Telemetry Upgrades	1	LS	$50,000.00	$50,000
Active Controls	1	LS	$50,000.00	$50,000
Channel Diversion and Pretreatment				**$590,380**
Pneumatic Gate (Rubber Dam) System	1	LS	$100,000.00	$100,000
Concrete Pad (Rubber Dam Controls)	200	SF	$10.00	$2,000
Fiberglass Shelter (Rubber Dam Controls)	1	LS	$100,000.00	$100,000
Actuated Valves and Vault	2	EA	$25,000.00	$50,000
Pretreatment Device (15 cfs)	2	EA	$100,000.00	$200,000
60" Junction Structure	1	LS	$45,000.00	$45,000
CB Junction Structures (with Pretreatment)	2	LS	$9,000.00	$18,000
Piping to Pretreatment (24" DIP)	210	LF	$175.00	$36,750
Piping to Pretreatment (18" DIP)	140	LF	$150.00	$21,000
Excavation for Piping	881	CY	$20.00	$17,630
Pump Station and Conveyance				**$1,502,276**
Excavation	163	CY	$9.00	$1,467
Shoring	1,260	SF	$15.00	$18,900
Pump Station (4-pump, 30 CFS)	1	LS	$762,750.00	$762,750
Pump Station Structure	1	LS	$570,540.00	$570,540
Piping from Pretreatment to Pump Station (24" DIP)	175	LF	$175.00	$30,625
Piping from Pump Station to Storage (24" DIP)	15	LF	$175.00	$2,625
Piping from Storage to Pump Station (24" DIP)	15	LF	$175.00	$2,625
20" DIP Force Main	225	LF	$140.00	$31,500
Maintenance Hole	1	EA	$5,000.00	$5,000
Excavation for Piping	212	CY	$20.00	$4,244
Actuated Valves and Vault	2	EA	$25,000.00	$50,000
Check Valves and Vault	2	EA	$10,000.00	$20,000
Chain Link Fence	100	LF	$20.00	$2,000
Site Preparation and Demolition - Existing Park Area				**$16,085**
Concrete Walkway and Sidewalk Removal	250	SF	$3.50	$875
Concrete Curb and Gutter Removal	50	LF	$5.00	$250
AC Pavement Removal	560	SF	$3.50	$1,960
Tree Removal	8	EA	$1,000.00	$8,000
Irrigation Removal	1	LS	$3,000.00	$3,000
Water Line Relocation	1	LS	$2,000.00	$2,000
Storage				**$5,300,599**
Excavation	39,438	CY	$9.00	$354,942
Shoring	25,000	SF	$20.00	$500,000
Backfill of Sides (Aggregate)	900	CY	$30.00	$27,000
Backfill and Compaction (On-site Materials)	13,890	CY	$9.00	$125,008
Hauling - Non-hazardous Material	12,928	CY	$30.00	$387,847
Hauling - Hazardous Material	12,620	CY	$79.00	$996,980
Underground Storage (11 Acre-Ft)	479,160	CF	$6.00	$2,874,960
Subgrade (6" Stone Base)	789	CY	$30.00	$23,662
Maintenance Hole	2	EA	$5,000.00	$10,000
Flap Gate Valve	1	EA	$200.00	$200

CARRIAGE CREST 10% DESIGN COST ESTIMATE

Client: **County of Los Angeles Sanitation District**
Project: **Carson Stormwater and Runoff Capture Project - Carriage Crest Park**
Status: **Preliminary Engineering Design - Alternative 2**

Prepared by: **JH**
Checked by: **JLF**
Date: **Dec. 8, 2016**

Description	Qty	Unit	Unit Price	Total
Electrical Service, Controls, Instrumentation				**$274,200**
Electrical Service	1	LS	$110,000.00	$110,000
Control Panel and PLC Programming	1	LS	$70,000.00	$70,000
Conduit & Wiring	1	LS	$25,000.00	$25,000
NEMA 4 Junction Box, 6"x6"x6" (3 each for 480V and 120V conduits)	6	EA	$200.00	$1,200
Misc. Conduit Fittings, Elbows, Core Drilling and Sealing, etc.	1	LS	$8,000.00	$8,000
Instrumentation	1	LS	$60,000.00	$60,000
Landscape and Irrigation Modifications				**$228,250**
Re-Planting/Seeding Excavation Areas	75,000	SF	$0.50	$37,500
Irrigation System (including all components and mainline)	75,000	SF	$2.15	$161,250
90-Day Plant Establishment Period	1	LS	$20,000.00	$20,000
Tree Planting	19	EA	$500.00	$9,500
Site Amenities and Improvements				**$66,550**
Baseball Infield	13,000	SF	$3.00	$39,000
Concrete Paving	400	SF	$10.00	$4,000
Concrete Walkway and Sidewalk	250	SF	$10.00	$2,500
Concrete Curb and Gutter	50	LF	$26.00	$1,300
AC Paving (Figueroa Street)	600	SF	$7.00	$4,200
AC Overlay (Laydown Area)	15,550	SF	$1.00	$15,550
Start-up, Testing, Prepare Operations & Maintenance Manuals, and Prepare Record Drawings				**$75,000**
SWPPP Implementation	1	LS	$15,000.00	$15,000
Start-up and Testing	1	LS	$50,000.00	$50,000
O&M Manuals	1	LS	$5,000.00	$5,000
Record Drawings	1	LS	$5,000.00	$5,000
SUBTOTAL				**$8,434,941**

20% Contingency = $1,686,988.20

TOTAL **$10,121,929**

Note:
Cost for optional water treatment and re-use has not been included.
A 13' depth was chosed based on an average height from multiple precast concrete vendors. Extending the height will decrease the required footprint and lower hazardous export quantities.

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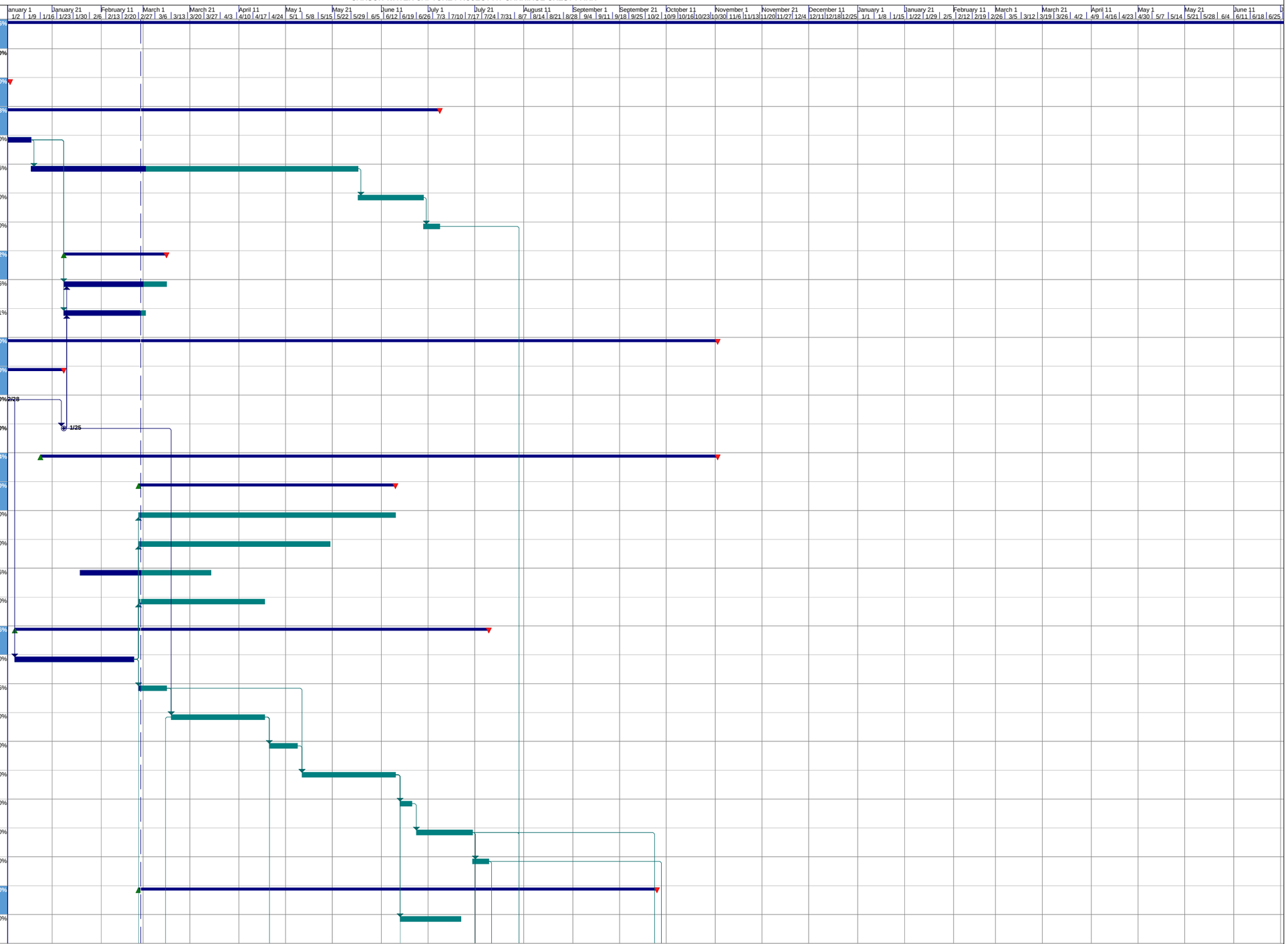
APPENDIX F: DETAILED IMPLEMENTATION SCHEDULE

PROJECT SCHEDULE FOR
CARSON WATER CAPTURE PROJECT AT CARRIAGE CREST PARK

ID	TASK NAME	DUR	START	FINISH	%
1	**CARSON WATER CAPTURE PROJECT AT CARRIAGE CREST PARK**	**1497 d**	**Tue 8/2/16**	**Thu 4/28/22**	**16%**
2	**LACSD issues Notice to Proceed**	**0 d**	**Tue 8/23/16**	**Tue 8/23/16**	**0%**
3	**PHASE 1. PRELIMINARY ENGINEERING DESIGN STUD**	**95 d**	**Tue 8/23/16**	**Mon 1/2/17**	**50%**
39	**Environmental Documentation (LACSD)**	**135 d**	**Thu 12/29/16**	**Wed 7/5/17**	**48%**
40	CEQA Initial Study Check List	10 d	Thu 12/29/16	Wed 1/11/17	100%
41	Preparation of a IS/MND	100 d	Thu 1/12/17	Wed 5/31/17	35%
42	IS/MND Public Review Period	20 d	Thu 6/1/17	Wed 6/28/17	0%
43	IS/MND Approved	5 d	Thu 6/29/17	Wed 7/5/17	0%
44	**CEQA Support**	**32 d**	**Thu 1/26/17**	**Fri 3/10/17**	**82%**
45	Air Emissions Study	32 d	Thu 1/26/17	Fri 3/10/17	75%
46	Traffic Study	25 d	Thu 1/26/17	Wed 3/1/17	91%
47	**PHASE 2. DESIGN DOCUMENTS**	**220 d**	**Wed 12/28/16**	**Wed 11/1/17**	**10%**
48	**PHASE 2 NTP**	**20 d**	**Wed 12/28/16**	**Wed 1/25/17**	**0%**
49	**Design NTP (Prelim)**	**0 d**	**Wed 12/28/16**	**Wed 12/28/16**	**0%**
50	**Phase 2 NTP**	**0 d**	**Wed 1/25/17**	**Wed 1/25/17**	**0%**
51	**201. Project Management**	**208 d**	**Mon 1/16/17**	**Wed 11/1/17**	**14%**
63	**202. Geotechnical Support Services**	**80 d**	**Mon 2/27/17**	**Fri 6/16/17**	**0%**
64	202.1 Geotechnical Design Reviews	80 d	Mon 2/27/17	Fri 6/16/17	0%
65	202.2 Soil Management Plan	60 d	Mon 2/27/17	Fri 5/19/17	0%
66	203. Additional Site Investigation	40 d	Thu 2/2/17	Wed 3/29/17	45%
67	204. Active Controls	40 d	Mon 2/27/17	Fri 4/21/17	0%
68	**205. Plans, Specifications, and Estimate**	**145 d**	**Thu 1/5/17**	**Wed 7/26/17**	**26%**
69	Design Drawings (30%)	37 d	Thu 1/5/17	Fri 2/24/17	100%
70	LACSD/CITY REVIEW	10 d	Mon 2/27/17	Fri 3/10/17	5%
71	Design Drawings (60%)	30 d	Mon 3/13/17	Fri 4/21/17	0%
72	LACSD/CITY REVIEW	10 d	Mon 4/24/17	Fri 5/5/17	0%
73	Design Drawings (90%)	30 d	Mon 5/8/17	Fri 6/16/17	0%
74	LACSD/CITY REVIEW	5 d	Mon 6/19/17	Fri 6/23/17	0%
75	Design Drawings (100%)	18 d	Mon 6/26/17	Wed 7/19/17	0%
76	LACSD/CITY Approval	5 d	Thu 7/20/17	Wed 7/26/17	0%
77	**207. Permitting Support**	**160 d**	**Mon 2/27/17**	**Fri 10/6/17**	**0%**
78	Building and Electrical Permit	20 d	Mon 6/19/17	Fri 7/14/17	0%

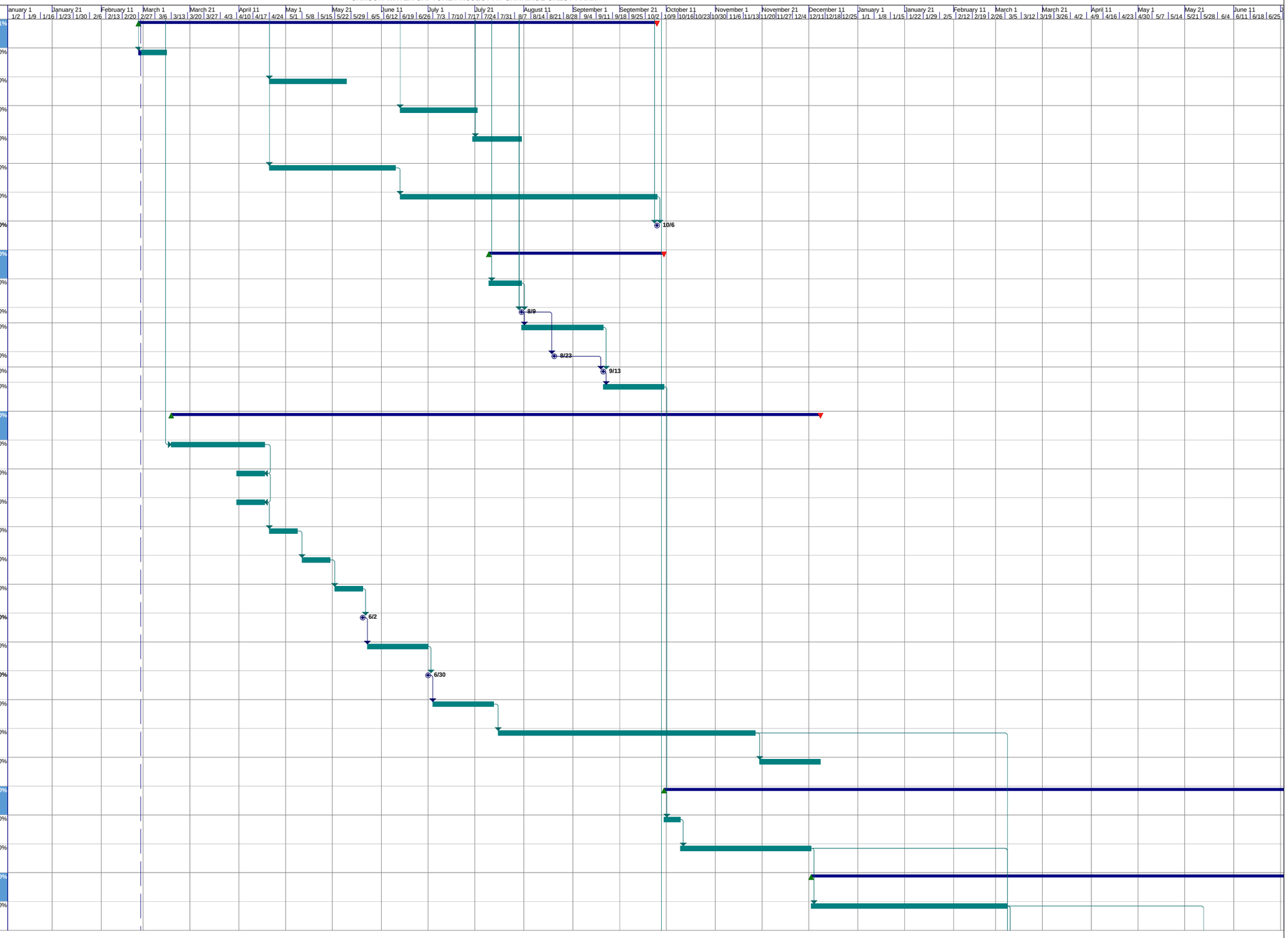


Project: CARSON CARRIAGE CREST PARK SW AND RUNOFF CAPTURE PROJECT
Date: Tue 2/28/17

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Critical | Critical Split | Progress | Deadline

PROJECT SCHEDULE FOR
CARSON WATER CAPTURE PROJECT AT CARRIAGE CREST PARK

ID	TASK NAME	DUR	START	FINISH	%
79	**LACFCD Permit**	**160 d**	**Mon 2/27/17**	**Fri 10/6/17**	**1%**
80	Submit LACFCD Permit Application	10 d	Mon 2/27/17	Fri 3/10/17	10%
81	Review 60% Plans	25 d	Mon 4/24/17	Fri 5/26/17	0%
82	Review 90% Plans	25 d	Mon 6/19/17	Fri 7/21/17	0%
83	Review 100% Plans	15 d	Thu 7/20/17	Wed 8/9/17	0%
84	Draft MOU	40 d	Mon 4/24/17	Fri 6/16/17	0%
85	MOU Board Letter	80 d	Mon 6/19/17	Fri 10/6/17	0%
86	**LACFCD Permit Issued**	**0 d**	**Fri 10/6/17**	**Fri 10/6/17**	**0%**
87	**208. Bid and Award**	**53 d**	**Thu 7/27/17**	**Mon 10/9/17**	**0%**
88	City Approval to Adopt Plans and Advertise	10 d	Thu 7/27/17	Wed 8/9/17	0%
89	Advertise for Construction Bids	0 d	Wed 8/9/17	Wed 8/9/17	0%
90	Advertisement Period	25 d	Thu 8/10/17	Wed 9/13/17	0%
91	Pre-Bid Conference	0 d	Wed 8/23/17	Wed 8/23/17	0%
92	Receive Bids from Prospective Contractors	0 d	Wed 9/13/17	Wed 9/13/17	0%
93	Award Construction Contract	18 d	Thu 9/14/17	Mon 10/9/17	0%
94	**CITY PROCUREMENT ITEMS**	**200 d**	**Mon 3/13/17**	**Fri 12/15/17**	**0%**
95	Prepare PreCast Structures Plan (with 60%)	30 d	Mon 3/13/17	Fri 4/21/17	0%
96	Prepare Procurement Specifications (with 60%)	10 d	Mon 4/10/17	Fri 4/21/17	0%
97	Prepare PreCast Bid Documents	10 d	Mon 4/10/17	Fri 4/21/17	0%
98	LACSD/City Review	10 d	Mon 4/24/17	Fri 5/5/17	0%
99	Final PreCast Bid Package	10 d	Mon 5/8/17	Fri 5/19/17	0%
100	City Prepare RFP Package	10 d	Mon 5/22/17	Fri 6/2/17	0%
101	**Issue RFP for PreCast Structures**	**0 d**	**Fri 6/2/17**	**Fri 6/2/17**	**0%**
102	RFP Response Period	20 d	Mon 6/5/17	Fri 6/30/17	0%
103	**Receive Proposals from Suppliers**	**0 d**	**Fri 6/30/17**	**Fri 6/30/17**	**0%**
104	Select and Issue Contract for Procurement	20 d	Mon 7/3/17	Fri 7/28/17	0%
105	Procure Pre-Cast Structures	80 d	Mon 7/31/17	Fri 11/17/17	0%
106	Submit Invoice to Caltrans	20 d	Mon 11/20/17	Fri 12/15/17	0%
107	**PHASE 3. CONSTRUCTION**	**285 d**	**Tue 10/10/17**	**Mon 11/12/18**	**0%**
108	Issue NTP to Construction Contractor	5 d	Tue 10/10/17	Mon 10/16/17	0%
109	Contractor Move-in Period	40 d	Tue 10/17/17	Mon 12/11/17	0%
110	**Construction of SW Capture Facility**	**160 d**	**Tue 12/12/17**	**Mon 7/23/18**	**0%**
111	Clearing and Excavation	60 d	Tue 12/12/17	Mon 3/5/18	0%

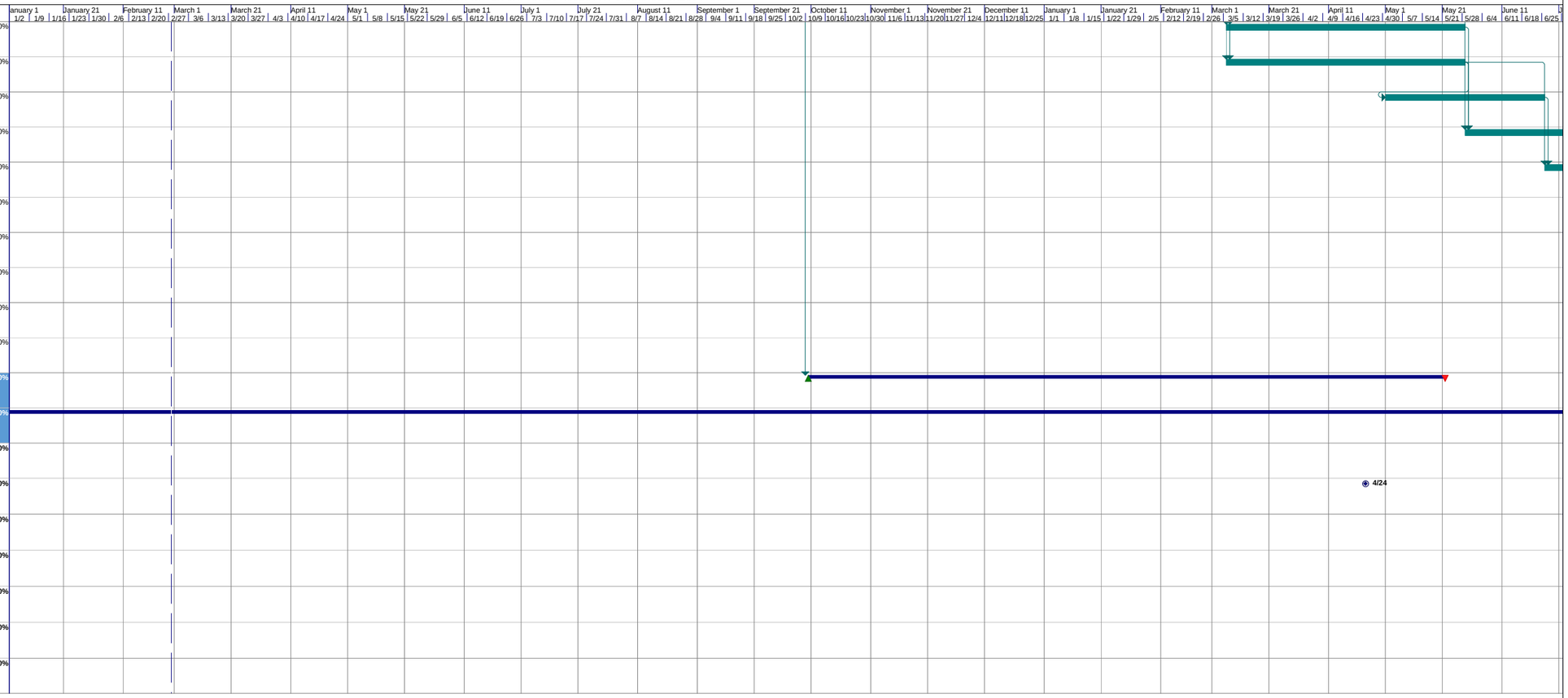


Project: CARSON CARRIAGE CREST PARK SW AND RUNOFF CAPTURE PROJECT
Date: Tue 2/28/17

Task | Milestone | Project Summary | External Milestone | Inactive Milestone | Manual Task | Manual Summary Rollup | Start-only | Critical | Progress
Split | Summary | External Tasks | Inactive Task | Inactive Summary | Duration-only | Manual Summary | Finish-only | Critical Split | Deadline

PROJECT SCHEDULE FOR
CARSON WATER CAPTURE PROJECT AT CARRIAGE CREST PARK

ID	TASK NAME	DUR	START	FINISH	%
112	Infiltration/Storage Facility	60 d	Tue 3/6/18	Mon 5/28/18	0%
113	Construction of Pump Station and Pre-Treatment	60 d	Tue 3/6/18	Mon 5/28/18	0%
114	Storm Drain Diversion (Rubber Dam and DW Inlet)	40 d	Tue 5/1/18	Mon 6/25/18	0%
115	Construction of Surface Improvements	40 d	Tue 5/29/18	Mon 7/23/18	0%
116	Installation of Control Systems	20 d	Tue 6/26/18	Mon 7/23/18	0%
117	Operational Testing	20 d	Tue 7/24/18	Mon 8/20/18	0%
118	Site Walkthrough	20 d	Tue 8/21/18	Mon 9/17/18	0%
119	Field Acceptance	20 d	Tue 9/18/18	Mon 10/15/18	0%
120	Operations and Maintenance Manual	20 d	Tue 7/24/18	Mon 8/20/18	0%
121	As-Built Drawings	20 d	Tue 10/16/18	Mon 11/12/18	0%
122	**300. Water Quality Technical Support**	**160 d**	**Tue 10/10/17**	**Mon 5/21/18**	**0%**
126	**CALTRANS Funding**	**1497 d**	**Tue 8/2/16**	**Thu 4/28/22**	**0%**
127	**City executes agreement with Caltrans**	**0 d**	**Tue 8/2/16**	**Tue 8/2/16**	**0%**
128	**City to bill Caltrans for FY 2015-16 Funding Allocation ($2.5M)**	**0 d**	**Tue 4/24/18**	**Tue 4/24/18**	**0%**
129	**City to bill Caltrans for FY 2016-17 Funding Allocation ($3M)**	**0 d**	**Tue 4/30/19**	**Tue 4/30/19**	**0%**
130	**City to bill Caltrans for FY 2017-18 Funding Allocation ($2.5M)**	**0 d**	**Thu 4/30/20**	**Thu 4/30/20**	**0%**
131	**City to bill Caltrans for FY 2018-19 Funding Allocation ($2.5M)**	**0 d**	**Thu 4/29/21**	**Thu 4/29/21**	**0%**
132	**City to bill Caltrans for FY 2019-20 Funding Allocation ($2.5M)**	**0 d**	**Thu 4/28/22**	**Thu 4/28/22**	**0%**
133	**Project Complete**	**0 d**	**Mon 11/12/18**	**Mon 11/12/18**	**0%**



Project: CARSON CARRIAGE CREST PARK SW AND RUNOFF CAPTURE PROJECT
Date: Tue 2/28/17

Task — Milestone — Project Summary — External Milestone — Inactive Milestone — Manual Task — Manual Summary Rollup — Start-only — Critical — Progress
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