



CITY OF CANNON BEACH

BEFORE THE PLANNING COMMISSION OF THE CITY OF CANNON BEACH

IN THE MATTER OF A CONDITIONAL USE
PERMIT FOR A MUNICIPAL BUILDING IN
A LIMITED COMMERCIAL (C1) ZONE AT
163 E. GOWER ST., TAXLOTS 11900 AND
12000, MAP 51030AD.

FINDINGS OF FACT,
CONCLUSIONS, AND
ORDER NO. CU#23-03

IN ZONE: Limited Commercial (C1)

Applicant: Leslie Jones/CIDA
15895 SW 72nd Ave, Ste. 200
Portland, OR 97224

CIDA, on behalf of the City of Cannon Beach, application for a Conditional Use Permit for the construction of a municipal building in the Limited Commercial (C1) zone at 163 E. Gower St., Taxlots 11900 and 12000, Map 51030AD. The request was reviewed under Cannon Beach Municipal Code Section 17.22, Limited Commercial Zone and Section 17.80, Conditional Uses.

The public hearing on the above-entitled matter was opened before the Planning Commission on 1/17/2024; the Planning Commission closed the public hearing at the 1/17/2024 meeting and a final decision was made at the 1/17/2024 meeting.

THE PLANNING COMMISSION ORDERS that the request for a Conditional Use Permit is APPROVED and adopts the findings of fact, conclusions and conditions that accompany this document. The effective date of this ORDER is 14 days following the signing of this order, subject to the conditions contained in those findings.

This decision may be appealed to the City Council by an affected party by filing an appeal with the City Manager within 14 days of the date this order is signed.

CANNON BEACH PLANNING COMMISSION

DATED: 1/25/24


Chair Clay Newton



Cannon Beach Planning Commission

Findings of Fact and Conclusions of Law

PUBLIC HEARING AND CONSIDERATION OF CU 23-03, CIDA, APPLICANT, ON BEHALF OF THE CITY OF CANNON BEACH, REQUEST FOR A CONDITIONAL USE PERMIT FOR A MUNICIPAL BUILDING IN A LIMITED COMMERCIAL (C1) ZONE AT 163 E. GOWER ST. (TAXLOTS 11900 AND 12000, MAP 51030AD). THE PROPERTY IS CURRENTLY DEVELOPED WITH A MUNICIPAL BUILDING HOUSING THE CITY OF CANNON BEACH CITY HALL. THE CONDITIONAL USE REQUEST WILL BE REVIEWED AGAINST THE CRITERIA OF CANNON BEACH MUNICIPAL CODE, SECTION 17.22, LIMITED COMMERCIAL (C1) ZONE; AND 17.80, CONDITIONAL USES.

Agenda Date: December 19, 2023
Rescheduled to January 17, 2024

EXHIBITS

The following Exhibits are attached hereto as referenced. All application documents were received at the Cannon Beach Community Development office on November 28, 2023 unless otherwise noted.

"A" Exhibits – Application Materials

- A-1** CU#23-03 Application with project narrative and schematics
- A-2** Report of Geotechnical Engineering Services, Geotech Solutions Inc., dated July 31, 2023

"C" Exhibits – Cannon Beach Supplements

- C-1** CU#23-03 Completeness determination, November 29, 2023
- C-2** SRG City Hall Police Station Facility Report, dated December 18, 2018

Summary & Background

The applicant, CIDA, on behalf of the City of Cannon Beach, requested a conditional use permit for the construction of a government structure in the Limited Commercial (C1) zone. The proposed new structure will be a replacement of the existing City Hall building which the City is seeking to replace as the current structure has been determined to have reached the end of its economical lifespan and is no longer considered suitable for continuing use due by the City.

The proposed replacement will be an approximately 10,600 square foot single story building that will be constructed to meet current building and design standards. As the building will be a non-residential structure the design will be reviewed by the Design Review Board prior to the issuance of building permits.

After evaluating multiple potential sites the City has determined the existing location to be the best available option for the siting of a replacement City Hall due to the availability of developable land with supporting infrastructure and ease of public accessibility.

Findings

The Planning Commission finds that the current City Hall building was constructed in 1948 for non-municipal purposes and was adapted for its current use in 1969. The applicant, CIDA, conducted community outreach events for the purpose of identifying and evaluating potential locations for a new City Hall. During these events CIDA heard that there was public desire for community accessibility and that the current site is considered to be centrally located and accessible by pedestrians. The current site is located within a tsunami inundation zone, however, the new facility will no longer house the police station as that will be relocated to an undeveloped City owned parcel that is outside of modeled tsunami areas.

The Commission finds that the proposed City Hall will be a single-story structure measuring approximately 10,600 square feet with a maximum vertical height above grade less than feet. This is not significantly larger than the current facility which measures 9,280 square feet. The amount of off-street parking will be increased as will the number of ADA accessible parking spaces serving the property. The Commission finds that the City will need to provide additional information about impacts to surrounding areas that may result due to changes to available publicly accessible parking during the construction process. The City is currently evaluating project staging timelines and temporary staff housing locations with the intent to minimize operational and other impacts. Additionally, the City may need to develop policy regarding public accessibility to newly created off-street parking, particularly ADA accessible spaces during public meetings that take place after normal business hours.

The Planning Commission finds that the application is consistent with the conditionally permissible uses in the Limited Commercial (C1) zone, and the applicable provisions of CBMC 17.80 Conditional Uses.

Decision

Motion: Having considered the evidence in the record, based on a motion from Commissioner Bates, seconded by Commissioner Farrow, the Planning Commission moves to approve the CIDA application, on behalf of the City of Cannon Beach, the conditional use request for the construction of a government structure in a commercial zone, application CU#23-03, as discussed at this public meeting.



CITY OF CANNON BEACH

CONDITIONAL USE APPLICATION

Please fill out this form completely. Please type or print.

Applicant Name: Leslie Jones, RA
Email Address: lesliej@cidainc.com
Mailing Address: 15895 SW 72nd Ave, Suite 200
Portland, OR 97224
Telephone: (503) 226-1285

Property-Owner Name: City of Cannon Beach
(if other than applicant)
Mailing Address: 163 E. Gower, Cannon Beach, OR 97110
Telephone: (503) 436-1581
Property Location: 163 E. Gower, Cannon Beach, OR 97110
(street address)
Map No.: 5.10.30AD Tax Lot No.: 12000

CONDITIONAL USE REQUEST: See attached Project Memorandum / Supplemental Information for responses to items 1 and 2 below.

1. Description of the proposal.
2. Justification of the conditional use request. Explain how the request meets each of the following criteria for granting a conditional use.
 - a. Explain how a demand exists for the use at the proposed location. Several factors which should be considered include: accessibility for users (such as customers and employees); availability of similar existing uses; availability of other appropriately zoned sites, particularly those not requiring conditional use approval; and the desirability of other suitably zoned sites for the use.
 - b. Explain in what way(s) the proposed use will not create traffic congestion on nearby streets or over-burden the following public facilities and services: water, sewer, storm drainage, electrical service, fire protection and schools.

- c. Show that the site has an adequate amount of space for any yards, buildings, drives, parking, loading and unloading areas, storage facilities, utilities, or other facilities which are required by City Ordinances or desired by the applicant.
- d. Show that the topography, soils, and other physical characteristics of the site are appropriate for the use. Potential problems due to weak foundation soils must be shown to be eliminated or reduced to the extent necessary for avoiding hazardous situations.
- e. Explain in what way an adequate site layout will be used for transportation activities. Consideration should be given to the suitability of any access points, on-site drives, parking, loading and unloading areas, refuse collection and disposal points, sidewalks, bike paths or other transportation facilities required by City ordinances or desired by the applicant. Suitability, in part, should be determined by the potential impact of these facilities on safety, traffic flow and control and emergency vehicle movements.
- f. Explain how the proposed site and building design will be compatible with the surrounding area.

Use extra sheets, if necessary, for answering the above questions. Attach a scale-drawing showing the dimensions of the property, adjacent street(s), dimensions of existing structure, and dimensions of proposed development.

City of Cannon Beach
Finance Department

Application Fee: \$750.00

Applicant Signature: 
Property Owner Signature: _____

Date: 11/28/2023
Date: _____

PAID

DEC 19 2023

If the applicant is other than the owner, the owner hereby grants permission for the applicant to act on his/her behalf. Please attach the name, address, phone number, and signature of any additional property owners.

For Staff Use Only:

Date Received: _____ By: _____

Fee Paid: _____ Receipt No.: _____

(Last revised March 2021)



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(Last revised March 2021)

CONDITIONAL USE PERMIT - GENERAL INFORMATION

What is a Conditional Use Permit?

Land use on all property in Cannon Beach is governed by zoning districts established by the City Council. Cannon Beach has two main types of zoning districts: residential and commercial. Within each of these main categories there are specific zoning districts, such as Medium Density Residential, R-2, and High Density Residential, R-3. Every zoning district has a list of permitted uses and a list of uses that are only allowed after being approved for a conditional use permit. For example, on property zoned R-2, Medium Density Residential, a single-family dwelling is allowed outright, but a church would be allowed only if approved under a conditional use permit.

The Purpose of Conditional Use Permits

Certain uses by their very nature need special consideration before they can be allowed in a particular zoning district. The reasons for requiring such special consideration involve, among other things, the size and intensity of the use, traffic generated by the use and compatibility of the use with the area. These issues are addressed through the conditional use permit process which involves a public hearing before the Planning Commission.

Application and Processing.

If the use you wish to establish on your property requires a conditional use permit, the first step is to informally discuss your proposal with the City Planner. Applications may be submitted by the property owner or an authorized agent. An application should include a detailed statement of the proposed use and a plot plan showing the development of the site. After you submit a completed application, accompanied by a fee to help defray the cost of processing, the City will begin processing your conditional use application.

Public Hearing - Planning Commission.

Conditional use permit requests are considered by the Cannon Beach Planning Commission at a public hearing. Hearings for conditional use permits will be held within 40 days after the application is submitted. Notice of the hearing is mailed to the applicant and to property owners with 250 feet of the site in question. Prior to public hearing, the City Planner will prepare a written report on the request. The report will contain the background of the request and a recommendation based on an investigation of the facts of the proposal and how they pertain to the criteria for granting a conditional use permit. A copy of the report will be mailed to the applicant. Anyone interested in the application may request a copy of the report. At the public hearing, the property owner desiring the conditional use permit has the burden of establishing that the requested conditional use meets the criteria in the Zoning Ordinance. Other people will be given the opportunity to speak in favor of the request, offer comments, ask questions, and/or speak in opposition. At the end of the hearing, the Planning Commission will approve, approve with conditions, or deny the conditional use request.

Appeals to the City Council.

Appeals of the Planning Commission action must be made within 20 days of the decision. The basis of the written appeal must be that the Planning Commission made an error in its decision. The applicant may ask for a new hearing before the City Council or request that the City Council review the Planning Commission record established in making its decision. The City Council may either uphold, reverse or place conditions upon the Planning Commission decision.



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WWW.CIDAINC.COM

Project Memorandum

Project No: 220234.02 Date: 11.28.2023
Project Name: Cannon Beach – City Hall
Subject: Conditional Use Application Response Summary
By: Leslie Jones
To: Planning Commission

SUPPLEMENTAL INFORMATION IN SUPPORT OF THE CONDITIONAL USE APPLICATION

1. Description of the proposal.

The proposed project is the design and construction of a new City Hall and associated site improvements on the site of the existing City Hall. Based on the 2018 Building System Analysis by Tolovana Architects, the existing City Hall - built as a building supply store and home to City Hall since 1969 - has exhausted its useful life and "the building is simply not able to be remodeled in an economic manner as compared to constructing a new facility." The existing City Hall is proposed to be demolished and a new building constructed in its place to meet current building and design standards.

2. Justification for the conditional use request. Explain how the request meets each of the following criteria for granting a conditional use.

- a. Explain how a demand exists for the use at the proposed location. Several factors which should be considered include: accessibility for users (such as customers and employees); availability of similar existing uses; availability of other appropriately zoned sites, particularly those not requiring conditional use approval; and the desirability of other suitably zoned sites for the use.

- *The existing City Hall has been located on its current site, in the heart of Mid-town, since approximately 1969. Based on community feedback, the existing location is both familiar and convenient for residents. We propose to maintain the new building in the same location on the Gower Street site, as approved by City Council on June 13, 2023.*

The existing Limited Commercial (C1) zone remains an appropriate zone for the proposed use as Government Structures are allowed as a conditional use. Properties zoned for allowance of government structures outright, (i.e. General Commercial – C2) are less centrally located on the east side of Highway 101 and would present increased hazard for residents, particularly pedestrians, accessing City services. Moreover, the primary office function of the City Hall is similar to, and compatible with, commercial structures in the C1 zone.

- b. Explain in what way(s) the proposed use with not create traffic congestion on nearby streets or over-burden the following public facilities and services: water, sewer, storm drainage, electrical service, fire protection and schools.

- *Site improvements associated with the proposed new building include increasing on-site parking capacity. The proposed parking, east of the new building, will serve City Hall staff with additional flex space for volunteers and City vehicles. No change is proposed to the public parking off Hemlock. All new parking will be designed to meet current City design standards.*



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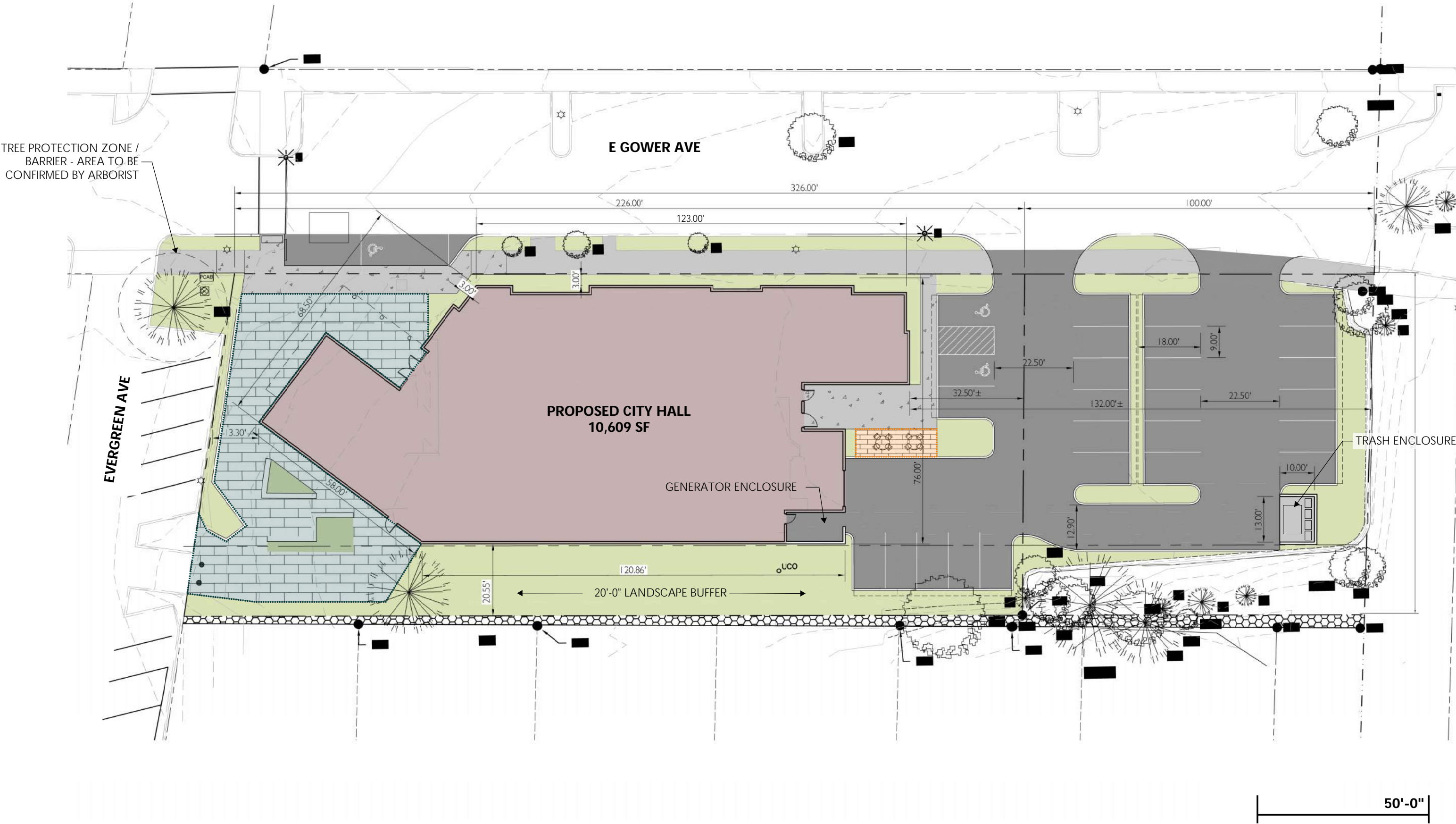
Additionally, while there is no substantive change in the overall building size, the Police Department, currently housed inside the City Hall, will be relocated, thereby reducing overall traffic congestion and burden on public facilities and services.

- c. Show that the site has an adequate amount of space for any yards, buildings, drives, parking, loading and unloading areas, storage facilities, utilities, or other facilities which are required by City Ordinances or desired by the applicant.
 - *The existing City Hall extends up to 17" into the adjacent properties south of the subject site. The proposed new building resolves the potential intrusion onto neighboring properties and provides the required twenty-foot buffer between the proposed building and adjacent residentially zoned properties. This buffer will be planted and screened per City standards with additional consideration given to providing opportunity for community involvement in enhanced landscaping efforts. At the north property line, a three-foot buffer will be maintained between the new building and the sidewalk, and area is included for an entry pedestrian plaza. See the provided site plan for additional site amenities.*
- d. Show that the topography, soils, and other physical characteristics of the site are appropriate for the use. Potential problems due to weak foundation soils must be shown to be eliminated or reduced to the extent necessary for avoiding hazardous situations.
 - *The conceptual foundation design is based upon the ground and soil conditions described in the attached geotechnical report and is included in current construction cost estimates. The building's structural system will be designed to the highest safety standard under current code in order to remain operational following a seismic or wind event. Note that, based on the site elevation, a tsunami event remains a potential risk.*
- e. Explain in what way an adequate site layout will be used for transportation activities. Consideration should be given to the suitability of any access points, on-site drives, parking, loading and unloading areas, refuse collection and disposal points, sidewalks, bike paths or other transportation facilities required by City Ordinances or desired by the applicant. Suitability, in part, should be determined by the potential impact of these facilities on safely, traffic flow and control and emergency vehicle movements.
 - *The proposed sidewalks and curb cuts alter existing traffic patterns to enhance efficiency and safety by separating public and pedestrian access on the west side of the building from parking, loading, and refuse collection on the east side of the building. Access for emergency vehicles will be maintained and no impact is proposed to the existing pedestrian path at the eastern edge of the property.*

In addition to the required standard and accessible parking located east of the building, new accessible parallel parking access is proposed along Gower Street near the primary building entrance.
- f. Explain how the proposed site and building design will be compatible with the surrounding area.
 - *The proposed building and site are designed to provide a welcoming orientation and increased public gathering space for the community. Specific building elements, such as building materials, roof form, and a visual low profile, are highlighted elements of the Cannon Beach and Mid-Town vernacular. As a central feature and anchor of Mid-Town, the proposed new City Hall is designed to reflect the values and priorities of the community and to provide an efficient and attractive platform from which to offer important civic services.*



EXISTING / DEMOLITION SITE PLAN



PROPOSED SITE PLAN



EXTERIOR RENDER - PUBLIC ENTRANCE



EXTERIOR RENDER - GOWER FACADE / STAFF ENTRANCE

REPORT OF GEOTECHNICAL ENGINEERING SERVICES

**Cannon Beach City Hall Improvements
163 Gower Street, Cannon Beach, Oregon**

**Geotech
Solutions Inc.**

July 31, 2023

GSI Project: cannon-22-2-gi

July 31, 2023

cannon-22-2-gi

City of Cannon Beach
stdenis@ci.cannon-beach.or.us

cc: lesliej@cidainc.com; curtisg@cidainc.com

REPORT OF GEOTECHNICAL ENGINEERING SERVICES
City Hall Improvements, 163 E Gower Street
Cannon Beach, Oregon

As authorized, herein we present our report of geotechnical engineering services for the proposed improvements to City Hall at 163 East Gower Street in Cannon Beach, Oregon. We understand that the facility is to be two stories and expanded to the east and may also be used as a tsunami vertical evacuation refuge. A previous geotechnical exploration by others from 2011 was provided (attached) and also included a seismic hazard evaluation. The logs and data from that report were used as background for our analyses. In our opinion the previous report is suitable for the seismic hazard aspects other than liquefaction and site class, as those criteria and standard methods have changed since 2011. The accepted and suitably addressed issues are seismic sources, faults and rupture, and dynamic slope stability, and those seismic hazard elements were therefore not a part of our scope but are appended herein. The previous report also included detailed description of site geology by a qualified certified engineering geologist (CEG). Tsunami modeling and mapping has been updated since that report but did not change the scenario that inundation is likely even in a moderate design CSZ interface earthquake.

The purpose of our work was to conduct additional explorations to the east of the existing buildings, and analyze the conditions to provide upgraded recommendations for building foundations and related building seismic design. Specifically, our scope included the following:

- Provide principal level geotechnical project management including a site reconnaissance, review of provided information, client communications, and review of analyses, reports, and standard format invoicing.
- Explore subsurface conditions by advancing two CPT probes in the east lot gravel area to depths of up to 40 feet or refusal with ppd testing and shear wave velocity readings in each.
- Complete detailed liquefaction analyses of site soils and estimate liquefaction induced deformations and provide qualitative means to reduce or address deformations as needed.
- Provide recommendations for earthwork including suitable fill materials, seasonal material usage, compaction criteria, utility trench backfill, and need for subsurface drainage.
- Provide recommendations for asphalt concrete subgrade preparation and pavement thickness for parking and driveways.
- As appropriate, provide recommendations for deep foundation support for either deep helical piers or a drilled or drilled piles, or a qualitative approach for dual-purpose ground improvement and foundation support application (such as stone columns, deep mixing, etc.). Include vertical capacity versus embedment, allowable lateral loads and related deflection, installation criteria, and geotechnical design parameters for pile caps and grade beams.
- Provide a PE/GE stamped written report summarizing the results of our geotechnical evaluation.

SITE OBSERVATIONS AND CONDITIONS

Surface Conditions

The site is located at 163 E Gower Street in Cannon Beach, Oregon, and includes the single-story building in the western portion of the property with abutting planters, sidewalks, and pavement. The expansion includes going to two stories and/or two-story expansion east of the existing building. The east expansion area includes paved and gravel parking and drives and a few trees. That area has evidence of slope cuts of several feet in the east and south side of the parking area (based on visual observations and bare earth LIDAR mapping). The overall site slopes gently roughly 1% down to the west, and the existing building is roughly 750 feet east of the ocean beach and its access off Ecola Court.

Subsurface Conditions

The site was explored on July 12, 2023 with two CPT probes that are in addition to the two borings and CPT probe completed for the site in 2011. The approximate locations of our explorations are shown on the attached Site Plan, with explorations by others summarized in their attached report. According to geologic maps of the area the site is underlain by coastal terrace deposits with alluvial deposits to the west and “fingers” of alluvial deposits to the northwest and southeast. The 2011 report by others includes a detailed geological mapping description by the CEG and is appended to this report for reference and not repeated or part of the scope herein but was reviewed in a geotechnical engineering context. Soil conditions encountered are generally consistent with the marine terrace mapping, overlying older siltstone of the Astoria Formation at depth. No landslides are mapped on site, with a low risk of dynamic instability.

Subsurface conditions under gravel and pavement sections generally encountered stiff silt and fill up to 2 feet in depth, overlying soft to very soft organic silt to depths of 18 to 25 feet, in turn underlain by dense to very dense fine sand with gravel layers to depths of roughly 100 feet. Below roughly 100 feet the borings encountered massive siltstone with inferred layers of basalt intrusion in B-1 to the 121 foot depths explored.

Surface Fill - This includes the pavement and base rock and mixed fill which extended to depths of up to 2 feet in explorations. The material was generally stiff below the rock with moderate dry strength and low compressibility.

Silt with Organics - The silt unit generally transitioned from medium stiff in the top several feet to soft to very soft below that and contained organics for a discontinuous vertical extent of about 8 feet which included matted sediment/decayed material as well as intact wood at discrete layers. The total layer thickness averages about 20 feet. Organic layers were non-plastic, and inorganic portions had a moderate to high plasticity with some clay content. Moisture contents ranged from 61% to 63%. Where small dispersed organics are present, testing in this unit at the Pelican Pub 600 feet S-SW of the site ranged from 6-13% organics (a range of trace to some), and is obviously higher in actual buried wood. CPT tip resistance in this unit ranged from generally 6-20 tsf in the silt, with sand layers in P-1 ranging from 100 to 300 tsf. Blow counts from the borings (auto hammer N85) ranged from 9 to 2, generally lower with depth. Measured shear wave velocities in our CPT's ranged from 400-650 ft/sec in the silt, and up to 1100 ft/sec in some sand layers in P-1. The averaged shear wave velocity in the unit was 638 ft/sec.

The silt has low strength and high initial and long-term compressibility. A few feet of the silts sandy layers lower in P-I were analyzed as susceptible to liquefaction or at least strength decrease in design level seismic events at moderate to low strains, primarily at depths of 13-18 feet.

Sand - The organic silt unit was underlain by dense sand that extended below roughly 18 to 25 feet to depths to near 100 feet. CPT tip resistance in the sand was generally over 200 tsf with refusal at 500 tsf or more in gravelly sand at depths of 18 to 21 feet in the recent CPT probes. Blow counts ranged from 35 to well over 50, with the exception of one sample at 45 feet in B-I that had a blow count of 17. Shear wave velocities in this unit measured at nearby sites and correlated from SPT blow-counts range from 1100 to 1300 ft/sec. The sand has a high static strength and low compressibility.

Siltstone - At depths of 100-101 feet in the previous borings marine siltstone was encountered that was interpreted as Astoria Formation by the CEG. Blow counts in this unit ranged from 35 to over 50 for a few inches or 30 for zero inches where inferred basalt intrusions were present below 105 feet in B-I. This material has a high strength and is not susceptible to liquefaction.

Groundwater - Pore pressure dissipation testing and free water in CPT probe holes prior to grouting indicated ground water at roughly 11 feet below the ground surface. Previous explorations noted ground water near 21 feet in depth.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on our explorations and analyses, development of the site is feasible by following recommendations provided herein. Surficial soils at the site consist of thin fills over soft silt with organics and dense to very dense sand. The silt soils are unsuitable for foundation or slab support and must be founded on piles penetrating into the very dense sand unit. Liquefaction is calculated to occur in thin layers generally near the top of the sand interface, with some near 45 feet, but at calculated low strains and low to laterally moderate deformations. Specific recommendations for site design are detailed in the following sections.

Earthwork

Preparation - Site preparation for earthwork will require removal of vegetation, existing utilities to be abandoned and existing pavements and unsuitable fill within proposed building and new pavement or hardscaping areas. Root balls from trees may extend several feet and grubbing operations can cause considerable subgrade disturbance. All disturbed material should be removed to undisturbed subgrade and backfilled with structural fill. In general, roots greater than one-inch in diameter should be removed.

Stabilization and Soft Areas - After stripping, we should be contacted to evaluate the exposed subgrade. This evaluation can be done by proof rolling or probing. Soft areas will require overexcavation and backfilling with well graded, clean angular gravel or clean sand compacted as structural fill.

Working Blankets and Haul Roads - Construction equipment should not operate directly on the subgrade when wet, as it is susceptible to disturbance and softening. Existing gravel and pavement, or

new rock working blankets and haul roads placed over a the preceding geosynthetic can be used to protect subgrades. We recommend that sound, angular, pit run or crushed basalt with no more than 6 percent passing a #200 sieve be used to construct haul roads and working blankets. Working blankets should be at least 12 inches thick, and haul roads at least 18 inches thick. These can be reduced to 9 and 14 inches, respectively, with the use of the preceding geogrid.

The preceding rock thicknesses are the minimum recommended. Subgrade protection is the responsibility of the contractor and thicker sections may be required based on subgrade conditions and type and frequency of construction equipment.

Imported Granular Fill - Imported granular fill, such as clean sand or rock, should have a maximum particle size of 6-inches, be well graded, and have less than 6 percent passing the #200 sieve. This material should be compacted to 95 percent relative to ASTM D 1557.

Trenches - Utility trenches may encounter groundwater seepage and severe caving and flowing should be expected where seepage is present and in soft and/or loose soils. Shoring of utility trenches will be required for depths greater than 4 feet. We recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation.

Pipe bedding should be installed in accordance with the pipe manufacturers' recommendations. If groundwater seepage is present in the base of the utility trench excavation, we recommend over-excavating the trench by 12 to 18 inches and placing trench stabilization material in the base. Trench stabilization material should consist of well-graded, crushed rock or crushed gravel with a maximum particle size of 4 inches and be free of deleterious materials. The percent passing the U.S. Standard #200 Sieve shall be less than 6 percent by weight when tested in accordance with ASTM C 117.

Trench backfill above the pipe zone should consist of well graded, angular crushed rock or sand fill with no more than 7 percent passing a #200 sieve. Trench backfill should be compacted to 92 percent relative to ASTM D 1557, and construction of hard surfaces, such as sidewalks or pavement, should not occur within one week of backfilling.

Slopes - Temporary slopes may be inclined up to 2H:1V for slopes up to 8 feet high. Such slopes should be expected to erode somewhat, depending on weather conditions and duration of exposure, and in the winter should be covered with weighted plastic sheeting. Permanent slopes should be inclined no steeper than 2H:1V for slopes up to 6 feet high. Erosion control is critical to maintaining slopes and drainage must be routed away from slope faces.

Seismic Issues

Liquefaction - The critical liquefaction triggering event at the site is a Cascadia subduction zone earthquake with an expected Magnitude of 8.5 to 9.0 and PGA_M of 1.02g with a 2% chance of being exceeded in 50 years. Strains at that level of shaking become asymptotic, so similar liquefaction deformation is also expected with much lower and higher CSZ interface quakes and accelerations. Using the CPT and B-I profiles, we analyzed liquefaction and deformations using several methods incorporated into the CLiq software program and SPT methods by authors Idriss, Tokimatsu, Seed, Seed

and Fear, and others. We evaluated sensitivity to fines content, relative density, unit weight, slope and free face dimensions and proximity, and several other variables to estimate site deformations. An example calculation output for P1 is attached for reference. Based on this, liquefaction and strength reduction induced settlement can occur in layers at depths between 13 and 19 feet in P-1, and less in other explorations, and in a thin layer represented by one sample near 45 feet in B-1. Free field settlement is estimated at less than 1 inch (roughly 0.5 inches from the 45-foot-deep layer), with lateral spreading toward the ocean calculated to be up to 3.5 inches. Differential lateral spreading is likely half of that. Controlling lateral spreading was the “gently sloping” model versus the “free face” model of the distant ocean and low walls 750 feet west. Previous reporting used appropriate methods for that time, which are super-ceded by methods used in our analyses. Use of more detailed (with no more detailed input) finite element models of deformation are not a part of this scope and in our opinion are not justified due to the modest movement and resulting recommendations to structural systems which are not likely to be improved by such analyses.

Seismic Site Class - We used procedures from ASCE 7-22 to determine the seismic site class. Site soils technically correspond to Site Class F although liquefaction is limited. However, in accordance with the building code for short appropriate response periods the subject project soils could have structural seismic lateral forces evaluated using the parameters associated with Site Class D. Other code criteria may impact this classification.

Shear wave velocities in the upper silt unit were measured, and in the sand were obtained from nearby experience and correlation with the SPT blow counts in the borings. The weighted average of the velocities in the top 30 meters (approx. 100 feet) is used to determine the “ V_{s30} ” site class, as well as other criteria to capture the site response character. As the organic vertical extent was less than 10 feet, and the soft silt less than 25 feet, other criteria for Class E were not met. The calculation sheet for V_{s30} is attached. We calculated site class to be Class CD near the margin of Class D, and we therefore recommend using Class D as it is more conservative and would capture the variability in the profile.

Tsunamis and Coseismic Subsidence - DOGAMI 2013 tsunami mapping indicates the site will be inundated by a “medium slip” CSZ interface event or larger, and a distant Alaskan event, which is consistent with the information in the 2011 report. The structural engineer must design accordingly. The existing ground surface may drop an estimated 6 to 7 feet (ASCE 7-22) in elevation after a design level earthquake. This may impact flood elevations and tsunami inundation, as well as re-occupancy and vertical evacuation design.

Pile/Pier Foundations

General - Due to the presence of highly compressible silt soils all foundations and slabs must be supported on piles embedded into the lower dense sand unit. Based on our explorations, the top of the lower sand unit ranged from 19 to 25 feet below the ground surface. Capacities listed herein may be limited by the structural capacity of the pile and must be evaluated by a structural engineer. Piles/piers must be spaced a minimum of 3 pile diameters apart. Closer spacing will result in a reduction in pile/pier capacity resulting from group effects and we must be consulted. Fills greater than two feet above existing grades will induce down-drag on the piles and are not recommended.

Piles in a fixed condition in pile caps or within continuous grade beams are recommended. Due to the risk of long-term settlement in the silt with organics, as well as differential lateral movement from liquefaction, we recommend floors be designed as structural to free span between grade beams or be directly pile supported. Interior unsupported slabs-on-grade are not recommended.

Helical piers may be the most economical approach if they can reach suitable penetration. Grouted micropiles are more expensive but would have greater capacity and are more likely to advance through larger organics. The following sections discuss helical piers and grouted micropiles in more detail.

Helical Piers - Installation of helical piers may not be feasible to the required depths, and reaching these depths must be proven with the use of indicator piers. These depths must include both helixes being interpreted as being embedded in dense or better sand. If penetration is proven feasible, helical piers can be used to support vertical loads, and inclined piers can be used to provide greater lateral resistance. 3.5-inch diameter shafts are recommended due to penetration, efficient load use, lateral resistance, seismic motions, and related scour. Piers are generally installed in 5- to 7-foot-long sections and threaded, or sleeved and double/triple bolted pier shaft connections are required to reduce lateral deflection. A hydraulic motor mounted to an excavator is typically used for installation and observed torque during installation (with calibrated load devices) is used to confirm capacity, typically with a K factor of 7 for 3.5" shafts. Indicator piers are required prior to final design and construction to evaluate the feasibility of penetration to the required depths. Organics or the high density of the sand unit may present refusal short of the required depths, in which case predrilling or modification of the pier helixes may be required.

We recommend vertical piers with the following allowable capacities be used for design, with a minimum pier spacing (vertical and horizontal) of three helix diameters. Resistance to lateral loading of 2 kips per pile is allowed for vertical piles, and piles battered up to 30 degrees from vertical can be designed to the horizontal vector of the preceding loads in the direction of downward batter, and 90% in the opposite direction. All helical piers must be galvanized, or corrosion protected. Again, the following can only be used if the dense sand unit is penetrated to develop the needed torque. Plates larger than 12 inches are not recommended due to anticipated penetration issues, unless proved otherwise by indicator piling.

Helical Pier Type	Inclination	Est. Length (ft)	Allowable Load* (kips)
8" and 10" Double with 3-1/2" pipe with threaded or sleeved and double bolted connection	Vertical	25-30	40 (C), 36 (T)

* C – Compression T – Tension

Capacities for additional pier sizes and inclinations can be provided upon request. We recommend that we be retained to review pier support design and be called to the site to observe pier installation.

Grouted Micropiles - Grouted micro-piles are a higher capacity option for building and slab support that can often penetrate obstructions and reach suitable embedment better than helical piers. As

building loads are expected to be modest for a two-story building, 6-inch diameter grouted Titan 40/16 micropiles would be a reasonable approach, although other types and sizes can be proposed and may be viable. Embedment for the 40/16 grouted piles must be at least 10 feet into the dense lower sand unit. At 10 feet into the sand unit, a downward vertical allowable load of 70 kips can be used for design, at estimated total lengths of 30-35 feet. For the preceding pile, an allowable uplift capacity of 60 kips may be used. Higher capacities of 100 kips downward and 90 kips in uplift can be obtained from penetration of 30 feet into the sand (depths of 50-55 feet), which would also be below the one thin liquefaction layer in B-1 near 45 feet (that has one-half inch of calculated settlement). Resistance to lateral loading of 3 kips per pile is allowed for vertical piles, and for piles battered up to 30 degrees from vertical the horizontal vector of the preceding loads could be used in the direction of downward batter, with 90% of that in the opposite direction.

Capacities for additional pile sizes and inclinations can be provided upon request. We must be retained to review pile support design and called to the site to observe installation of piles.

Grade Beams - Isolated pile caps are not allowed. All piles must be embedded into self-supporting grade beams (with no long-term lateral soil restraint or subgrade support except during placement) or be pile-columns properly connected with beams for lateral continuity. We recommend perimeter grade beams or a continuous pile cap around the building perimeter to help resist tsunami scour damage and aid in post tsunami egress. These beams/caps should be embedded at least 3 feet below exterior perimeter grade. To improve tsunami scour, exterior perimeter abutting grades should be paving or sidewalk a distance of at least 4 feet out from the building perimeter, or alternatively have a wire mesh gabion rock mattress installed below surface features and at least 6 feet in width. Lateral load resistance of a 200 pcf equivalent fluid can be used below the top foot of the side of grade beams for wind and seismic forces, but not tsunami forces. Grade beam base friction must be neglected due to long term settlement.

Slabs - Slabs must be structural and designed to free span between pile caps and pile supported grade beams. A vapor barrier is required on the base rock – refer to **Ground Moisture** herein.

Hardscaping

Exterior perimeter abutting grades should be paving or sidewalk a distance of at least 4 feet out from the building perimeter on each side to reduce tsunami scour. Abutting planters are not recommended unless an underlying gabion rock mattress is used below it out past it and to a distance of 6 feet from the building. Due to modest expected deformations, abutting hardscaping such as sidewalks and parking aprons do not need pile support. A minimum of six inches of clean, angular crushed rock with no more than 6 percent passing a #200 sieve is recommended for use under hardscaping. Prior to rock placement the subgrade will need to be evaluated by us via probing. Rock under hard scaping should be compacted to 92 percent compaction relative to ASTM D 1557. In addition, any areas contaminated with fines must be removed and replaced with clean rock. If the base rock is saturated or trapping water, this water must be removed prior to slab placement.

Ground Moisture

General - The perimeter ground surface and hard-scaping should be sloped to drain away from all structures. Gutters should be tight-lined to a suitable discharge and maintained as free-flowing. Due to shallow groundwater anticipated at the site and expected very soft conditions below a few feet,

basements are not recommended. We should be consulted to evaluate moisture, drainage and stabilization impacts for finished floor embedment greater than 2 feet below existing grade.

Perimeter Foundation Drains - We recommend installing perimeter foundation drains around all exterior foundations/grade beams. The foundation drains should consist of a two-foot-wide zone of drain rock encompassing a 4-inch diameter perforated pipe, all enclosed with a non-woven filter fabric. The drain rock should have no more than 2 percent passing a #200 sieve and should extend to within one foot of the ground surface. The geosynthetic should be a Mirafi 160n or equivalent. One foot of low permeability soil prepared as structural fill should be placed over the fabric at the top of the drain to isolate the drain from surface runoff. Foundation drains must be routed to a suitable discharge.

Vapor Flow Retardant - A continuous, impervious 10-15 mil vapor barrier must be installed over the ground surface under all slabs. Barriers should be installed per the manufacturer's recommendations.

Pavement

Design - We have developed asphalt concrete pavement thickness at the site for 3 trucks per day (with a truck factor of 0.6) and a 20-year design life. These volumes can be revised if specific traffic data is available. Designs are also suitable to support a 75,000 pound fire truck. Our analyses are based on AASHTO methods and subgrade of undisturbed medium stiff silt or better native silt or fill having a resilient modulus of 3,000 psi. Construction will likely require protection and stabilization of subgrades as recommended in the **Stabilization and Soft Areas and Working Blankets** and **Haul Roads** sections of this report, and a Propex Geotex 801 (or equivalent) separation geosynthetic is required. The results of our analyses based on these parameters are provided in the following table.

Based on the results of our analyses we recommend a minimum of 3.0 inches of asphalt concrete (AC) over 9 inches of crushed rock base (CRB). Areas exposed to only car traffic can be constructed of 3 inches of AC over 8 inches of CRB.

Subgrade Preparation - The pavement subgrade should be prepared in accordance with the **Earthwork** recommendations presented in this report. All pavement subgrades will need to pass a proof roll prior to paving. Soft areas should be repaired by overexcavating the areas, installing a separation geosynthetic and geogrid, and brought to-grade with well graded, angular crushed rock compacted as structural fill. For a separation geosynthetic we recommend a Propex Geotex 801 or equivalent, and the geogrid a Hanes Egrid 2020 or equivalent.

Base Rock - The recommended thicknesses are intended to be the minimum acceptable. Crushed rock should conform to ODOT base rock standards and have less than 6 percent passing the #200 sieve. Asphalt concrete should be compacted in lifts no greater than 3 inches in thickness to 91 percent of a Rice Density, or to 98 percent of the maximum density from a test strip.

LIMITATIONS AND OBSERVATION DURING CONSTRUCTION

We have prepared this report for use by the City of Cannon Beach and members of their design and construction teams for this project only. The information herein can be used for bidding or estimating purposes but should not be construed as a warranty of subsurface conditions. We have made observations only at the surface and have drawn from adjacent personal experience and explorations

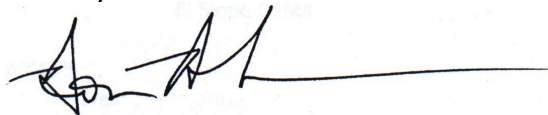
reported by others, only at the stated locations and to the stated depths. These observations do not reflect soil types, strata thicknesses, water levels or seepage that may exist between observations. We should be consulted to review final design and specifications in order to see that our recommendations are suitably followed. If any changes are made to the anticipated locations, loads, configurations, or construction timing, our recommendations may not be applicable, and we should be consulted. The preceding recommendations should be considered preliminary, as actual soil conditions may vary. In order for our recommendations to be final, we must be retained to review final building plans, to observe actual subsurface conditions encountered, and to observe foundation subgrades and pile driving. Our observations will allow us to adapt to actual conditions and to update our recommendations if needed.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty, expressed or implied, is given.

< >

We appreciate the opportunity to work with you on this project and look forward to our continued involvement. Please contact us if you have any questions.

Sincerely,



Don Rondema, MS, PE, GE
Principal



Attachments: Site Plan, CPT logs, Vs30 calculation sheet, liquefaction calculation example, ASCE 7-22 Hazard Tool, 2011 Chinook Geoservices Report

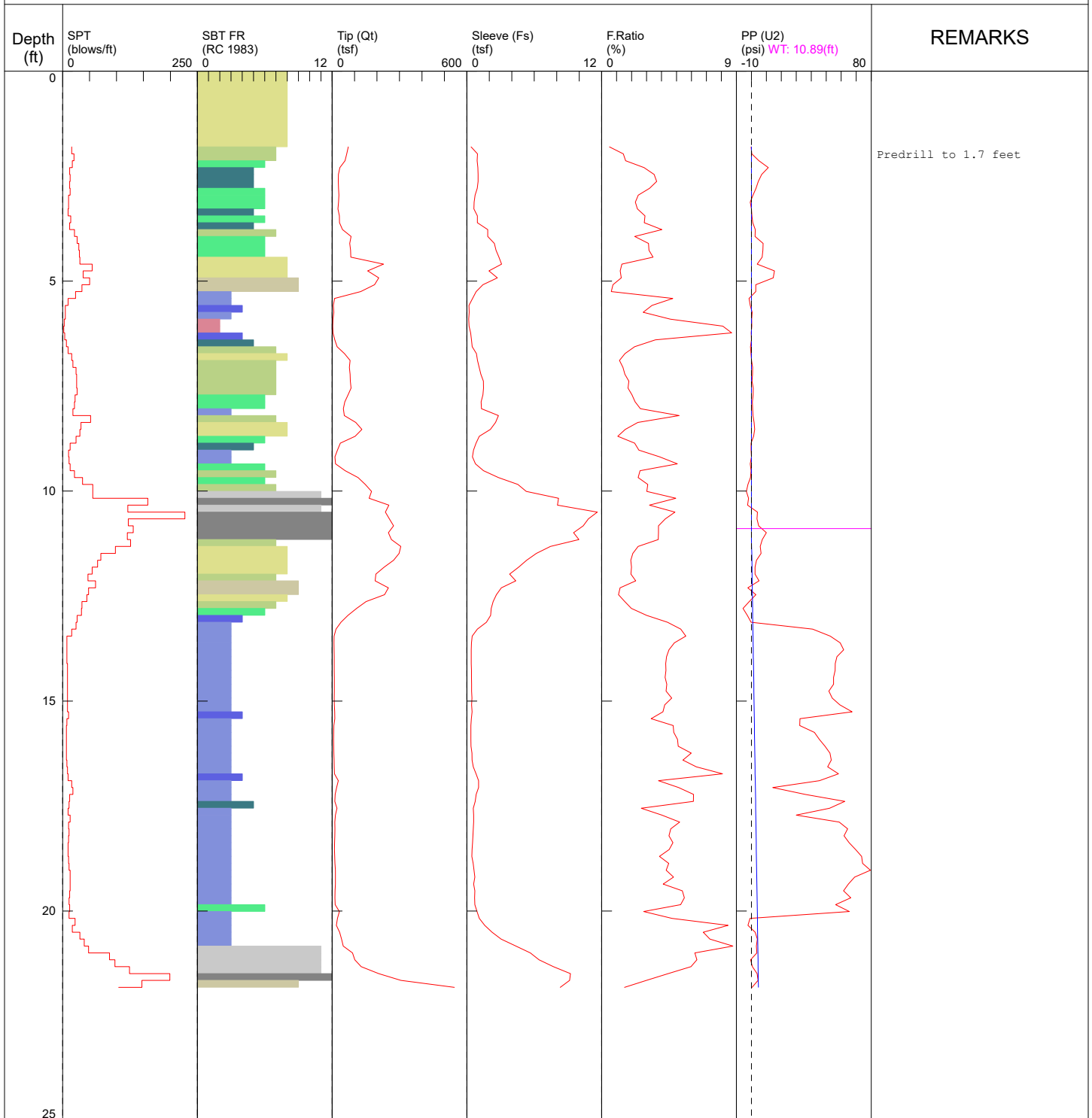


BASE PHOTO FROM GOOGLE EARTH 2021 AERIAL

Exhibit A-2

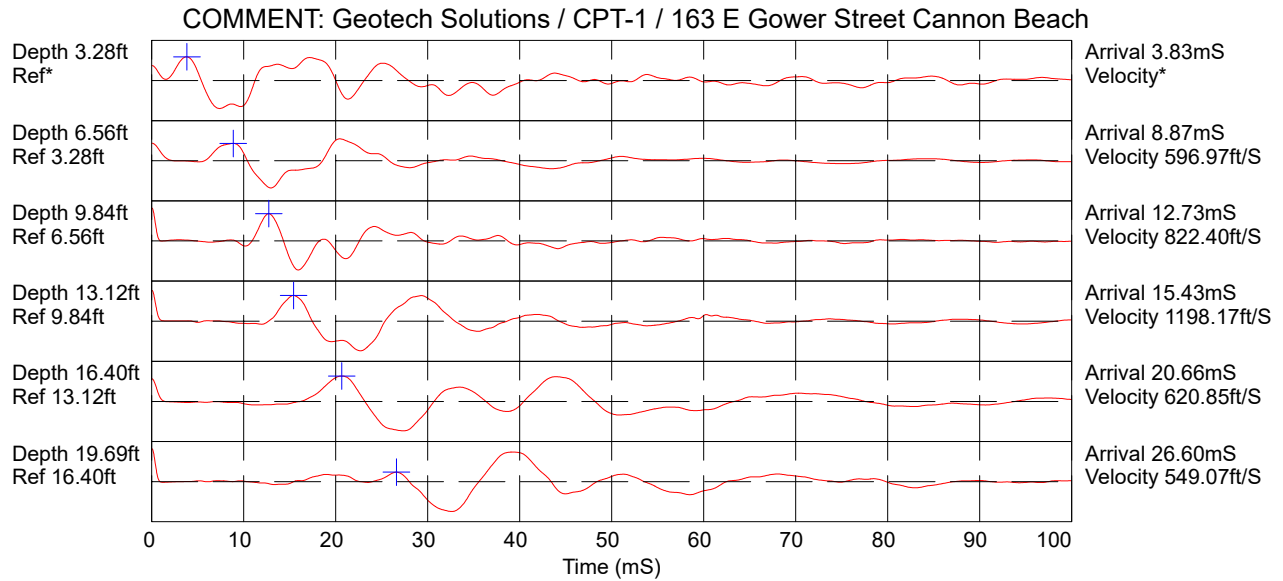
Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
 CONE ID: DDG1296
 TEST DATE: 7/12/2023 9:08:58 AM
 TOTAL DEPTH: 21.818 ft



- | | | | |
|--------------------------|-----------------------------|----------------------------|--------------------------------|
| 1 sensitive fine grained | 4 silty clay to clay | 7 silty sand to sandy silt | 10 gravelly sand to sand |
| 2 organic material | 5 clayey silt to silty clay | 8 sand to silty sand | 11 very stiff fine grained (*) |
| 3 clay | 6 sandy silt to clayey silt | 9 sand | 12 sand to clayey sand (*) |

*SBT/SPT CORRELATION: UBC-1983

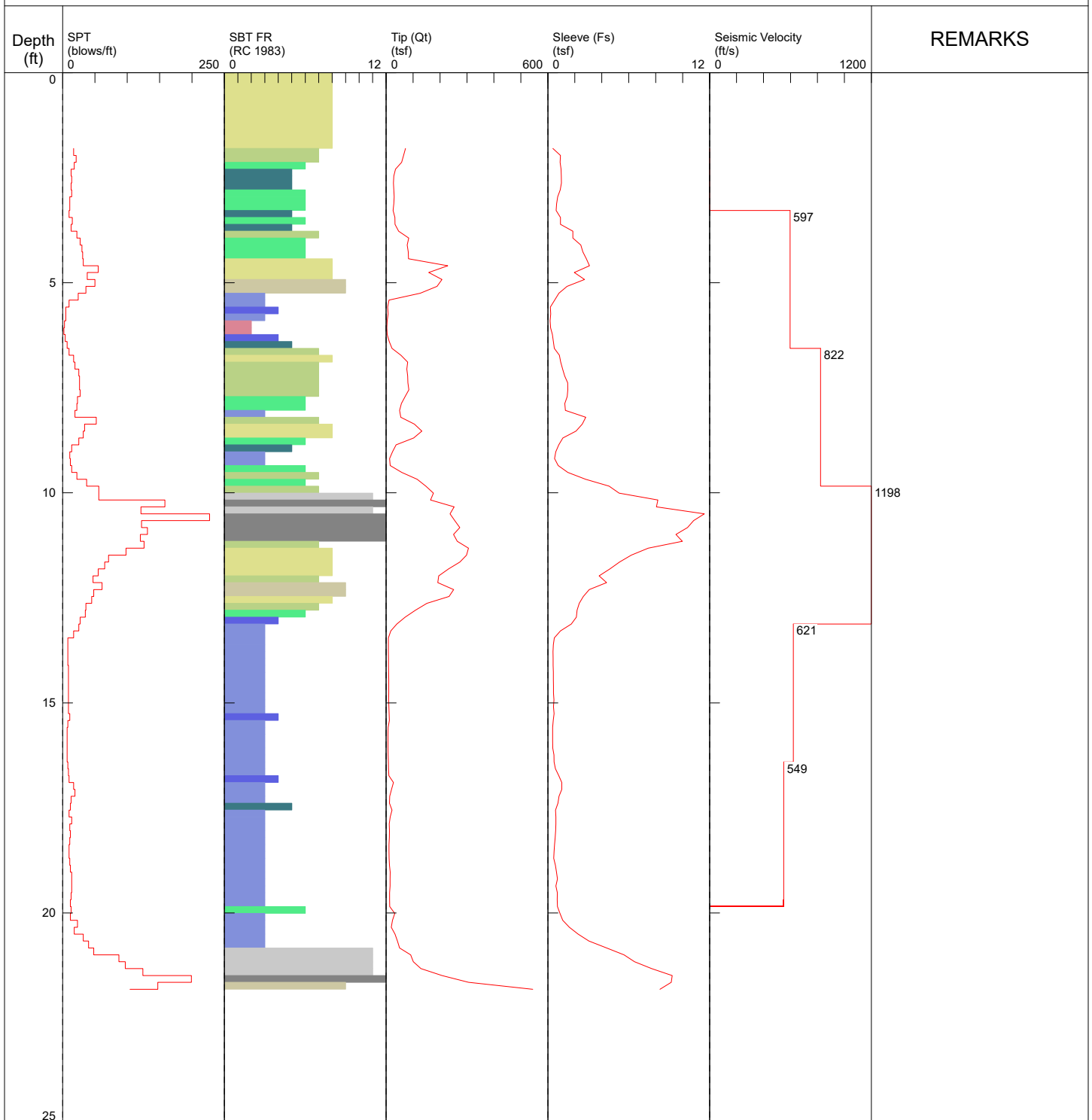


Hammer to Rod String Distance (ft): 2.04

* = Not Determined

Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
 CONE ID: DDG1296
 TEST DATE: 7/12/2023 9:08:58 AM
 TOTAL DEPTH: 21.818 ft



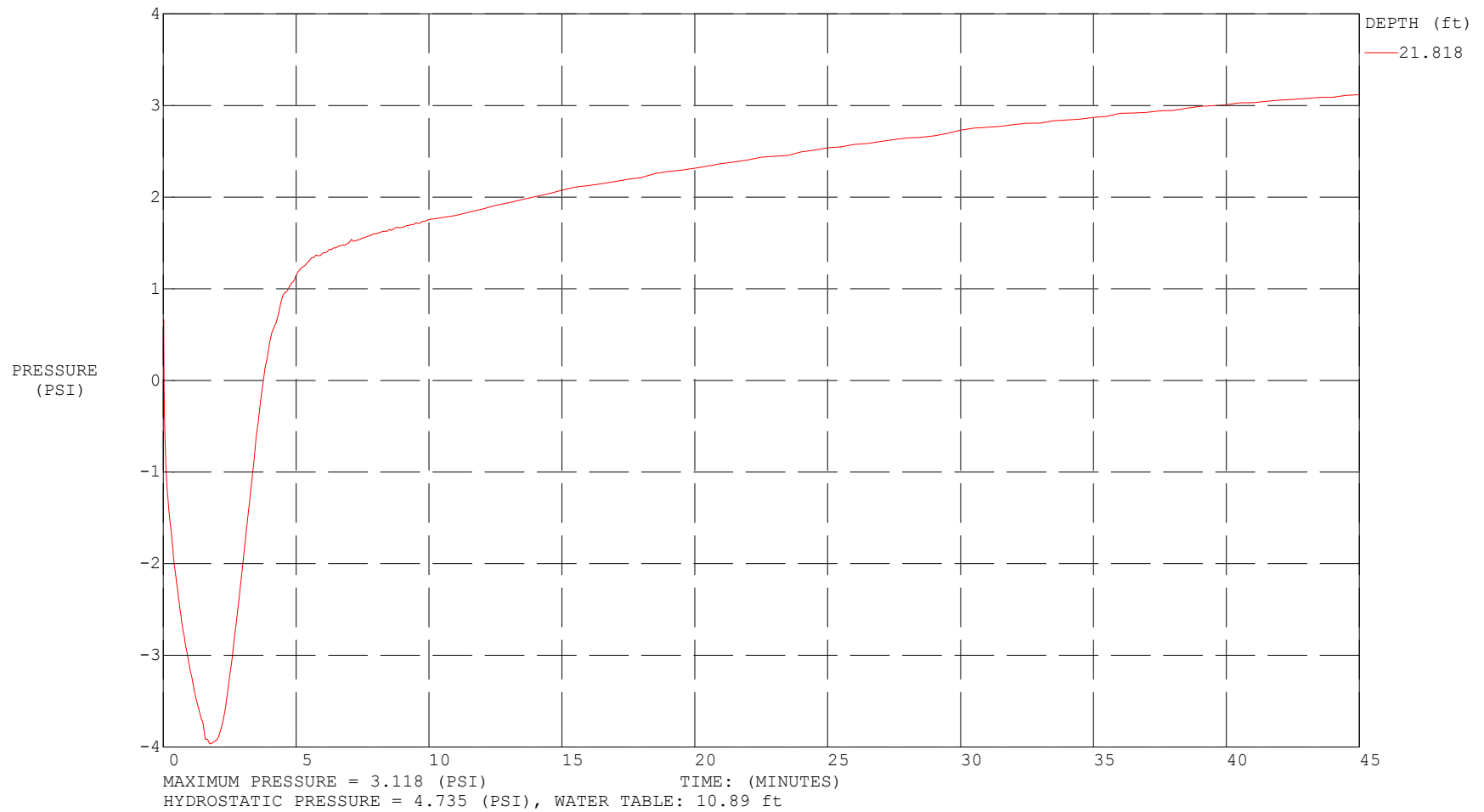
- | | | | |
|--------------------------|-----------------------------|----------------------------|--------------------------------|
| 1 sensitive fine grained | 4 silty clay to clay | 7 silty sand to sandy silt | 10 gravelly sand to sand |
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| 3 clay | 6 sandy silt to clayey silt | 9 sand | 12 sand to clayey sand (*) |

*SBT/SPT CORRELATION: UBC-1983

Exhibit A-2

COMMENT: Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach

CONE ID: DDG1296
TEST DATE: 7/12/2023 9:08:58 AM



Geotech Solutions / CPT-1 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
 CONE ID: DDG1296
 TEST DATE: 7/12/2023 9:08:58 AM
 TOTAL DEPTH: 21.818 ft

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
1.804	71.87	0.3755	0.523	-0.231	17	8	sand to silty sand
1.969	64.66	0.9340	1.444	0.284	21	7	silty sand to sandy silt
2.133	57.23	0.9119	1.593	4.979	18	7	silty sand to sandy silt
2.297	34.46	0.9747	2.828	11.323	13	6	sandy silt to clayey silt
2.461	28.37	0.9946	3.506	6.831	14	5	clayey silt to silty clay
2.625	27.26	1.0014	3.673	4.639	13	5	clayey silt to silty clay
2.789	28.73	0.9185	3.197	3.084	14	5	clayey silt to silty clay
2.953	29.83	0.7287	2.442	1.031	11	6	sandy silt to clayey silt
3.117	28.67	0.6464	2.255	-0.775	11	6	sandy silt to clayey silt
3.281	25.70	0.6126	2.383	-0.036	10	6	sandy silt to clayey silt
3.445	32.22	0.9319	2.892	0.312	15	5	clayey silt to silty clay
3.609	32.81	0.9317	2.839	0.919	13	6	sandy silt to clayey silt
3.773	46.11	1.8550	4.023	2.613	22	5	clayey silt to silty clay
3.937	83.87	1.8567	2.214	2.466	27	7	silty sand to sandy silt
4.101	78.06	2.4438	3.131	7.807	30	6	sandy silt to clayey silt
4.265	82.09	2.5886	3.153	7.628	31	6	sandy silt to clayey silt
4.429	83.01	2.8487	3.432	7.188	32	6	sandy silt to clayey silt
4.593	228.46	3.0823	1.349	3.892	55	8	sand to silty sand
4.757	158.01	1.9609	1.241	15.415	38	8	sand to silty sand
4.921	207.27	2.7152	1.310	14.621	50	8	sand to silty sand
5.085	188.57	1.4247	0.756	2.920	36	9	sand
5.249	126.91	0.8205	0.646	2.942	24	9	sand
5.413	10.60	0.5035	4.750	-1.557	10	3	clay
5.577	5.45	0.1831	3.360	-0.808	5	3	clay
5.741	7.40	0.2056	2.777	0.532	5	4	silty clay to clay
5.906	3.54	0.1623	4.585	0.176	3	3	clay
6.070	2.46	0.1994	8.091	0.248	2	2	organic material
6.234	3.83	0.3323	8.684	-0.167	4	2	organic material
6.398	11.51	0.4126	3.585	0.078	7	4	silty clay to clay
6.562	21.68	0.4760	2.195	-0.596	10	5	clayey silt to silty clay
6.726	54.60	0.8528	1.562	-0.312	17	7	silty sand to sandy silt
6.890	80.11	0.9508	1.187	0.145	19	8	sand to silty sand
7.054	76.77	1.0923	1.423	0.775	25	7	silty sand to sandy silt
7.218	80.15	1.2434	1.551	0.708	26	7	silty sand to sandy silt
7.382	80.69	1.4671	1.818	0.457	26	7	silty sand to sandy silt
7.546	84.34	1.4795	1.754	1.245	27	7	silty sand to sandy silt
7.710	70.53	1.4274	2.024	1.114	23	7	silty sand to sandy silt
7.874	56.41	1.2573	2.229	0.674	22	6	sandy silt to clayey silt
8.038	50.02	1.2937	2.586	0.805	19	6	sandy silt to clayey silt
8.202	54.25	2.8047	5.170	1.036	52	3	clay
8.366	105.14	2.5466	2.422	1.808	34	7	silty sand to sandy silt
8.530	132.63	2.0874	1.574	2.223	32	8	sand to silty sand
8.694	102.42	1.1063	1.080	1.463	25	8	sand to silty sand
8.858	36.73	0.8101	2.206	-0.237	14	6	sandy silt to clayey silt
9.022	23.58	0.5863	2.487	-0.184	11	5	clayey silt to silty clay
9.186	12.71	0.4925	3.874	0.047	12	3	clay

Exhibit A-2

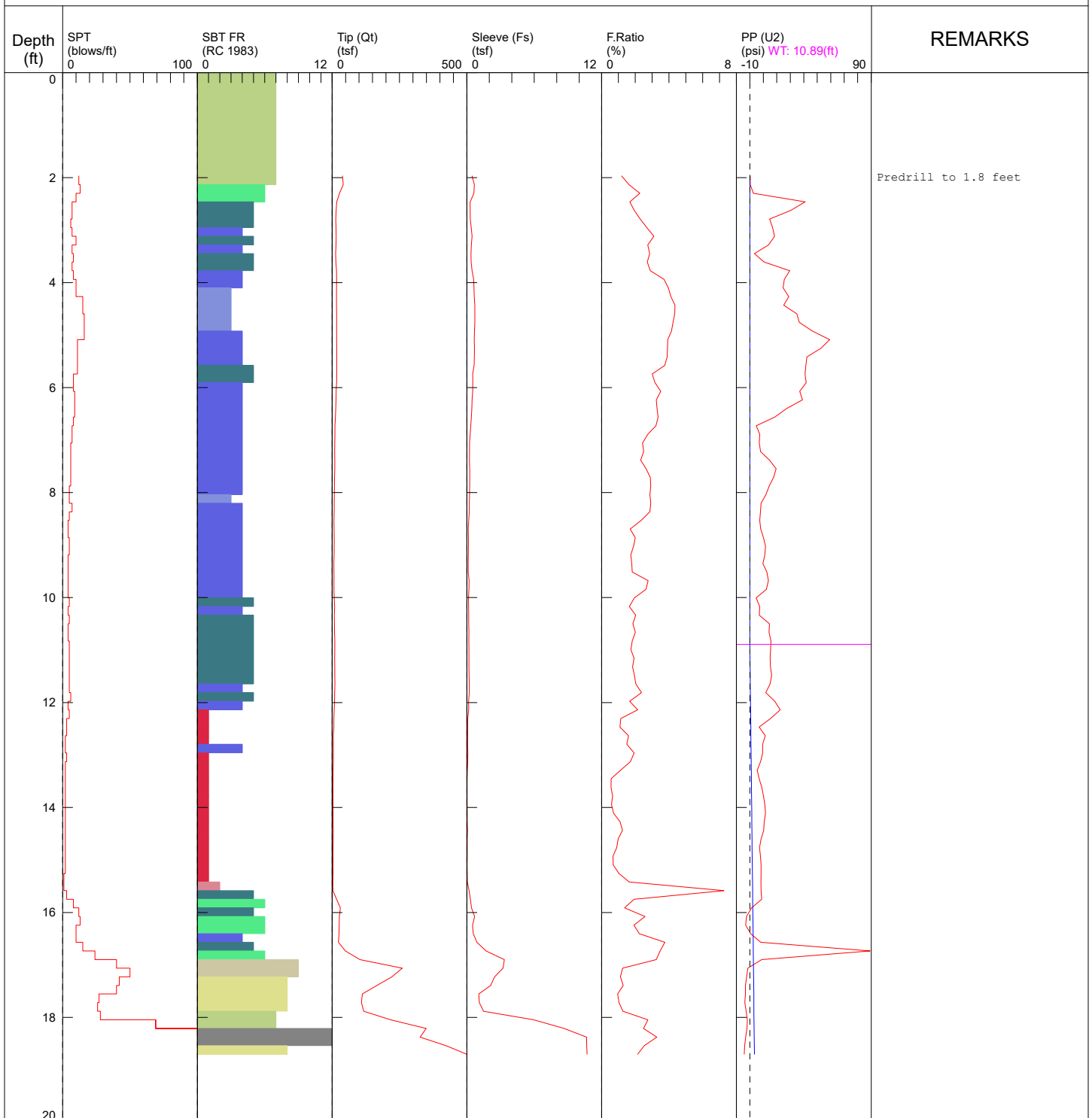
Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
9.350	14.99	0.7581	5.056	-0.833	14	3	clay
9.514	57.98	1.4826	2.557	-0.248	22	6	sandy silt to clayey silt
9.678	115.19	2.8017	2.432	-0.649	37	7	silty sand to sandy silt
9.843	147.45	4.5385	3.078	-2.307	56	6	sandy silt to clayey silt
10.007	175.15	5.2861	3.018	-3.335	56	7	silty sand to sandy silt
10.171	164.65	8.1563	4.954	-1.886	158	11	very stiff fine grained (*)
10.335	252.45	8.0568	3.191	-2.533	121	12	sand to clayey sand (*)
10.499	237.24	11.6048	4.891	4.062	227	11	very stiff fine grained (*)
10.663	254.58	10.8200	4.250	3.744	122	12	sand to clayey sand (*)
10.827	273.25	10.3557	3.790	4.887	131	12	sand to clayey sand (*)
10.991	250.30	9.5000	3.795	9.952	120	12	sand to clayey sand (*)
11.155	263.82	9.9730	3.780	7.244	126	12	sand to clayey sand (*)
11.319	305.65	7.4451	2.436	5.867	98	7	silty sand to sandy silt
11.483	298.04	6.1876	2.076	6.458	71	8	sand to silty sand
11.647	273.43	5.3124	1.943	3.396	65	8	sand to silty sand
11.811	231.42	4.6064	1.990	2.396	55	8	sand to silty sand
11.975	194.91	3.8040	1.952	2.466	47	8	sand to silty sand
12.139	191.57	4.3514	2.271	5.104	61	7	silty sand to sandy silt
12.303	250.67	3.0684	1.224	-2.354	48	9	sand
12.467	233.40	2.6272	1.126	2.992	45	9	sand
12.631	150.95	2.3288	1.543	-1.410	36	8	sand to silty sand
12.795	109.07	2.1640	1.984	-5.575	35	7	silty sand to sandy silt
12.959	70.33	2.1131	3.005	-2.719	27	6	sandy silt to clayey silt
13.123	39.48	1.7360	4.398	-0.217	25	4	silty clay to clay
13.287	17.60	0.9289	5.279	40.886	17	3	clay
13.451	8.47	0.4762	5.622	52.593	8	3	clay
13.615	8.26	0.4010	4.858	59.285	8	3	clay
13.780	8.51	0.3824	4.496	61.609	8	3	clay
13.944	8.85	0.3836	4.333	57.170	8	3	clay
14.108	9.03	0.3861	4.277	56.011	9	3	clay
14.272	9.32	0.4001	4.294	55.947	9	3	clay
14.436	9.67	0.4092	4.232	54.877	9	3	clay
14.600	9.63	0.4189	4.347	54.897	9	3	clay
14.764	9.69	0.4169	4.304	51.707	9	3	clay
14.928	9.47	0.4431	4.678	54.011	9	3	clay
15.092	9.90	0.4164	4.206	59.001	9	3	clay
15.256	11.27	0.4603	4.086	67.250	11	3	clay
15.420	11.94	0.3945	3.303	32.424	8	4	silty clay to clay
15.584	7.40	0.3533	4.772	32.305	7	3	clay
15.748	7.19	0.3465	4.818	42.073	7	3	clay
15.912	6.91	0.3503	5.067	45.360	7	3	clay
16.076	7.12	0.3638	5.112	49.172	7	3	clay
16.240	7.52	0.4502	5.983	52.484	7	3	clay
16.404	8.48	0.4601	5.426	53.312	8	3	clay
16.568	8.89	0.5616	6.320	50.916	9	3	clay
16.732	10.06	0.8112	8.066	58.129	10	3	clay
16.896	27.21	1.0327	3.796	45.477	17	4	silty clay to clay
17.060	20.16	1.0346	5.132	14.265	19	3	clay
17.224	13.41	0.8226	6.133	35.926	13	3	clay
17.388	12.17	0.7455	6.125	62.277	12	3	clay
17.552	21.50	0.5677	2.641	52.197	10	5	clayey silt to silty clay
17.717	14.82	0.5957	4.019	29.939	14	3	clay
17.881	11.47	0.5971	5.205	58.619	11	3	clay
18.045	12.35	0.5697	4.611	64.264	12	3	clay
18.209	11.99	0.5382	4.490	61.818	11	3	clay
18.373	10.55	0.5017	4.756	65.269	10	3	clay
18.537	10.29	0.4639	4.510	69.591	10	3	clay

Exhibit A-2

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
18.701	11.26	0.4351	3.863	73.611	11	3	clay
18.865	12.44	0.5572	4.480	74.207	12	3	clay
19.029	14.80	0.6376	4.308	79.465	14	3	clay
19.193	14.70	0.7053	4.798	68.969	14	3	clay
19.357	14.55	0.5974	4.106	64.774	14	3	clay
19.521	13.05	0.7035	5.388	61.475	13	3	clay
19.685	12.49	0.6895	5.522	66.378	12	3	clay
19.849	13.37	0.7056	5.276	56.226	13	3	clay
20.013	32.03	0.8997	2.809	65.364	12	6	sandy silt to clayey silt
20.177	23.55	1.1050	4.691	-0.983	23	3	clay
20.341	18.85	1.5922	8.446	-2.312	18	3	clay
20.505	33.08	2.2454	6.787	2.535	32	3	clay
20.669	42.13	3.0459	7.230	3.953	40	3	clay
20.833	49.73	4.3588	8.765	3.318	48	3	clay
20.997	90.81	5.6496	6.221	3.594	87	11	very stiff fine grained (*)
21.161	100.99	6.4220	6.359	-0.571	97	11	very stiff fine grained (*)
21.325	129.13	7.6998	5.963	0.680	124	11	very stiff fine grained (*)
21.490	207.82	9.2211	4.437	3.772	199	11	very stiff fine grained (*)
21.654	306.01	9.1524	2.991	4.388	147	12	sand to clayey sand (*)
21.818	543.94	8.3122	1.528	0.390	104	9	sand

Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
 CONE ID: DDG1296
 TEST DATE: 7/12/2023 10:44:55 AM
 TOTAL DEPTH: 18.701 ft



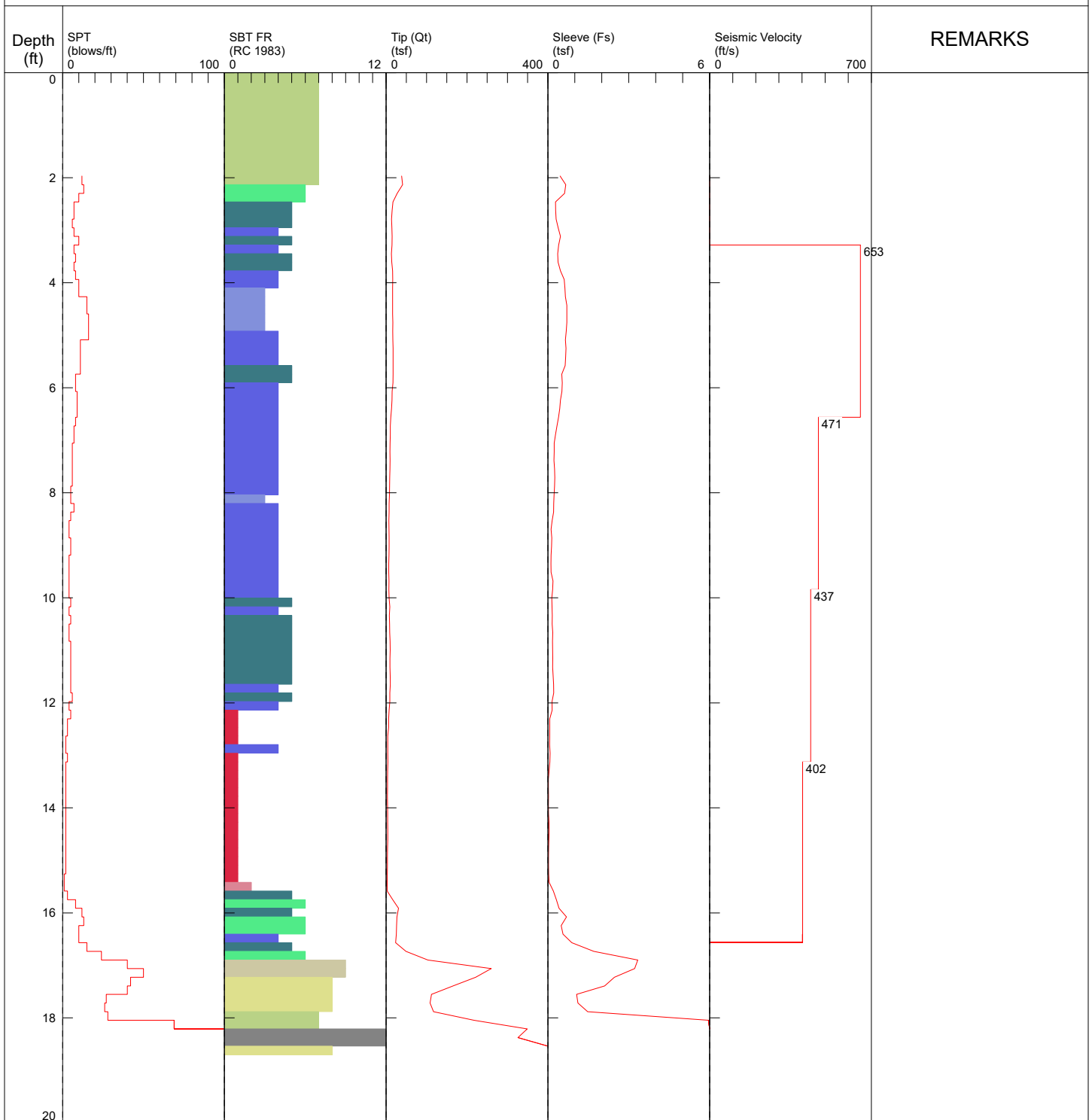
- | | | | |
|--------------------------|-----------------------------|----------------------------|--------------------------------|
| 1 sensitive fine grained | 4 silty clay to clay | 7 silty sand to sandy silt | 10 gravelly sand to sand |
| 2 organic material | 5 clayey silt to silty clay | 8 sand to silty sand | 11 very stiff fine grained (*) |
| 3 clay | 6 sandy silt to clayey silt | 9 sand | 12 sand to clayey sand (*) |

*SBT/SPT CORRELATION: UBC-1983



Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
 CONE ID: DDG1296
 TEST DATE: 7/12/2023 10:44:55 AM
 TOTAL DEPTH: 18.701 ft



1 sensitive fine grained
 2 organic material
 3 clay

4 silty clay to clay
 5 clayey silt to silty clay
 6 sandy silt to clayey silt

7 silty sand to sandy silt
 8 sand to silty sand
 9 sand

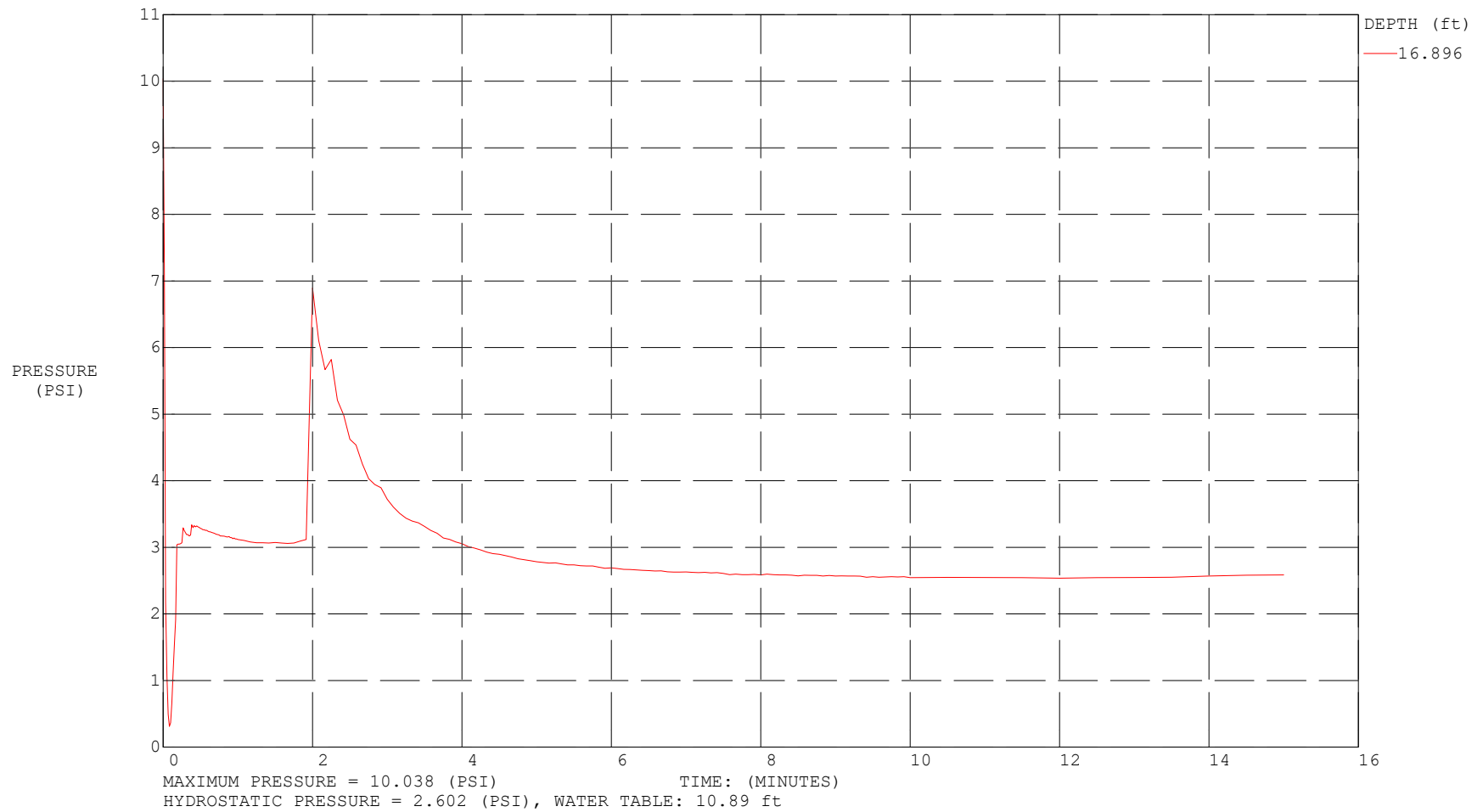
10 gravelly sand to sand
 11 very stiff fine grained (*)
 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

Exhibit A-2

COMMENT: Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

CONE ID: DDG1296
TEST DATE: 7/12/2023 10:44:55 AM



Geotech Solutions / CPT-2 / 163 E Gower Street Cannon Beach

OPERATOR: OGE BAK
 CONE ID: DDG1296
 TEST DATE: 7/12/2023 10:44:55 AM
 TOTAL DEPTH: 18.701 ft

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
1.969	38.24	0.4536	1.186	0.192	12	7	silty sand to sandy silt
2.133	40.81	0.6616	1.621	0.293	13	7	silty sand to sandy silt
2.297	27.23	0.6167	2.265	2.552	10	6	sandy silt to clayey silt
2.461	16.97	0.2840	1.673	40.986	7	6	sandy silt to clayey silt
2.625	14.78	0.2858	1.934	30.379	7	5	clayey silt to silty clay
2.789	13.30	0.3046	2.290	14.660	6	5	clayey silt to silty clay
2.953	14.19	0.3814	2.688	16.917	7	5	clayey silt to silty clay
3.117	15.01	0.4647	3.096	18.263	10	4	silty clay to clay
3.281	14.53	0.3970	2.732	13.799	7	5	clayey silt to silty clay
3.445	12.85	0.3660	2.848	3.421	8	4	silty clay to clay
3.609	13.91	0.3765	2.708	10.487	7	5	clayey silt to silty clay
3.773	16.18	0.4667	2.885	29.546	8	5	clayey silt to silty clay
3.937	16.28	0.6020	3.698	25.543	10	4	silty clay to clay
4.101	15.93	0.6310	3.960	24.637	10	4	silty clay to clay
4.265	15.83	0.6509	4.112	28.786	15	3	clay
4.429	16.14	0.7032	4.357	25.036	15	3	clay
4.593	16.23	0.7043	4.338	34.859	16	3	clay
4.757	16.59	0.7030	4.238	36.620	16	3	clay
4.921	16.40	0.6795	4.144	46.241	16	3	clay
5.085	16.63	0.6532	3.928	59.196	11	4	silty clay to clay
5.249	17.17	0.6708	3.907	52.752	11	4	silty clay to clay
5.413	17.02	0.6606	3.882	42.326	11	4	silty clay to clay
5.577	17.11	0.6415	3.749	41.499	11	4	silty clay to clay
5.741	17.12	0.5140	3.003	40.880	8	5	clayey silt to silty clay
5.906	16.78	0.5308	3.163	41.755	8	5	clayey silt to silty clay
6.070	14.85	0.5209	3.509	36.968	9	4	silty clay to clay
6.234	14.36	0.4663	3.248	39.000	9	4	silty clay to clay
6.398	13.34	0.4384	3.286	27.265	9	4	silty clay to clay
6.562	11.78	0.3951	3.353	18.458	8	4	silty clay to clay
6.726	10.46	0.3371	3.221	4.739	7	4	silty clay to clay
6.890	10.41	0.2846	2.733	7.294	7	4	silty clay to clay
7.054	9.68	0.2350	2.429	6.987	6	4	silty clay to clay
7.218	9.38	0.2343	2.499	7.912	6	4	silty clay to clay
7.382	9.72	0.2247	2.312	14.524	6	4	silty clay to clay
7.546	9.52	0.2506	2.632	19.514	6	4	silty clay to clay
7.710	8.96	0.2584	2.884	17.586	6	4	silty clay to clay
7.874	8.61	0.2509	2.913	14.365	5	4	silty clay to clay
8.038	8.10	0.2322	2.866	11.802	5	4	silty clay to clay
8.202	7.40	0.2156	2.913	8.258	7	3	clay
8.366	7.44	0.2127	2.858	7.784	5	4	silty clay to clay
8.530	6.74	0.1583	2.349	7.252	4	4	silty clay to clay
8.694	6.95	0.1178	1.694	8.010	4	4	silty clay to clay
8.858	7.36	0.1464	1.989	10.013	5	4	silty clay to clay
9.022	7.32	0.1388	1.896	11.615	5	4	silty clay to clay
9.186	7.00	0.1208	1.726	11.064	4	4	silty clay to clay
9.350	6.43	0.1150	1.788	9.609	4	4	silty clay to clay

Exhibit A-2

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
9.514	6.57	0.1190	1.812	12.549	4	4	silty clay to clay
9.678	6.84	0.1887	2.760	13.786	4	4	silty clay to clay
9.843	6.73	0.1766	2.625	12.186	4	4	silty clay to clay
10.007	7.49	0.1455	1.943	4.575	5	4	silty clay to clay
10.171	9.19	0.1512	1.645	7.252	4	5	clayey silt to silty clay
10.335	8.02	0.1621	2.021	6.965	5	4	silty clay to clay
10.499	8.55	0.1577	1.844	14.602	4	5	clayey silt to silty clay
10.663	8.93	0.1784	1.999	14.226	4	5	clayey silt to silty clay
10.827	9.56	0.1730	1.809	15.591	5	5	clayey silt to silty clay
10.991	10.08	0.1745	1.732	15.312	5	5	clayey silt to silty clay
11.155	9.42	0.1805	1.916	15.020	5	5	clayey silt to silty clay
11.319	9.55	0.1752	1.835	15.215	5	5	clayey silt to silty clay
11.483	10.01	0.1941	1.940	16.123	5	5	clayey silt to silty clay
11.647	10.47	0.2122	2.026	14.945	5	5	clayey silt to silty clay
11.811	9.19	0.2172	2.364	11.777	6	4	silty clay to clay
11.975	9.08	0.1508	1.662	18.430	4	5	clayey silt to silty clay
12.139	7.33	0.1565	2.136	22.484	5	4	silty clay to clay
12.303	6.20	0.0704	1.136	15.312	3	1	sensitive fine grained
12.467	6.26	0.0677	1.082	6.840	3	1	sensitive fine grained
12.631	4.27	0.0680	1.593	11.370	2	1	sensitive fine grained
12.795	4.30	0.0643	1.496	9.445	2	1	sensitive fine grained
12.959	4.32	0.0834	1.929	9.414	3	4	silty clay to clay
13.123	4.38	0.0747	1.704	7.915	2	1	sensitive fine grained
13.287	3.84	0.0432	1.127	5.413	2	1	sensitive fine grained
13.451	3.53	0.0197	0.558	6.854	2	1	sensitive fine grained
13.615	3.38	0.0188	0.556	8.854	2	1	sensitive fine grained
13.780	3.35	0.0218	0.651	10.133	2	1	sensitive fine grained
13.944	3.45	0.0202	0.584	11.108	2	1	sensitive fine grained
14.108	3.61	0.0256	0.710	11.610	2	1	sensitive fine grained
14.272	3.64	0.0397	1.092	10.618	2	1	sensitive fine grained
14.436	4.01	0.0495	1.235	10.222	2	1	sensitive fine grained
14.600	3.99	0.0390	0.976	8.289	2	1	sensitive fine grained
14.764	3.52	0.0315	0.895	7.160	2	1	sensitive fine grained
14.928	3.33	0.0224	0.673	7.899	2	1	sensitive fine grained
15.092	3.14	0.0216	0.687	8.266	2	1	sensitive fine grained
15.256	2.91	0.0300	1.032	8.238	1	1	sensitive fine grained
15.420	2.79	0.0457	1.638	8.180	1	1	sensitive fine grained
15.584	2.75	0.1996	7.264	8.269	3	2	organic material
15.748	16.41	0.3153	1.922	8.798	8	5	clayey silt to silty clay
15.912	30.44	0.4148	1.363	1.215	12	6	sandy silt to clayey silt
16.076	26.74	0.6875	2.571	-2.574	13	5	clayey silt to silty clay
16.240	25.91	0.4962	1.915	-3.159	10	6	sandy silt to clayey silt
16.404	25.19	0.5623	2.232	0.607	10	6	sandy silt to clayey silt
16.568	23.56	0.8840	3.752	8.049	15	4	silty clay to clay
16.732	49.09	1.7038	3.471	89.166	24	5	clayey silt to silty clay
16.896	103.17	3.3367	3.234	8.746	40	6	sandy silt to clayey silt
17.060	259.68	3.2177	1.239	-1.557	50	9	sand
17.224	221.48	2.4684	1.114	-2.374	42	9	sand
17.388	165.54	2.1064	1.272	-3.388	40	8	sand to silty sand
17.552	112.06	1.0629	0.948	-3.343	27	8	sand to silty sand
17.717	108.72	1.1122	1.023	-3.761	26	8	sand to silty sand
17.881	117.15	1.4765	1.260	-2.797	28	8	sand to silty sand
18.045	217.08	5.9547	2.743	-1.895	69	7	silty sand to sandy silt
18.209	348.96	8.6677	2.484	-2.215	111	7	silty sand to sandy silt
18.373	326.04	10.6558	3.268	-3.143	156	12	sand to clayey sand (*)
18.537	422.63	10.6728	2.525	-3.917	202	12	sand to clayey sand (*)
18.701	499.60	10.6928	2.140	-4.257	120	8	sand to silty sand

Exhibit A-2

Depth	Tip (Qt)	Sleeve (Fs)	F.Ratio	PP (U2)	SPT	Soil Behavior Type
ft	(tsf)	(tsf)	(%)	(psi)	(blows/ft)	Zone UBC-1983

SITE CLASS

Project	cannon-22-2-gi
Location	gower city hall

profile from site measurements and vicinity info

Soil Type	Thick (ft)	Vs-ave	Vs-low	N
silt - ave of measured in CPT	21	638	500	5
dense sand	79	1200	1100	50
siltstone	0	1900	1900	100

total depth	100	ave	low
weighted Vs 100 =		1082.0	974

ASCE 7-22 Site Class Table

Table 20.2-1. Site Classification.

Site Class	\bar{V}_s Calculated Using Measured or Estimated Shear Wave Velocity Profile (ft/s)
A. Hard rock	>5,000
B. Medium hard rock	>3,000 to 5,000
BC. Soft rock	>2,100 to 3,000
C. Very dense sand or hard clay	>1,450 to 2,100
CD. Dense sand or very stiff clay	>1,000 to 1,450
D. Medium dense sand or stiff clay	>700 to 1,000
DE. Loose sand or medium stiff clay	>500 to 700
E. Very loose sand or soft clay	≥500
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.2.1

Note: For SI: 1 ft = 0.3048 m; 1 ft/s = 0.3048 m/s.

TABLE OF CONTENTS

23092 CPT-1 Text File results

Summary data report	1
Input field data	8
Cyclic stress resistance results	11
Cyclic resistance ratio results	14
Liquefaction potential index data	17
Vertical settlements summary report	19
Vertical settlements data report	20
Lateral displacements summary report	21
Lateral displacements data report	22
Strength loss data report	24

LIQUEFACTION ANALYSIS REPORT

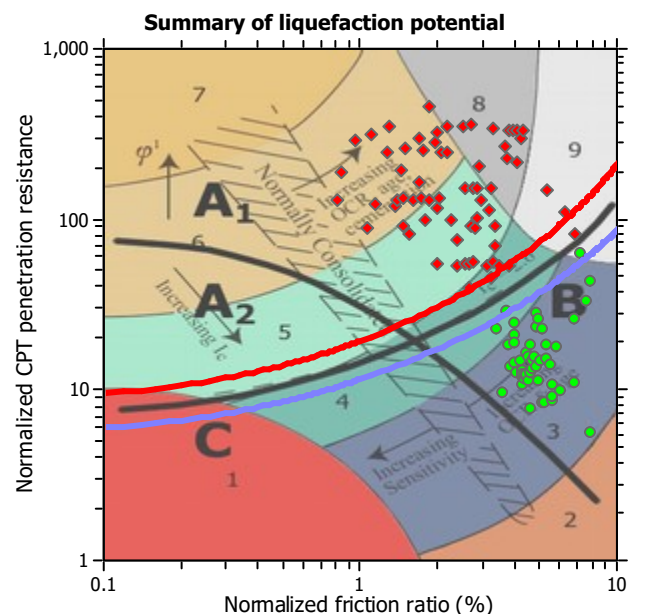
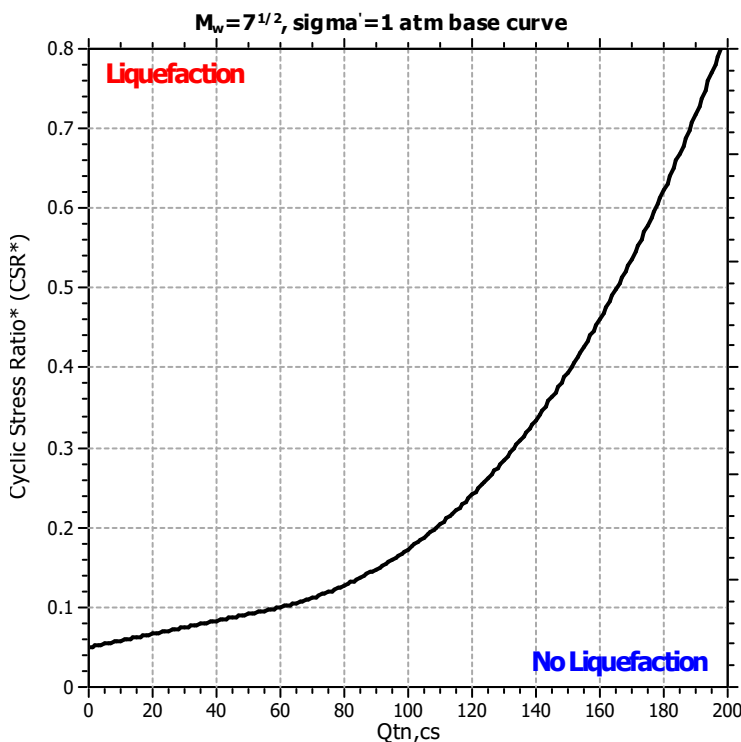
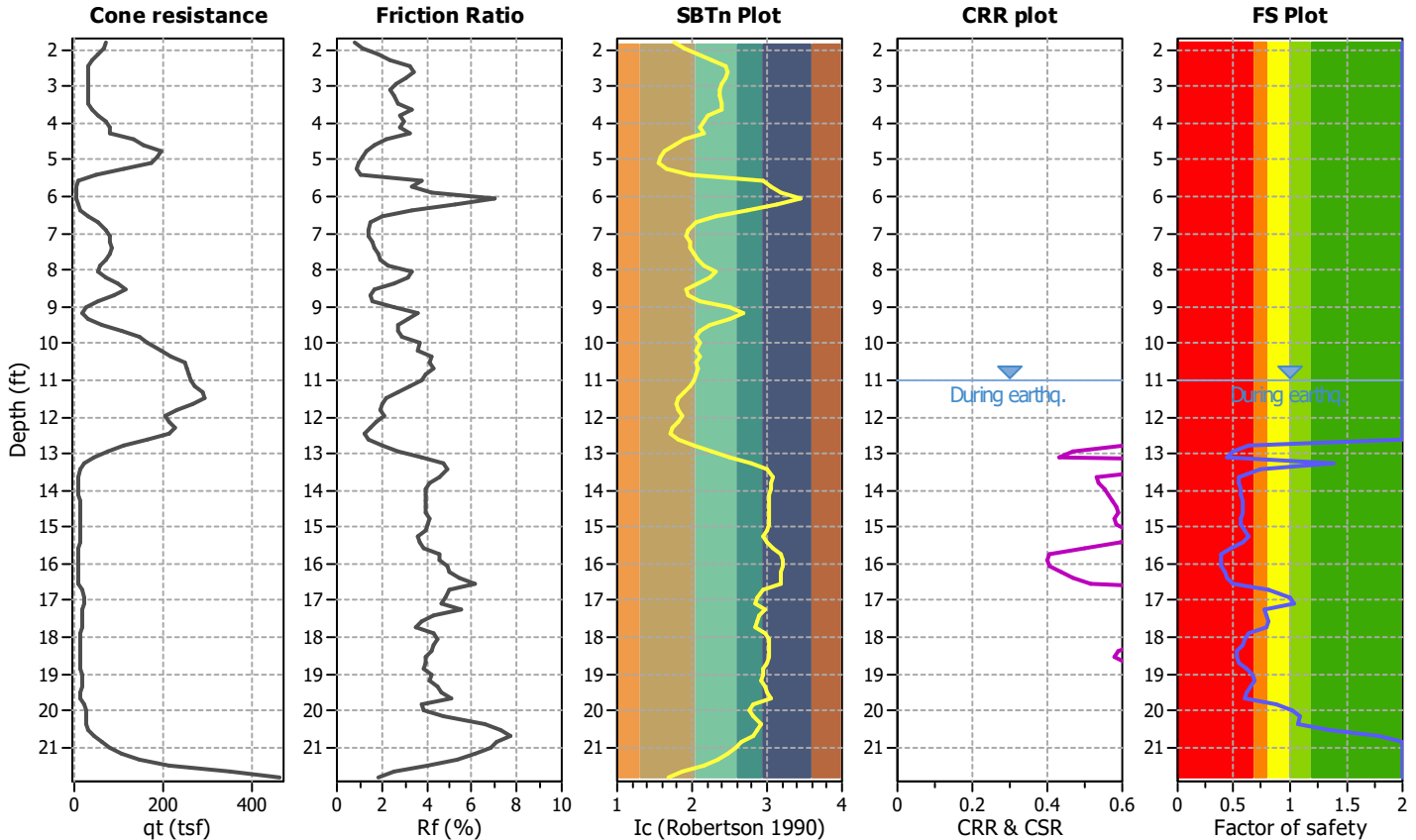
Project title : cannon beach gower city hall

Location :

CPT file : 23092 CPT-1 Text File

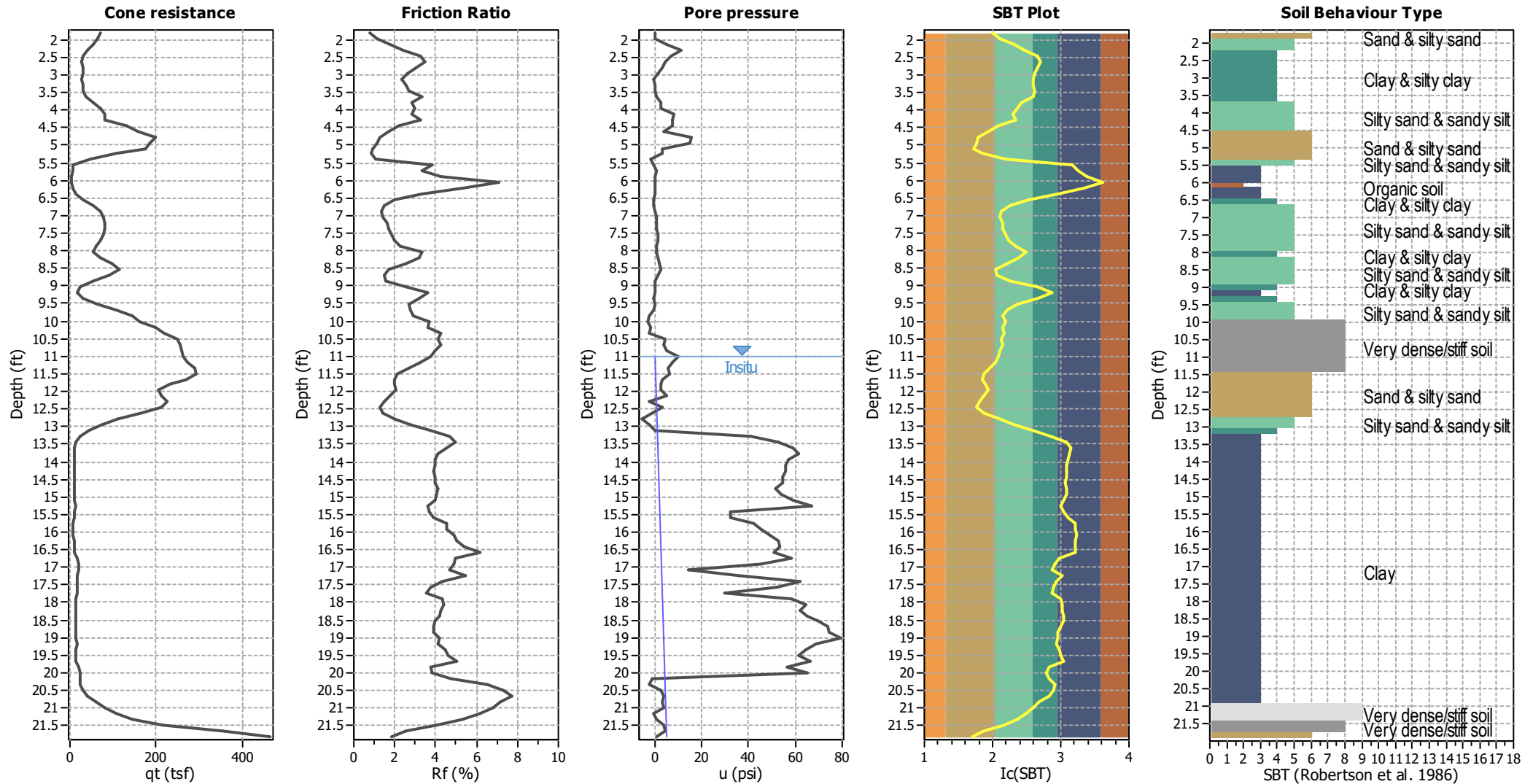
Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	11.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w :	8.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	1.02	Unit weight calculation:	Based on SBT	K_u applied:	No		



Zone A1: Cyclic liquefaction likely depending on size and duration of cyclic loading
 Zone A2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
 Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
 Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



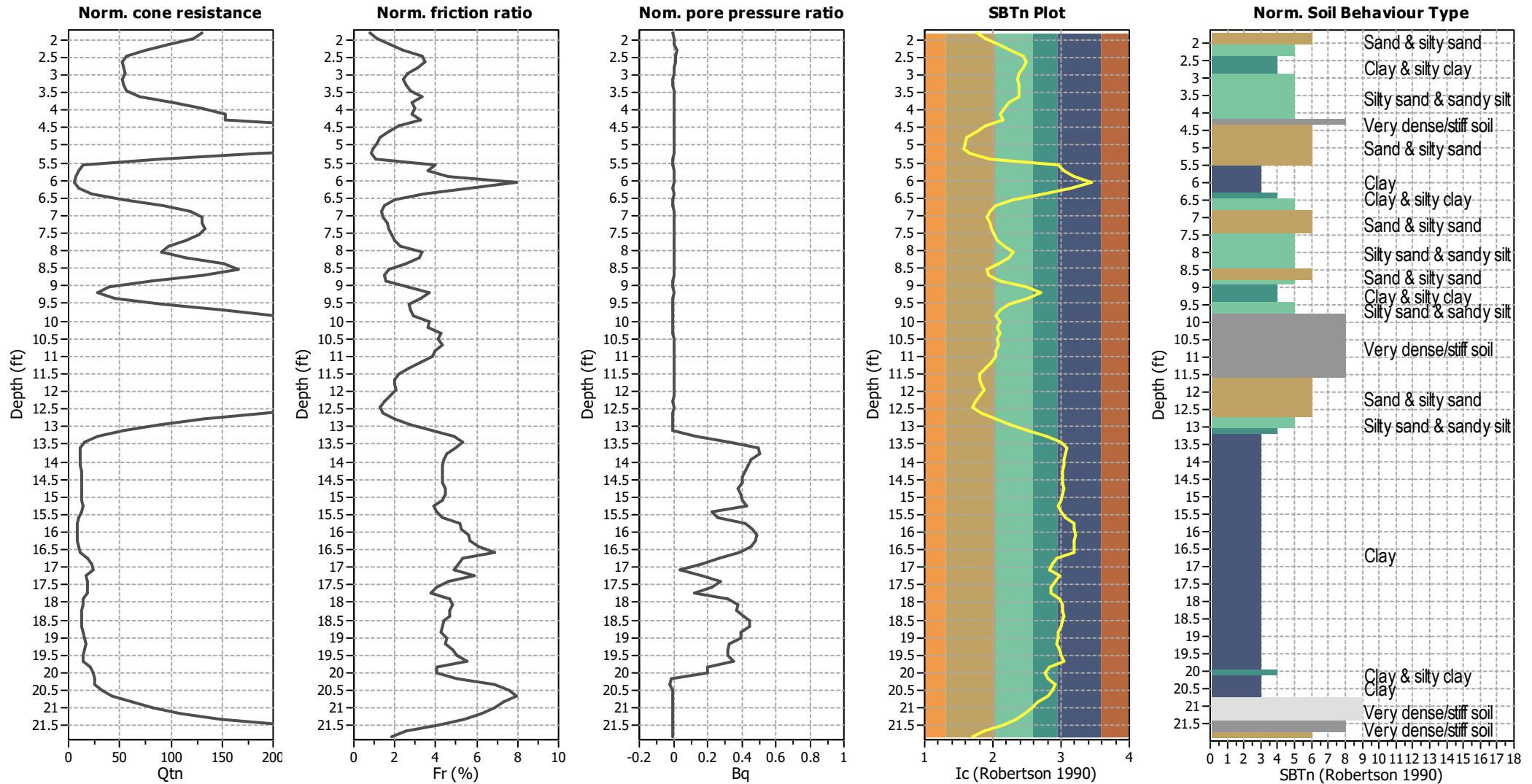
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_0 applied:	No
Earthquake magnitude M_w :	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

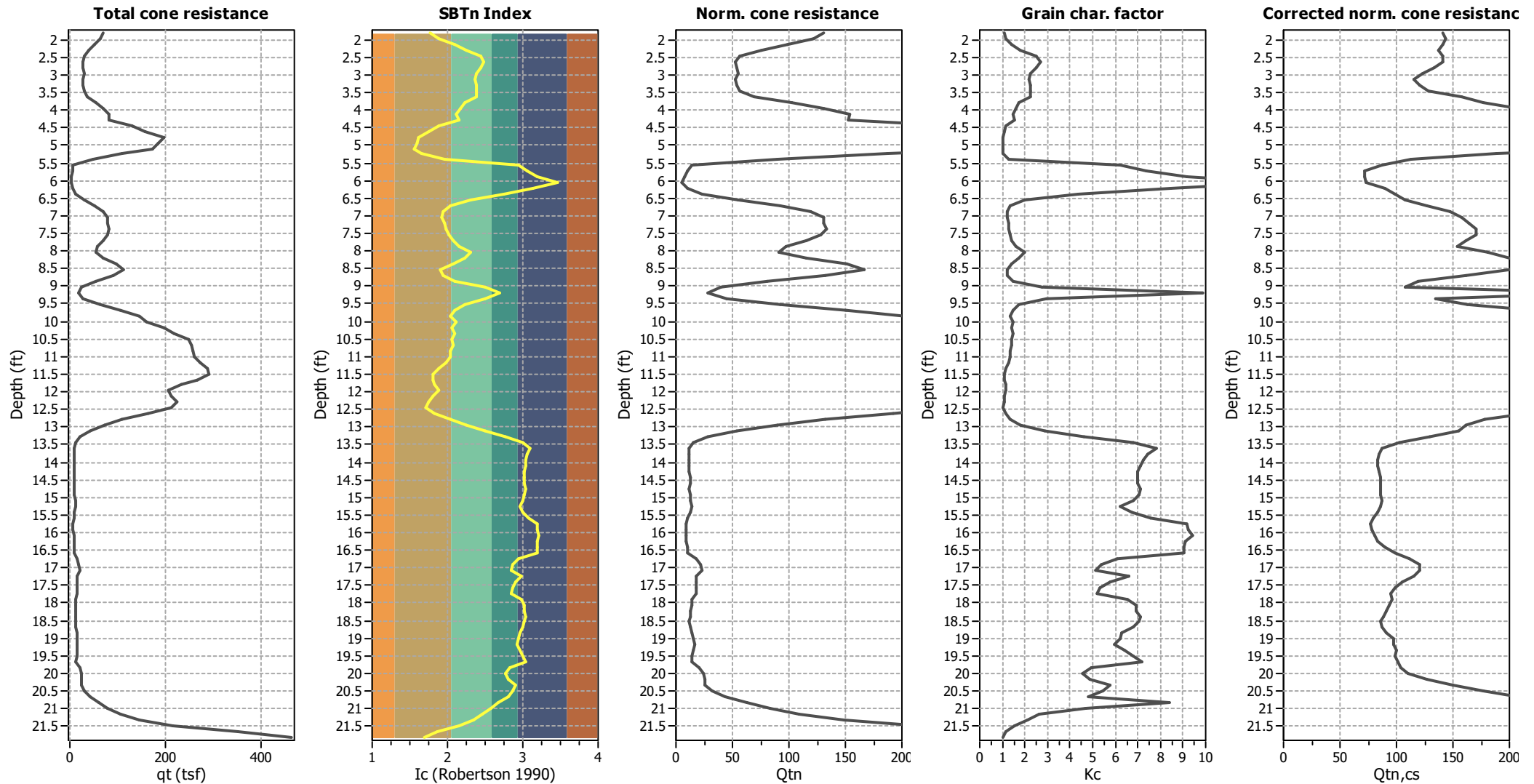
CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _s applied:	No
Earthquake magnitude M _w :	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

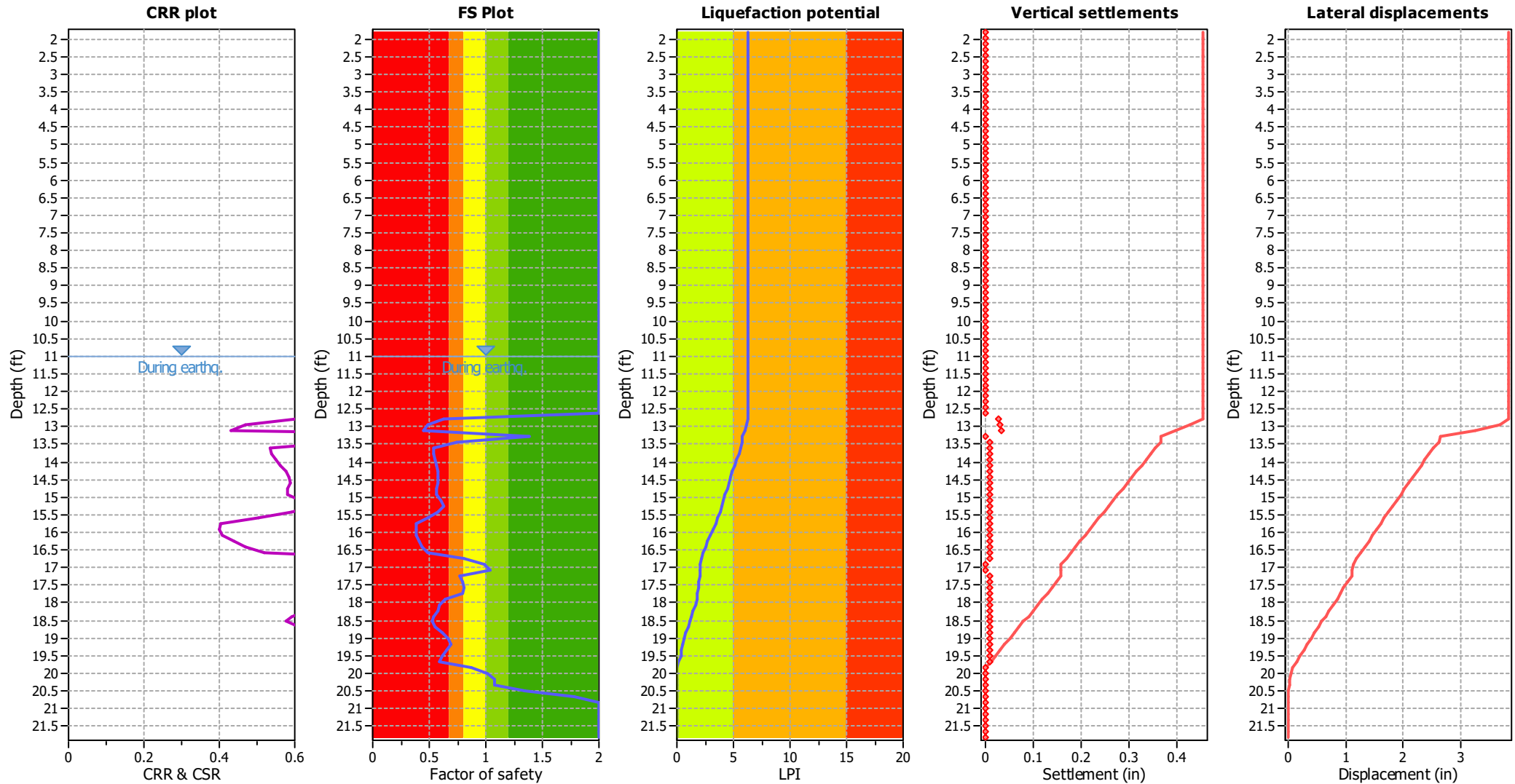
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on I_c value	I_c cut-off value:	2.60	K_s applied:	No
Earthquake magnitude M_w :	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (earthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_0 applied:	No
Earthquake magnitude M_w :	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

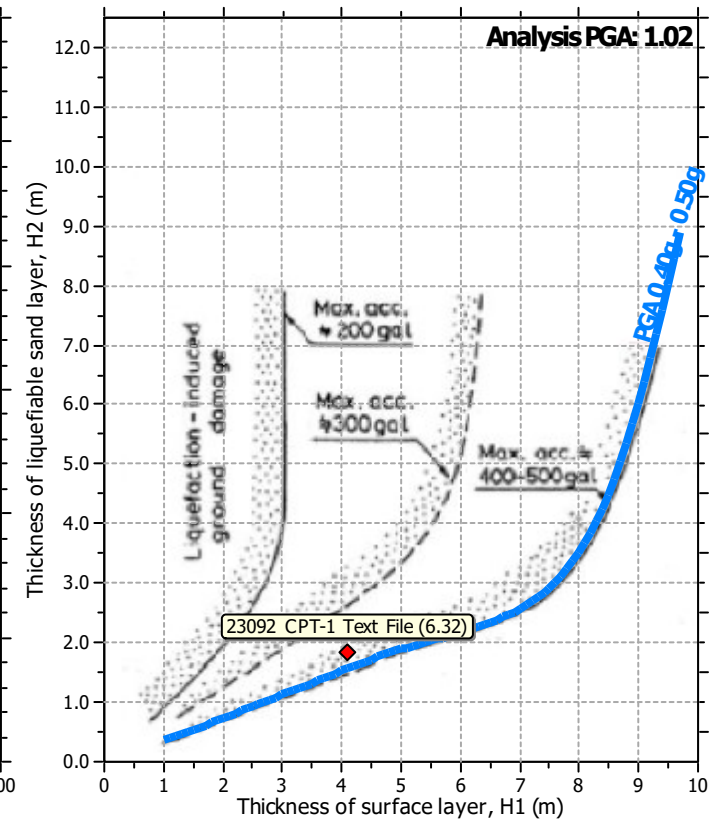
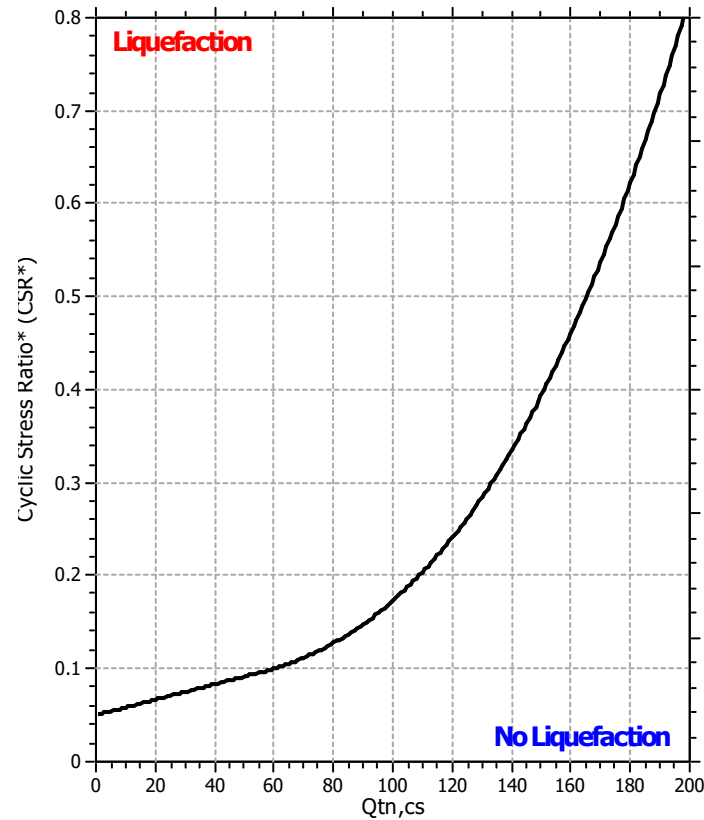
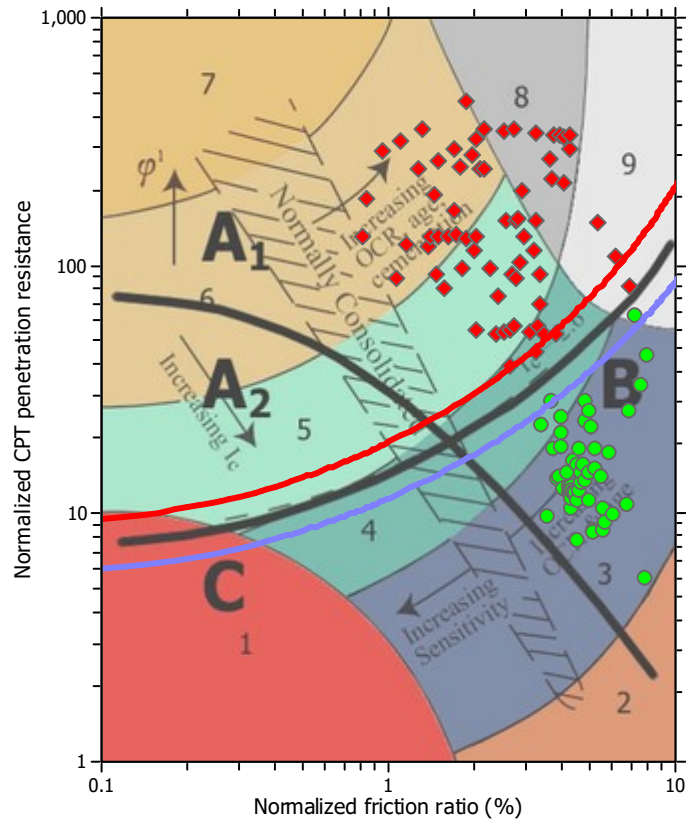
F.S. color scheme

Almost certain it will liquefy
Very likely to liquefy
Liquefaction and no liq. are equally likely
Unlike to liquefy
Almost certain it will not liquefy

LPI color scheme

Very high risk
High risk
Low risk

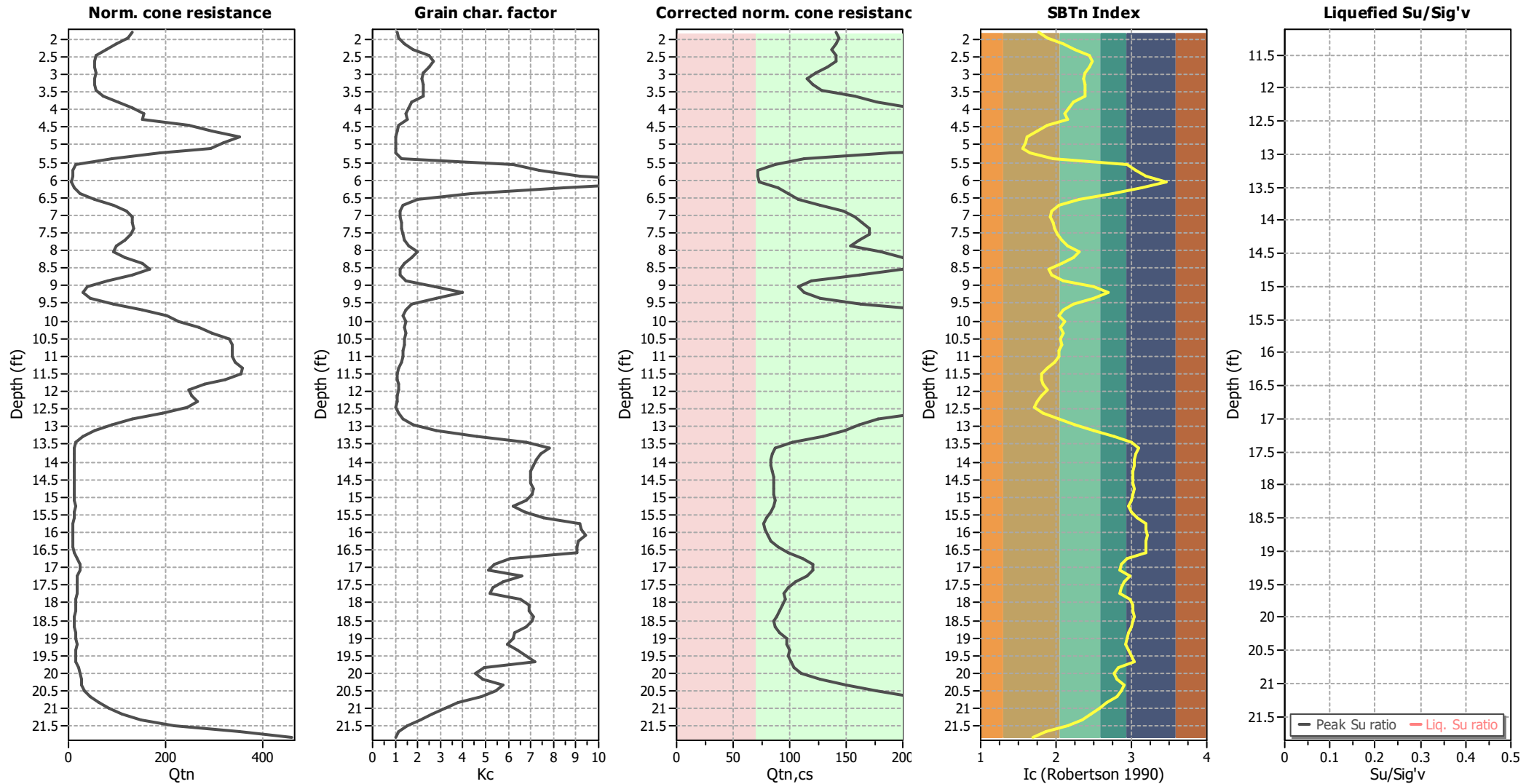
Liquefaction analysis summary plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (earthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	No
Earthquake magnitude M _w :	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	11.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _s applied:	No
Earthquake magnitude M _w :	8.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	1.02	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::						
Point ID	Depth (ft)	q _c (tsf)	f _s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	1.80	71.87	0.38	-0.23	7.32	116.39
2	1.97	64.66	0.93	0.28	10.04	118.24
3	2.13	57.23	0.91	4.98	15.46	119.47
4	2.30	34.46	0.97	11.32	20.96	118.98
5	2.46	28.37	0.99	6.83	28.21	118.51
6	2.63	27.26	1.00	4.64	29.74	118.20
7	2.79	28.73	0.92	3.08	28.06	117.54
8	2.95	29.83	0.73	1.03	25.88	116.53
9	3.12	28.67	0.65	-0.78	25.09	115.39
10	3.28	25.70	0.61	-0.04	25.55	116.17
11	3.44	32.22	0.93	0.31	25.86	117.18
12	3.61	32.81	0.93	0.92	25.89	120.65
13	3.77	46.11	1.85	2.61	19.80	123.21
14	3.94	83.87	1.86	2.47	17.90	125.87
15	4.10	78.06	2.44	7.81	16.05	127.09
16	4.26	82.09	2.59	7.63	17.57	128.06
17	4.43	83.01	2.85	7.19	10.20	129.80
18	4.59	228.46	3.08	3.89	7.24	129.67
19	4.76	158.01	1.96	15.41	4.76	130.12
20	4.92	207.27	2.72	14.62	4.21	128.19
21	5.08	188.57	1.42	2.92	3.79	126.54
22	5.25	126.91	0.82	2.94	5.37	121.07
23	5.41	10.60	0.50	-1.56	12.00	114.66
24	5.58	5.45	0.18	-0.81	55.08	106.41
25	5.74	7.40	0.21	0.53	62.12	102.01
26	5.91	3.54	0.16	0.18	72.38	101.74
27	6.07	2.46	0.20	0.25	94.65	102.46
28	6.23	3.83	0.33	-0.17	68.69	106.16
29	6.40	11.51	0.41	0.08	42.99	109.82
30	6.56	21.68	0.48	-0.60	22.79	114.53
31	6.73	54.60	0.85	-0.31	14.21	117.91
32	6.89	80.11	0.95	0.14	11.56	120.39
33	7.05	76.77	1.09	0.78	10.94	121.60
34	7.22	80.15	1.24	0.71	12.05	122.67
35	7.38	80.69	1.47	0.46	12.42	123.46
36	7.55	84.34	1.48	1.25	13.48	123.67
37	7.71	70.53	1.43	1.11	14.92	123.05
38	7.87	56.41	1.26	0.67	17.71	122.28
39	8.04	50.02	1.29	0.81	22.82	124.22
40	8.20	54.25	2.80	1.04	19.93	126.45
41	8.37	105.14	2.55	1.81	15.13	128.08
42	8.53	132.63	2.09	2.22	10.71	126.56
43	8.69	102.42	1.11	1.46	11.32	123.37
44	8.86	36.73	0.81	-0.24	15.91	118.69
45	9.02	23.58	0.59	-0.18	30.34	114.67
46	9.19	12.71	0.49	0.05	40.19	113.61
47	9.35	14.99	0.76	-0.83	31.08	117.76
48	9.51	57.98	1.48	-0.25	20.14	124.16

:: Field input data :: (continued)

Point ID	Depth (ft)	q _c (tsf)	f _s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	9.68	115.19	2.80	-0.65	15.91	129.56
50	9.84	147.45	4.54	-2.31	14.21	132.94
51	10.01	175.15	5.29	-3.33	16.08	135.79
52	10.17	164.65	8.16	-1.89	14.73	137.28
53	10.34	252.45	8.06	-2.53	15.89	137.28
54	10.50	237.24	11.60	4.06	14.79	137.28
55	10.66	254.58	10.82	3.74	15.19	137.28
56	10.83	273.25	10.36	4.89	14.26	137.28
57	10.99	250.30	9.50	9.95	13.84	137.28
58	11.15	263.82	9.97	7.24	12.22	137.28
59	11.32	305.65	7.45	5.87	10.23	137.28
60	11.48	298.04	6.19	6.46	8.29	137.28
61	11.65	273.43	5.31	3.40	8.17	136.20
62	11.81	231.42	4.61	2.40	8.71	134.69
63	11.97	194.91	3.80	2.47	9.81	133.86
64	12.14	191.57	4.35	5.10	8.45	132.99
65	12.30	250.67	3.07	-2.35	6.98	132.33
66	12.47	233.40	2.63	2.99	6.28	130.53
67	12.63	150.95	2.33	-1.41	8.56	129.04
68	12.79	109.07	2.16	-5.58	13.94	127.51
69	12.96	70.33	2.11	-2.72	20.82	125.82
70	13.12	39.48	1.74	-0.22	30.94	122.83
71	13.29	17.60	0.93	40.89	44.72	118.18
72	13.45	8.47	0.48	52.59	58.75	112.65
73	13.62	8.26	0.40	59.28	64.73	109.35
74	13.78	8.51	0.38	61.61	62.68	108.83
75	13.94	8.85	0.38	57.17	61.42	108.79
76	14.11	9.03	0.39	56.01	60.71	108.97
77	14.27	9.32	0.40	55.95	60.06	109.19
78	14.44	9.67	0.41	54.88	59.84	109.43
79	14.60	9.63	0.42	54.90	59.80	109.56
80	14.76	9.69	0.42	51.71	60.76	109.74
81	14.93	9.47	0.44	54.01	60.40	109.75
82	15.09	9.90	0.42	59.00	58.63	110.13
83	15.26	11.27	0.46	67.25	55.35	110.01
84	15.42	11.94	0.39	32.42	58.33	109.43
85	15.58	7.40	0.35	32.30	63.50	108.35
86	15.75	7.19	0.35	42.07	72.50	107.58
87	15.91	6.91	0.35	45.36	72.98	107.65
88	16.08	7.12	0.36	49.17	73.98	108.38
89	16.24	7.52	0.45	52.48	72.34	109.21
90	16.40	8.48	0.46	53.31	71.91	110.43
91	16.57	8.89	0.56	50.92	71.91	112.26
92	16.73	10.06	0.81	58.13	54.66	115.44
93	16.90	27.21	1.03	45.48	49.97	117.24
94	17.06	20.16	1.03	14.27	48.27	117.39
95	17.22	13.41	0.82	35.93	57.48	115.96
96	17.39	12.17	0.75	62.28	52.33	114.61

:: Field input data :: (continued)

Point ID	Depth (ft)	q _c (tsf)	f _s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	17.55	21.50	0.57	52.20	49.53	113.85
98	17.72	14.82	0.60	29.94	48.91	113.22
99	17.88	11.47	0.60	58.62	57.21	112.75
100	18.05	12.35	0.57	64.26	59.41	112.36
101	18.21	11.99	0.54	61.82	59.46	111.89
102	18.37	10.55	0.50	65.27	60.83	111.26
103	18.54	10.29	0.46	69.59	60.39	110.70
104	18.70	11.26	0.44	73.61	58.68	111.12
105	18.86	12.44	0.56	74.21	55.61	112.23
106	19.03	14.80	0.64	79.47	55.12	113.54
107	19.19	14.70	0.71	68.97	53.81	113.80
108	19.36	14.55	0.60	64.77	56.40	113.94
109	19.52	13.05	0.70	61.48	58.65	113.76
110	19.68	12.49	0.69	66.38	61.21	114.07
111	19.85	13.37	0.71	56.23	47.17	115.64
112	20.01	32.03	0.90	65.36	44.31	117.23
113	20.18	23.55	1.10	-0.98	46.74	119.46
114	20.34	18.85	1.59	-2.31	52.50	121.79
115	20.50	33.08	2.25	2.54	50.28	124.75
116	20.67	42.13	3.05	3.95	46.20	127.92
117	20.83	49.73	4.36	3.32	38.87	131.06
118	21.00	90.81	5.65	3.59	34.31	133.42
119	21.16	100.99	6.42	-0.57	29.40	135.47
120	21.32	129.13	7.70	0.68	24.16	137.28
121	21.49	207.82	9.22	3.77	17.50	137.28
122	21.65	306.01	9.15	4.39	9.65	137.28
123	21.82	543.94	8.31	0.39	6.00	137.28

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
 q_c: Measured cone resistance (tsf)
 f_s: Sleeve friction resistance (tsf)
 u: Pore pressure (tsf)
 Fines content: Percentage of fines in soil (%)
 Unit weight: Bulk soil unit weight (pcf)

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data ::												
Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR _{eq}	K_σ	User FS	CSR*	Belongs to transition
1	1.80	0.10	0.00	0.10	1.00	0.662	0.73	0.912	1.00	1.00	2.000	No
2	1.97	0.11	0.00	0.11	1.00	0.661	0.73	0.911	1.00	1.00	2.000	No
3	2.13	0.12	0.00	0.12	1.00	0.661	0.73	0.911	1.00	1.00	2.000	No
4	2.30	0.13	0.00	0.13	1.00	0.661	0.73	0.911	1.00	1.00	2.000	No
5	2.46	0.14	0.00	0.14	1.00	0.661	0.73	0.910	1.00	1.00	2.000	No
6	2.63	0.15	0.00	0.15	1.00	0.660	0.73	0.910	1.00	1.00	2.000	No
7	2.79	0.16	0.00	0.16	1.00	0.660	0.73	0.910	1.00	1.00	2.000	No
8	2.95	0.17	0.00	0.17	1.00	0.660	0.73	0.909	1.00	1.00	2.000	No
9	3.12	0.18	0.00	0.18	0.99	0.659	0.73	0.909	1.00	1.00	2.000	No
10	3.28	0.19	0.00	0.19	0.99	0.659	0.73	0.909	1.00	1.00	2.000	No
11	3.44	0.20	0.00	0.20	0.99	0.659	0.73	0.908	1.00	1.00	2.000	No
12	3.61	0.21	0.00	0.21	0.99	0.659	0.73	0.908	1.00	1.00	2.000	No
13	3.77	0.22	0.00	0.22	0.99	0.658	0.73	0.907	1.00	1.00	2.000	No
14	3.94	0.23	0.00	0.23	0.99	0.658	0.73	0.907	1.00	1.00	2.000	No
15	4.10	0.24	0.00	0.24	0.99	0.658	0.73	0.907	1.00	1.00	2.000	No
16	4.26	0.25	0.00	0.25	0.99	0.658	0.73	0.906	1.00	1.00	2.000	No
17	4.43	0.26	0.00	0.26	0.99	0.657	0.73	0.906	1.00	1.00	2.000	No
18	4.59	0.27	0.00	0.27	0.99	0.657	0.73	0.906	1.00	1.00	2.000	No
19	4.76	0.28	0.00	0.28	0.99	0.657	0.73	0.905	1.00	1.00	2.000	No
20	4.92	0.30	0.00	0.30	0.99	0.657	0.73	0.905	1.00	1.00	2.000	No
21	5.08	0.31	0.00	0.31	0.99	0.656	0.73	0.905	1.00	1.00	2.000	No
22	5.25	0.32	0.00	0.32	0.99	0.656	0.73	0.904	1.00	1.00	2.000	No
23	5.41	0.32	0.00	0.32	0.99	0.656	0.73	0.904	1.00	1.00	2.000	No
24	5.58	0.33	0.00	0.33	0.99	0.656	0.73	0.904	1.00	1.00	2.000	No
25	5.74	0.34	0.00	0.34	0.99	0.655	0.73	0.903	1.00	1.00	2.000	No
26	5.91	0.35	0.00	0.35	0.99	0.655	0.73	0.903	1.00	1.00	2.000	No
27	6.07	0.36	0.00	0.36	0.99	0.655	0.73	0.903	1.00	1.00	2.000	No
28	6.23	0.37	0.00	0.37	0.99	0.655	0.73	0.902	1.00	1.00	2.000	No
29	6.40	0.38	0.00	0.38	0.99	0.654	0.73	0.902	1.00	1.00	2.000	No
30	6.56	0.39	0.00	0.39	0.99	0.654	0.73	0.902	1.00	1.00	2.000	No
31	6.73	0.40	0.00	0.40	0.99	0.654	0.73	0.901	1.00	1.00	2.000	No
32	6.89	0.41	0.00	0.41	0.99	0.654	0.73	0.901	1.00	1.00	2.000	No
33	7.05	0.42	0.00	0.42	0.99	0.653	0.73	0.901	1.00	1.00	2.000	No
34	7.22	0.43	0.00	0.43	0.99	0.653	0.73	0.900	1.00	1.00	2.000	No
35	7.38	0.44	0.00	0.44	0.98	0.653	0.73	0.900	1.00	1.00	2.000	No
36	7.55	0.45	0.00	0.45	0.98	0.653	0.73	0.900	1.00	1.00	2.000	No
37	7.71	0.46	0.00	0.46	0.98	0.652	0.73	0.899	1.00	1.00	2.000	No
38	7.87	0.47	0.00	0.47	0.98	0.652	0.73	0.899	1.00	1.00	2.000	No
39	8.04	0.48	0.00	0.48	0.98	0.652	0.73	0.899	1.00	1.00	2.000	No
40	8.20	0.49	0.00	0.49	0.98	0.652	0.73	0.898	1.00	1.00	2.000	No
41	8.37	0.50	0.00	0.50	0.98	0.652	0.73	0.898	1.00	1.00	2.000	No
42	8.53	0.51	0.00	0.51	0.98	0.651	0.73	0.898	1.00	1.00	2.000	No
43	8.69	0.52	0.00	0.52	0.98	0.651	0.73	0.897	1.00	1.00	2.000	No
44	8.86	0.53	0.00	0.53	0.98	0.651	0.73	0.897	1.00	1.00	2.000	No
45	9.02	0.54	0.00	0.54	0.98	0.651	0.73	0.897	1.00	1.00	2.000	No
46	9.19	0.55	0.00	0.55	0.98	0.650	0.73	0.896	1.00	1.00	2.000	No
47	9.35	0.56	0.00	0.56	0.98	0.650	0.73	0.896	1.00	1.00	2.000	No
48	9.51	0.57	0.00	0.57	0.98	0.650	0.73	0.896	1.00	1.00	2.000	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_G	User FS	CSR*	Belongs to transition
49	9.68	0.58	0.00	0.58	0.98	0.650	0.73	0.895	1.00	1.00	2.000	No
50	9.84	0.59	0.00	0.59	0.98	0.649	0.73	0.895	1.00	1.00	2.000	No
51	10.01	0.60	0.00	0.60	0.98	0.649	0.73	0.895	1.00	1.00	2.000	No
52	10.17	0.61	0.00	0.61	0.98	0.649	0.73	0.894	1.00	1.00	2.000	No
53	10.34	0.62	0.00	0.62	0.98	0.649	0.73	0.894	1.00	1.00	2.000	No
54	10.50	0.63	0.00	0.63	0.98	0.648	0.73	0.894	1.00	1.00	2.000	No
55	10.66	0.64	0.00	0.64	0.98	0.648	0.73	0.893	1.00	1.00	2.000	No
56	10.83	0.65	0.00	0.65	0.98	0.648	0.73	0.893	1.00	1.00	2.000	No
57	10.99	0.67	0.00	0.67	0.98	0.648	0.73	0.893	1.00	1.00	2.000	No
58	11.15	0.68	0.00	0.67	0.98	0.652	0.73	0.899	1.00	1.00	0.899	No
59	11.32	0.69	0.01	0.68	0.98	0.657	0.73	0.905	1.00	1.00	0.905	No
60	11.48	0.70	0.02	0.68	0.98	0.661	0.73	0.911	1.00	1.00	0.911	No
61	11.65	0.71	0.02	0.69	0.98	0.666	0.73	0.918	1.00	1.00	0.918	No
62	11.81	0.72	0.03	0.70	0.98	0.670	0.73	0.924	1.00	1.00	0.924	No
63	11.97	0.73	0.03	0.70	0.97	0.674	0.73	0.929	1.00	1.00	0.929	No
64	12.14	0.74	0.04	0.71	0.97	0.679	0.73	0.935	1.00	1.00	0.935	No
65	12.30	0.75	0.04	0.71	0.97	0.683	0.73	0.941	1.00	1.00	0.941	No
66	12.47	0.77	0.05	0.72	0.97	0.687	0.73	0.947	1.00	1.00	0.947	No
67	12.63	0.78	0.05	0.73	0.97	0.691	0.73	0.952	1.00	1.00	0.952	No
68	12.79	0.79	0.06	0.73	0.97	0.695	0.73	0.957	1.00	1.00	0.957	No
69	12.96	0.80	0.06	0.74	0.97	0.699	0.73	0.963	1.00	1.00	0.963	No
70	13.12	0.81	0.07	0.74	0.97	0.702	0.73	0.968	1.00	1.00	0.968	No
71	13.29	0.82	0.07	0.75	0.97	0.706	0.73	0.973	1.00	1.00	0.973	No
72	13.45	0.83	0.08	0.75	0.97	0.710	0.73	0.979	1.00	1.00	0.979	No
73	13.62	0.83	0.08	0.75	0.97	0.714	0.73	0.984	1.00	1.00	0.984	No
74	13.78	0.84	0.09	0.76	0.97	0.718	0.73	0.989	1.00	1.00	0.989	No
75	13.94	0.85	0.09	0.76	0.97	0.721	0.73	0.994	1.00	1.00	0.994	No
76	14.11	0.86	0.10	0.76	0.97	0.725	0.73	0.999	1.00	1.00	0.999	No
77	14.27	0.87	0.10	0.77	0.97	0.729	0.73	1.004	1.00	1.00	1.004	No
78	14.44	0.88	0.11	0.77	0.97	0.732	0.73	1.009	1.00	1.00	1.009	No
79	14.60	0.89	0.11	0.78	0.97	0.736	0.73	1.014	1.00	1.00	1.014	No
80	14.76	0.90	0.12	0.78	0.97	0.739	0.73	1.019	1.00	1.00	1.019	No
81	14.93	0.91	0.12	0.78	0.97	0.743	0.73	1.024	1.00	1.00	1.024	No
82	15.09	0.92	0.13	0.79	0.97	0.746	0.73	1.028	1.00	1.00	1.028	No
83	15.26	0.92	0.13	0.79	0.97	0.749	0.73	1.033	1.00	1.00	1.033	No
84	15.42	0.93	0.14	0.80	0.97	0.753	0.73	1.037	1.00	1.00	1.037	No
85	15.58	0.94	0.14	0.80	0.97	0.756	0.73	1.042	1.00	1.00	1.042	No
86	15.75	0.95	0.15	0.80	0.97	0.759	0.73	1.047	1.00	1.00	1.047	No
87	15.91	0.96	0.15	0.81	0.97	0.763	0.73	1.051	1.00	1.00	1.051	No
88	16.08	0.97	0.16	0.81	0.97	0.766	0.73	1.055	1.00	1.00	1.055	No
89	16.24	0.98	0.16	0.81	0.97	0.769	0.73	1.060	1.00	1.00	1.060	No
90	16.40	0.99	0.17	0.82	0.97	0.772	0.73	1.064	1.00	1.00	1.064	No
91	16.57	1.00	0.17	0.82	0.97	0.775	0.73	1.068	1.00	1.00	1.068	No
92	16.73	1.01	0.18	0.83	0.96	0.778	0.73	1.072	1.00	1.00	1.072	No
93	16.90	1.02	0.18	0.83	0.96	0.781	0.73	1.076	1.00	1.00	1.076	No
94	17.06	1.02	0.19	0.84	0.96	0.784	0.73	1.080	1.00	1.00	1.080	No
95	17.22	1.03	0.19	0.84	0.96	0.787	0.73	1.084	1.00	1.00	1.084	No
96	17.39	1.04	0.20	0.84	0.96	0.789	0.73	1.088	1.00	1.00	1.088	No

:: Cyclic Stress Ratio fully adjusted (CSR*) calculation data :: (continued)

Point ID	Depth (ft)	σ_v (tsf)	u_0 (tsf)	σ_v' (tsf)	r_d	CSR	MSF	CSR_{eq}	K_σ	User FS	CSR*	Belongs to transition
97	17.55	1.05	0.20	0.85	0.96	0.792	0.73	1.092	1.00	1.00	1.092	No
98	17.72	1.06	0.21	0.85	0.96	0.795	0.73	1.096	1.00	1.00	1.096	No
99	17.88	1.07	0.21	0.86	0.96	0.798	0.73	1.099	1.00	1.00	1.099	No
100	18.05	1.08	0.22	0.86	0.96	0.800	0.73	1.103	1.00	1.00	1.103	No
101	18.21	1.09	0.22	0.87	0.96	0.803	0.73	1.107	1.00	1.00	1.107	No
102	18.37	1.10	0.23	0.87	0.96	0.806	0.73	1.110	1.00	1.00	1.110	No
103	18.54	1.11	0.24	0.87	0.96	0.808	0.73	1.114	1.00	1.00	1.114	No
104	18.70	1.12	0.24	0.88	0.96	0.811	0.73	1.118	1.00	1.00	1.118	No
105	18.86	1.13	0.25	0.88	0.96	0.814	0.73	1.121	1.00	1.00	1.121	No
106	19.03	1.14	0.25	0.89	0.96	0.816	0.73	1.125	1.00	1.00	1.125	No
107	19.19	1.15	0.26	0.89	0.96	0.818	0.73	1.128	1.00	1.00	1.128	No
108	19.36	1.15	0.26	0.89	0.96	0.821	0.73	1.131	1.00	1.00	1.131	No
109	19.52	1.16	0.27	0.90	0.96	0.823	0.73	1.135	1.00	1.00	1.135	No
110	19.68	1.17	0.27	0.90	0.96	0.826	0.73	1.138	1.00	1.00	1.138	No
111	19.85	1.18	0.28	0.91	0.96	0.828	0.73	1.141	1.00	1.00	1.141	No
112	20.01	1.19	0.28	0.91	0.96	0.830	0.73	1.144	1.00	1.00	1.144	No
113	20.18	1.20	0.29	0.92	0.96	0.832	0.73	1.147	1.00	1.00	1.147	No
114	20.34	1.21	0.29	0.92	0.96	0.834	0.73	1.150	1.00	1.00	1.150	No
115	20.50	1.22	0.30	0.93	0.96	0.836	0.73	1.153	1.00	1.00	1.153	No
116	20.67	1.23	0.30	0.93	0.96	0.838	0.73	1.156	1.00	1.00	1.156	No
117	20.83	1.24	0.31	0.94	0.95	0.840	0.73	1.158	1.00	1.00	1.158	No
118	21.00	1.25	0.31	0.94	0.95	0.842	0.73	1.160	1.00	1.00	1.160	No
119	21.16	1.27	0.32	0.95	0.95	0.844	0.73	1.163	1.00	1.00	1.163	No
120	21.32	1.28	0.32	0.95	0.95	0.845	0.73	1.165	1.00	1.00	1.165	No
121	21.49	1.29	0.33	0.96	0.95	0.847	0.73	1.167	1.00	1.00	1.167	No
122	21.65	1.30	0.33	0.97	0.95	0.849	0.73	1.169	1.00	1.00	1.169	No
123	21.82	1.31	0.34	0.97	0.95	0.850	0.73	1.172	1.00	1.00	1.172	No

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
 σ_v : Total overburden pressure at test point (tsf)
 u_0 : Water pressure at test point (tsf)
 σ_v' : Effective overburden pressure based on GWT during earthquake (tsf)
 r_d : Nonlinear shear mass factor
 CSR: Cyclic Stress Ratio
 MSF: Magnitude Scaling Factor
 CSR_{eq} : CSR adjusted for M=7.5
 K_σ : Effective overburden stress factor
 CSR*: CSR fully adjusted

:: Cyclic Resistance Ratio (CRR) calculation data ::												
Point ID	Depth (ft)	q _t (tsf)	I _c	Fr (%)	n	Q _{tn}	K _c	Q _{tn,cs}	CRR _{7.5}	Belongs to trans. layer	Clay-like behaviour	FS
1	1.80	69.47	1.76	0.81	0.53	131.10	1.08	141.50	4.000	No	No	2.00
2	1.97	64.61	1.89	1.15	0.57	121.91	1.18	143.26	4.000	No	No	2.00
3	2.13	52.20	2.09	1.81	0.65	98.42	1.43	141.16	4.000	No	No	2.00
4	2.30	40.13	2.26	2.40	0.72	75.60	1.82	137.46	4.000	No	No	2.00
5	2.46	30.14	2.44	3.30	0.79	56.70	2.50	141.60	4.000	No	No	2.00
6	2.63	28.19	2.48	3.47	0.80	52.99	2.66	141.14	4.000	No	No	2.00
7	2.79	28.65	2.44	3.10	0.79	53.84	2.48	133.63	4.000	No	No	2.00
8	2.95	29.09	2.39	2.64	0.77	54.66	2.26	123.54	4.000	No	No	2.00
9	3.12	28.07	2.37	2.38	0.76	52.71	2.18	115.04	4.000	No	No	2.00
10	3.28	28.86	2.38	2.55	0.77	54.19	2.23	120.71	4.000	No	No	2.00
11	3.44	30.25	2.39	2.75	0.77	56.79	2.26	128.25	4.000	No	No	2.00
12	3.61	37.07	2.39	3.36	0.77	69.66	2.26	157.47	4.000	No	No	2.00
13	3.77	54.29	2.22	2.86	0.71	102.20	1.73	176.48	4.000	No	No	2.00
14	3.94	69.41	2.17	2.97	0.69	130.76	1.59	207.84	4.000	No	No	2.00
15	4.10	81.43	2.11	2.83	0.66	153.45	1.47	225.43	4.000	No	No	2.00
16	4.26	81.16	2.16	3.25	0.68	152.93	1.57	239.59	4.000	No	No	2.00
17	4.43	131.28	1.89	2.17	0.58	247.64	1.18	292.53	4.000	No	No	2.00
18	4.59	156.62	1.76	1.68	0.53	295.52	1.08	318.24	4.000	No	No	2.00
19	4.76	198.08	1.62	1.31	0.48	352.44	1.00	352.44	4.000	No	No	2.00
20	4.92	184.77	1.59	1.10	0.47	317.63	1.00	317.63	4.000	No	No	2.00
21	5.08	174.35	1.56	0.95	0.46	291.27	1.00	291.27	4.000	No	No	2.00
22	5.25	108.71	1.66	0.85	0.50	186.86	1.01	188.66	4.000	No	No	2.00
23	5.41	47.66	1.96	1.06	0.61	89.46	1.26	112.35	4.000	No	No	2.00
24	5.58	7.81	2.95	3.98	0.99	14.13	6.19	87.43	4.000	No	Yes	2.00
25	5.74	5.46	3.05	3.59	1.00	9.68	7.35	71.17	4.000	No	Yes	2.00
26	5.91	4.47	3.19	4.59	1.00	7.79	9.14	71.19	4.000	No	Yes	2.00
27	6.07	3.28	3.45	7.92	1.00	5.52	13.27	73.21	4.000	No	Yes	2.00
28	6.23	5.93	3.14	5.65	1.00	10.52	8.49	89.29	4.000	No	Yes	2.00
29	6.40	12.34	2.75	3.40	0.91	22.61	4.35	98.35	4.000	No	Yes	2.00
30	6.56	29.26	2.31	2.01	0.75	54.58	1.97	107.65	4.000	No	No	2.00
31	6.73	52.13	2.05	1.47	0.65	92.58	1.36	126.30	4.000	No	No	2.00
32	6.89	70.50	1.95	1.38	0.61	119.02	1.24	147.19	4.000	No	No	2.00
33	7.05	79.02	1.92	1.39	0.60	130.41	1.21	157.91	4.000	No	No	2.00
34	7.22	79.21	1.97	1.61	0.62	130.88	1.26	164.68	4.000	No	No	2.00
35	7.38	81.74	1.98	1.72	0.62	133.80	1.28	170.63	4.000	No	No	2.00
36	7.55	78.53	2.02	1.87	0.64	128.36	1.33	170.21	4.000	No	No	2.00
37	7.71	70.44	2.07	1.98	0.66	115.32	1.40	161.80	4.000	No	No	2.00
38	7.87	59.00	2.16	2.27	0.70	97.85	1.58	154.26	4.000	No	No	2.00
39	8.04	53.57	2.31	3.36	0.75	91.48	1.97	180.64	4.000	No	No	2.00
40	8.20	69.82	2.23	3.19	0.72	114.81	1.74	199.41	4.000	No	No	2.00
41	8.37	97.36	2.08	2.56	0.66	151.32	1.42	214.14	4.000	No	No	2.00
42	8.53	113.42	1.91	1.69	0.60	166.22	1.20	199.72	4.000	No	No	2.00
43	8.69	90.61	1.94	1.48	0.61	131.97	1.23	161.89	4.000	No	No	2.00
44	8.86	54.25	2.10	1.55	0.68	81.32	1.46	118.81	4.000	No	No	2.00
45	9.02	24.34	2.49	2.65	0.82	39.39	2.73	107.54	4.000	No	No	2.00
46	9.19	17.09	2.70	3.70	0.90	28.43	9.88	280.73	4.000	No	No	2.00
47	9.35	28.56	2.51	3.25	0.83	45.23	2.97	134.43	4.000	No	No	2.00
48	9.51	62.71	2.23	2.70	0.73	92.63	1.75	162.41	4.000	No	No	2.00

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)												
Point ID	Depth (ft)	q _t (tsf)	I _c	Fr (%)	n	Q _{tn}	K _c	Q _{tn,cs}	CRR _{7.5}	Belongs to trans. layer	Clay-like behaviour	FS
49	9.68	106.86	2.10	2.77	0.68	151.70	1.46	221.60	4.000	No	No	2.00
50	9.84	145.90	2.05	2.90	0.66	202.19	1.36	275.83	4.000	No	No	2.00
51	10.01	162.38	2.11	3.70	0.68	225.50	1.47	331.69	4.000	No	No	2.00
52	10.17	197.38	2.06	3.64	0.66	268.31	1.39	373.54	4.000	No	No	2.00
53	10.34	218.11	2.10	4.26	0.68	295.40	1.46	431.12	4.000	No	No	2.00
54	10.50	248.12	2.07	4.11	0.67	329.76	1.40	460.31	4.000	No	No	2.00
55	10.66	255.08	2.08	4.29	0.67	336.02	1.42	476.66	4.000	No	No	2.00
56	10.83	259.47	2.05	3.95	0.66	335.93	1.37	459.13	4.000	No	No	2.00
57	10.99	262.56	2.03	3.80	0.66	335.32	1.34	450.82	4.000	No	No	2.00
58	11.15	273.37	1.97	3.29	0.63	343.43	1.27	434.68	4.000	No	No	2.00
59	11.32	289.26	1.89	2.73	0.60	356.57	1.18	421.60	4.000	No	No	2.00
60	11.48	292.45	1.81	2.16	0.57	353.56	1.11	393.31	4.000	No	No	2.00
61	11.65	267.69	1.80	2.01	0.57	321.65	1.11	356.44	4.000	No	No	2.00
62	11.81	233.29	1.83	1.97	0.58	279.98	1.13	315.49	4.000	No	No	2.00
63	11.97	206.01	1.88	2.07	0.60	247.83	1.17	289.16	4.000	No	No	2.00
64	12.14	212.41	1.82	1.77	0.58	251.98	1.12	281.70	4.000	No	No	2.00
65	12.30	225.24	1.74	1.49	0.55	263.24	1.07	281.15	4.000	No	No	2.00
66	12.47	211.67	1.71	1.27	0.53	244.98	1.04	255.66	4.000	No	No	2.00
67	12.63	164.45	1.82	1.45	0.58	192.45	1.12	215.90	4.000	No	No	2.00
68	12.79	110.07	2.04	2.01	0.66	131.91	1.35	178.07	0.605	No	No	0.63
69	12.96	72.92	2.25	2.78	0.74	89.30	1.81	161.37	0.471	No	No	0.49
70	13.12	42.65	2.51	3.81	0.84	53.37	2.91	155.46	0.429	No	No	0.44
71	13.29	22.30	2.78	4.87	0.94	28.26	4.60	129.95	1.348	No	Yes	1.39
72	13.45	12.18	3.00	5.30	1.00	15.15	6.79	102.84	0.723	No	Yes	0.74
73	13.62	9.25	3.09	4.99	1.00	11.17	7.80	87.08	0.533	No	Yes	0.54
74	13.78	9.39	3.06	4.55	1.00	11.30	7.45	84.13	0.539	No	Yes	0.54
75	13.94	9.64	3.04	4.37	1.00	11.55	7.23	83.51	0.551	No	Yes	0.55
76	14.11	9.88	3.03	4.32	1.00	11.79	7.11	83.90	0.563	No	Yes	0.56
77	14.27	10.14	3.02	4.30	1.00	12.06	7.01	84.52	0.575	No	Yes	0.57
78	14.44	10.34	3.02	4.33	1.00	12.24	6.97	85.34	0.584	No	Yes	0.58
79	14.60	10.44	3.02	4.35	1.00	12.30	6.96	85.66	0.587	No	Yes	0.58
80	14.76	10.37	3.03	4.50	1.00	12.14	7.12	86.48	0.579	No	Yes	0.57
81	14.93	10.48	3.03	4.45	1.00	12.21	7.06	86.22	0.582	No	Yes	0.57
82	15.09	11.08	3.00	4.33	1.00	12.90	6.77	87.31	0.615	No	Yes	0.60
83	15.26	11.80	2.95	3.90	1.00	13.73	6.23	85.59	0.655	No	Yes	0.63
84	15.42	10.84	3.00	4.07	1.00	12.45	6.72	83.63	0.594	No	Yes	0.57
85	15.58	9.36	3.07	4.34	1.00	10.53	7.59	79.86	0.502	No	Yes	0.48
86	15.75	7.74	3.19	5.15	1.00	8.46	9.16	77.47	0.403	No	Yes	0.39
87	15.91	7.73	3.20	5.22	1.00	8.39	9.25	77.58	0.400	No	Yes	0.38
88	16.08	7.89	3.21	5.61	1.00	8.54	9.43	80.49	0.407	No	Yes	0.39
89	16.24	8.45	3.19	5.68	1.00	9.18	9.13	83.79	0.438	No	Yes	0.41
90	16.40	9.05	3.19	6.09	1.00	9.85	9.05	89.21	0.470	No	Yes	0.44
91	16.57	9.92	3.19	6.84	1.00	10.85	9.06	98.30	0.518	No	Yes	0.48
92	16.73	16.13	2.94	5.30	1.00	18.29	6.12	111.96	0.873	No	Yes	0.81
93	16.90	19.71	2.87	5.13	0.98	22.39	5.38	120.54	1.068	No	Yes	0.99
94	17.06	20.72	2.84	4.89	0.97	23.41	5.12	119.92	1.116	No	Yes	1.03
95	17.22	15.79	2.99	5.88	1.00	17.56	6.58	115.53	0.838	No	Yes	0.77
96	17.39	16.42	2.91	4.63	1.00	18.19	5.75	104.60	0.868	No	Yes	0.80

:: Cyclic Resistance Ratio (CRR) calculation data :: (continued)

Point ID	Depth (ft)	q _t (tsf)	I _c	Fr (%)	n	Q _{tn}	K _c	Q _{tn,cs}	CRR _{7.5}	Belongs to trans. layer	Clay-like behaviour	FS
97	17.55	16.86	2.86	4.03	0.98	18.54	5.32	98.55	0.884	No	Yes	0.81
98	17.72	16.61	2.85	3.78	0.98	18.13	5.22	94.67	0.865	No	Yes	0.79
99	17.88	13.61	2.98	4.68	1.00	14.64	6.53	95.62	0.698	No	Yes	0.64
100	18.05	12.82	3.01	4.84	1.00	13.64	6.90	94.06	0.651	No	Yes	0.59
101	18.21	12.55	3.01	4.68	1.00	13.25	6.91	91.47	0.632	No	Yes	0.57
102	18.37	11.89	3.03	4.65	1.00	12.41	7.13	88.56	0.592	No	Yes	0.53
103	18.54	11.70	3.03	4.41	1.00	12.13	7.06	85.66	0.579	No	Yes	0.52
104	18.70	12.37	3.00	4.31	1.00	12.83	6.78	86.96	0.612	No	Yes	0.55
105	18.86	13.92	2.96	4.25	1.00	14.52	6.27	91.11	0.693	No	Yes	0.62
106	19.03	15.05	2.95	4.55	1.00	15.71	6.20	97.36	0.750	No	Yes	0.67
107	19.19	15.71	2.93	4.44	1.00	16.37	5.98	97.96	0.781	No	Yes	0.69
108	19.36	15.04	2.97	4.82	1.00	15.53	6.40	99.45	0.741	No	Yes	0.65
109	19.52	14.29	3.00	5.06	1.00	14.61	6.77	98.96	0.697	No	Yes	0.61
110	19.68	13.85	3.04	5.52	1.00	14.05	7.20	101.17	0.670	No	Yes	0.59
111	19.85	20.20	2.82	4.02	0.97	20.87	4.96	103.48	0.995	No	Yes	0.87
112	20.01	23.56	2.77	4.04	0.95	24.36	4.54	110.57	1.162	No	Yes	1.02
113	20.18	25.11	2.81	5.02	0.97	25.97	4.90	127.14	1.239	No	Yes	1.08
114	20.34	25.16	2.91	6.88	1.00	26.01	5.78	150.25	1.241	No	Yes	1.08
115	20.50	31.37	2.87	7.61	0.99	32.52	5.43	176.59	1.551	No	Yes	1.35
116	20.67	41.69	2.80	7.95	0.96	43.24	4.81	208.19	2.063	No	Yes	1.79
117	20.83	60.94	2.67	7.29	0.91	63.05	8.43	531.44	4.000	No	No	2.00
118	21.00	80.54	2.58	6.91	0.88	82.93	4.70	389.64	4.000	No	No	2.00
119	21.16	106.99	2.47	6.23	0.84	109.49	2.63	287.52	4.000	No	No	2.00
120	21.32	146.00	2.34	5.38	0.79	148.32	2.10	310.83	4.000	No	No	2.00
121	21.49	214.36	2.15	4.08	0.72	215.77	1.56	337.06	4.000	No	No	2.00
122	21.65	352.63	1.87	2.53	0.61	350.70	1.16	407.01	4.000	No	No	2.00
123	21.82	464.65	1.69	1.85	0.54	458.19	1.03	473.63	4.000	No	No	2.00

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
 q_t: Total cone resistance
 I_c: Soil behavior type index
 Fr: Normalized friction ratio (%)
 n: Stress exponent
 Q_{tn}: Normalized cone resistance
 K_c: Cone resistance correction factor due to fines
 Q_{tn,cs}: Normalized and adjusted cone resistance
 CRR_{7.5}: Cyclic resistance ratio for M_w=7.5
 FS: Factor of safety against soil liquefaction

Exhibit A-2

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CPT name: 23092 CPT-1 Text File

:: Liquefaction Potential Index calculation data ::											
Depth (ft)	FS	F _L	w _z	d _z	LPI	Depth (ft)	FS	F _L	w _z	d _z	LPI
1.80	2.00	0.00	9.73	0.17	0.00	1.97	2.00	0.00	9.70	0.17	0.00
2.13	2.00	0.00	9.67	0.16	0.00	2.30	2.00	0.00	9.65	0.16	0.00
2.46	2.00	0.00	9.62	0.16	0.00	2.63	2.00	0.00	9.60	0.16	0.00
2.79	2.00	0.00	9.57	0.16	0.00	2.95	2.00	0.00	9.55	0.16	0.00
3.12	2.00	0.00	9.52	0.16	0.00	3.28	2.00	0.00	9.50	0.16	0.00
3.44	2.00	0.00	9.47	0.16	0.00	3.61	2.00	0.00	9.45	0.16	0.00
3.77	2.00	0.00	9.42	0.16	0.00	3.94	2.00	0.00	9.40	0.16	0.00
4.10	2.00	0.00	9.38	0.16	0.00	4.26	2.00	0.00	9.35	0.16	0.00
4.43	2.00	0.00	9.33	0.16	0.00	4.59	2.00	0.00	9.30	0.16	0.00
4.76	2.00	0.00	9.28	0.16	0.00	4.92	2.00	0.00	9.25	0.16	0.00
5.08	2.00	0.00	9.23	0.16	0.00	5.25	2.00	0.00	9.20	0.16	0.00
5.41	2.00	0.00	9.18	0.16	0.00	5.58	2.00	0.00	9.15	0.16	0.00
5.74	2.00	0.00	9.13	0.16	0.00	5.91	2.00	0.00	9.10	0.17	0.00
6.07	2.00	0.00	9.07	0.16	0.00	6.23	2.00	0.00	9.05	0.16	0.00
6.40	2.00	0.00	9.02	0.16	0.00	6.56	2.00	0.00	9.00	0.16	0.00
6.73	2.00	0.00	8.97	0.16	0.00	6.89	2.00	0.00	8.95	0.16	0.00
7.05	2.00	0.00	8.92	0.16	0.00	7.22	2.00	0.00	8.90	0.16	0.00
7.38	2.00	0.00	8.87	0.16	0.00	7.55	2.00	0.00	8.85	0.16	0.00
7.71	2.00	0.00	8.82	0.16	0.00	7.87	2.00	0.00	8.80	0.16	0.00
8.04	2.00	0.00	8.78	0.16	0.00	8.20	2.00	0.00	8.75	0.16	0.00
8.37	2.00	0.00	8.73	0.16	0.00	8.53	2.00	0.00	8.70	0.16	0.00
8.69	2.00	0.00	8.68	0.16	0.00	8.86	2.00	0.00	8.65	0.16	0.00
9.02	2.00	0.00	8.63	0.16	0.00	9.19	2.00	0.00	8.60	0.16	0.00
9.35	2.00	0.00	8.58	0.16	0.00	9.51	2.00	0.00	8.55	0.16	0.00
9.68	2.00	0.00	8.53	0.16	0.00	9.84	2.00	0.00	8.50	0.16	0.00
10.01	2.00	0.00	8.47	0.16	0.00	10.17	2.00	0.00	8.45	0.16	0.00
10.34	2.00	0.00	8.42	0.16	0.00	10.50	2.00	0.00	8.40	0.16	0.00
10.66	2.00	0.00	8.37	0.16	0.00	10.83	2.00	0.00	8.35	0.16	0.00
10.99	2.00	0.00	8.32	0.16	0.00	11.15	2.00	0.00	8.30	0.16	0.00
11.32	2.00	0.00	8.27	0.16	0.00	11.48	2.00	0.00	8.25	0.16	0.00
11.65	2.00	0.00	8.22	0.16	0.00	11.81	2.00	0.00	8.20	0.16	0.00
11.97	2.00	0.00	8.18	0.16	0.00	12.14	2.00	0.00	8.15	0.16	0.00
12.30	2.00	0.00	8.13	0.16	0.00	12.47	2.00	0.00	8.10	0.16	0.00
12.63	2.00	0.00	8.08	0.16	0.00	12.79	0.63	0.37	8.05	0.16	0.15
12.96	0.49	0.51	8.03	0.16	0.21	13.12	0.44	0.56	8.00	0.16	0.22
13.29	1.39	0.00	7.98	0.16	0.00	13.45	0.74	0.26	7.95	0.16	0.10
13.62	0.54	0.46	7.93	0.16	0.18	13.78	0.54	0.46	7.90	0.16	0.18
13.94	0.55	0.45	7.87	0.16	0.18	14.11	0.56	0.44	7.85	0.16	0.17
14.27	0.57	0.43	7.82	0.16	0.17	14.44	0.58	0.42	7.80	0.16	0.16
14.60	0.58	0.42	7.77	0.16	0.16	14.76	0.57	0.43	7.75	0.16	0.17
14.93	0.57	0.43	7.72	0.16	0.17	15.09	0.60	0.40	7.70	0.16	0.15
15.26	0.63	0.37	7.67	0.16	0.14	15.42	0.57	0.43	7.65	0.16	0.16
15.58	0.48	0.52	7.62	0.16	0.20	15.75	0.39	0.61	7.60	0.16	0.23
15.91	0.38	0.62	7.58	0.16	0.23	16.08	0.39	0.61	7.55	0.16	0.23
16.24	0.41	0.59	7.53	0.16	0.22	16.40	0.44	0.56	7.50	0.16	0.21
16.57	0.48	0.52	7.48	0.16	0.19	16.73	0.81	0.19	7.45	0.16	0.07
16.90	0.99	0.01	7.43	0.16	0.00	17.06	1.03	0.00	7.40	0.16	0.00
17.22	0.77	0.23	7.38	0.16	0.08	17.39	0.80	0.20	7.35	0.16	0.07

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F _L	w _z	d _z	LPI	Depth (ft)	FS	F _L	w _z	d _z	LPI
17.55	0.81	0.19	7.33	0.16	0.07	17.72	0.79	0.21	7.30	0.16	0.08
17.88	0.64	0.36	7.27	0.16	0.13	18.05	0.59	0.41	7.25	0.16	0.15
18.21	0.57	0.43	7.22	0.16	0.15	18.37	0.53	0.47	7.20	0.16	0.17
18.54	0.52	0.48	7.17	0.16	0.17	18.70	0.55	0.45	7.15	0.16	0.16
18.86	0.62	0.38	7.12	0.16	0.14	19.03	0.67	0.33	7.10	0.16	0.12
19.19	0.69	0.31	7.07	0.16	0.11	19.36	0.65	0.35	7.05	0.16	0.12
19.52	0.61	0.39	7.02	0.16	0.14	19.68	0.59	0.41	7.00	0.16	0.14
19.85	0.87	0.13	6.98	0.16	0.04	20.01	1.02	0.00	6.95	0.16	0.00
20.18	1.08	0.00	6.93	0.16	0.00	20.34	1.08	0.00	6.90	0.16	0.00
20.50	1.35	0.00	6.88	0.16	0.00	20.67	1.79	0.00	6.85	0.16	0.00
20.83	2.00	0.00	6.83	0.16	0.00	21.00	2.00	0.00	6.80	0.16	0.00
21.16	2.00	0.00	6.78	0.16	0.00	21.32	2.00	0.00	6.75	0.16	0.00
21.49	2.00	0.00	6.72	0.16	0.00	21.65	2.00	0.00	6.70	0.16	0.00
21.82	2.00	0.00	6.67	0.16	0.00						

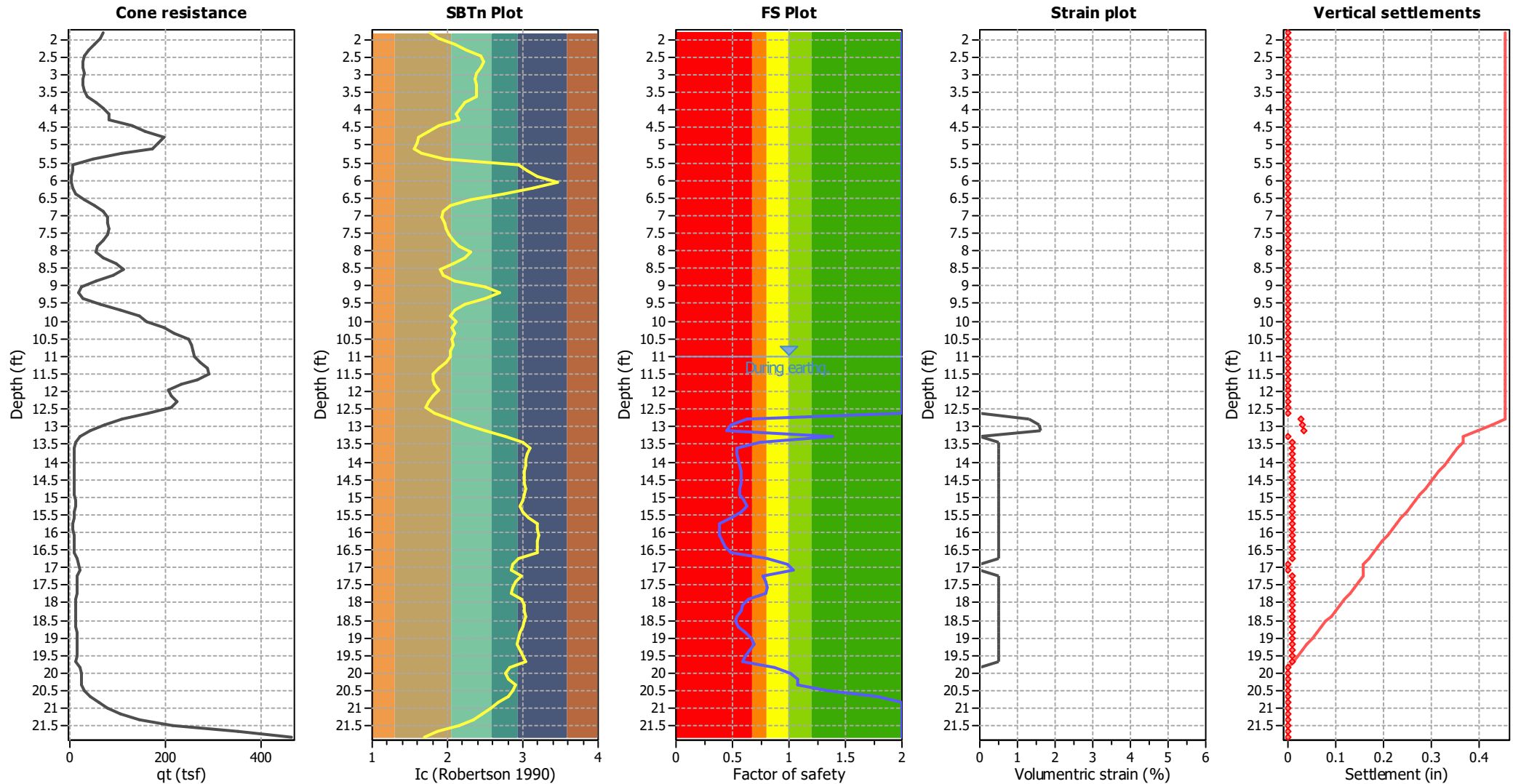
Overall liquefaction potential: 6.32

LPI = 0.00 - Liquefaction risk very low
 LPI between 0.00 and 5.00 - Liquefaction risk low
 LPI between 5.00 and 15.00 - Liquefaction risk high
 LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS: Calculated factor of safety for test point
 F_L: 1 - FS
 w_z: Function value of the extend of soil liquefaction according to depth
 d_z: Layer thickness (ft)
 LPI: Liquefaction potential index value for test point

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
 Volumetric strain: Post-liquefaction volumetric strain

:: Post-earthquake settlement due to soil liquefaction ::

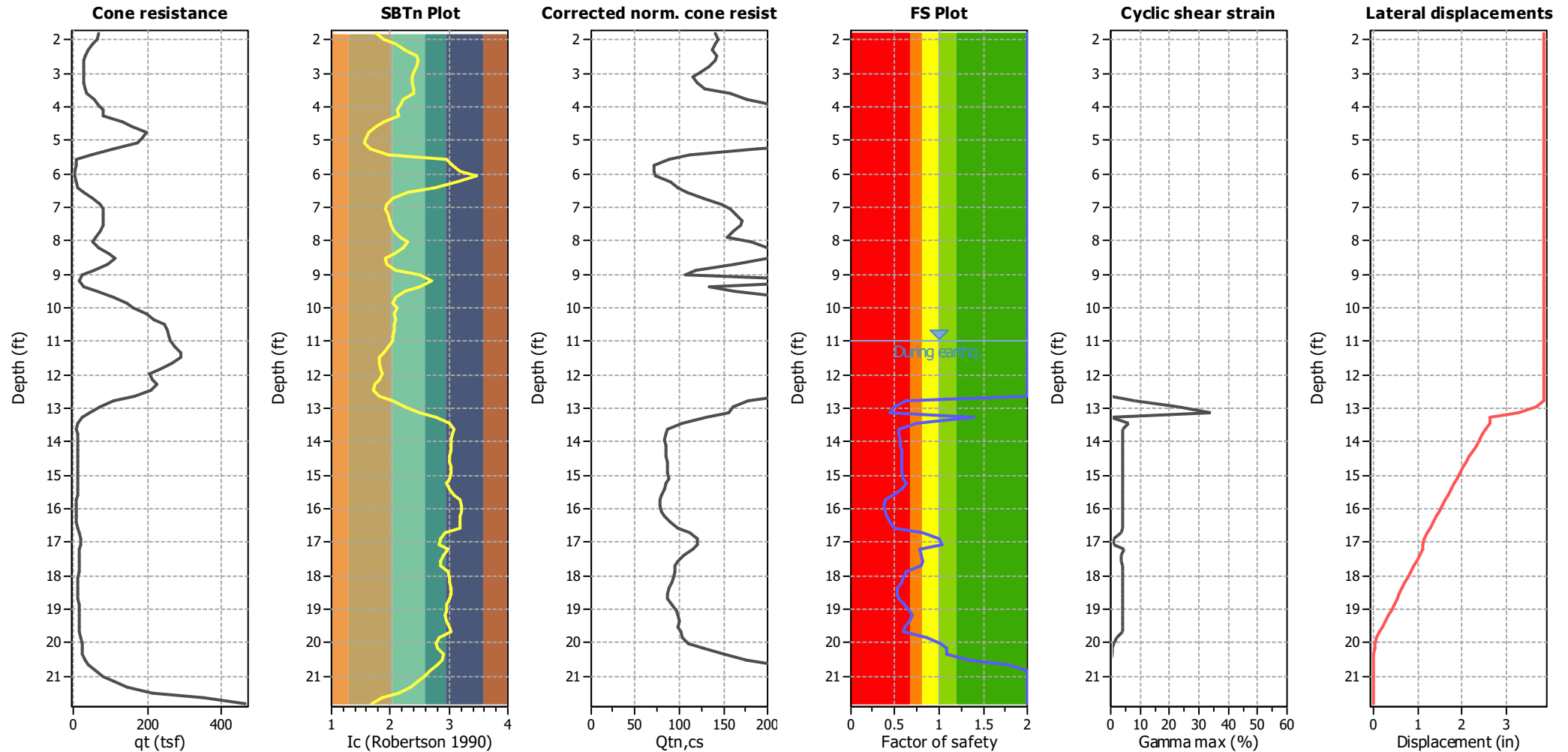
Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
11.15	434.68	2.00	0.00	1.00	0.00	11.32	421.60	2.00	0.00	1.00	0.00
11.48	393.31	2.00	0.00	1.00	0.00	11.65	356.44	2.00	0.00	1.00	0.00
11.81	315.49	2.00	0.00	1.00	0.00	11.97	289.16	2.00	0.00	1.00	0.00
12.14	281.70	2.00	0.00	1.00	0.00	12.30	281.15	2.00	0.00	1.00	0.00
12.47	255.66	2.00	0.00	1.00	0.00	12.63	215.90	2.00	0.00	1.00	0.00
12.79	178.07	0.63	1.31	1.00	0.03	12.96	161.37	0.49	1.58	1.00	0.03
13.12	155.46	0.44	1.63	1.00	0.03	13.29	129.95	1.39	0.00	1.00	0.00
13.45	102.84	0.74	0.50	1.00	0.01	13.62	87.08	0.54	0.50	1.00	0.01
13.78	84.13	0.54	0.50	1.00	0.01	13.94	83.51	0.55	0.50	1.00	0.01
14.11	83.90	0.56	0.50	1.00	0.01	14.27	84.52	0.57	0.50	1.00	0.01
14.44	85.34	0.58	0.50	1.00	0.01	14.60	85.66	0.58	0.50	1.00	0.01
14.76	86.48	0.57	0.50	1.00	0.01	14.93	86.22	0.57	0.50	1.00	0.01
15.09	87.31	0.60	0.50	1.00	0.01	15.26	85.59	0.63	0.50	1.00	0.01
15.42	83.63	0.57	0.50	1.00	0.01	15.58	79.86	0.48	0.50	1.00	0.01
15.75	77.47	0.39	0.50	1.00	0.01	15.91	77.58	0.38	0.50	1.00	0.01
16.08	80.49	0.39	0.50	1.00	0.01	16.24	83.79	0.41	0.50	1.00	0.01
16.40	89.21	0.44	0.50	1.00	0.01	16.57	98.30	0.48	0.50	1.00	0.01
16.73	111.96	0.81	0.50	1.00	0.01	16.90	120.54	0.99	0.01	1.00	0.00
17.06	119.92	1.03	0.01	1.00	0.00	17.22	115.53	0.77	0.50	1.00	0.01
17.39	104.60	0.80	0.50	1.00	0.01	17.55	98.55	0.81	0.50	1.00	0.01
17.72	94.67	0.79	0.50	1.00	0.01	17.88	95.62	0.64	0.50	1.00	0.01
18.05	94.06	0.59	0.50	1.00	0.01	18.21	91.47	0.57	0.50	1.00	0.01
18.37	88.56	0.53	0.50	1.00	0.01	18.54	85.66	0.52	0.50	1.00	0.01
18.70	86.96	0.55	0.50	1.00	0.01	18.86	91.11	0.62	0.50	1.00	0.01
19.03	97.36	0.67	0.50	1.00	0.01	19.19	97.96	0.69	0.50	1.00	0.01
19.36	99.45	0.65	0.50	1.00	0.01	19.52	98.96	0.61	0.50	1.00	0.01
19.68	101.17	0.59	0.50	1.00	0.01	19.85	103.48	0.87	0.01	1.00	0.00
20.01	110.57	1.02	0.01	1.00	0.00	20.18	127.14	1.08	0.01	1.00	0.00
20.34	150.25	1.08	0.01	1.00	0.00	20.50	176.59	1.35	0.01	1.00	0.00
20.67	208.19	1.79	0.00	1.00	0.00	20.83	531.44	2.00	0.00	1.00	0.00
21.00	389.64	2.00	0.00	1.00	0.00	21.16	287.52	2.00	0.00	1.00	0.00
21.32	310.83	2.00	0.00	1.00	0.00	21.49	337.06	2.00	0.00	1.00	0.00
21.65	407.01	2.00	0.00	1.00	0.00	21.82	473.63	2.00	0.00	1.00	0.00

Total estimated settlement: 0.45**Abbreviations**

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
 FS: Factor of safety against liquefaction
 e_v (%): Post-liquefaction volumetric strain
 DF: e_v depth weighting factor
 Settlement: Calculated settlement

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



Abbreviations

qt: Total cone resistance (cone resistance q_c corrected for pore water effects)

Ic: Soil Behaviour Type Index

$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety

γ_{max} : Maximum cyclic shear strain

LDI: Lateral displacement index

Surface condition



:: Lateral displacement index calculation ::								
Depth (ft)	q _t (tsf)	Q _{tn}	R _f (%)	Q _{tn,cs}	FS	D _r	Gamma _{max} (%)	Lat. disp. (in)
11.15	273.37	343.43	3.28	434.68	2.00	100.00	0.00	0.00
11.32	289.26	356.57	2.72	421.60	2.00	100.00	0.00	0.00
11.48	292.45	353.56	2.16	393.31	2.00	100.00	0.00	0.00
11.65	267.69	321.65	2.01	356.44	2.00	100.00	0.00	0.00
11.81	233.29	279.98	1.96	315.49	2.00	100.00	0.00	0.00
11.97	206.01	247.83	2.06	289.16	2.00	96.96	0.00	0.00
12.14	212.41	251.98	1.76	281.70	2.00	97.50	0.00	0.00
12.30	225.24	263.24	1.49	281.15	2.00	98.95	0.00	0.00
12.47	211.67	244.98	1.26	255.66	2.00	96.57	0.00	0.00
12.63	164.45	192.45	1.44	215.90	2.00	88.61	0.00	0.00
12.79	110.07	131.91	2.00	178.07	0.63	76.14	8.36	0.15
12.96	72.92	89.30	2.75	161.37	0.49	63.27	22.70	0.42
13.12	42.65	53.37	3.73	155.46	0.44	46.27	34.10	0.63
13.29	22.30	28.26	4.70	129.95	1.39	25.29	0.22	0.00
13.45	12.18	15.15	4.94	102.84	0.74	4.71	5.90	0.11
13.62	9.25	11.17	4.54	87.08	0.54	0.00	4.00	0.07
13.78	9.39	11.30	4.14	84.13	0.54	0.00	4.00	0.07
13.94	9.64	11.55	3.99	83.51	0.55	0.00	4.00	0.07
14.11	9.88	11.79	3.95	83.90	0.56	0.00	4.00	0.07
14.27	10.14	12.06	3.93	84.52	0.57	0.00	4.00	0.07
14.44	10.34	12.24	3.96	85.34	0.58	0.00	4.00	0.07
14.60	10.44	12.30	3.98	85.66	0.58	0.00	4.00	0.07
14.76	10.37	12.14	4.11	86.48	0.57	0.00	4.00	0.07
14.93	10.48	12.21	4.06	86.22	0.57	0.00	4.00	0.07
15.09	11.08	12.90	3.97	87.31	0.60	0.00	4.00	0.07
15.26	11.80	13.73	3.59	85.59	0.63	1.47	4.00	0.07
15.42	10.84	12.45	3.72	83.63	0.57	0.00	4.00	0.07
15.58	9.36	10.53	3.90	79.86	0.48	0.00	4.00	0.07
15.75	7.74	8.46	4.52	77.47	0.39	0.00	4.00	0.07
15.91	7.73	8.39	4.57	77.58	0.38	0.00	4.00	0.07
16.08	7.89	8.54	4.92	80.49	0.39	0.00	4.00	0.07
16.24	8.45	9.18	5.03	83.79	0.41	0.00	4.00	0.07
16.40	9.05	9.85	5.42	89.21	0.44	0.00	4.00	0.07
16.57	9.92	10.85	6.16	98.30	0.48	0.00	4.00	0.07
16.73	16.13	18.29	4.97	111.96	0.81	10.93	3.38	0.06
16.90	19.71	22.39	4.87	120.54	0.99	17.60	1.20	0.02
17.06	20.72	23.41	4.65	119.92	1.03	19.07	0.97	0.02
17.22	15.79	17.56	5.50	115.53	0.77	9.58	4.38	0.07
17.39	16.42	18.19	4.34	104.60	0.80	10.75	3.71	0.06
17.55	16.86	18.54	3.77	98.55	0.81	11.38	3.42	0.06
17.72	16.61	18.13	3.53	94.67	0.79	10.64	3.89	0.06
17.88	13.61	14.64	4.32	95.62	0.64	3.57	4.00	0.07
18.05	12.82	13.64	4.43	94.06	0.59	1.24	4.00	0.07
18.21	12.55	13.25	4.28	91.47	0.57	0.28	4.00	0.07
18.37	11.89	12.41	4.22	88.56	0.53	0.00	4.00	0.07
18.54	11.70	12.13	3.99	85.66	0.52	0.00	4.00	0.06
18.70	12.37	12.83	3.92	86.96	0.55	0.00	4.00	0.06
18.86	13.92	14.52	3.90	91.11	0.62	3.32	4.00	0.06

:: Estimation of post-earthquake lateral Displacements :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	R_f (%)	$Q_{tn,cs}$	FS	D_r	Gamma_{max} (%)	Lat. disp. (in)
19.03	15.05	15.71	4.21	97.36	0.67	5.92	4.00	0.06
19.19	15.71	16.37	4.12	97.96	0.69	7.27	4.00	0.06
19.36	15.04	15.53	4.45	99.45	0.65	5.53	4.00	0.06
19.52	14.29	14.61	4.64	98.96	0.61	3.52	4.00	0.06
19.68	13.85	14.05	5.05	101.17	0.59	2.23	4.00	0.06
19.85	20.20	20.87	3.79	103.48	0.87	15.28	2.25	0.04
20.01	23.56	24.36	3.83	110.57	1.02	20.39	1.01	0.02
20.18	25.11	25.97	4.78	127.14	1.08	22.50	0.72	0.01
20.34	25.16	26.01	6.55	150.25	1.08	22.55	0.73	0.01
20.50	31.37	32.52	7.31	176.59	1.35	29.92	0.21	0.00
20.67	41.69	43.24	7.72	208.19	1.79	39.33	0.04	0.00
20.83	60.94	63.05	7.14	531.44	2.00	51.77	0.00	0.00
21.00	80.54	82.93	6.80	389.64	2.00	60.82	0.00	0.00
21.16	106.99	109.49	6.16	287.52	2.00	69.99	0.00	0.00
21.32	146.00	148.32	5.33	310.83	2.00	80.01	0.00	0.00
21.49	214.36	215.77	4.05	337.06	2.00	92.38	0.00	0.00
21.65	352.63	350.70	2.52	407.01	2.00	100.00	0.00	0.00
21.82	464.65	458.19	1.85	473.63	2.00	100.00	0.00	0.00

Total estimated displacement: 3.85**Abbreviations**

q_t :	Total cone resistance
Q_{tn} :	Adjusted cone resistance to an effective overburden stress of 1 atm
R_f :	Friction ration
$Q_{tn,cs}$:	Adjusted and corrected cone resistance due to fines
FS:	Calculated factor of safety against liquefaction
D_r :	Calculated relative density
Gamma_{max} :	Calculated maximum cyclic shear strain
Lat. disp.:	Lateral displacement

:: Strength loss calculation (Robertson (2009)) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
1.80	69.47	131.10	1.08	141.50	1.76	N/A	N/A
1.97	64.61	121.91	1.18	143.26	1.89	N/A	N/A
2.13	52.20	98.42	1.43	141.16	2.09	N/A	N/A
2.30	40.13	75.60	1.82	137.46	2.26	N/A	N/A
2.46	30.14	56.70	2.50	141.60	2.44	N/A	N/A
2.63	28.19	52.99	2.66	141.14	2.48	N/A	N/A
2.79	28.65	53.84	2.48	133.63	2.44	N/A	N/A
2.95	29.09	54.66	2.26	123.54	2.39	N/A	N/A
3.12	28.07	52.71	2.18	115.04	2.37	N/A	N/A
3.28	28.86	54.19	2.23	120.71	2.38	N/A	N/A
3.44	30.25	56.79	2.26	128.25	2.39	N/A	N/A
3.61	37.07	69.66	2.26	157.47	2.39	N/A	N/A
3.77	54.29	102.20	1.73	176.48	2.22	N/A	N/A
3.94	69.41	130.76	1.59	207.84	2.17	N/A	N/A
4.10	81.43	153.45	1.47	225.43	2.11	N/A	N/A
4.26	81.16	152.93	1.57	239.59	2.16	N/A	N/A
4.43	131.28	247.64	1.18	292.53	1.89	N/A	N/A
4.59	156.62	295.52	1.08	318.24	1.76	N/A	N/A
4.76	198.08	352.44	1.00	352.44	1.62	N/A	N/A
4.92	184.77	317.63	1.00	317.63	1.59	N/A	N/A
5.08	174.35	291.27	1.00	291.27	1.56	N/A	N/A
5.25	108.71	186.86	1.01	188.66	1.66	N/A	N/A
5.41	47.66	89.46	1.26	112.35	1.96	N/A	N/A
5.58	7.81	14.13	6.19	87.43	2.95	N/A	N/A
5.74	5.46	9.68	7.35	71.17	3.05	N/A	N/A
5.91	4.47	7.79	9.14	71.19	3.19	N/A	N/A
6.07	3.28	5.52	13.27	73.21	3.45	N/A	N/A
6.23	5.93	10.52	8.49	89.29	3.14	N/A	N/A
6.40	12.34	22.61	4.35	98.35	2.75	N/A	N/A
6.56	29.26	54.58	1.97	107.65	2.31	N/A	N/A
6.73	52.13	92.58	1.36	126.30	2.05	N/A	N/A
6.89	70.50	119.02	1.24	147.19	1.95	N/A	N/A
7.05	79.02	130.41	1.21	157.91	1.92	N/A	N/A
7.22	79.21	130.88	1.26	164.68	1.97	N/A	N/A
7.38	81.74	133.80	1.28	170.63	1.98	N/A	N/A
7.55	78.53	128.36	1.33	170.21	2.02	N/A	N/A
7.71	70.44	115.32	1.40	161.80	2.07	N/A	N/A
7.87	59.00	97.85	1.58	154.26	2.16	N/A	N/A
8.04	53.57	91.48	1.97	180.64	2.31	N/A	N/A
8.20	69.82	114.81	1.74	199.41	2.23	N/A	N/A
8.37	97.36	151.32	1.42	214.14	2.08	N/A	N/A
8.53	113.42	166.22	1.20	199.72	1.91	N/A	N/A
8.69	90.61	131.97	1.23	161.89	1.94	N/A	N/A
8.86	54.25	81.32	1.46	118.81	2.10	N/A	N/A
9.02	24.34	39.39	2.73	107.54	2.49	N/A	N/A
9.19	17.09	28.43	3.96	112.59	2.70	N/A	N/A
9.35	28.56	45.23	2.81	127.24	2.51	N/A	N/A
9.51	62.71	92.63	1.75	162.41	2.23	N/A	N/A

:: Strength loss calculation (Robertson (2009)) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.68	106.86	151.70	1.46	221.60	2.10	N/A	N/A
9.84	145.90	202.19	1.36	275.83	2.05	N/A	N/A
10.01	162.38	225.50	1.47	331.69	2.11	N/A	N/A
10.17	197.38	268.31	1.39	373.54	2.06	N/A	N/A
10.34	218.11	295.40	1.46	431.12	2.10	N/A	N/A
10.50	248.12	329.76	1.40	460.31	2.07	N/A	N/A
10.66	255.08	336.02	1.42	476.66	2.08	N/A	N/A
10.83	259.47	335.93	1.37	459.13	2.05	N/A	N/A
10.99	262.56	335.32	1.34	450.82	2.03	N/A	N/A
11.15	273.37	343.43	1.27	434.68	1.97	1.02	1.02
11.32	289.26	356.57	1.18	421.60	1.89	1.02	1.02
11.48	292.45	353.56	1.11	393.31	1.81	1.02	1.02
11.65	267.69	321.65	1.11	356.44	1.80	1.01	1.01
11.81	233.29	279.98	1.13	315.49	1.83	0.98	0.98
11.97	206.01	247.83	1.17	289.16	1.88	0.96	0.96
12.14	212.41	251.98	1.12	281.70	1.82	0.97	0.97
12.30	225.24	263.24	1.07	281.15	1.74	0.97	0.97
12.47	211.67	244.98	1.04	255.66	1.71	0.96	0.96
12.63	164.45	192.45	1.12	215.90	1.82	0.92	0.92
12.79	110.07	131.91	1.35	178.07	2.04	0.87	0.87
12.96	72.92	89.30	1.81	161.37	2.25	0.81	0.81
13.12	42.65	53.37	2.80	149.31	2.51	0.74	0.74
13.29	22.30	28.26	4.60	129.95	2.78	2.06	2.06
13.45	12.18	15.15	6.79	102.84	3.00	1.08	1.08
13.62	9.25	11.17	7.80	87.08	3.09	0.80	0.80
13.78	9.39	11.30	7.45	84.13	3.06	0.81	0.81
13.94	9.64	11.55	7.23	83.51	3.04	0.82	0.82
14.11	9.88	11.79	7.11	83.90	3.03	0.84	0.84
14.27	10.14	12.06	7.01	84.52	3.02	0.86	0.86
14.44	10.34	12.24	6.97	85.34	3.02	0.87	0.87
14.60	10.44	12.30	6.96	85.66	3.02	0.88	0.88
14.76	10.37	12.14	7.12	86.48	3.03	0.87	0.87
14.93	10.48	12.21	7.06	86.22	3.03	0.87	0.87
15.09	11.08	12.90	6.77	87.31	3.00	0.92	0.92
15.26	11.80	13.73	6.23	85.59	2.95	0.98	0.98
15.42	10.84	12.45	6.72	83.63	3.00	0.89	0.89
15.58	9.36	10.53	7.59	79.86	3.07	0.75	0.75
15.75	7.74	8.46	9.16	77.47	3.19	0.60	0.60
15.91	7.73	8.39	9.25	77.58	3.20	0.60	0.60
16.08	7.89	8.54	9.43	80.49	3.21	0.61	0.61
16.24	8.45	9.18	9.13	83.79	3.19	0.66	0.66
16.40	9.05	9.85	9.05	89.21	3.19	0.70	0.70
16.57	9.92	10.85	9.06	98.30	3.19	0.78	0.78
16.73	16.13	18.29	6.12	111.96	2.94	1.31	1.31
16.90	19.71	22.39	5.38	120.54	2.87	1.61	1.61
17.06	20.72	23.41	5.12	119.92	2.84	1.68	1.68
17.22	15.79	17.56	6.58	115.53	2.99	1.25	1.25
17.39	16.42	18.19	5.75	104.60	2.91	1.30	1.30

:: Strength loss calculation (Robertson (2009)) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
17.55	16.86	18.54	5.32	98.55	2.86	1.33	1.33
17.72	16.61	18.13	5.22	94.67	2.85	1.30	1.30
17.88	13.61	14.64	6.53	95.62	2.98	1.05	1.05
18.05	12.82	13.64	6.90	94.06	3.01	0.97	0.97
18.21	12.55	13.25	6.91	91.47	3.01	0.95	0.95
18.37	11.89	12.41	7.13	88.56	3.03	0.89	0.89
18.54	11.70	12.13	7.06	85.66	3.03	0.87	0.87
18.70	12.37	12.83	6.78	86.96	3.00	0.92	0.92
18.86	13.92	14.52	6.27	91.11	2.96	1.04	1.04
19.03	15.05	15.71	6.20	97.36	2.95	1.12	1.12
19.19	15.71	16.37	5.98	97.96	2.93	1.17	1.17
19.36	15.04	15.53	6.40	99.45	2.97	1.11	1.11
19.52	14.29	14.61	6.77	98.96	3.00	1.04	1.04
19.68	13.85	14.05	7.20	101.17	3.04	1.00	1.00
19.85	20.20	20.87	4.96	103.48	2.82	1.50	1.50
20.01	23.56	24.36	4.54	110.57	2.77	1.75	1.75
20.18	25.11	25.97	4.90	127.14	2.81	1.86	1.86
20.34	25.16	26.01	5.78	150.25	2.91	1.86	1.86
20.50	31.37	32.52	5.43	176.59	2.87	2.33	2.33
20.67	41.69	43.24	4.81	208.19	2.80	3.10	3.10
20.83	60.94	63.05	3.78	238.40	2.67	4.55	4.55
21.00	80.54	82.93	3.20	265.05	2.58	0.80	0.80
21.16	106.99	109.49	2.63	287.52	2.47	0.84	0.84
21.32	146.00	148.32	2.10	310.83	2.34	0.88	0.88
21.49	214.36	215.77	1.56	337.06	2.15	0.94	0.94
21.65	352.63	350.70	1.16	407.01	1.87	1.02	1.02
21.82	464.65	458.19	1.03	473.63	1.69	1.07	1.07

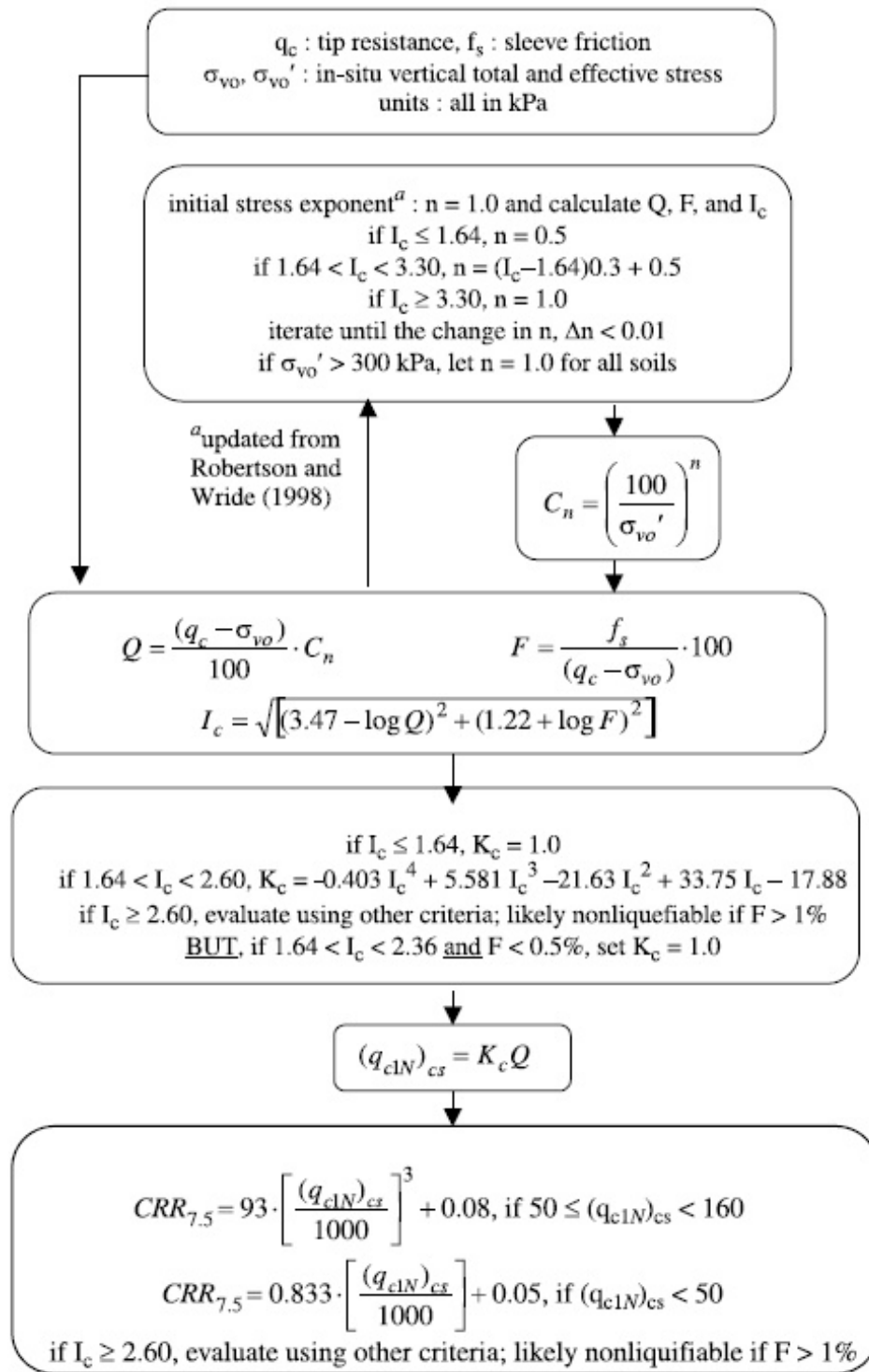
Abbreviations

q_t :	Total cone resistance
K_c :	Cone resistance correction factor due to fines
$Q_{tn,cs}$:	Adjusted and corrected cone resistance due to fines
I_c :	Soil behavior type index
$S_{u(liq)}/\sigma'_v$:	Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$:	Calculated peak undrained strength ratio

Exhibit A-2

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart¹:

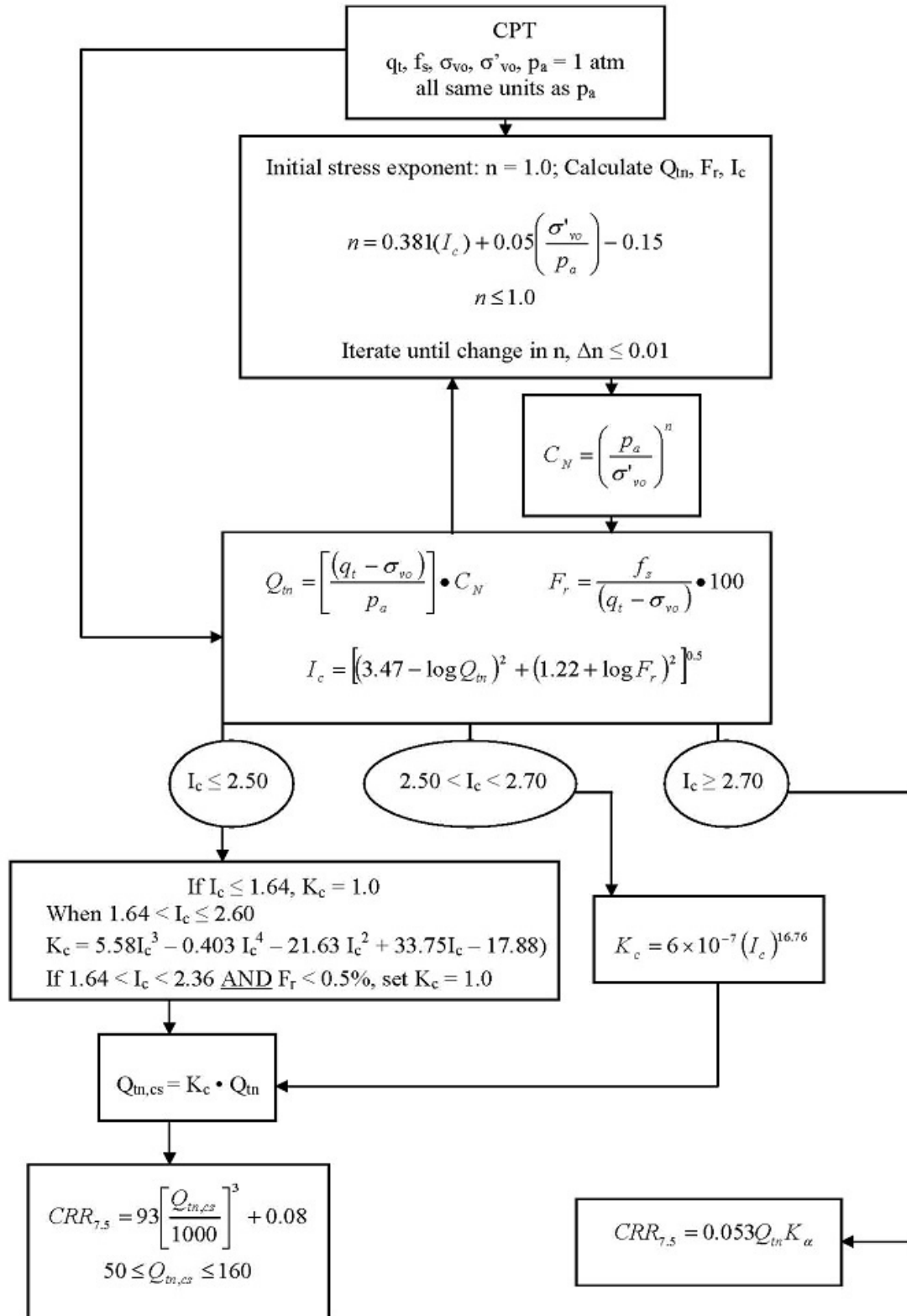


¹ "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Exhibit A-2

Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart¹:



¹ P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

Exhibit A-2

Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)

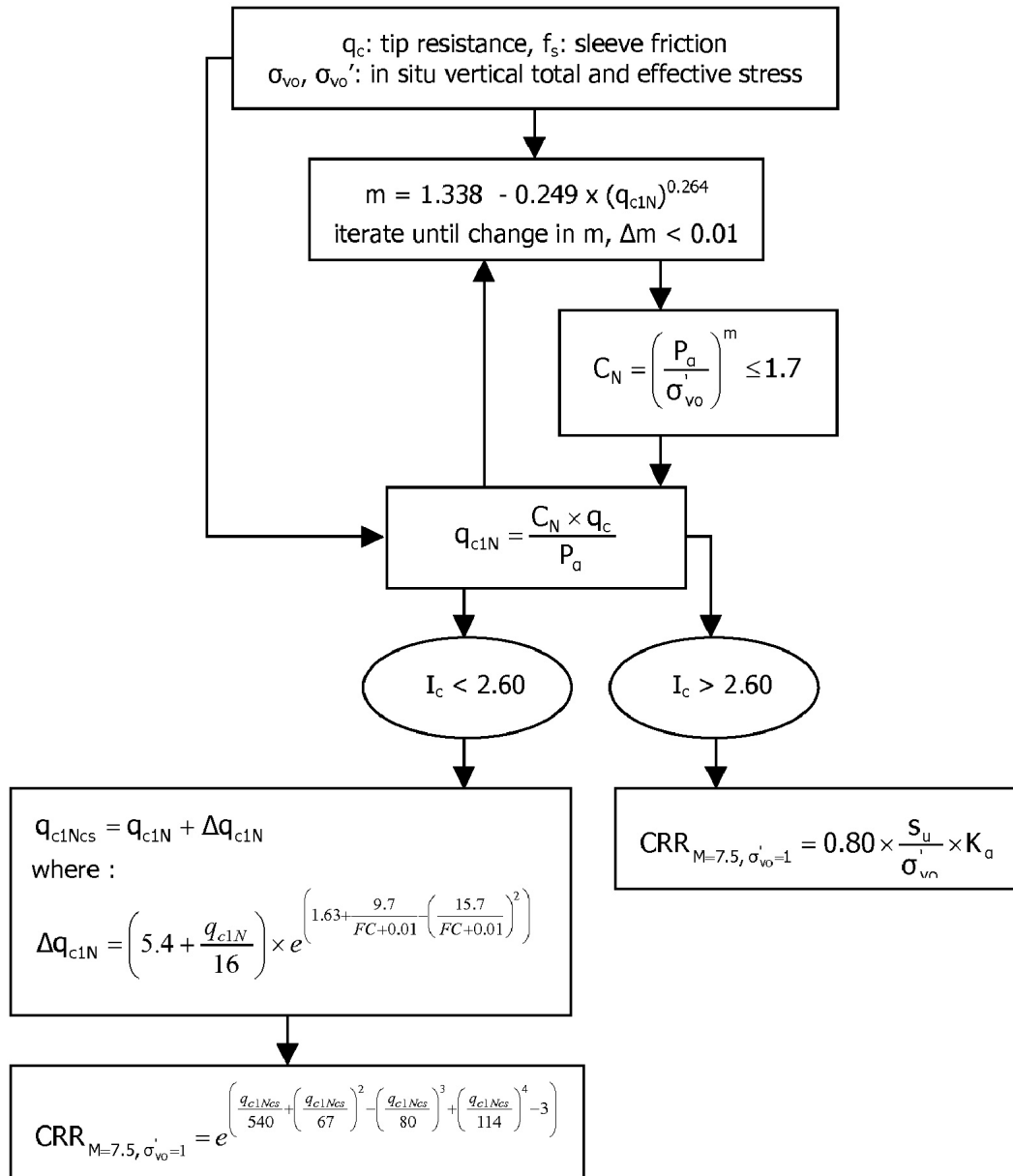


Exhibit A-2

Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)

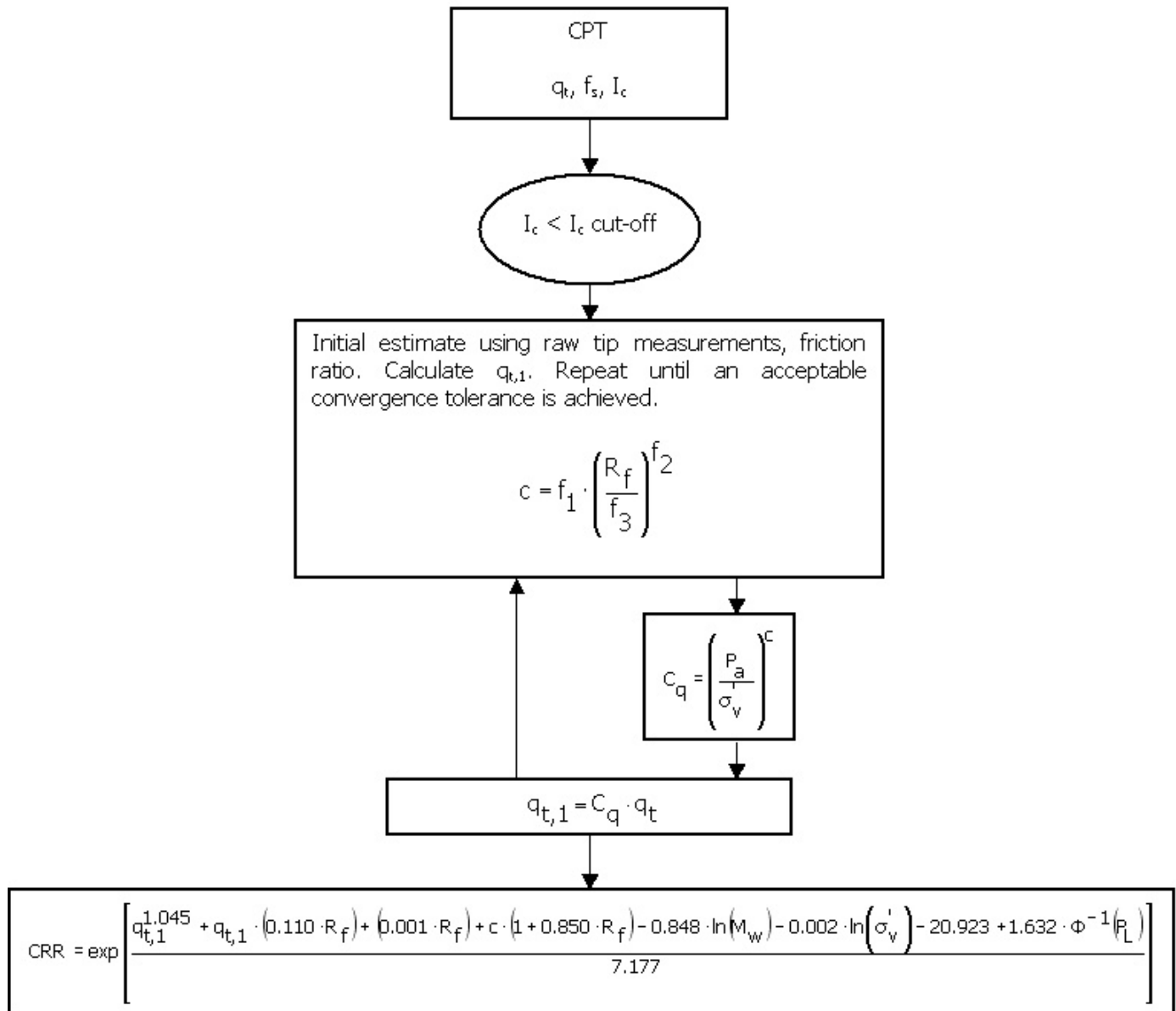


Exhibit A-2

Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)

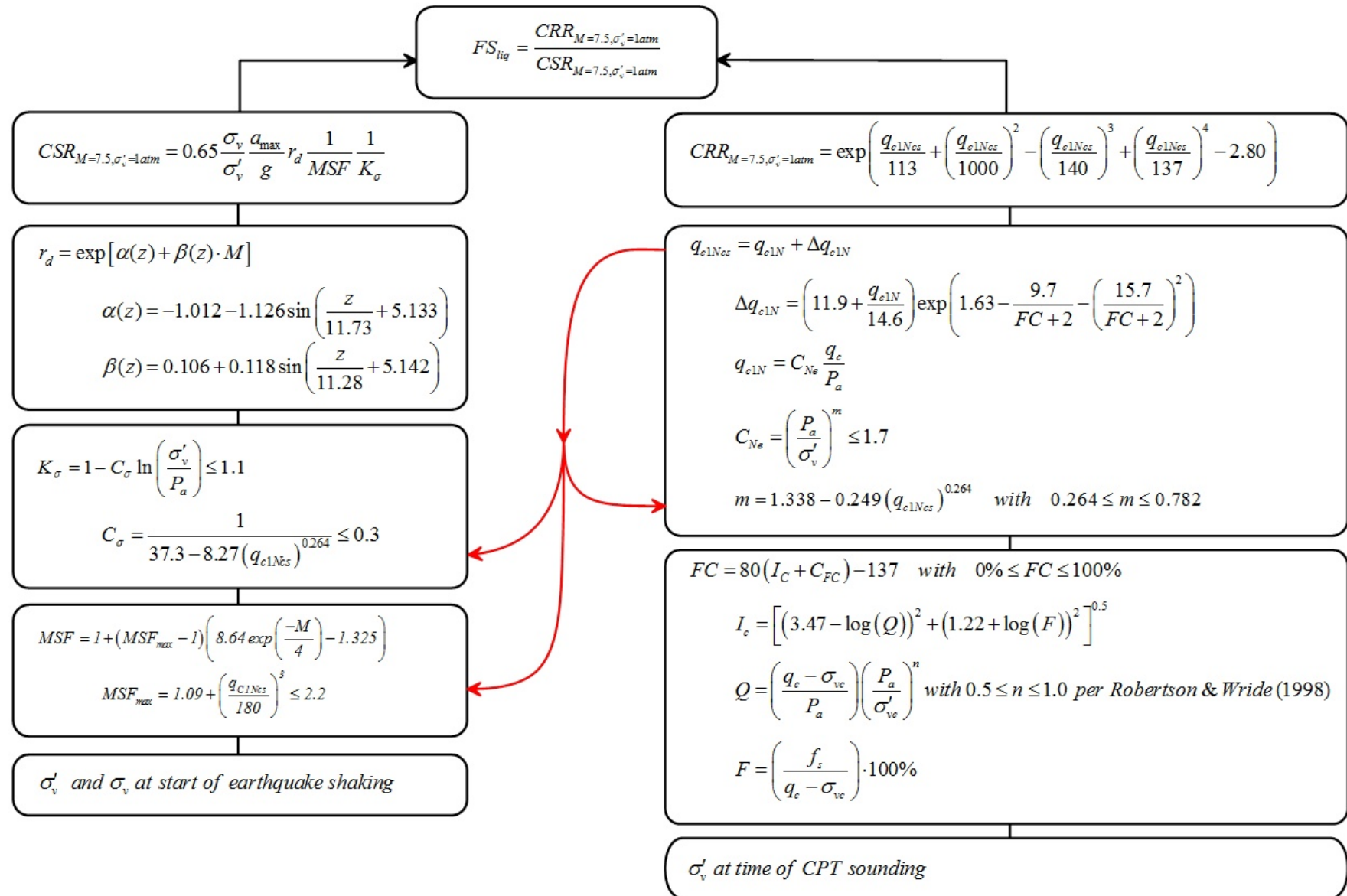
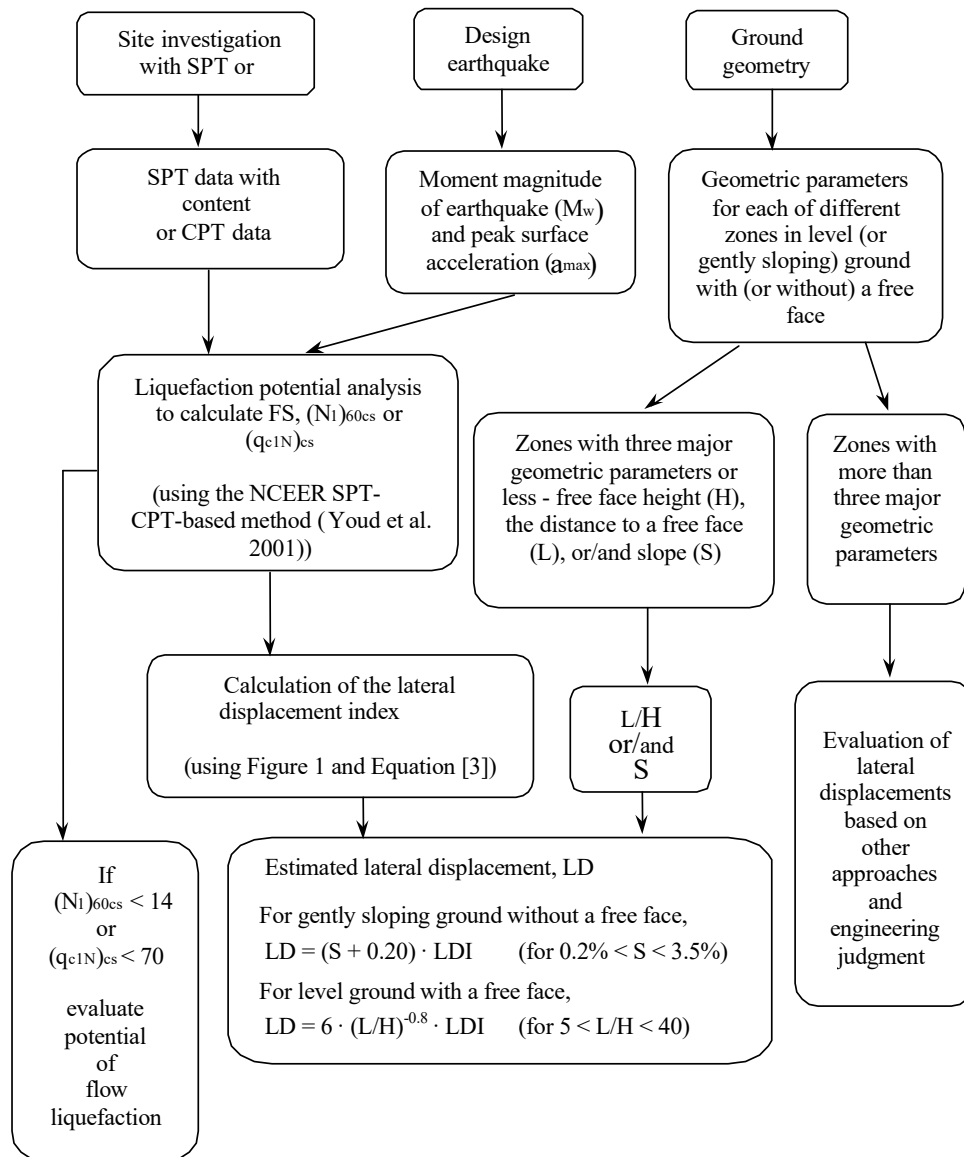
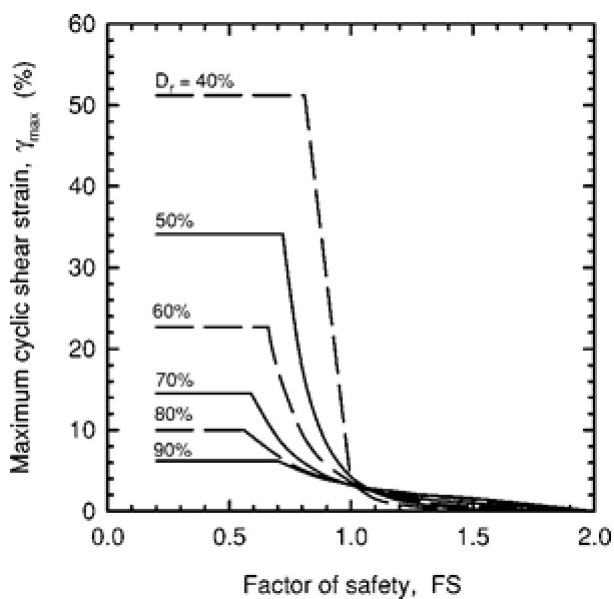


Exhibit A-2

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



¹ Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



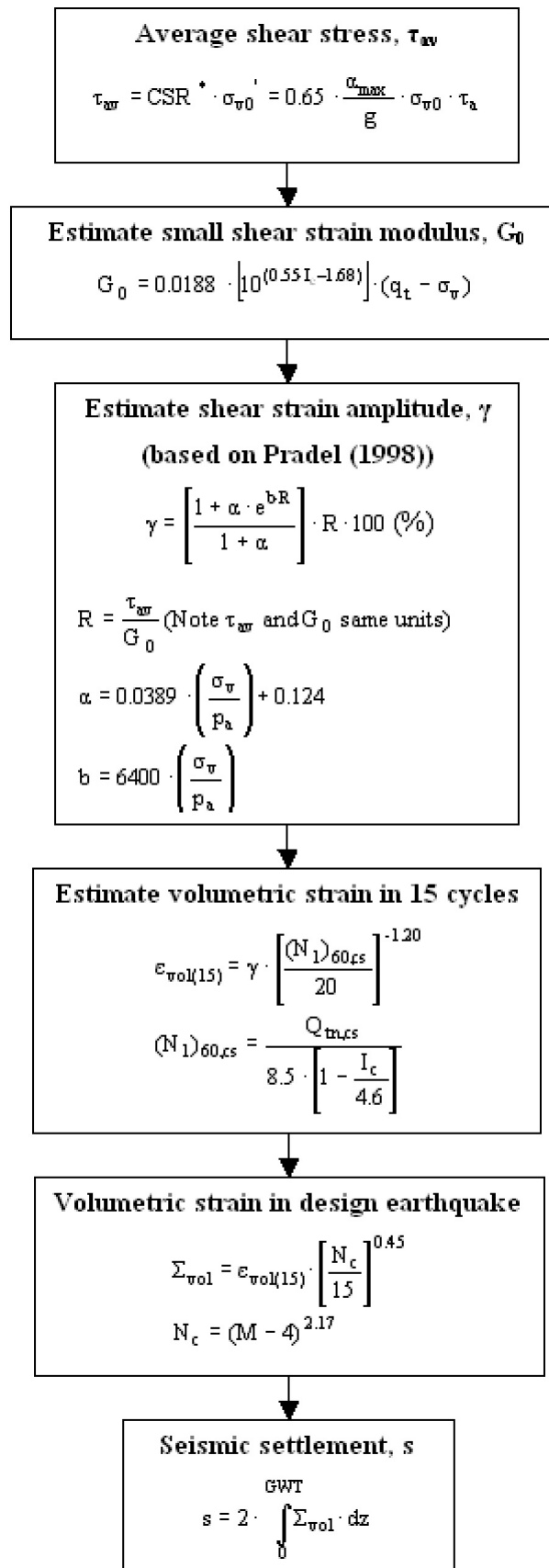
¹ Figure 1

$$LDI = \int_0^{Z_{max}} \gamma_{max} dz$$

¹ Equation [3]

¹ "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Exhibit A-2

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methodology developed by Iwasaki (1982) and is adopted by AFPS.

To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$LPI = \int_0^{20} (10 - 0.5z) \times F_L \times d_z$$

where:

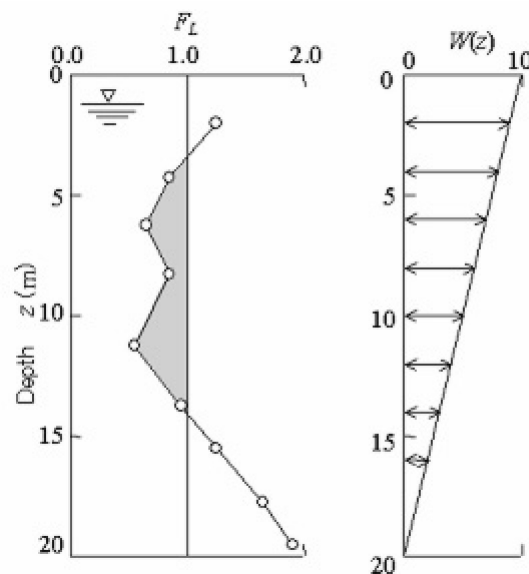
$F_L = 1 - F.S.$ when F.S. less than 1

$F_L = 0$ when F.S. greater than 1

z depth of measurement in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- $LPI = 0$: Liquefaction risk is very low
- $0 < LPI \leq 5$: Liquefaction risk is low
- $5 < LPI \leq 15$: Liquefaction risk is high
- $LPI > 15$: Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Exhibit A-2

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$\begin{aligned} \ln(Ds) = & c1 + c2 * LBS + 0.58 * \ln\left(\tanh\left(\frac{HL}{6}\right)\right) + \\ & 4.59 * \ln(Q) - 0.42 * \ln(Q)^2 - 0.02 * B + \\ & 0.84 * \ln(CAVdp) + 0.41 * \ln(Sa1) + \varepsilon \end{aligned}$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for $LBS \leq 16$, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein $W = 0.0$ for z less than Df, which is the embedment depth of the foundation, and $W = 1.0$ otherwise. The shear strain parameter (ε_{shear}) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

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ASCE 7 Hazards Report

Address:

Cannon Beach Police
Department - 163 E Gower St
Cannon Beach,

Standard:

ASCE/SEI 7-22

Risk Category: IV

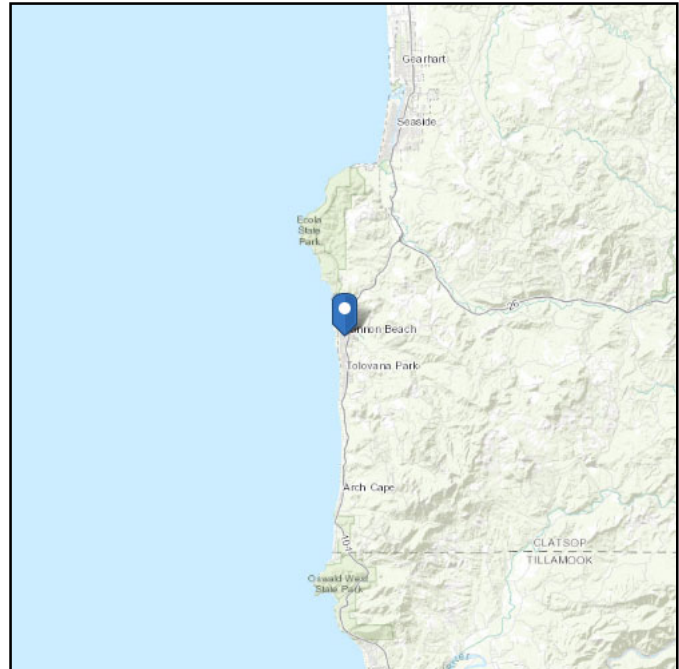
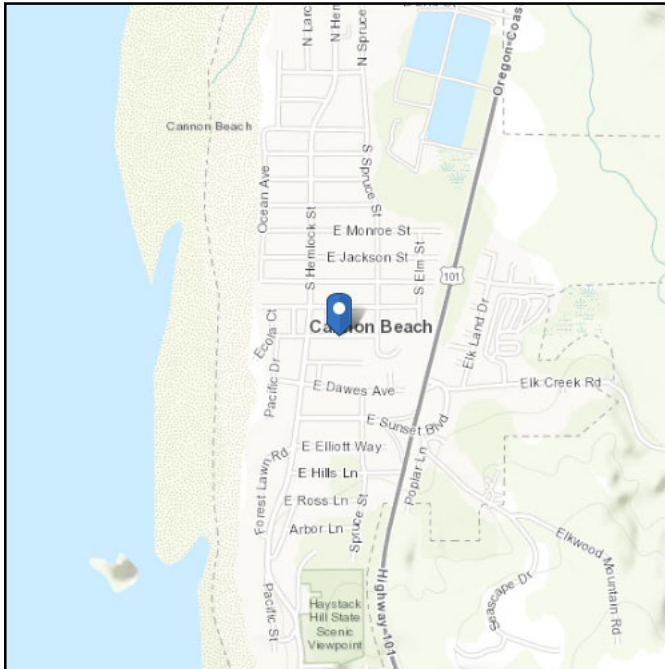
Soil Class:

D - Stiff Soil

Latitude: 45.88997

Longitude: -123.96076

Elevation: 33.006202949243075 ft
(NAVD 88)

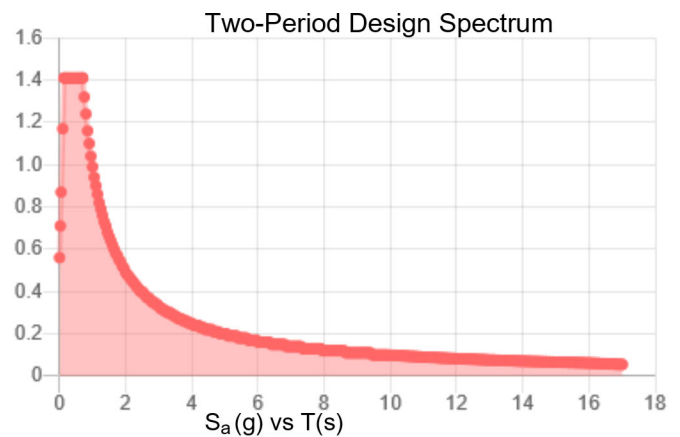
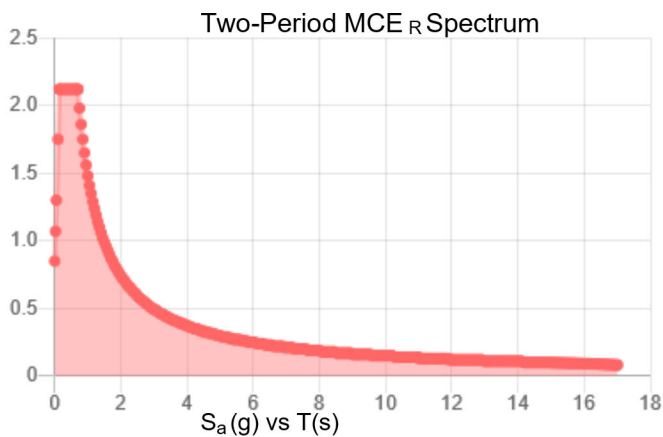
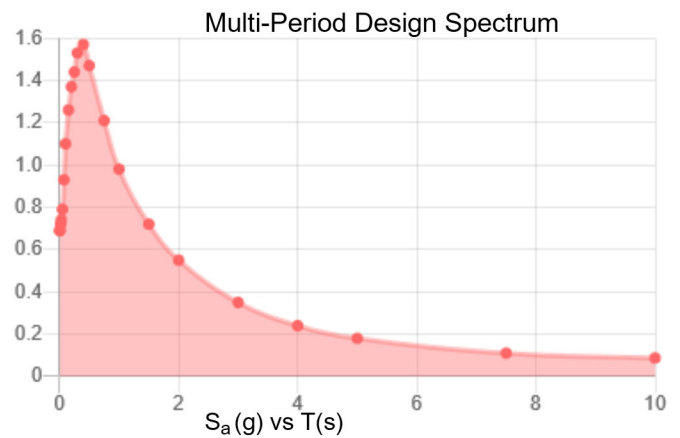
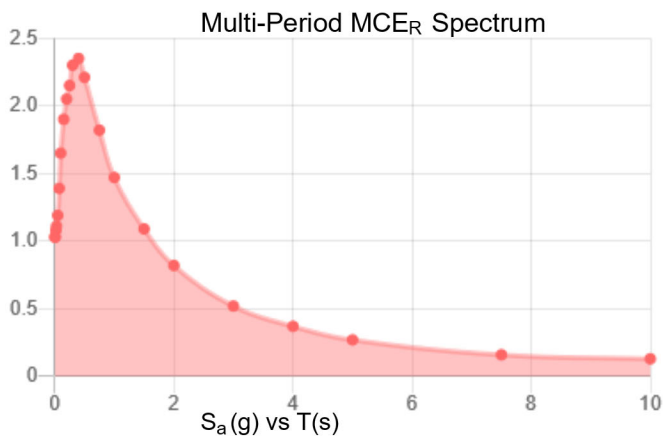


Site Soil Class:

Results:

PGA_M :	1.02	T_L :	16
S_{MS} :	2.12	S_S :	1.71
S_{M1} :	1.48	S_1 :	0.72
S_{DS} :	1.41	V_{S30} :	260
S_{D1} :	0.99		

Seismic Design Category: D



MCE_R Vertical Response Spectrum
 Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum
 Vertical ground motion data has not yet been made available by USGS.

Data Accessed: Sun Jul 30 2023

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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**Geotechnical Engineering Report and
Site Specific Seismic Hazard Investigation**

For the

**Proposed New City Hall/Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon**

Prepared for

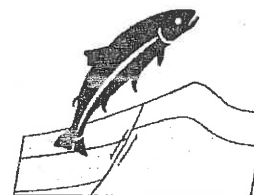
**Mr. Mark See
Public Works Director
City of Cannon Beach
163 East Gower Street
P.O. Box 368
Cannon Beach, Oregon 97110**

Prepared by

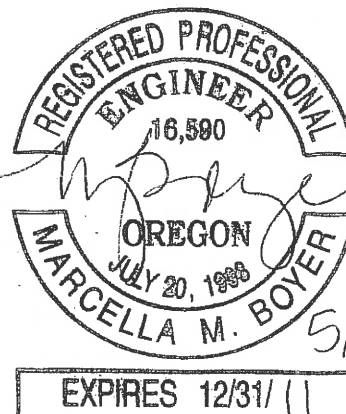
**Chinook GeoServices, Inc.
1701 Broadway #105
Vancouver, Washington 98663
Telephone (360) 695-8500
Fax (360) 695-8510**

CGI Report No. 11-022-1

May 4, 2011

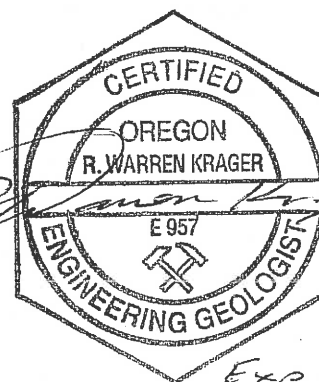


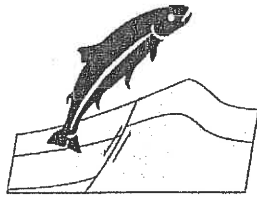
Chinook GeoServices, Inc.



**Marcella Boyer, P.E., G.E.
Principal Geotechnical Engineer**

**R. Warren Krager, R.G., C.E.G.
Principal Engineering Geologist**





Chinook GeoServices Inc.

May 4, 2011

Mr. Mark See
Public Works Director
City of Cannon Beach
163 East Gower Street
P.O. Box 368
Cannon Beach, Oregon 97110
see@ci.cannon-beach.or.us

**Subject: Geotechnical Engineering Report and
Site-Specific Seismic Hazard Evaluation
Proposed New City Hall/Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon
CGI Report No. 11-022-1**

Dear Mr. See:

Chinook GeoServices, Inc. (CGI) is pleased to submit our Geotechnical Engineering Report and Site-Specific Seismic Hazard Evaluation for the proposed new City Hall/Tsunami Evacuation Building (TEB) located at 163 East Gower Street in Cannon Beach, Oregon. This report includes the results of our field and laboratory testing, geotechnical engineering analysis, recommendations for site development, and results of our site-specific seismic hazard evaluation.

We appreciate the opportunity to perform this evaluation and look forward to continued participation during the remaining design and construction phases of this project. Please contact Marcy Boyer at (360) 695-8500 if you have any questions or if we may be of further service.

Respectfully submitted,

CHINOOK GEOSERVICES, INC.

Marcella Boyer, P.E., G.E.
Principal Geotechnical Engineer

R. Warren Krager, R.G., C.E.G.
Principal Engineering Geologist

Distribution: Addressee
Oregon Department of Geology and Mineral Industries

1701 Broadway #105 • Vancouver, Washington 98663 • Phone 360-695-8500 • Fax 360-695-8510

TABLE OF CONTENTS

	Page No.
1.0 EXECUTIVE SUMMARY	1
2.0 PROJECT INFORMATION.....	2
2.1 Project Authorization	2
2.2 Project Description	2
2.3 Purpose and Scope of Services	2
3.0 SITE AND SUBSURFACE CONDITIONS	3
3.1 Site Location and Description	3
3.2 Soil and Geologic Setting	4
3.3 Subsurface Soil Conditions	5
3.4 Groundwater Information.....	7
4.0 GEOTECHNICAL ENGINEERING EVALUATION.....	7
4.1 Geotechnical Engineering Discussion.....	7
4.2 Site Preparation and Earthwork Recommendations.....	7
4.3 Temporary Excavations.....	8
4.4 Construction Dewatering	9
4.5 Permanent Cut and Fill Slopes.....	10
4.6 Structural Fill Materials	10
4.7 Deep Foundation Recommendations.....	11
4.8 Seismic Design	14
4.9 Drainage.....	14
4.10 Floor Slabs	14
4.11 Pavement Design	15
5.0 REPORT LIMITATIONS.....	15
ATTACHMENTS	
Figure 1: Site Location Plan	
Figure 2: Site Plan with Exploration Locations	
Appendix A: Site-Specific Seismic Hazard Evaluation	
Appendix B: Field Exploration Procedures and Logs	
Appendix C: Laboratory Test Procedures and Results	
Appendix D: Pile Design Computer Output	
Appendix E: References	

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 1 of 16

1.0 EXECUTIVE SUMMARY

CGI has completed a geotechnical engineering study and seismic site hazard investigation to evaluate the feasibility of the proposed City of Cannon Beach, City Hall/Tsunami Evacuation Building (TEB) that is proposed at 163 East Gower Street in Cannon Beach, Oregon. The seismic site hazard investigation was conducted in general accordance with the Oregon Structural Specialty Code (OSSC) Chapter 1802.4.2.

The geotechnical subsurface exploration consisted of one 28-foot deep cone penetrometer test (CPT-1) and two mud rotary soil borings (B-1 and B-2) to depths of 115.5 feet and 121 feet using a subcontracted truck mounted drill rig. In general, the subsurface conditions consisted of medium stiff to soft silt and clay in the approximately upper 25 feet, which included abundant organic material below 15 feet. Below 25 feet, we encountered medium dense to dense gray sand. Multiple thin gravel layers were observed in the two borings at various depths. At an approximate depth of 100 feet below the ground surface we encountered siltstone bedrock. Static groundwater was encountered at about 21 feet below the ground surface based on interpretation of the pore-water pressure dissipation test conducted in CPT-1.

Based on the results of the field exploration and engineering analyses, it is our opinion that the proposed project is geotechnically feasible, based on the assumptions stated in this report.

In our opinion, the greatest geotechnical constraints at this site include the dynamic response of the subsurface conditions to earthquakes and the significant depth required for the foundations. Deep foundations that are embedded into the underlying siltstone bedrock are recommended for the proposed Tsunami Evacuation Building (TEB).

The owner and/or designer should not rely solely on this Executive Summary and must read and evaluate the entire contents of this report prior to using our engineering recommendations to prepare the design/construction documents.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 2 of 16

2.0 PROJECT INFORMATION

2.1 Project Authorization

Chinook GeoServices, (CGI) has completed a geotechnical engineering evaluation and a site specific seismic hazard study to evaluate the feasibility of the proposed City Hall/Tsunami Evacuation Building (TEB) that may be located at 163 East Gower Street in Cannon Beach, Oregon. The site specific seismic hazard evaluation is included as Appendix A of this report. Our work was completed in general accordance with the March 7, 2011 Personal Services Contract with the City of Cannon Beach.

2.2 Project Description

Our understanding of the project is based on a September 2010 site visit with Mark See, our review of the RFP and our participation in the Ad-Hoc Committee for the Tsunami Evacuation Building at City Hall during 2009 and 2010. The proposed City Hall/TEB is proposed to be in the same location as the existing City Hall. The current conceptual design consists of the main city hall offices on the main floor with a flat roof for evacuation during a tsunami. The main offices would be elevated on robust concrete posts above the anticipated tsunami inundation elevation established by computer modeling. Stairs and a flat roof will be constructed for public access if a tsunami occurs. We anticipate that the new structure will be supported on concrete piers founded below the anticipated liquefaction depth and scour depth.

The geotechnical recommendations presented in this report are based on the available project information, and the subsurface conditions described in this report. If any of the project information is known to be incorrect, the client or authorized representatives should advise CGI in writing so that we may amend the recommendations as appropriate based on the corrected information. CGI will not be responsible for the applicability of its recommendations when not notified of changes in the project.

2.3 Purpose and Scope of Services

The purpose of our services was to provide geotechnical engineering design recommendations and conduct a site-specific seismic hazard study to evaluate the feasibility of development for the proposed new City Hall/TEB. Our general scope of work for this project was outlined in Exhibit A of the March 7, 2011 Personal Services Contract between the City of Cannon Beach and CGI.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 3 of 16

Our scope of services included two mud rotary soil borings, one cone penetration test, soil laboratory testing, and engineering analyses to evaluate the soil properties for deep foundation support, seismic characteristics and hazards and other geotechnical engineering concerns for subsurface materials underlying the site. This geotechnical engineering report provides our recommendations for site earthwork, deep foundation design, subsurface drainage, slab support, pavement design, and other geotechnical engineering design and construction considerations. Appendix A includes the results of our Site-Specific Seismic Hazard Evaluation, which was prepared in general conformance with Exhibit A and the 2010 Oregon Structural Specialty Code (OSSC).

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Location and Description

The site location is shown on Figure 1, Site Location Plan, attached to the back of this report. The site address is 163 East Gower Street, Cannon Beach, Oregon. The site is comprised of Tax Lots 11100, 12000, and 11900, of T5N R10W Section 30-AD in Clatsop County. Lots 12000 and 11900 are adjacent and are bordered on the north by East Gower Street, on the west by Evergreen Avenue, on the east by the undeveloped Harding Avenue right-of-way, and on the south by developed residential properties. The combined lot dimensions are approximately 325 feet east to west and 100 feet north to south. Lot 11100 across the street to the west of the other lots is bordered on the north by East Gower Street, on the west by South Hemlock Avenue, on the east by Evergreen Avenue, and on the south by Coolidge Avenue. The approximate lot dimensions are 100 feet east to west and 200 feet north to south.

Lot 12000 is currently developed with a single story structure housing the City of Cannon Beach municipal offices. Lot 12000 also includes paved parking areas east and west of the developed structure. Lot 11900 is currently undeveloped. Lot 11100 is developed with a paved municipal parking lot. It is our understanding that the proposed structure will be located on Lot 12000, which is referred to in this report as the project site.

Based on an aerial topographic survey of The City of Cannon Beach dated December 28, 2004, the project site elevation is roughly 30 feet above mean sea level (MSL). The area of the project site is relatively level, with a minor descending slope toward the west. Site specific topographic mapping was not available at the time of this report.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 4 of 16

3.2 Soil and Geologic Setting

Soils mapped in the project area by the United States Department of Agriculture (USDA), Natural Resource Conservation Service Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov>) consist of Walluski silt loam, 0 to 7 percent slopes. This mapped unit consists of very deep, moderately well drained soils found on fluvio-marine and stream terraces. The soil formed from mixed alluvium and/or fluvio-marine deposits derived from sedimentary rock. A typical soil profile consists of medial silt loam to a depth of 13 inches, underlain by silty clay loam to a depth of 60 inches.

Geologic mapping for the project area is included in the 2009 Oregon Department of Geology and Mineral Industries (DOGAMI) open file report O-09-06 "Coastal Erosion Hazard Zones in Southern Clatsop County, Oregon: Seaside to Cape Falcon". This publication maps the geology in the project area as late Pleistocene age (126,000 years to 10,000 years ago) coastal terrace deposits (unit Qpt). This unit is described as unconsolidated to moderately consolidated gravel, beach, and dune sand; locally containing minor consolidated clay-rich paleosol, colluvium, debris flows, and alluvial sand, silt, and gravel deposited in channel and point bar environments. The 1985 Geologic Map of the Astoria Basin, Clatsop and Northernmost Tillamook Counties, Northwest Oregon, Oil and Gas Investigation 14 prepared by DOGAMI similarly maps the site as Pleistocene age (1.8 million years to 10,000 years ago) coastal marine-terrace deposits (Qmt). This unit is described as predominantly laminated to cross-bedded beach sand and crudely stratified rounded basalt gravels with some discontinuous paleosols, mud beds, and layers of partially carbonized tree trunks and limbs. The 1972 Environmental Geology of the Coastal Region of Tillamook and Clatsop Counties, Oregon, Bulletin 74 prepared by DOGAMI also maps the geology at the site as Pleistocene age Marine Terraces (Qmt).

The DOGAMI O-09-06 geologic map also shows undifferentiated Holocene age (10,000 years ago to present) alluvial deposits (Qha) directly west of the site. This unit is described as unconsolidated sand, silt, and gravel deposited in alluvial fan, stream terrace, or basin environments. The mapped geologic unit may represent an old stream channel in the vicinity of the project.

The uplands to the south of the subject site are mapped by Bulletin 81 as Oligocene to Miocene Sedimentary Rocks (unit Toms) and by Oil and Gas Investigation 14 as middle to lower Miocene Cannon Beach member of the Astoria Formation (unit Tac). The Toms unit consists of thin bedded to massive, medium to dark gray (orange to white where weathered), tuffaceous siltstone, with lesser amounts of sandstone and claystone. Unit Tac is described as well bedded, laminated to massive micaceous mudstone with subordinate rhythmically thin bedded feldspathic sandstone and mudstone in the lower part of the unit. Numerous outcrops of Intrusive Grande Ronde Basalt (unit Tgri) are mapped within unit Tac south of the site. Unit Tgri is described as a Tertiary middle

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 5 of 16

Miocene age, invasive sills, dikes, and irregular bodies of massive to columnar-jointed, aphyric to rarely phyrlic basalt and peperite or intrusive bodies related to Grande Ronde Basalt.

3.3 Subsurface Soil Conditions

Subsurface soil conditions were explored by CGI Geologic Associate Chuck Bolduc, G.I.T., who visited the site on March 29 and March 30, 2011. We observed advancement of two mud rotary soil borings (B-1 and B-2) to depths of 115.5 feet and 121 feet using a subcontracted truck mounted drill rig and one cone penetrometer test (CPT-1) to a depth of 28 feet using a subcontracted rig. The borings and CPT were located in the general vicinity of the proposed structure and were selected in the field by Mark See, the Public Works Director with the City of Cannon Beach, Oregon. The approximate boring and CPT locations are shown on Figure 2. Detailed boring and CPT logs are included in the attached Appendix B.

Boring B-1 was drilled on March 29, 2011 and with sample intervals between 0 feet and 5 feet and took more than 1 day to drill. Because we observed primarily sand that was similar in gradation between 25 feet and 100 feet and bedrock at 100 feet, we recommended to Mr. See that we expand the sample intervals to between 10 feet and 25 feet so that we could get better information for foundation design in the bedrock. Mr. See agreed with the recommendation and boring B-2 was drilled on March 30, 2011 using the expanded sample intervals.

In general, the subsurface conditions consisted of medium stiff to soft silt and clay in the approximately upper 25 feet, which included abundant organic material below 15 feet. Below 25 feet, we encountered medium dense to very dense gray sand. Multiple thin gravel layers were observed in the two borings at various depths. At approximately 100 feet below the ground surface, we encountered siltstone bedrock. A more detailed description of the soils encountered in the borings is included below:

Clay and Organic Debris - The clay was stiff in the near surface becoming softer with depth. Clay was tan with rust mottling with minor inclusions of rust concretions. Some sandy texture was observed but sand particles were not present. In boring B-2, the drill cuttings were observed to be significantly more orange in color than in boring B-1. Wood fiber was observed in the cuttings from boring B-2 at a depth of 10 feet and again at 15 feet. A sample in boring B-2 encountered a log or stump oriented vertically based on the vertical wood grain, which was relatively fresh to minimally decomposed. Other samples encountered gray clay with decomposed wood debris and gray clayey sand with decomposed wood debris. We interpret this sequence of sediments were deposited in an

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 6 of 16

alluvial environment. Based on the CPT data, the shear wave velocity was between 402 feet per second and 582 feet per second in this soil layer.

Beach and Dune Sand - Dense, wet, gray sand was encountered at a depth of 25 feet in boring B-1 and dense sand to silty sand was found in CPT-1 below 26 feet. The sand was fine-grained, poorly-sorted sand with abundant micaceous flakes at selected depths. The micaceous material may have been derived from weathering of local mica-bearing sandstones of the Astoria Formation and deposited as alluvial sands. Very dense basaltic gravel and sand was encountered in boring B-1 at 55 feet below the ground surface, and ended at 57.5 feet below the ground surface based on drilling characteristics. Thin layers of gravel were also interpreted at 61.5 feet in boring B-1 and 65 feet in boring B-2 based on drilling characteristics. Based on the limited thickness and variable depth, we interpret the gravel to be discontinuous. We interpret the sands and gravel deposits to be consistent with the geologic mapping of marine terrace deposits. The CPT met refusal near the top of the contact of the upper dense sand layer at 26 feet and shear wave velocities were not obtained below 25 feet. However, based on our blow count data, we estimate that the beach and dune sand has a shear wave velocity between 650 feet per second and 1,300 feet per second.

Siltstone Bedrock - Hard siltstone bedrock was encountered in boring B-1 at 100 feet below the ground surface and in boring B-2 at 101 feet below the ground surface. The siltstone observed in each boring differed in blow counts, drilling characteristics, and cutting return. The siltstone in boring B-1 had very high blow counts, variably hard and easy drilling and black fragments of basaltic rock returned in the drill cuttings. The siltstone in boring B-2 had relatively lower blow counts, consistent drilling characteristics, and no basaltic cuttings were observed. We interpret that the siltstone in boring B-1 also included a minor basalt intrusion, which is consistent with the abundantly mapped basaltic intrusives within the Astoria Formation in the area. In boring B-1, we drilled 15 feet into the formation and in boring B-2, we drilled 20 feet into the formation. According to a Madin and Wang 1999 paper, the shear wave velocity of the siltstone bedrock was estimated to be 1,870 feet per second.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in Appendix B should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, and test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then will be discarded.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 7 of 16

3.4 Groundwater Information

The static groundwater elevation in the project area was interpreted to be approximately 25 feet to 30 feet below the ground surface based on our observation of soil samples recorded during mud rotary drilling. The cone penetrometer test conducted a pore-water dissipation test within the dense gray sand at a depth of approximately 27.5 feet. Results of the pore-water dissipation test indicated a static water level of approximately 21 feet below the ground surface. We have assumed a groundwater depth of 21 feet below the ground surface for the purpose of this report.

4.0 GEOTECHNICAL ENGINEERING EVALUATION

4.1 Geotechnical Engineering Discussion

Based on the results of the field exploration and engineering analyses, it is our opinion that the proposed project is geotechnically feasible based on assumptions and preliminary design criteria discussed below. However, this report may not include geotechnical analyses and design recommendations sufficient for final design.

In our opinion, the greatest geotechnical constraints at this site include the dynamic response of the subsurface conditions to earthquakes and the significant depth required for the foundations. Deep foundations that are embedded into the underlying siltstone bedrock are recommended for this development.

4.2 Site Preparation and Earthwork Recommendations

We anticipate that the proposed building footprint and related parking areas, sidewalks, and other site improvements will be located in areas that are currently developed with the existing city building and paved parking areas. We recommend that the existing pavement and foundations be completely removed from the site in areas that will be developed with structures or pavement. The existing base rock could remain in-place if it is below finished subgrade elevation. Based on our subsurface explorations, the thickness of the asphalt pavement was 1.5 inches in boring B-1. The depths of the existing foundations for the city building are unknown; therefore, the depth of removal in this area is unknown. In areas where there are trees, soft disturbed soil, or manmade fill, additional stripping may be necessary. A representative of the geotechnical engineer should determine the depth of removal at the time of construction.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 8 of 16

The existing asphaltic pavement and stripped soils may not be suitable for re-use as structural fill and should be exported from the site. The base rock gravel could re-used as structural fill. Additionally, the removed concrete foundations could potentially be crushed for re-use as structural fill. A representative of the geotechnical engineer should be contacted to review and approve the onsite materials for re-use as structural fill at the time of construction. Our recommendations for structural fill and compaction are included below in section 4.6.

Wet weather and construction equipment could severely disturb the upper several feet of the clayey subgrade during initial phases of site clearing. We recommend dry weather construction to protect the subgrade from disturbance. If the subgrade becomes wet or is exposed to significant construction traffic, the subgrade may soften and require additional stripping prior to construction. After stripping, a granular working pad consisting of crushed rock should be placed over the subgrade to protect it from disturbance and provide access for construction equipment. The thickness of the working pad would depend on the use of the stripped area (haul road, material storage, etc.) We can provide thickness recommendations prior to construction when construction sequencing and staging is known.

Alternately, the site could be stripped in phases. The proposed building area could be prepared for placement of foundations and the existing pavement could be used for construction access and staging during construction. The paved areas could then be stripped for construction of the new parking areas and other related improvements outside the building area. We are providing these considerations solely for your use in developing a plan for your project. It is the ultimate responsibility of the contractor to determine the construction methods that are most appropriate for the site.

Following subgrade preparation, and prior to placement of structural fill or base course, we recommend that the site be proof rolled with a fully loaded 10 yard to 12 yard dump truck or other suitably loaded rubber-tired construction vehicle. Any areas that pump, weave, or appear exceptionally soft or muddy should be overexcavated to a depth determined by the geotechnical engineer and backfilled with compacted granular fill. If significant time passes between completion of subgrade preparation and commencement of other construction activities, or if significant traffic has been routed across the site, we recommend that the site be similarly proof rolled before placement of base rock or paving. A representative of our firm should observe this operation.

4.3 Temporary Excavations

Stability of temporary excavations is the responsibility of the contractor, who must maintain safe excavation slopes and/or shoring. Excavations must comply with the current requirements of OSHA

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 9 of 16

and the State of Oregon. We are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that CGI is assuming responsibility for construction site safety or the contractor's compliance with local, state, and federal safety or other regulations.

The contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

We recommend that the temporary excavations not encroach below a 2H:1V line extended downward from the existing utilities to reduce the risk of settlement and/or collapse of existing features, such as the sidewalk and street pavement. If this setback cannot be maintained, we recommend installing temporary shoring. We should be contracted to review the final documents for construction.

The near surface soils generally consist of medium stiff fine-grained cohesive soils, which are considered a Type B soil when applying the OSHA regulations. For Type B soils, the maximum recommended temporary slope inclination is 1 Horizontal to 1 Vertical (1H:1V). Flatter slopes and/or trench shields may be required if loose soils, debris, voids, and/or water are encountered along the slope face. The recommended maximum inclination for temporary slopes is based on the assumption that the ground surface behind the cut slope is level, that surface loads from equipment and materials are kept a sufficient distance away from the top of the slope (typically at least half the slope height), and that utility trench excavations are completed and backfilled prior to the construction of structures adjacent to the excavations. If these assumptions are not valid, we should be contacted for additional recommendations.

4.4 Construction Dewatering

Groundwater was estimated to be approximately 21 feet below the ground surface during our explorations, which were conducted in March, when groundwater is typically at higher levels in response to the wet season. However, it is possible that shallow perched water within the fine-grained soils may be encountered during construction. If shallow water is encountered during construction, for most excavations, pumping from a sump inside or outside the limits of the excavation should adequately control seepage and surface water ponding. As an alternative, dewatering wells may be installed outside of the excavation if water seepage is significant. During

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 10 of 16

wet weather, earthen berms or other methods should be used to prevent runoff water from entering excavations. All runoff water and groundwater encountered within the excavation(s) should be collected and disposed of outside the construction limits.

4.5 Permanent Cut and Fill Slopes

We do not expect significant cut or fill slopes will be associated with this project based on the relatively level topography in the area. If any are planned, we recommend that permanent slopes in native soils or engineered fill be graded no steeper than 2H:1V and be protected from erosion by civil engineer designed and approved methods.

4.6 Structural Fill Materials

Imported structural fill should only be installed on a subgrade that has been prepared in accordance with the preceding recommendations. Fill materials should be free of organic or other deleterious materials have a maximum particle size less than 3 inches, be relatively well graded, and have a liquid limit less than 45 and plasticity index less than 25. The suitability of soil for use as compacted structural fill will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion finer than the US Standard No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and compaction becomes more difficult to achieve. Soils containing more than about 5 percent fines cannot consistently be compacted to a dense, non-yielding condition when the water content is significantly greater (or significantly less) than optimum. The onsite clay soil will not be acceptable for re-use as structural fill. The existing base rock will likely be acceptable for re-use as structural fill provided it meets the specifications above, is free of organic material, and is separated from the asphalt pavement. The demolished concrete foundations can potentially be processed to create a crushed rock product meeting the above specifications for use as structural fill.

On-site base rock and imported granular material that are used for engineered fill should be uniformly moisture conditioned to within ± 2 percent of the optimum moisture content and compacted in thin lifts using suitable mechanical compaction equipment. We recommend that fill intended to support foundations, slabs or pavements be placed in horizontal lifts in thickness from 8 inches to 12 inches, and be compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor compaction test method (AASHTO T-180 or ASTM D1557).

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 11 of 16

4.7 Deep Foundation Recommendations

Deep foundations and a structural slab are recommended for this development. At this time, 2-foot diameter concrete auger cast-in-place piles would be generally compatible with the site subsurface conditions and earthquake performance criteria for this project. No structural load information was available at the time of this evaluation and our foundation analysis is intended for a feasibility evaluation only.

The results of our liquefaction analysis (included in Appendix A) indicate the presence of up to 75 feet of unconsolidated clayey silt, sand and gravel that may liquefy and/or strain soften during the modeled earthquakes. Based on the thickness of liquefiable soils we anticipate that deep foundations will need to be embedded in the bedrock. For feasibility evaluation purposes we have calculated the axial capacity of 2-foot diameter concrete auger cast-in-place piles embedded 10 feet into the underlying siltstone bedrock at an approximate depth of 100 feet below the ground surface. Other pile sizes and types could be used, subject to structural design and constructability criteria.

We assumed a cohesion value of 2,500 pounds per square foot (psf) for the blue-gray siltstone. A friction angle is not appropriate for the siltstone bedrock material.

Estimated Axial Pile Capacity – We expect that the static and transient compressive loads on the piles will be achieved through a combination of end bearing and skin friction. Our estimated allowable compressive capacities are based on a static factor of safety of 3.0 for end bearing, side friction and uplift. The capacities can be increased by 1/3 for transient loads. Axial pile capacities were determined using the computer program AllPile 7. The pile has an axial downward capacity of approximately 975 kips and an allowable uplift capacity of 230 kips under static conditions. The results of the analysis are included in Appendix D.

Estimated Downdrag – Downdrag is the additional load caused by adhesion or friction between the pile and the surrounding settling soil. Downdrag loads are caused by negative skin friction. Some negative skin friction would occur during settlement of the clay with organics layer between 15 feet and 25 feet below the ground surface. In addition, we expect that the pile will be subjected to negative skin friction from liquefaction during the modeled earthquakes. The earthquake ground motions will strain soften the clayey soils and liquefy the saturated sand. The structural capacity of piles is affected by downdrag loads. Downdrag increases the stresses in the pile and pile cap and has the potential for creating settlement. For a single pile, the downward load transferred to a pile is equal to the shearing resistance along the pile. This may be calculated using the formula on the following page.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 12 of 16

$$Q_{nf} = s * L * P^1$$

Where Q_{nf} = Average downward load transferred to the pile
 s = Shear resistance of the soil
 L = Length of embedment above the bottom of the compressible layer
 P^1 = Perimeter of the Pile

Then, the average downward load, Q_{nf} is then added to the total live load and dead load, Q , applied to the pile, according to the following equation:

$$Q_T = Q + Q_{nf}$$

Where Q_T = Total applied load
 Q = Live load plus dead load
 Q_{nf} = Average downward load transferred to the pile

For this site, we estimate that the load transferred to the pile (Q_{nf}) for consolidating organics would be approximately 46 kips. The downward load transferred to the pile (Q_{nf}) from liquefaction during the modeled earthquake is estimated to be 450 kips, assuming the upper 75 feet contributes to the downdrag load.

Estimated Lateral Pile Capacities – Lateral loads on piles could be imposed by wind and seismic events and by liquefied soil. These loads are resisted primarily by horizontal bearing support of the soils adjacent to the pile shafts. The lateral capacity of a pile depends on its length, stiffness in the direction of loading, proximity to other piles and degree of zero moment, as well as the engineering properties of the soil. Lateral pile capacities were estimated using the computer program LPILE Plus V5.0. The results are included in Appendix D.

Our model included liquefied sand that could be present during the modeled earthquakes.

We have presented our estimated lateral pile top capacities for free and fixed head conditions in Table 1 on the following page. These include a factor of safety of 3 applied to the lateral load.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report

CGI Report No.: 11-022-1

May 4, 2011

Page 13 of 16

Table 1 – Lateral Load Information

Lateral Load Information for ½-inch Deflection				
Pile Length (feet)	Pile Head Condition	Allowable Lateral Load (kips)	Maximum Bending Moment (feet-kips)	Depth of Zero Moment (feet)
110	Free	12.0	253	0, 50
	Fixed	21.2	663	17
Lateral Load Information for 1-inch Deflection				
110	Free	16.4	408	0, 54
	Fixed	31.2	1,153	18

Pile Spacing and Group Effects – The above mentioned values for compressive, uplift and lateral capacity refer to single piles unaffected by group interactions. To reduce or eliminate group effects, we recommend that the pile spacing not be less than three pile diameters measured center to center. If piles are at least three diameters apart, group effects can be neglected for compressive, uplift and perpendicularly applied lateral loads. For in-line lateral loads, however, group effects reduce the lateral load capacity of the pile at a pile spacing less than eight diameters. The following reduction factors should be applied to in-line laterally loaded piles with a center-to-center spacing between three and eight diameters as shown in the following table.

Table 2 – Reduction Factors for In-Line Laterally Loaded Piles

Pile Spacing Center to Center	In-line Load Reduction Factor
3 pile widths	.25
4 pile widths	.4
6 pile widths	.7
8 pile widths	1.0

Estimated Settlements – We estimate that total post-construction static settlements of pile-supported elements will not exceed 1 inch. Differential settlements could approach ½ of the actual total settlement amount.

Installation Monitoring – CGI should be retained to continuously monitor installation of the piles. CGI will verify that the suitable tip depths are reached. The monitoring program would include

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 14 of 16

observation and documentation of installation procedures, construction equipment, pile materials, drilling conditions and sequencing and load testing.

4.8 Seismic Design

The seismic analysis for the feasibility study was conducted using historic earthquakes with shorter duration than the 5 minutes to 6 minutes of shaking that the scientific community believes may be possible. In our opinion, the selected ground motions were adequate for this feasibility study and showed that seismic hazards do exist at the site. Longer duration ground motions may need to be considered during the final design phase of this project.

According to the site specific seismic hazard feasibility summary, we recommend using the site specific values of S_{DS} and S_{D1} , which are recommended to be 0.52g and 1.41g, respectively. Both values exceed the IBC response spectrum. The analysis was conducted for shorter duration earthquakes and these values could change.

4.9 Drainage

All roof, landscape, and other upland surface water should be directed to approved discharge points away from foundations and retaining walls. In our opinion, underslab and perimeter drains are not needed for this project. We do not expect that infiltration of stormwater into the underlying clay soils will be feasible for this site. A professional civil engineer should be consulted to provide grading plans for drainage, stormwater management options, and utility design.

4.10 Floor Slabs

Because of the intended function of the proposed building as an essential facility, we do not recommend conventional floor slab on grade. We have concern that a conventional floor slab would provide performance liabilities during an earthquake and/or subsequent tsunami event. Liquefaction under a concrete floor slab may cause it to heave or tilt and become more susceptible to tsunami shear forces or scour. A non structural slab could potentially damage foundation components during an earthquake and tsunami.

We recommend that any required floor slabs be designed as structural slabs that would not rely on near surface soil for support and would be engineered to remain intact during the design seismic event.

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 15 of 16

4.11 Pavement Design

Our scope of services did not include extensive sampling and CBR testing for the existing subgrade, or testing of potential sources of imported fill, for the specific purpose of detailed pavement analysis. Instead, we have assumed pavement related design parameters that are considered to be typical for the area soil types. The pavement recommendations presented in this report are limited to the on-site parking areas and driveways. A more detailed analysis of the subgrade and traffic conditions should be made for street improvements to the existing right-of-way or where pavements are subject to significant traffic loading conditions. The results of such a study would provide information necessary to design an economical and serviceable pavement.

We anticipate that stiff to medium stiff clay will remain underlying proposed driveway and parking areas. We recommend that the subgrade be prepared in accordance with Section 4.2, Site Preparation and Earthwork Recommendations, of this report. Pavement may be placed after the subgrade has been properly prepared, fine-graded and proof rolled.

The thickness recommendations presented below are considered minimum for the assumed parameters. We understand that budgetary considerations sometimes warrant thinner pavement sections than those presented. However, the project team should be aware that thinner pavement sections might result in increased maintenance costs and lower than anticipated pavement life.

We have estimated the near surface subgrade soils will be have a CBR of at least 4. Our recommended pavement sections are outlined in Table 3. The pavement materials and installation procedures should be completed in accordance with Oregon Department of Transportation guidelines.

Table 3 – Pavement Section Recommendations

	Car Parking and Driveways
Asphalt Surface Course	2.5
Granular Base Course	8

Rigid concrete pavements are not recommended for this site because of potentially poor performance during an earthquake event.

5.0 REPORT LIMITATIONS

The recommendations submitted in this report are based on the available subsurface information obtained by CGI and project information provided by Mark See of the City of Cannon Beach,

City Hall/Tsunami Evacuation Building - Geotechnical Engineering Report
CGI Report No.: 11-022-1
May 4, 2011
Page 16 of 16

Oregon for the feasibility study for the proposed City Hall/Tsunami Evacuation Building. We will be available to provide further geotechnical analysis and design services as the project progresses.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed. This report has been prepared for the exclusive use of the client or their authorized agents for the specific application to the proposed project.

APPENDIX A:
SITE-SPECIFIC SEISMIC HAZARD EVALUATION

APPENDIX A

SITE-SPECIFIC SEISMIC HAZARD EVALUATION

TABLE OF CONTENTS

	PageNo.
Site Location and Description.....	1
Regional Geology.....	1
Soil and Geologic Setting.....	2
Subsurface Soil Conditions.....	4
Groundwater Information	6
Seismic Setting	6
Ground Shaking.....	7
Probabilistic Seismic Hazard Analysis (PSHA)	7
Deterministic Seismic Hazard Analysis (DSHA)	10
Site Specific Acceleration Parameters for Design	14
Site Specific Seismic Hazard Summary	14
Limitations	16

FIGURES

- Figure A-1: Site Location Plan
- Figure A-2: Site Plan with Exploration Locations
- Figure A-3: Geologic Maps
- Figure A-4: Historic Earthquakes and Fault Map
- Figure A-5: Tsunami Inundation Map

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 1 of 16

SITE-SPECIFIC SEISMIC HAZARD EVALUATION

Chinook GeoServices, (CGI) has completed this site specific seismic hazard evaluation for the proposed City Hall/Tsunami Evacuation Building (TEB) located at 163 East Gower Street in Cannon Beach, Oregon to determine the feasibility of the project. This study is an attachment to our geotechnical engineering report titled "Proposed New City Hall/Tsunami Evacuation Building, 163 East Gower Street, Cannon Beach, Oregon", CGI Report No. 11-022-1 dated May 4, 2011. Our work was completed in general accordance with the March 7, 2011 Personal Services Contract with the City of Cannon Beach.

Site Location and Description

The site location is shown on Figure A-1, Site Location Plan, attached to the back of this report. The site address is 163 East Gower Street, Cannon Beach, Oregon. The site is comprised of Tax Lots 11100, 12000, and 11900, of T5N R10W Section 30-AD in Clatsop County. Lots 12000 and 11900 are adjacent and are bordered on the north by East Gower Street, on the west by Evergreen Avenue, on the east by the undeveloped Harding Avenue right-of-way, and on the south by developed residential properties. The combined lot dimensions are approximately 325 feet east to west and 100 feet north to south. Lot 11100 lies across the street to the west of the other lots is bordered on the north by East Gower Street, on the west by South Hemlock Avenue, on the east by Evergreen Avenue, and on the south by Coolidge Avenue. The approximate lot dimensions are 100 feet east to west and 200 feet north to south. The approximate site layout is included in Figure A-2.

Lot 12000 is currently developed with a single story structure housing the City of Cannon Beach municipal offices. Lot 12000 also includes paved parking areas east and west of the developed structure. Lot 11900 is currently undeveloped. Lot 11100 is developed with a paved municipal parking lot. It is our understanding that the proposed structure will be located on Lot 12000, which is referred to in this report as the project site.

Based on an aerial topographic survey of The City of Cannon Beach dated December 28, 2004, the project site elevation is roughly 30 feet above mean sea level (MSL). The area of the project site is relatively level, with a minor descending slope toward the west. Site specific topographic mapping was not available at the time of this report.

Regional Geology

Much of Oregon's geologic history is defined by its location on a convergent plate tectonic boundary (subduction zone). The oceanic crust west of Oregon has collided with and subducted beneath the continental crust, a process which continues to the present day. As the oceanic crust moved toward the continent, material that could not be subducted was accreted onto the continent. The

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 2 of 16

subducting oceanic plate melted as it plunged deeper into the earth and magma migrated to the surface, creating a volcanic arc; known today as the Cascade Range. Other local and massive volcanic episodes, large earthquakes, tectonic shifting, continued erosion and sedimentation, catastrophic flooding and other geologic processes further defined Oregon's landscape. Oregon can be generally divided into geologic provinces, which share similar geologic histories, landforms, and composition. The subject site is generally located in the geologic province known as the Coast Range.

Marine sedimentary formations make up the primary bedrock in the Coast Range, which began forming approximately 65 million years ago (early Paleocene) when forearc sedimentation built a thick wedge of marine sediments off the coast. Silt, sand, and mud were deposited on the Pacific Ocean floor off the coast of Oregon and were compressed into thick layers of sedimentary rocks. As the ocean sediments were steadily accumulating, the two tectonic plates continued to collide. Uplift, folding, and faulting associated with the plate convergence continued to push the marine sedimentary rock upward to form much of the Coast Range. Accumulation of marine sediments and convergence of the plates continues to the present day.

Approximately 45 million years to 36 million years ago (middle Eocene age), the North American continental plate drifted west over a hot spot. The hot spot fed magma through the submarine Coast Range sediments and erupted lava that built up along the coast. These volcanic and intrusive rocks make up the Tillamook Highlands. Hot spot volcanism again influenced the Coast Range province between 17 million years and 15 million years ago (middle Miocene age). This period of highly active volcanism produced a series of gigantic lava floods originating from great fissures near the current Oregon-Idaho-Washington border. The thick and widespread deposits are collectively known as the Columbia River Basalts. Some basalt flows travelled all the way to the Oregon coast.

Marine sediment accumulation, lithification, and uplift were taking place before, during, and after the intermittent volcanic episodes. Where the marine sedimentary formations are older, intrusive sills and dykes, and flows of younger volcanics are sometimes present within and overlying the sedimentary rock. Basalt flows were also deposited along with the marine sediments in shallow marine environments, creating intermittent layers of marine sedimentary rock and submarine basalt formations. Large flows of basalt, such as the Columbia River Basalt, also created injection sills and dikes in the underlying sedimentary formations, which are abundant in the northwest Coast Range.

Soil and Geologic Setting

Soils mapped in the project area by the United States Department of Agriculture (USDA), Natural Resource Conservation Service Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov>) consist of

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 3 of 16

Walluski silt loam, 0 to 7 percent slopes. This mapped unit consists of very deep, moderately well drained soils found on fluvio-marine and stream terraces. The soil formed from mixed alluvium and/or fluvio-marine deposits derived from sedimentary rock. A typical soil profile consists of medial silt loam to a depth of 13 inches, underlain by silty clay loam to a depth of 60 inches.

Geologic mapping for the project area is included in the 2009 Oregon Department of Geology and Mineral Industries (DOGAMI) open file report O-09-06 "Coastal Erosion Hazard Zones in Southern Clatsop County, Oregon: Seaside to Cape Falcon". This publication maps the geology in the project area as late Pleistocene age (126,000 years to 10,000 years ago) coastal terrace deposits (unit Qpt). This unit is described as unconsolidated to moderately consolidated gravel, beach, and dune sand; locally containing minor consolidated clay-rich paleosol, colluvium, debris flows, and alluvial sand, silt, and gravel deposited in channel and point bar environments. The 1985 Geologic Map of the Astoria Basin, Clatsop and Northernmost Tillamook Counties, Northwest Oregon, Oil and Gas Investigation 14 prepared by DOGAMI similarly maps the site as Pleistocene age (1.8 million years to 10,000 years ago) coastal marine-terrace deposits (Qmt). This unit is described as predominantly laminated to cross-bedded beach sand and crudely stratified rounded basalt gravels with some discontinuous paleosols, mud beds, and layers of partially carbonized tree trunks and limbs. The 1972 Environmental Geology of the Coastal Region of Tillamook and Clatsop Counties, Oregon, Bulletin 74 prepared by DOGAMI also maps the geology at the site as Pleistocene age Marine Terraces (Qmt).

The DOGAMI O-09-06 geologic map also shows undifferentiated Holocene age (10,000 years ago to present) alluvial deposits (Qha) directly west of the site. This unit is described as unconsolidated sand, silt, and gravel deposited in alluvial fan, stream terrace, or basin environments. The mapped geologic unit may represent an old stream channel in the vicinity of the project.

The uplands to the south of the subject site are mapped by Bulletin 81 as Oligocene to Miocene Sedimentary Rocks (unit Toms) and by Oil and Gas Investigation 14 as middle to lower Miocene Cannon Beach member of the Astoria Formation (unit Tac). The Toms unit consists of thin bedded to massive, medium to dark gray (orange to white where weathered), tuffaceous siltstone, with lesser amounts of sandstone and claystone. Unit Tac is described as well bedded, laminated to massive micaceous mudstone with subordinate rhythmically thin bedded feldspathic sandstone and mudstone in the lower part of the unit. Numerous outcrops of Intrusive Grande Ronde Basalt (unit Tgri) are mapped within unit Tac south of the site. Unit Tgri is described as a Tertiary middle Miocene age, invasive sills, dikes, and irregular bodies of massive to columnar-jointed, aphyric to rarely phyrlic basalt and peperite or intrusive bodies related to Grande Ronde Basalt. A figure illustrating the geologic maps is included in Figure A-3.

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 4 of 16

Subsurface Soil Conditions

Subsurface soil conditions were explored by CGI Geologic Associate Chuck Bolduc, G.I.T., who visited the site on March 29 and March 30, 2011. We observed advancement of two mud rotary soil borings (B-1 and B-2) to depths of 115.5 feet and 121 feet using a subcontracted truck mounted drill rig and one cone penetrometer test (CPT-1) to a depth of 28 feet using a subcontracted rig. The borings and CPT were located in the general vicinity of the proposed structure and were selected in the field by Mark See, the Public Works Director with the City of Cannon Beach, Oregon. The approximate boring and CPT locations are shown on Figure A-2. Detailed boring and CPT logs are included in the attached Appendix B.

Boring B-1 was drilled on March 29, 2011 and with sample intervals between 0 feet and 5 feet and took more than 1 day to drill. Because we observed primarily sand that was similar in gradation between 25 feet and 100 feet and bedrock at 100 feet, we recommended to Mr. See that we extend the sample intervals to between 10 feet and 25 feet so that we could get better information for foundation design in the bedrock. Mr. See agreed with the recommendation and boring B-2 was drilled on March 30, 2011 using the extended sample intervals.

In general, the subsurface conditions consisted of medium stiff to soft silt and clay in the approximately upper 25 feet, which included abundant organic material below 15 feet. Below 25 feet, we encountered medium dense to very dense gray sand. Multiple thin gravel layers were observed in the two borings at various depths. At approximately 100 feet below the ground surface, we encountered siltstone bedrock. A more detailed description of the soils encountered in the borings is included below:

Clay and Organic Debris

The clay was stiff in the near surface becoming softer with depth. Clay was tan with rust mottling with minor inclusions of rust concretions. Some sandy texture was observed but sand particles were not present. In boring B-2, the drill cuttings were observed to be significantly more orange in color than in boring B-1. Wood fiber was observed in the cuttings from boring B-2 at a depth of 10 feet and again at 15 feet. A sample in boring B-2 encountered a relatively fresh to minimally decomposed log or stump oriented vertically based on the vertical wood grain recovered in the sampler. Other samples encountered gray clay with decomposed wood debris and gray clayey sand with decomposed wood debris. We interpret this sequence of sediments were deposited in an alluvial environment. Based on the CPT data, the shear wave velocity was between 402 feet per second and 582 feet per second in this soil layer.

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 5 of 16

Beach and Dune Sand

Dense, wet, gray sand was encountered at a depth of 25 feet in boring B-1 and dense sand to silty sand was interpreted in CPT-1 below 26 feet. The sand was generally fine-grained poorly-sorted with abundant micaceous flakes in select samples. The micaceous material may have been derived from weathering of local mica-bearing sandstones of the Astoria Formation and deposited as alluvial sands. Very dense basaltic gravel and sand was encountered in boring B-1 at 55 feet below the ground surface, and ended at 57.5 feet below the ground surface based on drilling characteristics. Thin layers of gravel were also interpreted at 61.5 feet in boring B-1 and 65 feet in boring B-2 based on drilling characteristics. Based on the limited thickness and variable depth, we interpret the gravel to be discontinuous. We interpret the sands and gravel deposits to be consistent with the geologic mapping of marine terrace deposits. The CPT met refusal near the top of the contact of the upper dense sand layer at 26 feet and shear wave velocities were not obtained below 25 feet. However, based on our blow count data, we estimate that the beach and dune sand has a shear wave velocity between 650 feet per second and 1,300 feet per second.

Siltstone Bedrock

Hard siltstone bedrock was encountered in boring B-1 at 100 feet below the ground surface and in boring B-2 at 101 feet below the ground surface. The siltstone observed in each boring differed in blow counts, drilling characteristics, and cutting return. The siltstone in boring B-1 had very high blow counts, variably hard and easy drilling and black fragments of basaltic rock returned in the drill cuttings. The siltstone in boring B-2 had relatively lower blow counts, consistent drilling characteristics, and no basaltic cuttings were observed. We interpret that the siltstone in boring B-1 also included a minor basalt intrusion, which is consistent with the abundantly mapped basaltic intrusives within the Astoria Formation in the area. In boring B-1, we drilled 15 feet into the formation and in boring B-2, we drilled 20 feet into the formation. According to a Madin and Wang 1999 paper, the shear wave velocity of the siltstone bedrock was estimated to be 1,870 feet per second.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in Appendix B should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, and test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then will be discarded.

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 6 of 16

Groundwater Information

The static groundwater elevation in the project area was interpreted to be approximately 25 feet to 30 feet below the ground surface based on our observation of soil samples recorded during mud rotary drilling. The cone penetrometer test conducted a pore-water dissipation test within the dense gray sand at a depth of approximately 27.5 feet. Results of the pore-water dissipation test indicated a static water level of approximately 21 feet below the ground surface. We have assumed a groundwater depth of 21 feet below the ground surface for the purpose of this report.

Seismic Setting

The Oregon Coast is located near the western margin of the North American tectonic plate. The Pacific and Juan de Fuca tectonic plates that form the ocean floor are converging upon, and being subducted beneath, the North American Plate off the Oregon coastline. This zone of tectonic plate convergence, called the Cascadia Subduction Zone, has created a complex set of stress regimes that influence the tectonic and volcanic activity of the Pacific Northwest.

The moment magnitude (M_w) scale, rather than the Richter magnitude (M_L) scale, is now being used by seismologists to provide more accurate information. Moment magnitude measures an earthquake in terms of energy released and takes into account the rigidity of the earth, the average amount of slip on the fault and the size of the area that slipped. Richter magnitude is a base-10 logarithmic scale where the magnitude is calculated based on the combined shaking amplitude and the largest displacement from zero on a particular type of seismometer. The effective limit of measurement on the Richter scale is about M_L equal to 6.8. The size of an earthquake measured by moment magnitude and Richter magnitude are similar up to about 6.8.

The following paragraphs describe the distinct seismic sources that could potentially generate earthquakes affecting the subject site.

Cascadia Subduction Zone

The Cascadia Subduction Zone, located approximately 50 miles to 60 miles off the Oregon and Washington coastlines, is an immense thrust fault and a potential source of earthquakes large enough to cause significant ground shaking at the subject site and potentially throughout western Oregon and Washington. Research over the last several years has shown that this offshore fault zone has repeatedly produced large earthquakes every 300 years to 700 years. Geologic research of ancient Japanese tsunami records along with dendrochronology (tree ring dating techniques) has established that the last large Cascadia Subduction Zone earthquake occurred in January of 1700 AD. Although researchers do not fully agree on the likely magnitude of the next Cascadia Subduction Zone thrust fault earthquake, it is widely believed that earthquakes of moment

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 7 of 16

magnitude (M_w) 8.0 to 9.0 are possible. The scientific community believes that the duration of strong ground shaking may be as long as 5 minutes to 6 minutes, with minor shaking lasting on the order of several minutes longer. Subduction zone earthquake aftershocks could continue to occur for hours or days after the initial rupture.

Intra-Slab Seismic Sources

Additional earthquake sources in this region include fault ruptures within the subducting oceanic plates. Earthquakes occurring within the subducting oceanic plates are called intraplate earthquakes. Originating at depths on the order of 20 miles to 30 miles within the remains of the subducting Juan de Fuca Plate, these large earthquakes have occurred with historical frequency in western Washington and to a lesser extent in western Oregon. These earthquakes range up to about M_w 7.5 and have caused widespread damage in the southern Puget Sound and northwest Oregon region in 1949, 1965, and 2001.

Crustal Seismic Sources

Crustal earthquakes are relatively shallow, occurring within approximately 6 miles to 12 miles of the earth's surface as a result of localized tectonic stresses. Oregon has experienced at least two significant crustal earthquakes in the past 18 years—the Scotts Mills (Mt. Angel) earthquake (M_w 5.6) on March 25, 1993 and the Klamath Falls earthquake (M_w 6.0) on September 21, 1993. Although there are no mapped crustal faults in the immediate vicinity of the project site that pose a surface rupture hazard, there may be yet undiscovered faults capable of generating significant ground motion and capable of influencing local relative seismic hazards. Based on limited data available in Oregon, it would be reasonable to assume M_w 6.0 to 6.6 crustal earthquakes may occur in Oregon.

Ground Shaking

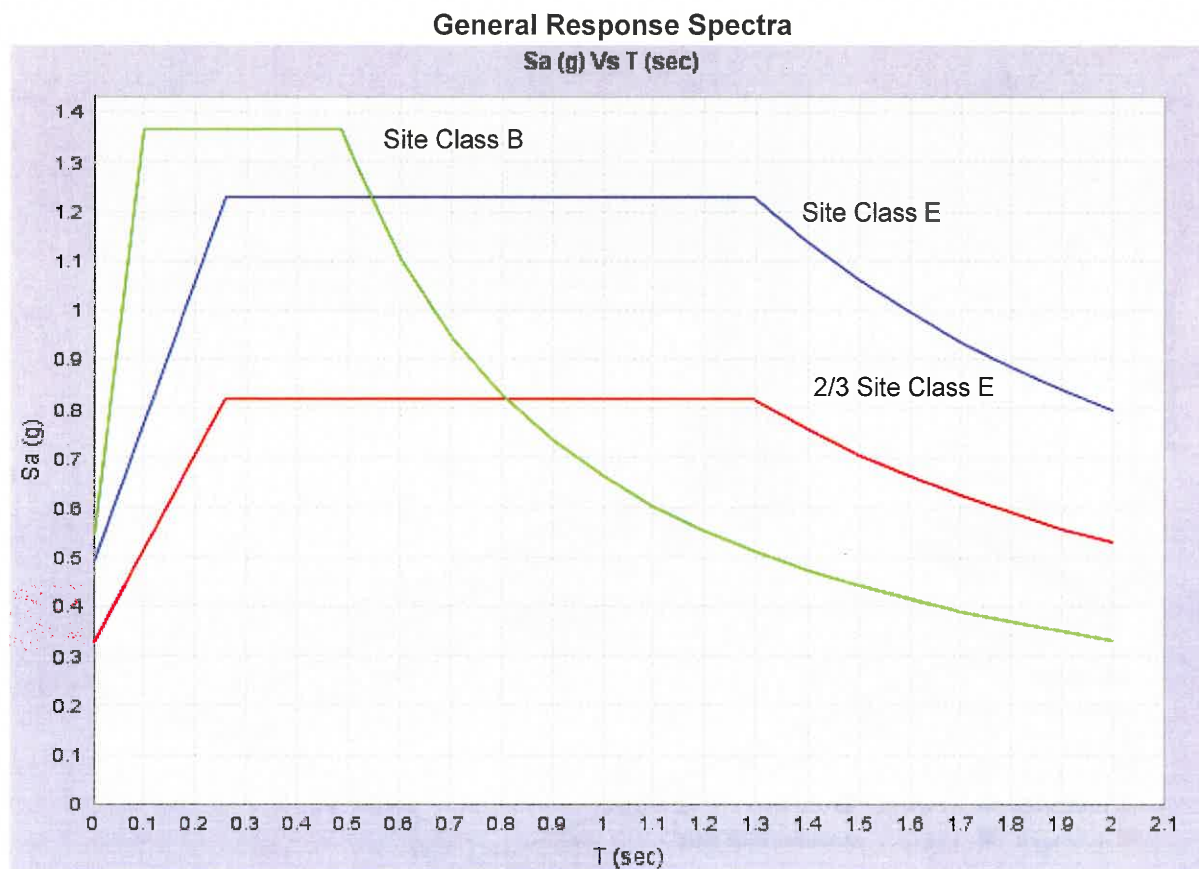
The peak horizontal ground acceleration (PGA) is the standard quantitative method of describing ground motion associated with propagating seismic waves in bedrock. The PGA is based on empirical attenuation relationships of seismic wave energy with distance from the seismic source. PGA's are expressed as a fraction of the acceleration due to gravity (g). Both Probabilistic Seismic Site Hazard (PSHA) and Deterministic Seismic Site Hazard (DSHA) were used to determine the PGA's for the site. The results are summarized in the following sections.

Probabilistic Seismic Hazard Analysis (PSHA)

The PSHA uses a response spectrum that is based on the chance that a particular ground motion will be exceeded in a defined recurrence interval (typically the lifetime of the planned development) due to earthquakes on numerous nearby and distant sources. We used the USGS National Seismic Hazard Mapping Program to obtain the ground motions evaluated for this study. Based on

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
 CGI Report No.: 11-022-1
 May 4, 2011
 Page 8 of 16

the exploration logs, we classified this site as a Site Class E in accordance with the 2010 Oregon Structural Specialty Code (OSSC) Table 1613.5.6(1) and (2). The probabilistic response is based on a return interval of 2 percent probability of exceedance within 50 years as described by ASCE 7-10 Section 21.2.1. The values determined in the PSHA assessment are shown and discussed on the below.



In accordance with Table 1613.5.2 of the 2010 OSSC, which is an amendment to the 2009 International Building Code (IBC), we recommend a Site Class E (stiff soil profile) for this site. According to the USGS Java Ground Motion Parameter Calculator using the ASCE 7-05, the maximum considered earthquake (MCE) ground motions for the site are $S_5=1.379g$ and $S_1=0.676g$ (for Site Class B and 5 percent critical damping). The USGS values are a more accurate interpolation of the values presented in Figure 1613.5(1) and 1613.5(2) of the OSSC. Site Coefficients F_a and F_v are 0.9 and 2.4, respectively for Site Class E. Therefore the adjusted MCE

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation

CGI Report No.: 11-022-1

May 4, 2011

Page 9 of 16

ground motions are $S_{MS}=1.241g$ and $S_{M1}=1.623g$ (for Site Class E). The return interval for these ground motions is 2 percent probability of exceedance in 50 years.

In addition, we performed a seismic deaggregation for the site. The estimated ground surface PGA is approximately $0.5778g$ for a Site Class B based on that evaluation. The seismic deaggregation is included on the following page.

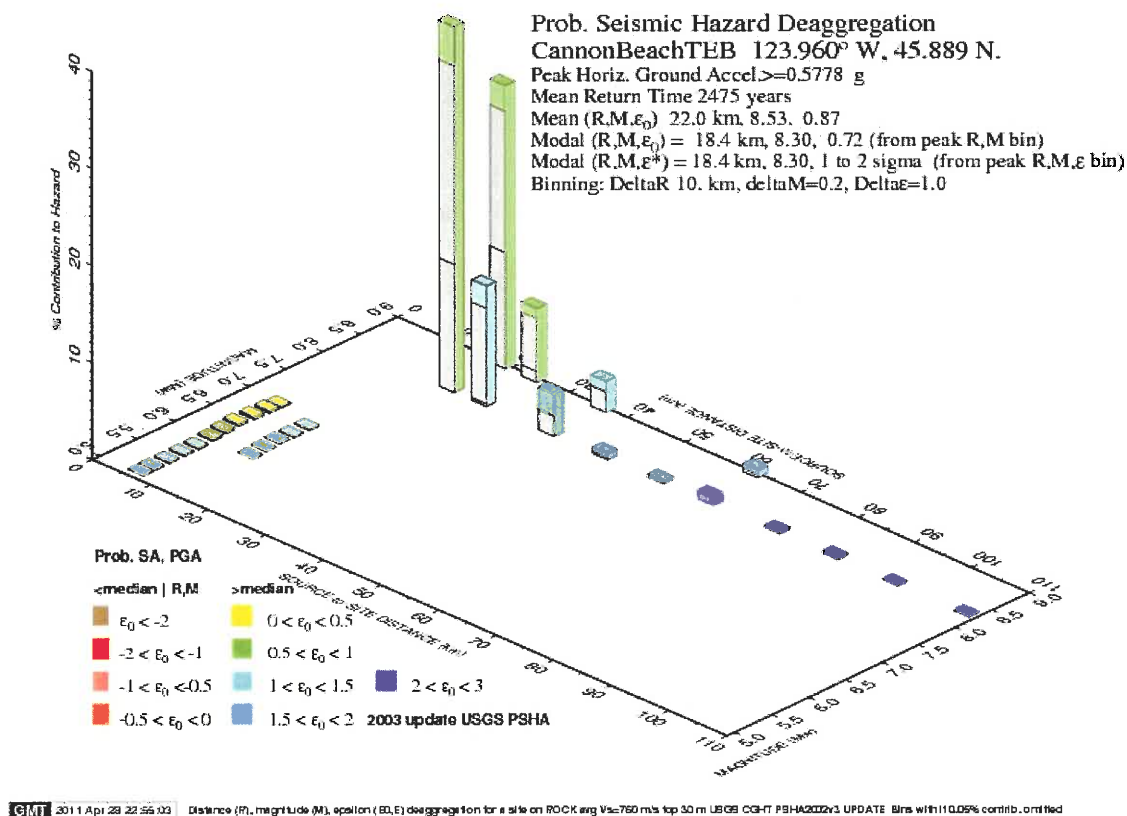


Table A-1: Principal Seismic Sources with Greater than 10 Percent Contribution to the Probabilistic Hazard at the Site

Earthquake Source	Percent Contribution	Probabilistic Magnitude
Cascadia M8.3	57 percent	8.3
Cascadia Megathrust	41 percent	9.0

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 10 of 16

Deterministic Seismic Hazard Analysis (DSHA)

A DSHA calculates the ground motions due to a specific maximum characteristic earthquake magnitude that is defined as the largest earthquake that could be expected to occur for a particular seismic source, regardless of the frequency of occurrence. The maximum characteristic earthquake is defined as the maximum earthquake that appears capable of occurring under the known tectonic framework (Kramer 1996). The size of the maximum characteristic earthquakes are discussed above in the Seismic Setting section of this appendix and are M_w 6.0 to 6.6 for shallow crustal earthquakes, M_w 7.5 for intraplate earthquakes and M_w 8.0 to 9.0 for the interface (subduction) zone earthquakes. These magnitudes are also reflected in the probabilistic analysis used by the USGS.

For the DSHA, we only conducted seismic analysis for the interface zone earthquake because that is the controlling earthquake at this site. The results of the DSHA are summarized in the following paragraphs.

Historical Seismicity

For historical seismicity within a 20 kilometer (12 mile) radius of the site, we reviewed the DOGAMI 2002 open-file report O-03-02, Map of Selected Earthquakes for Oregon, 1841 through 2002. The publication shows the location of earthquakes greater than magnitude 2.0 between 1841 and 2002.

Based on our review, no earthquakes have been recorded within a 12 mile radius. No earthquakes greater than 5.9 were shown on the map. A copy of the pertinent section of the DOGAMI O-03-02 map is included in Figure A-4.

Local and Regional Potentially Active Faults

Based on review of the USGS 2006 (updated November 3, 2010) Quaternary Fault and Fold Database of the United States website, there are both on-shore and off-shore potentially active fault zones present in northwestern Oregon. The nearest potentially active fault, Fault "H", is mapped by the USGS offshore of Cannon Beach. Fault "H" consists of multiple fault strands, the eastern most of which is approximately 5.6 kilometers (3.5 miles) east of the site, although the reliability of the location is poor. The USGS describes Fault "H" as a 30 mile long northwest-striking, normal and/or left-lateral fault, which offsets accretionary wedge sediment of unknown age that underlies the continental shelf in the forearc of the Cascadia Subduction Zone. Similarities with other faults suggest most recent movement in the late Pleistocene and Holocene (<15,000 years ago). As with other folds and faults located in the Cascadia forearc, it is unknown if coseismic displacements on these faults are always related to great megathrust earthquakes on the subduction zone, or whether some displacements are related to smaller earthquakes in the North American Plate.

The known faults within 100 kilometers (62 miles) of the site have been listed in Table A-2 on the following page.

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation

CGI Report No.: 11-022-1

May 4, 2011

Page 11 of 16

Table A-2: Class A Seismic Sources within 100-km (62 mile) Radius of the Site

Fault Name or Zone	USGS ID No.	Approximate Distance from Site (km)	Slip Rate (mm/yr)	Fault Length (km)	Most Recent Deformation
Fault "H" (offshore)	790	5.6	>5.0	49	<15Ka
Nehalem Bank Fault	789	19.0	1.0 to 5.0	101	<15Ka
Unnamed Offshore Faults	785	20.7	1.0 to 5.0	300	<15Ka
Gales Creek Fault Zone	718	22.5	<0.2	73	<1.6Ma
Tillamook Bay Fault Zone	881	35.0	<0.2	32	<1.6Ma
Cascadia Fold and Fault Belt	784	46.0	1.0 to 5.0	484	<15Ka
Fault "G" (offshore)	791	46.0	>5.0	56	<15Ka
Fault "J" (offshore)	788	48.6	1.0 to 5.0	8	<15Ka
Happy Camp Fault	882	49.5	<0.2	3	<1.6Ma
Willapa Bay fault zone	592	57.5	0.2 to 1.0	37	<15Ka
Portland Hills Fault	877	82.1	<0.2	49	<1.6Ma
Helvetia Fault	714	84.0	<0.2	7	<1.6Ma
Beaverton Fault Zone	715	88.9	<0.2	15	<750Ka
Unnamed fault set offshore of mouth of Willapa Bay	590	92.1	<0.2	26	<130Ka
Stonewall Anticline	786	92.3	1.0 to 5.0	80	<15Ka
East Bank Fault	876	94.9	<0.2	29	<15Ka
Oatfield Fault	875	95.1	<0.2	29	<1.6Ma
Unnamed fault zone offshore of Cape Shoalwater	591	95.8	<0.2	6	<1.6Ma
Newberg Fault	717	98.0	<0.2	5	<1.6Ma

USGS 2006 (updated November 3, 2010) Quaternary Fault and Fold Database of the United States.

Site Response Model

CGI used the computer program SHAKE2000 version 8.1.0 to perform dynamic analysis of a model soil profile created from subsurface information obtained in our field exploration and soil laboratory testing. Troy Hull, P.E., G.E. of Earth Engineers, Inc. provided technical expertise with the SHAKE2000 modeling. We modeled subsurface conditions represented by boring B-1 with 5 foot thick layers that extended to the bedrock. The dynamic model consisted of five different types of soil.

The following dynamic properties were selected for the model; shear modulus/maximum shear modulus (G/Gmax) and damping curves. We used soil with PI=15 (Vucetic and Dobry, JGE, 1/91)

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
 CGI Report No.: 11-022-1
 May 4, 2011
 Page 12 of 16

for the upper clay layer; soil with $PI=50$ (Vucetic and Dobry, JGE, 1/91) for the clay with organics; average sand (Seed and Idriss, 1970) for the dense to very dense sand; G/G_{max} curves for sand $CP>3.0ksc$ 3/11 1988 and damping curves for deep cohesionless soil 21 to 50 feet for the medium dense sand; G/G_{max} curves for sand $CP>3.0ksc$ 3/11 1988 and damping curves for deep cohesionless soil 21 to 50 feet for the lower dense sand layer between 60 feet and 65 feet below the ground surface; and EPRI, 1993 for rock 51 to 120 feet for the siltstone bedrock. Shear wave velocities were determined in the field in the CPT or correlated with the N_{60} value calculated from the corrected blow counts in the boring log for B-1. The shear wave velocity of the bedrock was estimated to be 1,870 feet per second (Madin and Wang 1999).

The horizontal PGAs were calculated using three attenuation relationships for a M_w of either 8.5 or 9 because the some of the models are reliable only to that magnitude. The source to site distance was 80 kilometers (50 miles) and a depth of 20 kilometers (13 miles) was assumed for this site. The calculated PGAs are summarized in Table A-3 below.

Table A-3: Calculated PGA at Bedrock, g

Relationship	Calculated PGA
Gregor, et.al (2002)	0.349
Youngs, et.al (1997)	0.437
Atkinson and Boore (2003)	0.165

We modeled only the interface or subduction zone earthquake because that is the principal seismic source for this site based on the research obtained during the PSHA analysis. We selected three historic earthquakes to complete the analysis. The length of recorded shaking for these earthquakes varied from 1 minute to over 3 minutes. Longer records were not available to us. However, the analysis showed that liquefaction and lateral spreading would occur at the site during the shorter duration ground motions. In our opinion, the selected ground motions were adequate for this feasibility study. Longer duration ground motions may need to be considered during the final design phase of this project. The earthquakes were scaled so that their response spectrum is, on average, approximately at the level of the targeted base spectrum over the anticipated range of significance to the structure. The details of the earthquake records are listed in Table A-4 on the next page.

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation

CGI Report No.: 11-022-1

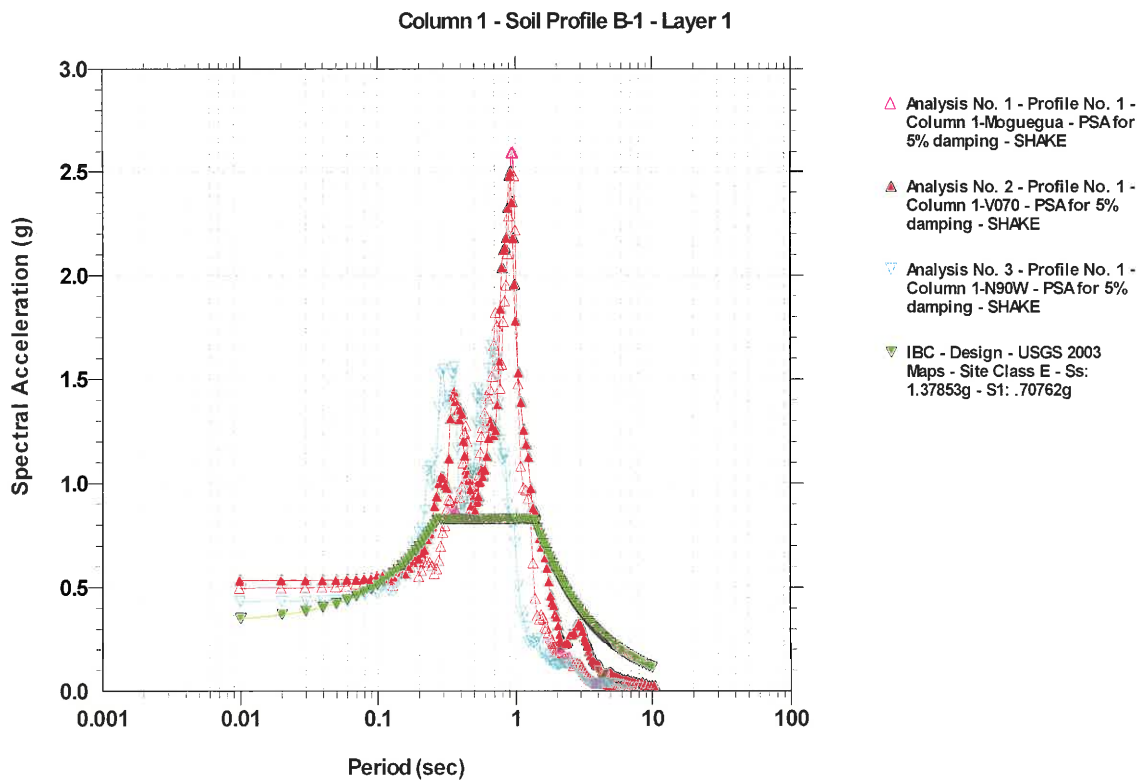
May 4, 2011

Page 13 of 16

Table A-4: Earthquake Motions Used In Analysis

Earthquake	Earthquake Type	Station	Magnitude	Source to Site Distance	Recorded PGA	Scaling Factor
2001 Peru	Subduction Zone, Interface	Moquegua	8.4	--	0.30	1.2
1985 Valparaiso (Chili)	Subduction Zone, Interface	Valparaiso (VALU) 70	7.8	109 km (80 miles)	0.23	1.4
1985 Michoacan (Mexico)	Subduction Zone, Interface	Caleta de Campos, N90W	8.1	38 km (23 miles)	0.14	1.6

The response spectrum for the earthquake motions and the IBC code values for reference are provided in the figure included below.



City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 14 of 16

Site Specific Acceleration Parameters for Design

As specified in ASCE 7-10, the design spectral response acceleration parameter at short periods (S_{DS}) obtained from a site specific procedure should be taken at the 0.2 second spectral acceleration, but should not be less than 80 percent of the peak spectral acceleration at any period larger than 0.2 seconds. ASCE 7-10 requires that the parameter S_{D1} , the design spectral response acceleration at a period of 1 second, shall be taken as the greater of the spectral acceleration values at 1 second or two times the spectral acceleration value at 2 seconds. Based on these procedures, the site specific values of S_{DS} and S_{D1} are recommended to be 0.52g and 1.41g, respectively. These values were obtained from the average of the three earthquake response spectrums shown above. Both values exceed the IBC response spectrum. The analysis was conducted for 1 to 3 minute duration earthquakes and these values could change under longer duration earthquakes.

Site Specific Seismic Hazard Summary

The following section of this report presents out evaluation of the site-specific seismic hazards including:

- Liquefaction and Lateral Spread
- Fault Rupture Hazard
- Tsunami Hazard
- Co-Seismic Ground Subsidence
- Earthquake-Induced Landslide Hazard
- Settlement Mitigation and Scour Protection

Liquefaction and Lateral Spread Hazard

Liquefaction occurs when saturated deposits of loose to medium dense, cohesionless, fine-grained soils, generally sands and sand-silt mixtures, are subjected to strong earthquake shaking. If these deposits are saturated and cannot drain rapidly, there will be an increase in pore water pressure. With increasing seismic shaking, the pore water pressure can increase to the value of the overburden pressure. The shear strength of a cohesionless soil is directly proportional to the effective stress, which is equal to the difference between the overburden pressure and the pore water pressure. Therefore, when the pore water pressure increases to the value of the overburden pressure, the shear strength of the soil reduces to zero, and the soil deposits turn to a liquefied state. Liquefaction typically occurs when very loose to loose, saturated sediments are subjected to large earthquake motions. Ground surface response to seismic liquefaction could include softening or settlement of soil grades, loss of foundation support, tipping or tilting of taller structures founded on shallow footings, and a form of slope stability failure called lateral spreading.

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 15 of 16

Simplified empirical field methods were used to assess liquefaction. These methods are effective to depths of 75 feet. Cyclic laboratory testing and additional ground response analysis would need to be completed to assess the liquefaction potential below depths of 75 feet.

For our liquefaction analysis, we assumed that groundwater would be at a depth of 21 feet below the ground surface. We found that the clay layer will strain soften in the upper 25 feet of boring B-1 and underlying sand could liquefy at all depths except for the between 35 feet and 40 feet and below 75 feet. Based on our soil explorations, laboratory testing and analysis, we estimated that 9 to 15 inches of liquefaction induced settlement in the sand layers and strain softening in the upper clay layers could occur within the upper 75 feet of the site soil profile during the earthquakes modeled. Liquefaction could result in softening or deformation of surface grades or expulsion of water and sediment from the subsurface. Liquefaction can also reduce soil support and pile foundation capacity during an earthquake. Between 1 foot and 4 feet of lateral spreading could occur at the site during the earthquakes modeled with the anticipated direction of movement toward the Pacific Ocean beaches.

Fault Rupture Hazard

There are no mapped crustal faults in the immediate vicinity of the project site. We also reviewed available LIDAR imagery and bathymetry for the project area and did not observe significant signs or trends of any unmapped fault traces, such as lineaments, off-set topographic features, or off-set drainages. However, there may be yet undiscovered faults capable of generating significant ground motion and capable of influencing local relative seismic hazards.

Tsunami Hazards

Due to the relatively low elevation of the site above sea level, tsunami inundation and scour are considered likely seismic hazards at this site. A tsunami, or seismic sea wave, is produced when a fault under the ocean floor shifts vertically, displacing the seawater above it. Based on the DOGAMI Special Paper 41, 2009, the City Hall site lies within in a zone predicted to be inundated by between 50 percent and 70 percent of possible Cascadia Tsunami scenarios as shown on Figure A-5. The site is also subject to inundation by the maximum distant tsunami scenario modeled from Gulf of Alaska seismic source. Lines of 50 percent, 70 percent, 90 percent, and 99 percent lines on Figure A-5 correspond to inundation depths of 9 meters (29 feet), 11meters (36 feet), 16 meters (52 meters), and 30 meters (100 feet), where tsunamis were amplified by local topography. Scour from a tsunami could remove several feet of surface soil from the site, potentially eroding parking and street grades, damaging shallow underground utilities and undermining shallow foundations.

Co-Seismic Ground Subsidence

Co-seismic ground subsidence occurs when large areas of the coastline release built up strain during a large earthquake. The historical and geologic evidence suggest that 2 meters (6 feet) or

City Hall/Tsunami Evacuation Building - Appendix A: Site-Specific Seismic Hazard Evaluation
CGI Report No.: 11-022-1
May 4, 2011
Page 16 of 16

more of rapid co-seismic subsidence could occur in this area during a strong Cascadia Subduction zone earthquake. Site effects could include immediate flooding of low lying or coastal areas and relatively higher tsunami inundation levels.

Earthquake Induced Landslide Hazard

The risk of earthquake induced landslides on the site is negligible because the site slopes are mild to level.

Settlement Mitigation and Scour Protection

A building supported on concrete piles with a structural slab would not be affected by dynamic settlement and lateral spreading. However, the ground surface, surrounding structures and utilities will be affected by the dynamic settlement and lateral spreading. Ground improvement techniques, such as deep soil mixing and installation of vertical drains could reduce the risk of liquefaction and lateral spreading.

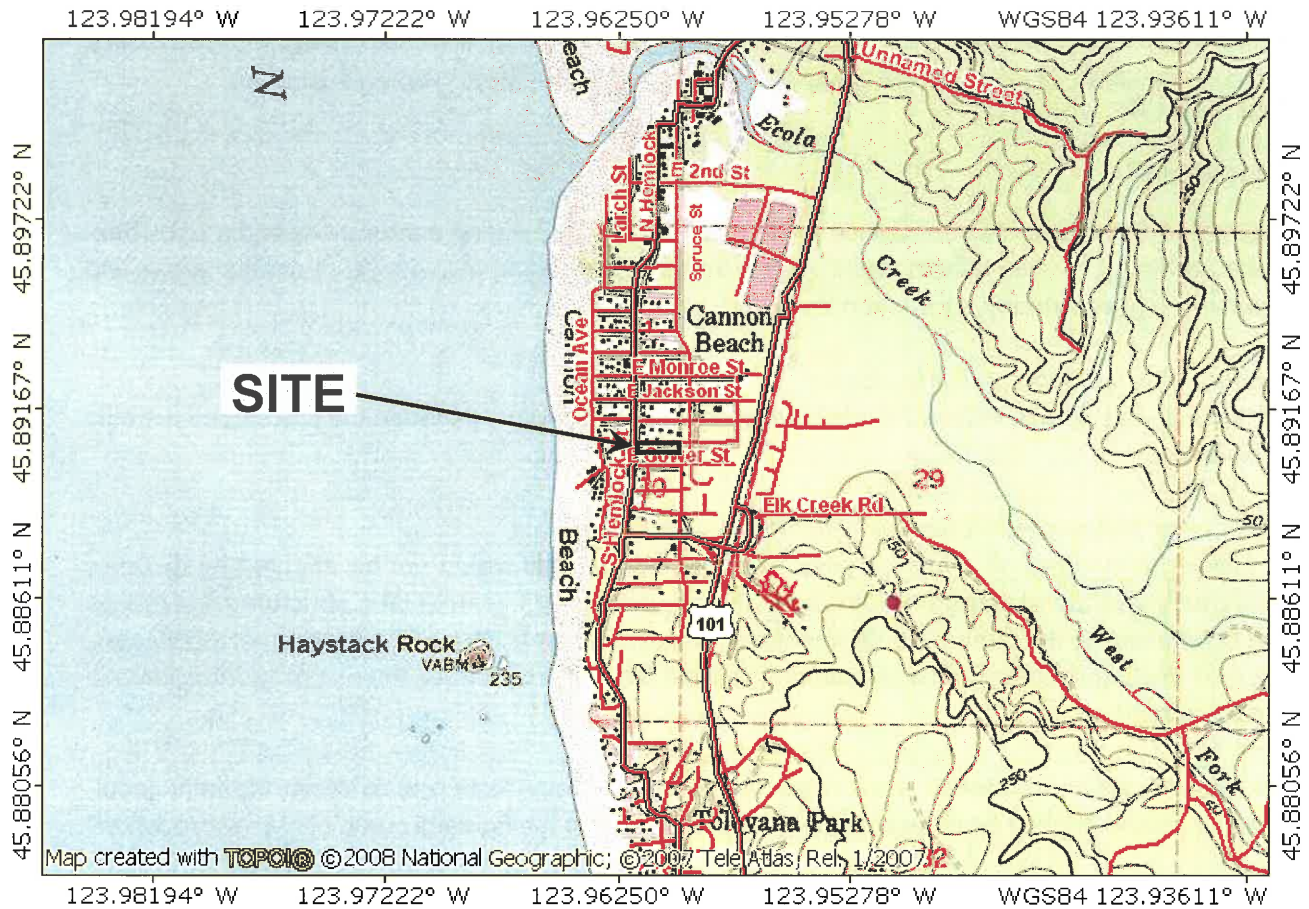
Foundation elements should be constructed of cast-in-place concrete to resist tsunami scour. Placing the rectangular building with the long axis parallel to the tsunami surge could reduce forces. Bearing walls or structural walls should be placed perpendicular to the water flow. Tsunami forces could be reduced by allowing non-structural elements at lower levels to break away

Limitations

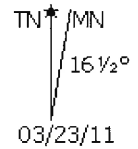
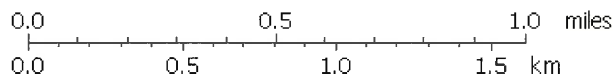
This feasibility study showed that seismic hazards do exist at the site. Final design may need to consider different earthquake scenarios for longer duration ground motions than were considered for this analysis.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed. This report has been prepared for the exclusive use of the client or their authorized agents for the specific application to the proposed project.

FIGURE A-1: SITE LOCATION PLAN



Scale: 1 inch = 2,000 feet



Approximate Scale: 1 inch = 2,000 feet

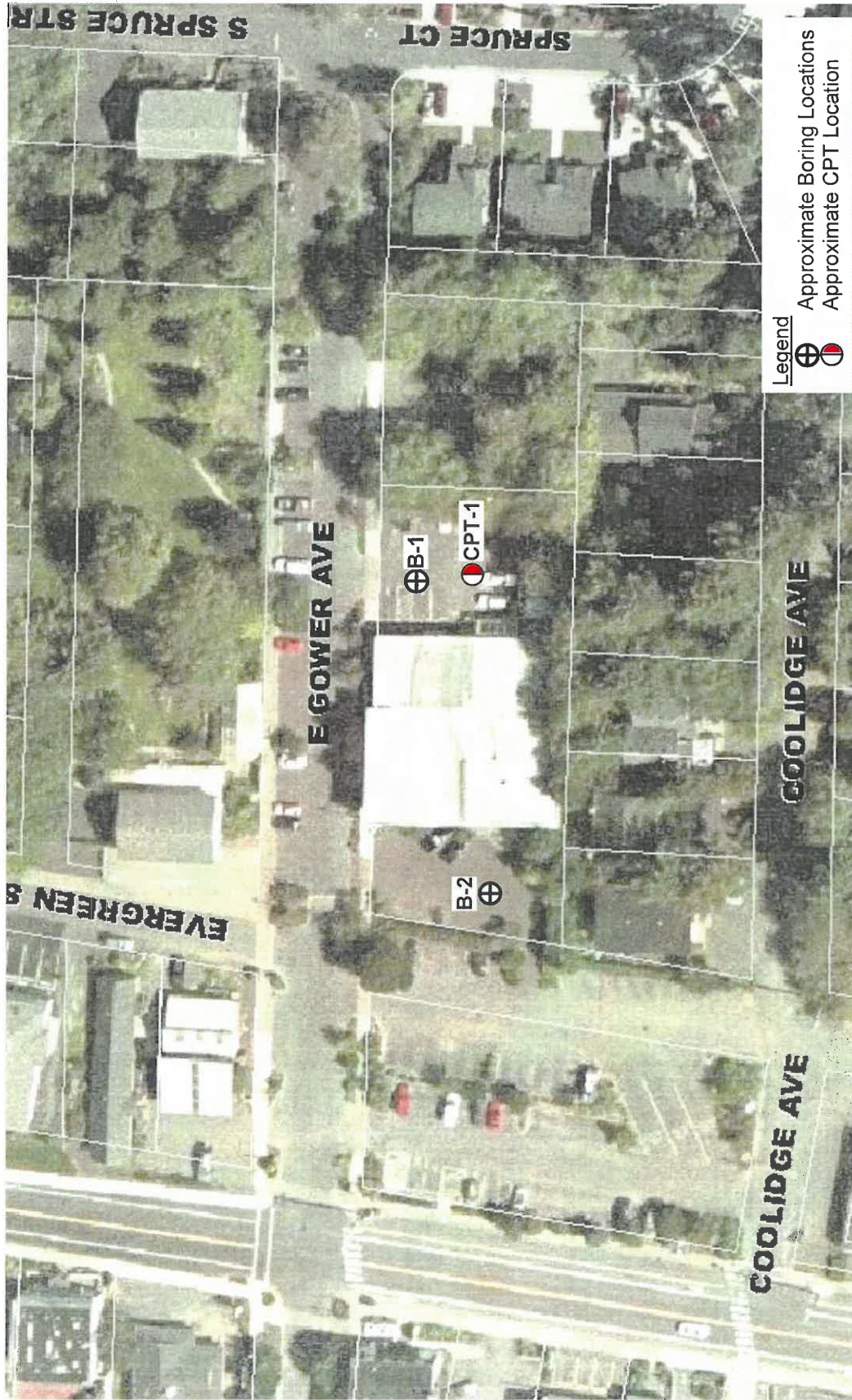


Proposed New City Hall
Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon

Report No.
11-022-1

Date:
May 4, 2011

FIGURE A-2: SITE PLAN WITH EXPLORATION LOCATIONS

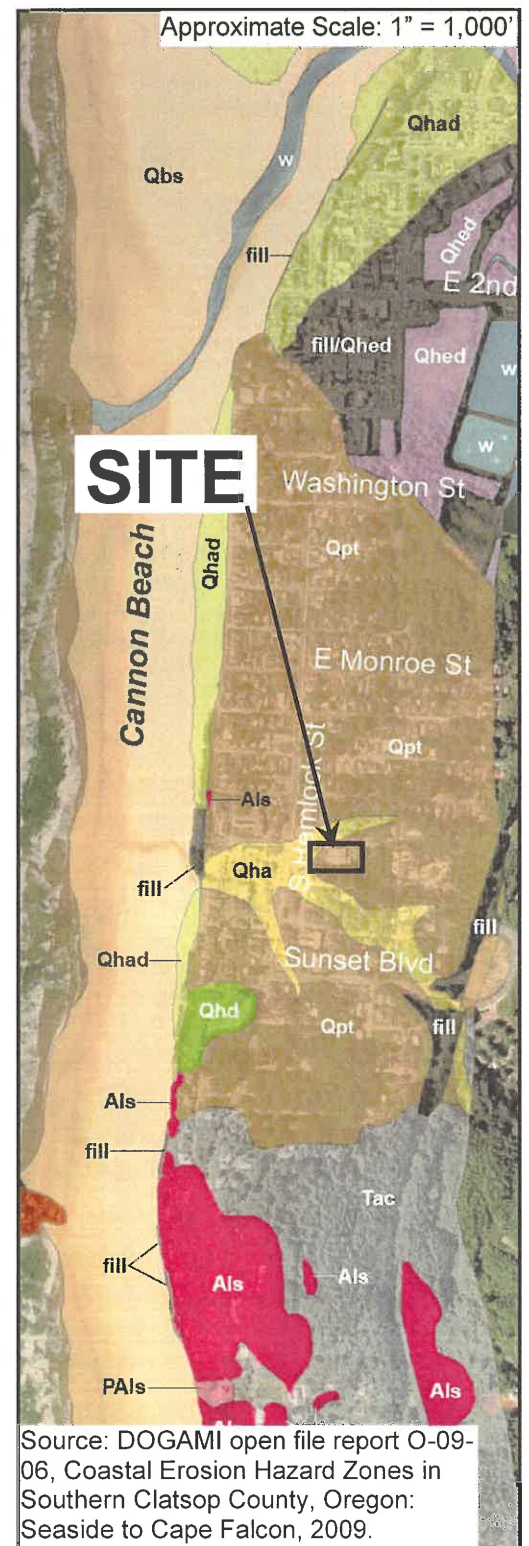
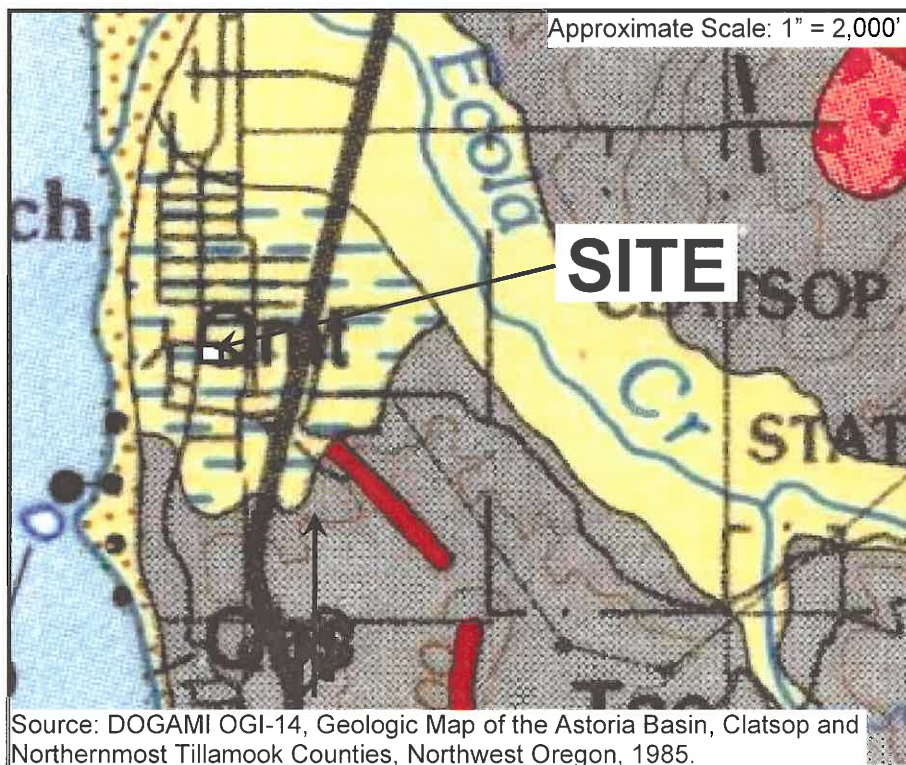
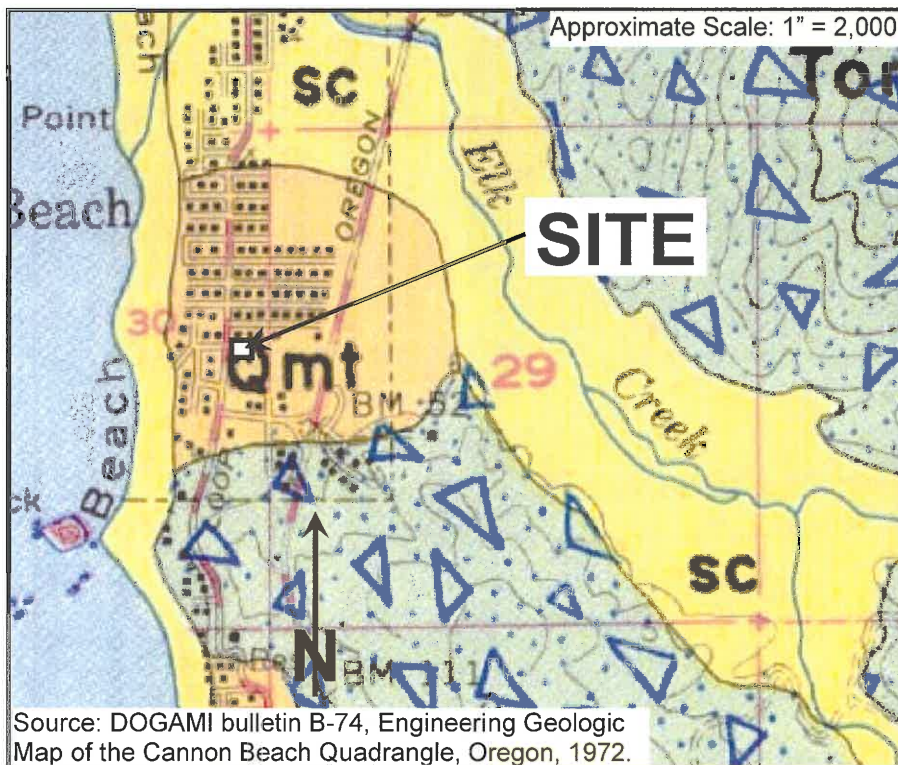


**Proposed New City Hall
 Tsunami Evacuation Building
 163 East Gower Street
 Cannon Beach, Oregon**

**Report No.
 11-022-1**

**Date:
 May 4, 2011**

FIGURE A-3: GEOLOGIC MAPS

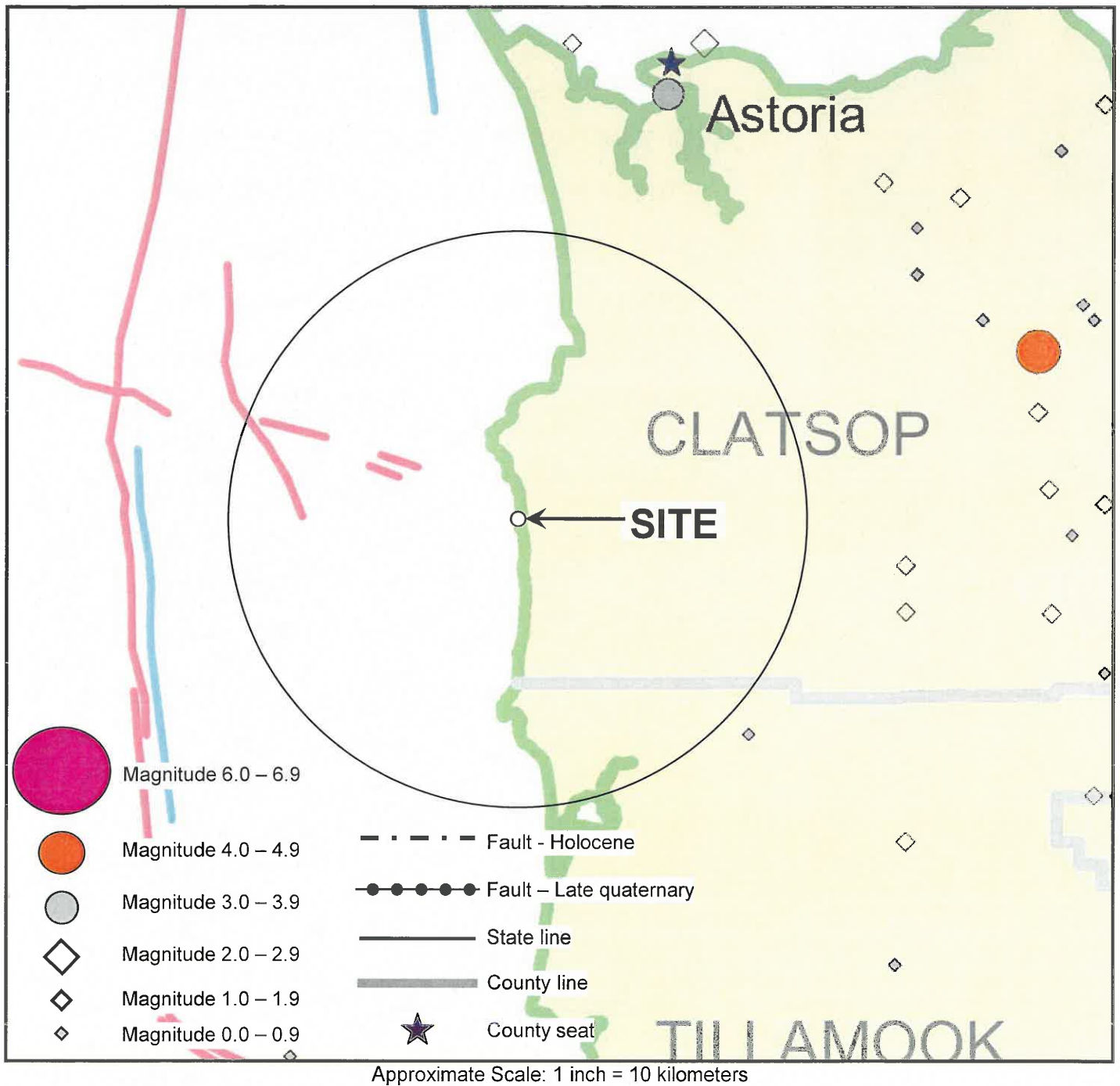


Proposed New City Hall
Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon

Report No.
11-022-1

Date:
May 4, 2011

FIGURE A-4: HISTORIC EARTHQUAKES AND FAULT MAP



Source: DOGAMI 0-03-02 Map of Selected Earthquakes for Oregon 1841 through 2002

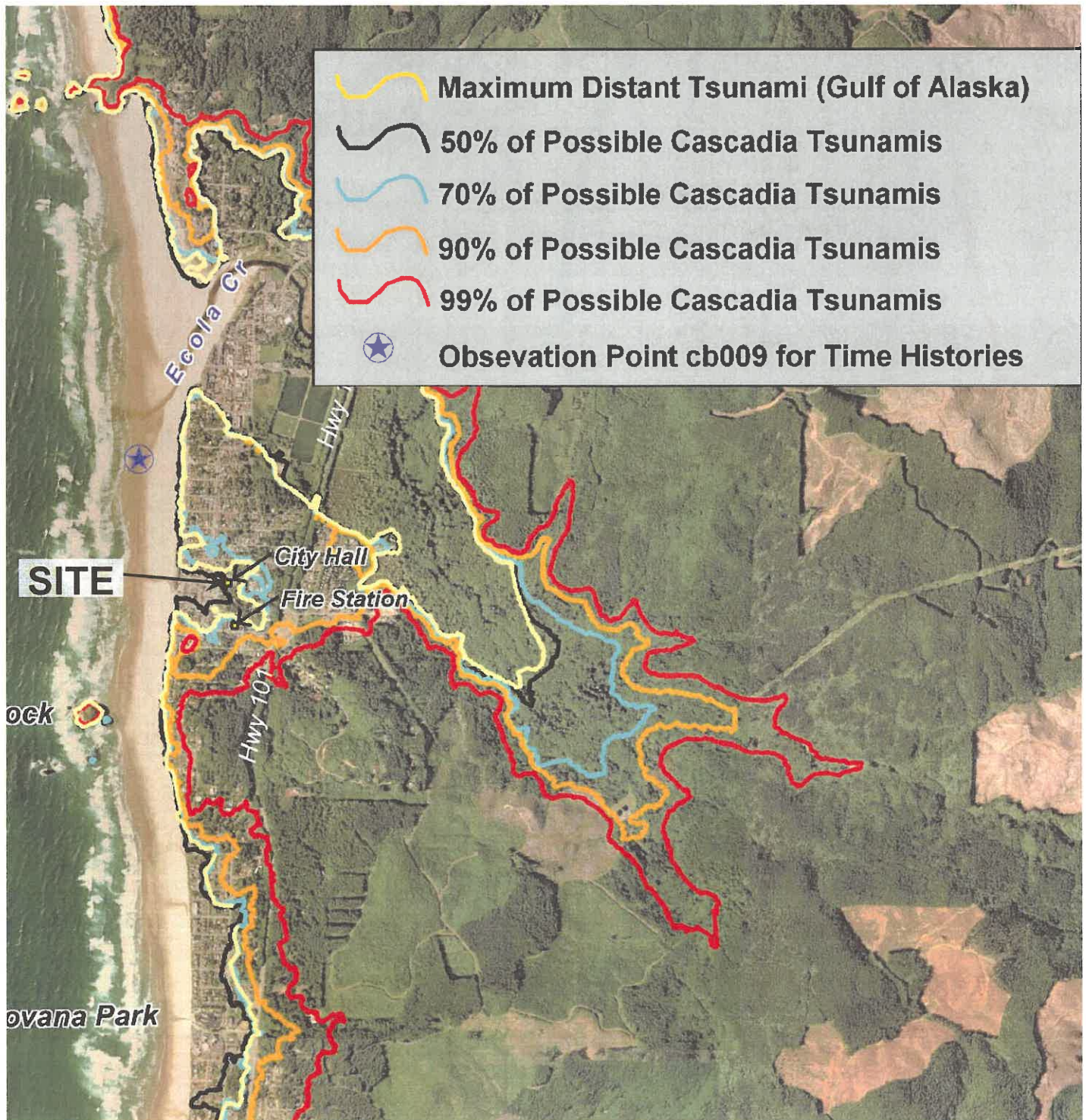


**Proposed New City Hall
Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon**

**Report No.
11-022-1**

**Date:
May 4, 2011**

FIGURE A-5: TSUNAMI INUNDATION MAP



Approximate Scale: 1 inch = 2,000 feet

Source: DOGAMI SP-41, Tsunami hazard assessment of the northern Oregon coast: a multi-deterministic approach tested at Cannon Beach, Clatsop County, Oregon, Figure 50 page 73.



**Proposed New City Hall
Tsunami Evacuation Building
163 East Gower Street
Cannon Beach, Oregon**

**Report No.
11-022-1**

**Date:
May 4, 2011**

APPENDIX B:
FIELD EXPLORATION PROCEDURES AND LOGS

APPENDIX B

FIELD EXPLORATION PROCEDURES AND LOGS

Chinook GeoServices, Inc. (CGI) explored subsurface conditions on March 29 and 30, 2011, during which time two soil borings (B-1 and B-2) were drilled and one cone penetrometer (CPT-1) was advanced.

Drilled Borings

Our two soil borings (B-1 and B-2) were drilled and sampled using mud rotary drilling equipment. The drill rig was operated by Subsurface Technologies of North Plains, Oregon under contract to CGI. Boring locations were selected in the field by the Client in the general vicinity of proposed structure. Field measurements from site features were used to locate the borings on the site plan. A qualified representative from CGI continuously observed the borings, logged the subsurface conditions and collected representative soil samples. All samples were stored in watertight containers and later transported to a subcontracted laboratory for further testing. After each boring was completed, the borehole was backfilled with bentonite chips and patched with asphalt cold patch.

Throughout the drilling operation, soil samples were generally obtained at 5-foot intervals in boring B-1 and 25-foot to 10-foot intervals in boring B-2 using a Standard Penetration Test (SPT) in accordance with ASTM D1586 using an automatic hammer. The testing and sampling procedure consists of driving a 2-inch diameter steel split spoon sampler 18 inches into the soil with a 140 pound hammer free-falling a distance of 30 inches. The number of blows required to drive the sampler through each 6-inch interval are counted, and the total number of blows struck during the final 12 inches is recorded as the SPT blow count (N-value). If the total blow count of 50 blows is recorded for any 6-inch interval, the driving is stopped and the blow count is recorded as 50 blows for the actual penetration distance. The resulting SPT resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The automatic hammer produces lower blow counts and SPT N-values than the traditional safety hammer. Studies have generally shown that penetration resistances may vary by a factor of 1.5 to 2 between the two methods. We have not adjusted the numbers recorded on the boring logs, and therefore the SPT values should be considered conservative.

The enclosed Boring Logs describe the vertical sequence of soils and materials encountered in each boring, based primarily on field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to


be gradational, our logs indicate the average contact depth. Where the soil type changed between sample intervals, we inferred the contact depth. Our logs graphically present the blow count per 6-inch interval, the sample number, and approximate depth of each soil sample obtained from the borings, as well as any laboratory tests performed on these samples. If any ground water was encountered in a boring, the approximate ground water depth is shown in the boring log. Ground water depth estimates were determined by visual examination of the samples.

Cone Penetrometer Test Probe

One cone penetrometer test probe (CPT) (CPT-1) was advanced using electronic cone equipment. The CPT rig was a Hogentogler Seismic/Pore Pressure 10 ton Subtraction Electronic Cone Penetrometer operated by Subsurface Technologies of North Plains, Oregon under contract to CGI. The exploration location was selected in the field by the Client in the general vicinity of proposed structure. Field measurements from site features were used to locate the CPT probe on the site plan. The exploration was advanced in general conformance with ASTM D3441. The test method consists of pushing an instrumented cone, with the tip facing down, into the ground at a controlled rate.

Seismic shear wave velocity testing was obtained at 2 meter intervals. The seismic shear wave testing equipment consists of hammer, a static load and a field computer all connected with a trigger that serves as the seismic source. The time for the shear wave to arrive at the seismic cone is measured. The shear wave velocity is calculated based on the information obtained in the field.

Pore pressure dissipation was also measured within the sand material present at a depth of 27.5 feet. The testing is conducted by allowing the excess pore water pressure to dissipate from the test depth. Pore pressure dissipation testing allows for calculation of the static water table. Results of the pore-water dissipation test indicated a static water level of approximately 21 feet below the ground surface.

Boring Log B-1										
CLIENT: Mark See, Public Works Director, City of Cannon Beach				CGI PROJECT NO.: 11-022						
PROJECT: Proposed New City Hall / Tsunami Evacuation Building				BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer						
LOCATION: 163 East Gower Street, Cannon Beach, Oregon				ELEVATION: Approximately 30 feet above mean sea level						
DATE DRILLED: March 29, 2011				LOGGED BY: Chuck Bolduc, G.I.T.						
DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
			1.5 inches asphalt underlain by approximately 7.5 inches base rock							
	S-1		Stiff, moist, gray-brown with rust mottling, clay with sand texture	3 4 4	9					
	S-2		Becomes medium stiff.	2 2 4	7	53	35	61.5		
5										
	S-3		Becomes light tan.	2 2 2	5					
10										
	S-4		Becomes soft.	1 1 1	2	62	36	63.1		
15										
	S-5		Tree or stump in upright position. Wood core had grains oriented vertically. Fresh to partially decomposed.	3 5 6	11					
20										
	S-6		Soft, moist to wet, gray clay with sand texture and decomposed wood debris and organics.	0 2 1	3					
25										
	S-7		Dense, wet, gray fine-grained sand.	10 15 20	35					▼ Estimated Static Groundwater
30										
	S-8		Becomes tan.	16 20 19	39					
35										
	S-9			18 22 27	49					
40										
	S-10			14 18 17	35					
45										
	S-11		Becomes medium dense, wet, gray and tan sand with abundant micaceous grains.	7 8 9	17					
50										

Boring Log B-1 Continued



CLIENT: Mark See, Public Works Director, City of Cannon Beach

CGI PROJECT NO.: 11-022

PROJECT: Proposed New City Hall / Tsunami Evacuation Building

BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer


LOCATION: 163 East Gower Street, Cannon Beach, Oregon


ELEVATION: Approximately 30 feet above mean sea level

DATE DRILLED: March 29, 2011


LOGGED BY: Chuck Bolduc, G.I.T.

DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
	S-12		Becomes dense.	10 14 20	34					
55	S-13		Very dense, wet, gray sand and basaltic gravel.	45 50 for 3"	>50					
			Base of gravel layer, based on drilling characteristics.							
60	S-14		Dense, wet, gray fine-grained sand with micaceous flakes and trace rounded black gravel.	8 20 15	35					
			Layer of gravel inferred from drilling characteristics.							
65	S-15		Very dense, wet, gray fine-grained sand with no micaceous flakes	16 47 42	89					
70	S-16			20 31 31	62					
75	S-17			20 26 33	59					
80	S-18		Becomes dense with some micaceous flakes.	15 17 25	42					
85	S-19		More abundant micaceous flakes.	22 24 18	42					
90	S-20			16 23 25	48					
95	S-21		Becomes very dense.	22 27 26	53					
100										

Boring Log B-1 Continued							 Chinook GeoServices Inc.			
CLIENT: Mark See, Public Works Director, City of Cannon Beach				CGI PROJECT NO.: 11-022						
PROJECT: Proposed New City Hall / Tsunami Evacuation Building				BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer						
LOCATION: 163 East Gower Street, Cannon Beach, Oregon				ELEVATION: Approximately 30 feet above mean sea level						
DATE DRILLED: March 29, 2011				LOGGED BY: Chuck Bolduc, G.I.T.						
DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
	S-22		Hard, moist, purplish-brown siltstone.	36 50 for 3"	>50					
	S-23		No sample recovery. Fragments of black basalt observed in the drill cuttings.	30 for 0"	>50					
105	S-24		No sample recovery.	30 for 0"	>50					
			Drilling indicated contact between harder and softer material							
110	S-25		Hard, moist, purplish-brown siltstone. Drill cuttings continue to bring up black basalt fragments	50 for 4"	>50					
115	S-26		Boring terminated at 115.5 feet below the ground surface and backfilled with bentonite/cement grout and bentonite chip hole-plug	50 for 6"	>50					
120										
125										
130										
135										
140										
145										
150										

Boring Log B-2						 Chinook GeoServices Inc.				
CLIENT: Mark See, Public Works Director, City of Cannon Beach				CGI PROJECT NO.: 11-022						
PROJECT: Proposed New City Hall / Tsunami Evacuation Building				BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer						
LOCATION: 163 East Gower Street, Cannon Beach, Oregon				ELEVATION: Approximately 30 feet above mean sea level						
DATE DRILLED: March 30, 2011				LOGGED BY: Chuck Bolduc, G.I.T.						
DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
5										
10			Woody debris observed in cuttings.							
15			Woody debris observed in cuttings.							
20										
25	S-1		Stiff, moist, gray clayey sand with wood and organic debris	4 6 8	14					
30										
35										
40										
45										
50										

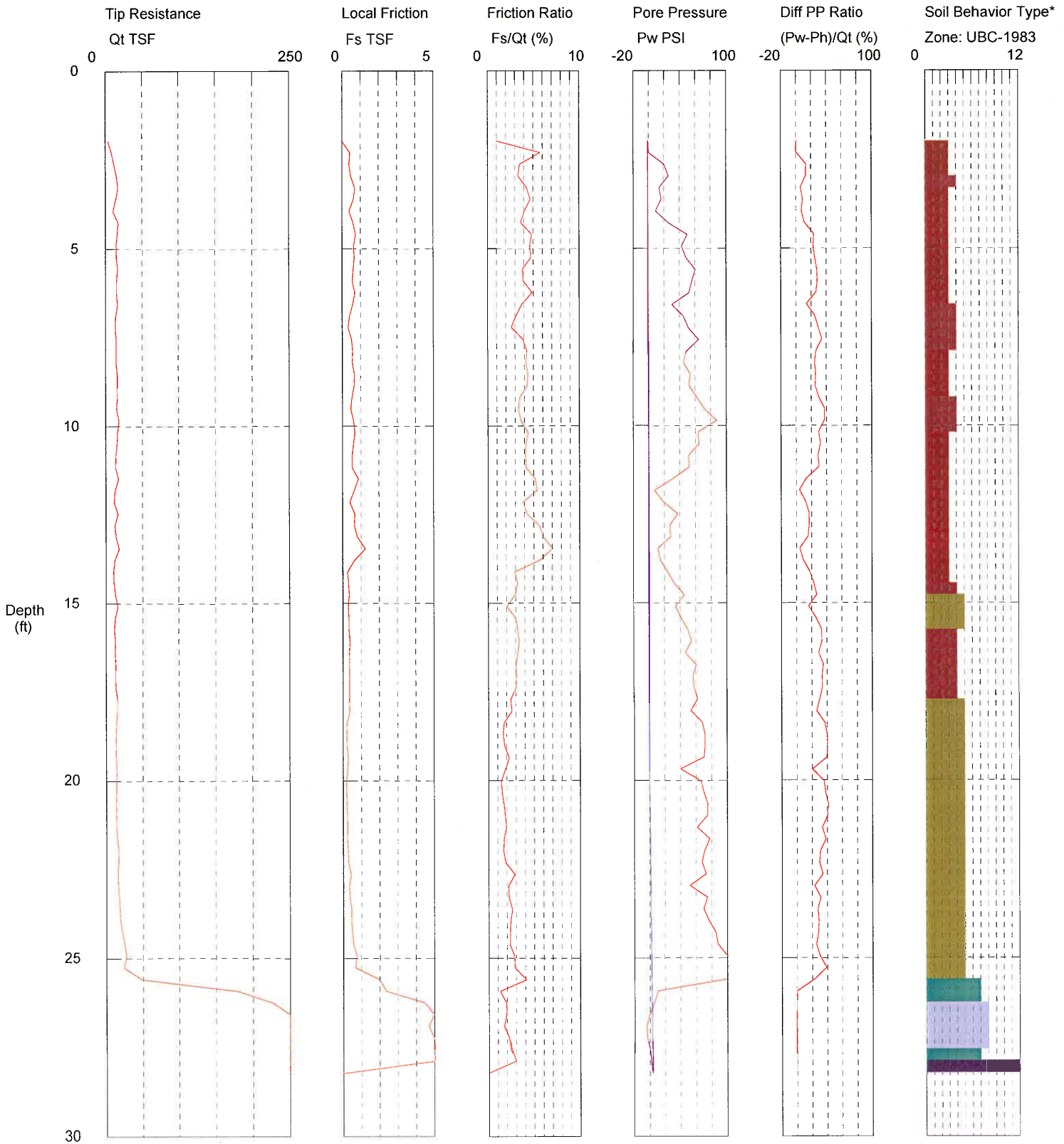
Boring Log B-2 Continued										
CLIENT: Mark See, Public Works Director, City of Cannon Beach				CGI PROJECT NO.: 11-022						
PROJECT: Proposed New City Hall / Tsunami Evacuation Building				BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer						
LOCATION: 163 East Gower Street, Cannon Beach, Oregon				ELEVATION: Approximately 30 feet above mean sea level						
DATE DRILLED: March 30, 2011				LOGGED BY: Chuck Bolduc, G.I.T.						
DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
	S-2		Medium dense, wet gray sand with layers of mica and micaceous sand.	4 8 15	23					
55										
60										
65			Layer of gravelly material based on drilling characteristics							
70										
75	S-3		Medium dense, wet, tan and gray fine-grained sand with no mica	8 12 15	27					
80										
85	S-4		Becomes dense with layers of concentrated micaceous flakes.	12 16 20	36					
90			Alternately hard and easier drilling between 90 and 95 feet							
95	S-5			13 19 24	43					
100										

Boring Log B-2 Continued							 Chinook GeoServices Inc.			
CLIENT: Mark See, Public Works Director, City of Cannon Beach				CGI PROJECT NO.: 11-022						
PROJECT: Proposed New City Hall / Tsunami Evacuation Building				BORING TYPE: Mud rotary using truck mounted rig equipped with automatic SPT hammer						
LOCATION: 163 East Gower Street, Cannon Beach, Oregon				ELEVATION: Approximately 30 feet above mean sea level						
DATE DRILLED: March 30, 2011				LOGGED BY: Chuck Bolduc, G.I.T.						
DEPTH (ft)	SAMPLE NO.	SAMPLE	SOIL DESCRIPTION	BLOWS PER 6 INCHES	SPT "N" Value	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT (%)	UNIT DRY WT. (p.c.f.)	REMARKS
			Contact with bedrock based on drilling characteristics.							
	S-6		Hard, moist, grayish brown siltstone.	50 for 4"	>50					
105										
110	S-7			32 43 50 for 5"	>50					
115										
120	S-8			48 50 for 5"						
			Boring terminated at 121 feet below the ground surface and backfilled with bentonite/cement grout and bentonite chip hole-plug							
125										
130										
135										
140										
145										
150										

Subsurface Technologies

Operator: SAM
Sounding: P-1
Cone Used: DSG1021

CPT Date/Time: 3/29/2011 9:24:20 AM
Location: CANNON-CITY HALL
Job Number: 11-022



Maximum Depth = 28.22 feet

Depth Increment = 0.328 feet

1 sensitive fine grained
2 organic material
3 clay

4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt

7 silty sand to sandy silt
8 sand to silty sand
9 sand

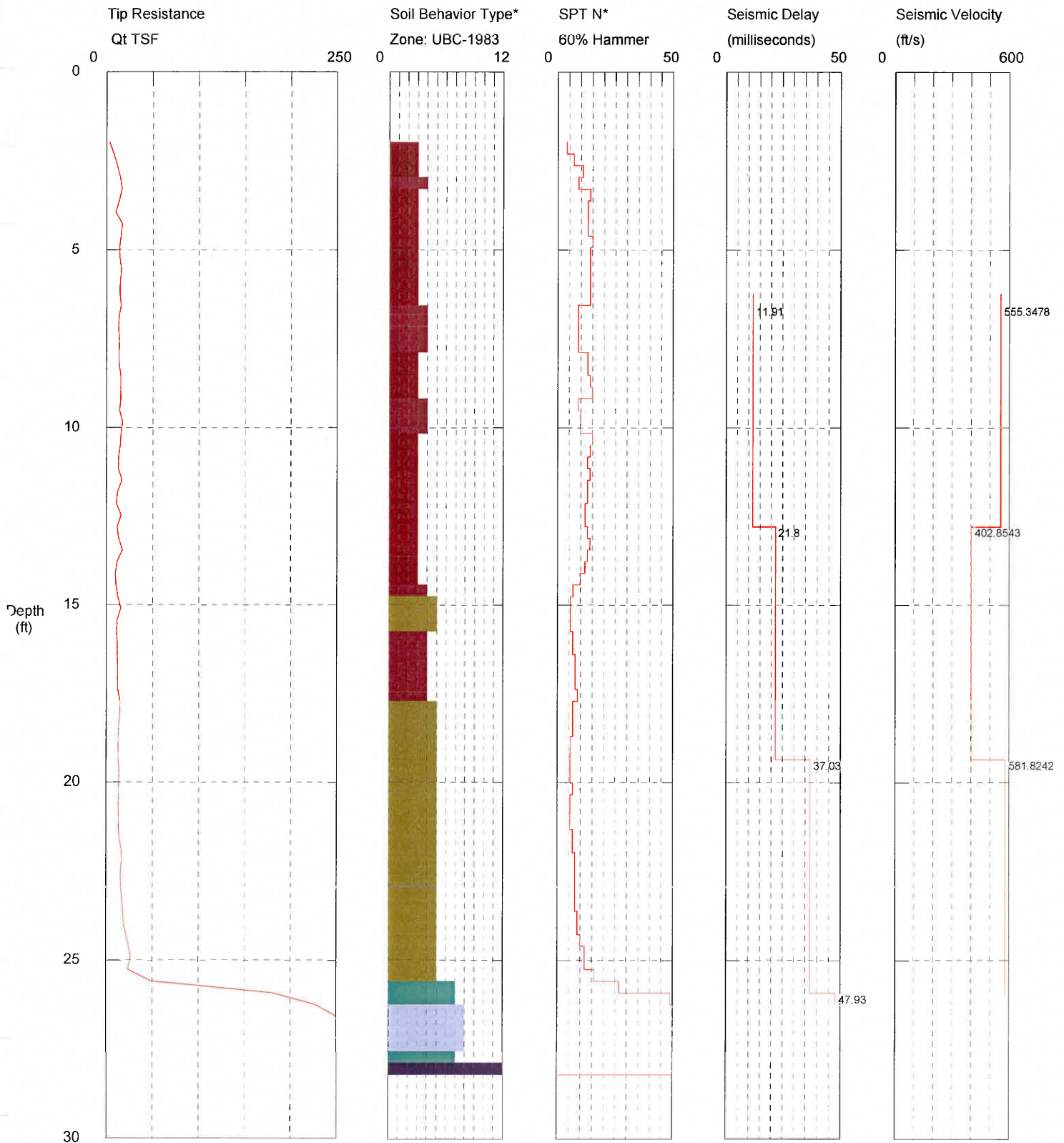
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Exhibit A-2

Subsurface Technologies

Operator: SAM
Sounding: P-1
Cone Used: DSG1021

CPT Date/Time: 3/29/2011 9:24:20 AM
Location: CANNON-CITY HALL
Job Number: 11-022

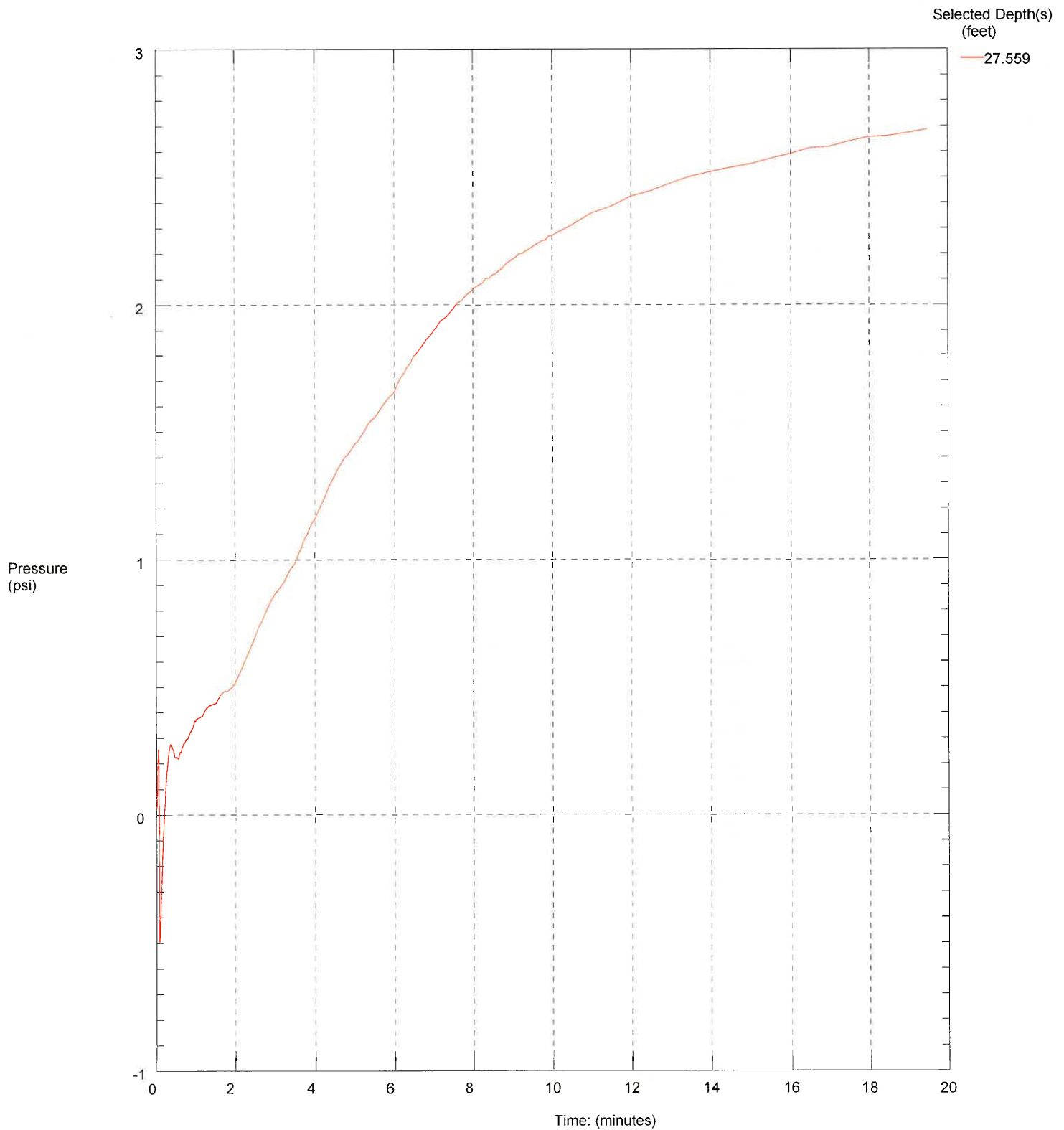


- | | | | |
|--------------------------|-----------------------------|----------------------------|--------------------------------|
| 1 sensitive fine grained | 4 silty clay to clay | 7 silty sand to sandy silt | 10 gravelly sand to sand |
| 2 organic material | 5 clayey silt to silty clay | 8 sand to silty sand | 11 very stiff fine grained (*) |
| 3 clay | 6 sandy silt to clayey silt | 9 sand | 12 sand to clayey sand (*) |

Subsurface Technologies

Operator SAM
Sounding: P-1
Cone Used: DSG1021

CPT Date/Time: 3/29/2011 9:24:20 AM
Location: CANNON-CITY HALL
Job Number: 11-022



Maximum Pressure = 2.686 psi
Hydrostatic Pressure = 3.417 psi

APPENDIX C:
LABORATORY TEST PROCEDURES AND RESULTS

APPENDIX C

LABORATORY TEST PROCEDURES AND RESULTS

The following paragraphs describe the procedures associated with the laboratory testing that we conducted for this project. Graphic results of certain laboratory tests are enclosed with this appendix.

Visual Classification Procedures

Visual soil classifications were conducted on all samples in the field and on selected samples in the laboratory. All soils were classified in general accordance with ASTM D2488 and the Unified Soil Classification System. The resulting classifications are included in our boring logs included in Appendix B.

Moisture Content Determination Procedures

Moisture content determinations were performed on representative samples to aid in identification and correlation with soil types. All determinations were made in general accordance with ASTM D2216. The results of these tests are shown on the boring logs included in Appendix B.

Atterberg Limits Testing

The plastic limit, liquid limit and plasticity index were determined on selected soil samples in general accordance with ASTM D4318. The results are shown on the boring logs included in Appendix B.

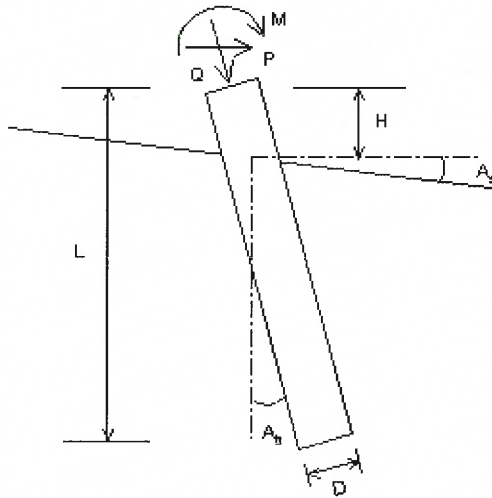
Grain Size Analysis Procedure

A grain size analysis indicates the range of soil particle diameters included in a particular sample. Grain size analyses were performed on representative samples in general accordance with ASTM D422. The results are included with this appendix and were used to classify the soils described in the boring logs.

APPENDIX D:
PILE DESIGN COMPUTER OUTPUT

VERTICAL ANALYSIS

Axial Fig

**Loads:**

Load Factor for Vertical Loads= 1.0
 Load Factor for Lateral Loads= 1.0
 Loads Supported by Pile Cap= 0 %
 Shear Condition: Static

Vertical Load, $Q = 975.0$ -kp
 Shear Load, $P = 0.0$ -kp
 Moment, $M = 0.0$ -kp-f

Profile:

Pile Length, $L = 110.0$ -ft
 Top Height, $H = 0$ -ft
 Slope Angle, $As = 0$
 Batter Angle, $Ab = 0$

Drilled Pile (dia ≤ 24 in. or 61 cm)

Soil Data:

Depth -ft	Gamma -lb/f ³	Phi	C -kp/f ²	K -lb/f ³	e50 or Dr %	Nspt
0	105	0	1.0	0	0	
7.5	105	0	1.00	0	0	
15	100	0	0.25	0	0	
21	37.6	0	.25	0	0	
25	42.6	38	0.00	0	0	
45	42.6	35	0.00	0	0	
50	42.6	38	0.00	0	0	
100	77.6	0	2.5	0	0	
150	77.6	0	2.5	0	0	

Pile Data:

Depth -ft	Width -in	Area -in ²	Per. -in	I -in ⁴	E -kp/i ²	Weight -kp/f
0.0	24	452.4	75.4	16286.0	3000	0.471
110.0	24	452.4	75.4	16286.0	3000	0.471

Vertical capacity:

Weight above Ground= 0.00 Total Weight= 34.39-kp *Soil Weight is not included
 Side Resistance (Down)= 908.260-kp Side Resistance (Up)= 587.619-kp
 Tip Resistance (Down)= 70.688-kp Tip Resistance (Up)= 0.000-kp
 Total Ultimate Capacity (Down)= 978.948-kp Total Ultimate Capacity (Up)= 622.013-kp
 Total Allowable Capacity (Down)= 326.316-kp Total Allowable Capacity (Up)= 230.267-kp
 N/G! $Q_{allow} < Q$

Settlement Calculation:

At $Q = 975.00$ -kp Settlement= 0.83467-in
 At $X_{allow} = 1.00$ -in $Q_{allow} = 976.87335$ -kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.



TEB/City Hall Cannon Beach, OR
 2 ft diameter piles

Axial Capacity.txt

ALLPILE 7
 VERTICAL ANALYSIS DETAILED OUTPUT
 Copyright by CivilTech Software
 www.civiltechsoftware.com

Licensed to Marcella M Boyer Chino GeoServices, Inc.
 Date: 4/29/2011 File: P:\2011 Projects\11-022 (Cannon Beach TEB)\Pile
 Analysis\Allpile\TEB24.alp 1.0

Title 1: TEB/City Hall Cannon Beach, OR
 Title 2: 2 ft diameter piles

Pile Profile and Loading:

Pile type: Drilled Pile (dia <=24 in. or 61 cm)
 Pile Length, L= 110.0 -ft
 Top Height, H= 0 -ft
 Slope Angle, As= 0
 Batter Angle, Ab= 0.00

Single Pile, Vertical Analysis:

Vertical Load, Q 975.0 -kp
 Load Factor for Vertical Loads: 1.0

Bearing stratum from pile tip extending to 10 Diameter of pile, which
 is=20.0-ft Starting from Pile Tip= 110.0-ft
 From Ztip=110.0 to 130.0-ft Average Properties: Es= 937.50-kp/f²
 C=2.50-kp/f² Friction=0.00 Cp=0.14 Ksand=1.00
 Limits of Max. tip resistance, q_{lim}= N/A
 Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00
 Q_{tip_dw}=70.7-kp based on q_{ult}=22.5-kp/f² and Base Area=3.1-ft²
 Q_{tip_up}=0.0-kp and Base Area=0.0-ft²

TIP RESISTANCE (Down) CALCULATION:

Tip Depth= 110.0-ft Critical Depth Ratio Z/D= 20 Critical Depth= 40.0-ft
 Effective Width of Tip= 2.00-ft, Tip Area= 3.14-ft²
 Bearing stratum from pile tip extending to 10 Diameter of pile. Bearing
 stratum= 20.00-ft
 Btip: width at pile tip= 2.00-ft
 Phi & C are average value in bearing stratum
 Batter Angle= 0.00, Batter Factor for Tip and Side= 1.00

Ztip	Z/D	Z _{lim}	q _{lim}	Width	Area	Phi	C	Nq	Nc
Sv	q _{ult}	Q _{tip_dw}							
-ft		-ft	-kp/f ²	-ft	-ft ²	-o	-kp/f ²		
-kp/f ²	-kp/f ²	-kp							

110.0	20.0	40.0	N/A	2.0	3.14	0.0	2.50	0.0	9.0
3.0	22.5	70.7							

Ztip - Depth of pile tip from ground surface
 D - Pile average diameter (below ground) for calculation of critical depth.
 D=2.00-ft
 Z/D - Critical depth (for tip resistances) as ratio of depth/diameter.
 Vertical stress will be constant below critical depth
 Z_{lim} - Critical depth (for tip resistances)
 q_{lim} - Limit of Max. tip resistance
 Btip: width or diameter at pile tip
 Bearing stratum A stratum from pile tip extending to some depth. Average
 soil properties in the stratum are used for bearing calculation

SIDE RESISTANCE (Up & Down) CALCULATION:

Exhibit A-2

Axial Capacity.txt									
D	Z/D	Z_lim	Sf_lim	K_dw	K_up	dz			
-ft		-ft	-kp/f2			-ft			
2.00	20.0	40.00	N/A	0.8	0.4	0.220			
D - Pile average diameter for calculation of critical depth									
Z/D - Critical depth (for side resistances) as ratio of depth h/ diameter.									
Vertical stress will be constant below critical depth									
Z_lim - Critical depth (for side resistances)									
Sf_lim - Limit of Max. side resistance									
Users Setting: Ka=1, which is constant. Ca=KcKaC=KcC									
SIDE RESISTANCE (Up & Down) CALCULATION vs DEPTH:									
Calculation is based on segment dZ= 0.22									
Zs	Prem	Sv	Phi	Kf (<2)	Delta	f_dw	f_up	C	Ka
Kc (<2)	Ca_dw	Ca_up	Sf_dw	Sf_up	Weight	Qneg	Q_dw	Q_up	
-ft	-ft	-kp/f2	-o	Delta	-o	-kp/f2	-kp/f2	-kp/f2	
Ca	-kp/f2	-kp/f2	-kp/f2	-kp/f2	-kp	-kp	-kp	-kp	
110.00	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	0.00	0.00	0.00	0.00	70.7	0.0	
109.78	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.06	0.00	74.2	3.5	
109.56	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.12	0.00	77.6	7.0	
109.34	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.18	0.00	81.1	10.6	
109.12	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.24	0.00	84.5	14.1	
108.90	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.30	0.00	88.0	17.6	
108.68	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.36	0.00	91.5	21.1	
108.46	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.42	0.00	94.9	24.7	
108.24	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.48	0.00	98.4	28.2	
108.02	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.55	0.00	101.9	31.7	
107.80	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.61	0.00	105.3	35.2	
107.58	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.67	0.00	108.8	38.8	
107.35	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.73	0.00	112.2	42.3	
107.13	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.79	0.00	115.7	45.8	
106.91	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.85	0.00	119.2	49.3	
106.69	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.91	0.00	122.6	52.9	
106.47	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	0.97	0.00	126.1	56.4	
106.25	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.03	0.00	129.6	59.9	
106.03	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.09	0.00	133.0	63.4	
105.81	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.15	0.00	136.5	66.9	
105.59	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.21	0.00	139.9	70.5	
105.37	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.27	0.00	143.4	74.0	

Exhibit A-2

Axial Capacity.txt									
105.15	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.33	0.00	146.9	77.5	
104.93	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.39	0.00	150.3	81.0	
104.71	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.45	0.00	153.8	84.6	
104.49	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.52	0.00	157.3	88.1	
104.27	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.58	0.00	160.7	91.6	
104.05	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.64	0.00	164.2	95.1	
103.83	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.70	0.00	167.6	98.7	
103.61	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.76	0.00	171.1	102.2	
103.39	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.82	0.00	174.6	105.7	
103.17	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.88	0.00	178.0	109.2	
102.95	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	1.94	0.00	181.5	112.7	
102.73	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.00	0.00	185.0	116.3	
102.51	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.06	0.00	188.4	119.8	
102.28	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.12	0.00	191.9	123.3	
102.06	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.18	0.00	195.3	126.8	
101.84	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.24	0.00	198.8	130.4	
101.62	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.30	0.00	202.3	133.9	
101.40	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.36	0.00	205.7	137.4	
101.18	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.42	0.00	209.2	140.9	
100.96	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.49	0.00	212.7	144.5	
100.74	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.55	0.00	216.1	148.0	
100.52	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.61	0.00	219.6	151.5	
100.30	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.67	0.00	223.0	155.0	
100.08	6.28	2.98	0.0	0.80	0.00	0.00	0.00	2.5	1.00
1.0	2.50	2.50	2.50	2.50	2.73	0.00	226.5	158.6	
99.86	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.79	0.00	228.5	159.6	
99.64	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.85	0.00	230.4	160.6	
99.42	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.91	0.00	232.3	161.6	
99.20	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	2.97	0.00	234.3	162.7	
98.98	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.03	0.00	236.2	163.7	
98.76	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.09	0.00	238.1	164.7	
98.54	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.15	0.00	240.1	165.8	
98.32	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.21	0.00	242.0	166.8	
98.10	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.27	0.00	244.0	167.8	

Exhibit A-2

Axial Capacity.txt									
97.88	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.33	0.00	245.9	168.9	
97.66	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.39	0.00	247.8	169.9	
97.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.45	0.00	249.8	170.9	
97.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.52	0.00	251.7	171.9	
96.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.58	0.00	253.7	173.0	
96.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.64	0.00	255.6	174.0	
96.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.70	0.00	257.5	175.0	
96.33	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.76	0.00	259.5	176.1	
96.11	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.82	0.00	261.4	177.1	
95.89	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.88	0.00	263.3	178.1	
95.67	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	3.94	0.00	265.3	179.2	
95.45	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.00	0.00	267.2	180.2	
95.23	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.06	0.00	269.2	181.2	
95.01	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.12	0.00	271.1	182.2	
94.79	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.18	0.00	273.0	183.3	
94.57	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.24	0.00	275.0	184.3	
94.35	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.30	0.00	276.9	185.3	
94.13	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.36	0.00	278.9	186.4	
93.91	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.42	0.00	280.8	187.4	
93.69	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.49	0.00	282.7	188.4	
93.47	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.55	0.00	284.7	189.5	
93.25	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.61	0.00	286.6	190.5	
93.03	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.67	0.00	288.6	191.5	
92.81	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.73	0.00	290.5	192.5	
92.59	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.79	0.00	292.4	193.6	
92.36	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.85	0.00	294.4	194.6	
92.14	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.91	0.00	296.3	195.6	
91.92	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	4.97	0.00	298.2	196.7	
91.70	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.03	0.00	300.2	197.7	
91.48	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.09	0.00	302.1	198.7	
91.26	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.15	0.00	304.1	199.8	
91.04	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.21	0.00	306.0	200.8	
90.82	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.27	0.00	307.9	201.8	

Exhibit A-2

Axial Capacity.txt									
90.60	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.33	0.00	309.9	202.8	
90.38	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.39	0.00	311.8	203.9	
90.16	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.46	0.00	313.8	204.9	
89.94	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.52	0.00	315.7	205.9	
89.72	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.58	0.00	317.6	207.0	
89.50	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.64	0.00	319.6	208.0	
89.28	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.70	0.00	321.5	209.0	
89.06	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.76	0.00	323.5	210.1	
88.84	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.82	0.00	325.4	211.1	
88.62	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.88	0.00	327.3	212.1	
88.40	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	5.94	0.00	329.3	213.1	
88.18	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.00	0.00	331.2	214.2	
87.96	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.06	0.00	333.1	215.2	
87.74	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.12	0.00	335.1	216.2	
87.52	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.18	0.00	337.0	217.3	
87.29	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.24	0.00	339.0	218.3	
87.07	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.30	0.00	340.9	219.3	
86.85	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.36	0.00	342.8	220.4	
86.63	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.42	0.00	344.8	221.4	
86.41	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.49	0.00	346.7	222.4	
86.19	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.55	0.00	348.7	223.4	
85.97	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.61	0.00	350.6	224.5	
85.75	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.67	0.00	352.5	225.5	
85.53	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.73	0.00	354.5	226.5	
85.31	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.79	0.00	356.4	227.6	
85.09	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.85	0.00	358.3	228.6	
84.87	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.91	0.00	360.3	229.6	
84.65	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	6.97	0.00	362.2	230.7	
84.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.03	0.00	364.2	231.7	
84.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.09	0.00	366.1	232.7	
83.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.15	0.00	368.0	233.7	
83.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.21	0.00	370.0	234.8	
83.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.27	0.00	371.9	235.8	

Exhibit A-2

Axial Capacity.txt									
83.33	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.33	0.00	373.9	236.8	
83.11	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.39	0.00	375.8	237.9	
82.89	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.46	0.00	377.7	238.9	
82.67	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.52	0.00	379.7	239.9	
82.44	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.58	0.00	381.6	241.0	
82.22	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.64	0.00	383.6	242.0	
82.00	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.70	0.00	385.5	243.0	
81.78	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.76	0.00	387.4	244.0	
81.56	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.82	0.00	389.4	245.1	
81.34	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.88	0.00	391.3	246.1	
81.12	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	7.94	0.00	393.2	247.1	
80.90	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.00	0.00	395.2	248.2	
80.68	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.06	0.00	397.1	249.2	
80.46	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.12	0.00	399.1	250.2	
80.24	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.18	0.00	401.0	251.3	
80.02	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.24	0.00	402.9	252.3	
79.80	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.30	0.00	404.9	253.3	
79.58	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.36	0.00	406.8	254.3	
79.36	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.43	0.00	408.8	255.4	
79.14	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.49	0.00	410.7	256.4	
78.92	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.55	0.00	412.6	257.4	
78.70	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.61	0.00	414.6	258.5	
78.48	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.67	0.00	416.5	259.5	
78.26	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.73	0.00	418.5	260.5	
78.04	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.79	0.00	420.4	261.6	
77.82	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.85	0.00	422.3	262.6	
77.60	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.91	0.00	424.3	263.6	
77.37	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	8.97	0.00	426.2	264.6	
77.15	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.03	0.00	428.1	265.7	
76.93	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.09	0.00	430.1	266.7	
76.71	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.15	0.00	432.0	267.7	
76.49	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.21	0.00	434.0	268.8	
76.27	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.27	0.00	435.9	269.8	

Exhibit A-2

Axial Capacity.txt									
76.05	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.33	0.00	437.8	270.8	
75.83	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.39	0.00	439.8	271.9	
75.61	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.46	0.00	441.7	272.9	
75.39	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.52	0.00	443.7	273.9	
75.17	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.58	0.00	445.6	274.9	
74.95	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.64	0.00	447.5	276.0	
74.73	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.70	0.00	449.5	277.0	
74.51	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.76	0.00	451.4	278.0	
74.29	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.82	0.00	453.3	279.1	
74.07	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.88	0.00	455.3	280.1	
73.85	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	9.94	0.00	457.2	281.1	
73.63	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.00	0.00	459.2	282.2	
73.41	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.06	0.00	461.1	283.2	
73.19	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.12	0.00	463.0	284.2	
72.97	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.18	0.00	465.0	285.2	
72.75	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.24	0.00	466.9	286.3	
72.53	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.30	0.00	468.9	287.3	
72.30	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.36	0.00	470.8	288.3	
72.08	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.43	0.00	472.7	289.4	
71.86	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.49	0.00	474.7	290.4	
71.64	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.55	0.00	476.6	291.4	
71.42	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.61	0.00	478.6	292.5	
71.20	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.67	0.00	480.5	293.5	
70.98	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.73	0.00	482.4	294.5	
70.76	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.79	0.00	484.4	295.5	
70.54	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.85	0.00	486.3	296.6	
70.32	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.91	0.00	488.2	297.6	
70.10	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	10.97	0.00	490.2	298.6	
69.88	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.03	0.00	492.1	299.7	
69.66	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.09	0.00	494.1	300.7	
69.44	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.15	0.00	496.0	301.7	
69.22	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.21	0.00	497.9	302.8	
69.00	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.27	0.00	499.9	303.8	

Exhibit A-2

Axial Capacity.txt									
68.78	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.33	0.00	501.8	304.8	
68.56	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.40	0.00	503.8	305.8	
68.34	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.46	0.00	505.7	306.9	
68.12	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.52	0.00	507.6	307.9	
67.90	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.58	0.00	509.6	308.9	
67.68	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.64	0.00	511.5	310.0	
67.45	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.70	0.00	513.5	311.0	
67.23	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.76	0.00	515.4	312.0	
67.01	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.82	0.00	517.3	313.1	
66.79	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.88	0.00	519.3	314.1	
66.57	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	11.94	0.00	521.2	315.1	
66.35	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.00	0.00	523.1	316.1	
66.13	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.06	0.00	525.1	317.2	
65.91	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.12	0.00	527.0	318.2	
65.69	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.18	0.00	529.0	319.2	
65.47	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.24	0.00	530.9	320.3	
65.25	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.30	0.00	532.8	321.3	
65.03	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.36	0.00	534.8	322.3	
64.81	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.43	0.00	536.7	323.4	
64.59	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.49	0.00	538.7	324.4	
64.37	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.55	0.00	540.6	325.4	
64.15	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.61	0.00	542.5	326.4	
63.93	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.67	0.00	544.5	327.5	
63.71	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.73	0.00	546.4	328.5	
63.49	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.79	0.00	548.3	329.5	
63.27	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.85	0.00	550.3	330.6	
63.05	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.91	0.00	552.2	331.6	
62.83	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	12.97	0.00	554.2	332.6	
62.61	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.03	0.00	556.1	333.7	
62.38	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.09	0.00	558.0	334.7	
62.16	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.15	0.00	560.0	335.7	
61.94	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.21	0.00	561.9	336.7	
61.72	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.27	0.00	563.9	337.8	

Exhibit A-2

Axial Capacity.txt									
61.50	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.33	0.00	565.8	338.8	
61.28	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.40	0.00	567.7	339.8	
61.06	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.46	0.00	569.7	340.9	
60.84	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.52	0.00	571.6	341.9	
60.62	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.58	0.00	573.6	342.9	
60.40	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.64	0.00	575.5	344.0	
60.18	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.70	0.00	577.4	345.0	
59.96	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.76	0.00	579.4	346.0	
59.74	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.82	0.00	581.3	347.0	
59.52	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.88	0.00	583.2	348.1	
59.30	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	13.94	0.00	585.2	349.1	
59.08	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.00	0.00	587.1	350.1	
58.86	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.06	0.00	589.1	351.2	
58.64	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.12	0.00	591.0	352.2	
58.42	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.18	0.00	592.9	353.2	
58.20	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.24	0.00	594.9	354.3	
57.98	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.30	0.00	596.8	355.3	
57.76	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.37	0.00	598.8	356.3	
57.54	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.43	0.00	600.7	357.3	
57.31	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.49	0.00	602.6	358.4	
57.09	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.55	0.00	604.6	359.4	
56.87	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.61	0.00	606.5	360.4	
56.65	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.67	0.00	608.5	361.5	
56.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.73	0.00	610.4	362.5	
56.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.79	0.00	612.3	363.5	
55.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.85	0.00	614.3	364.6	
55.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.91	0.00	616.2	365.6	
55.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	14.97	0.00	618.1	366.6	
55.33	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.03	0.00	620.1	367.6	
55.11	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.09	0.00	622.0	368.7	
54.89	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.15	0.00	624.0	369.7	
54.67	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.21	0.00	625.9	370.7	
54.45	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.27	0.00	627.8	371.8	

Exhibit A-2

Axial Capacity.txt									
54.23	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.33	0.00	629.8	372.8	
54.01	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.40	0.00	631.7	373.8	
53.79	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.46	0.00	633.7	374.9	
53.57	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.52	0.00	635.6	375.9	
53.35	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.58	0.00	637.5	376.9	
53.13	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.64	0.00	639.5	377.9	
52.91	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.70	0.00	641.4	379.0	
52.69	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.76	0.00	643.3	380.0	
52.46	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.82	0.00	645.3	381.0	
52.24	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.88	0.00	647.2	382.1	
52.02	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	15.94	0.00	649.2	383.1	
51.80	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.00	0.00	651.1	384.1	
51.58	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.06	0.00	653.0	385.2	
51.36	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.12	0.00	655.0	386.2	
51.14	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.18	0.00	656.9	387.2	
50.92	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.24	0.00	658.9	388.2	
50.70	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.30	0.00	660.8	389.3	
50.48	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.37	0.00	662.7	390.3	
50.26	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.43	0.00	664.7	391.3	
50.04	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	16.49	0.00	666.6	392.4	
49.82	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.55	0.00	668.4	393.3	
49.60	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.61	0.00	670.1	394.2	
49.38	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.67	0.00	671.9	395.2	
49.16	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.73	0.00	673.6	396.1	
48.94	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.79	0.00	675.4	397.1	
48.72	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.85	0.00	677.2	398.0	
48.50	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.91	0.00	678.9	398.9	
48.28	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	16.97	0.00	680.7	399.9	
48.06	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.03	0.00	682.4	400.8	
47.84	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.09	0.00	684.2	401.8	
47.62	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.15	0.00	685.9	402.7	
47.39	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.21	0.00	687.7	403.6	
47.17	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.27	0.00	689.5	404.6	

Exhibit A-2

Axial Capacity.txt									
46.95	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.34	0.00	691.2	405.5	
46.73	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.40	0.00	693.0	406.4	
46.51	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.46	0.00	694.7	407.4	
46.29	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.52	0.00	696.5	408.3	
46.07	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.58	0.00	698.2	409.3	
45.85	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.64	0.00	700.0	410.2	
45.63	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.70	0.00	701.8	411.1	
45.41	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.76	0.00	703.5	412.1	
45.19	6.28	2.98	35.0	0.80	28.00	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	17.82	0.00	705.3	413.0	
44.97	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	17.88	0.00	707.2	414.1	
44.75	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	17.94	0.00	709.1	415.1	
44.53	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.00	0.00	711.1	416.1	
44.31	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.06	0.00	713.0	417.1	
44.09	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.12	0.00	715.0	418.2	
43.87	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.18	0.00	716.9	419.2	
43.65	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.24	0.00	718.8	420.2	
43.43	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.30	0.00	720.8	421.3	
43.21	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.37	0.00	722.7	422.3	
42.99	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.43	0.00	724.7	423.3	
42.77	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.49	0.00	726.6	424.4	
42.55	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.55	0.00	728.5	425.4	
42.32	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.61	0.00	730.5	426.4	
42.10	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.67	0.00	732.4	427.4	
41.88	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.73	0.00	734.4	428.5	
41.66	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.79	0.00	736.3	429.5	
41.44	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.85	0.00	738.2	430.5	
41.22	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.91	0.00	740.2	431.6	
41.00	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	18.97	0.00	742.1	432.6	
40.78	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.03	0.00	744.0	433.6	
40.56	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.09	0.00	746.0	434.7	
40.34	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.15	0.00	747.9	435.7	
40.12	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.21	0.00	749.9	436.7	
39.90	6.28	2.98	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.27	0.00	751.8	437.7	

Exhibit A-2

Axial Capacity.txt									
39.68	6.28	2.97	38.0	0.80	30.40	1.40	0.70	0.0	1.00
1.0	0.00	0.00	1.40	0.70	19.34	0.00	753.7	438.8	
39.46	6.28	2.96	38.0	0.80	30.40	1.39	0.70	0.0	1.00
1.0	0.00	0.00	1.39	0.70	19.40	0.00	755.7	439.8	
39.24	6.28	2.95	38.0	0.80	30.40	1.39	0.69	0.0	1.00
1.0	0.00	0.00	1.39	0.69	19.46	0.00	757.6	440.8	
39.02	6.28	2.94	38.0	0.80	30.40	1.38	0.69	0.0	1.00
1.0	0.00	0.00	1.38	0.69	19.52	0.00	759.5	441.8	
38.80	6.28	2.94	38.0	0.80	30.40	1.38	0.69	0.0	1.00
1.0	0.00	0.00	1.38	0.69	19.58	0.00	761.4	442.8	
38.58	6.28	2.93	38.0	0.80	30.40	1.37	0.69	0.0	1.00
1.0	0.00	0.00	1.37	0.69	19.64	0.00	763.3	443.9	
38.36	6.28	2.92	38.0	0.80	30.40	1.37	0.68	0.0	1.00
1.0	0.00	0.00	1.37	0.68	19.70	0.00	765.2	444.9	
38.14	6.28	2.91	38.0	0.80	30.40	1.36	0.68	0.0	1.00
1.0	0.00	0.00	1.36	0.68	19.76	0.00	767.1	445.9	
37.92	6.28	2.90	38.0	0.80	30.40	1.36	0.68	0.0	1.00
1.0	0.00	0.00	1.36	0.68	19.82	0.00	769.0	446.9	
37.70	6.28	2.89	38.0	0.80	30.40	1.36	0.68	0.0	1.00
1.0	0.00	0.00	1.36	0.68	19.88	0.00	770.9	447.9	
37.47	6.28	2.88	38.0	0.80	30.40	1.35	0.68	0.0	1.00
1.0	0.00	0.00	1.35	0.68	19.94	0.00	772.7	448.9	
37.25	6.28	2.87	38.0	0.80	30.40	1.35	0.67	0.0	1.00
1.0	0.00	0.00	1.35	0.67	20.00	0.00	774.6	449.9	
37.03	6.28	2.86	38.0	0.80	30.40	1.34	0.67	0.0	1.00
1.0	0.00	0.00	1.34	0.67	20.06	0.00	776.5	450.9	
36.81	6.28	2.85	38.0	0.80	30.40	1.34	0.67	0.0	1.00
1.0	0.00	0.00	1.34	0.67	20.12	0.00	778.3	451.8	
36.59	6.28	2.84	38.0	0.80	30.40	1.33	0.67	0.0	1.00
1.0	0.00	0.00	1.33	0.67	20.18	0.00	780.2	452.8	
36.37	6.28	2.83	38.0	0.80	30.40	1.33	0.66	0.0	1.00
1.0	0.00	0.00	1.33	0.66	20.24	0.00	782.0	453.8	
36.15	6.28	2.82	38.0	0.80	30.40	1.32	0.66	0.0	1.00
1.0	0.00	0.00	1.32	0.66	20.31	0.00	783.8	454.8	
35.93	6.28	2.81	38.0	0.80	30.40	1.32	0.66	0.0	1.00
1.0	0.00	0.00	1.32	0.66	20.37	0.00	785.7	455.8	
35.71	6.28	2.80	38.0	0.80	30.40	1.32	0.66	0.0	1.00
1.0	0.00	0.00	1.32	0.66	20.43	0.00	787.5	456.7	
35.49	6.28	2.79	38.0	0.80	30.40	1.31	0.66	0.0	1.00
1.0	0.00	0.00	1.31	0.66	20.49	0.00	789.3	457.7	
35.27	6.28	2.79	38.0	0.80	30.40	1.31	0.65	0.0	1.00
1.0	0.00	0.00	1.31	0.65	20.55	0.00	791.1	458.7	
35.05	6.28	2.78	38.0	0.80	30.40	1.30	0.65	0.0	1.00
1.0	0.00	0.00	1.30	0.65	20.61	0.00	792.9	459.6	
34.83	6.28	2.77	38.0	0.80	30.40	1.30	0.65	0.0	1.00
1.0	0.00	0.00	1.30	0.65	20.67	0.00	794.7	460.6	
34.61	6.28	2.76	38.0	0.80	30.40	1.29	0.65	0.0	1.00
1.0	0.00	0.00	1.29	0.65	20.73	0.00	796.5	461.5	
34.39	6.28	2.75	38.0	0.80	30.40	1.29	0.64	0.0	1.00
1.0	0.00	0.00	1.29	0.64	20.79	0.00	798.3	462.5	
34.17	6.28	2.74	38.0	0.80	30.40	1.29	0.64	0.0	1.00
1.0	0.00	0.00	1.29	0.64	20.85	0.00	800.1	463.5	
33.95	6.28	2.73	38.0	0.80	30.40	1.28	0.64	0.0	1.00
1.0	0.00	0.00	1.28	0.64	20.91	0.00	801.8	464.4	
33.73	6.28	2.72	38.0	0.80	30.40	1.28	0.64	0.0	1.00
1.0	0.00	0.00	1.28	0.64	20.97	0.00	803.6	465.3	
33.51	6.28	2.71	38.0	0.80	30.40	1.27	0.64	0.0	1.00
1.0	0.00	0.00	1.27	0.64	21.03	0.00	805.4	466.3	
33.29	6.28	2.70	38.0	0.80	30.40	1.27	0.63	0.0	1.00
1.0	0.00	0.00	1.27	0.63	21.09	0.00	807.1	467.2	
33.07	6.28	2.69	38.0	0.80	30.40	1.26	0.63	0.0	1.00
1.0	0.00	0.00	1.26	0.63	21.15	0.00	808.9	468.2	
32.85	6.28	2.68	38.0	0.80	30.40	1.26	0.63	0.0	1.00
1.0	0.00	0.00	1.26	0.63	21.21	0.00	810.6	469.1	
32.63	6.28	2.67	38.0	0.80	30.40	1.25	0.63	0.0	1.00
1.0	0.00	0.00	1.25	0.63	21.27	0.00	812.4	470.0	

Exhibit A-2

Axial Capacity.txt									
32.40	6.28	2.66	38.0	0.80	30.40	1.25	0.62	0.0	1.00
1.0	0.00	0.00	1.25	0.62	21.34	0.00	814.1	470.9	
32.18	6.28	2.65	38.0	0.80	30.40	1.25	0.62	0.0	1.00
1.0	0.00	0.00	1.25	0.62	21.40	0.00	815.8	471.9	
31.96	6.28	2.64	38.0	0.80	30.40	1.24	0.62	0.0	1.00
1.0	0.00	0.00	1.24	0.62	21.46	0.00	817.5	472.8	
31.74	6.28	2.63	38.0	0.80	30.40	1.24	0.62	0.0	1.00
1.0	0.00	0.00	1.24	0.62	21.52	0.00	819.2	473.7	
31.52	6.28	2.63	38.0	0.80	30.40	1.23	0.62	0.0	1.00
1.0	0.00	0.00	1.23	0.62	21.58	0.00	821.0	474.6	
31.30	6.28	2.62	38.0	0.80	30.40	1.23	0.61	0.0	1.00
1.0	0.00	0.00	1.23	0.61	21.64	0.00	822.7	475.5	
31.08	6.28	2.61	38.0	0.80	30.40	1.22	0.61	0.0	1.00
1.0	0.00	0.00	1.22	0.61	21.70	0.00	824.3	476.4	
30.86	6.28	2.60	38.0	0.80	30.40	1.22	0.61	0.0	1.00
1.0	0.00	0.00	1.22	0.61	21.76	0.00	826.0	477.3	
30.64	6.28	2.59	38.0	0.80	30.40	1.21	0.61	0.0	1.00
1.0	0.00	0.00	1.21	0.61	21.82	0.00	827.7	478.2	
30.42	6.28	2.58	38.0	0.80	30.40	1.21	0.61	0.0	1.00
1.0	0.00	0.00	1.21	0.61	21.88	0.00	829.4	479.1	
30.20	6.28	2.57	38.0	0.80	30.40	1.21	0.60	0.0	1.00
1.0	0.00	0.00	1.21	0.60	21.94	0.00	831.1	480.0	
29.98	6.28	2.56	38.0	0.80	30.40	1.20	0.60	0.0	1.00
1.0	0.00	0.00	1.20	0.60	22.00	0.00	832.7	480.9	
29.76	6.28	2.55	38.0	0.80	30.40	1.20	0.60	0.0	1.00
1.0	0.00	0.00	1.20	0.60	22.06	0.00	834.4	481.8	
29.54	6.28	2.54	38.0	0.80	30.40	1.19	0.60	0.0	1.00
1.0	0.00	0.00	1.19	0.60	22.12	0.00	836.0	482.7	
29.32	6.28	2.53	38.0	0.80	30.40	1.19	0.59	0.0	1.00
1.0	0.00	0.00	1.19	0.59	22.18	0.00	837.7	483.6	
29.10	6.28	2.52	38.0	0.80	30.40	1.18	0.59	0.0	1.00
1.0	0.00	0.00	1.18	0.59	22.24	0.00	839.3	484.5	
28.88	6.28	2.51	38.0	0.80	30.40	1.18	0.59	0.0	1.00
1.0	0.00	0.00	1.18	0.59	22.31	0.00	841.0	485.4	
28.66	6.28	2.50	38.0	0.80	30.40	1.17	0.59	0.0	1.00
1.0	0.00	0.00	1.17	0.59	22.37	0.00	842.6	486.2	
28.44	6.28	2.49	38.0	0.80	30.40	1.17	0.59	0.0	1.00
1.0	0.00	0.00	1.17	0.59	22.43	0.00	844.2	487.1	
28.22	6.28	2.48	38.0	0.80	30.40	1.17	0.58	0.0	1.00
1.0	0.00	0.00	1.17	0.58	22.49	0.00	845.8	488.0	
28.00	6.28	2.48	38.0	0.80	30.40	1.16	0.58	0.0	1.00
1.0	0.00	0.00	1.16	0.58	22.55	0.00	847.4	488.8	
27.78	6.28	2.47	38.0	0.80	30.40	1.16	0.58	0.0	1.00
1.0	0.00	0.00	1.16	0.58	22.61	0.00	849.0	489.7	
27.56	6.28	2.46	38.0	0.80	30.40	1.15	0.58	0.0	1.00
1.0	0.00	0.00	1.15	0.58	22.67	0.00	850.6	490.6	
27.33	6.28	2.45	38.0	0.80	30.40	1.15	0.57	0.0	1.00
1.0	0.00	0.00	1.15	0.57	22.73	0.00	852.2	491.4	
27.11	6.28	2.44	38.0	0.80	30.40	1.14	0.57	0.0	1.00
1.0	0.00	0.00	1.14	0.57	22.79	0.00	853.8	492.3	
26.89	6.28	2.43	38.0	0.80	30.40	1.14	0.57	0.0	1.00
1.0	0.00	0.00	1.14	0.57	22.85	0.00	855.4	493.1	
26.67	6.28	2.42	38.0	0.80	30.40	1.14	0.57	0.0	1.00
1.0	0.00	0.00	1.14	0.57	22.91	0.00	857.0	494.0	
26.45	6.28	2.41	38.0	0.80	30.40	1.13	0.57	0.0	1.00
1.0	0.00	0.00	1.13	0.57	22.97	0.00	858.5	494.8	
26.23	6.28	2.40	38.0	0.80	30.40	1.13	0.56	0.0	1.00
1.0	0.00	0.00	1.13	0.56	23.03	0.00	860.1	495.6	
26.01	6.28	2.39	38.0	0.80	30.40	1.12	0.56	0.0	1.00
1.0	0.00	0.00	1.12	0.56	23.09	0.00	861.6	496.5	
25.79	6.28	2.38	38.0	0.80	30.40	1.12	0.56	0.0	1.00
1.0	0.00	0.00	1.12	0.56	23.15	0.00	863.2	497.3	
25.57	6.28	2.37	38.0	0.80	30.40	1.11	0.56	0.0	1.00
1.0	0.00	0.00	1.11	0.56	23.21	0.00	864.7	498.1	
25.35	6.28	2.36	38.0	0.80	30.40	1.11	0.55	0.0	1.00
1.0	0.00	0.00	1.11	0.55	23.28	0.00	866.3	499.0	

Axial Capacity.txt									
25.13	6.28	2.35	38.0	0.80	30.40	1.10	0.55	0.0	1.00
1.0	0.00	0.00	1.10	0.55	23.34	0.00	867.8	499.8	
24.91	6.28	2.34	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.40	0.00	868.1	500.2	
24.69	6.28	2.34	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.46	0.00	868.5	500.6	
24.47	6.28	2.33	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.52	0.00	868.8	501.0	
24.25	6.28	2.32	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.58	0.00	869.2	501.4	
24.03	6.28	2.31	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.64	0.00	869.5	501.8	
23.81	6.28	2.30	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.70	0.00	869.9	502.2	
23.59	6.28	2.30	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.76	0.00	870.2	502.6	
23.37	6.28	2.29	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.82	0.00	870.6	503.1	
23.15	6.28	2.28	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.88	0.00	870.9	503.5	
22.93	6.28	2.27	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	23.94	0.00	871.3	503.9	
22.71	6.28	2.26	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.00	0.00	871.6	504.3	
22.48	6.28	2.25	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.06	0.00	871.9	504.7	
22.26	6.28	2.25	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.12	0.00	872.3	505.1	
22.04	6.28	2.24	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.18	0.00	872.6	505.5	
21.82	6.28	2.23	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.24	0.00	873.0	505.9	
21.60	6.28	2.22	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.31	0.00	873.3	506.3	
21.38	6.28	2.21	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.37	0.00	873.7	506.7	
21.16	6.28	2.20	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.43	0.00	874.0	507.1	
20.94	6.28	2.18	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.53	0.00	874.4	507.6	
20.72	6.28	2.16	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.63	0.00	874.7	508.0	
20.50	6.28	2.14	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.74	0.00	875.1	508.5	
20.28	6.28	2.12	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.84	0.00	875.4	508.9	
20.06	6.28	2.09	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	24.95	0.00	875.8	509.4	
19.84	6.28	2.07	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.05	0.00	876.1	509.8	
19.62	6.28	2.05	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.15	0.00	876.4	510.3	
19.40	6.28	2.03	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.26	0.00	876.8	510.7	
19.18	6.28	2.01	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.36	0.00	877.1	511.2	
18.96	6.28	1.98	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.47	0.00	877.5	511.6	
18.74	6.28	1.96	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.57	0.00	877.8	512.1	
18.52	6.28	1.94	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.67	0.00	878.2	512.5	
18.30	6.28	1.92	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.78	0.00	878.5	513.0	
18.08	6.28	1.90	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.88	0.00	878.9	513.4	

Exhibit A-2

Axial Capacity.txt									
17.86	6.28	1.87	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	25.98	0.00	879.2	513.9	
17.64	6.28	1.85	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.09	0.00	879.6	514.3	
17.41	6.28	1.83	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.19	0.00	879.9	514.8	
17.19	6.28	1.81	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.30	0.00	880.3	515.2	
16.97	6.28	1.79	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.40	0.00	880.6	515.7	
16.75	6.28	1.76	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.50	0.00	880.9	516.1	
16.53	6.28	1.74	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.61	0.00	881.3	516.6	
16.31	6.28	1.72	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.71	0.00	881.6	517.0	
16.09	6.28	1.70	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.81	0.00	882.0	517.5	
15.87	6.28	1.67	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	26.92	0.00	882.3	517.9	
15.65	6.28	1.65	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	27.02	0.00	882.7	518.4	
15.43	6.28	1.63	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	27.13	0.00	883.0	518.8	
15.21	6.28	1.61	0.0	0.80	0.00	0.00	0.00	0.3	1.00
1.0	0.25	0.25	0.25	0.25	27.23	0.00	883.4	519.3	
14.99	6.28	1.59	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.33	0.00	884.8	520.8	
14.77	6.28	1.56	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.44	0.00	886.1	522.3	
14.55	6.28	1.54	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.54	0.00	887.5	523.7	
14.33	6.28	1.52	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.65	0.00	888.9	525.2	
14.11	6.28	1.49	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.75	0.00	890.3	526.7	
13.89	6.28	1.47	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.85	0.00	891.7	528.2	
13.67	6.28	1.45	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	27.96	0.00	893.1	529.7	
13.45	6.28	1.42	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.06	0.00	894.5	531.2	
13.23	6.28	1.40	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.16	0.00	895.8	532.7	
13.01	6.28	1.38	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.27	0.00	897.2	534.2	
12.79	6.28	1.35	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.37	0.00	898.6	535.7	
12.57	6.28	1.33	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.48	0.00	900.0	537.1	
12.34	6.28	1.31	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.58	0.00	901.4	538.6	
12.12	6.28	1.28	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.68	0.00	902.8	540.1	
11.90	6.28	1.26	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.79	0.00	904.2	541.6	
11.68	6.28	1.24	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	28.89	0.00	905.5	543.1	
11.46	6.28	1.22	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.00	0.00	906.9	544.6	
11.24	6.28	1.19	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.10	0.00	908.3	546.1	
11.02	6.28	1.17	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.20	0.00	909.7	547.6	
10.80	6.28	1.15	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.31	0.00	911.1	549.1	

Exhibit A-2

Axial Capacity.txt									
10.58	6.28	1.12	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.41	0.00	912.5	550.5	
10.36	6.28	1.10	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.51	0.00	913.8	552.0	
10.14	6.28	1.08	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.62	0.00	915.2	553.5	
9.92	6.28	1.05	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.72	0.00	916.6	555.0	
9.70	6.28	1.03	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.83	0.00	918.0	556.5	
9.48	6.28	1.01	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	29.93	0.00	919.4	558.0	
9.26	6.28	0.98	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.03	0.00	920.8	559.5	
9.04	6.28	0.96	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.14	0.00	922.2	561.0	
8.82	6.28	0.94	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.24	0.00	923.5	562.5	
8.60	6.28	0.91	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.34	0.00	924.9	563.9	
8.38	6.28	0.89	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.45	0.00	926.3	565.4	
8.16	6.28	0.87	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.55	0.00	927.7	566.9	
7.94	6.28	0.84	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.66	0.00	929.1	568.4	
7.72	6.28	0.82	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.76	0.00	930.5	569.9	
7.49	6.28	0.80	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.86	0.00	931.9	571.4	
7.27	6.28	0.78	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	30.97	0.00	933.2	572.9	
7.05	6.28	0.75	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.07	0.00	934.6	574.4	
6.83	6.28	0.73	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.18	0.00	936.0	575.9	
6.61	6.28	0.71	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.28	0.00	937.4	577.3	
6.39	6.28	0.68	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.38	0.00	938.8	578.8	
6.17	6.28	0.66	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.49	0.00	940.2	580.3	
5.95	6.28	0.64	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.59	0.00	941.5	581.8	
5.73	6.28	0.61	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.69	0.00	942.9	583.3	
5.51	6.28	0.59	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.80	0.00	944.3	584.8	
5.29	6.28	0.57	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	31.90	0.00	945.7	586.3	
5.07	6.28	0.54	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.01	0.00	947.1	587.8	
4.85	6.28	0.52	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.11	0.00	948.5	589.3	
4.63	6.28	0.50	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.21	0.00	949.9	590.7	
4.41	6.28	0.47	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.32	0.00	951.2	592.2	
4.19	6.28	0.45	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.42	0.00	952.6	593.7	
3.97	6.28	0.43	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.53	0.00	954.0	595.2	
3.75	6.28	0.41	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.63	0.00	955.4	596.7	
3.53	6.28	0.38	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.73	0.00	956.8	598.2	

Exhibit A-2

Axial Capacity.txt									
3.31	6.28	0.36	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.84	0.00	958.2	599.7	
3.09	6.28	0.34	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	32.94	0.00	959.6	601.2	
2.87	6.28	0.31	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.04	0.00	960.9	602.7	
2.65	6.28	0.29	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.15	0.00	962.3	604.1	
2.42	6.28	0.27	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.25	0.00	963.7	605.6	
2.20	6.28	0.24	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.36	0.00	965.1	607.1	
1.98	6.28	0.22	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.46	0.00	966.5	608.6	
1.76	6.28	0.20	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.56	0.00	967.9	610.1	
1.54	6.28	0.17	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.67	0.00	969.3	611.6	
1.32	6.28	0.15	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.77	0.00	970.6	613.1	
1.10	6.28	0.13	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.88	0.00	972.0	614.6	
0.88	6.28	0.10	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	33.98	0.00	973.4	616.1	
0.66	6.28	0.08	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.08	0.00	974.8	617.5	
0.44	6.28	0.06	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.19	0.00	976.2	619.0	
0.22	6.28	0.03	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.29	0.00	977.6	620.5	
0.00	6.28	0.01	0.0	0.80	0.00	0.00	0.00	1.0	1.00
1.0	1.00	1.00	1.00	1.00	34.39	0.00	978.9	622.0	

DEPTH - SETTLEMENT RELATION by Vesic Method (1977):

Ztip=110.00 Btip= 2.00 Qp= 0.135 Cs= 0.286
Xpp=2.545 Xps= 1.258

Qp & Cs are average value at bearing stratum from pile tip extend to 10 Btip

Zs -ft	Qdw -kp	Area' -ft ²	E -kp/i ²	dXs -in	Xall -in
110.00	70.7	3.142	3000.0	0.0000	3.803
109.78	74.2	3.142	3000.0	0.0001	3.803
109.56	77.6	3.142	3000.0	0.0002	3.803
109.34	81.1	3.142	3000.0	0.0002	3.804
109.12	84.5	3.142	3000.0	0.0002	3.804
108.90	88.0	3.142	3000.0	0.0002	3.804
108.68	91.5	3.142	3000.0	0.0002	3.804
108.46	94.9	3.142	3000.0	0.0002	3.804
108.24	98.4	3.142	3000.0	0.0002	3.804
108.02	101.9	3.142	3000.0	0.0002	3.805
107.80	105.3	3.142	3000.0	0.0002	3.805
107.58	108.8	3.142	3000.0	0.0002	3.805
107.35	112.2	3.142	3000.0	0.0002	3.805
107.13	115.7	3.142	3000.0	0.0002	3.805
106.91	119.2	3.142	3000.0	0.0002	3.806
106.69	122.6	3.142	3000.0	0.0002	3.806
106.47	126.1	3.142	3000.0	0.0002	3.806
106.25	129.6	3.142	3000.0	0.0003	3.806
106.03	133.0	3.142	3000.0	0.0003	3.807
105.81	136.5	3.142	3000.0	0.0003	3.807
105.59	139.9	3.142	3000.0	0.0003	3.807
105.37	143.4	3.142	3000.0	0.0003	3.808
105.15	146.9	3.142	3000.0	0.0003	3.808
104.93	150.3	3.142	3000.0	0.0003	3.808
104.71	153.8	3.142	3000.0	0.0003	3.808

Exhibit A-2

				Axi al	Capaci t y. t xt	
104.49	157.3	3.142	3000.0	0.0003	3.809	
104.27	160.7	3.142	3000.0	0.0003	3.809	
104.05	164.2	3.142	3000.0	0.0003	3.809	
103.83	167.6	3.142	3000.0	0.0003	3.810	
103.61	171.1	3.142	3000.0	0.0003	3.810	
103.39	174.6	3.142	3000.0	0.0003	3.810	
103.17	178.0	3.142	3000.0	0.0003	3.811	
102.95	181.5	3.142	3000.0	0.0004	3.811	
102.73	185.0	3.142	3000.0	0.0004	3.811	
102.51	188.4	3.142	3000.0	0.0004	3.812	
102.28	191.9	3.142	3000.0	0.0004	3.812	
102.06	195.3	3.142	3000.0	0.0004	3.813	
101.84	198.8	3.142	3000.0	0.0004	3.813	
101.62	202.3	3.142	3000.0	0.0004	3.813	
101.40	205.7	3.142	3000.0	0.0004	3.814	
101.18	209.2	3.142	3000.0	0.0004	3.814	
100.96	212.7	3.142	3000.0	0.0004	3.815	
100.74	216.1	3.142	3000.0	0.0004	3.815	
100.52	219.6	3.142	3000.0	0.0004	3.815	
100.30	223.0	3.142	3000.0	0.0004	3.816	
100.08	226.5	3.142	3000.0	0.0004	3.816	
99.86	228.5	3.142	3000.0	0.0004	3.817	
99.64	230.4	3.142	3000.0	0.0004	3.817	
99.42	232.3	3.142	3000.0	0.0005	3.818	
99.20	234.3	3.142	3000.0	0.0005	3.818	
98.98	236.2	3.142	3000.0	0.0005	3.819	
98.76	238.1	3.142	3000.0	0.0005	3.819	
98.54	240.1	3.142	3000.0	0.0005	3.819	
98.32	242.0	3.142	3000.0	0.0005	3.820	
98.10	244.0	3.142	3000.0	0.0005	3.820	
97.88	245.9	3.142	3000.0	0.0005	3.821	
97.66	247.8	3.142	3000.0	0.0005	3.821	
97.43	249.8	3.142	3000.0	0.0005	3.822	
97.21	251.7	3.142	3000.0	0.0005	3.822	
96.99	253.7	3.142	3000.0	0.0005	3.823	
96.77	255.6	3.142	3000.0	0.0005	3.823	
96.55	257.5	3.142	3000.0	0.0005	3.824	
96.33	259.5	3.142	3000.0	0.0005	3.824	
96.11	261.4	3.142	3000.0	0.0005	3.825	
95.89	263.3	3.142	3000.0	0.0005	3.825	
95.67	265.3	3.142	3000.0	0.0005	3.826	
95.45	267.2	3.142	3000.0	0.0005	3.826	
95.23	269.2	3.142	3000.0	0.0005	3.827	
95.01	271.1	3.142	3000.0	0.0005	3.827	
94.79	273.0	3.142	3000.0	0.0005	3.828	
94.57	275.0	3.142	3000.0	0.0005	3.829	
94.35	276.9	3.142	3000.0	0.0005	3.829	
94.13	278.9	3.142	3000.0	0.0005	3.830	
93.91	280.8	3.142	3000.0	0.0005	3.830	
93.69	282.7	3.142	3000.0	0.0006	3.831	
93.47	284.7	3.142	3000.0	0.0006	3.831	
93.25	286.6	3.142	3000.0	0.0006	3.832	
93.03	288.6	3.142	3000.0	0.0006	3.832	
92.81	290.5	3.142	3000.0	0.0006	3.833	
92.59	292.4	3.142	3000.0	0.0006	3.834	
92.36	294.4	3.142	3000.0	0.0006	3.834	
92.14	296.3	3.142	3000.0	0.0006	3.835	
91.92	298.2	3.142	3000.0	0.0006	3.835	
91.70	300.2	3.142	3000.0	0.0006	3.836	
91.48	302.1	3.142	3000.0	0.0006	3.836	
91.26	304.1	3.142	3000.0	0.0006	3.837	
91.04	306.0	3.142	3000.0	0.0006	3.838	
90.82	307.9	3.142	3000.0	0.0006	3.838	
90.60	309.9	3.142	3000.0	0.0006	3.839	
90.38	311.8	3.142	3000.0	0.0006	3.839	
90.16	313.8	3.142	3000.0	0.0006	3.840	

Exhibit A-2

Axi al Capaci t y. t x t					
89.94	315.7	3.142	3000.0	0.0006	3.841
89.72	317.6	3.142	3000.0	0.0006	3.841
89.50	319.6	3.142	3000.0	0.0006	3.842
89.28	321.5	3.142	3000.0	0.0006	3.843
89.06	323.5	3.142	3000.0	0.0006	3.843
88.84	325.4	3.142	3000.0	0.0006	3.844
88.62	327.3	3.142	3000.0	0.0006	3.844
88.40	329.3	3.142	3000.0	0.0006	3.845
88.18	331.2	3.142	3000.0	0.0006	3.846
87.96	333.1	3.142	3000.0	0.0006	3.846
87.74	335.1	3.142	3000.0	0.0007	3.847
87.52	337.0	3.142	3000.0	0.0007	3.848
87.29	339.0	3.142	3000.0	0.0007	3.848
87.07	340.9	3.142	3000.0	0.0007	3.849
86.85	342.8	3.142	3000.0	0.0007	3.850
86.63	344.8	3.142	3000.0	0.0007	3.850
86.41	346.7	3.142	3000.0	0.0007	3.851
86.19	348.7	3.142	3000.0	0.0007	3.852
85.97	350.6	3.142	3000.0	0.0007	3.852
85.75	352.5	3.142	3000.0	0.0007	3.853
85.53	354.5	3.142	3000.0	0.0007	3.854
85.31	356.4	3.142	3000.0	0.0007	3.854
85.09	358.3	3.142	3000.0	0.0007	3.855
84.87	360.3	3.142	3000.0	0.0007	3.856
84.65	362.2	3.142	3000.0	0.0007	3.857
84.43	364.2	3.142	3000.0	0.0007	3.857
84.21	366.1	3.142	3000.0	0.0007	3.858
83.99	368.0	3.142	3000.0	0.0007	3.859
83.77	370.0	3.142	3000.0	0.0007	3.859
83.55	371.9	3.142	3000.0	0.0007	3.860
83.33	373.9	3.142	3000.0	0.0007	3.861
83.11	375.8	3.142	3000.0	0.0007	3.862
82.89	377.7	3.142	3000.0	0.0007	3.862
82.67	379.7	3.142	3000.0	0.0007	3.863
82.44	381.6	3.142	3000.0	0.0007	3.864
82.22	383.6	3.142	3000.0	0.0007	3.865
82.00	385.5	3.142	3000.0	0.0008	3.865
81.78	387.4	3.142	3000.0	0.0008	3.866
81.56	389.4	3.142	3000.0	0.0008	3.867
81.34	391.3	3.142	3000.0	0.0008	3.868
81.12	393.2	3.142	3000.0	0.0008	3.868
80.90	395.2	3.142	3000.0	0.0008	3.869
80.68	397.1	3.142	3000.0	0.0008	3.870
80.46	399.1	3.142	3000.0	0.0008	3.871
80.24	401.0	3.142	3000.0	0.0008	3.871
80.02	402.9	3.142	3000.0	0.0008	3.872
79.80	404.9	3.142	3000.0	0.0008	3.873
79.58	406.8	3.142	3000.0	0.0008	3.874
79.36	408.8	3.142	3000.0	0.0008	3.875
79.14	410.7	3.142	3000.0	0.0008	3.875
78.92	412.6	3.142	3000.0	0.0008	3.876
78.70	414.6	3.142	3000.0	0.0008	3.877
78.48	416.5	3.142	3000.0	0.0008	3.878
78.26	418.5	3.142	3000.0	0.0008	3.879
78.04	420.4	3.142	3000.0	0.0008	3.879
77.82	422.3	3.142	3000.0	0.0008	3.880
77.60	424.3	3.142	3000.0	0.0008	3.881
77.37	426.2	3.142	3000.0	0.0008	3.882
77.15	428.1	3.142	3000.0	0.0008	3.883
76.93	430.1	3.142	3000.0	0.0008	3.884
76.71	432.0	3.142	3000.0	0.0008	3.884
76.49	434.0	3.142	3000.0	0.0008	3.885
76.27	435.9	3.142	3000.0	0.0008	3.886
76.05	437.8	3.142	3000.0	0.0009	3.887
75.83	439.8	3.142	3000.0	0.0009	3.888
75.61	441.7	3.142	3000.0	0.0009	3.889

Exhibit A-2

				Axi al	Capaci t y. t xt	
75.39	443.7	3.142	3000.0	0.0009	3.890	
75.17	445.6	3.142	3000.0	0.0009	3.890	
74.95	447.5	3.142	3000.0	0.0009	3.891	
74.73	449.5	3.142	3000.0	0.0009	3.892	
74.51	451.4	3.142	3000.0	0.0009	3.893	
74.29	453.3	3.142	3000.0	0.0009	3.894	
74.07	455.3	3.142	3000.0	0.0009	3.895	
73.85	457.2	3.142	3000.0	0.0009	3.896	
73.63	459.2	3.142	3000.0	0.0009	3.897	
73.41	461.1	3.142	3000.0	0.0009	3.898	
73.19	463.0	3.142	3000.0	0.0009	3.898	
72.97	465.0	3.142	3000.0	0.0009	3.899	
72.75	466.9	3.142	3000.0	0.0009	3.900	
72.53	468.9	3.142	3000.0	0.0009	3.901	
72.30	470.8	3.142	3000.0	0.0009	3.902	
72.08	472.7	3.142	3000.0	0.0009	3.903	
71.86	474.7	3.142	3000.0	0.0009	3.904	
71.64	476.6	3.142	3000.0	0.0009	3.905	
71.42	478.6	3.142	3000.0	0.0009	3.906	
71.20	480.5	3.142	3000.0	0.0009	3.907	
70.98	482.4	3.142	3000.0	0.0009	3.908	
70.76	484.4	3.142	3000.0	0.0009	3.909	
70.54	486.3	3.142	3000.0	0.0009	3.910	
70.32	488.2	3.142	3000.0	0.0010	3.911	
70.10	490.2	3.142	3000.0	0.0010	3.911	
69.88	492.1	3.142	3000.0	0.0010	3.912	
69.66	494.1	3.142	3000.0	0.0010	3.913	
69.44	496.0	3.142	3000.0	0.0010	3.914	
69.22	497.9	3.142	3000.0	0.0010	3.915	
69.00	499.9	3.142	3000.0	0.0010	3.916	
68.78	501.8	3.142	3000.0	0.0010	3.917	
68.56	503.8	3.142	3000.0	0.0010	3.918	
68.34	505.7	3.142	3000.0	0.0010	3.919	
68.12	507.6	3.142	3000.0	0.0010	3.920	
67.90	509.6	3.142	3000.0	0.0010	3.921	
67.68	511.5	3.142	3000.0	0.0010	3.922	
67.45	513.5	3.142	3000.0	0.0010	3.923	
67.23	515.4	3.142	3000.0	0.0010	3.924	
67.01	517.3	3.142	3000.0	0.0010	3.925	
66.79	519.3	3.142	3000.0	0.0010	3.926	
66.57	521.2	3.142	3000.0	0.0010	3.927	
66.35	523.1	3.142	3000.0	0.0010	3.928	
66.13	525.1	3.142	3000.0	0.0010	3.929	
65.91	527.0	3.142	3000.0	0.0010	3.930	
65.69	529.0	3.142	3000.0	0.0010	3.931	
65.47	530.9	3.142	3000.0	0.0010	3.932	
65.25	532.8	3.142	3000.0	0.0010	3.933	
65.03	534.8	3.142	3000.0	0.0010	3.935	
64.81	536.7	3.142	3000.0	0.0010	3.936	
64.59	538.7	3.142	3000.0	0.0010	3.937	
64.37	540.6	3.142	3000.0	0.0011	3.938	
64.15	542.5	3.142	3000.0	0.0011	3.939	
63.93	544.5	3.142	3000.0	0.0011	3.940	
63.71	546.4	3.142	3000.0	0.0011	3.941	
63.49	548.3	3.142	3000.0	0.0011	3.942	
63.27	550.3	3.142	3000.0	0.0011	3.943	
63.05	552.2	3.142	3000.0	0.0011	3.944	
62.83	554.2	3.142	3000.0	0.0011	3.945	
62.61	556.1	3.142	3000.0	0.0011	3.946	
62.38	558.0	3.142	3000.0	0.0011	3.947	
62.16	560.0	3.142	3000.0	0.0011	3.948	
61.94	561.9	3.142	3000.0	0.0011	3.949	
61.72	563.9	3.142	3000.0	0.0011	3.951	
61.50	565.8	3.142	3000.0	0.0011	3.952	
61.28	567.7	3.142	3000.0	0.0011	3.953	
61.06	569.7	3.142	3000.0	0.0011	3.954	

Exhibit A-2

				Axi al	Capaci t y. t xt	
60.84	571.6	3.142	3000.0		0.0011	3.955
60.62	573.6	3.142	3000.0		0.0011	3.956
60.40	575.5	3.142	3000.0		0.0011	3.957
60.18	577.4	3.142	3000.0		0.0011	3.958
59.96	579.4	3.142	3000.0		0.0011	3.960
59.74	581.3	3.142	3000.0		0.0011	3.961
59.52	583.2	3.142	3000.0		0.0011	3.962
59.30	585.2	3.142	3000.0		0.0011	3.963
59.08	587.1	3.142	3000.0		0.0011	3.964
58.86	589.1	3.142	3000.0		0.0011	3.965
58.64	591.0	3.142	3000.0		0.0012	3.966
58.42	592.9	3.142	3000.0		0.0012	3.968
58.20	594.9	3.142	3000.0		0.0012	3.969
57.98	596.8	3.142	3000.0		0.0012	3.970
57.76	598.8	3.142	3000.0		0.0012	3.971
57.54	600.7	3.142	3000.0		0.0012	3.972
57.31	602.6	3.142	3000.0		0.0012	3.973
57.09	604.6	3.142	3000.0		0.0012	3.975
56.87	606.5	3.142	3000.0		0.0012	3.976
56.65	608.5	3.142	3000.0		0.0012	3.977
56.43	610.4	3.142	3000.0		0.0012	3.978
56.21	612.3	3.142	3000.0		0.0012	3.979
55.99	614.3	3.142	3000.0		0.0012	3.980
55.77	616.2	3.142	3000.0		0.0012	3.982
55.55	618.1	3.142	3000.0		0.0012	3.983
55.33	620.1	3.142	3000.0		0.0012	3.984
55.11	622.0	3.142	3000.0		0.0012	3.985
54.89	624.0	3.142	3000.0		0.0012	3.987
54.67	625.9	3.142	3000.0		0.0012	3.988
54.45	627.8	3.142	3000.0		0.0012	3.989
54.23	629.8	3.142	3000.0		0.0012	3.990
54.01	631.7	3.142	3000.0		0.0012	3.991
53.79	633.7	3.142	3000.0		0.0012	3.993
53.57	635.6	3.142	3000.0		0.0012	3.994
53.35	637.5	3.142	3000.0		0.0012	3.995
53.13	639.5	3.142	3000.0		0.0012	3.996
52.91	641.4	3.142	3000.0		0.0013	3.998
52.69	643.3	3.142	3000.0		0.0013	3.999
52.46	645.3	3.142	3000.0		0.0013	4.000
52.24	647.2	3.142	3000.0		0.0013	4.001
52.02	649.2	3.142	3000.0		0.0013	4.003
51.80	651.1	3.142	3000.0		0.0013	4.004
51.58	653.0	3.142	3000.0		0.0013	4.005
51.36	655.0	3.142	3000.0		0.0013	4.007
51.14	656.9	3.142	3000.0		0.0013	4.008
50.92	658.9	3.142	3000.0		0.0013	4.009
50.70	660.8	3.142	3000.0		0.0013	4.010
50.48	662.7	3.142	3000.0		0.0013	4.012
50.26	664.7	3.142	3000.0		0.0013	4.013
50.04	666.6	3.142	3000.0		0.0013	4.014
49.82	668.4	3.142	3000.0		0.0013	4.016
49.60	670.1	3.142	3000.0		0.0013	4.017
49.38	671.9	3.142	3000.0		0.0013	4.018
49.16	673.6	3.142	3000.0		0.0013	4.019
48.94	675.4	3.142	3000.0		0.0013	4.021
48.72	677.2	3.142	3000.0		0.0013	4.022
48.50	678.9	3.142	3000.0		0.0013	4.023
48.28	680.7	3.142	3000.0		0.0013	4.025
48.06	682.4	3.142	3000.0		0.0013	4.026
47.84	684.2	3.142	3000.0		0.0013	4.027
47.62	685.9	3.142	3000.0		0.0013	4.029
47.39	687.7	3.142	3000.0		0.0013	4.030
47.17	689.5	3.142	3000.0		0.0013	4.031
46.95	691.2	3.142	3000.0		0.0013	4.033
46.73	693.0	3.142	3000.0		0.0014	4.034
46.51	694.7	3.142	3000.0		0.0014	4.036

Exhibit A-2

				Axial Capacity.txt	
46.29	696.5	3.142	3000.0	0.0014	4.037
46.07	698.2	3.142	3000.0	0.0014	4.038
45.85	700.0	3.142	3000.0	0.0014	4.040
45.63	701.8	3.142	3000.0	0.0014	4.041
45.41	703.5	3.142	3000.0	0.0014	4.042
45.19	705.3	3.142	3000.0	0.0014	4.044
44.97	707.2	3.142	3000.0	0.0014	4.045
44.75	709.1	3.142	3000.0	0.0014	4.046
44.53	711.1	3.142	3000.0	0.0014	4.048
44.31	713.0	3.142	3000.0	0.0014	4.049
44.09	715.0	3.142	3000.0	0.0014	4.051
43.87	716.9	3.142	3000.0	0.0014	4.052
43.65	718.8	3.142	3000.0	0.0014	4.053
43.43	720.8	3.142	3000.0	0.0014	4.055
43.21	722.7	3.142	3000.0	0.0014	4.056
42.99	724.7	3.142	3000.0	0.0014	4.058
42.77	726.6	3.142	3000.0	0.0014	4.059
42.55	728.5	3.142	3000.0	0.0014	4.060
42.32	730.5	3.142	3000.0	0.0014	4.062
42.10	732.4	3.142	3000.0	0.0014	4.063
41.88	734.4	3.142	3000.0	0.0014	4.065
41.66	736.3	3.142	3000.0	0.0014	4.066
41.44	738.2	3.142	3000.0	0.0014	4.068
41.22	740.2	3.142	3000.0	0.0014	4.069
41.00	742.1	3.142	3000.0	0.0014	4.071
40.78	744.0	3.142	3000.0	0.0015	4.072
40.56	746.0	3.142	3000.0	0.0015	4.073
40.34	747.9	3.142	3000.0	0.0015	4.075
40.12	749.9	3.142	3000.0	0.0015	4.076
39.90	751.8	3.142	3000.0	0.0015	4.078
39.68	753.7	3.142	3000.0	0.0015	4.079
39.46	755.7	3.142	3000.0	0.0015	4.081
39.24	757.6	3.142	3000.0	0.0015	4.082
39.02	759.5	3.142	3000.0	0.0015	4.084
38.80	761.4	3.142	3000.0	0.0015	4.085
38.58	763.3	3.142	3000.0	0.0015	4.087
38.36	765.2	3.142	3000.0	0.0015	4.088
38.14	767.1	3.142	3000.0	0.0015	4.090
37.92	769.0	3.142	3000.0	0.0015	4.091
37.70	770.9	3.142	3000.0	0.0015	4.093
37.47	772.7	3.142	3000.0	0.0015	4.094
37.25	774.6	3.142	3000.0	0.0015	4.096
37.03	776.5	3.142	3000.0	0.0015	4.097
36.81	778.3	3.142	3000.0	0.0015	4.099
36.59	780.2	3.142	3000.0	0.0015	4.100
36.37	782.0	3.142	3000.0	0.0015	4.102
36.15	783.8	3.142	3000.0	0.0015	4.103
35.93	785.7	3.142	3000.0	0.0015	4.105
35.71	787.5	3.142	3000.0	0.0015	4.106
35.49	789.3	3.142	3000.0	0.0015	4.108
35.27	791.1	3.142	3000.0	0.0015	4.109
35.05	792.9	3.142	3000.0	0.0015	4.111
34.83	794.7	3.142	3000.0	0.0015	4.113
34.61	796.5	3.142	3000.0	0.0016	4.114
34.39	798.3	3.142	3000.0	0.0016	4.116
34.17	800.1	3.142	3000.0	0.0016	4.117
33.95	801.8	3.142	3000.0	0.0016	4.119
33.73	803.6	3.142	3000.0	0.0016	4.120
33.51	805.4	3.142	3000.0	0.0016	4.122
33.29	807.1	3.142	3000.0	0.0016	4.123
33.07	808.9	3.142	3000.0	0.0016	4.125
32.85	810.6	3.142	3000.0	0.0016	4.127
32.63	812.4	3.142	3000.0	0.0016	4.128
32.40	814.1	3.142	3000.0	0.0016	4.130
32.18	815.8	3.142	3000.0	0.0016	4.131
31.96	817.5	3.142	3000.0	0.0016	4.133

Exhibit A-2

				Axi al	Capaci t y. t xt	
31.74	819.2	3.142	3000.0		0.0016	4.135
31.52	821.0	3.142	3000.0		0.0016	4.136
31.30	822.7	3.142	3000.0		0.0016	4.138
31.08	824.3	3.142	3000.0		0.0016	4.139
30.86	826.0	3.142	3000.0		0.0016	4.141
30.64	827.7	3.142	3000.0		0.0016	4.143
30.42	829.4	3.142	3000.0		0.0016	4.144
30.20	831.1	3.142	3000.0		0.0016	4.146
29.98	832.7	3.142	3000.0		0.0016	4.147
29.76	834.4	3.142	3000.0		0.0016	4.149
29.54	836.0	3.142	3000.0		0.0016	4.151
29.32	837.7	3.142	3000.0		0.0016	4.152
29.10	839.3	3.142	3000.0		0.0016	4.154
28.88	841.0	3.142	3000.0		0.0016	4.156
28.66	842.6	3.142	3000.0		0.0016	4.157
28.44	844.2	3.142	3000.0		0.0016	4.159
28.22	845.8	3.142	3000.0		0.0016	4.161
28.00	847.4	3.142	3000.0		0.0017	4.162
27.78	849.0	3.142	3000.0		0.0017	4.164
27.56	850.6	3.142	3000.0		0.0017	4.166
27.33	852.2	3.142	3000.0		0.0017	4.167
27.11	853.8	3.142	3000.0		0.0017	4.169
26.89	855.4	3.142	3000.0		0.0017	4.171
26.67	857.0	3.142	3000.0		0.0017	4.172
26.45	858.5	3.142	3000.0		0.0017	4.174
26.23	860.1	3.142	3000.0		0.0017	4.176
26.01	861.6	3.142	3000.0		0.0017	4.177
25.79	863.2	3.142	3000.0		0.0017	4.179
25.57	864.7	3.142	3000.0		0.0017	4.181
25.35	866.3	3.142	3000.0		0.0017	4.182
25.13	867.8	3.142	3000.0		0.0017	4.184
24.91	868.1	3.142	3000.0		0.0017	4.186
24.69	868.5	3.142	3000.0		0.0017	4.187
24.47	868.8	3.142	3000.0		0.0017	4.189
24.25	869.2	3.142	3000.0		0.0017	4.191
24.03	869.5	3.142	3000.0		0.0017	4.192
23.81	869.9	3.142	3000.0		0.0017	4.194
23.59	870.2	3.142	3000.0		0.0017	4.196
23.37	870.6	3.142	3000.0		0.0017	4.198
23.15	870.9	3.142	3000.0		0.0017	4.199
22.93	871.3	3.142	3000.0		0.0017	4.201
22.71	871.6	3.142	3000.0		0.0017	4.203
22.48	871.9	3.142	3000.0		0.0017	4.204
22.26	872.3	3.142	3000.0		0.0017	4.206
22.04	872.6	3.142	3000.0		0.0017	4.208
21.82	873.0	3.142	3000.0		0.0017	4.209
21.60	873.3	3.142	3000.0		0.0017	4.211
21.38	873.7	3.142	3000.0		0.0017	4.213
21.16	874.0	3.142	3000.0		0.0017	4.215
20.94	874.4	3.142	3000.0		0.0017	4.216
20.72	874.7	3.142	3000.0		0.0017	4.218
20.50	875.1	3.142	3000.0		0.0017	4.220
20.28	875.4	3.142	3000.0		0.0017	4.221
20.06	875.8	3.142	3000.0		0.0017	4.223
19.84	876.1	3.142	3000.0		0.0017	4.225
19.62	876.4	3.142	3000.0		0.0017	4.226
19.40	876.8	3.142	3000.0		0.0017	4.228
19.18	877.1	3.142	3000.0		0.0017	4.230
18.96	877.5	3.142	3000.0		0.0017	4.232
18.74	877.8	3.142	3000.0		0.0017	4.233
18.52	878.2	3.142	3000.0		0.0017	4.235
18.30	878.5	3.142	3000.0		0.0017	4.237
18.08	878.9	3.142	3000.0		0.0017	4.238
17.86	879.2	3.142	3000.0		0.0017	4.240
17.64	879.6	3.142	3000.0		0.0017	4.242
17.41	879.9	3.142	3000.0		0.0017	4.244

Exhibit A-2

				Axi al	Capaci t y. t xt	
17. 19	880. 3	3. 142	3000. 0	0. 0017	4. 245	
16. 97	880. 6	3. 142	3000. 0	0. 0017	4. 247	
16. 75	880. 9	3. 142	3000. 0	0. 0017	4. 249	
16. 53	881. 3	3. 142	3000. 0	0. 0017	4. 250	
16. 31	881. 6	3. 142	3000. 0	0. 0017	4. 252	
16. 09	882. 0	3. 142	3000. 0	0. 0017	4. 254	
15. 87	882. 3	3. 142	3000. 0	0. 0017	4. 256	
15. 65	882. 7	3. 142	3000. 0	0. 0017	4. 257	
15. 43	883. 0	3. 142	3000. 0	0. 0017	4. 259	
15. 21	883. 4	3. 142	3000. 0	0. 0017	4. 261	
14. 99	884. 8	3. 142	3000. 0	0. 0017	4. 263	
14. 77	886. 1	3. 142	3000. 0	0. 0017	4. 264	
14. 55	887. 5	3. 142	3000. 0	0. 0017	4. 266	
14. 33	888. 9	3. 142	3000. 0	0. 0017	4. 268	
14. 11	890. 3	3. 142	3000. 0	0. 0017	4. 269	
13. 89	891. 7	3. 142	3000. 0	0. 0017	4. 271	
13. 67	893. 1	3. 142	3000. 0	0. 0017	4. 273	
13. 45	894. 5	3. 142	3000. 0	0. 0017	4. 275	
13. 23	895. 8	3. 142	3000. 0	0. 0017	4. 276	
13. 01	897. 2	3. 142	3000. 0	0. 0017	4. 278	
12. 79	898. 6	3. 142	3000. 0	0. 0018	4. 280	
12. 57	900. 0	3. 142	3000. 0	0. 0018	4. 282	
12. 34	901. 4	3. 142	3000. 0	0. 0018	4. 283	
12. 12	902. 8	3. 142	3000. 0	0. 0018	4. 285	
11. 90	904. 2	3. 142	3000. 0	0. 0018	4. 287	
11. 68	905. 5	3. 142	3000. 0	0. 0018	4. 289	
11. 46	906. 9	3. 142	3000. 0	0. 0018	4. 290	
11. 24	908. 3	3. 142	3000. 0	0. 0018	4. 292	
11. 02	909. 7	3. 142	3000. 0	0. 0018	4. 294	
10. 80	911. 1	3. 142	3000. 0	0. 0018	4. 296	
10. 58	912. 5	3. 142	3000. 0	0. 0018	4. 298	
10. 36	913. 8	3. 142	3000. 0	0. 0018	4. 299	
10. 14	915. 2	3. 142	3000. 0	0. 0018	4. 301	
9. 92	916. 6	3. 142	3000. 0	0. 0018	4. 303	
9. 70	918. 0	3. 142	3000. 0	0. 0018	4. 305	
9. 48	919. 4	3. 142	3000. 0	0. 0018	4. 307	
9. 26	920. 8	3. 142	3000. 0	0. 0018	4. 308	
9. 04	922. 2	3. 142	3000. 0	0. 0018	4. 310	
8. 82	923. 5	3. 142	3000. 0	0. 0018	4. 312	
8. 60	924. 9	3. 142	3000. 0	0. 0018	4. 314	
8. 38	926. 3	3. 142	3000. 0	0. 0018	4. 316	
8. 16	927. 7	3. 142	3000. 0	0. 0018	4. 317	
7. 94	929. 1	3. 142	3000. 0	0. 0018	4. 319	
7. 72	930. 5	3. 142	3000. 0	0. 0018	4. 321	
7. 49	931. 9	3. 142	3000. 0	0. 0018	4. 323	
7. 27	933. 2	3. 142	3000. 0	0. 0018	4. 325	
7. 05	934. 6	3. 142	3000. 0	0. 0018	4. 326	
6. 83	936. 0	3. 142	3000. 0	0. 0018	4. 328	
6. 61	937. 4	3. 142	3000. 0	0. 0018	4. 330	
6. 39	938. 8	3. 142	3000. 0	0. 0018	4. 332	
6. 17	940. 2	3. 142	3000. 0	0. 0018	4. 334	
5. 95	941. 5	3. 142	3000. 0	0. 0018	4. 336	
5. 73	942. 9	3. 142	3000. 0	0. 0018	4. 337	
5. 51	944. 3	3. 142	3000. 0	0. 0018	4. 339	
5. 29	945. 7	3. 142	3000. 0	0. 0018	4. 341	
5. 07	947. 1	3. 142	3000. 0	0. 0018	4. 343	
4. 85	948. 5	3. 142	3000. 0	0. 0018	4. 345	
4. 63	949. 9	3. 142	3000. 0	0. 0019	4. 347	
4. 41	951. 2	3. 142	3000. 0	0. 0019	4. 348	
4. 19	952. 6	3. 142	3000. 0	0. 0019	4. 350	
3. 97	954. 0	3. 142	3000. 0	0. 0019	4. 352	
3. 75	955. 4	3. 142	3000. 0	0. 0019	4. 354	
3. 53	956. 8	3. 142	3000. 0	0. 0019	4. 356	
3. 31	958. 2	3. 142	3000. 0	0. 0019	4. 358	
3. 09	959. 6	3. 142	3000. 0	0. 0019	4. 360	
2. 87	960. 9	3. 142	3000. 0	0. 0019	4. 362	

Exhibit A-2

Axial Capacity.txt					
2.65	962.3	3.142	3000.0	0.0019	4.363
2.42	963.7	3.142	3000.0	0.0019	4.365
2.20	965.1	3.142	3000.0	0.0019	4.367
1.98	966.5	3.142	3000.0	0.0019	4.369
1.76	967.9	3.142	3000.0	0.0019	4.371
1.54	969.3	3.142	3000.0	0.0019	4.373
1.32	970.6	3.142	3000.0	0.0019	4.375
1.10	972.0	3.142	3000.0	0.0019	4.377
0.88	973.4	3.142	3000.0	0.0019	4.379
0.66	974.8	3.142	3000.0	0.0019	4.380
0.44	976.2	3.142	3000.0	0.0019	4.382
0.22	977.6	3.142	3000.0	0.0019	4.384
0.00	978.9	3.142	3000.0	0.0019	4.386

LOAD - SETTLEMENT RELATION (from t-z, and q-w curves):
Based on Vesic Method (1977)

Xall -in	Qip -kp	Qside -kp	Qtotal -kp
0.006099	0.1	16.2	16.4
0.293557	2.5	566.8	569.3
0.383112	3.6	685.1	688.7
0.454502	4.8	764.0	768.8
0.513476	6.0	819.3	825.3
0.563530	7.2	859.1	866.3
0.606961	8.3	888.2	896.6
0.645368	9.5	909.6	919.1
0.679915	10.7	925.3	936.0
0.711477	11.8	936.8	948.6
0.740729	13.0	945.0	958.0
0.768197	14.2	950.7	964.9
0.794294	15.3	954.6	969.9
0.819346	16.4	957.0	973.4
0.843609	17.6	958.3	975.9
0.867278	18.7	958.8	977.5
0.890503	19.8	958.7	978.5
0.913391	20.9	958.0	978.9
0.936017	22.0	956.9	978.9
0.958429	23.1	955.5	978.6
0.980657	24.2	953.6	977.8
1.002710	25.2	951.5	976.7
1.024592	26.3	949.1	975.4
1.046300	27.3	946.4	973.7
1.067839	28.4	943.4	971.8
1.089218	29.4	940.4	969.7
1.110424	30.4	937.1	967.5
1.131452	31.4	933.7	965.1
1.152316	32.4	930.2	962.6
1.173033	33.3	926.6	959.9
1.193618	34.3	922.8	957.1
1.214123	35.2	919.1	954.3
1.234598	36.2	915.4	951.6
1.255109	37.1	911.8	948.9
1.275730	38.0	908.5	946.5
1.296541	38.9	905.5	944.4
1.317638	39.8	902.9	942.7
1.339099	40.7	900.8	941.5
1.361022	41.5	899.3	940.8
1.383932	42.3	898.9	941.3
1.406152	43.2	897.8	940.9
1.428362	44.0	896.6	940.6
1.450562	44.8	895.5	940.3
1.472752	45.6	894.4	940.0
1.494934	46.4	893.4	939.7
1.517105	47.1	892.4	939.5
1.539268	47.9	891.4	939.2

Exhibit A-2

Axial Capacity.txt			
1. 561422	48.6	890.4	939.0
1. 583568	49.3	889.5	938.8
1. 605704	50.1	888.5	938.6
1. 627829	50.8	887.6	938.4
1. 649945	51.5	886.7	938.2
1. 672052	52.1	885.8	937.9
1. 694145	52.8	884.8	937.6
1. 716225	53.5	883.7	937.2
1. 738290	54.1	882.5	936.6
1. 760338	54.7	881.3	936.0
1. 782370	55.3	880.2	935.6
1. 804396	56.0	879.2	935.1
1. 826415	56.6	878.2	934.7
1. 848434	57.1	877.3	934.4
1. 870454	57.7	876.5	934.2
1. 892463	58.3	875.6	933.9
1. 914466	58.8	874.8	933.6
1. 936466	59.4	874.0	933.4
1. 958451	59.9	873.2	933.1
1. 980430	60.5	872.3	932.8
2. 002402	61.0	871.5	932.5
2. 024363	61.5	870.7	932.2
2. 046318	62.0	869.9	931.9
2. 068265	62.5	869.0	931.5
2. 090204	63.0	868.2	931.2
2. 112136	63.4	867.4	930.8
2. 134058	63.9	866.6	930.5
2. 155979	64.4	865.7	930.1
2. 177890	64.8	864.9	929.7
2. 199789	65.3	864.1	929.4
2. 221689	65.7	863.3	929.0
2. 243581	66.1	862.4	928.6
2. 265468	66.6	861.6	928.2
2. 287346	67.0	860.8	927.8
2. 309220	67.4	860.0	927.4
2. 331088	67.8	859.1	926.9
2. 352950	68.2	858.3	926.5
2. 374807	68.6	857.5	926.1
2. 396659	69.0	856.7	925.7
2. 418506	69.4	855.8	925.2
2. 440348	69.7	855.0	924.8
2. 462187	70.1	854.2	924.3
2. 484020	70.5	853.4	923.9
2. 505852	70.8	852.5	923.4
2. 527674	71.2	851.7	922.9
2. 549495	71.5	850.9	922.5
2. 571310	71.9	850.1	922.0
2. 702132	73.9	845.1	919.0
3. 137424	79.7	828.7	908.4
3. 571583	84.2	812.3	896.5
4. 004045	86.8	795.9	882.7
4. 433840	86.5	779.5	866.0
4. 860473	82.6	763.2	845.7

At $Q_{work} = 975.00$ -kp Settlement = 0.83467-in

At $Q_{work} = 975.00$ -kp Secant Stiffness $K_{qx} = 1168.13$ -kp/-in

At $X_{allow} = 1.00$ -in $Q_{allow} = 976.87$ -kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

SUMMARY:

Total Ultimate Capacity (Down) = 978.948-kp Total Ultimate Capacity (Up) = 622.013-kp

Total Allowable Capacity (Down) = 326.316-kp Total Allowable Capacity (Up) = 230.267-kp

Exhibit A-2

Axial Capacity.txt

Weight above Ground= 0.00 Total Pile Weight = 34.39-kp

* Soil Weight is not included

Side Resistance (Down)= 908.260-kp Side Resistance (Up)= 587.619-kp

Tip Resistance (Down)= 70.688-kp Tip Resistance (Up)= 0.000-kp

Negative Friction, Qneg= 0.000-kp, which has been subtracted from

Total Ultimate Capacity (Down)

Negative friction does not affect Total Uplift Ultimate Capacity (Up)

N/G! Qallow < Q * Vertical Load, Q= 975.0 -kp

FACTOR OF SAFETY:

FSside FS tip FSup FSweight

3.0 3.0 3.0 1.0

Notes:

* Settlement in the program is Elastic Settlement only. Consolidation Settlement is not calculated!

Length - Pile length, distance from pile top to tip (not from ground surface)

Width or D - Width of pile shaft (pile diameter)

Ds and Dl - Short Side and Long Side of Footing

Area - Section area of pile shaft or tip area of pile

Sv - Vertical stress in soils (It may be limited based on critical depth, Z_{lim} or Z/D)

qult - Ultimate tip resistance (pressure)

Qtip_dw - Ultimate downward tip resistance (Force or Capacity)

Qtip_up - Ultimate uplift tip resistance for belled pile or uplift plate (Force or Capacity)

dz - Small Segment of Depth for Calculation

Zs - Soil Depth, Depth from ground surface

Zp - Pile Depth, Depth from pile top

Prem - Primer of pile shaft

Phi - Soil internal friction angle (between soils)

Kf - Friction factor to convert Phi to Delta

Delta - Skin friction between soil and pile (function of Phi. It is different from Phi)

f_dw - Resistance between soil and pile from Delta

f_up - Resistance between soil and pile from Delta

C - Soil cohesion (between soils)

Ca - Adhesion between soil and pile (function of C. It is different from C)

Ca=KaKcC

Ka - Adhesion ratio, C/ Ca

Kc - Adhesion factor defended by users

Ca_dw - Downward adhesion between pile and soil

Ca_up - Uplift adhesion between pile and soil

Sf_dw - Downward side resistance (sum of friction and adhesion, f_dw + Ca_dw)

Sf_up - Uplift side resistance (sum of friction and adhesion, f_up + Ca_up)

Weight - Weight of Pile shaft

Qneg - negative friction Resistance

Qside - Ultimate side resistance (Qside_dw or Qside_up)

Qtip - Ultimate tip resistance (Qtip_dw or Qtip_up for uplift plate)

Q_dw - Ultimate downward capacity (Qtip + Qside_dw)

Q_up - Ultimate uplift capacity (Weight + Qside_up)

E - Elastic modulus

dXs - Axial deformation of pile shaft in each segment, dz

Xs - Settlement due to axial deformation of pile shaft

Xpp - Settlement due to point load from pile tip

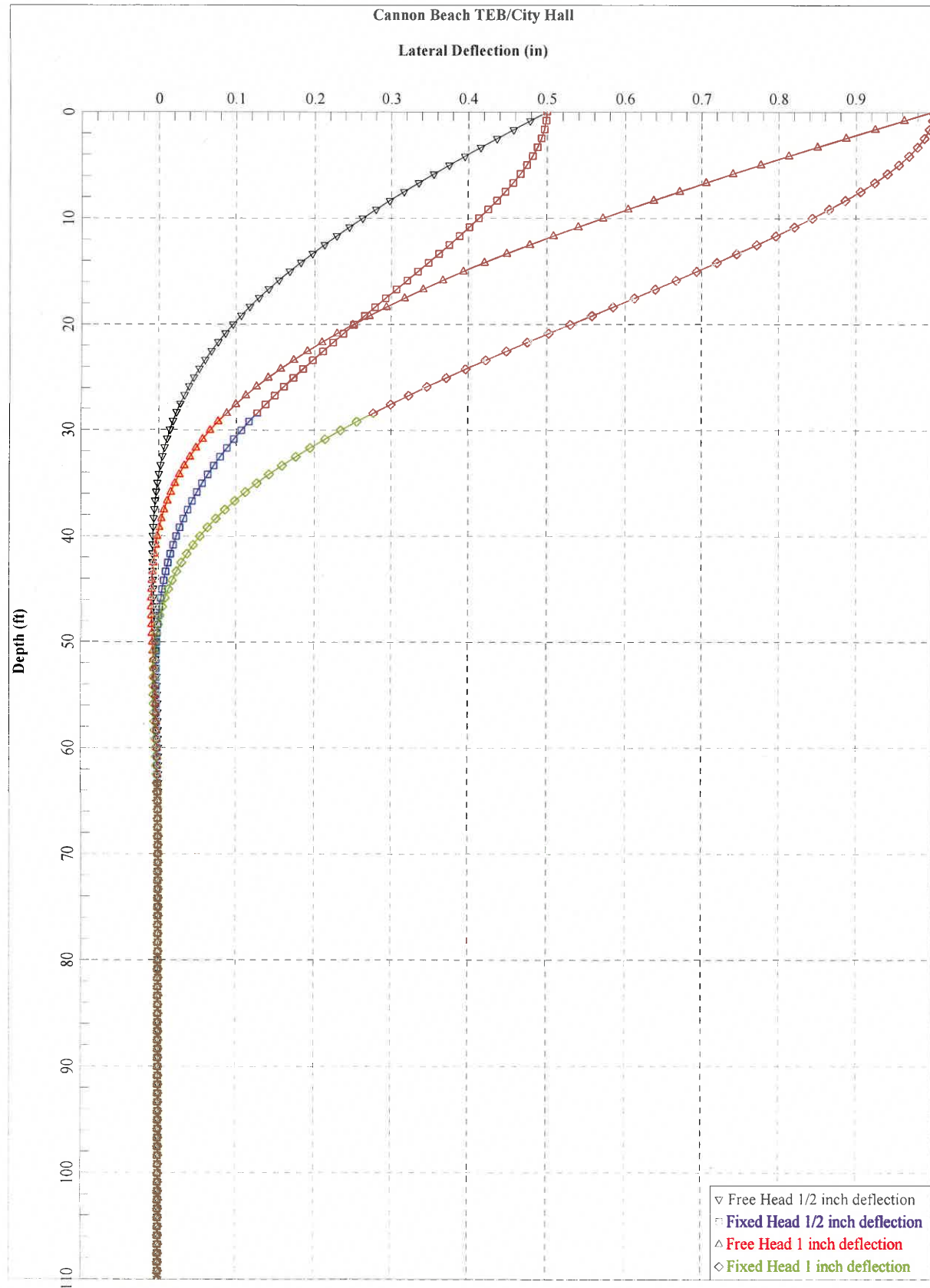
Xps - Settlement due to load from pile shaft

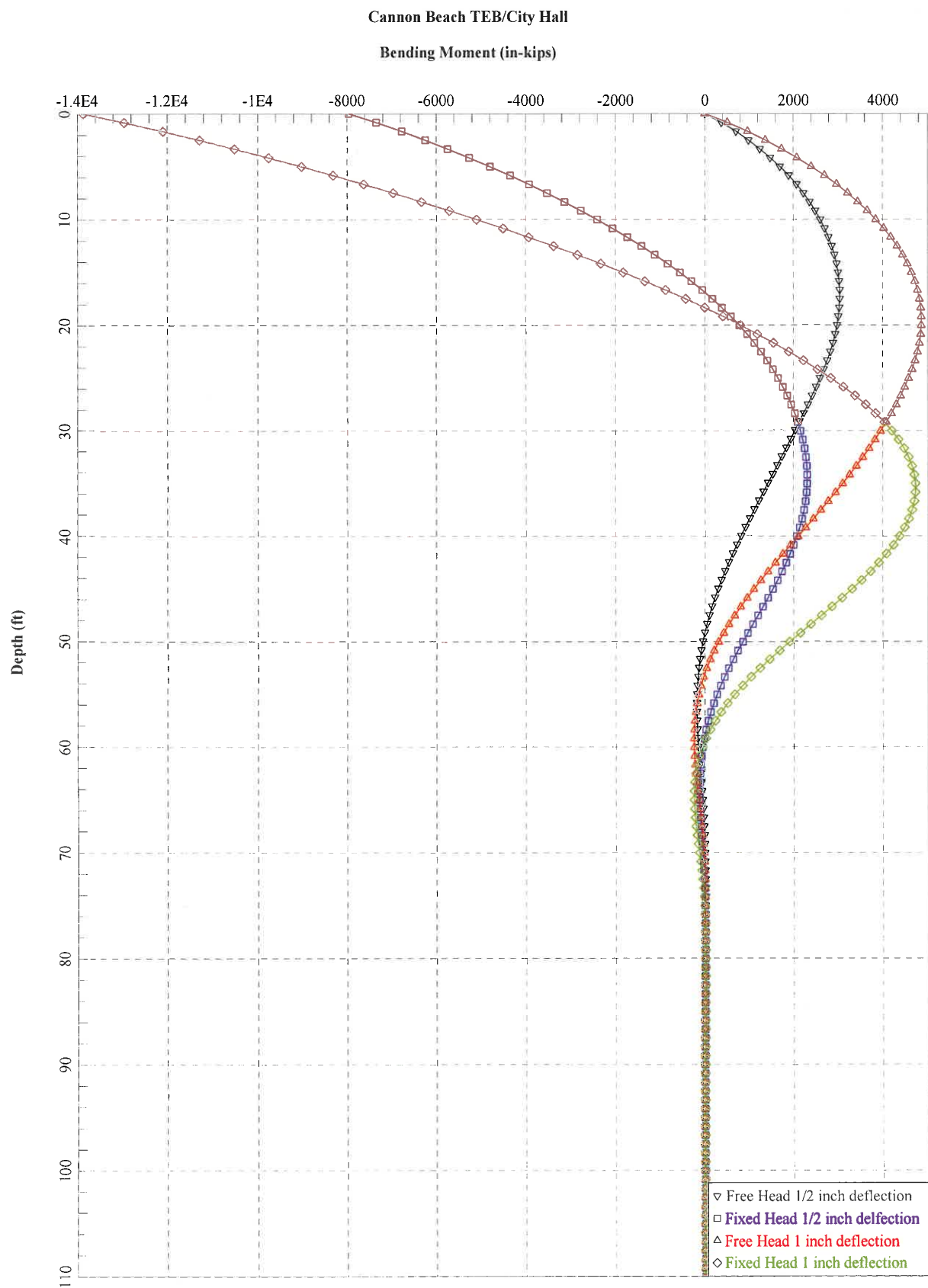
Xall - Total Settlement, Xs + Xpp + Xps

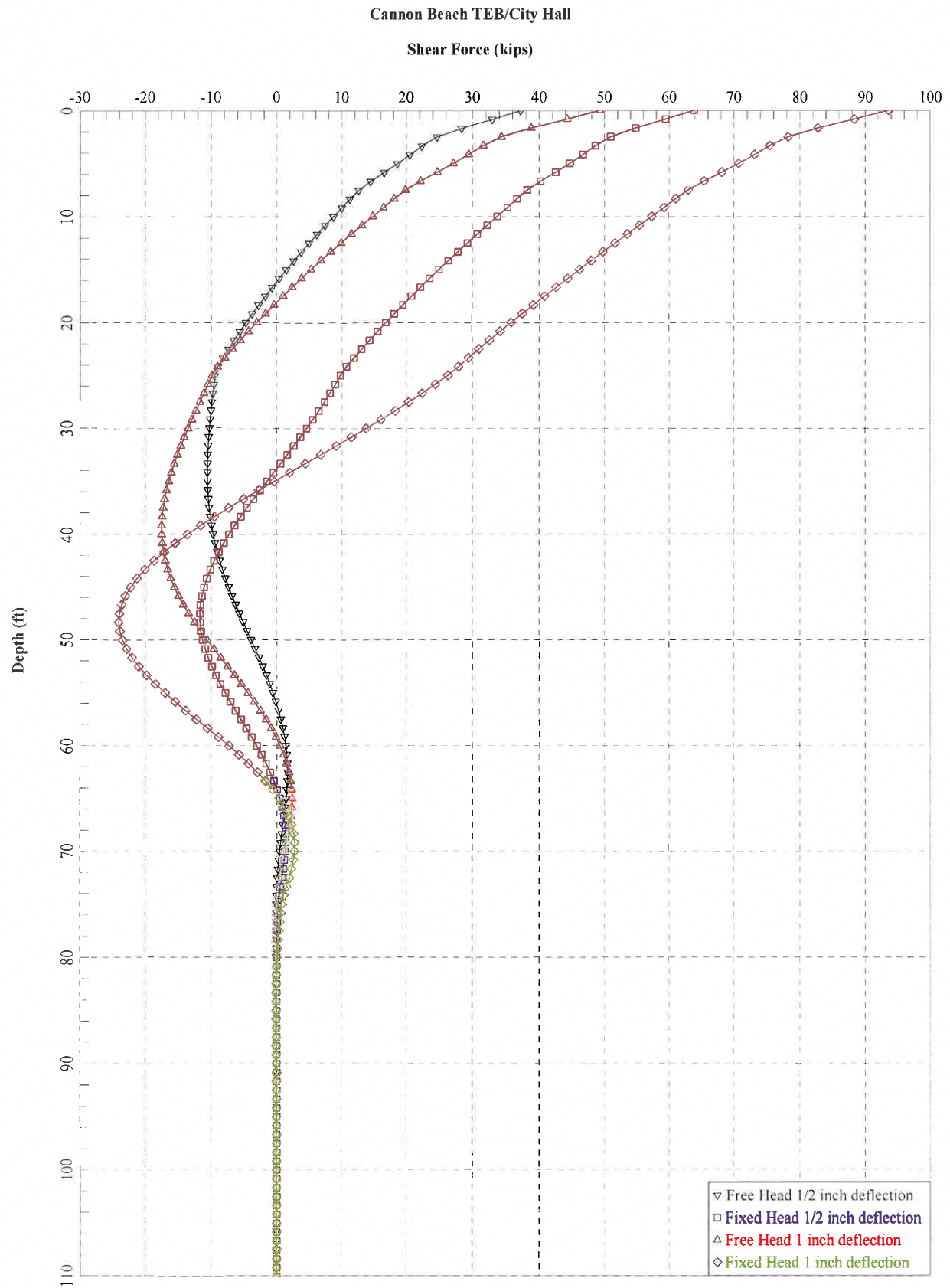
Xallow - Allowable settlement specified by users

Qwork - Vertical working load applied to pile

Qallow - Vertical allowable load, Qult/F.S.







Lateral pile.lpo.txt

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LPILE Plus for Windows, Version 5.0 (5.0.46)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

Marcella Boyer
Chinook GeoServices, Inc.

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Files Used for Analysis

--

Path to file locations: P:\2011 Projects\11-022 (Cannon Beach TEB)\Pile
Analysis\Lpile\
Name of input data file: Conc24.lpd
Name of output file: Conc24.lpo
Name of plot output file: Conc24.lpp
Name of runtime file: Conc24.lpr

Time and Date of Analysis

Date: April 28, 2011 Time: 15:47:47

Problem Title

TEB/ City Hall, Cannon Beach 2 ft dia concrete

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:

- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:

- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile

Lateral pile.lpo.txt

- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:

- Number of pile increments = 132
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:

- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 1320.00 in
 Depth of ground surface below top of pile = 0.00 in
 Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	24.00000000	16286.0000	452.0000	30000000.
2	1320.0000	24.00000000	16286.0000	452.0000	30000000.

Soil and Rock Layering Information

The soil profile is modelled using 8 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer = 0.000 in
 Distance from top of pile to bottom of layer = 30.000 in

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 30.000 in
 Distance from top of pile to bottom of layer = 90.000 in

Layer 3 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer = 90.000 in
 Distance from top of pile to bottom of layer = 180.000 in

Layer 4 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer = 180.000 in
 Distance from top of pile to bottom of layer = 252.000 in

Layer 5 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer = 252.000 in
 Distance from top of pile to bottom of layer = 300.000 in

Layer 6 is liquefiable sand, by Rollins et al, 2004

Distance from top of pile to top of layer = 300.000 in
 Distance from top of pile to bottom of layer = 900.000 in

Warning : The depth of this layer is deeper than the recommended depth limit

Exhibit A-2

Lateral pile.lpo.txt
 for using the p-y criteria for liquefied sand.
 Please consult the LPILE Technical Manual for additional background
 information regarding limitations on the use of the liquefied sand criteria.

Layer 7 is sand, p-y criteria by Reese et al., 1974
 Distance from top of pile to top of layer = 900.000 in
 Distance from top of pile to bottom of layer = 1200.000 in
 p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
 p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 8 is stiff clay without free water
 Distance from top of pile to top of layer = 1200.000 in
 Distance from top of pile to bottom of layer = 1440.000 in

(Depth of lowest layer extends 120.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 16 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	0.00	0.06076
2	30.00	0.06076
3	30.00	0.06076
4	90.00	0.06076
5	90.00	0.06076
6	180.00	0.06076
7	180.00	0.05787
8	252.00	0.05787
9	252.00	0.02176
10	300.00	0.02176
11	300.00	0.02465
12	900.00	0.02465
13	900.00	0.02465
14	1200.00	0.02465
15	1200.00	0.04491
16	1440.00	0.04491

Shear Strength of Soils

Shear strength parameters with depth defined using 16 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	10.00000	0.00	0.00500	0.0
2	30.000	10.00000	0.00	0.00500	0.0
3	30.000	5.00000	0.00	0.04000	0.0
4	90.000	5.00000	0.00	0.04000	0.0
5	90.000	2.00000	0.00	0.02000	0.0
6	180.000	2.00000	0.00	0.02000	0.0
7	180.000	2.00000	0.00	0.02000	0.0
8	252.000	2.00000	0.00	0.02000	0.0
9	252.000	2.00000	0.00	0.02000	0.0
10	300.000	2.00000	0.00	0.02000	0.0
11	300.000	0.00000	0.00	-----	-----

Exhibit A-2

Lateral pile.lpo.txt					
12	900.000	0.00000	0.00	-----	-----
13	900.000	0.00000	38.00	-----	-----
14	1200.000	0.00000	38.00	-----	-----
15	1200.000	15.00000	0.00	0.00500	0.0
16	1440.000	15.00000	0.00	0.00500	0.0

Notes:

- (1) Cohesion = uniaxial compressive strength for rock materials.
- (2) Values of E50 are reported for clay strata.
- (3) Default values will be generated for E50 when input values are 0.
- (4) RCD and k_{rm} are reported only for weak rock strata.

----- Loading Type -----

Static loading criteria was used for computation of p-y curves.

----- Pile-head Loading and Pile-head Fixity Conditions -----

Number of loads specified = 4

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Deflection at pile head = 0.500 in

Bending moment at pile head = 0.000 in-lbs

Axial load at pile head = 1100000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

Deflection at pile head = 0.500 in

Slope at pile head = 0.000 in/in

Axial load at pile head = 1100000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Deflection at pile head = 1.000 in

Bending moment at pile head = 0.000 in-lbs

Axial load at pile head = 1100000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

Deflection at pile head = 1.000 in

Slope at pile head = 0.000 in/in

Axial load at pile head = 1100000.000 lbs

----- Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1 -----

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition

Exhibit A-2

Lateral pile.lpo.txt

Type 4)

Specified deflection at pile head = 0.500000 in
 Specified moment at pile head = 0.000 in-lbs
 Specified axial load at pile head = 1100000.000 lbs

Depth Es*h X F/L in lbs/in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in
0.000	0.500000	0.0000	37185.2215	-0.0021226	2433.6283	-409.0390
4090.3897						
10.000	0.478774	374749.	32935.4190	-0.0021187	2709.7540	-440.9215
9209.3825						
20.000	0.457625	705321.	28371.5292	-0.0021077	2953.3292	-471.8564
10310.9802						
30.000	0.436621	988548.	24622.3410	-0.0020904	3162.0195	-277.9812
6366.6548						
40.000	0.415818	1243755.	22346.1725	-0.0020675	3350.0635	-177.2525
4262.7403						
50.000	0.395270	1480957.	20521.7645	-0.0020396	3524.8406	-187.6291
4746.8549						
60.000	0.375026	1699062.	18595.5057	-0.0020071	3685.5469	-197.6226
5269.5761						
70.000	0.355129	1897023.	16571.2785	-0.0019703	3831.4100	-207.2228
5835.1451						
80.000	0.335620	2073834.	14453.0676	-0.0019296	3961.6897	-216.4194
6448.3436						
90.000	0.316536	2228536.	12613.5847	-0.0018856	4075.6788	-151.4772
4785.4659						
100.000	0.297908	2367589.	11243.6883	-0.0018386	4178.1370	-122.5021
4112.0789						
110.000	0.279764	2493859.	9993.5380	-0.0017888	4271.1762	-127.5280
4558.4064						
120.000	0.262131	2606814.	8705.4553	-0.0017366	4354.4049	-130.0885
4962.7235						
130.000	0.245032	2706174.	7419.0312	-0.0016823	4427.6160	-127.1963
5191.0097						
140.000	0.228486	2792204.	6161.7167	-0.0016260	4491.0059	-124.2666
5438.6910						
150.000	0.212512	2865180.	4933.8801	-0.0015681	4544.7763	-121.3007
5707.9424						
160.000	0.197124	2925380.	3735.8785	-0.0015088	4589.1335	-118.2996
6001.2648						
170.000	0.182336	2973091.	2568.0592	-0.0014485	4624.2889	-115.2643
6321.5476						
180.000	0.168155	3008607.	1430.7602	-0.0013873	4650.4580	-112.1955
6672.1451						
190.000	0.154590	3032226.	324.3123	-0.0013254	4667.8611	-109.0941
7056.9719						
200.000	0.141646	3044253.	-750.9600	-0.0012632	4676.7228	-105.9604
7480.6248						
210.000	0.129326	3044998.	-1794.7362	-0.0012009	4677.2720	-102.7949
7948.5358						
220.000	0.117628	3034779.	-2806.6980	-0.0011387	4669.7419	-99.5975
8467.1717						
230.000	0.106551	3013916.	-3786.5260	-0.0010768	4654.3697	-96.3681
9044.2928						
240.000	0.096092	2982738.	-4733.8965	-0.0010154	4631.3968	-93.1060
9689.2975						
250.000	0.086242	2941578.	-5648.4771	-0.0009548	4601.0688	-89.8101
10413.6841						
260.000	0.076995	2890775.	-6529.9211	-0.0008951	4563.6354	-86.4787

Exhibit A-2

Lat er al pi l e. l po. t xt						
11231. 6854						
270. 000 0. 068340	2830672.	- 7377. 8601	- 0. 0008366	4519. 3504	- 83. 1091	
12161. 1542						
280. 000 0. 060264	2761622.	- 8191. 8946	- 0. 0007793	4468. 4720	- 79. 6978	
13224. 8304						
290. 000 0. 052753	2683980.	- 8971. 5811	- 0. 0007236	4411. 2632	- 76. 2395	
14452. 2001						
300. 000 0. 045791	2598110.	- 9430. 0334	- 0. 0006696	4347. 9916	- 15. 4509	
3374. 1990						
310. 000 0. 039362	2510110.	- 9583. 2752	- 0. 0006173	4283. 1505	- 15. 1974	
3860. 9742						
320. 000 0. 033446	2420025.	- 9732. 9913	- 0. 0005668	4216. 7732	- 14. 7458	
4408. 8856						
330. 000 0. 028025	2327920.	- 9877. 1301	- 0. 0005182	4148. 9080	- 14. 0820	
5024. 7852						
340. 000 0. 023081	2233884.	- 10013. 5061	- 0. 0004716	4079. 6189	- 13. 1932	
5716. 1147						
350. 000 0. 018594	2138025.	- 10139. 8164	- 0. 0004268	4008. 9872	- 12. 0688	
6490. 7802						
360. 000 0. 014544	2040477.	- 10253. 6606	- 0. 0003841	3937. 1115	- 10. 7000	
7356. 7785						
370. 000 0. 010913	1941401.	- 10352. 5639	- 0. 0003433	3864. 1089	- 9. 0806	
8321. 1880						
380. 000 0. 007678	1840979.	- 10434. 0062	- 0. 0003046	3790. 1152	- 7. 2078	
9387. 3084						
390. 000 0. 004821	1739422.	- 10495. 4629	- 0. 0002680	3715. 2849	- 5. 0835	
10545. 1442						
400. 000 0. 002319	1636965.	- 10534. 4774	- 0. 0002334	3639. 7916	- 2. 7194	
11726. 0968						
410. 000 0. 000153	1533867.	- 10548. 9834	- 0. 0002010	3563. 8263	- 0. 1817719	
11912. 6095						
420. 000 -0. 001700	1430406.	- 10536. 5534	- 0. 0001706	3487. 5931	2. 6678	
15692. 7726						
430. 000 -0. 003260	1326890.	- 10492. 8923	- 0. 0001424	3411. 3193	6. 0644	
18603. 6458						
440. 000 -0. 004548	1223681.	- 10413. 5145	- 0. 0001163	3335. 2721	9. 8111	
21572. 1538						
450. 000 -0. 005586	1121178.	- 10295. 3304	- 9. 2304E- 05	3259. 7449	13. 8257	
24751. 3651						
460. 000 -0. 006394	1019805.	- 10136. 0115	- 7. 0394E- 05	3185. 0504	18. 0381	
28210. 3809						
470. 000 -0. 006994	920006.	- 9933. 9202	- 5. 0542E- 05	3111. 5158	22. 3802	
32000. 4314						
480. 000 -0. 007405	822239.	- 9688. 1042	- 3. 2713E- 05	3039. 4777	26. 7830	
36168. 9707						
490. 000 -0. 007648	726964.	- 9398. 3057	- 1. 6859E- 05	2969. 2766	31. 1767	
40764. 6603						
500. 000 -0. 007742	634643.	- 9064. 9728	- 2. 9242E- 06	2901. 2520	35. 4899	
45839. 8845						
510. 000 -0. 007706	545729.	- 8689. 2653	9. 1554E- 06	2835. 7372	39. 6516	
51452. 4796						
520. 000 -0. 007559	460657.	- 8273. 0529	1. 9455E- 05	2773. 0535	43. 5909	
57667. 2481						
530. 000 -0. 007317	379840.	- 7818. 9033	2. 8056E- 05	2713. 5053	47. 2390	
64557. 5094						
540. 000 -0. 006998	303661.	- 7330. 0593	3. 5051E- 05	2657. 3748	50. 5298	
72206. 8300						
550. 000 -0. 006616	232467.	- 6810. 4046	4. 0537E- 05	2604. 9171	53. 4012	
80711. 0500						
560. 000 -0. 006187	166561.	- 6264. 4167	4. 4621E- 05	2556. 3556	55. 7964	
90180. 7234						
570. 000 -0. 005724	106197.	- 5697. 1089	4. 7412E- 05	2511. 8777	57. 6651	
100744.						
580. 000 -0. 005239	51576. 1302	- 5113. 9599	4. 9027E- 05	2471. 6311	58. 9647	
112551.						
590. 000 -0. 004743	2839. 6628	- 4520. 8325	4. 9584E- 05	2435. 7207	59. 6608	

Exhibit A-2

	Lat er al p i l e . l p o . t x t					
125777. 600.000 -0.004247 -39931.3604	-3923.8822	4.9204E-05	2463.0509	59.7292		
140630. 610.000 -0.003759 -76720.4717	-3329.4574	4.8010E-05	2490.1582	59.1557		
157358. 620.000 -0.003287 -107577.	-2743.9916	4.6124E-05	2512.8940	57.9374		
176260. 630.000 -0.002837 -132615.	-2173.8905	4.3666E-05	2531.3429	56.0828		
197696. 640.000 -0.002414 -152015.	-1625.4162	4.0753E-05	2545.6376	53.6121		
222113. 650.000 -0.002022 -166020.	-1104.5698	3.7499E-05	2555.9567	50.5572		
250066. 660.000 -0.001664 -174932.	-616.9780	3.4009E-05	2562.5230	46.9612		
282260. 670.000 -0.001342 -179108.	-167.7839	3.0386E-05	2565.6001	42.8776		
319610. 680.000 -0.001056 -178956.	238.4507	2.6722E-05	2565.4881	38.3693		
363336. 690.000 -0.000807 -174927.	597.8268	2.3100E-05	2562.5193	33.5060		
415129. 700.000 -0.000594 -167507.	907.1659	1.9596E-05	2557.0527	28.3619		
477458. 710.000 -0.000415 -157214.	1164.0285	1.6273E-05	2549.4685	23.0106		
554208. 720.000 -0.000269 -144585.	1366.6649	1.3184E-05	2540.1627	17.5166		
652248. 730.000 -0.000152 -130171.	1513.8222	1.0373E-05	2529.5422	11.9148		
786404. 740.000 -6.11E-05 -114537.	1604.1009	7.8684E-06	2518.0222	6.1409		
1004985. 750.000 5.86E-06 -98262.2175	1630.0099	5.6907E-06	2506.0308	-0.9591394		
1637411. 760.000 5.27E-05 -82061.6110	1592.0588	3.8453E-06	2494.0937	-6.6311		
1258070. 770.000 8.28E-05 -66505.6372	1505.8067	2.3249E-06	2482.6316	-10.6193		
1283102. 780.000 9.92E-05 -51996.6245	1384.9328	1.1122E-06	2471.9409	-13.5554		
1366396. 790.000 0.000105 -38831.4494	1239.2139	1.8264E-07	2462.2405	-15.5883		
1484516. 800.000 0.000103 -27216.3640	1077.2550	-4.9328E-07	2453.6821	-16.8035		
1633646. 810.000 9.51E-05 -17275.4965	906.8649	-9.4859E-07	2446.3574	-17.2746		
1815690. 820.000 8.39E-05 -9058.1976	735.1032	-1.2181E-06	2440.3027	-17.0777		
2035810. 830.000 7.08E-05 -2546.6343	568.2386	-1.3368E-06	2435.5048	-16.2952		
2302263. 840.000 5.71E-05 2335.9860	411.6883	-1.3390E-06	2435.3495	-15.0149		
2627290. 850.000 4.40E-05 5716.5889	269.9722	-1.2566E-06	2437.8405	-13.3283		
3029236. 860.000 3.20E-05 7763.0753	146.7056	-1.1186E-06	2439.3484	-11.3250		
3537090. 870.000 2.16E-05 8675.3106	44.6517	-9.5042E-07	2440.0205	-9.0857		
4201320. 880.000 1.30E-05 8677.0185	-34.1197	-7.7284E-07	2440.0218	-6.6685		
5125890. 890.000 6.17E-06 8009.9187	-87.8413	-6.0207E-07	2439.5303	-4.0758		
6606752. 900.000 9.68E-07 6933.4386	-108.8849	-4.4915E-07	2438.7371	-0.1329555		
1373373. 910.000 -2.81E-06 5842.1020	-107.5999	-3.1840E-07	2437.9329	0.3899579		
1385873. 920.000 -5.40E-06 4788.4458	-101.8745	-2.0961E-07	2437.1566	0.7551183		

Lateral pile.lpo.txt					
1398373.					
930.000 -7.01E-06	3809.2234	-93.1566	-1.2163E-07	2436.4351	0.9884681
1410873.					
940.000 -7.83E-06	2927.9901	-82.6399	-5.2680E-08	2435.7857	1.1149
1423373.					
950.000 -8.06E-06	2157.5837	-71.2793	-6.3579E-10	2435.2181	1.1573
1435873.					
960.000 -7.85E-06	1502.4182	-59.8115	3.6820E-08	2434.7353	1.1363
1448373.					
970.000 -7.32E-06	960.5427	-48.7809	6.2025E-08	2434.3361	1.0698
1460873.					
980.000 -6.60E-06	525.4348	-38.5661	7.7232E-08	2434.0155	0.9731238
1473373.					
990.000 -5.78E-06	187.5211	-29.4073	8.4528E-08	2433.7665	0.8586329
1485873.					
1000. -4.91E-06	-64.5716	-21.4325	8.5787E-08	2433.6759	0.7363258
1498373.					
1010. -4.06E-06	-243.0172	-14.6816	8.2639E-08	2433.8074	0.6138543
1510873.					
1020. -3.26E-06	-360.0226	-9.1282	7.6467E-08	2433.8936	0.4968319
1523373.					
1030. -2.53E-06	-427.2638	-4.6984	6.8411E-08	2433.9431	0.3891231
1535873.					
1040. -1.89E-06	-455.4965	-1.2871	5.9377E-08	2433.9639	0.2931353
1548373.					
1050. -1.35E-06	-454.3131	1.2290	5.0066E-08	2433.9631	0.2100984
1560873.					
1060. -8.92E-07	-432.0175	2.9811	4.0995E-08	2433.9466	0.1403238
1573373.					
1070. -5.26E-07	-395.5924	4.0999	3.2526E-08	2433.9198	0.0834366
1585873.					
1080. -2.41E-07	-350.7344	4.7100	2.4888E-08	2433.8867	0.0385767
1598373.					
1090. -2.84E-08	-301.9399	4.9257	1.8209E-08	2433.8508	0.0045687
1610873.					
1100. 1.23E-07	-252.6205	4.8489	1.2534E-08	2433.8145	-0.0199393
1623373.					
1110. 2.22E-07	-205.2382	4.5673	7.8480E-09	2433.7795	-0.0363671
1635873.					
1120. 2.80E-07	-161.4463	4.1549	4.0954E-09	2433.7473	-0.0461192
1648373.					
1130. 3.04E-07	-122.2301	3.6717	1.1924E-09	2433.7184	-0.0505268
1660873.					
1140. 3.04E-07	-88.0390	3.1650	-9.5948E-10	2433.6932	-0.0508092
1673373.					
1150. 2.85E-07	-58.9089	2.6707	-2.4633E-09	2433.6717	-0.0480522
1685873.					
1160. 2.54E-07	-34.5709	2.2144	-3.4200E-09	2433.6538	-0.0432010
1698373.					
1170. 2.17E-07	-14.5452	1.8131	-3.9226E-09	2433.6390	-0.0370626
1710873.					
1180. 1.76E-07	1.7776	1.4762	-4.0533E-09	2433.6296	-0.0303167
1723373.					
1190. 1.36E-07	15.0683	1.2070	-3.8809E-09	2433.6394	-0.0235323
1735873.					
1200. 9.83E-08	26.0023	0.7575505	-3.4606E-09	2433.6475	-0.0663511
6750000.					
1210. 6.64E-08	30.2954	0.2018522	-2.8844E-09	2433.6506	-0.0447886
6750000.					
1220. 4.06E-08	30.1028	-0.1591479	-2.2663E-09	2433.6505	-0.0274115
6750000.					
1230. 2.10E-08	27.1623	-0.3671713	-1.6803E-09	2433.6483	-0.0141932
6750000.					
1240. 7.00E-09	22.7964	-0.4617756	-1.1690E-09	2433.6451	-0.0047276
6750000.					
1250. -2.35E-09	17.9525	-0.4774710	-7.5201E-10	2433.6415	0.0015885

Exhibit A-2

Lateral pile.lpo.txt						
6750000.						
1260. -8.04E-09	13.2635	-0.4424060	-4.3255E-10	2433.6381	0.0054245	
6750000.						
1270. -1.10E-08	9.1139	-0.3781438	-2.0355E-10	2433.6350	0.0074280	
6750000.						
1280. -1.21E-08	5.7051	-0.3001423	-5.1893E-11	2433.6325	0.0081723	
6750000.						
1290. -1.20E-08	3.1122	-0.2186380	3.8341E-11	2433.6306	0.0081285	
6750000.						
1300. -1.13E-08	1.3315	-0.1397217	8.3817E-11	2433.6293	0.0076547	
6750000.						
1310. -1.04E-08	0.3159236	-0.0664630	1.0068E-10	2433.6286	0.0069970	
6750000.						
1320. -9.33E-09	0.0000	0.0000	1.0391E-10	2433.6283	0.0062956	
3375000.						

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.50000000 in
 Computed slope at pile head = -0.00212257
 Maximum bending moment = 3044998. lbs-in
 Maximum shear force = 37185.22152 lbs
 Depth of maximum bending moment = 210.00000 in
 Depth of maximum shear force = 0.00000 in
 Number of iterations = 10
 Number of zero deflection points = 5

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)

Specified deflection at pile head = 0.500000 in
 Specified slope at pile head = 0.000E+00 in/in
 Specified axial load at pile head = 1100000.000 lbs

Depth Es* h X F/L in lbs/in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in
0.000	0.500000	-7961505.	63879.8610	0.0000	8299.8972	-409.0390
4090.3897						
10.000	0.499185	-7344087.	59424.3892	-0.0001566	7844.9660	-445.5472
8925.4878						
20.000	0.496867	-6769571.	54788.3465	-0.0003011	7421.6457	-481.6614
9693.9635						
30.000	0.493164	-6241697.	50947.1717	-0.0004342	7032.6926	-286.5736
5810.9202						
40.000	0.488183	-5741075.	48591.7734	-0.0005569	6663.8196	-184.5061
3779.4457						
50.000	0.482027	-5257610.	46683.3891	-0.0006694	6307.5891	-197.1708
4090.4527						

Exhibit A-2

			Lateral pile.lpo.txt			
60.000	0.474795	-4792680.	44649.4041	-0.0007723	5965.0146	-209.6262
4415.0919						
70.000	0.466582	-4347633.	42491.9955	-0.0008658	5637.0909	-221.8555
4754.9129						
80.000	0.457479	-3923792.	40213.5051	-0.0009504	5324.7929	-233.8426
5111.5515						
90.000	0.447573	-3522453.	38194.2104	-0.0010267	5029.0743	-170.0164
3798.6314						
100.000	0.436946	-3137322.	36648.2108	-0.0010948	4745.2985	-139.1836
3185.3749						
110.000	0.425677	-2765403.	35218.9055	-0.0011552	4471.2578	-146.6775
3445.7496						
120.000	0.413841	-2407529.	33728.1467	-0.0012082	4207.5659	-151.4743
3660.2015						
130.000	0.401514	-2064261.	32220.9999	-0.0012539	3954.6357	-149.9551
3734.7453						
140.000	0.388763	-1735523.	30729.4710	-0.0012928	3712.4122	-148.3507
3815.9664						
150.000	0.375658	-1421229.	29254.3943	-0.0013251	3480.8317	-146.6646
3904.2117						
160.000	0.362261	-1121283.	27796.5704	-0.0013511	3259.8221	-144.9001
3999.8820						
170.000	0.348635	-835573.	26356.7688	-0.0013712	3049.3031	-143.0602
4103.4369						
180.000	0.334838	-563982.	24935.7299	-0.0013855	2849.1867	-141.1476
4215.3999						
190.000	0.320926	-306378.	23534.1665	-0.0013944	2659.3768	-139.1651
4336.3660						
200.000	0.306950	-62622.2391	22152.7660	-0.0013982	2479.7702	-137.1150
4467.0094						
210.000	0.292962	167436.	20792.1918	-0.0013971	2557.0004	-134.9998
4608.0931						
220.000	0.279009	383957.	19453.0849	-0.0013914	2716.5394	-132.8216
4760.4815						
230.000	0.265134	587110.	18136.0652	-0.0013815	2866.2280	-130.5824
4925.1533						
240.000	0.251379	777072.	16841.7333	-0.0013675	3006.1975	-128.2840
5103.2191						
250.000	0.237783	954030.	15570.6715	-0.0013498	3136.5858	-125.9283
5295.9408						
260.000	0.224382	1118181.	14323.4456	-0.0013286	3257.5370	-123.5169
5504.7560						
270.000	0.211210	1269729.	13100.6057	-0.0013042	3369.2017	-121.0511
5731.3068						
280.000	0.198298	1408886.	11902.6883	-0.0012768	3471.7364	-118.5324
5977.4750						
290.000	0.185675	1535872.	10730.2170	-0.0012466	3565.3035	-115.9619
6245.4254						
300.000	0.173366	1650916.	9779.5116	-0.0012140	3650.0714	-74.1792
4278.7705						
310.000	0.161394	1758170.	9015.6672	-0.0011791	3729.0996	-78.5897
4869.4175						
320.000	0.149783	1857170.	8208.6056	-0.0011421	3802.0456	-82.8226
5529.5080						
330.000	0.138552	1947470.	7360.3779	-0.0011032	3868.5808	-86.8229
6266.4626						
340.000	0.127719	2028648.	6473.5929	-0.0010625	3928.3955	-90.5341
7088.5376						
350.000	0.117301	2100317.	5551.4268	-0.0010203	3981.2029	-93.8991
8004.9398						
360.000	0.107314	2162122.	4597.6256	-0.0009766	4026.7432	-96.8611
9025.9631						
370.000	0.097769	2213755.	3616.5006	-0.0009319	4064.7877	-99.3639
10163.1479						
380.000	0.088677	2254953.	2612.9167	-0.0008861	4095.1436	-101.3529
11429.4721						

Exhibit A-2

		Lat er al p i l e . l p o . t x t		
390.000 0.080046	2285508.	1592.2713	-0.0008397	4117.6574 -102.7762
12839.5800				
400.000 0.071884	2305271.	560.4664	-0.0007927	4132.2193 -103.5848
14410.0573				
410.000 0.064193	2314156.	-476.1286	-0.0007454	4138.7663 -103.7342
16159.7683				
420.000 0.056976	2312147.	-1510.7219	-0.0006981	4137.2859 -103.1845
18110.2707				
430.000 0.050232	2299299.	-2536.1531	-0.0006509	4127.8190 -101.9018
20286.3331				
440.000 0.043958	2275743.	-3544.9543	-0.0006040	4110.4623 -99.8585
22716.5917				
450.000 0.038151	2241689.	-4529.4185	-0.0005578	4085.3702 -97.0344
25434.3960				
460.000 0.032802	2197427.	-5481.6746	-0.0005124	4052.7565 -93.4169
28478.9232				
470.000 0.027903	2143328.	-6393.7676	-0.0004680	4012.8950 -89.0017
31896.6823				
480.000 0.023443	2079847.	-7257.7420	-0.0004247	3966.1200 -83.7932
35743.6079				
490.000 0.019408	2007518.	-8065.7274	-0.0003829	3912.8259 -77.8039
40088.0879				
500.000 0.015785	1926956.	-8810.0217	-0.0003427	3853.4659 -71.0549
45015.5481				
510.000 0.012555	1838855.	-9483.1682	-0.0003041	3788.5507 -63.5744
50635.8183				
520.000 0.009702	1743983.	-10078.0200	-0.0002674	3718.6461 -55.3960
57095.8958				
530.000 0.007206	1643179.	-10587.7787	-0.0002328	3644.3705 -46.5557
64604.3765				
540.000 0.005047	1537349.	-11005.9823	-0.0002002	3566.3919 -37.0850
73485.0843				
550.000 0.003202	1427464.	-11326.3879	-0.0001699	3485.4258 -26.9961
84321.2013				
560.000 0.001649	1314559.	-11542.5694	-0.0001418	3402.2337 -16.2402
98501.4007				
570.000 0.000365	1199733.	-11646.2461	-0.0001161	3317.6269 -4.4951
123179.				
580.000 -0.000673	1084188.	-11624.1441	-9.2729E-05	3232.4898 8.9155
132413.				
590.000 -0.001490	969291.	-11476.1631	-7.1714E-05	3147.8299 20.6806
138829.				
600.000 -0.002108	856243.	-11214.7900	-5.3032E-05	3064.5329 31.5940
149905.				
610.000 -0.002550	746161.	-10848.4744	-3.6634E-05	2983.4218 41.6692
163390.				
620.000 -0.002840	640079.	-10386.0340	-2.2447E-05	2905.2573 50.8189
178923.				
630.000 -0.002999	538935.	-9837.2430	-1.0381E-05	2830.7311 58.9393
196514.				
640.000 -0.003048	443563.	-9212.8918	-3.2681E-07	2760.4582 65.9310
216316.				
650.000 -0.003006	354684.	-8524.6961	7.8422E-06	2694.9698 71.7082
238568.				
660.000 -0.002891	272896.	-7785.1375	1.4265E-05	2634.7062 76.2035
263584.				
670.000 -0.002720	198667.	-7007.2644	1.9091E-05	2580.0122 79.3711
291754.				
680.000 -0.002509	132331.	-6204.4670	2.2478E-05	2531.1336 81.1884
323558.				
690.000 -0.002271	74083.5156	-5390.2360	2.4590E-05	2488.2152 81.6578
359580.				
700.000 -0.002017	23985.2138	-4577.9110	2.5594E-05	2451.3013 80.8072
400544.				
710.000 -0.001759	-18037.7703	-3780.4271	2.5655E-05	2446.9191 78.6896
447344.				

Exhibit A-2

Lateral pile.l po.txt							
720.000	-0.001504	-52187.7335	-3010.0647	2.4936E-05	2472.0818	75.3829	
501103.							
730.000	-0.001260	-78787.6598	-2278.2102	2.3596E-05	2491.6814	70.9880	
563255.							
740.000	-0.001032	-98271.0450	-1595.1344	2.1784E-05	2506.0373	65.6271	
635661.							
750.000	-0.000825	-111170.	-969.7970	1.9640E-05	2515.5413	59.4403	
720801.							
760.000	-0.000640	-118099.	-409.6870	1.7294E-05	2520.6472	52.5817	
822084.							
770.000	-0.000479	-119744.	79.2909	1.4860E-05	2521.8590	45.2139	
944397.							
780.000	-0.000342	-116840.	492.8643	1.2439E-05	2519.7196	37.5008	
1095194.							
790.000	-0.000230	-110160.	828.3484	1.0116E-05	2514.7975	29.5960	
1286899.							
800.000	-0.000140	-100496.	1084.4411	7.9601E-06	2507.6765	21.6225	
1543434.							
810.000	-7.08E-05	-88646.4743	1260.6640	6.0245E-06	2498.9456	13.6220	
1924648.							
820.000	-1.96E-05	-75415.0228	1355.4163	4.3455E-06	2489.1963	5.3284	
2718074.							
830.000	1.61E-05	-61633.7502	1357.2879	2.9430E-06	2479.0419	-4.9541	
3070612.							
840.000	3.93E-05	-48334.0115	1276.9887	1.8176E-06	2469.2422	-11.1057	
2829009.							
850.000	5.25E-05	-36133.9646	1144.8998	9.5321E-07	2460.2529	-15.3120	
2917323.							
860.000	5.83E-05	-25456.9863	977.4729	3.2290E-07	2452.3858	-18.1733	
3116096.							
870.000	5.89E-05	-16591.6102	786.7020	-1.0741E-07	2445.8535	-19.9808	
3389761.							
880.000	5.62E-05	-9720.5828	582.0233	-3.7668E-07	2440.7907	-20.9549	
3730444.							
890.000	5.14E-05	-4942.8565	370.8491	-5.2674E-07	2437.2704	-21.2800	
4139178.							
900.000	4.56E-05	-2292.0128	233.1105	-6.0078E-07	2435.3171	-6.2678	
1373373.							
910.000	3.94E-05	-267.4302	174.4731	-6.2698E-07	2433.8254	-5.4597	
1385873.							
920.000	3.31E-05	1211.2423	124.0327	-6.1732E-07	2434.5208	-4.6284	
1398373.							
930.000	2.70E-05	2226.8048	81.8094	-5.8213E-07	2435.2691	-3.8163	
1410873.							
940.000	2.15E-05	2860.2381	47.4584	-5.3007E-07	2435.7358	-3.0539	
1423373.							
950.000	1.64E-05	3187.6339	20.3804	-4.6818E-07	2435.9771	-2.3617	
1435873.							
960.000	1.21E-05	3278.1456	-0.1848069	-4.0201E-07	2436.0438	-1.7514	
1448373.							
970.000	8.41E-06	3192.7821	-15.0827	-3.3579E-07	2435.9809	-1.2282	
1460873.							
980.000	5.38E-06	2983.8790	-25.1843	-2.7258E-07	2435.8269	-0.7921128	
1473373.							
990.000	2.96E-06	2695.0929	-31.3408	-2.1446E-07	2435.6141	-0.4391868	
1485873.							
1000.	1.09E-06	2361.7813	-34.3510	-1.6271E-07	2435.3685	-0.1628625	
1498373.							
1010.	-2.98E-07	2011.6517	-34.9399	-1.1796E-07	2435.1106	0.0450987	
1510873.							
1020.	-1.27E-06	1665.5791	-33.7454	-8.0324E-08	2434.8556	0.1938009	
1523373.							
1030.	-1.90E-06	1338.5116	-31.3135	-4.9581E-08	2434.6146	0.2925791	
1535873.							
1040.	-2.26E-06	1040.4006	-28.0980	-2.5236E-08	2434.3949	0.3505202	
1548373.							

Exhibit A-2

Lat er al p i l e . l p o . t x t						
1050. -2. 41E- 06	777. 1074	- 24. 4648	- 6. 6356E- 09	2434. 2009	0. 3761205	
1560873.						
1060. -2. 40E- 06	551. 2513	- 20. 6989	6. 9584E- 09	2434. 0345	0. 3770603	
1573373.						
1070. -2. 27E- 06	362. 9772	- 17. 0132	1. 6314E- 08	2433. 8958	0. 3600742	
1585873.						
1080. -2. 07E- 06	210. 6287	- 13. 5583	2. 2185E- 08	2433. 7835	0. 3308985	
1598373.						
1090. -1. 83E- 06	91. 3227	- 10. 4324	2. 5275E- 08	2433. 6956	0. 2942775	
1610873.						
1100. -1. 56E- 06	1. 4238	- 7. 6910	2. 6224E- 08	2433. 6294	0. 2540137	
1623373.						
1110. -1. 30E- 06	- 63. 0740	- 5. 3557	2. 5593E- 08	2433. 6748	0. 2130470	
1635873.						
1120. -1. 05E- 06	- 106. 2529	- 3. 4227	2. 3860E- 08	2433. 7066	0. 1735523	
1648373.						
1130. -8. 25E- 07	- 132. 0526	- 1. 8697	2. 1421E- 08	2433. 7256	0. 1370459	
1660873.						
1140. -6. 24E- 07	- 144. 1180	- 0. 6619995	1. 8595E- 08	2433. 7345	0. 1044930	
1673373.						
1150. -4. 53E- 07	- 145. 7017	0. 2425209	1. 5629E- 08	2433. 7357	0. 0764111	
1685873.						
1160. -3. 12E- 07	- 139. 6115	0. 8894070	1. 2709E- 08	2433. 7312	0. 0529661	
1698373.						
1170. -1. 99E- 07	- 128. 1932	1. 3245	9. 9686E- 09	2433. 7228	0. 0340564	
1710873.						
1180. -1. 12E- 07	- 113. 3404	1. 5917	7. 4968E- 09	2433. 7118	0. 0193865	
1723373.						
1190. -4. 91E- 08	- 96. 5234	1. 7313	5. 3491E- 09	2433. 6994	0. 0085270	
1735873.						
1200. -5. 51E- 09	- 78. 8320	1. 7925	3. 5546E- 09	2433. 6864	0. 0037185	
6750000.						
1210. 2. 20E- 08	- 60. 7510	1. 7370	2. 1261E- 09	2433. 6731	- 0. 0148295	
6750000.						
1220. 3. 70E- 08	- 44. 1393	1. 5379	1. 0527E- 09	2433. 6608	- 0. 0249843	
6750000.						
1230. 4. 30E- 08	- 30. 0161	1. 2678	2. 9382E- 10	2433. 6504	- 0. 0290411	
6750000.						
1240. 4. 29E- 08	- 18. 7902	0. 9778178	- 2. 0565E- 10	2433. 6422	- 0. 0289509	
6750000.						
1250. 3. 89E- 08	- 10. 4552	0. 7017391	- 5. 0494E- 10	2433. 6360	- 0. 0262648	
6750000.						
1260. 3. 28E- 08	- 4. 7444	0. 4597438	- 6. 6049E- 10	2433. 6318	- 0. 0221343	
6750000.						
1270. 2. 57E- 08	- 1. 2458	0. 2623314	- 7. 2179E- 10	2433. 6292	- 0. 0173482	
6750000.						
1280. 1. 84E- 08	0. 5181501	0. 1136398	- 7. 2924E- 10	2433. 6287	- 0. 0123901	
6750000.						
1290. 1. 11E- 08	1. 0430	0. 0141716	- 7. 1326E- 10	2433. 6291	- 0. 0075035	
6750000.						
1300. 4. 09E- 09	0. 8172739	- 0. 0371515	- 6. 9422E- 10	2433. 6289	- 0. 0027611	
6750000.						
1310. -2. 77E- 09	0. 3152493	- 0. 0416146	- 6. 8263E- 10	2433. 6286	0. 0018685	
6750000.						
1320. -9. 56E- 09	0. 0000	0. 0000	- 6. 7941E- 10	2433. 6283	0. 0064545	
3375000.						

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0. 50000000 in
 Computed slope at pile head = - 0. 00000632

Exhibit A-2

Lateral pile.lpo.txt
 Maximum bending moment = -7961505. lbs-in
 Maximum shear force = 63879.86102 lbs
 Depth of maximum bending moment = 0.00000 in
 Depth of maximum shear force = 0.00000 in
 Number of iterations = 7
 Number of zero deflection points = 5

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)

Specified deflection at pile head = 1.000000 in
 Specified moment at pile head = 0.000 in-lbs
 Specified axial load at pile head = 1100000.000 lbs

Depth Es*h X F/L in lbs/in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in
0.000	1.000000	0.0000	49286.3543	-0.0037684	2433.6283	-486.4321
2432.1603						
10.000	0.962316	509994.	44229.2033	-0.0037631	2809.4067	-524.9981
5455.5667						
20.000	0.924737	967373.	38791.2992	-0.0037480	3146.4170	-562.5827
6083.7029						
30.000	0.887356	1368276.	34318.8645	-0.0037241	3441.8142	-331.9043
3740.3733						
40.000	0.850255	1735681.	31599.5468	-0.0036924	3712.5287	-211.9592
2492.8904						
50.000	0.813509	2081499.	29416.0894	-0.0036533	3967.3375	-224.7322
2762.5046						
60.000	0.777189	2404375.	27106.8756	-0.0036074	4205.2420	-237.1105
3050.8726						
70.000	0.741361	2702999.	24675.9034	-0.0035551	4425.2767	-249.0839
3359.8179						
80.000	0.706087	2976106.	22127.2709	-0.0034970	4626.5098	-260.6426
3691.3664						
90.000	0.671422	3222478.	19850.9275	-0.0034336	4808.0442	-194.6261
2898.7172						
100.000	0.637416	3448662.	18088.5317	-0.0033653	4974.7034	-157.8530
2476.4532						
110.000	0.604116	3658285.	16475.1032	-0.0032926	5129.1595	-164.8327
2728.4949						
120.000	0.571565	3850601.	14807.5033	-0.0032157	5270.8633	-168.6873
2951.3254						
130.000	0.539802	4025181.	13136.5526	-0.0031351	5399.4990	-165.5028
3065.9941						
140.000	0.508862	4182304.	11497.6462	-0.0030511	5515.2722	-162.2785
3189.0448						
150.000	0.478779	4322258.	9891.1768	-0.0029641	5618.3945	-159.0154
3321.2694						
160.000	0.449581	4445338.	8317.5253	-0.0028744	5709.0830	-155.7149
3463.5595						
170.000	0.421292	4551845.	6777.0612	-0.0027823	5787.5605	-152.3779
3616.9213						
180.000	0.393935	4642089.	5270.1436	-0.0026882	5854.0553	-149.0056

Exhibit A-2

		Lat er al	pi le	l po. t xt		
3782. 4946						
190. 000 0. 367528	4716388.	3797. 1213	- 0. 0025924	5908. 8008	- 145. 5989	
3961. 5744						
200. 000 0. 342086	4775065.	2358. 3338	- 0. 0024953	5952. 0357	- 142. 1586	
4155. 6379						
210. 000 0. 317622	4818451.	954. 1122	- 0. 0023971	5984. 0039	- 138. 6857	
4366. 3769						
220. 000 0. 294144	4846884.	- 415. 2201	- 0. 0022982	6004. 9539	- 135. 1808	
4595. 7367						
230. 000 0. 271658	4860707.	- 1749. 3460	- 0. 0021989	6015. 1394	- 131. 6444	
4845. 9655						
240. 000 0. 250167	4860272.	- 3047. 9540	- 0. 0020994	6014. 8186	- 128. 0772	
5119. 6742						
250. 000 0. 229670	4845935.	- 4310. 7361	- 0. 0020000	6004. 2544	- 124. 4793	
5419. 9121						
260. 000 0. 210166	4818058.	- 5537. 3864	- 0. 0019011	5983. 7143	- 120. 8508	
5750. 2626						
270. 000 0. 191647	4777012.	- 6727. 5985	- 0. 0018030	5953. 4703	- 117. 1916	
6114. 9648						
280. 000 0. 174107	4723171.	- 7881. 0634	- 0. 0017057	5913. 7988	- 113. 5013	
6519. 0719						
290. 000 0. 157533	4656917.	- 8997. 4655	- 0. 0016097	5864. 9807	- 109. 7791	
6968. 6572						
300. 000 0. 141912	4578636.	- 9839. 3142	- 0. 0015152	5807. 3012	- 58. 5907	
4128. 6665						
310. 000 0. 127228	4493466.	- 10430. 1489	- 0. 0014224	5744. 5450	- 59. 5763	
4682. 6331						
320. 000 0. 113464	4401326.	- 11028. 8450	- 0. 0013314	5676. 6536	- 60. 1630	
5302. 3773						
330. 000 0. 100601	4302179.	- 11631. 2307	- 0. 0012423	5603. 5991	- 60. 3142	
5995. 3838						
340. 000 0. 088618	4196032.	- 12232. 7787	- 0. 0011553	5525. 3868	- 59. 9954	
6770. 0864						
350. 000 0. 077495	4082940.	- 12828. 6312	- 0. 0010706	5442. 0577	- 59. 1751	
7636. 0242						
360. 000 0. 067207	3963012.	- 13413. 6304	- 0. 0009883	5353. 6912	- 57. 8247	
8604. 0346						
370. 000 0. 057730	3836409.	- 13982. 3526	- 0. 0009084	5260. 4065	- 55. 9197	
9686. 4960						
380. 000 0. 049038	3703351.	- 14529. 1493	- 0. 0008313	5162. 3650	- 53. 4396	
10897. 6365						
390. 000 0. 041104	3564114.	- 15048. 1906	- 0. 0007569	5059. 7717	- 50. 3686	
12253. 9413						
400. 000 0. 033900	3419039.	- 15533. 5133	- 0. 0006854	4952. 8757	- 46. 6959	
13774. 7032						
410. 000 0. 027395	3268524.	- 15979. 0705	- 0. 0006170	4841. 9719	- 42. 4155	
15482. 8041						
420. 000 0. 021560	3113031.	- 16378. 7813	- 0. 0005517	4727. 4005	- 37. 5266	
17405. 8866						
430. 000 0. 016361	2953085.	- 16726. 5782	- 0. 0004896	4609. 5477	- 32. 0327	
19578. 2549						
440. 000 0. 011767	2789271.	- 17016. 4446	- 0. 0004308	4488. 8447	- 25. 9406	
22044. 3273						
450. 000 0. 007744	2622235.	- 17242. 4339	- 0. 0003755	4365. 7676	- 19. 2573	
24866. 0441						
460. 000 0. 004258	2452683.	- 17398. 6399	- 0. 0003235	4240. 8365	- 11. 9839	
28143. 9022						
470. 000 0. 001274	2281380.	- 17479. 0214	- 0. 0002751	4114. 6156	- 4. 0924	
32128. 6709						
480. 000 - 0. 001244	2109154.	- 17476. 5770	- 0. 0002302	3987. 7147	4. 5813	
36837. 6606						
490. 000 - 0. 003329	1936912.	- 17384. 7886	- 0. 0001887	3860. 8014	13. 7764	
41378. 7978						
500. 000 - 0. 005019	1765611.	- 17199. 6024	- 0. 0001509	3734. 5820	23. 2608	
46349. 2819						
510. 000 - 0. 006346	1596239.	- 16918. 9833	- 0. 0001165	3609. 7835	32. 8630	

Exhibit A-2

	Lat er al p i l e . l p o . t x t					
51781. 3792						
520. 000 - 0. 007348	1429793.	- 16542. 5676	- 8. 5485E- 05	3487. 1417		42. 4202
57732. 8805						
530. 000 - 0. 008056	1267268.	- 16071. 5912	- 5. 7884E- 05	3367. 3883		51. 7751
64267. 4525						
540. 000 - 0. 008505	1109635.	- 15508. 8388	- 3. 3560E- 05	3251. 2397		60. 7754
71455. 4411						
550. 000 - 0. 008727	957829.	- 14858. 5907	- 1. 2402E- 05	3139. 3850		69. 2743
79375. 6607						
560. 000 - 0. 008753	812736.	- 14126. 5565	5. 7175E- 06	3032. 4758		77. 1326
88117. 3548						
570. 000 - 0. 008613	675173.	- 13319. 7918	2. 0944E- 05	2931. 1152		84. 2204
97782. 3909						
580. 000 - 0. 008335	545879.	- 12446. 5937	3. 3440E- 05	2835. 8481		90. 4192
108488.						
590. 000 - 0. 007944	425505.	- 11516. 3778	4. 3381E- 05	2747. 1528		95. 6240
120369.						
600. 000 - 0. 007467	314597.	- 10539. 5328	5. 0955E- 05	2665. 4328		99. 7450
133583.						
610. 000 - 0. 006925	213593.	- 9527. 2575	5. 6361E- 05	2591. 0101		102. 7100
148315.						
620. 000 - 0. 006340	122812.	- 8491. 3797	5. 9803E- 05	2524. 1200		104. 4655
164781.						
630. 000 - 0. 005729	42450. 0593	- 7444. 1596	6. 1495E- 05	2464. 9068		104. 9785
183238.						
640. 000 - 0. 005110	- 27423. 8308	- 6398. 0816	6. 1648E- 05	2453. 8350		104. 2371
203995.						
650. 000 - 0. 004496	- 86867. 8353	- 5365. 6368	6. 0479E- 05	2497. 6351		102. 2518
227423.						
660. 000 - 0. 003900	- 136067.	- 4359. 1002	5. 8197E- 05	2533. 8865		99. 0555
253975.						
670. 000 - 0. 003332	- 175330.	- 3390. 3073	5. 5010E- 05	2562. 8167		94. 7031
284210.						
680. 000 - 0. 002800	- 205083.	- 2470. 4358	5. 1117E- 05	2584. 7398		89. 2712
318826.						
690. 000 - 0. 002310	- 225863.	- 1609. 7954	4. 6707E- 05	2600. 0511		82. 8568
358717.						
700. 000 - 0. 001866	- 238307.	- 817. 6361	4. 1957E- 05	2609. 2198		75. 5750
405043.						
710. 000 - 0. 001471	- 243139.	- 101. 9781	3. 7030E- 05	2612. 7804		67. 5565
459359.						
720. 000 - 0. 001125	- 241161.	530. 5222	3. 2074E- 05	2611. 3229		58. 9435
523825.						
730. 000 - 0. 000829	- 233234.	1074. 6611	2. 7219E- 05	2605. 4823		49. 8842
601600.						
740. 000 - 0. 000581	- 220267.	1526. 7039	2. 2578E- 05	2595. 9273		40. 5243
697646.						
750. 000 - 0. 000378	- 203197.	1884. 2859	1. 8244E- 05	2583. 3498		30. 9921
820690.						
760. 000 - 0. 000216	- 182982.	2146. 0763	1. 4292E- 05	2568. 4551		21. 3660
989231.						
770. 000 - 9. 18E- 05	- 160590.	2310. 7513	1. 0776E- 05	2551. 9557		11. 5690
1260388.						
780. 000 - 4. 61E- 07	- 137004.	2369. 4366	7. 7307E- 06	2534. 5772	0. 1680595	
3643296.						
790. 000 6. 28E- 05	- 113371.	2319. 0476	5. 1684E- 06	2517. 1636	- 10. 2459	
1630849.						
800. 000 0. 000103	- 90737. 2222	2183. 7674	3. 0797E- 06	2500. 4862	- 16. 8102	
1633520.						
810. 000 0. 000124	- 69763. 7196	1992. 4044	1. 4371E- 06	2485. 0323	- 21. 4624	
1725018.						
820. 000 0. 000132	- 50920. 7511	1762. 3502	2. 0208E- 07	2471. 1482	- 24. 5484	
1864670.						
830. 000 0. 000128	- 34521. 1622	1508. 2468	- 6. 7231E- 07	2459. 0645	- 26. 2722	
2045168.						
840. 000 0. 000118	- 20741. 0246	1242. 8487	- 1. 2379E- 06	2448. 9109	- 26. 8074	

Exhibit A-2

Lat er al pi l e. l po. t xt						
2267889.						
850.000	0.000104	-9636.9559	977.1835	-1.5487E-06	2440.7291	-26.3257
2538562.						
860.000	8.72E-05	-1163.2832	720.5342	-1.6593E-06	2434.4855	-25.0042
2866484.						
870.000	7.05E-05	4810.2314	480.3935	-1.6219E-06	2437.1726	-23.0239
3264978.						
880.000	5.48E-05	8480.2702	262.4639	-1.4859E-06	2439.8768	-20.5620
3752821.						
890.000	4.08E-05	10092.1997	70.7640	-1.2959E-06	2441.0645	-17.7780
4357414.						
900.000	2.89E-05	9924.0589	-37.9530	-1.0910E-06	2440.9407	-3.9654
1373373.						
910.000	1.90E-05	9357.1415	-70.9314	-8.9370E-07	2440.5229	-2.6303
1385873.						
920.000	1.10E-05	8525.0920	-91.7735	-7.1070E-07	2439.9099	-1.5382
1398373.						
930.000	4.77E-06	7537.3071	-102.8258	-5.4632E-07	2439.1820	-0.6722967
1410873.						
940.000	7.33E-08	6480.5956	-106.2394	-4.0286E-07	2438.4034	-0.0104305
1423373.						
950.000	-3.29E-06	5421.3820	-103.9280	-2.8106E-07	2437.6230	0.4727091
1435873.						
960.000	-5.55E-06	4408.2188	-97.5467	-1.8047E-07	2436.8764	0.8035478
1448373.						
970.000	-6.90E-06	3474.4178	-88.4879	-9.9798E-08	2436.1884	1.0082
1460873.						
980.000	-7.54E-06	2640.6564	-77.8893	-3.7218E-08	2435.5740	1.1115
1473373.						
990.000	-7.65E-06	1917.4504	-66.6514	9.4282E-09	2435.0412	1.1361
1485873.						
1000.	-7.36E-06	1307.4202	-55.4605	4.2431E-08	2434.5917	1.1021
1498373.						
1010.	-6.80E-06	807.3060	-44.8152	6.4072E-08	2434.2232	1.0270
1510873.						
1020.	-6.07E-06	409.7076	-35.0539	7.6527E-08	2433.9302	0.9252803
1523373.						
1030.	-5.27E-06	104.5450	-26.3830	8.1790E-08	2433.7054	0.8088975
1535873.						
1040.	-4.44E-06	-119.7515	-18.9026	8.1634E-08	2433.7166	0.6871835
1548373.						
1050.	-3.63E-06	-275.3025	-12.6305	7.7591E-08	2433.8312	0.5672238
1560873.						
1060.	-2.89E-06	-374.0693	-7.5238	7.0946E-08	2433.9039	0.4541194
1573373.						
1070.	-2.22E-06	-427.3398	-3.4968	6.2744E-08	2433.9432	0.3512875
1585873.						
1080.	-1.63E-06	-445.3854	-0.4365619	5.3813E-08	2433.9565	0.2607580
1598373.						
1090.	-1.14E-06	-437.2550	1.7845	4.4780E-08	2433.9505	0.1834538
1610873.						
1100.	-7.36E-07	-410.6807	3.2990	3.6103E-08	2433.9309	0.1194466
1623373.						
1110.	-4.17E-07	-372.0692	4.2371	2.8092E-08	2433.9025	0.0681822
1635873.						
1120.	-1.74E-07	-326.5558	4.7214	2.0943E-08	2433.8689	0.0286732
1648373.						
1130.	2.06E-09	-278.1016	4.8631	1.4755E-08	2433.8332	-0.0003420
1660873.						
1140.	1.21E-07	-229.6189	4.7600	9.5589E-09	2433.7975	-0.0202723
1673373.						
1150.	1.93E-07	-183.1118	4.4958	5.3351E-09	2433.7632	-0.0325772
1685873.						
1160.	2.28E-07	-139.8212	4.1394	2.0303E-09	2433.7313	-0.0386971
1698373.						
1170.	2.34E-07	-100.3688	3.7459	-4.2777E-10	2433.7023	-0.0400074

Lateral pile.lpo.txt

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1710873.
1180. 2.19E-07 -64.8945 3.3569 -2.1190E-09 2433.6761 -0.0377923
1723373.
1190. 1.91E-07 -33.1849 3.0017 -3.1227E-09 2433.6528 -0.0332352
1735873.
1200. 1.57E-07 -4.7913 2.3062 -3.5114E-09 2433.6318 -0.1058654
6750000.
1210. 1.21E-07 13.0169 1.3677 -3.4272E-09 2433.6379 -0.0818326
6750000.
1220. 8.83E-08 22.6388 0.6605795 -3.0623E-09 2433.6450 -0.0595981
6750000.
1230. 6.00E-08 26.2958 0.1601320 -2.5615E-09 2433.6477 -0.0404913
6750000.
1240. 3.71E-08 25.8978 -0.1674120 -2.0274E-09 2433.6474 -0.0250175
6750000.
1250. 1.94E-08 22.9922 -0.3581068 -1.5271E-09 2433.6453 -0.0131215
6750000.
1260. 6.52E-09 18.7693 -0.4457244 -1.0997E-09 2433.6421 -0.0044020
6750000.
1270. -2.55E-09 14.1019 -0.4591127 -7.6330E-10 2433.6387 0.0017244
6750000.
1280. -8.74E-09 9.6038 -0.4209784 -5.2070E-10 2433.6354 0.0059025
6750000.
1290. -1.30E-08 5.6938 -0.3476967 -3.6415E-10 2433.6325 0.0087538
6750000.
1300. -1.60E-08 2.6579 -0.2498349 -2.7868E-10 2433.6303 0.0108185
6750000.
1310. -1.85E-08 0.7032109 -0.1331620 -2.4428E-10 2433.6288 0.0125160
6750000.
1320. -2.09E-08 0.0000 0.0000 -2.3709E-10 2433.6283 0.0141164
3375000.

```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

```

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.00376836
Maximum bending moment = 4860707. lbs-in
Maximum shear force = 49286.35427 lbs
Depth of maximum bending moment = 230.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 9
Number of zero deflection points = 5

```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)

```

Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 1100000.000 lbs

```

Depth Es* h X F/L	Deflect. y	Moment M	Shear V	Slope S	Total Stress	Soil Res. p
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Exhibit A-2

in lbs/in	in	lbs-in	Lat er al lbs	pi l e. l po. t xt Rad.	lbs/in**2	lbs/in
0.000	1.000000	-1.3866E+07	93591.8876	0.0000	12650.3251	-486.4321
2432.1603						
10.000	0.998581	-1.2955E+07	88293.1297	-0.0002745	11979.0841	-529.8758
5306.2875						
20.000	0.994511	-1.2094E+07	82779.2164	-0.0005308	11344.7367	-572.9069
5760.6918						
30.000	0.987965	-1.1288E+07	78209.9991	-0.0007701	10750.5966	-340.9366
3450.8986						
40.000	0.979109	-1.0513E+07	75407.4671	-0.0009932	10179.7051	-219.5698
2242.5479						
50.000	0.968101	-9757513.	73136.0055	-0.0012006	9623.2482	-234.7225
2424.5667						
60.000	0.955096	-9023583.	70714.1457	-0.0013928	9082.4677	-249.6495
2613.8677						
70.000	0.940244	-8312587.	68144.2435	-0.0015702	8558.5852	-264.3310
2811.3015						
80.000	0.923691	-7626153.	65428.8474	-0.0017334	8052.8003	-278.7482
3017.7647						
90.000	0.905577	-6965876.	62959.9273	-0.0018827	7566.2893	-215.0358
2374.5724						
100.000	0.886037	-6325535.	61003.9044	-0.0020187	7094.4672	-176.1688
1988.2771						
110.000	0.865203	-5701387.	59194.0684	-0.0021418	6634.5764	-185.7984
2147.4556						
120.000	0.843201	-5094534.	57304.9230	-0.0022523	6187.4299	-192.0306
2277.3995						
130.000	0.820157	-4505738.	55393.4443	-0.0023505	5753.5876	-190.2651
2319.8613						
140.000	0.796191	-3934954.	53500.1514	-0.0024369	5333.0172	-188.3935
2366.1846						
150.000	0.771419	-3382123.	51626.0888	-0.0025118	4925.6754	-186.4190
2416.5725						
160.000	0.745955	-2847173.	49772.2692	-0.0025755	4531.5085	-184.3449
2471.2591						
170.000	0.719909	-2330016.	47939.6757	-0.0026285	4150.4522	-182.1738
2530.5131						
180.000	0.693385	-1830552.	46129.2642	-0.0026711	3782.4326	-179.9085
2594.6406						
190.000	0.666487	-1348667.	44341.9648	-0.0027036	3427.3654	-177.5514
2663.9895						
200.000	0.639312	-884233.	42578.6842	-0.0027265	3085.1571	-175.1048
2738.9541						
210.000	0.611957	-437111.	40840.3066	-0.0027400	2755.7042	-172.5708
2819.9810						
220.000	0.584512	-7146.9715	39127.6955	-0.0027445	2438.8944	-169.9514
2907.5758						
230.000	0.557066	405823.	37441.6952	-0.0027405	2732.6507	-167.2486
3002.3110						
240.000	0.529703	801977.	35783.1315	-0.0027281	3024.5485	-164.4641
3104.8353						
250.000	0.502504	1181504.	34152.8132	-0.0027078	3304.1951	-161.5996
3215.8851						
260.000	0.475547	1544605.	32551.5324	-0.0026799	3571.7385	-158.6566
3336.2968						
270.000	0.448906	1891493.	30980.0657	-0.0026447	3827.3354	-155.6367
3467.0231						
280.000	0.422652	2222391.	29439.1745	-0.0026026	4071.1508	-152.5415
3609.1506						
290.000	0.396853	2537535.	27929.6051	-0.0025539	4303.3578	-149.3724
3763.9213						
300.000	0.371573	2837170.	26272.0033	-0.0024989	4524.1376	-182.1480
4902.0723						

Exhibit A-2

		Lat er al pi l e. l po. t xt					
310.000	0.346874	3117951.	24403.4961	-0.0024380	4731.0256	-191.5535	
5522.2706							
320.000	0.322814	3378875.	22443.4695	-0.0023715	4923.2822	-200.4518	
6209.5208							
330.000	0.299444	3618993.	20397.5652	-0.0022999	5100.2083	-208.7290	
6970.5415							
340.000	0.276816	3837424.	18272.5680	-0.0022236	5261.1543	-216.2704	
7812.7870							
350.000	0.254973	4033364.	16076.4043	-0.0021430	5405.5283	-222.9623	
8744.5483							
360.000	0.233955	4206099.	13818.1277	-0.0020587	5532.8046	-228.6930	
9775.0708							
370.000	0.213799	4355018.	11507.8889	-0.0019711	5642.5324	-233.3547	
10914.6936							
380.000	0.194533	4479621.	9156.8916	-0.0018807	5734.3436	-236.8447	
12175.0151							
390.000	0.176185	4579531.	6777.3332	-0.0017880	5807.9601	-239.0670	
13569.0899							
400.000	0.158774	4654503.	4382.3296	-0.0016935	5863.2018	-239.9338	
15111.6668							
410.000	0.142315	4704434.	1985.8256	-0.0015977	5899.9924	-239.3671	
16819.4779							
420.000	0.126820	4729369.	-397.5100	-0.0015012	5918.3653	-237.3001	
18711.5936							
430.000	0.112292	4729509.	-2752.4031	-0.0014044	5918.4686	-233.6786	
20809.8638							
440.000	0.098733	4705217.	-5063.1062	-0.0013078	5900.5693	-228.4621	
23139.4740							
450.000	0.086136	4657019.	-7313.5424	-0.0012120	5865.0556	-221.6252	
25729.6585							
460.000	0.074493	4585610.	-9487.4587	-0.0011174	5812.4394	-213.1581	
28614.6312							
470.000	0.063788	4491853.	-11568.5873	-0.0010245	5743.3563	-203.0676	
31834.8311							
480.000	0.054002	4376777.	-13540.8116	-0.0009338	5658.5655	-191.3772	
35438.6348							
490.000	0.045113	4241579.	-15388.3324	-0.0008456	5558.9474	-178.1269	
39484.7925							
500.000	0.037091	4087613.	-17095.8298	-0.0007603	5445.5008	-163.3725	
44046.0417							
510.000	0.029906	3916389.	-18648.6117	-0.0006784	5319.3382	-147.1839	
49214.7544							
520.000	0.023523	3729566.	-20032.7401	-0.0006002	5181.6811	-129.6418	
55112.3600							
530.000	0.017903	3528938.	-21235.1129	-0.0005259	5033.8528	-110.8327	
61906.4671							
540.000	0.013006	3316433.	-22243.4701	-0.0004558	4877.2727	-90.8387	
69845.7188							
550.000	0.008787	3094097.	-23046.2485	-0.0003902	4713.4491	-69.7170	
79343.1078							
560.000	0.005201	2864093.	-23632.0905	-0.0003292	4543.9753	-47.4514	
91231.5093							
570.000	0.002202	2628698.	-23988.2738	-0.0002730	4370.5300	-23.7852	
108024.							
580.000	-0.000259	2390334.	-24088.6704	-0.0002217	4194.8960	3.7059	
142823.							
590.000	-0.002232	2151802.	-23920.4812	-0.0001752	4019.1386	29.9319	
134130.							
600.000	-0.003763	1915778.	-23503.2703	-0.0001336	3845.2297	53.5103	
142192.							
610.000	-0.004903	1684675.	-22859.7635	-9.6715E-05	3674.9457	75.1911	
153364.							
620.000	-0.005698	1460711.	-22009.2106	-6.4526E-05	3509.9226	94.9195	
166597.							
630.000	-0.006193	1245910.	-20971.9356	-3.6827E-05	3351.6512	112.5355	
181705.							

Exhibit A-2

Lateral pile load						
640.000 - 0.006434 198734.	1042082. - 19769.9227	- 1.3413E- 05	3201.4649	127.8671		
650.000 - 0.006462 217841.	850807. - 18426.7916	5.9588E- 06	3060.5275	140.7592		
660.000 - 0.006315 239255.	673415. - 16967.5586	2.1557E- 05	2929.8204	151.0874		
670.000 - 0.006030 263275.	510981. - 15418.2941	3.3678E- 05	2810.1342	158.7655		
680.000 - 0.005641 290266.	364309. - 13805.7215	4.2636E- 05	2702.0615	163.7491		
690.000 - 0.005178 320681.	233929. - 12156.7804	4.8758E- 05	2605.9939	166.0392		
700.000 - 0.004666 355071.	120100. - 10498.1707	5.2381E- 05	2522.1217	165.6828		
710.000 - 0.004130 394116.	22812.9678 - 8855.8907	5.3843E- 05	2450.4376	162.7732		
720.000 - 0.003589 438660.	- 58202.1234 - 7254.7807	5.3481E- 05	2476.5133	157.4488		
730.000 - 0.003060 489764.	- 123459. - 5718.0843	5.1622E- 05	2524.5967	149.8905		
740.000 - 0.002557 548789.	- 173699. - 4267.0399	4.8581E- 05	2561.6152	140.3184		
750.000 - 0.002089 617505.	- 209869. - 2920.5138	4.4656E- 05	2588.2658	128.9868		
760.000 - 0.001664 698284.	- 233092. - 1694.6916	4.0123E- 05	2605.3775	116.1776		
770.000 - 0.001286 794412.	- 244645. - 602.8431	3.5234E- 05	2613.8901	102.1921		
780.000 - 0.000959 910652.	- 245924. 344.8144	3.0213E- 05	2614.8324	87.3394		
790.000 - 0.000682 1054382.	- 238414. 1141.1202	2.5257E- 05	2609.2985	71.9217		
800.000 - 0.000454 1238208.	- 223657. 1781.7739	2.0528E- 05	2598.4256	56.2090		
810.000 - 0.000272 1487411.	- 203230. 2264.7830	1.6159E- 05	2583.3740	40.3928		
820.000 - 0.000131 1870338.	- 178717. 2589.0385	1.2251E- 05	2565.3124	24.4583		
830.000 - 2.66E- 05 2819627.	- 151719. 2748.7665	8.8689E- 06	2545.4190	7.4873		
840.000 4.66E- 05 2727397.	- 123937. 2722.6428	6.0479E- 06	2524.9488	- 12.7120		
850.000 9.44E- 05 2583757.	- 97398.8211 2537.1238	3.7828E- 06	2505.3946	- 24.3918		
860.000 0.000122 2667394.	- 73277.8188 2252.1003	2.0362E- 06	2487.6216	- 32.6129		
870.000 0.000135 2839460.	- 52401.6105 1897.1908	7.5000E- 07	2472.2394	- 38.3690		
880.000 0.000137 3072883.	- 35350.5022 1494.4462	- 1.4803E- 07	2459.6756	- 42.1799		
890.000 0.000132 3361198.	- 22509.4294 1061.4268	- 7.4016E- 07	2450.2139	- 44.4239		
900.000 0.000122 1373373.	- 14105.6834 755.2141	- 1.1149E- 06	2444.0218	- 16.8186		
910.000 0.000110 1385873.	- 7380.6197 594.9885	- 1.3348E- 06	2439.0666	- 15.2265		
920.000 9.58E- 05 1398373.	- 2176.5481 451.8970	- 1.4326E- 06	2435.2321	- 13.3918		
930.000 8.12E- 05 1410873.	1688.8364 327.6437	- 1.4375E- 06	2434.8727	- 11.4589		
940.000 6.70E- 05 1423373.	4407.9511 222.6549	- 1.3752E- 06	2436.8762	- 9.5388		
950.000 5.37E- 05 1435873.	6172.1885 136.3965	- 1.2669E- 06	2438.1762	- 7.7128		
960.000 4.17E- 05 1448373.	7163.7520 67.6495	- 1.1304E- 06	2438.9068	- 6.0366		

Exhibit A-2

			Lat er al	pi l e. l po. t xt		
970.000	3. 11E- 05	7550. 0474	14. 7449	- 9. 7983E- 07	2439. 1914	- 4. 5444
1460873.						
980.000	2. 21E- 05	7480. 2058	- 24. 2442	- 8. 2601E- 07	2439. 1400	- 3. 2534
1473373.						
990.000	1. 46E- 05	7083. 3359	- 51. 3486	- 6. 7697E- 07	2438. 8475	- 2. 1674
1485873.						
1000.	8. 54E- 06	6468. 1273	- 68. 5854	- 5. 3829E- 07	2438. 3942	- 1. 2799
1498373.						
1010.	3. 82E- 06	5723. 4696	- 77. 8717	- 4. 1353E- 07	2437. 8455	- 0. 5773265
1510873.						
1020.	2. 72E- 07	4919. 7906	- 80. 9652	- 3. 0461E- 07	2437. 2534	- 0. 0413767
1523373.						
1030.	- 2. 27E- 06	4110. 8662	- 79. 4282	- 2. 1219E- 07	2436. 6573	0. 3487911
1535873.						
1040.	- 3. 97E- 06	3335. 8955	- 74. 6090	- 1. 3598E- 07	2436. 0863	0. 6150366
1548373.						
1050.	- 4. 99E- 06	2621. 6774	- 67. 6390	- 7. 5012E- 08	2435. 5600	0. 7789629
1560873.						
1060.	- 5. 47E- 06	1984. 7653	- 59. 4392	- 2. 7870E- 08	2435. 0908	0. 8610094
1573373.						
1070.	- 5. 55E- 06	1433. 5073	- 50. 7349	7. 1113E- 09	2434. 6846	0. 8798373
1585873.						
1080.	- 5. 33E- 06	969. 9102	- 42. 0760	3. 1707E- 08	2434. 3430	0. 8519574
1598373.						
1090.	- 4. 91E- 06	591. 2906	- 33. 8584	4. 7684E- 08	2434. 0640	0. 7915546
1610873.						
1100.	- 4. 38E- 06	291. 6933	- 26. 3483	5. 6720E- 08	2433. 8432	0. 7104646
1623373.						
1110.	- 3. 78E- 06	63. 0768	- 19. 7047	6. 0351E- 08	2433. 6748	0. 6182646
1635873.						
1120.	- 3. 17E- 06	- 103. 7275	- 14. 0011	5. 9935E- 08	2433. 7047	0. 5224439
1648373.						
1130.	- 2. 58E- 06	- 218. 2640	- 9. 2458	5. 6640E- 08	2433. 7891	0. 4286244
1660873.						
1140.	- 2. 04E- 06	- 289. 8890	- 5. 3986	5. 1439E- 08	2433. 8419	0. 3408085
1673373.						
1150.	- 1. 55E- 06	- 327. 3678	- 2. 3864	4. 5123E- 08	2433. 8695	0. 2616353
1685873.						
1160.	- 1. 13E- 06	- 338. 6094	- 0. 1150591	3. 8307E- 08	2433. 8778	0. 1926300
1698373.						
1170.	- 7. 86E- 07	- 330. 5118	1. 5203	3. 1460E- 08	2433. 8718	0. 1344376
1710873.						
1180.	- 5. 05E- 07	- 308. 8959	2. 6276	2. 4916E- 08	2433. 8559	0. 0870323
1723373.						
1190.	- 2. 87E- 07	- 278. 5073	3. 3123	1. 8905E- 08	2433. 8335	0. 0498998
1735873.						
1200.	- 1. 27E- 07	- 243. 0660	3. 9901	1. 3567E- 08	2433. 8074	0. 0856689
6750000.						
1210.	- 1. 61E- 08	- 199. 0031	4. 4729	9. 0431E- 09	2433. 7749	0. 0108815
6750000.						
1220.	5. 39E- 08	- 153. 8073	4. 3452	5. 4325E- 09	2433. 7416	- 0. 0364125
6750000.						
1230.	9. 25E- 08	- 112. 2180	3. 8509	2. 7101E- 09	2433. 7110	- 0. 0624571
6750000.						
1240.	1. 08E- 07	- 76. 8492	3. 1736	7. 7520E- 10	2433. 6849	- 0. 0729983
6750000.						
1250.	1. 08E- 07	- 48. 7630	2. 4440	- 5. 1028E- 10	2433. 6642	- 0. 0729223
6750000.						
1260.	9. 79E- 08	- 27. 9579	1. 7488	- 1. 2954E- 09	2433. 6489	- 0. 0661095
6750000.						
1270.	8. 21E- 08	- 13. 7576	1. 1411	- 1. 7223E- 09	2433. 6385	- 0. 0554341
6750000.						
1280.	6. 35E- 08	- 5. 0975	0. 6496662	- 1. 9153E- 09	2433. 6321	- 0. 0428580
6750000.						
1290.	4. 38E- 08	- 0. 7221200	0. 2874881	- 1. 9748E- 09	2433. 6289	- 0. 0295776
6750000.						

Exhibit A-2

Lateral pile.lpo.txt

1300.	2.40E-08	0.6956832	0.0586121	-1.9751E-09	2433.6288	-0.0161975
6750000.						
1310.	4.32E-09	0.4935751	-0.0369434	-1.9629E-09	2433.6287	-0.0029136
6750000.						
1320.	-1.53E-08	0.0000	0.0000	-1.9579E-09	2433.6283	0.0103022
3375000.						

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-0.00000932
Maximum bending moment	=	-13865760. lbs-in
Maximum shear force	=	93591.88759 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	7
Number of zero deflection points	=	5

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,	y = pile-head displacement in
Type 2 = Shear and Slope,	M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,	V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,	S = Pile-head Slope, radians
Type 5 = Deflection and Slope,	R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.500000	M= 0.000	1100000.	0.5000000	3044998.	37185.2215
5	y= 0.500000	S= 0.000	1100000.	0.5000000	-7961505.	63879.8610
4	y= 1.000000	M= 0.000	1100000.	1.0000000	4860707.	49286.3543
5	y= 1.000000	S= 0.000	1100000.	1.0000000	-1.3866E+07	93591.8876

The analysis ended normally.

Summary of Warning Messages

APPENDIX E:
REFERENCES

APPENDIX E

REFERENCES

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CANNON BEACH COMMUNITY DEVELOPMENT

163 E. GOWER ST.

PO Box 368

CANNON BEACH, OR 97110

November 29, 2023

Leslie Jones
CIDA
15895 SW 72nd Ave, Ste. 200
Portland, OR 97224

RE: Completeness Determination for Conditional Use Application at 163 E. Gower St., Taxlots 51030AD12000 and 51030AD11900 (File: CU 23-03)

Dear Ms. Jones:

Your application for a Conditional Use Permit for a municipal building in a (C1) Limited Commercial zone at 163 E. Gower St. was received on November 28, 2023 and determined to be complete on November 29th. The City has 120 days from this date of determination to exhaust all local review, that period ends on Thursday, March 28, 2024. The first evidentiary hearing for this application will be held on Tuesday, December 19, 2023 at 6:00pm, you may participate in person or by Zoom.

The materials received with this application include:

- Conditional Use application with supplemental Project Memorandum
- Geotech Solutions Inc. Report of Geotechnical Engineering Services dated July 31, 2023

Please be aware that the determination of a complete application is not a decision or a guarantee of outcome for the application.

Please feel free to contact my office at (503) 436-8053, or by email at stclair@ci.cannon-beach.or.us if you have questions regarding this information.

Sincerely,

Robert St. Clair
Planner

**CITY HALL / POLICE
STATION FACILITY
REPORT**

**Volume One
SUMMARY**

12.18.2018

Exhibit C-2
TABLE OF CONTENTS

VOLUME ONE

INTRODUCTION	1.3
EXECUTIVE SUMMARY	1.4
PROJECT COST COMPARISON CHART	1.5
PROGRAM DEVELOPMENT	1.6 - 1.9
SITE OPTIONS	1.8 - 1.15
COST SUMMARY / FINANCES	1.16 - 1.19

VOLUME TWO

PROGRAM	2.1 - 2.3
ROOM DATA SHEETS & ROOM DIAGRAMS	2.4 - 2.105

VOLUME THREE

COST ESTIMATE	
TRAFFIC MEMO	
GEOTECHNICAL INVESTIGATION	
STRUCTURAL ANALYSIS	
CIVIL ENGINEERING MEMO	
UTILITY PLAN - GOWER STREET SITE	
UTILITY PLAN - SOUTH WIND SITE Option A	
UTILITY PLAN - SOUTH WIND SITE Option B	

The building in which the current City Hall/Police Station is located was built around 1948 and has been maintained as a City Hall for over 40 years. The building was originally constructed to support operations in the local lumber industry.

The facility has many challenges including uneven floors due to settling (sawdust was mixed with dirt to support the slab), walls constructed from hollow block which are very poor at withstanding seismic events, past renovations that seem to have occurred without the expected level of engineering and inadequate (or non-existent) air circulation in occupied areas.

For several years people have talked about building a new City Hall/Police Station facility that would be of adequate size, be constructed in a manner that would improve survivability so that emergency operations could be supported immediately after a disaster, would meet all code requirements for an Emergency Operations facility as well as being better suited to support and enhance community events.

In March of 2018 the City commissioned a local Architectural firm to put together a team to analyze the feasibility of renovating the current City Hall/Police Station.

This was their conclusion:

“It is the opinion of the Tolovana Architect and our consultants that the useful life of the current City Hall building has been realized. Since it was constructed for the storage and sale of building materials, the construction techniques employed were not meant for a higher occupant load or increased structural capacities of a public building. When considering the many phases of expansion over its history, the building is simply not able to be remodeled in an economic manner as compared to constructing a new facility.”

In August of 2018 the City Council directed staff to initiate the process to determine the necessary elements and estimated costs for a modern City Hall/Police Station in Cannon Beach. The City hired the Portland firm of the SRG Partnership to put together a team to do the initial studies for a new facility.

The product of the project team is this City Hall/Police Station Facility Report that defines all work spaces in terms of size, unique characteristics and adjacency requirements, advanced study of the foundation considerations, project budget including the building cost per square foot and the allowance for site work.

This study shows that the costs of a new City Hall/Police Station is higher than most people would suspect. The reason is that the two building sites available both have significant foundation challenges and the facility will be built to higher structural standards than a residence or a commercial building.

The following report should help the reader understand these considerations as the decision process for a new City Hall/Police Station progresses.

Exhibit C-2 EXECUTIVE SUMMARY

The purpose of this study was to determine the costs to develop a new City Hall / Police Station on two different sites in order to provide the project cost information needed for development of a referral which asks voters to approve general obligation bonds to build the facility.

The first step in the process was to develop a program for the new facility. In order to determine the size and quantity of spaces needed, the design team interviewed existing facility staff and users and surveyed the existing building. The discussion included projecting future growth for each department.

After developing a conceptual space adjacency diagram - which illustrates the important relationships between the various spaces, both sites were evaluated and options for where to place the building on each site were tested.

Criteria for development of the Gower Street Site included the need to maintain as much parking as possible for the City Hall / Police Station site in the redevelopment and the need for the facility to remain operational during construction.

For the South Wind site, consideration for future site amenities, including a school, an emergency preparedness center and additional residential development was given when developing the potential site location for the center. South Wind Option A includes only the costs for the utility infrastructure needed for the City Hall / Police, while Site Option B includes the costs for utility infrastructure sized to include the future school, emergency preparedness center and / or residential development. The costs for developing those facilities and associated parking for the future buildings is not included in this project cost. The costs for widening Highway 101 per ODOT requirements to allow for proper ingress and egress from the site are also included, as are the costs for development a roadway from Highway 101 to the existing gravel road in order to allow the Police to have a second way out of the site in case of emergency. A geotechnical investigation is currently underway which will determine the foundation and site measures needed to mitigate the site's known landslide risk.

PROJECT COST COMPARISON CHART

Option	Size	Direct Construction	Cost per SF	Soft Costs	Other Costs	Project Cost
GOWER STREET SITE OPTION A - one story non-tsunami resistant building - includes site work and parking lot	16,000 sf	\$10,121,398	\$632.59	\$4,391,880	NA	\$14,513,278
GOWER STREET SITE OPTION B - two story tsunami resistant building to M level - includes site work and both a parking lot to the south and to the east of the site	16,400 sf	\$11,333,471	\$691.07	\$4,834,241	NA	\$16,167,712
Additional Cost for Tsunami Resistant Building	\$1,654,435					
SOUTH WIND SITE OPTION A - 1 1/2 story tsunami resistant building above XXL line - includes required highway improvements - includes utilities for Police / City Hall / Police Station Only	16,600 sf	\$19,883,943	\$1,197.83	\$6,956,551	\$388,994	\$27,229,488
SOUTH WIND OPTION B - 1 1/2 story tsunami resistant building above XXL line - includes required highway improvements - includes utilities for full build out of site	16,600 sf	\$20,285,088	\$1,221.99	\$7,055,517	\$388,994	\$27,729,599
Additional Cost for Building Out Site Utilities	\$500,111					

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Project programming is the phase where what you need to know before beginning the design of the building is developed. It is a process that the architect leads a client through to identify and articulate what the project's objectives and constraints are now and in the future.

Detailed programming is imperative to a successful project. It is the crucial process of gathering, organizing, and assessing a client's building-use information. This process includes program objectives, staff and employee projections, current and future space requirements, adjacencies and relationships, equipment and utility requirements, and developing an estimated project cost. Programming precedes the design process and does not include the development of the design or floor plans.

PROGRAM DEVELOPMENT

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Exhibit C-2 PROGRAM SUMMARY

The program summary below was developed in conjunction with the City Hall and Police Department Heads, with input from their staff during two day-long workshops held at the current City Hall / Police Station. The proposed program is intended to account for growth in each department for the next 15 to 20 years. Additional growth can easily be accommodated in all options, except for the Gower Street Option A scheme.

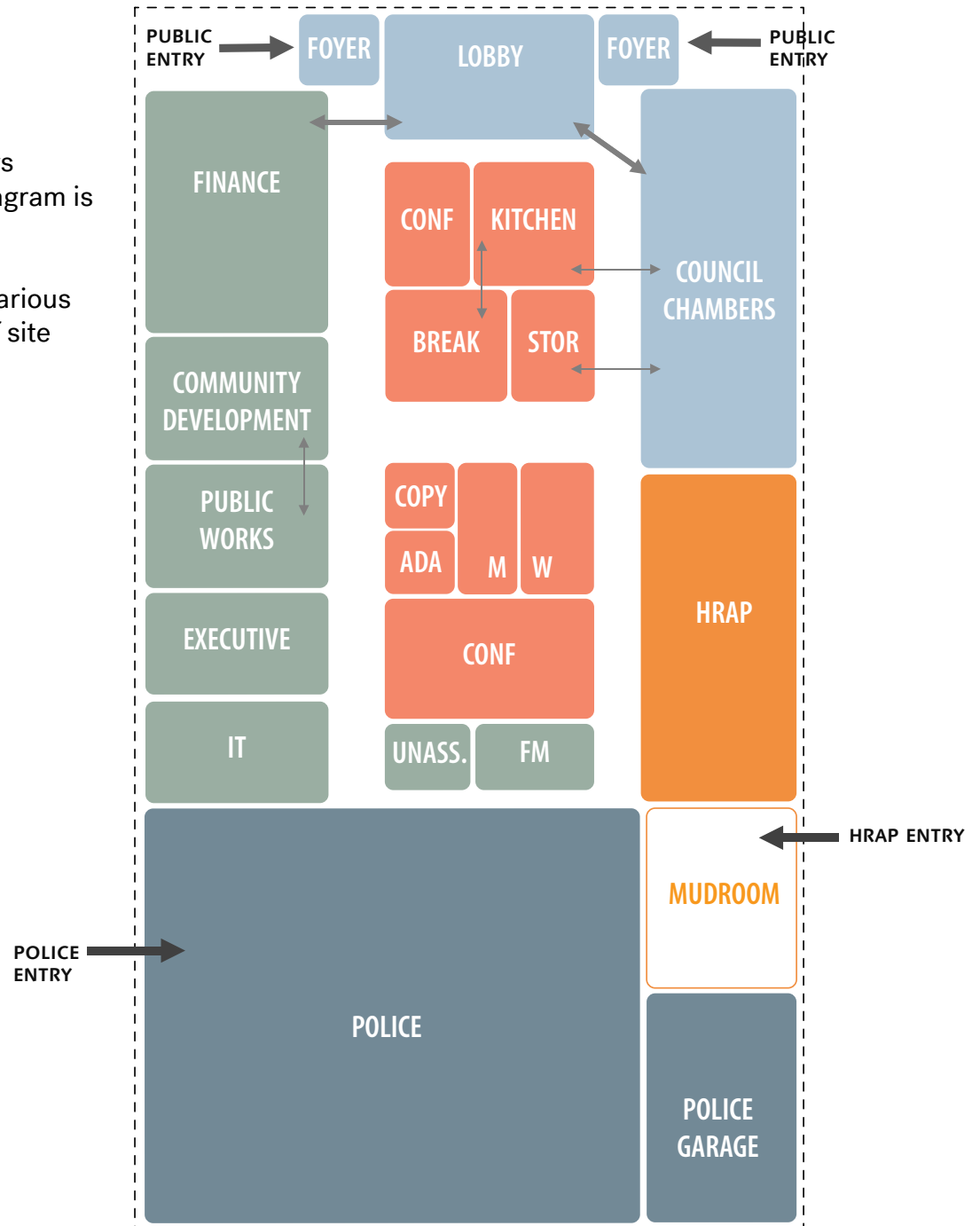
A detailed program with both current and proposed square footage for each room is included in Volume 2 of this report.

FUNCTION	SPACE ID	Existing	Proposed	% Increase
Public Works	1	373	457	123%
Community Development	2	346	407	147%
Executive	3	263	286	109%
Farmer's Market	4	63	170	270%
Finance	5	487	561	115%
HRAP	6	1,158	1,258	109%
IT	7	144	243	169%
Community Spaces	8	1,369	1,776	130%
Public Safety / Police Department	9	1,338	2,869	214%
Shared	10	2,163	1,469	68%
Garage	10.1		600	
Additional Bay for Farmers Market / Wheel chairs			200	
		Sub-total SF	800	
		NET AREA (approx.) SF	12,008	135%
		GROSS AREA (approx.) SF	16,000	174%
		not including Garage		

SPATIAL RELATIONSHIP DIAGRAM

A spatial relationship diagram graphically depicts the proposed program adjacencies based on the interviews performed as part of the programming phase. This diagram is not intended to represent the building floor plan.

The diagram is intended to show relationships of the various program elements to each other and is independent of site factors.



This study evaluated the potential development of two possible sites for the new City Hall / Police Station.

The first site analyzed, called the Gower Street site includes 3 parcels, the parcel between Hemlock and Evergreen that is currently used for parking, the parcel that the current City Hall / Police Station is located on and the parcel that contains the gravel parking lot immediately to the east of the current facility. This site is within the Tsunami Inundation zone. The study determined it could be possible to build a structure that would resist a medium tsunami event, allowing a second floor to be occupied after that event.

The second site analyzed, called the South Wind site, is a 55 acre parcel approximately 1.5 miles south of the current City Hall / Police Station. The parcel is accessed from Highway 101 and is currently undeveloped. A gravel / dirt access road from the south exists on the site. This site is above the XXL Tsunami inundation zone.

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GOWER STREET SITE

1.22 Acres

Site has the potential to provide additional parking for tourists near Haystack Rock.

Site is immediately adjacent to current site in the heart of the City of Cannon Beach

Site can be accessed directly from Hemlock / Evergreen Streets.

No additional site infrastructure modifications are required.

Site is below the XXL Tsunami Inundation zone, but the second floor of a building could be designed to be tsunami resistant for a medium size event

Site has a required setback of 15' from residential areas to the south and east.

SOUTH WIND SITE

55 Acres

Site is large enough for other facilities in addition to the City Hall / Police Station to be included on the site.

Site is located approximately 1.5 miles south of current site.

Site can be accessed directly from Highway 101, however modifications will be required in order to meet the ODOT requirements for ingress and egress from Highway 101.

Additional utility infrastructure is required to develop this site.

Site is above the XXL Tsunami Inundation zone, but has had slides in the past.

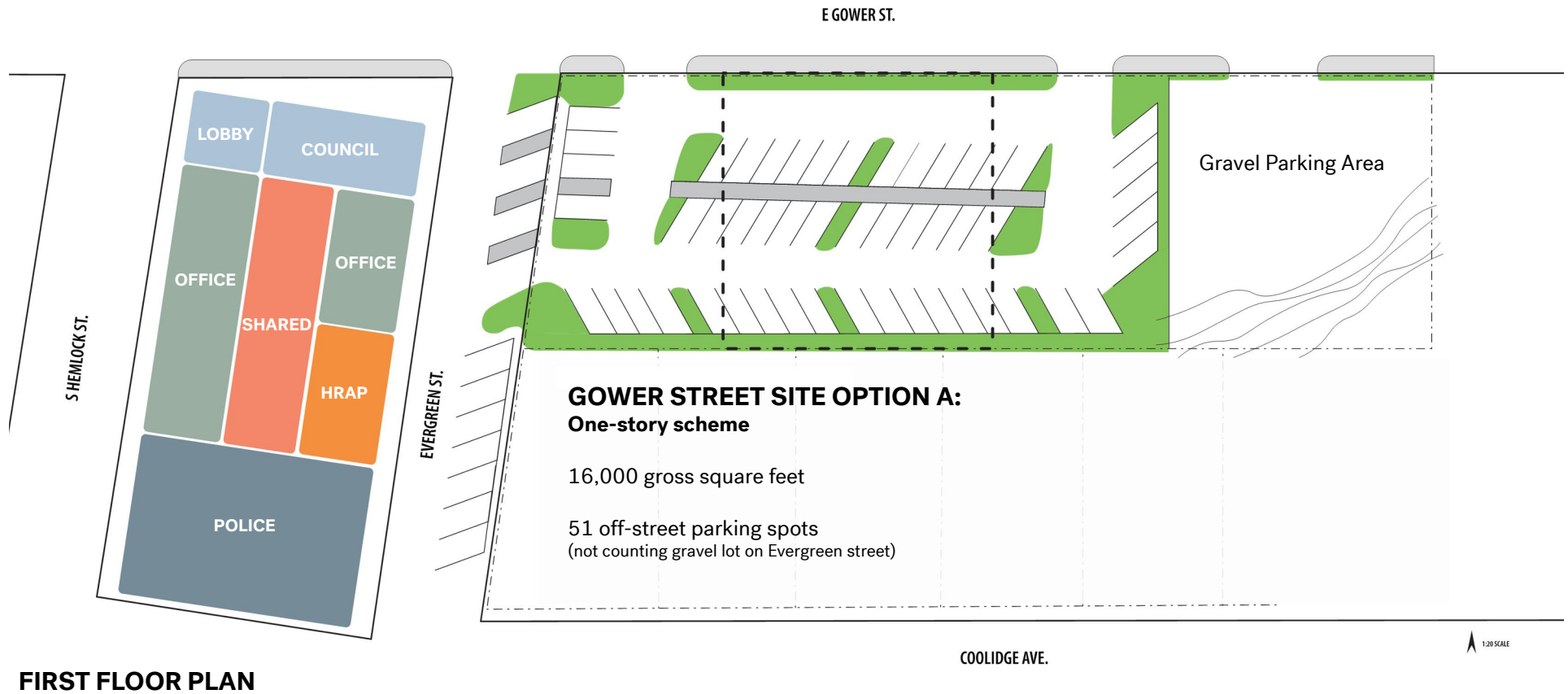
Site has a 100' setback from Highway 101 and a 280' setback from the residential area to the north.



Exhibit C-2

After initially developing 5 options for the Gower Street site and 2 options for the South Wind site, the development team with input from staff decided to proceed with cost estimating for two options on the City Hall / Police Station site and two options for the South Wind site. The options are intended to provide a range of costs for the various options. They are not intended to be design solutions or specific recommendations about an approach to proceed with.

- GOWER STREET Site - Option A: This option depicts a generic layout for a one story building located on the portion of the site between Hemlock and Evergreen streets. Parking is located on the eastern portion of the site.
- GOWER STREET Site - Option B: This option depicts a generic layout for a two story building located on the northern portion of the site between Hemlock and Evergreen streets. Parking is located on the both the eastern and southern parts of the site. The foundation system proposed for this option is proposed to be robust enough to withstand a medium size tsunami event, which would then allow the upper floor of the building to serve as an emergency command center.
- SOUTH WIND Site - Option A: This option depicts a generic layout for a one and half story building located on the southern portion of the center build-able site identified by the Horning Geosciences Report. This placement allows for future development of the site but only the costs for infrastructure needed for the City Hall / Police Station are included in the cost estimate. Improvements to Highway 101 required to ingress to and egress from the site are included. Parking for the building is also included in the cost estimate. Foundations for this option are currently under review. A foundation contingency has been included, but it will need to be revised after the geotechnical investigation is finalized and a strategy for mitigating the slide risk is developed. The site itself is above the XXL Tsunami Inundation line.
- SOUTH WIND Site - Option B: In addition to all of the items noted for South Wind Site Option A, this option also includes the costs to build the utility infrastructure needed for the future school, emergency preparedness center and residential development.



PROS:

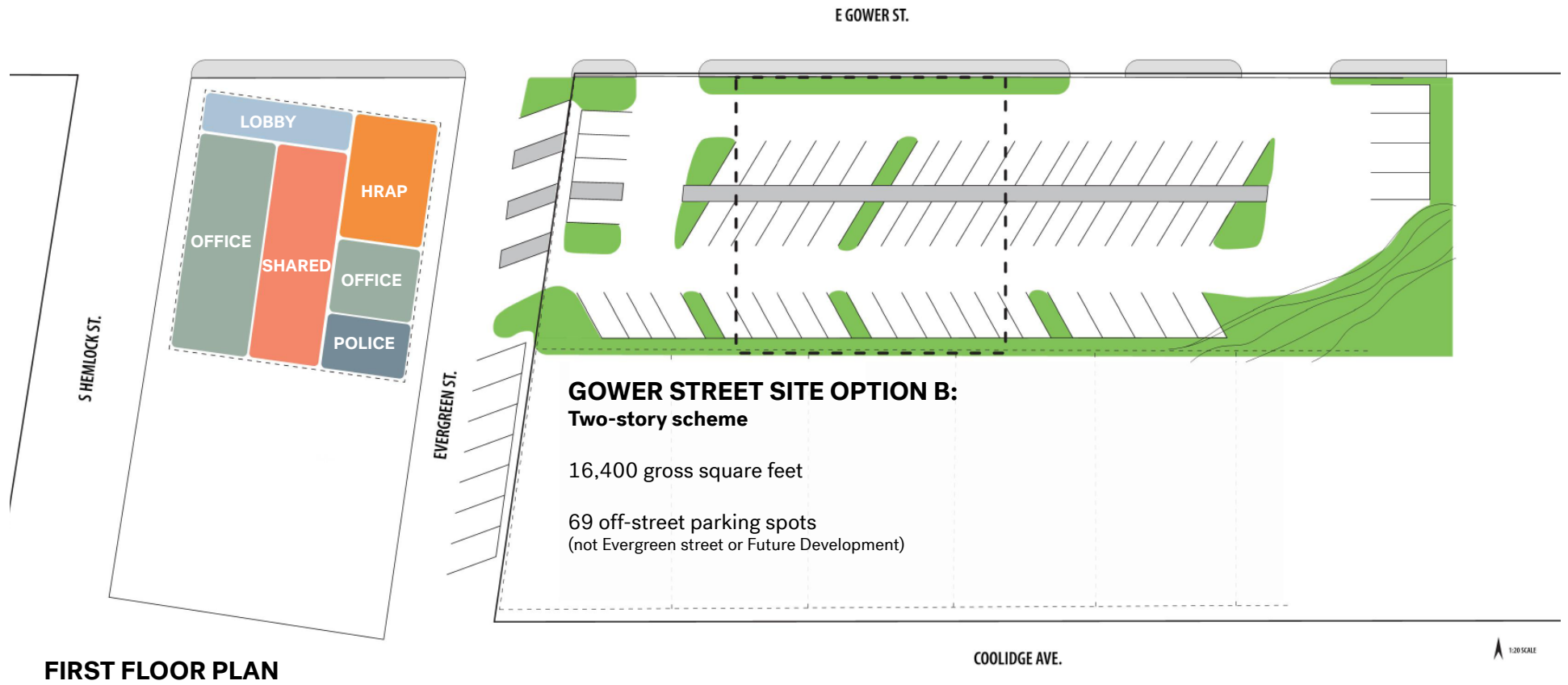
- Smallest Structure
- City Hall / Police Station is prominent
- Parking Consolidated
- Police have easy access and 2 ways in and out of site
- HRAP has separate Entry

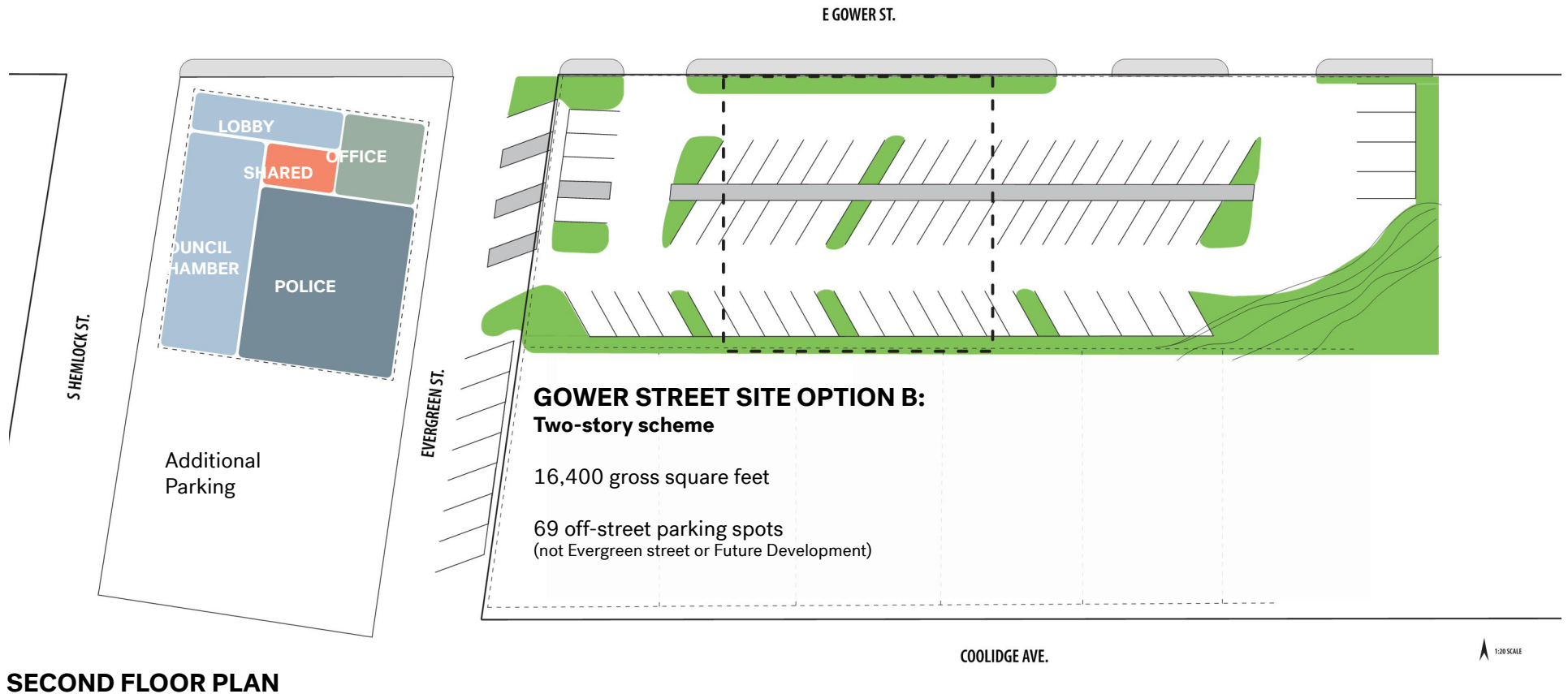
CONS:

- Entire structure is below Medium T shirt DOGAMI line
- One story structure does allow future development opportunities for the site

UNKNOWN:

- Cost for Soil Remediation





PROS:

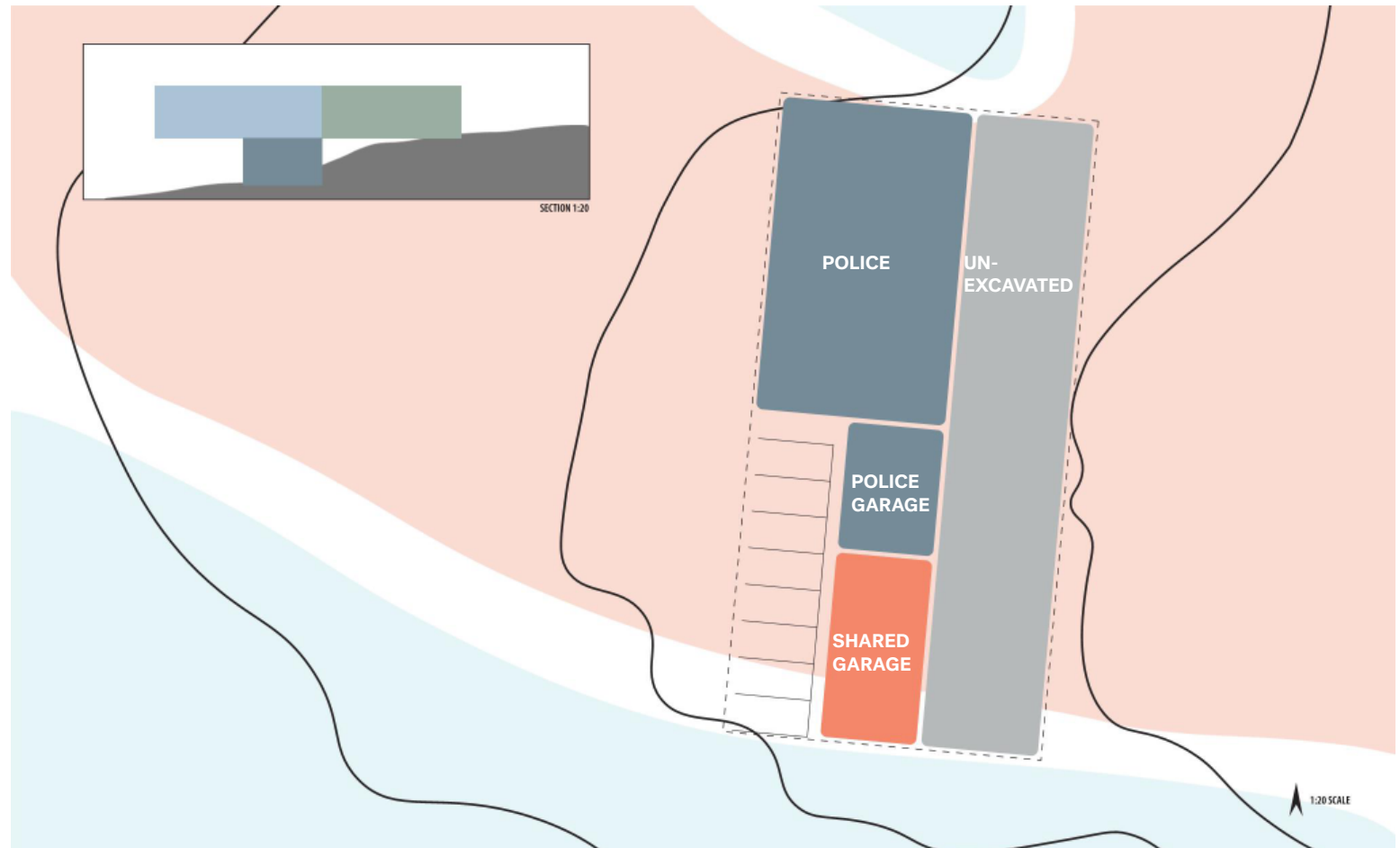
Smallest Footprint = less Foundation
City Hall / Police Station is prominent
Parking Consolidated
Police have easy access and 2 ways in and out of site
HRAP has separate Entry
Police garage is in structure
Upper Level is above Medium T shirt line

CONS:

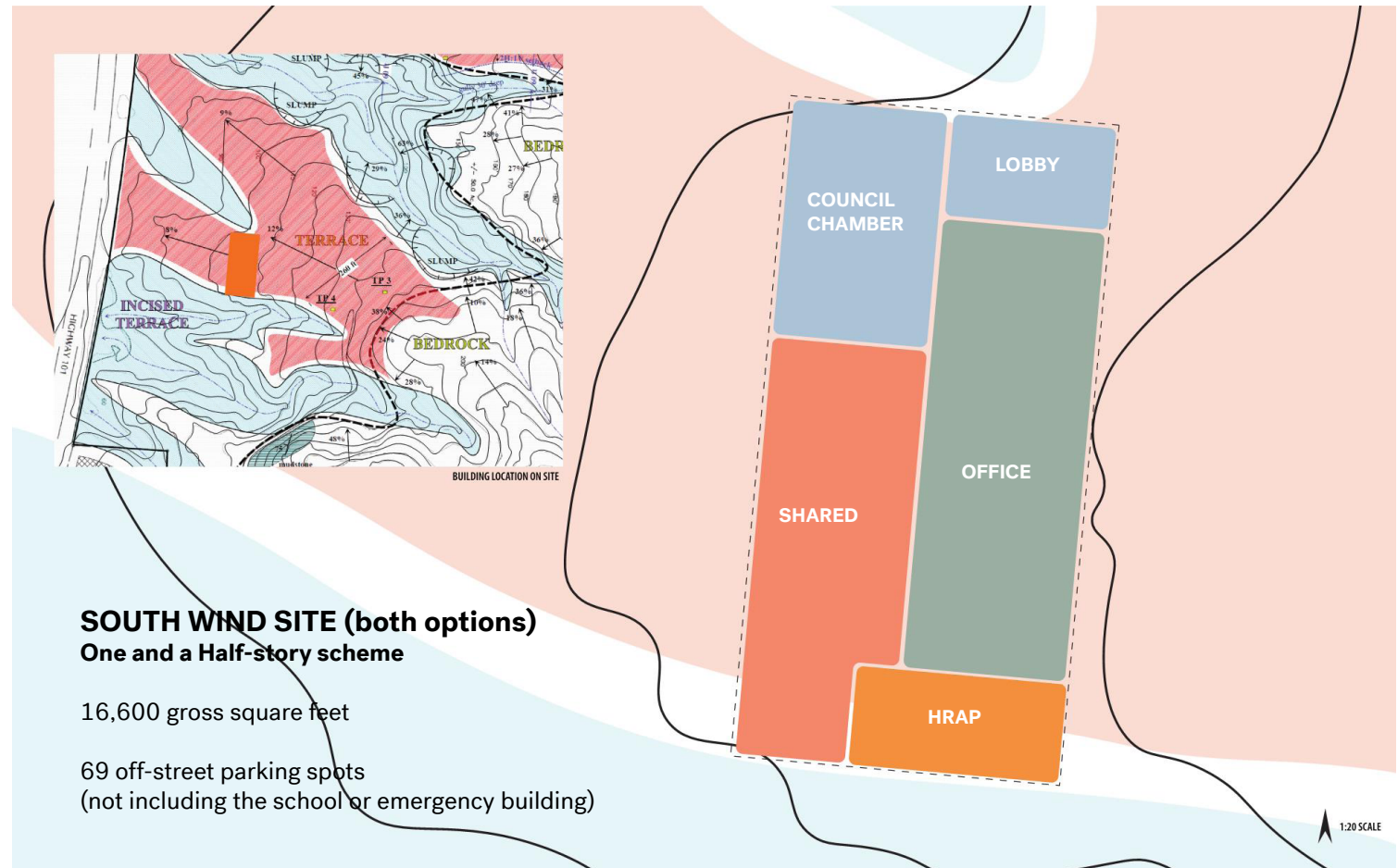
Added Elevator, stairs and toilet room due to 2 floors
Offices are split between 2 levels

UNKNOWN:

Cost for Soil Remediation



FIRST FLOOR PLAN



PROS:

Above the XXL DOGAMI T shirt line

CONS:

More expensive infrastructure
 Site slope makes parking difficult to access for ADA
 Added highway access costs
 Added costs due to site slope and distance from roadway

UNKNOWN:

Cost for Mitigating Landslide

Exhibit C-2

TOTAL PROJECT COSTS INCLUDES THE FOLLOWING ITEMS:

Net Construction Cost:

Net construction cost includes all the costs associated with building the building, including all subcontractor labor, material and markups.

Direct Construction Cost:

Direct Construction Cost includes Net Construction plus the general contractors overhead and profit, general conditions, bonds and insurance, contingencies, and escalation. Contingencies and Escalation factors are defined on page 1.17.

Soft Costs:

Soft Costs are a construction industry term used to account for expense items that are not considered part of the direct construction cost. Soft costs include architectural, engineering, financing, and legal fees, and other pre- and post-construction expenses. They also include costs for furniture, fixture and equipment needed in order for the Owner to occupy the building, costs for building permits, plan review fees, testing and inspection fees, surveys, and moving costs. An Owner's contingency is also included for unforeseen things in soft costs.

Other Costs:

Other costs are costs associated with the project that are not either direct construction costs or soft costs. Examples include the cost to acquire the Highway 101 right of way. For the South wind Site options, we are including the cost to demolish the existing City Hall / Police Station and replace it with a parking lot in the other costs category.

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Exhibit C-2

		City Hall Option A		City Hall Option B		South Wind Site A		South Wind Site B	
		One Story		Two Story		One 1/2 Story		One 1/2 Story	
				Tsunami Resistant		Police /City Hall Only		Utilities for Full Build	
square footage		16000		16400		16600		16600	
Estimate Net Construction Costs									
A1010	Standard Foundations	\$	268,475	\$	88,400	\$	207,000	\$	207,000
A1020	Special Foundations			\$	828,000	\$	498,000	\$	498,000
A1030	Slab on Grade	\$	192,000	\$	98,400	\$	50,400	\$	50,400
B1010	Floor Construction			\$	229,600	\$	347,200	\$	347,200
B1020	Roof Construction	\$	436,800	\$	243,860	\$	338,520	\$	338,520
B2010	Exterior Walls	\$	507,580	\$	676,360	\$	656,500	\$	656,500
B2020	Exterior Windows	\$	124,425	\$	166,650	\$	161,625	\$	161,625
B2030	Exterior Doors	\$	48,000	\$	49,200	\$	49,800	\$	49,800
B3010	Roof Coverings	\$	537,600	\$	275,520	\$	416,640	\$	416,640
C1010	Partitions	\$	288,000	\$	295,200	\$	298,800	\$	298,800
C1020	Interior Doors	\$	128,000	\$	131,200	\$	132,800	\$	132,800
C1030	Specialties	\$	147,540	\$	149,340	\$	150,240	\$	150,240
C2010	Stair Construction			\$	40,000	\$	40,000	\$	40,000
C3010	Wall Finishes	\$	142,576	\$	144,976	\$	146,176	\$	146,176
C3020	Floor Finishes	\$	144,000	\$	147,600	\$	149,400	\$	149,400
C3030	Ceiling Finishes	\$	215,680	\$	220,480	\$	222,880	\$	222,880
D10	Conveying			\$	90,000	\$	180,000	\$	180,000
D2010	Plumbing Fixtures	\$	224,000	\$	229,600	\$	232,400	\$	232,400
D2040	Rain Water Drainage	\$	29,600	\$	30,340	\$	30,710	\$	30,710
D3060	Controls and Instrumentation	\$	64,000	\$	65,600	\$	66,400	\$	66,400
D3090	Other HVAC Systems and Equipment	\$	608,000	\$	623,200	\$	630,800	\$	630,800
D4040	Sprinklers	\$	80,000	\$	82,000	\$	83,000	\$	83,000
D5010	Electrical Service and Distribution	\$	197,600	\$	202,540	\$	205,010	\$	205,010
D5020	Lighting and Branch Wiring	\$	256,000	\$	262,400	\$	265,600	\$	265,600
D5030	Communications & Security	\$	201,600	\$	206,640	\$	209,160	\$	209,160
E1090	Other Equipment	\$	10,000	\$	10,000	\$	10,000	\$	10,000
E2010	Fixed Furnishings	\$	201,680	\$	204,880	\$	206,480	\$	206,480
E2020	Movable Furnishings								

Costs for the Yellow highlighted line item are still being developed.

Exhibit C-2

		City Hall Option A		City Hall Option B		South Wind Site A		South Wind Site B	
		One Story		Two Story Tsunami Resistant		One 1/2 Story Police /City Hall Only		One 1/2 Story Utilities for Full Build	
G1010	Site Clearing	\$	13,098	\$	10,523	\$	52,189	\$	52,189
G1020	Site Demolition	\$	136,539	\$	104,061				
G1030	Site Earthwork	\$	192,242	\$	147,190	\$	166,768	\$	166,768
G2010	Roadways	\$	45,018	\$	45,018	\$	3,916,385	\$	3,916,385
G2020	Parking Lots	\$	252,455	\$	314,886	\$	233,425	\$	233,425
G2030	Pedestrian Paving	\$	90,840	\$	90,840	\$	377,590	\$	377,590
G2040	Site Development	\$	35,505	\$	35,505	\$	150,000	\$	150,000
G2050	Landscaping	\$	27,188	\$	44,215	\$	72,514	\$	72,514
G3010	Water Supply	\$	6,800	\$	6,800	\$	79,740	\$	319,880
G3020	Sanitary Sewer	\$	3,000	\$	3,000	\$	77,030	\$	77,940
G3030	Storm Sewer	\$	11,500	\$	11,500	\$	165,515	\$	165,515
G3090	Other Site Mechanical Utilities					\$	450,000	\$	450,000
G4020	Site Lighting	\$	104,784	\$	84,180	\$	201,680	\$	201,680
G4090	Other Site Utilities	\$	20,000	\$	20,000	\$	20,000	\$	20,000
	Estimated Net Construction Cost	\$	5,992,125	\$	6,709,704	\$	11,948,377	\$	12,189,427
0.9%	PreConstruction Fee	\$	53,930	\$	60,387	\$	107,535	\$	109,704
4.0%	Location Factor	\$	241,843	\$	270,803	\$	482,237	\$	491,965
1.5%	Phasing and Temporary Work	\$	94,318	\$	105,614				
10.0%	General Conditions	\$	638,221	\$	714,651	\$	1,253,815	\$	1,279,110
3.0%	Bonds and Insurance	\$	210,613	\$	235,834	\$	413,759	\$	422,107
4.0%	Overhead and Profit	\$	289,242	\$	323,880		568,229	\$	579,693
15.0%	Design Contingency	\$	1,128,044	\$	1,263,131	\$	2,216,093	\$	2,260,801
3.0%	CMGC Contingency	\$	259,450	\$	290,520	\$	509,701	\$	519,985
2.0%	Market Volatility Contingency	\$	178,156	\$	199,491	\$	349,995	\$	357,055
9.75%	Escalation to 3Q2020	\$	899,167	\$	1,006,846	\$	1,766,455	\$	1,802,093
1.5%	Solar / Green Energy	\$	136,289	\$	152,610	\$	267,747	\$	273,148
	Total Direct Construction	\$	10,121,398	\$	11,333,471	\$	19,883,943	\$	20,285,088
	Cost per square Foot	\$	632.59	\$	691.07	\$	1,197.83	\$	1,221.99

Exhibit C-2

	City Hall Option A		City Hall Option B		South Wind Site A		South Wind Site B	
	One Story		Two Story		One 1/2 Story		One 1/2 Story	
			Tsunami Resistant		Police /City Hall Only		Utilities for Full Build	
Soft Costs								
8.5% Design Fees	\$	860,319	\$	963,345	\$	1,690,135	\$	1,724,232
varies Additional Site Contingency	\$	253,035	\$	283,337	\$	-	\$	-
Site Engineering Fees			\$	100,000.00	\$	250,000.00	\$	250,000.00
Building Permit Costs	\$	33,171	\$	37,110	\$	64,899	\$	66,203
Mechanical Permit Cost	\$	5,000	\$	5,000	\$	5,000	\$	5,000
Plumbing Permit Cost	\$	4,000	\$	4,000	\$	4,000	\$	4,000
Structural Plan Review	\$	21,561	\$	24,122	\$	42,185	\$	43,032
Fire and Life Safety Fee	\$	21,561	\$	24,122	\$	42,185	\$	43,032
Mechanical Plan Review Fee	\$	3,250	\$	3,250	\$	3,250	\$	3,250
Plumbing Plan Review Fee	\$	2,600	\$	2,600	\$	2,600	\$	2,600
State Surcharge	\$	10,937	\$	12,024	\$	19,694	\$	20,054
Inspection Fees	\$	25,000	\$	25,000	\$	100,000	\$	100,000
Surveys	\$	50,000	\$	50,000	\$	150,000	\$	150,000
Geotechnical studies	\$	30,000	\$	30,000		completed		completed
Environmental Studies	\$	25,000	\$	25,000	\$	25,000	\$	25,000
Furniture Fixture and Equipment	\$	352,000	\$	352,000	\$	352,000	\$	352,000
Fee for FFE Design / Specifications	\$	35,200	\$	35,200	\$	35,200	\$	35,200
IT Budget	\$	400,000	\$	400,000	\$	400,000	\$	400,000
City Project Management Fees	\$	85,000	\$	85,000	\$	85,000	\$	85,000
Legal Fees	\$	300,000	\$	300,000	\$	300,000	\$	300,000
Move in Costs	\$	150,000	\$	150,000	\$	150,000	\$	150,000
4% Construction Contingency	\$	404,856	\$	453,339	\$	795,358	\$	811,404
10% Owners Contingency	\$	1,319,389	\$	1,469,792	\$	2,440,045	\$	2,485,510
TOTAL Soft Costs	\$	4,391,880	\$	4,834,241	\$	6,956,551	\$	7,055,517

Costs for the Yellow highlighted line item are still being developed.

Exhibit C-2

	City Hall Option A One Story	City Hall Option B Two Story Tsunami Resistant	South Wind Site A One 1/2 Story Police /City Hall Only	South Wind Site B One 1/2 Story Utilities for Full Build
Cost to Acquire Right of Way				
Cost for Demolition of Existing City Hall	included above	included above	\$136,539	\$136,539
Cost for Converting site to parking lot	included above	included above	\$ 252,455	\$ 252,455
Total Other Costs			\$ 388,994	\$ 388,994
TOTAL PROJECT COST	\$ 14,513,278	\$ 16,167,712	\$ 27,229,488	\$ 27,729,599
Direct construction + Soft Costs + Other Costs				

Costs for the Yellow highlighted line item are still being developed.

Definitions:

Design Contingency – This is an allocation of funds to cover anticipated but as yet undefined costs related to incomplete design. Ideally as the design progresses the Design Contingency is reduced to reflect more defined scope, but the cost of work above the line increases proportionally as more detailed line items are added. It is not meant to cover added scope or costs related to unforeseen site conditions.

CMGC (or Construction) Contingency – This is a CMGC's contingency primarily to cover costs to mitigate impacts due to unforeseen site conditions/constraints. It is only carried when CMGC is the chosen procurement model. It is not carried in estimates for projects using traditional (Design-Bid-Build) procurement. It is not meant to cover design development or added scope.

Owner Contingency – This is typically NOT carried in construction estimates but rather in the Owner's soft cost budget and it is an allocation of funds to cover added scope or "wish list" items.

Market Volatility Contingency – This is an allocation of funds to account for cost increases related to local market forces. It is also sometimes referred to as a "bidding contingency". In a hot market such as Portland, general contractors sometimes struggle to get subcontractors to bid on work in certain trades and the lack of competition causes the bids they do get to be inflated. This contingency tries to address that risk.

Location Factor – This is an allocation of funds to account for the fact that this project is located far enough from any urban centers that travel costs (vehicles, fuel, drive time, per diem, lodging in some cases, etc.) will likely be incurred by multiple subcontractors that will increase their prices.

Escalation – This is an allocation of funds to account for normal cost increases related to the passage of time from the estimating phase until the buyout/construction phase. Estimates are typically done in today's dollars and then escalation is added to account for material cost increases, labor rate increases, equipment cost increases, etc. In large jobs where design can take years, escalation can be a substantial cost to the project.

Staff and our consultants are looking at various ways to fund the City Hall / Police Station Project.

One option is to fund 100% of the project through the issuance of General Obligation bonds.

Our financial consultant has indicated that in today's market a General Obligation Bond would be \$0.75 (seventy-five cents) per \$1,000 in assessed value. This would raise bond proceeds of approximately \$16,000,000 and is slightly higher than the estimate of the lowest cost option. In this scenario the rough annual cost to a homeowner whose property has an appraised value of \$300,000 would see an assessment of \$225 per year or \$18.75 per month for a period of 30 years.

The City could also add an additional 1% TRT levy. 30% of those funds could be available for general purposes such as making the bond payments. In 2018-19 we anticipate the 30% (+ \$150,000) would generate enough funds to make bond payments that would reduce the amount to be funded out of property taxes by \$2.4 million. This has the potential of reducing the annual assessment to property owners to \$0.64 per \$1,000 of assessed value to an annual levy of \$192 or \$16.00 per month.

The City is meeting with multiple state agencies at the end of January in order to discuss grant opportunities. We will be seeking grants Public Safety Facilities as well as for Community spaces. There may be other grant opportunities that will be pursued also. Another factor to consider is that the estimated construction costs that have been generated at this time include significant contingencies for various items. We have been conservative in these estimates, so we anticipate the projected costs of the City Hall / Police Station will likely go down from what you see now.

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