Geotechnical Investigation Report

Jenkins Hall Renovation Project
Humboldt State University, Arcata, California

Prepared for:

Humboldt State University

Engineers & Geologists

812 W. Wabash Ave.
Eureka, CA 95501-2138
707-441-8855

August 2016
016147

SHN CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash • Eureka, CA 95501-2138 • 707/441-8855 • FAX: 707/441-8877 •shninfo@shn-engr.com

Reference: 016147

August 23, 2016

Traci Ferdolage, Associate Vice President
Facilities Management
Humboldt State University
1 Harpst Street
Arcata, CA 95521-8299

Subject: **Geotechnical Investigation Report, Jenkins Hall Renovation Project, Humboldt State University, Arcata, California**

Dear Ms. Ferdolage:

The enclosed report documents the results of SHN's geotechnical investigation for the proposed Jenkins Hall Renovation Project at Humboldt State University in Arcata, California. In the report, we discuss geotechnical site characteristics and provide specific recommendations for site preparation, and design and construction of the renovation project.

Our scope included investigating the geotechnical conditions in the vicinity for the proposed improvements for the renovation project. The results of our investigation are intended to facilitate project planning and structural design.

In general, site geotechnical conditions are consistent with those encountered during various investigations in the vicinity of Jenkins Hall. The primary geotechnical or geological site considerations are the potential for strong seismic shaking and the presence of some loose native soils. These issues are discussed within the attached report.

Thank you for the opportunity to assist you with this project. If you have any questions, please call us at 707-441-8855.

Sincerely,

SHN Engineers & Geologists

John H. Dailey, PE, GE
Senior Geotechnical Engineer

Gary D.

Gary D. Simpson, CEG
Geosciences Director

JHD:GDS/PRS:lms

Enclosure: Geotechnical Report

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Reference: 016147

Geotechnical Investigation Report

Jenkins Hall Renovation Project
Humboldt State University, Arcata, California

Prepared for:

Humboldt State University
Arcata, CA 95521

JOHN H. DAILEY
No. 256
Exp. 3/31/18

8/23/16

John H. Dailey, PE, GE
Senior Geotechnical Engineer

GARY D. SIMPSON
No. 2107

Gary D. Simpson, CEG
Geosciences Director

Engineers & Geologists
812 W. Wabash Ave.
Eureka, CA 95501
707-441-8855

August 2016

QA/QC: GDS___

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List of Illustrations

Acronyms and Abbreviations

km	kilometers
mg/kg	milligrams per kilogram
mV	millivolt
ohm-cm	ohm-centimeters
pcf	pounds per cubic foot
pci	pounds per cubic inch
psf	pounds per square foot

ACI	American Concrete Institute
ASCE	American Society of Civil Engineers
ASTM	ASTM-International
B-#	boring number -#
BGS	below ground surface
CBC	California Building Code
CL	clay
CSU	California State University
DOD	United States Department of Defense
HSU	Humboldt State University
ICBO	International Conference of Building Officials
M#	magnitude-#
ML	silt
MRfz	Mad River fault zone
NR	no reference
OSHA	United States Occupational Safety and Health Administration
SC	clayey sand
SERC	Schatz Energy Research Center
SHN	SHN Engineers & Geologists
SM	silty sand
SPT	standard penetration test
USGS	United States Geological Survey

1.0 Introduction

Humboldt State University (HSU; Figure 1) plans to renovate Jenkins Hall (Figure 2) and construct an exterior elevator and required walkways on the east side of the existing building. The site surrounding the building will be adapted as required for path of travel, accessible routes, and easing of ingress and egress at the building.

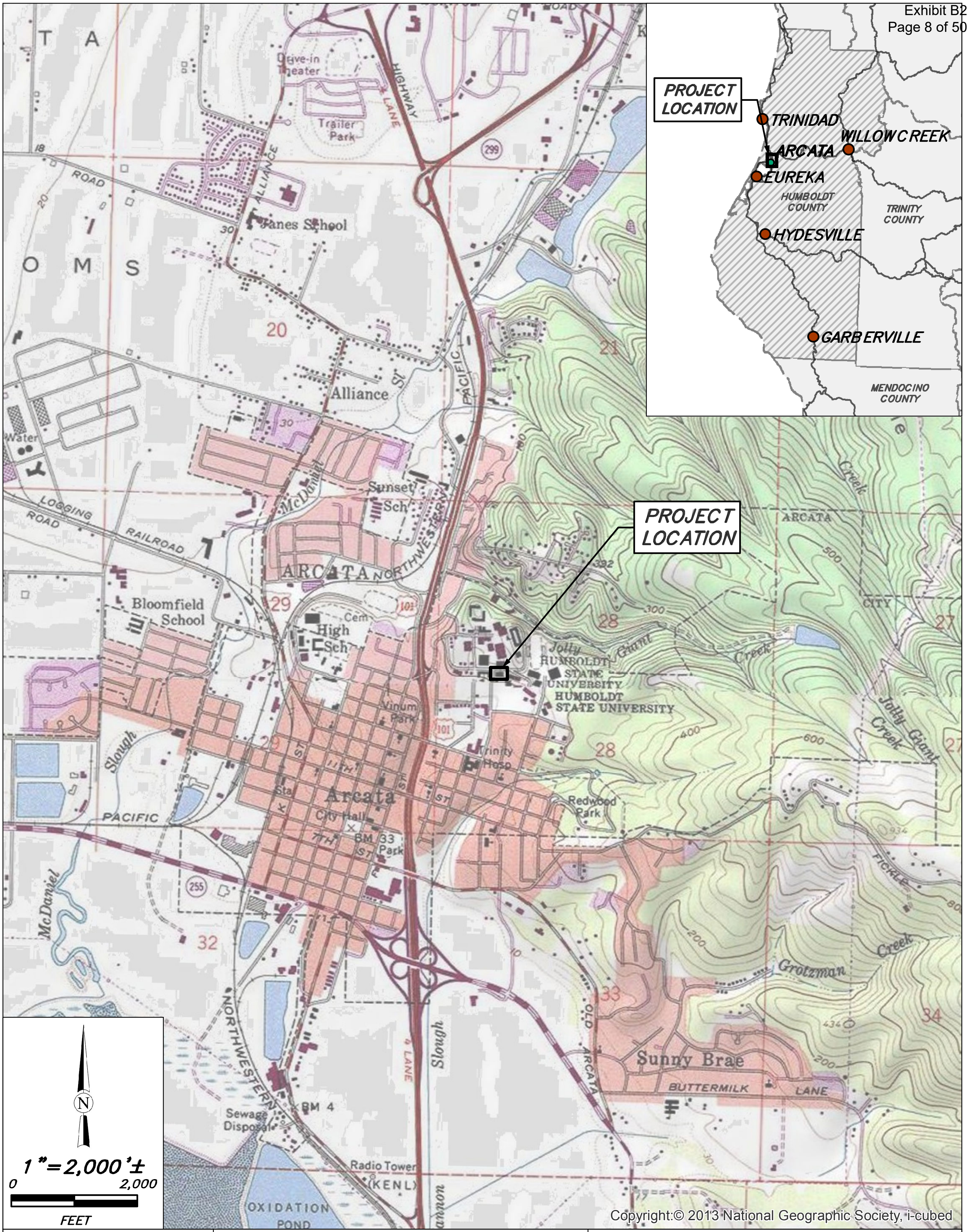
SHN Engineers & Geologists conducted this geotechnical investigation of behalf of HSU. The major project elements for geotechnical consideration for this renovation project are:

- the reconstruction of the primary north entry to achieve better interface with the existing sidewalks and improvements (the secondary entry at the northwest corner of the building may or may not be re-used);
- renovation to the building's south entry to improve access from the west side of the building and the B Street sidewalk into the south entry;
- construction of an outdoor elevated seating area near the southwest corner (above the existing electrical room); and
- construction of a new exterior elevator on the east side of the building connecting both the first and second floors of Jenkins Hall, and providing a new pedestrian bridge to the existing walkway serving the 3rd floor of the Science A building's west entrance.

The scope of geotechnical services for this investigation included performing a subsurface investigation using machine borings, laboratory testing, geotechnical analysis and preparation of this report consistent with the outline provided in the request for proposals for geotechnical services.

As a part of the investigation for the current renovation project, we reviewed previous geotechnical and/or geologic reports that included work done in the near vicinity, along with other near-vicinity subsurface information, listed as follows:

- Taber Consultants. (1985). *Preliminary Soils Investigation, Elevators for Wildlife and Forestry Buildings, Humboldt State University.*
- CH2MHill. (1993). *Geotechnical Exploration, Behavioral and Social Sciences Building, Humboldt State University, Arcata, California.*
- SHN Consulting Engineers & Geologists, Inc. (1998). *Geotechnical Report, Eight Stair System Locations, Infrastructure Project, Humboldt State University Campus, Arcata, California.*
- SHN Consulting Engineers & Geologists, Inc. (2003). *Geotechnical Investigation Report, Behavioral and Social Sciences Building, Humboldt State University, California.*
- GRI. (2004). *Geotechnical Investigation, Proposed Behavioral and Social Science Building, Humboldt State University, Arcata, California.*
- Geomatrix Consultants. (2005). *Assessment of the Potential for Surface Fault Rupture, Behavioral and Social Sciences and Forum Buildings, Humboldt State University.*
- SHN Consulting Engineers & Geologists, Inc. (2007). *Geotechnical Investigation Report, Schatz Energy Research Center, Humboldt State University, Arcata, California.*



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Arcata, California

Project Location

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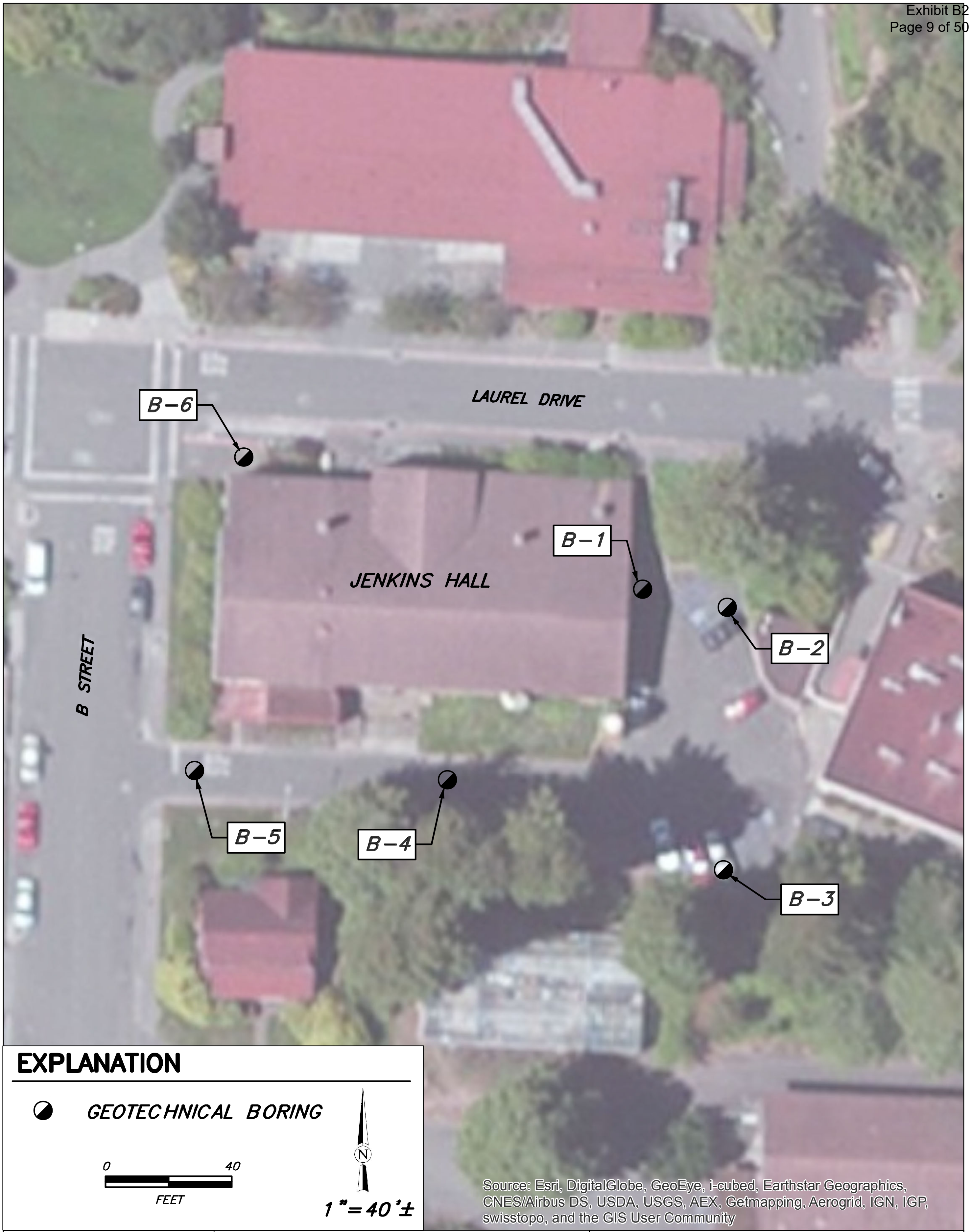
Figure1_ProjectLocationMap

Figure 1



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: \\eureka\projects\2016\016147-HSUJenkins\GIS\PROJ_MXD\Figure2_SiteMap.mxd

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Site Map Showing
Boring Locations
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Figure2_SiteMap
Figure 2

- Geomatrix Consultants. (2008). *Fault Evaluation Report, College Creek Housing Development, Humboldt State University.*
- SHN Consulting Engineers & Geologists, Inc. (2015). *Geotechnical Investigation Report, Schatz Energy Research Center Addition, Humboldt State University, Arcata, California.*

The purpose of this report is to provide geotechnical conclusions and recommendations necessary to complete the structural and architectural design of the Jenkins Hall Renovation Project.

2.0 Field Investigation and Laboratory Testing

SHN conducted a geotechnical investigation to evaluate subsurface soil conditions within the project area, and to provide foundation design and site development criteria for the project. Our field investigation included overseeing the drilling and sampling of six machine-drilled exploratory borings (B-1 through B-6; Figure 2) in the area surrounding the proposed renovations and improvements. Boring B-3 was drilled southeast of Jenkins Hall, in an area being considered for future improvements. We also reviewed the subsurface and seismic information from previous investigations in the near vicinity.

The exploratory borings were advanced to maximum depths of 51.5 feet below the ground surface (BGS), using solid-flight and hollow-stem auger equipment. Due to access limitations around Jenkins Hall, a small track-mounted drill rig (subcontracted from Clear Heart Drilling, Inc., of Santa Rosa, California) was used. Soils encountered in the borings were logged in general accordance with the Unified Soil Classification System (see Figure 2 for boring locations and Appendix A for the Boring Logs).

Penetration resistance tests were conducted as the borings were advanced. The sampler-driving hammer consisted of a 140-pound auto hammer with a nominal 30-inch drop, with drilling rod extensions between the hammer and the sampler. Two samplers were used: a modified California split spoon, with a nominal inside diameter of 2.5 inches, and a 2-inch outside diameter standard penetration test (SPT) sampler, as noted on the logs.

Selected undisturbed samples were collected, and laboratory tests were conducted. Laboratory testing for index properties included in-place moisture content, dry density, unconfined compressive strength, percent fines, triaxial compression, and Atterberg Limits (plasticity). Appendix A presents detailed soil descriptions and the penetration resistance test results. Appendices A and B present laboratory test results.

3.0 Site Conditions

3.1 Geologic Setting

3.1.1 Regional Geology

Base rock in the region is composed of late Jurassic to late Cretaceous age mélange of the Franciscan Complex (Clarke, 1992; McLaughlin et al., 2000). The mélange is part of the Central Belt terrane of the Franciscan Complex, and typically consists of blocks of conglomerate, graywacke sandstone, radiolarian chert, blueschist facies metamorphic rock, greenstone, and ophiolitic plutonic rock in an intensely sheared argillite matrix. In the Arcata area, Franciscan basement rock is unconformably overlain by early to middle Pleistocene-age marine and non-marine deposits of the Falor Formation (Carver, Stephens, and Young, 1985). A geologic and geomorphic features map of the Arcata region (Kelley, 1984) is shown on Figure 3 with unit descriptions presented on Figure 3A.

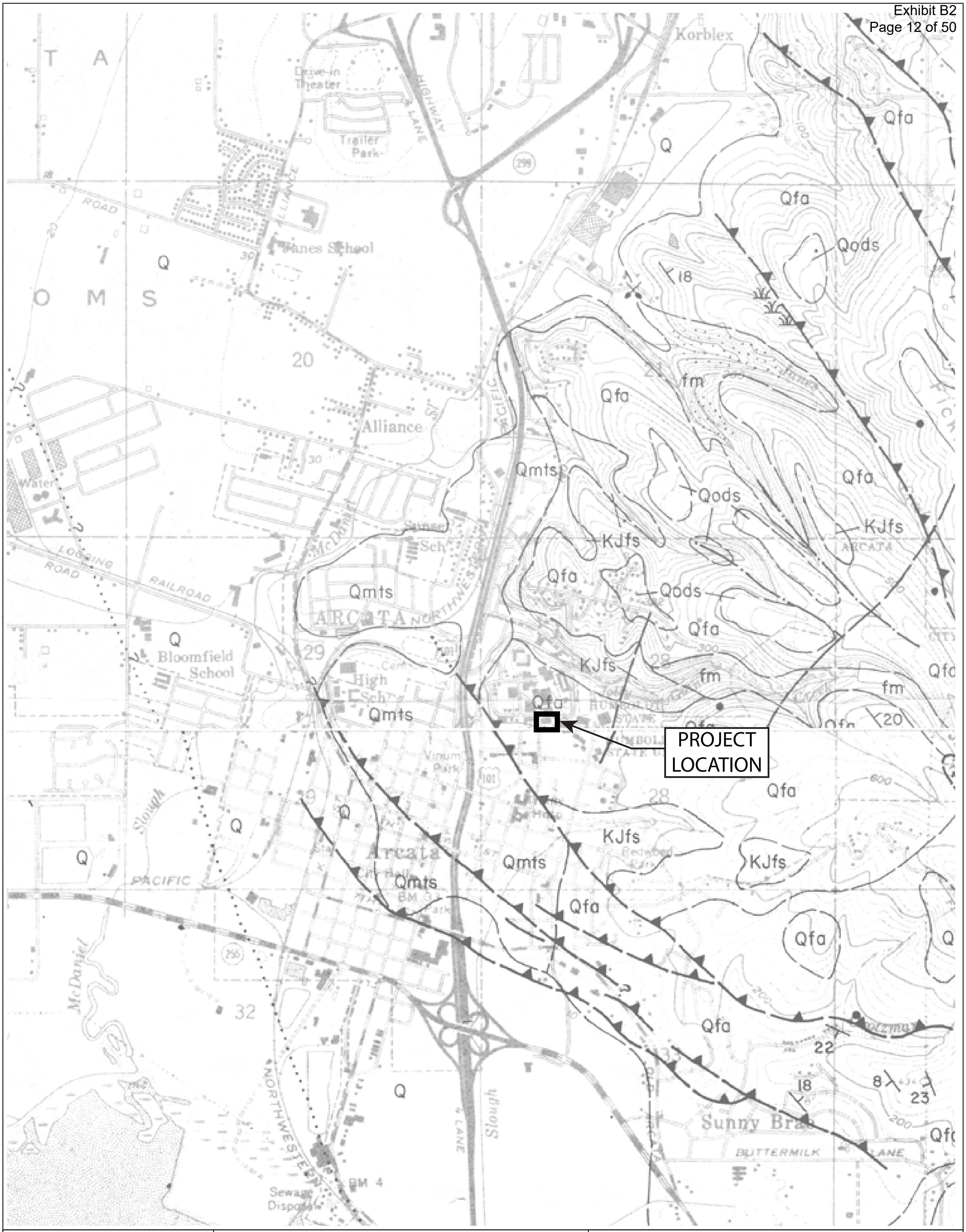
In coastal central Humboldt County, Franciscan basement rock and Falor Formation deposits are overlain by a series of late Pleistocene marine terraces. These terraces typically consist of an abrasion platform cut across bedrock, and terrace cover sediments typically consisting of near-shore marine deposits and eolian deposits. No datable material has been recovered from the marine terraces, so age assignments have been based on elevation distributions and comparisons with global sea level chronologies, as well as comparisons of relative amounts of pedogenic soil development. Based on these analyses, the Arcata marine terrace is correlated to the Oxygen Isotope Stage 7 interglacial period, about 176,000 years ago (Carver and Burke, 1992).

3.1.2 Tectonic Setting

Northwestern California is located in a complex tectonic region dominated by northeast-southwest compression associated with collision of the Gorda and North American tectonic plates. The Gorda plate is being actively subducted beneath North America north of Cape Mendocino, along the southern part of what is commonly referred to as the Cascadia Subduction Zone. This plate convergence has resulted in a broad fold and thrust belt along the western edge of the accretionary margin of the North American plate. In the Humboldt Bay region, this fold and thrust belt is manifested as a series of northwest-trending, southwest-vergent thrust faults, including the Little Salmon fault and faults that comprise the Mad River fault zone (MRfz). These faults are considered active and are capable of generating large-magnitude earthquakes.

The project study area is located within the MRfz (Figure 4). This zone consists of several major northwest-trending thrust faults and numerous minor, secondary synthetic and antithetic faults. Major faults within the MRfz include (from north to south) the Trinidad, McKinleyville, Mad River, and Fickle Hill faults. Specifically, the site is within a series of faults mapped as the Fickle Hill fault zone. The project study area is located approximately 1,600 feet northeast of an Alquist-Priolo Earthquake Fault Zone encompassing a strand of the Fickle Hill fault, and is bordered by a trace of the Fickle Hill fault identified by Carver, Stephens, and Young (1985).

Individual faults within the MRfz commonly exhibit variable strikes, which is common along thrust faults, and shallow to moderate dips ranging from as little as 10° to 55° (to the northeast). In the Arcata area, the Fickle Hill fault crosses and displaces the marine terraces described above. The faults are typically well expressed across the terraces as west- and southwest-facing scarps separating the displaced, relatively flat terrace surfaces. Antithetic faults within the MRfz typically are associated with lesser amounts of cumulative displacement, and form subtle northeast-facing scarps. Only one moderate historical earthquake may have been generated within the MRfz, but all the faults within the zone are considered active based on deformation of Holocene-age soils overlying the faults. The principal faults within the MRfz are considered active by the State of California, and are included within Alquist-Priolo Earthquake Fault Zones. As noted above, the strand crossing the site is not included within an Earthquake Fault Zone.



Path: \\eureka\projects\2016\016147-HSUJenkins\GIS\FIGURES\Figure3_GeologicandGeomorphicMap.pdf

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Geologic and Geomorphic Map
(Kelly, 1984)
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Figure3_GeologicandGeomorphicMap.pdf

Figure 3

ARCATA SOUTH 7.5' QUADRANGLE
OFR 84-39 SF

GEOLOGY AND GEOMORPHIC FEATURES RELATED TO LANDSLIDING ARCATA SOUTH 7.5' QUADRANGLE, HUMBOLDT COUNTY, CALIFORNIA

Compiled by
Frederic R. Kelley, Geologist
California Department of Conservation
Division of Mines and Geology
1984

EXPLANATION

TRANSLATIONAL/ROTATIONAL SLIDE: relatively cohesive slide mass with a failure plane that is deep-seated in comparison to that of a debris slide of similar areal extent; sense of motion along slide plane is linear in a translational slide and arcuate or "rotational" in a rotational slide; complex versions with rotational heads and translational movement or earthflows downslope are common; translational movement along a planar joint or bedding discontinuity may be referred to as a block glide; ↖ indicates scarp, ⇐ indicates direction of movement; dashed where dormant, queried where uncertain.

EARTHFLOW: mass movement resulting from slow to rapid flowage of saturated soil and debris in a semiviscous, highly plastic state; after initial failure, the flow may move, or creep, seasonally in response to destabilizing forces; ↷ indicates scarp, ← indicates direction of movement; dashed where dormant.

DEBRIS SLIDE: unconsolidated rock, colluvium, and soil that has moved slowly to rapidly downslope along a relatively steep (generally greater than 65 percent), shallow translational failure plane; forms steep, unvegetated scars in the head region and irregular hummocky deposits (when present) in the toe region; scars likely to ravel and remain unvegetated for many years; revegetated scars recognized by steep, even-faceted slope and light-bulb shape; includes scarp and slide deposits; solid where active, dashed where dormant.

DEBRIS SLIDE SLOPE: geomorphic feature characterized by steep (generally greater than 65 percent), usually well vegetated slopes that have been sculpted by numerous debris slide events; vegetated soils and colluvium above shallow soil/bedrock interface may be disrupted by active debris slides or bedrock exposed by former debris sliding; slopes near angle of repose may be relatively stable except where weak bedding planes and extensive bedrock joints and fractures parallel slope.

• **ACTIVE SLIDE:** too small to delineate at this scale.

DISRUPTED GROUND: irregular ground surface caused by complex landsliding processes resulting in features that are indistinguishable or too small to delineate individually at this scale; also may include areas affected by downslope creep, expansive soils, and/or gully erosion; boundaries usually are indistinct.

Qsc **STREAM CHANNEL DEPOSITS** (Holocene): unconsolidated silt, sand, and pebble- to cobble-sized gravel in active river channel and flood-stage, gravel bar areas.

Q **ALLUVIUM** (Holocene): unconsolidated, coarse- to fine-grained sand and silt on coastal plain, in valley bottoms and along modern river flood plains; minor amounts of gravel in channel areas.

Qrt **RIVER TERRACE DEPOSITS** (Holocene-Pleistocene): dominantly sand and gravel with minor amounts of silt and clay deposited during higher stands of major streams.

Qmts **MARINE TERRACE DEPOSITS** (Quaternary): poorly to moderately consolidated marine silts, sands, and gravels forming flat benches on wave-cut surfaces.

Qh **HOOKTON FORMATION** (Pleistocene): predominantly orange-brown, nonmarine sandstone with some clay and gravel; sandstone usually is medium-grained, well sorted, and poorly cemented; included are minor beds of well rounded pebbles of chert, quartz, and some greenstone ranging from 4 to 16 millimeters in size; in some exposures, cobbles up to 100 millimeters are present.

Qfo **FALOR FORMATION** (Early to Middle Pleistocene): fluvial and shallow-water marine sediments; includes pebble- to cobble-sized conglomerate, sandstone, and silt.

QTwu **WILDCAT GROUP UNDIFFERENTIATED** (Pleistocene-Miocene): mudstone, shale, sandstone, siltstone, and minor amounts of conglomerate.

Ty **YAGER FORMATION** (Tertiary): well consolidated silty shale, siltstone, sandstone, mudstone, and conglomerate; highly sheared i places; silty shale and mudstone often disaggregate by slaking whe wetted.

KJfs **CENTRAL BELT FRANCISCAN SEDIMENTARY ROCKS** (Cretaceous-Jurassic): well consolidated sandstone, siltstone, and shale with minor amoun of conglomerate; structurally deformed and usually highly sheared; includes areas mapped as Franciscan Broken Formation by Carver and others (1984).

fm **FRANCISCAN MELANGE** (Cretaceous-Jurassic): individual blocks of graywacke, sandstone, mudstone, conglomerate, greenstone, chert, a serpentinite in a sheared argillaceous matrix.

LITHOLOGIC CONTACT: dashed where approximately located, queried where uncertain.

FAULT: dashed where approximately located, dotted where projected or concealed, queried where uncertain.

THRUST FAULT: dashed where approximately located, dotted where projected, queried where uncertain; barbs on upper plate.

LINEAMENT: linear feature of unknown origin observed on aerial photographs.

32 **STRIKE AND DIP OF BEDDING:** approximate; may vary over short distances.

X **QUARRY OR BORROW PIT**

† **SPRING**

ψ **MARSH**

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Geologic and Geomorphic Map
Explanation (Kelly, 1984)
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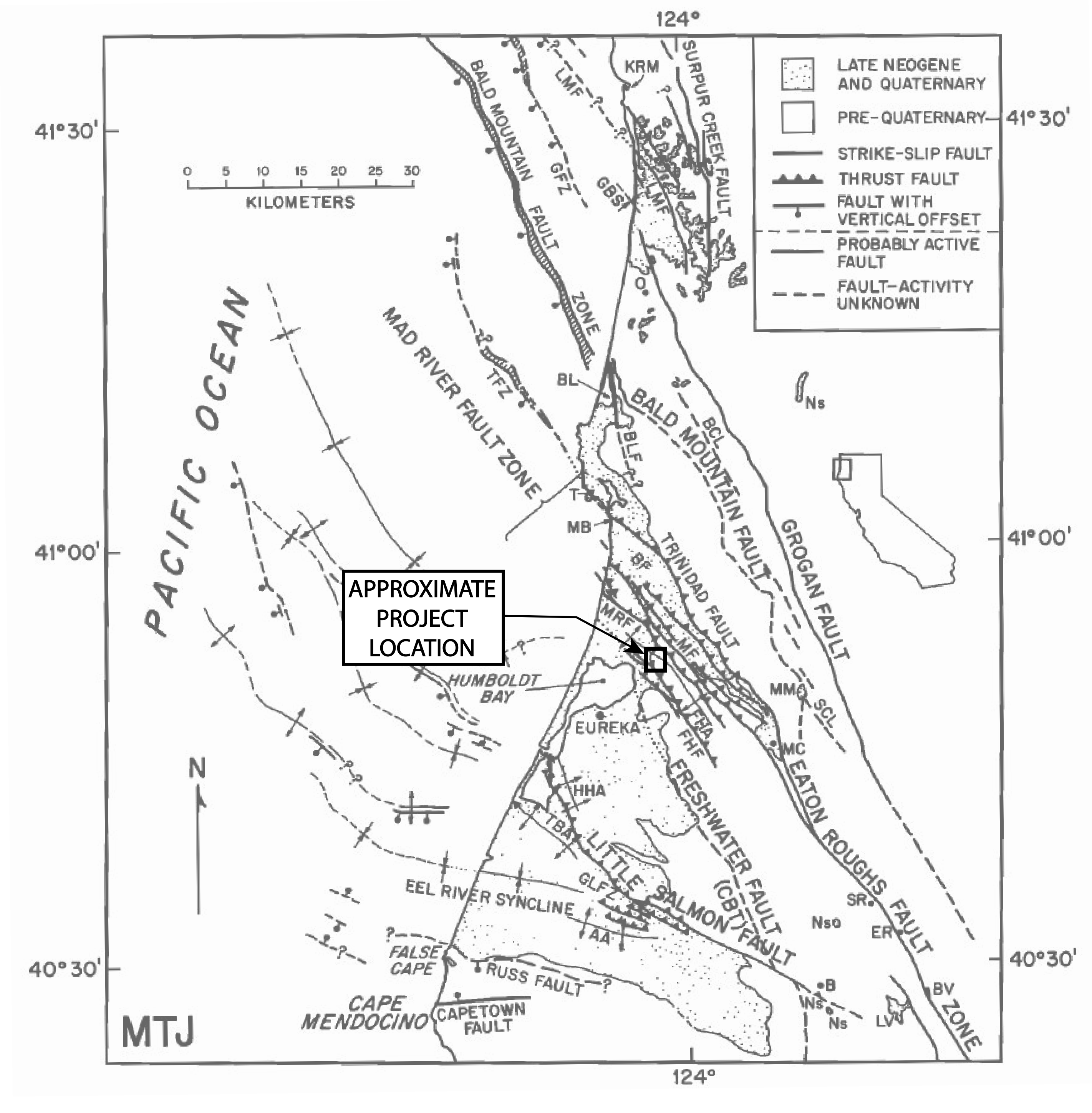
Figure3A_GeologicandGeomorphicMapLegend.pdf

Figure 3A



Path: \\eureka\projects\2016\016147-HSUJenkins\GIS\FIGURES\Figure4_RegionalFaultMap.pdf

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Regional Fault Map
(Kelsey and Carver, 1988)
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Figure4_RegionalFaultMap.pdf

Figure 4

3.1.3 Project Site Geology

The geologic maps of the Arcata North and Arcata South quadrangles (Kelley, 1984) indicate that materials beneath the Jenkins Hall area are comprised of Quaternary Falor Formation (Figure 3). The Falor Formation, originally mapped and described by Manning and Ogle (1950), is made up of early to middle Pleistocene age sediments composed of poorly cemented sandstone, clay, thin red beds, and pebbly conglomerate. The sandstones are characteristically fine-grained, poorly cemented and compacted, and well sorted. Falor Formation deposits at the site are mostly loose to dense silty and/or clayey sands, with some fine-grained sediment.

3.2 Surface Conditions

Jenkins Hall is situated on the southeast corner of the intersection of B Street and Laurel Drive in the northern portion of the HSU campus. Site surface elevations generally increase to the north and east of the project area. The building is cut into sloping ground with about 25 feet of relief. It also exhibits a general descending slope gradient to the south and southwest. The nearest significant descending slope (approximately 10 feet high) is present to the south of the parking area on the south side of the building (south of boring B-3; Figure 2). The area surrounding Jenkins Hall is paved for parking and an access driveway, and is generally vegetated with landscaping, and some large redwood trees to the east.

3.3 Soil Conditions

Five of the six borings (B-1 through B-5) were drilled through asphalt and varying thicknesses of base rock; to a maximum depth of 6 feet (B-4 was drilled through abandoned utility-trench backfill). The sixth boring (B-6) was drilled through a concrete slab underlain with base rock extending to a depth of 2 feet.

Native soils around Jenkins Hall are interpreted as late Pleistocene marine terrace sediments and Plio-Pleistocene Falor Formation sediments. The native soils encountered in the borings consist of soft to very stiff clay (CL), medium stiff to very stiff clay with sand (CL), medium stiff to stiff sandy clay (CL), medium stiff to very stiff silt (ML), medium stiff silt with sand (ML), stiff sandy silt (ML), very loose to dense silty sand (SM), loose to medium dense sand with silt (SM), and loose clayey sand (SC). In general, the subsurface materials are composed predominantly of low plasticity, fine-grained soil with dry densities ranging from 82 to 114 pounds per cubic foot (pcf) and moisture contents as high as 30 percent. Coarser grained silty sands were typically encountered at depth and were observed to be very loose when below the groundwater table.

Soils encountered in boring B-3 were different from soils found in the other borings. Beginning at 11 feet BGS, clay with sand grades to dark brownish-gray, contains wood fragments, and becomes very soft at 25 feet. Underlying the clay is black silt with sand that is medium stiff and contains wood fragments. These materials are generally characteristic of a low energy, organic-rich depositional environment. This is worth noting, because this boring location was chosen to support future developments in this area.

Final boring logs (presented in Appendix A) were prepared based on field logs, examination of samples in the laboratory, and laboratory test results. Laboratory test results are presented in Appendices A and B.

3.4 Groundwater

Groundwater was encountered at depths of 34 feet in B-1, 23 feet in B-4, and 16 feet in B-5. Water levels can be expected to fluctuate in response to seasons, storm events, and other factors, and may become significantly higher or lower than observed. Groundwater is not expected to be encountered during the excavation of shallow foundations or site grading, and is unlikely to be encountered during deeper excavations for the footings associated with the elevator, assuming that the work is conducted during the dry season.

4.0 Geologic Hazards

4.1 Surface Fault Rupture

The HSU campus is not located within an Alquist-Priolo Earthquake Fault Hazard Zone (Bryant and Hart, 2007). The campus is, however, situated north of the Fickle Hill fault which is considered "active" and is associated with Alquist-Priolo special studies zone. Jenkins Hall is approximately 1,200 feet northeast of the Alquist-Priolo Earthquake Fault Hazard Zone boundary.

A fault trace associated with the Fickle Hill fault zone is located less than 600 feet to the southwest of Jenkins Hall and projects through the southwestern portion of the campus. This fault trace is currently not considered active by the State Geologist. SHN previously compiled and reviewed available geologic data assessing the location and recency of faulting for this fault trace related to the Behavioral and Social Sciences Building and College Creek housing projects (Geomatrix, 2005 and 2008). SHN's Schatz Energy Research Center (SERC) geotechnical investigation report (2007) provides a detailed analysis of surface rupture potential at the SERC site, associated with the northern Fickle Hill fault trace. Based on results of these previous studies, we conclude that the potential for surface fault rupture at the Jenkins Hall site is remote.

4.2 Seismicity

Northwestern California is the most seismically active region in the continental United States. More than 60 earthquakes have produced discernible damage in the region since the mid-1800s (Dengler et al., 1992). Historical seismicity and paleoseismic studies in the area suggest there are six distinct sources of damaging earthquakes in the Arcata region: 1) the Gorda Plate, 2) the Mendocino fault, 3) the Mendocino Triple Junction, 4) the northern end of the San Andreas fault, 5) faults within the North American Plate (including the MRfz, Figure 4), and 6) the Cascadia Subduction Zone (Dengler et al., 1992).

Gorda Plate earthquakes account for the majority of historical seismicity. These earthquakes occur primarily offshore along left-lateral faults, and are generated by the internal deformation within the plate as it moves toward the subduction zone. Significant historical Gorda Plate earthquakes have ranged in magnitude from M5 to M7.5. The November 8, 1980, earthquake (M7.2) was generated on a left-lateral fault within the Gorda Plate.

The Mendocino fault is the second most frequent source of earthquakes in the region. The fault represents the plate boundary between the Gorda and Pacific plates, and typically generates right lateral strike-slip displacement. Historical Mendocino fault events have ranged in magnitude from M5 to M7.5. The September 1, 1994, M7.2 event west of Petrolia was generated along the Mendocino fault. The Mendocino triple junction was identified as a separate seismic source only after the August 17, 1991 (M6.0), earthquake. Events associated with the triple junction are shallow onshore earthquakes that appear to range in magnitude from about M5 to M6. Raised Holocene terraces near Cape Mendocino suggest larger events are possible in this region.

Northern San Andreas fault events are rare, but can be very large. The northern San Andreas fault is a right lateral strike-slip fault that represents the plate boundary between the Pacific and North American plates. The fault extends through the Point Delgada region and terminating at the Mendocino triple junction. The 1906 San Francisco earthquake (M8.3) caused the most significant damage in the north coast region, with the possible exception of the 1992 Petrolia earthquake.

Earthquakes within the North American plate can be anticipated from a number of intra-plate sources, including the MRfz. There have been no large magnitude earthquakes associated with faults within the North American plate, although the December 21, 1954, M6.5 event may have occurred in the MRfz. Expected magnitudes for North American plate earthquakes are in the M6.5 to M8 range.

The Cascadia Subduction Zone represents the most significant potential seismic source in the north coast region. A great subduction event may rupture along 200 km or more of the coast from Cape Mendocino to British Columbia, may be up to M9, and could be associated with extensive tsunami inundation in low-lying coastal areas. The April 25, 1992, Petrolia earthquake (M7.1) appears to be the only documented historical earthquake involving slip along the subduction zone, but this event was confined to the southernmost portion of the fault. Paleoseismic studies along the subduction zone suggest that great earthquakes are generated along the zone every 300 to 500 years. The last large subduction earthquake occurred in 1700. A great subduction earthquake would generate long duration, very strong ground shaking throughout the Pacific Northwest.

4.3 Liquefaction, Lateral Spreading, and Co-seismic Settlement,

The presence of medium dense, to occasionally loose, clean to silty sand deposits within the Falor Formation soils suggests that the project site may be susceptible to liquefaction. However, geologic materials most susceptible to liquefaction are typically limited to Holocene age sand- and silt-rich deposits, located adjacent to streams, rivers, bays, or ocean shorelines. Although late Pleistocene deposits have been considered susceptible to liquefaction, the early to middle Pleistocene Falor Formation sediments are not likely to liquefy due to their geologic age.

The relatively high fines contents of the silty sand deposits that were encountered in the borings also generally preclude the potential for liquefaction. Laboratory testing indicated combined silt and clay contents of approximately 36 to 45 percent. Youd and others (2001) report that a fines content of greater than 35 percent significantly decreases the potential for liquefaction.

Based on our initial qualitative screening, we conclude that the potential for liquefaction to occur at this site is low due to the geologic age of the soils and relatively high fines content. Lateral spreading and co-seismic settlements (which both typically occur due to liquefaction) are, therefore, also considered low.

4.4 Expansive Soil

Expansive soils are defined as soils that undergo large volume changes (shrinking or swelling) due to variations in moisture content. Such volume changes may cause damaging heave of foundations, concrete slabs-on-grade, and pavements. The soils encountered in SHN's exploratory borings at foundation contact depths consist of low-plasticity silt and lean clay.
As an initial screening, one Atterberg Limits test performed on the lean clay soils between 4 and 10 feet of the ground surface had a plasticity index of 12, indicating a low swelling potential.

A cursory review of foundation conditions along the exterior portion of the existing building did not reveal any distortion or cracking typically resulting from cyclical volumetric changes in soil due to wetting and drying. We attribute the lack of soil swelling and/or shrinkage to the relatively deep groundwater table and the relatively low soil moisture conditions encountered in the shallow subsoils. In our opinion, the hazard posed to the proposed developments associated with potential swelling or shrinkage from alternating wetting and drying of the shallow fine grained soils is low, as indicated by the current foundation conditions of the existing structure.

4.5 Corrosion of Buried Concrete and Metals

As part of this investigation, laboratory corrosivity tests were performed on composite soil samples collected at 4-5 feet BGS. Tests were performed to evaluate the reduction and oxidation potential (redox), pH, resistivity, and concentrations of chloride and sulfate, of/in the soil that would be in contact with foundation elements and underground utilities. The results of the corrosivity tests are included in Appendix C and are summarized Table 1.

Table 1
Soil Corrosivity Results

Test	Composite from 4-5 feet
Redox (mV)[1]	440
pH	5.46
Resistivity (ohms-cm)[2]	9,500
Chloride (mg/kg)[3]	None Detected
Sulfate (mg/kg)	31

1. mV: millivolts
2. ohms-cm: ohms-centimeter
3. mg/kg: milligrams per kilogram

- The redox potential is indicative of aerobic soil conditions.
- As in this case, any soil with a pH of less than 6.0 is considered corrosive to buried iron, steel, mortar-coated steel, and reinforced concrete structures. Therefore, corrosion prevention measures need to be considered for structures placed in this acidic soil.
- Based upon the resistivity measurement, the soil sample is classified as "mildly corrosive." All buried iron, steel, cast iron, ductile iron, galvanized steel, and dielectric coated steel or iron should be properly protected against corrosion. All buried metallic pressure piping (such as, ductile iron firewater pipelines) should be protected against corrosion.
- The chloride and sulfate ion concentrations are not considered to be indicative of corrosive soils.

5.0 Geotechnical Conclusions and Discussion

Based on the results of our field and laboratory investigations, it is our opinion that the planned renovations and improvements can be developed as proposed, provided that our recommendations are followed, and that noted conditions and risks are acknowledged. The primary geotechnical or geological site considerations are the potential for strong seismic shaking and the presence of loose native soils.

Following stripping of hardscapes and base rock, and any vegetation and topsoils, exposed soils should be reasonably competent, in-place native materials (except for in areas of thick layers of base rock, such as, utility trenches). The proposed site location of the exterior elevator, on the east side of Jenkins Hall, is considered suitable for construction of the proposed improvement using typical elevator foundation systems.

In our opinion, the risk of significant post-construction settlement will be mitigated to a low level if the recommended site preparation is completed. We estimate that with the project constructed in accordance with the following recommendations, total post-construction settlement is not likely to exceed ½ inch, and post-construction differential settlement is not likely to exceed ¼ inch.

5.1 Slab-on-Grade and Foundation Support

Any ancillary structure that may in the future be considered as part of this project can be supported on conventional spread footing systems with slab-on-grade floors. In order to provide uniform foundation conditions below the entire slabs-on-grade and foundations and to reduce the potential for differential settlement, overexcavation of loose or disturbed soils should be undertaken to encompass the building area. The surficial fine-grained soils will require over-excavation and replacement with engineered fill. The depth of over-excavation and replacement is expected to be as deep as 12 inches BGS in order to provide a minimum of 12 inches of engineered fill below any spread footing foundations.

5.2 Excessive Soil Moisture during Earthwork

Based on the presence of fine-grained soils in the shallow subsurface, it is expected that areas of bare ground exposed to prolonged periods of rainfall may adversely impact earthwork at the site. During the winter and spring, moisture content in the silty clayey site soils is likely to exceed optimum levels. Excessive soil moisture can result in an unstable and yielding (pumping) subgrade across the site. Moisture conditioning and/or aeration of site soils will be required in order to achieve the grading and compaction recommendations presented below.

6.0 Recommendations

6.1 CSU Seismic Parameters

- The California State University (CSU) system uses seismic parameters for its different campuses as presented in its publication "CSU Seismic Requirements." The current version is dated January 8, 2016.

- In accordance with the 2013 California Building Code (CBC), Table 1604.5, the risk category for the proposed structure is II.
- In accordance with the "CSU Seismic Requirements," Section 3.3, the seismic design category for Risk Category II structures is E.
- A Site Class D is appropriate in accordance with Section 1613.3.2 of the CBC and the American Society of Civil Engineers (ASCE) 7-10 Chapter 20.
- Seismic coefficients for CSU's Humboldt campus can be obtained from the methods and data presented in Attachment B of the "CSU Seismic Requirements" using Site Class D.
- The characteristic site period can be calculated from the depth of Falor Formation soils overlying the Franciscan bedrock materials, multiplied by 4, and divided by the average shear wave velocity of the soil (Kramer, 1996). The shear wave velocity of the soil can be estimated from SPT N-values using correlations detailed in Section 1.3.1 of MIL-HDBK-1007/3 (DOD, 1997). Using Equation 20.4-1 of ASCE 7-10 Chapter 20, the average shear wave velocity is estimated to be 900 feet per second. Based on this and previous subsurface investigations (Sweet, 1978; SHN, 2003), we estimate the depth to bedrock as 60 to 70 feet, resulting in a characteristic site period for the study area of 0.3 seconds.
- Based on a 0.2-second fundamental period for Jenkins Hall–a two-story structure–and a characteristic site period of 0.3 seconds, the numerical coefficient for site-structure resonance is 1.4.

6.2 Site Preparation and Grading

We recommend the following:

a) As appropriate, notify Underground Service Alert (1-800-642-2444), and check HSU records of underground service locations prior to commencing site work. Use these methods to avoid injury or risk to life from underground and overhead utilities, and to avoid damaging them.

b) From areas to receive structural fill or improvements, and for 3 feet outside, strip all existing improvements, cultural debris, vegetation, root systems, dark-colored organic-rich topsoil, existing structures to be removed, and uncontrolled existing fill. Additionally, excavate as required to accommodate design grades.

c) With the exception of vertical sides or steps, subgrade surfaces to receive structural fill should be cut-graded to slope no steeper than 10 percent.

d) Conduct a geotechnical engineering review of exposed subgrade surfaces. The geotechnical engineer will recommend that remaining unsuitable soils, such as, overly weak, compressible, or disturbed soils, also be stripped.

e) Scarify and compact the upper 6 inches of exposed subgrade soils that are to receive structural fills.

f) Structural fill material should consist of relatively non-plastic (Liquid Limit less than 35, Plasticity Index less than 14) material containing no organic material or debris, and no individual particles more than 4 inches across. We suggest the use of granular soils (such as, sand or gravel) for fill, because these soils are relatively easy to moisture condition and compact.

g) Structural fill should be placed to design grades and compacted to a minimum of 90% of the maximum relative dry density as determined by the current ASTM-International (ASTM) D1557 test method. Planned fills more than 6 feet in depth should be reviewed by the Geotechnical Engineer in advance in order to assess conditions that could result in excess differential settlement or instability of adjacent slopes. Structural fill should extend horizontally beyond the exterior footing perimeters a minimum distance equal to at least 5 feet.

h) Cut and fill slopes up to 6 feet in height should be placed no steeper than 1½:1 and 2:1 (horizontal to vertical), respectively. Higher or steeper slopes should be reviewed by the Geotechnical Engineer.

6.3 Foundation Recommendation for the Proposed Elevator

We understand an exterior elevator is proposed for the east side of Jenkins Hall, connecting the first and second floors. We recommend the following:

a) During construction, OSHA excavation safety standards (OSHA, 2015) must be followed.

b) The excavation for the elevator pit should extend to at least 6 feet below current grade, in order to remove any soil containing wood pieces, as found in B-1 at depths of 4.5 to 5.5 feet.

c) The excavation should be checked by a representative of our firm to ensure all inadequate material has been removed.

d) Scarify and compact the upper 6 inches of exposed subgrade soils to a minimum of 90% of the maximum relative dry density, as determined by the current ASTM D1557 test method.

e) At least 6 inches of structural fill should be placed and compacted in the floor slab area to a minimum of 90% of the maximum relative dry density, as determined by the current ASTM D1557 test method.

f) Footings for the perimeter walls and corner columns of the elevator pit should be sized, embedded, and reinforced to at least the minimums presented in the current edition of the CBC. These footings should designed using an allowable soil bearing pressure of 1,500 pounds per square foot (psf) for dead loads plus live loads. This allowable load may be increased to 2,000 psf to account for the short-term effects of wind and/or seismic loading.

g) Total resistance to lateral loads for the elevator pit equal the sum of the lateral bearing pressure and lateral sliding resistance. The lateral bearing pressure is calculated using an equivalent fluid unit weight of 100 pcf (increased to 130 pcf to account for effects of wind and/or seismic loading). The lateral sliding resistance is calculated using a cohesion value of 130 psf, multiplied by the contact area between the footings and the soil.

h) Active earth pressures against the elevator pit perimeter walls can be calculated using an equivalent fluid pressure of 60 pcf. This assumes the walls are back drained, to avoid potential hydrostatic pressure build-up.

i) To control moisture inside the elevator pit, the base of the floor should be waterproofed and wall back drainage should be installed.

j) Waterproofing can be achieved as follows:

   1) The floor slab of the elevator pit should be underlain by a moisture/vapor barrier manufactured for the purpose, such as Moiststop 737, TU-TUFF 4 by Sto-Cote Products, or Griffolyn T-65 by Griffolyn Company, or a polyethylene vapor reduction membrane at least 10 mils in thickness. The membrane should be taped at joints.

   2) The membrane should overlie a capillary break consisting of a 4-inch layer of No. 4 U.S. Sieve (0.187 inch) minimum, up to 1-inch maximum, gravel.

k) Back drainage can be achieved as follows:

   1) A perforated pipe/drain rock back drain system should be placed behind the wall, with the drainpipe at the bottom of the wall, and with the drain rock extending up to within 2 feet of finished grade. This back drain system should be encased in filter fabric, and have a gravity drainage outlet. If gravity drainage is not feasible, then a sump pump should be installed.

   2) Drain rock for the elevator pit walls should be free-draining, durable, granular material, with 100% passing the 1½ inch sieve, and not over 3% passing the No. 10 sieve. Caltrans Class 2 permeable material is acceptable. To avoid excess pressure against the wall, drain rock close to the wall should not be over compacted. Drain rock should be compacted to between 88 and 92 percent of the maximum relative dry density as determined by the current ASTM D1557 test method.

   3) For back drain filter fabric, use 6-ounce per square yard minimum weight, non-woven, geotextile fabric by a reputable manufacturer, specifically designed for allowing water passage while retaining soil materials.

   4) Perforated pipe should be durable, and at least 4 inches in minimum diameter. Holes or slots should be matched to surrounding permeable material such that the finer particles do not enter the pipe during or subsequent to installation.

   5) Backfill consisting of relatively “impermeable” soil, at least 1.5 feet thick should be placed above the permeable drain rock to prevent infiltration of surface water. This “impermeable” backfill should consist of compact clayey or silty soil, but should not be expansive (the Liquid Limit should not exceed 35, and the Plasticity Index should not exceed 20). Alternatively, asphalt or concrete pavement may be substituted for the “impermeable” backfill.

   6) The surface should be sloped such that runoff is not allowed to pond above the back drain system. All surface runoff conveyance systems (including rooftop downdrains) should be isolated from the back drain systems, and provided with positive gravity flow discharge.

6.4 Modulus of Subgrade Reaction

In the vicinity of the elevator pit, we assume that the floor of the pit will be several feet below current grade, and the exposed subgrade before placement of base rock will be the moist, stiff clay encountered in B-1. Assuming scarification and recompaction of the subgrade to 90% relative compaction (in accordance with ASTM D1557), the design modulus of subgrade reaction is estimated to be 75 pounds per cubic inch (pci).

Along the north and south entry areas, where renovation will occur, any removal of existing asphalt, concrete, and base rock will likely expose moist, stiff clay, similar to the clay found in the vicinity of the proposed elevator. Assuming scarification and recompaction of the subgrade to 90% relative compaction (in accordance with ASTM D1557), the design modulus of subgrade reaction is estimated to be 75 pci.

6.5 Slab-on-Grade

Concrete slabs-on-grade supporting any ancillary structure should be supported by engineered fill prepared in accordance with our recommendations for site preparation.

To reduce water vapor transmission upward through floor slabs, concrete slabs-on-grade should be constructed on a minimum 4-inch thick layer of capillary break material covered with a vapor retarder. The capillary break material should be free-draining, clean gravel or rock, such as, No. 4 by ¾-inch pea gravel or permeable aggregate complying with Caltrans Standard Specification, Section 68, Class 1, Type B Permeable Material. The vapor retarder should be at least 10 mil thick and meet the material requirements for Class C vapor retarders presented in ASTM E1745, and should be installed according to ASTM E1643. These installation requirements include overlapping seams by 6 inches, taping seams, and sealing penetrations in the vapor retarder.

The field of moisture vapor transmission is a specialty field and we suggest that qualified experts be contacted to assist in the design and construction of measures related to moisture transmission through slabs-on-grade.

The American Concrete Institute (ACI) Committee document "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials" (ACI 302.2R-06) provides guidelines for reducing moisture migration through slabs-on-grade. This document advises that concrete slabs be cast directly on the vapor retarder (ACI 302.2R-06, Section 9.3) and provides guidelines for selecting vapor permeance, tensile strength, and puncture resistance. When casting the slab directly on the vapor retarder, a reduced joint spacing, low shrinkage mix design, or other appropriate measures should be used to control slab curl. The ACI guide also notes that a maximum water-cement ratio of 0.5 has yielded satisfactory performance on many slab-on-grade projects. Water-reducing admixtures may be useful in achieving workability at low water-cement ratios. Control joints should be provided at appropriate intervals to control the location of shrinkage cracks. After proper curing, the slab should be allowed to dry and then should be tested to check that the moisture transmission rate is appropriate for the intended floor covering.

For exterior flatwork and other slabs-on-grade where water vapor transmission through slabs is not a concern, the vapor barrier and capillary break material described in this section may be omitted.

It is important that the subgrade be moist and free of desiccation cracks at the time the slab is cast. Recommendations for slab reinforcement, strength, thickness, control and construction joints, etc., should be provided by others.

Although cracks in concrete slabs are common and should be expected, the following measures may help to reduce cracking of slabs:

- Slabs should be cast using concrete with a maximum slump of 4 inches or less.
- Add a water reducing agent or plasticizer to the concrete to increase slump while maintaining a low water-cement ratio to reduce concrete shrinkage. (Concrete having a high water-cement ratio is a major cause of concrete cracking.)
- Control joints should be provided at appropriate intervals to control the location of shrinkage cracks.

6.6 Drainage and Erosion Control

To mitigate erosion potential, we recommend the following measures:

a) Wherever possible, design finished grade to allow sheet runoff rather than concentrated runoff.
b) Where concentrated runoff will occur, minimize its velocity by controlling slopes, and protect the channel and discharge area by dissipating flow energy, using rock or other erosion resistant surfacing as appropriate.
c) Compact exposed fill slopes, and protect both cut-and-fill slopes from concentrated runoff or heavy sheet runoff by using brow ditches or other drainage control facilities.
d) Erodible cut or fill slopes or other soil surfaces should be protected by using vegetative cover, jute mesh and straw, rock slope protection, or other measures to provide erosion resistance.
e) Perform site work and vegetation establishment during seasons not subject to repeated or prolonged rainfall.
f) Provide periodic maintenance of erosion control measures.

7.0 Additional Services

7.1 Plan and Specification Review

In preparing our recommendations, it is our assumption that we will be retained to review those portions of the plans and specifications that pertain to earthwork and foundations. The purpose of this review is to confirm that our earthwork and foundation recommendations have been properly interpreted and implemented during design. If we are not provided this opportunity for review of the plans and specifications, our recommendations could be misinterpreted.

7.2 Construction Phase Monitoring

In order to assess construction conformance with the intent of our recommendations, it is important that a representative of our firm monitor:

- subgrade preparation and placement of engineered fill;
- foundation excavations; and
- any subdrainage, back drainage, and under drainage.

This construction phase monitoring is important because it provides the owner and SHN the opportunity to verify anticipated site conditions, and recommend appropriate changes in design or construction procedures if site conditions encountered during construction vary from those described in this report. The construction phase monitoring also allows SHN to recommend appropriate changes in design or construction procedures if construction methods adversely affect the competence of onsite soils to support the structural improvements.

8.0 Limitations

This report has been prepared for the specific application to the design and construction of the proposed development as discussed herein. SHN prepared the findings, conclusions, and recommendations presented herein in accordance with generally accepted geotechnical engineering practices at the time and location that this report was prepared. No other warranty, express or implied, is made.

Soil and rock materials are typically not homogeneous in type, strength, and other geotechnical properties, and can vary between points of observation and exploration. In addition, groundwater and soil moisture conditions can vary seasonally and for other reasons. SHN does not and cannot have a complete knowledge of the subsurface conditions underlying a site. The conclusions and recommendations presented in this report are based upon the findings at the points of exploration, interpolation and extrapolation of information between and beyond the points of observation, and are subject to confirmation of the conditions revealed by construction. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by our firm during the construction phase in order to evaluate compliance with our recommendations.

Findings of this report are valid as of the date of issuance; however, changes in condition of a property can and will occur with the passage of time. Furthermore, changes in applicable or appropriate standards occur whether they result from legislation or advancement in technology. Accordingly, findings of this report may be invalidated wholly or partially by changes outside of SHN’s control. This report is subject to SHN’s review and remains valid for a period of two years, unless SHN issues a written opinion of its continued applicability thereafter. If the scope of the proposed construction, including the proposed loads, grades, or structural locations, changes from that described in this report, our recommendations should also be reviewed.

The scope of SHN’s geotechnical services did not include any assessment for the presence or absence of any hazardous/toxic substances in the soil, ground water, surface water, or atmosphere, or the presence of any environmentally sensitive habitats or culturally significant areas.

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A

Boring Logs

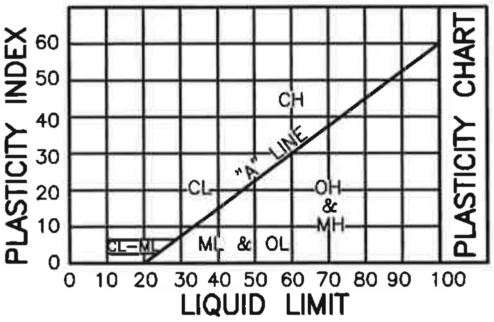
METHOD OF SOIL CLASSIFICATION

CLASSIFICATION CHART

MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN 1/2 OF SOIL >NO. 200 SIEVE SIZE)	**GRAVELS** (MORE THAN 1/2 OF COARSE FRACTION > NO.4 SIEVE SIZE)	GW	WELL GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (MORE THAN 1/2 OF COARSE FRACTION < NO.4 SIEVE SIZE)	SW	WELL GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
		SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
		SM	SILTY SANDS, SAND-SILT MIXTURES
		SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN 1/2 OF SOIL <NO. 200 SIEVE SIZE)	**SILTS & CLAYS** LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS & CLAYS LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTY CLAYS, ORGANIC SILTS
HIGHLY ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

GRAIN SIZE CHART

CLASSIFICATION	U.S. STANDARD SIEVE SIZE
BOULDERS	ABOVE 12"
COBBLES	12" TO 3"
GRAVEL	3" TO NO. 4
COARSE	3" TO 3/4"
FINE	3/4" TO NO. 4
SAND	NO. 4 TO NO. 200
COARSE	NO. 4 TO NO. 10
MEDIUM	NO. 10 TO NO. 40
FINE	NO. 40 TO NO. 200
SILT & CLAY	BELOW NO. 200



CONSISTENCY OF FINE GRAINED SOILS		DENSITY OF COARSE GRAINED SOILS	
CLASSIFICATION	COHESION (PSF)	CLASSIFICATION	STANDARD PENETRATION (BLOW COUNT)
VERY SOFT	0-250	VERY LOOSE	0-4
SOFT	250-500	LOOSE	4-10
MEDIUM STIFF	500-1000	MEDIUM	10-30
STIFF	1000-2000	DENSE	30-50
VERY STIFF	2000-4000	VERY DENSE	50+
HARD	4000+		

MOISTURE CLASSIFICATIONS
DRY
DAMP
MOIST
WET

BASED ON UNIFIED SOILS CLASSIFICATION SYSTEM

BORING LOG KEY

SAMPLE TYPES

☒	DISTURBED SAMPLE (BULK)
◨	HAND DRIVEN TUBE SAMPLE
I	1.4" I.D. STANDARD PENETRATION TEST SAMPLE (SPT)
◪	2.5" I.D. MODIFIED CALIFORNIA SAMPLE (SOLID WHERE RETAINED)
⧄	CORE BARREL SAMPLE (NOT RETAINED)
◢	CORE BARREL SAMPLE (RETAINED)

SYMBOLS

▽	INITIAL WATER LEVEL
▼	STABILIZED WATER LEVEL
– – – – –	GRADATIONAL CONTACT
———	WELL DEFINED CONTACT
SS	SPLIT SPOON

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall East
GROUND SURFACE ELEVATION: ~130' (Goolge Earth)
EXCAVATION METHOD: 6-5/8" Hollow Stem Auger
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/14/2016
TOTAL DEPTH OF BORING: 51.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-1

DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits		REMARKS
											Liquid Limit	Plastic Index	
0.0						ASPHALT AND BASE ROCK							
-1.0				ML		SILT; Strong Brown, medium stiff, moist, low plasticity, 5-10% fine sand.							Marine terrace deposits
-2.0 to -3.5		◪	7 10 12				19	108					
-4.0						becomes stiff							
-4.0 to -5.5	☒	◪	6 7 10	CL		LEAN CLAY; Yellowish-brown, stiff, moist, medium plasticity, <5% fine sand, wood fragments.	30	93					
-7.0 to -8.5		◪	12 16 20			becomes very stiff	24	101	5016		35	12	
-10.0 to -11.5	☒	◪	10 20 27	CL		LEAN CLAY with SAND; Yellowish-brown, very stiff, moist, high plasticity, ~15% medium sand, trace coarse sand.	19	114					TXCU test; See Appendix B
-15.0 to -16.5		◪	7 10 12	SM		SILTY SAND; Strong brown, medium dense, moist, non-plastic, medium sand, weathered bedrock.							Quaternary Falor Formation
-20.0 to -21.5	☒	▦	4 4 6			medium dense							
-25.0 to -26.5		◪	11 10 14			grades yellowish-brown medium dense	22	99					
-30.0													

LOG OF BORING

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall East
GROUND SURFACE ELEVATION: ~130' (Goolge Earth)
EXCAVATION METHOD: 6-5/8" Hollow Stem Auger
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/14/2016
TOTAL DEPTH OF BORING: 51.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-1

DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Index	REMARKS
-30.0	☒		3 4 6										
-31.0													
-32.0													
-33.0													
-34.0 ▼													Groundwater at 34'.
-35.0	☒		3 5 8			becomes wet							
-36.0										41			
-37.0													
-38.0													
-39.0													
-40.0													
-41.0													
-42.0													
-43.0													
-44.0													
-45.0	☒		8 13 17			becomes dense							
-46.0													
-47.0													
-48.0													
-49.0													
-50.0	☒		9 11 12										
-51.0						becomes medium dense							
-52.0						Boring terminated at a depth of 51.5 feet. Groundwater encountered at a detph of 34 feet. Borehole backfilled with cement grout.							
-53.0													
-54.0													
-55.0													
-56.0													
-57.0													
-58.0													
-59.0													

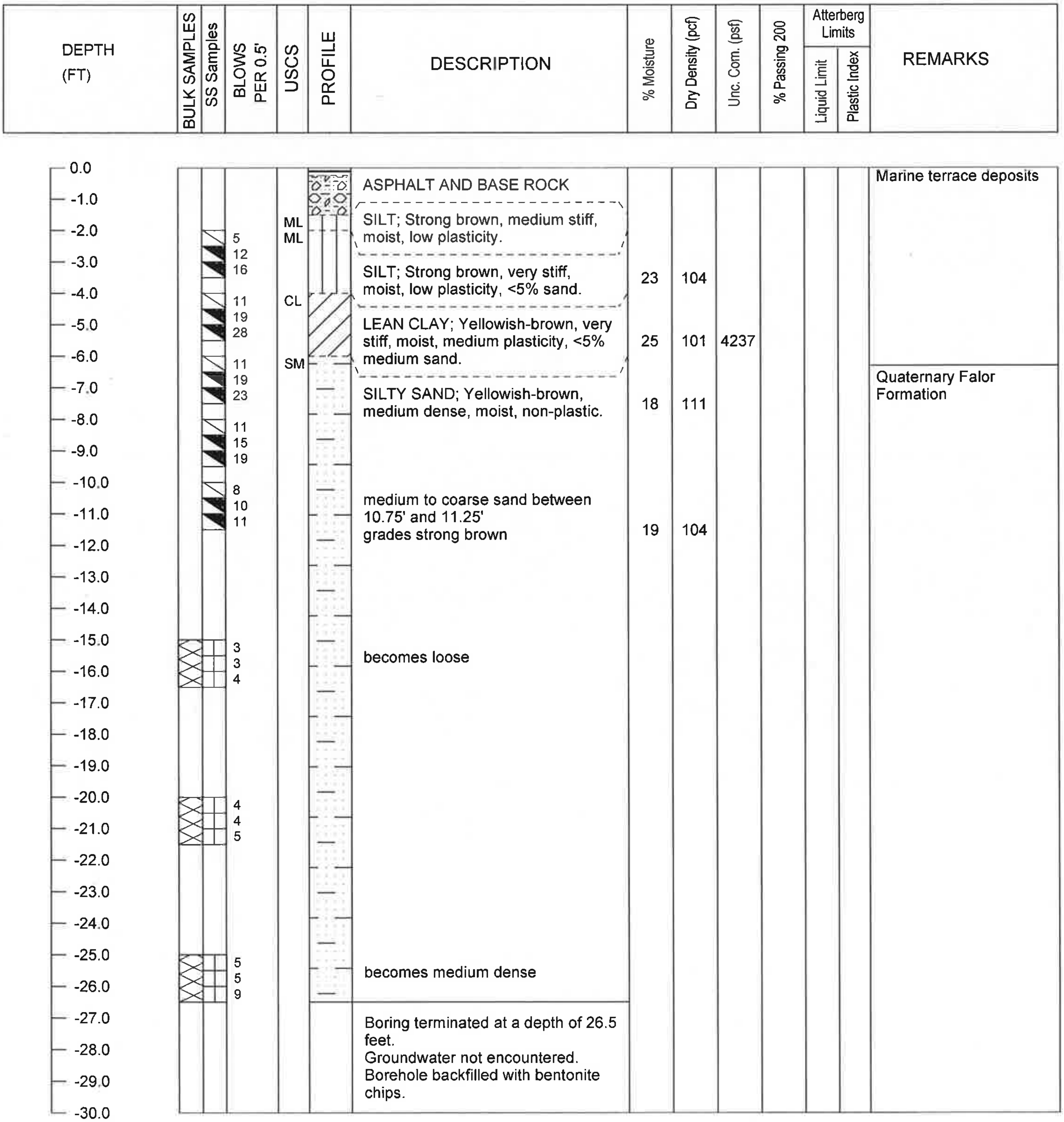
LOG OF BORING

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall East
GROUND SURFACE ELEVATION: ~133' (Google Earth)
EXCAVATION METHOD: 4" Solid Flight Augers
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/14/2016
TOTAL DEPTH OF BORING: 26.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-2



DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits		REMARKS
											Liquid Limit	Plastic Index	
0.0						ASPHALT AND BASE ROCK							Marine terrace deposits
-2.0			5 12 16	ML ML		SILT; Strong brown, medium stiff, moist, low plasticity.							
-3.0						SILT; Strong brown, very stiff, moist, low plasticity, <5% sand.	23	104					
-4.0			11 19 28	CL		LEAN CLAY; Yellowish-brown, very stiff, moist, medium plasticity, <5% medium sand.	25	101	4237				
-6.0			11 19 23	SM		SILTY SAND; Yellowish-brown, medium dense, moist, non-plastic.	18	111					Quaternary Falor Formation
-8.0			11 15 19										
-10.0			8 10 11			medium to coarse sand between 10.75' and 11.25' grades strong brown	19	104					
-15.0			3 3 4			becomes loose							
-20.0			4 4 5										
-25.0			5 5 9			becomes medium dense							
-27.0						Boring terminated at a depth of 26.5 feet. Groundwater not encountered. Borehole backfilled with bentonite chips.							

LOG OF BORING

Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall Southeast
GROUND SURFACE ELEVATION: ~125' (Google Earth)
EXCAVATION METHOD: 4" Solid Flight Augers
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/15/2016
TOTAL DEPTH OF BORING: 31.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-3

DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Index	REMARKS
0.0						ASPHALT							
-1.0						BASE ROCK							
-2.0			8 10 11	CL		LEAN CLAY; Yellowish-brown, stiff, moist, medium plasticity, <10% medium sand.							
-4.0			7 9 11										
-5.0							21	101					
-6.0			5 5 8	CL		LEAN CLAY with SAND; Yellowish-brown, medium stiff to stiff, moist, medium plasticity, ~15-20% medium to coarse sand.							
-7.0							21	106	1235				
-8.0			10 16 21	SM		SILTY SAND; Strong brown, medium dense, moist, non-plastic, ~15% medium to coarse sand.							
-10.0			14 21 26										
-11.0				CL		LEAN CLAY with SAND; Yellowish-brown, very stiff, moist, medium plasticity, 5-10% medium sand.							
-15.0			3 6 5			becomes stiff grades light olive brown sand content increases with depth							
-20.0													

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall Southeast
GROUND SURFACE ELEVATION: ~125' (Google Earth)
EXCAVATION METHOD: 4" Solid Flight Augers
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/15/2016
TOTAL DEPTH OF BORING: 31.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-3

DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Index	REMARKS
-20.0	☒		2			becomes medium stiff ~25% sand							
	☒		2										
-21.0	☒		3										
-22.0													
-23.0													
-24.0													
-25.0	☒		1	CL		LEAN CLAY; Dark brownish-gray, very soft, moist, medium plasticity, wood fragments.							
	☒		1										
-26.0	☒		1										
-27.0													
-28.0		▲	5										
		▲	7			grades gray becomes medium stiff							
-29.0		▲	9				27	96					
				ML		SILT with SAND; Black, medium stiff, moist, ~15% sand, wood fragments.							
-30.0	☒		4										
	☒		6										
-31.0	☒		8	ML		SANDY SILT; Light brownish-gray, stiff, moist, low plasticity, ~30% fine sand.							
-32.0						Boring terminated at a depth of 31.5 feet. Groundwater not encountered. Borehole backfilled with bentonite chips.							
-33.0													
-34.0													
-35.0													
-36.0													
-37.0													
-38.0													
-39.0													

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall South
GROUND SURFACE ELEVATION: ~117' (Google Earth)
EXCAVATION METHOD: 4" Solid Flight Auger
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/15/2016
TOTAL DEPTH OF BORING: 26.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-4

DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits		REMARKS
											Liquid Limit	Plastic Index	
0.0						ASPHALT							
-1.0						BASE ROCK							
-2.0		⧄	15 9 7										
-4.0		⧄	4 4 6			BASE ROCK; WELL-GRADED SAND; Gray, loose, moist (FILL).							
-6.0		◩	9 7 8	SP/SM SM		POORLY GRADED SAND with SILT; Strong brown, loose to medium dense.	27	86					Marine terrace deposits
-8.0	☒	◩	5 5 7	SC		SILTY SAND; Strong brown, loose to medium dense, moist, medium sand, non-plastic.	35	82		45			
-10.0		◩	5 7 9			CLAYEY SAND; Yellowish-brown, loose, moist, low plasticity.							
-11.5				SM		SILTY SAND; Yellowish-brown, medium dense, moist, low plasticity fines.							Quaternary Falor Formation
-15.0	☒	⊞	4 3 6	SM		SILTY SAND; Strong brown, loose, moist, non-plastic, medium sand.				44			
-20.0	☒	⊞	2 2 5							37			
-23.0	▼												Groundwater at 23'.
-25.0	☒	⊞	3 5 7			becomes wet							
-26.5						Boring terminated at a depth of 26.5 feet. Groundate encountered at a depth of 23 feet. Borehole backfilled with bentonite chips.							
-30.0													

LOG OF BORING

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall South
GROUND SURFACE ELEVATION: ~108'
EXCAVATION METHOD: 4" Solid Flight Auger
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/15/2016
TOTAL DEPTH OF BORING: 26.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-5

DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Index	REMARKS
0.0						ASPHALT							
-1.0						BASE ROCK							
-2.0			4 6 8	CL		LEAN CLAY; Yellowish-brown, stiff, moist, medium plasticity, some roots.							Marine terrace deposits
-3.0							25	103	2908				
-4.0			7 10 13										
-5.0							24	83					
-6.0			7 8 10	CL		LEAN CLAY with SAND; Yellowish-brown, stiff, moist, medium plasticity, ~25% fine to medium sand							
-7.0							27	98					
-8.0			6 5 6										
-9.0						becomes stiff	23	98	1654				
-10.0			3 3 4										
-11.0							31	91					
-12.0													
-13.0													
-14.0													
-15.0			1 1 2	SM		SILTY SAND; Yellowish-brown, very loose, moist to wet, low plasticity fines, medium sand.							Quaternary Falor Formation Groundwater at 16'
-16.0 ▼										44			
-17.0													
-18.0													
-19.0													
-20.0			1 1 1			becomes wet, very loose, non-plastic fines; sand content increases							
-21.0										36			
-22.0													
-23.0													
-24.0													
-25.0			1 1 3	SM		SILTY SAND; Light olive brown, very loose, wet, ~30% silt, non-plastic, non-cohesive.							
-26.0							30	92					
-27.0						Boring terminated at a depth of 26.5 feet. Groundwater encountered at a depth of 16 feet. Borehole backfilled with bentonite chips.							
-28.0													
-29.0													
-30.0													

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Jenkins Hall Geotech
LOCATION: Jenkins Hall Northwest
GROUND SURFACE ELEVATION: ~120' (Google Earth)
EXCAVATION METHOD: 4" Solid Flight Auger
LOGGED BY: PRS

JOB NUMBER: 016147
DATE DRILLED: 6/15/2016
TOTAL DEPTH OF BORING: 26.5'
SAMPLER TYPE: MCS/SPT

BORING NUMBER B-6

DEPTH (FT)	BULK SAMPLES	SS Samples	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	% Passing 200	Atterberg Limits		REMARKS
											Liquid Limit	Plastic Index	
0.0						CONCRETE							
-1.0						BASE ROCK							
-2.0				CL		LEAN CLAY; Strong brown, medium stiff, moist, medium plasticity.							Marine terrace deposits
-3.0		◩	4 4 6										
-4.0							25	99					
-5.0													
-6.0		◩	7 8 10	CL		LEAN CLAY with SAND; Strong brown, stiff, moist, low to medium plasticity, ~15% sand.							
-7.0							26	98					
-8.0													
-9.0		◩	6 6 7	CI		SANDY LEAN CLAY; Strong brown, medium stiff to stiff, moist, low to medium plasticity, ~30% medium sand.							
-10.0													
-11.0													
-12.0													
-13.0													
-14.0													
-15.0		⊞	2 2 4										
-16.0													
-17.0						Boring completed to 16.5'; groundwater not encountered. Borehole backfilled with bentonite chips.							
-18.0													
-19.0													
-20.0													
-21.0													
-22.0													
-23.0													
-24.0													
-25.0													
-26.0													
-27.0													
-28.0													
-29.0													
-30.0													

LOG OF BORING

B

Laboratory Test Results

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash Eureka, CA 95501-2138 Tel: 707/441-8855 FAX: 707/441-8877 E-mail: shninfo@shn-engr.com

DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

Project Name: Jenkins Hall **Project Number:** 016147
Performed By: JA **Date:** 6/22/2016
Checked By: DG **Date:** 7/26/16
Project Manager: G. Simpson

Lab Sample Number	16-575	16-577	16-585	16-587	16-591
Boring Label	B-1	B-1	B-1	B-2	B-2
Sample Depth (ft)	3-3.5'	5-5.5'	26-26.5'	3-3.5'	7-7.5'
Diameter of Cylinder, in	2.42	2.42	2.42	2.42	2.42
Total Length of Cylinder, in.	6.00	6.00	6.00	6.00	5.98
Length of Empty Cylinder A, in.	0.00	0.00	0.00	0.00	0.00
Length of Empty Cylinder B, in.	0.00	0.92	0.00	0.30	0.00
Length of Cylinder Filled, in	6.00	5.08	6.00	5.70	5.98
Volume of Sample, in^3	27.60	23.37	27.60	26.22	27.51
Volume of Sample, cc.	452.24	382.90	452.24	429.63	450.73

Pan #	A2	A7	A8	A9	A3
Weight of Wet Soil and Pan	1016.5	829.9	960.1	964.4	1032.0
Weight of Dry Soil and Pan	868.5	659.8	803.7	802.4	888.4
Weight of Water	148.0	170.1	156.4	162.0	143.6
Weight of Pan	87.5	86.7	87.3	88.1	85.4
Weight of Dry Soil	781.0	573.1	716.4	714.3	803.0
Percent Moisture	19.0	29.7	21.8	22.7	17.9
Dry Density, g/cc	1.73	1.50	1.58	1.66	1.78
Dry Density, lb/ft^3	107.8	93.4	98.9	103.8	111.2

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash Eureka, CA 95501-2138 Tel: 707/441-8855 FAX: 707/441-8877 E-mail: shninfo@shn-engr.com

DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

Project Name: Jenkins Hall **Project Number:** 016147
Performed By: JA **Date:** 6/22/2016
Checked By: **Date:** 7/26/14
Project Manager: G. Simpson

Lab Sample Number	16-595	16-599	16-607	16-610	16-612
Boring Label	B-2	B-3	B-3	B-4	B-4
Sample Depth (ft)	11-11.5'	5-5.5'	28.5-29'	6.5-7'	8.5-9'
Diameter of Cylinder, in	2.41	2.42	2.42	2.42	2.42
Total Length of Cylinder, in.	6.00	6.00	6.00	6.00	6.00
Length of Empty Cylinder A, in.	0.00	0.00	0.00	0.00	0.00
Length of Empty Cylinder B, in.	0.00	1.04	0.51	0.21	0.51
Length of Cylinder Filled, in	6.00	4.96	5.49	5.79	5.49
Volume of Sample, in^3	27.37	22.81	25.25	26.63	25.25
Volume of Sample, cc.	448.51	373.85	413.80	436.41	413.80

Pan #	A5	A11	A12	A4	A10
Weight of Wet Soil and Pan	980.2	819.0	898.3	854.4	821.9
Weight of Dry Soil and Pan	835.8	690.9	723.9	691.8	629.7
Weight of Water	144.4	128.1	174.4	162.6	192.2
Weight of Pan	87.0	86.1	87.5	87.8	87.1
Weight of Dry Soil	748.8	604.8	636.4	604.0	542.6
Percent Moisture	19.3	21.2	27.4	26.9	35.4
Dry Density, g/cc	1.67	1.62	1.54	1.38	1.31
Dry Density, lb/ft^3	104.2	101.0	96.0	86.4	81.9

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DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

Project Name: Jenkins Hall **Project Number:** 016147
Performed By: JA **Date:** 6/22/2016
Checked By: **Date:** 7/26/16
Project Manager: G. Simpson

Lab Sample Number	16-619	16-621	16-625	16-626	16-629	16-631
Boring Label	B-5	B-5	B-5	B-5	B-6	B-6
Sample Depth (ft)	5-5.5'	7-7.5'	11-11.5'	25.5-26'	4-4.5'	7-7.5'
Diameter of Cylinder, in	2.42	2.42	2.42	2.42	2.42	2.42
Total Length of Cylinder, in.	5.99	5.99	6.00	5.99	5.99	5.99
Length of Empty Cylinder A, in.	0.00	0.00	0.00	0.00	0.00	0.00
Length of Empty Cylinder B, in.	0.00	0.48	0.91	2.15	0.63	0.75
Length of Cylinder Filled, in	5.99	5.51	5.09	3.84	5.36	5.24
Volume of Sample, in^3	27.55	25.34	23.41	17.66	24.65	24.10
Volume of Sample, cc.	451.49	415.31	383.65	289.44	404.00	394.96

Pan #	A1	A7	A9	A10	A3	A4
Weight of Wet Soil and Pan	828.2	912.5	821.5	637.8	885.7	865.8
Weight of Dry Soil and Pan	682.4	738.6	649.2	511.3	725.6	705.8
Weight of Water	145.8	173.9	172.3	126.5	160.1	160.0
Weight of Pan	85.9	86.7	88.1	87.1	85.3	87.9
Weight of Dry Soil	596.5	651.9	561.1	424.2	640.3	617.9
Percent Moisture	24.4	26.7	30.7	29.8	25.0	25.9
Dry Density, g/cc	1.32	1.57	1.46	1.47	1.58	1.56
Dry Density, lb/ft^3	82.5	98.0	91.3	91.5	98.9	97.7

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PERCENT PASSING # 200 SIEVE (ASTM - D1140)

Project Name: Jenkins Hall **Project Number:** 016147
Performed By: JA, LW **Date:** 7/13/16
Checked By: DG **Date:** 7/26/16
Project Manager: G.Simpson

Lab Sample Number	16-613	16-639	16-653	16-654	16-656
Boring Label	B-4	B-1	B-4	B-4	B-5
Sample Depth (ft)	9-9.5'	35-36.5'	15-16.5'	20-21.5'	15-16.5'
Pan Number	SS-2	SS-12	SS-14	SS-3	SS-9
Dry Weight of Soil & Pan	306.6	313.2	313.0	323.8	322.6
Pan Weight	193.9	194.2	192.7	197.0	196.5
Weight of Dry Soil	112.7	119.0	120.3	126.8	126.1
Soil Weight Retained on #200&Pan	255.4	265.0	260.5	277.5	267.6
Soil Weight Passing #200	51.2	48.2	52.5	46.3	55.0
Percent Passing #200	**45.4**	**40.5**	**43.6**	**36.5**	**43.6**

Lab Sample Number	16-657				
Boring Label	B-5				
Sample Depth (ft)	20-21.5'				
Pan Number	SS-8				
Dry Weight of Soil & Pan	326.7				
Pan Weight	192.9				
Weight of Dry Soil	133.8				
Soil Weight Retained on #200&Pan	278.7				
Soil Weight Passing #200	48.0				
Percent Passing #200	**35.9**				

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LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

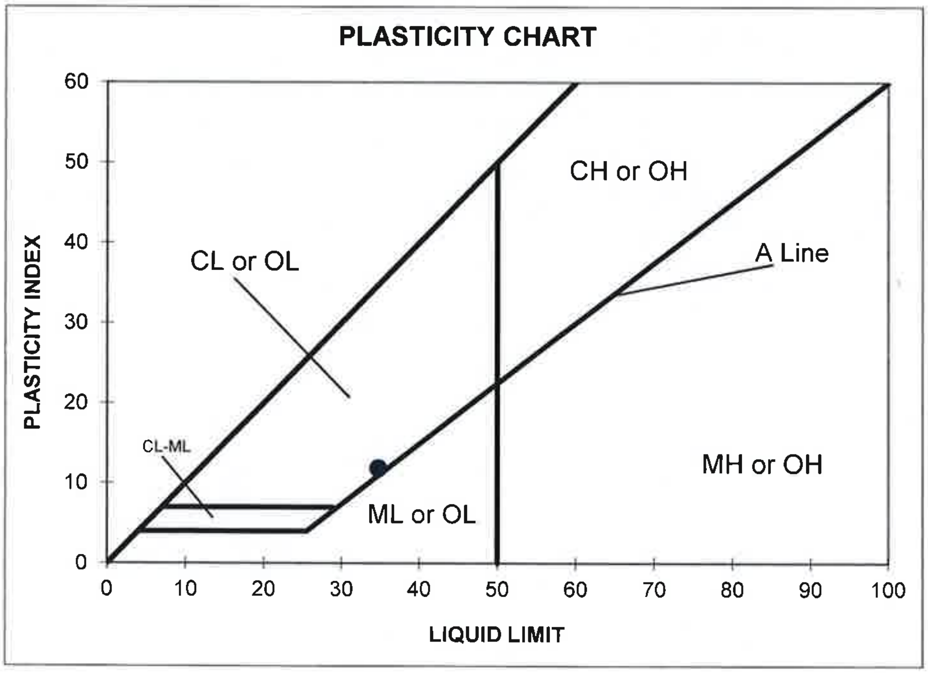
JOB NAME: **Jenkins Hall** JOB #: **016147** LAB SAMPLE #: **16-578**

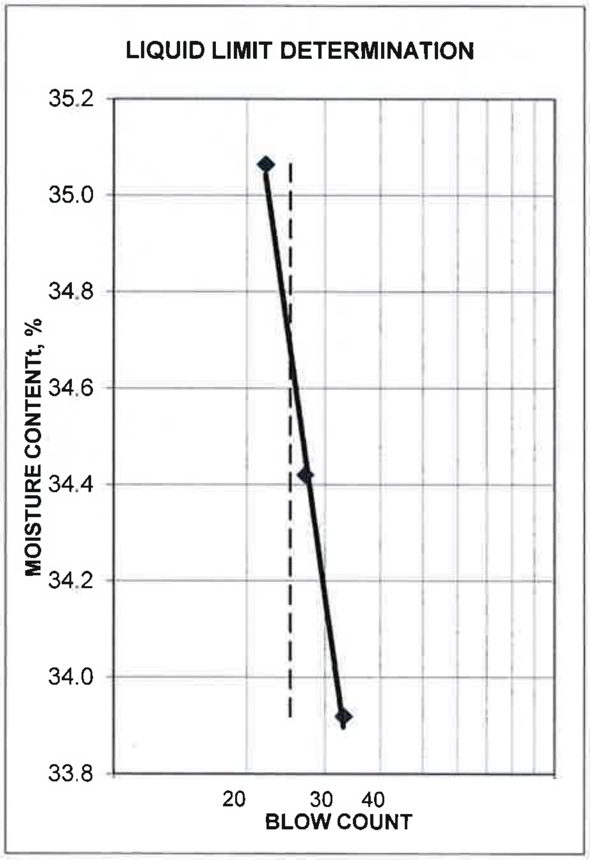
SAMPLE ID: **B-1 @ 7.5-8'** PERFORMED BY: **JA** DATE: **6/22/2016**

PROJECT MANGER: **G. Simpson** CHECKED BY: Dh DATE: 7/26/16

LINE NO.		TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 3
A	PAN #	17	18	1	2	3
B	PAN WT. (g)	20.400	20.230	29.880	29.250	29.240
C	WT. WET SOIL & PAN (g)	26.790	26.390	37.500	37.490	37.560
D	WT. DRY SOIL & PAN (g)	25.590	25.260	35.570	35.380	35.400
E	WT. WATER (C-D)	1.200	1.130	1.930	2.110	2.160
F	WT. DRY SOIL (D-B)	5.190	5.030	5.690	6.130	6.160
G	BLOW COUNT	--	--	33	27	22
H	MOISTURE CONTENT (E/F*100)	23.1	22.5	33.9	34.4	35.1

LIQUID LIMIT	**PLASTIC INDEX**	PLASTIC LIMIT
35	**12**	23

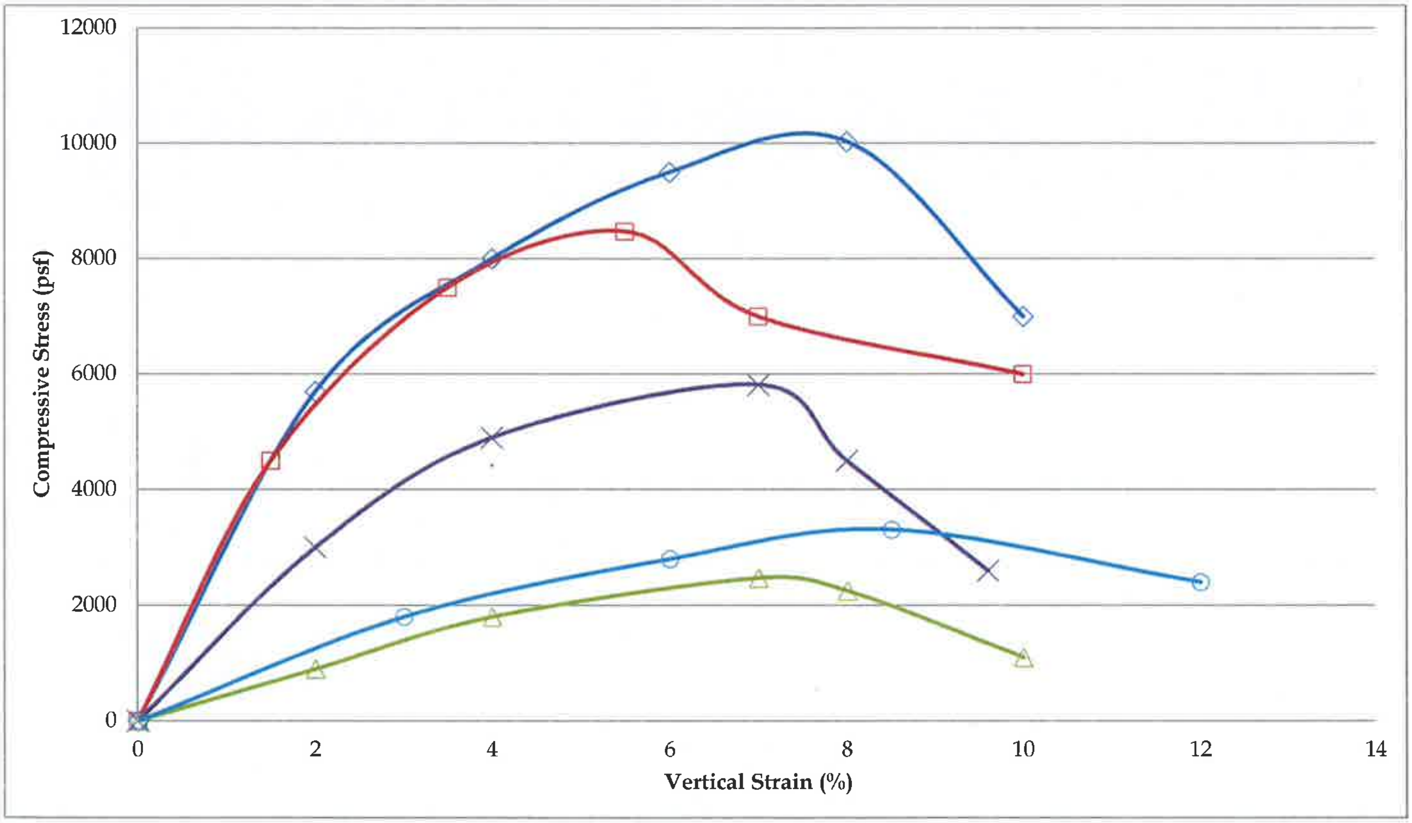




SHN
CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W.Wabash Eureka,CA 95501-2138 Tel:707/441-8855 FAX:707/441-8877 E-mail:shninfo@shn-engr.com

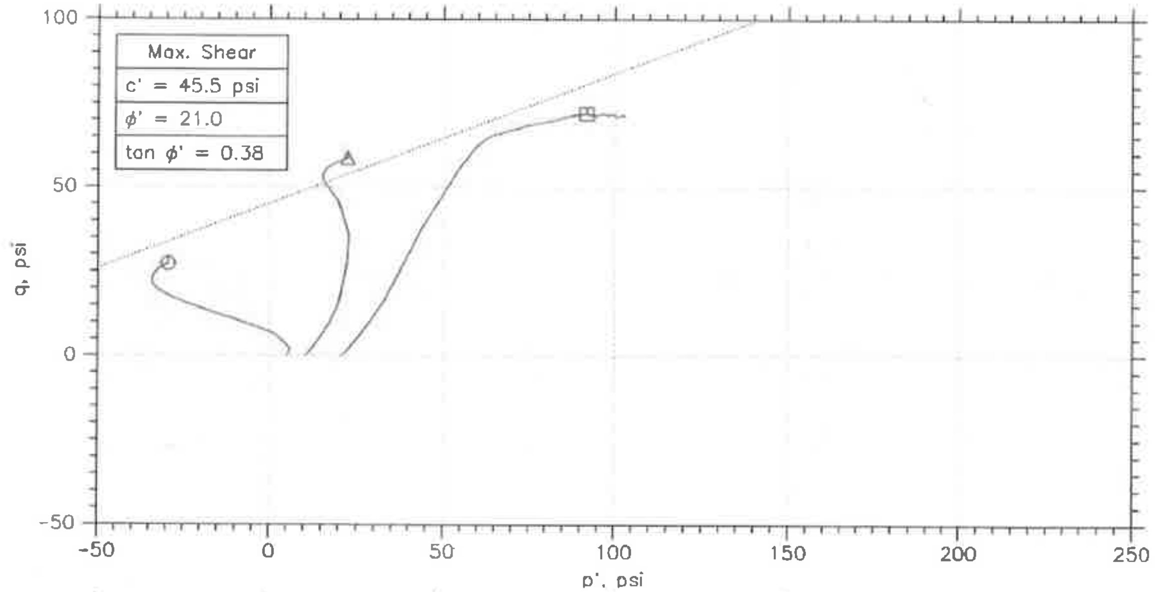
UNCONFINED COMPRESSION TEST REPORT
ASTM D2166

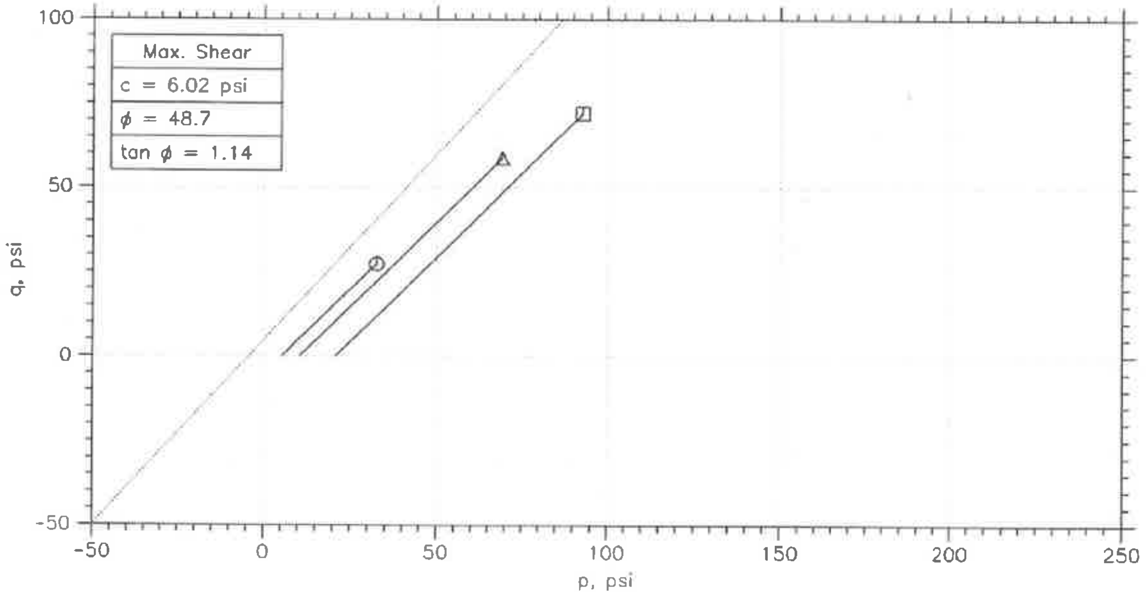
Job Name:	Jenkins Hall				
Job Number:	016147	**Tested By:**	JA	**Date:**	3/18/2016
Project Manager:	G. Simpson	**Checked By:**	DL	**Date:**	7/26/16

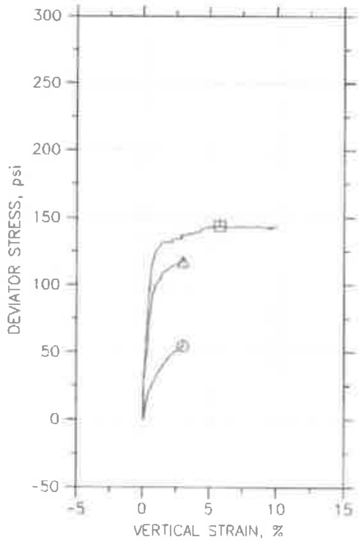


Symbol		◊	□	△	X	o
Lab Sample #		16-579	16-589	16-601	16-617	16-622
Initial	**Diameter (in)**	2.42	2.42	2.42	2.42	2.42
	Height (in)	5.58	4.91	5.12	5.25	5.41
	Water Content (%)	23.7	24.7	21.4	24.6	23.3
	Dry Density (pcf)	101.4	100.7	105.7	103.0	98.4
	Saturation (%)	96.5	98.7	97.1	104.1	88.4
	Void Ratio	0.66	0.67	0.60	0.64	0.71
Unc. Comp. Strength (psf)		10032	8473	2471	5816	3308
Undrnd. Shear Strength (psf)		5016	4237	1235	2908	1654
Time to Failure (min)		8.5	6	7.5	7.5	9.5
Strain Rate (%/min)		1	1	1	1	1
Est. Specific Gravity		2.7	2.7	2.7	2.7	2.7
Boring No. & Depth		B-1 @ 8-8.5'	B-2 @ 5-5.5'	B-3 @ 7-7.5'	B-5 @ 3-3.5'	B-5 @ 8.5-9'
Sample Type		Cal Mod	Cal Mod	Cal Mod	Cal Mod	Cal Mod
Description		CL	CL	CL	CL	CL
Remarks						

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







Project:	Jenkins Hall
Location:	Arcata, CA
Project #:	416009
Boring #:	B 1@11 11.5'
Sample Type:	Cal Brl
Description:	Clay with sand
Time of Test:	7 25 16

Symbol	O	Δ	□
Test No.	16-581a	16-581b	16-581c
Confining Stress (psi)	5.2	10.4	20.8
Shear Strength (psi)	27.3	58.7	71.9
Strain at Failure (%)	3	3	5.8

Sample No.		16 581
Depth (ft)		11-11.5'
Initial	Diameter (in)	2.42
	Height (in)	5.5
	Water Content (%)	19.2
	Dry Density (pcf)	113.5
	Saturation (%)	99.3
	Void Ratio	0.54
After Test	Water Content (%)	15.7
	Dry Density (pcf)	120.9
	Saturation (%)	98.3
	Void Ratio	0.45
Strain Rate (%/min)		0.16
B-Value		0.95
Est. Specific Gravity		2.8

C

Corrosivity Test Results

California State Certified Laboratory No. 2153

CERCO
analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 **462 2771** Fax. 925 **462 2775**
www.cercoanalytical.com

26 July 2016

Job No. 1607123
Cust. No. 11258

Mr. Greg Williston
SHN Consulting Consulting Engineers
812 W. Wabash Avenue
Eureka, CA 95501

Subject: Project No.: 016147
Project Name: Jenkins Hall, HSU
Corrosivity Analysis – ASTM Test Methods with Brief Evaluation

Dear Mr. Williston:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on July 19, 2016. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurement, the sample is classified as "mildly corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentration is none detected to 15 mg/kg.

The sulfate ion concentration is none detected to 15 mg/kg.

The pH of the soil is 5.46. Any soil with a pH of <6.0 is considered to be corrosive to buried iron, steel, mortar-coated steel and reinforced concrete structures. Therefore, corrosion prevention measures need to be considered for structures to be placed in this acidic soil.

The redox potential is 440-mV which is indicative of aerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client:	SHN Consulting Engineers & Geologists
Client's Project No.:	016147
Client's Project Name:	Jenkins Hall, HSU
Date Sampled:	13-Jul-16
Date Received:	19-Jul-16
Matrix:	Soil
Authorization:	Signed Chain of Custody

Date of Report: 26-Jul-2016

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1607123-001	B-1 @ 4'-4.5' & B-1 @ 4.5'-5'	440	5.46	-	9,500	-	N.D.	31

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	22-Jul-2016	22-Jul-2016	-	25-Jul-2016	-	22-Jul-2016	22-Jul-2016

* Results Reported on "As Received" Basis

N.D. - None Detected

Cheryl McMillen
Laboratory Director

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

1607123

Chain of Custody

Page 1 of 1

1100 Willow Pass Court
Concord, CA 94520-1006
925 462 2771
Fax: 925 462 2775

CERCC analytica

Job No.	CU#		Client Project I.D.
[redacted]	11258		016147

Schedule
Analyte

Date Sampled: 6-14-16

Date Due: standard turn-around

Full Name
Greg Williston

Fax 707-441-8877

Phone 707-441-8855

Company
SHN Engineers & Geologists

Cell ☒

Sample Source
Jenkins Hall, HSU

ASTM w/Brief Evaluation — ANALYSIS

Lab No.	Sample I.D.	Date	Time	Matrix	Contain.	Size	Preserv.	Qty.	Redox Potential	pH	Sulfate	Chloride	Resistivity-100% Saturated		Brief Evaluation							
001	B-1 4-4.5' B-1 4.5-5' combined	7-13-16		S	bag	quart		1	X	X	X	X	X		X							

Fed-Ex

MATRIX
- DW - Drinking Water
- GW - Ground Water
- SW - Surface Water
- WW - Waste Water
- Water
- SL - Sludge
- S - Soil
- Product

ABBREVIATIONS
- HB - Hosebib
- PV - Petcock Valve
- PT - Pressure Tank
- PH - Pump House
- RR - Restroom
- GL - Glass
- PL - Plastic
- ST - Sterile

SAMPLE RECEIPT

Total No. of Containers
Rec'd Good Cond/Cold
Conforms to Record
Temp. a t Lab -°C
Sampler

	Date	Time
Relinquished By:		
Received By:	7/19/16	10:30
Relinquished By:		
Received By:		
Relinquished By:		
Received By:		

Comments:
THERE IS AN ADDITIONAL CHARGE FOR METAL/POLY TUBES

please email results to:
psundberg@shn-engr.com
twinklerprins@shn-engr.com

8/6/2009