# APPENDIX D

# GEOTECHNICAL INVESTIGATION

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# UPDATED GEOTECHNICAL INVESTIGATION
## Northgate Town Square
## San Rafael, California

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# UPDATED GEOTECHNICAL INVESTIGATION
## Northgate Town Square
## San Rafael, California

## 1.0 INTRODUCTION

This report presents the results of the geotechnical investigation performed by Langan Engineering and Environmental Services, Inc. (Langan) for the proposed Northgate Town Square in San Rafael, California. Our original geotechnical investigation report was dated 7 December 2021; this report updates that version to address comments from Dudek and MGP XI Northgate, LLC. The existing Northgate Shopping Center site (project site) is bordered by Las Gallinas Avenue to the north and to the east, and Northgate Drive to the west and to the south as shown on Figure 1. The site is irregularly-shaped site, occupies an area of about 44.7 acres.

The existing shopping center includes four main anchor stores (RH Outlet, Macy's, Kohls, and Homegoods) and a Century Theater (cinema) as shown on Figure 2. Numerous retail stores, shops and restaurant facilities occupy the areas between the anchor stores and cinema.

We understand the proposed Northgate Town Square development will be divided into two phases:

- 2025 Master Plan
- 2040 Vision Plan

<u>2025 Master Plan</u>

The 2025 Master Plan includes demolition of some of the existing retail structures; development of four residential parcels, each with its own parking component; construction of a new shop north of the cinema and a major retail space, and two new restaurant pads; and expansion of the existing cinema.

Residential parcels, denoted as Residential 1 through 4 on Figure 2, vary from 96 to 309 residential units with 96 to 541 parking stalls and are proposed to be constructed on the southern and eastern portions of the site. We understand that the number of residential units and parking stalls may slightly change as the project planning progresses. Residential 1 is planned as a 4-story structure over a podium. Residential 2 through Residential 4 are planned as 5-story buildings.

Restaurant pads, denoted as Pad 1 and 2 on Figure 2, are proposed on the northwestern portion of the site, along Las Gallinas Avenue, and occupy an area of approximately 4,200 square feet and 8,400 square feet, respectively.

2040 Vision Plan

We understand the 2040 Vision Plan includes demolition of some of the remaining existing retail structures; development of two residential parcels with parking components; construction of additional shops, a major retail space, and three new restaurant pads.

New shops are planned on the western portion of Residential 6, north of the cinema, and southeast of Residential 5. New major retail space is planned on the northern portion of Residential Parcel 6 (Figure 2).

Residential Parcels for this phase, denoted Residential 5 and 6 on Figure 2, have 264 and 145 residential units respectively, and 462 and 251 parking stalls, respectively. Similar to the Residential 1 through 4 developments, the number of residential units and parking stalls may slightly change as the project planning progresses. Residential 5 and Residential 6 are proposed on the eastern and western portions of the site, respectively. Both of these building are planned as 5-story structures.

Restaurant pads, denoted as Pad 3 and 4 on Figure 2, are proposed on the northern portion of the site, along Las Gallinas Avenue and will occupy an area of 5,000 square feet and 3,800 square feet, respectively. Pad 5 is proposed on the northwestern portion of the site (along Northgate Drive and will occupy an area of approximately 5,000 square feet.

## 2.0 SCOPE OF SERVICES

Our geotechnical investigation was performed in accordance with the scope of services included in our proposal dated 1 September 2021. Our scope of services consisted of evaluating subsurface conditions by reviewing the findings from previous investigations at the site and performing supplemental geotechnical exploration. Using the results of previous and current investigations and laboratory testing, we performed engineering evaluations to develop conclusions and recommendations for the geotechnical aspects of the proposed development (for both the 2025 and 2040 plans) regarding:

- soil and groundwater conditions at the site
- appropriate foundation type(s) for the buildings

- design criteria for the recommended foundation type(s), including values for vertical and lateral resistance
- required foundation embedment
- estimated foundation settlement, including total and differential settlements
- site seismicity and seismic hazards, including ground rupture, liquefaction, and cyclic densification
- mitigation of liquefaction potential
- site grading, including criteria for fill quality and compaction
- temporary and permanent cut and fill slopes
- floor slabs and exterior concrete flatwork
- seismic design criteria (mapped values) in accordance with the 2019 California Building Code, as appropriate
- corrosion potential of near-surface soil
- flexible and rigid pavement design
- groundwater/stormwater infiltration considerations
- construction considerations.

## 3.0 SITE CONDITIONS

The site currently consists of an active shopping center, which includes commercial and retail buildings, primarily occupying the middle portion of the site, surrounded by paved parking areas.

Based on our review of the Woodward-Clyde Consultants (WCC 1982), we understand the site was developed by cutting into a steep ridge that was present on the western side of the site. The excavated material was then placed as fill to level the site on the eastern portion of the site. Therefore, the western portion of the site is predominantly an area of cut with shallow bedrock, while the eastern portion of the site are fill areas, up to 20 feet thick.

The site is relatively level with ground surface elevations ranging from about Elevation 30 to 40 feet[1].

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[1] Elevations are based on a topographic site survey presented on Sheet No. C1.0 - "Existing Conditions" prepared by CSW/Stuber-Stroeh Engineering Group, Inc. and Will, dated May 14,2021, using the North American Vertical Datum 1988 (NAVD88). All elevations described herein reference NAVD88 datum.

## 4.0 FIELD INVESTIGATIONS

### 4.1 Current Field Investigation

Our subsurface investigation for the Northgate Town Square development included drilling 33 borings to supplement the existing subsurface data. Prior to performing our field investigation, we coordinated site access, performed a site walk and marked exploration points, notified Underground Service Alert (USA), retained a private utility locator to check the proposed exploration locations were clear of underground utilities, and performed work in general accordance with our drilling permit with Marin County Environmental Health Services (MCEHS).

The borings were drilled by Gulf Shore Construction Services, Inc. (Gulf Shore) of Rancho Cordova, California, using a truck-mounted hollow-stem auger drill rig between 20 October and 3 November 2021, under the supervision of a field engineer or geologist of Divis Consulting, Inc. (Divis), our subconsultant, with Langan oversight. A summary of the borings performed during this field investigation is presented in Table 1. The approximate locations of the borings are shown on Figure 2. The borings drilled in the proposed residential areas and pad areas are designated as R and P, respectively. Borings designated S and C were drilled in areas to near proposed shops and cinema expansion.

## TABLE 1
## Summary of Borings

| Boring ID | Approximate Ground Surface Elevation (feet, NAVD88) | Depth of Boring (feet) | Approximate Bottom of Boring Elevation (feet, NAVD88) |
|---|---|---|---|
| C-1 | 36 | 35.3 | 0.7 |
| P-1 | 30 | 11.5 | 18.5 |
| P-2 | 29.5 | 11.5 | 18 |
| P-3 | 28 | 16.5 | 11.5 |
| P-4 | 27.5 | 21.5 | 6 |
| P-5 | 39.5 | 10.5 | 29 |
| R1-1 | 37 | 10.2 | 26.8 |
| R1-2 | 37 | 5.2 | 31.8 |
| R1-3 | 36.5 | 5.9 | 30.6 |
| R2-1 | 38 | 11.25 | 26.75 |
| R2-2 | 36 | 10.4 | 25.6 |
| R2-3 | 35.5 | 16 | 19.5 |
| R2-4 | 34 | 15.25 | 18.75 |
| R2-5 | 36 | 20.9 | 15.1 |
| R3-1 | 35 | 31.5 | 3.5 |
| R3-2 | 32.5 | 25.7 | 6.8 |
| R3-3 | 33.5 | 21 | 12.5 |
| R3-4 | 33 | 21.5 | 11.5 |
| R3-5 | 33 | 10.25 | 22.75 |
| R4-1 | 36 | 30.4 | 5.6 |
| R4-2 | 36 | 26.2 | 9.8 |
| R4-3 | 33.5 | 41.2 | -7.7 |
| R4-4 | 32.5 | 30.5 | 2 |
| R4-5 | 32 | 46 | -14 |
| R5-1 | 34.5 | 25.4 | 9.1 |
| R5-2 | 35 | 41.25 | -6.25 |
| R5-3 | 34.5 | 45.3 | -10.8 |
| R5-4 | 30.5 | 35.25 | -4.75 |
| R5-5 | 30.5 | 46.5 | -16 |
| R6-1 | 40.5 | 5.8 | 34.7 |
| R6-2 | 37 | 11.25 | 25.75 |
| R6-3 | 37 | 10.2 | 26.8 |
| S3-1 | 37 | 15.25 | 21.75 |

The borings were drilled into bedrock, to depths ranging from about 5 to 46.5 feet below the existing ground surface (bgs), which correspond to approximate Elevations 34.7 to -16 feet, respectively. During drilling, Divis field representative logged the soil encountered in the borings and obtained samples of the materials encountered for visual classification and laboratory testing. Logs of the borings are presented on Figures A-1 through A-33 in Appendix A. The soil encountered in the borings were classified in accordance with the classification charts shown on Figure A-34. Samples of the materials encountered were obtained using the following sampler types:

- Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter (O.D.) and a 1-3/8-inch inside diameter (I.D.)
- Sprague and Henwood (S&H) split-barrel sampler with a 3.0-inch O.D. and 2.5-inch I.D., lined with 2.43-inch-I.D. steel tubes

The sampler types were chosen on the basis of soil type and desired sample quality for laboratory testing. In general, the SPT sampler was used to evaluate the relative density of sandy soil and the S&H sampler was used to obtain samples in medium stiff to very stiff cohesive soil.

The SPT and S&H samplers were driven with a 140-pound automatic safety hammer falling 30 inches. The samplers were driven up to 18 inches and the hammer blows required to drive the samplers every six inches of penetration were recorded and are presented on the boring logs. A “blow count” is defined as the number of hammer blows per six inches of penetration.

The blow counts required to drive the S&H and SPT samplers 12 inches were converted to approximate SPT N-values using factors of 0.8 and 1.3, respectively, to account for sampler type and hammer energy. The N-values are shown on the boring logs. The blow counts used for the conversions were: 1) the last two blow counts if the sampler was driven more than 12 inches, or 2) the last one blow count if the sampler was driven more than six inches but less than 12 inches.

Upon completion, the boreholes were backfilled with cement grout in accordance with MCEHS requirements. Soil cuttings generated during drilling of the borings were placed into 55-gallon drums, and temporarily stored onsite. Drum contents were tested for the presence of chemicals, were classified as non-hazardous, and subsequently disposed offsite.

### 4.2 Previous Field Investigations

4.2.1 Woodward-Clyde Consultants (WCC)

In 1982, WCC performed a geotechnical investigation for the site to develop geotechnical recommendations for new site improvements including, a one-story parking structure, Mervyn's Department store and Payless Drug store. The investigation included 16 exploratory borings ranging in depth from 6½ to 34½ feet.

The approximate locations of the exploration points are shown of Figure 2. Borings logs and laboratory testing from previous explorations are provided in Appendix B.

4.2.2 Kleinfelder

In 2007, Kleinfelder drilled eleven borings, designated K-1 through K-11, and two borings through concrete slabs, designated C-1 and C-2, to evaluate soil conditions for two restaurant buildings, a vehicular access road, a new Rite Aid store, and exterior hardscape rehabilitations. The borings were advanced to depths of approximately 2 feet to 20 feet. The approximate locations of the exploration points are shown on Figure 2. Borings logs and laboratory testing from previous explorations are provided in Appendix B.

## 5.0 LABORATORY TESTING

### 5.1 Current Investigation

The soil samples recovered from our geotechnical exploration were re-examined in the office for soil classifications and representative samples were selected for laboratory testing. Samples were tested to measure moisture content, dry density, Atterberg limits, fines content, shear strength, and resistance value. Results of the laboratory tests are included on the boring logs in Appendix A and on Figures C-1 through C4 in Appendix C.

Because corrosive soil can adversely affect underground utilities and foundation elements, laboratory testing was also performed to evaluate the corrosivity of the near-surface soil. The results of the corrosivity analysis are presented in Appendix D.

### 5.2 Laboratory Testing From Previous Investigations

Woodward-Clyde Consultants Inc. and Kleinfelder submitted select soil samples recovered from their respective geotechnical exploration programs for laboratory testing. Samples were tested to measure moisture content, dry density, Atterberg limits, fines content, shear strength, expansion index, sieve analysis, resistance value, and corrosivity. Results of the laboratory tests of the previous investigations are provided in Appendix B.

## 6.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered during our exploratory drilling include asphalt concrete (AC), variable thicknesses of undocumented fill, native soil, residual soil, and variable bedrock types. Where explored, the pavement section of the parking lot consists of approximately two to eight inches of AC over up to 12 inches of aggregate base (AB). The subsurface soil and bedrock encountered during our investigation, including material types and general descriptions of their physical characteristics, are summarized below.

***Undocumented Fill:***

As previously discussed, the current grades at the Northgate Shopping Center were created by cutting into a hillside ridge that was present on the western side of the site and placing the excavated material as fill on the eastern side of the site. It is not known whether this fill was placed in a compacted (engineered) manner and no records were available at the time of this report to substantiate the nature of the fill placement; therefore, it is considered “undocumented”.

Undocumented fill was encountered in all of the exploratory borings, except R1-2 and R6-1, where shallow bedrock was encountered directly beneath the pavement section. The thicknesses of undocumented fill encountered ranged from approximately 2 to 20½ feet and generally consists of medium to very stiff clay with varying amounts of sand and gravel with interbedded layers of medium dense to very dense sand and gravel with varying fines contents. Results of Atterberg limits tests performed on samples of the clayey fill indicate it is low to moderately expansive[2]. Contours of the bottom of fill elevation and depth are presented on Figures 3a and 3b, respectively.

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[2] Expansive soil will shrink and swell significantly with changes in moisture content.

***Native Soil:***

The undocumented fill is underlain by native soil characterized as alluvial deposits and residual soil. Where encountered, native soils vary in thickness from one to 22 feet.

Alluvial deposits generally consist of medium stiff to hard clays with varying amounts of sand. However, in Boring R5-5, a 4-foot thick layer of medium dense clayey silty sand was encountered at a depth of about 25 feet bgs (about Elevation 10.5 feet). In Borings R3-3, R3-4 and R5-3, soft clay was encountered immediately below the undocumented fill. Where encountered, the soft clay was 4 to 6.5 feet thick.

Soil formed from highly weathered rock, or residual soil, was encountered in Borings P-3, R3-1, and S3-1 at depths of about 6½, 24½, and 11 feet bgs, respectively (about Elevation 21.7, 11, and 26 feet, respectively). Where encountered, residual soil consists of very stiff sandy clay.

***Bedrock:*** Bedrock was encountered beneath the site at depths ranging from about 1 to 41½ feet bgs and generally consists of interbedded shale and sandstone, shale, sandstone, siltstone, and claystone. Bedrock beneath the site is predominantly crushed to closely fractured, low to moderate hardness, friable to moderately strong, little to deeply weathered, and oxidized. Contours of the top of bedrock elevation and depth are presented on Figures 4a and 4b, respectively.

### 5.3.1 Groundwater

During drilling, groundwater was encountered at depths ranging between 15 and 33 feet bgs (corresponding to about Elevations 17½ and 2 feet, respectively). The groundwater levels measured during the current investigation and previous investigations by others are summarized in Table 2. Seasonal fluctuations in rainfall influence groundwater levels and may cause several feet of variation.

## TABLE 2
## Summary of Groundwater (GW) Depth and Elevation Data

| Consultant | Location | Year of Exploration | Ground Surface Elevation (feet) | Exploration Depth (feet) | GW Depth (feet) | GW Elevation (feet) |
|---|---|---|---|---|---|---|
| Langan | C-1 | 2021 | 36 | 35.3 | 18.4 | 17.6 |
| | R3-1 | 2021 | 35 | 31.5 | 20 | 15 |
| | R4-1 | 2021 | 36 | 30.4 | 20 | 16 |
| | R4-2 | 2021 | 36 | 26.2 | 23 | 13 |
| | R4-3 | 2021 | 33.5 | 41.2 | 30 | 3.5 |
| | R4-4 | 2021 | 32.5 | 30.5 | 15.5 | 17 |
| | R4-5 | 2021 | 32 | 46 | 24 | 8 |
| | R5-2 | 2021 | 35 | 41.3 | 33 | 2 |
| | R5-3 | 2021 | 34.5 | 45.3 | 24.1 | 10.4 |
| | R5-4 | 2021 | 30.5 | 35.3 | 20.4 | 10.1 |
| | R5-5 | 2021 | 30.5 | 46.5 | 20 | 10.5 |
| WCC | 1 | 1982 | -- | 34.5 | 15 | -- |
| | 1 | 1982 | -- | 34.5 | 20 | -- |
| | 2 | 1982 | -- | 26.5 | 20.5 | -- |
| | 3 | 1982 | -- | 28.5 | 11.5 | -- |
| Kleinfelder | K-10 | 2007 | -- | 19.5 | 16 | -- |

## 7.0 GEOLOGY AND SEISMICITY

Our evaluation of the geology and seismicity of the area is based on our review of published reports and information in our files from other sites in the vicinity.

### 7.1 Regional Geology

The San Francisco Bay Area is in the California Coastal Range Province, a region characterized by northwest-trending ridges and valleys that generally parallel the major geologic structures, such as the San Andreas and Hayward fault systems. These are controlled by folds and faults that resulted from the collision of the Farallon and North American plates, and subsequent strike-slip faulting and shearing along the San Andreas fault system.

### 7.2 Regional Seismicity

The project site is in a seismically active region. Numerous earthquakes have been recorded in the region in the past, and moderate to large earthquakes should be anticipated during the service life of the proposed development. The Hayward, San Andreas, and San Gregorio faults are the major faults closest to the site. These and other faults of the region in the UCERF3 source model are shown on Figure 5. For each of these faults, as well as other active faults within about 50 kilometers (km) of the site, the distance from the site and estimated mean characteristic Moment magnitude[3] are summarized in Table 3. The mean moment magnitude presented on Table 3 was computed assuming full rupture of the segment using Hanks and Bakun (2008) relationship.

**TABLE 3**
**Regional Faults and Seismicity**

| Fault Name | Distance (km) | Direction from Site | Mean Moment Magnitude[3] |
|---|---|---|---|
| Total Hayward-Rodgers Creek Healdsburg | 13 | East | 7.58 |
| San Andreas 1906 event | 16 | Southwest | 8.06 |
| Total San Gregorio | 16 | West | 7.61 |
| Bennett Valley | 26 | Northeast | 6.50 |
| Franklin | 27 | East | 6.68 |
| Contra Costa (Vallejo) | 29 | East | 5.60 |
| Contra Costa (Dillon Point) | 31 | East | 6.12 |
| Contra Costa Shear Zone (connector) | 31 | East | 6.57 |
| Contra Costa (Lake Chabot) | 32 | East | 5.63 |
| West Napa | 32 | Northeast | 6.75 |
| Contra Costa (Lafayette) | 39 | East | 6.07 |
| Green Valley | 40 | East | 6.78 |
| Concord | 40 | East | 6.42 |
| Pilarcitos | 41 | South | 6.66 |
| Contra Costa (Larkey) | 42 | East | 6.05 |
| Mount Diablo Thrust | 47 | East | 6.58 |
| Total Calaveras | 48 | East | 7.54 |

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[3] Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

Figure 5 also shows the earthquake epicenters for events with magnitude greater than 5.0 from January 1800 through August 2014. Since 1800, four major earthquakes have been recorded on the San Andreas Fault. In 1836, an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale (Figure 6) occurred east of Monterey Bay on the San Andreas fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, $M_{w,}$ for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to an $M_w$ of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas fault, from Shelter Cove to San Juan Bautista, approximately 470 kilometers in length. It had a maximum intensity of XI (MM), an $M_w$ of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The Loma Prieta Earthquake occurred on 17 October 1989 in the Santa Cruz Mountains with an $M_w$ of 6.9, the epicenter of which is approximately 122 km from the site.

In 1868 an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward fault. The estimated $M_w$ for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably an $M_w$ of about 6.5) was reported on the Calaveras fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake ($M_w = 6.2$).

The most recent earthquake to affect the Bay Area occurred on 24 August 2014 and was located on the West Napa fault, approximately 31 kilometers northeast of the site, with an $M_W$ of 6.0.

The 2014 Working Group for California Earthquake Probabilities (WGCEP) at the U.S. Geologic Survey (USGS) predicted a 72 percent chance of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area in 30 years (WGCEP 2015). More specific estimates of the probabilities for different faults in the Bay Area are presented in Table 4.

## TABLE 4

### WGCEP (2015) Estimates of 30-Year Probability (2014 to 2043) of a Magnitude 6.7 or Greater Earthquake

| **Fault** | **Probability (percent)** |
|---|---|
| N. San Andreas | 33 |
| Hayward-Rodgers Creek | 32 |
| Calaveras | 25 |
| Green Valley | 7 |
| San Gregorio | 6 |
| Greenville | 6 |
| Mount Diablo Thrust | 4 |

## 7.3 Geologic Hazards

During a major earthquake, strong to very strong ground shaking is expected to occur at the project site. Strong ground shaking during an earthquake can result in ground failure such as that associated with soil liquefaction, lateral spreading, cyclic densification, and fault rupture. We evaluated the potential for each of these phenomena to occur at the site, and the results of our evaluations are discussed in this section.

### 7.3.1 Liquefaction

When saturated soil with little to no cohesion liquefies during a major earthquake, it experiences a temporary loss of shear strength as a result of a transient rise in excess pore water pressure generated by strong ground motion. Flow failure, lateral spreading, differential settlement, loss of bearing, ground fissures, and sand boils are evidence of excess pore pressure generation and liquefaction. The northwest area of the site is located within a zone mapped as moderate liquefaction susceptibility as designated by the United States Geological Survey liquefaction susceptibility hazards map for the county of Marin titled *Map 2-11, Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California* dated 14 June 2005. The remainder of the site is located within an area mapped as low susceptibility to liquefaction. Because the materials at the site below the groundwater level are predominately clayey or bedrock, we judge that the potential for liquefaction settlement at the site is low.

### 7.3.2 Lateral Spreading

Lateral spreading is a phenomenon in which a surficial soil layer displaces along a shear zone that forms within a continuous underlying liquefied layer. The surficial blocks are transported downslope or in the direction of a free face, such as a channel, by earthquake and gravitational forces. Lateral spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes.

Since the potential for liquefaction at the site is low, we likewise judge that potential for lateral spreading to occur at the site is low.

### 7.3.3 Cyclic Densification

Cyclic densification (also referred to as seismic densification and differential compaction) can occur during strong ground shaking in loose, clean granular deposits above the water table, resulting in ground surface settlement. The degree of susceptibility to cyclic densification is directly related to the relative density of the existing granular soil.

The borings indicate that loose to medium dense granular soil is present above the design groundwater level. We used the approach developed by Tokimatsu and Seed (1984) to evaluate the potential for cyclic densification of the medium dense clayey sand encountered in the fill above the anticipated water level. We judge that the materials encountered above the groundwater table are sufficiently cohesive and/or dense and as such the potential for cyclic densification at the site is low.

### 7.3.4 Fault Rupture

Historically, ground surface displacements closely follow the traces of geologically young faults. The site is not within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act, and no known active or potentially active faults exist on the site. In a seismically active area, the remote possibility exists for future faulting in areas where no faults previously existed; however, we conclude the risk of surface faulting and consequent secondary ground failure at the site is low.

## 8.0 DISCUSSION AND CONCLUSIONS

From a geotechnical engineering standpoint, we judge the proposed site development is feasible, provided the recommendations presented in this report are incorporated into the project plans and specifications, and are implemented during construction.

The primary geotechnical issues of concern include:

- the presence undocumented fill
- varying depth of bedrock
- selection of an appropriate foundation type to support building loads
- construction considerations.

Our conclusions regarding these and other geotechnical issues are discussed in the remainder of this section.

### 8.1 Foundations and Settlement

As previously discussed, the western portion of the site is generally underlain by shallow bedrock, while the eastern portion of the site is underlain by undocumented fill which extends to a depth of about 20 feet bgs at some portions of the site. Where explored, the undocumented fill appears to be comprised of relatively stiff clay, however, we cannot confirm that the fill was placed in an engineered fashion across the entire site. Therefore, the undocumented fill, in its current condition and without documentation that it was appropriately placed, cannot be relied upon to provide adequate foundation support for the new structures. We conclude new foundations should bear in the native soil and bedrock below the undocumented fill.

In areas where the finished floor is close to the anticipated top of bedrock, the building foundations can bear on bedrock or bear on lean concrete extending to bedrock. Elsewhere, either shallow foundations bearing on ground improvement extending to competent native soil or bedrock or deep foundations extending into bedrock, should be used. If ground improvement is used, the ground improvement elements for a single structure should bear in the same material, either competent native soil or bedrock across the entire structure, i.e. no combination of ground improvement into bedrock in some areas and only into native soil (above bedrock) in other areas for a single structure.

Considering the variable depth to rock in portions of the site, a combination of shallow foundations, shallow foundations over ground improvement, and/or deep foundations, all bearing in rock, may be used across a single building footprint. The general contractor and structural engineer should review Figures 3a and 3b (depth/elevation of bottom of fill) and Figures 4a and 4b (depth/elevation of top of bedrock) and determine the most appropriate foundation type(s).

### 8.1.1 Shallow Foundations

Settlement of properly installed shallow foundations, consisting of footings or mats, bearing in bedrock should be small, less than ½ inch. We judge that settlement of new shallow foundations bearing in rock during an earthquake should also be relatively small. Settlement of properly constructed shallow foundations bearing on improved ground extending to rock is anticipated to be less than one inch.

### 8.1.2 Deep Foundations

New buildings may be supported on deep foundations (piles) primarily gaining support in the native soil (friction) and bedrock (friction and end-bearing, provided proper cleanout of the bottom can be confirmed) below the fill. As there is typically only 5 to 15 feet of native clayey soil between the fill and bedrock for buildings in the eastern portion of the site, we judge the piles would not gain adequate capacity in the native soil alone and therefore should be installed to bear in bedrock.

We judge augered-cast-in-place (ACIP) piles would be an appropriate deep foundation system that could be used to support the proposed buildings. ACIP piles are proprietary design-build piling systems and are installed by drilling to the required depth using a displacement or non-displacement drilling tool that displaces or removes soil, respectively. When the drilling tool reaches the required depth, cement grout or concrete is injected through ports in the bottom of the tool. After the grout is injected, steel reinforcing cages can be lowered into the pile while the grout is still fluid. ACIP piles can range in diameter; however, 18- and 24-inch-diameter ACIP piles are typical.

Assuming the deep foundation elements are socketed approximately 5 to 10 feet into rock, the elements will likely be about 15 to 50 feet long; however, variations in depth to and hardness of the bedrock should be expected, resulting in variable element lengths. The deep foundation elements will transfer building loads to relatively incompressible bedrock; however, some elastic shortening of the piles will still occur. We estimate the piles could settle and compress up to about one inch, depending on the loads, section properties, and lengths of the elements.

Differential settlement should be no more than about ½ inch between any adjacent columns, provided all foundations extend into bedrock.

## 8.2 Ground Improvement

As discussed in Section 8.1, ground improvement can be performed to transfer building loads down to competent native soil or bedrock and provide support for a shallow foundation system. On the basis of our experience with different methods of improvement, we judge that the most appropriate methods to perform ground improvement include:

- compacted aggregate piers (CAPs)
- drilled displacement columns (DDCs)

These ground improvement techniques could be used separately or in combination. CAP and DDC systems are installed under design-build contracts by specialty contractors, and as such we do not provide specific design recommendations or settlement estimates for these systems; however, we typically provide design guidelines that should be considered in the design of the ground improvement. Detailed discussions for each of the proposed methods are presented in the following subsections.

### 8.2.1 Compacted Aggregate Piers

CAPs are used to reduce settlement potential and increase allowable bearing capacities by strengthening the soil matrix with compacted aggregate (gravel) columns and by densifying the soil between the columns. CAPs are designed and installed by specialty contractors on a design-build basis. CAPs are typically installed by drilling 24- to 33-inch-diameter shafts with an auger or specialty vibration tooling and then backfilling the shaft with compacted aggregate material placed in lifts. CAPs should be installed to transmit the building loads down to bedrock.

### 8.2.2 Drilled Displacement Columns

DDCs are installed under design-build contracts by specialty contractors. They are constructed by using a displacement auger to create a soil shaft that is filled with CLSM (Controlled Low Strength Material) injected under pressure as the displacement auger is withdrawn from the hole. DDCs typically vary between 18 to 30 inches in diameter. The intent of the DDCs is to provide rigid inclusions and densify the surrounding soil, thereby transferring building loads down to competent native soil or bedrock. Installation of DDCs produces minimal soil cuttings because the soil is displaced during column installation.

## 8.3 Groundwater/Stormwater Infiltration Considerations

In general, the site is underlain by shallow bedrock and/or near-surface clayey soil, neither of which are conducive to infiltration. Therefore, some other means of handling stormwater, e.g. use of tanks or other systems, should be considered.

## 8.4 Groundwater

Groundwater was encountered during our field investigation in some of the borings. Where encountered, the groundwater level was measured at depths from 15 to 33 feet bgs (Elevation 17.5 to 2 feet) in the borings, these measured depths may not represent stabilized conditions. The groundwater elevation could be influenced by seasonal rainfall, wet and dry seasons, or climate change.

Based on our understanding of the site and the observed levels, we conclude a design high groundwater level of Elevation 20 feet is appropriate. This corresponds to depths of about 10½ to 16 feet below existing ground surfaces.

## 8.5 Corrosion Potential

Because corrosive soil can adversely affect underground utilities and foundation elements, laboratory testing was performed during previous investigations to evaluate the corrosivity of the near-surface soil. Cerco Analytical of Concord, California, performed tests on a soil sample to evaluate corrosion potential to buried metals and concrete. On the basis of the resistivity measurements, the near-surface soils were found to be moderately corrosive to corrosive. The results of the tests are presented in Appendix D and summarized in Table 5.

Unprotected steel elements placed below grade will corrode; protection of foundations, utilities, and other structural elements, which extend into these layers, will be required. A corrosion specialist should be retained to develop long-term corrosion control recommendations for the selected foundation system and proposed construction materials for the underground site utilities.

## TABLE 5

## Summary of Corrosivity Test Results

| Test Boring | Sample Depth (feet) | pH | Sulfate (mg/kg) | Resistivity (ohm-centimeter) | Chloride (mg/kg) | Redox Potential (mV) |
|---|---|---|---|---|---|---|
| R2-4 | 2.5 | 6.9 | 65 | 3,000 | 39 | 330 |
| P-5 | 2.5 | 7.9 | 210 | 1,100 | N.D. | 360 |

N.D. = None Detected

### 8.6 Construction Considerations

As previously discussed, the fill encountered at the site generally consists of medium to very stiff clay with varying amounts of sand and gravel with interbedded layers of medium dense to very dense sand and gravel with varying fines contents. This material can be excavated with conventional earth-moving equipment such as loaders and backhoes.

Where encountered, the bedrock was generally crushed to closely fractured with low to moderate hardness, and could be drilled using standard auger drilling equipment (specialty rock bits or cores were not required). However, the possibility exists that harder, more intact inclusions of rock will be encountered at the site than what was encountered in the borings. Where there will be shallow excavations, such as elevator pits, footings, and utility trenches, we judge it is likely that most of the bedrock should be excavatable or rippable using conventional or heavy duty equipment, such as a Caterpillar D9R with a single or multi shank No. 9 ripper. However, we anticipate additional equipment, such as a hydraulic hoe ram or jackhammer, may be required in some areas, especially narrow trenches and deeper excavations, to facilitate excavation and rippability.

During excavation, debris, concrete rubble, and foundation elements from previous structures that occupied the site may be encountered. Hoe-rams, jack-hammers, and other similar equipment could be needed to remove some of the larger obstacles and/or foundation elements. Soil containing hazardous material could be encountered during excavation and foundation installation. If encountered, these materials will require special handling and disposal.

We understand there are historically significant homes in the neighborhood southwest of the site. Construction activities could cause vibrations, which may cause settlement of the fill materials and/or could adversely affect nearby improvements. During ground improvement and/or deep foundation pre-production test programs and throughout construction, vibration monitoring should be performed to check for vibrations and evaluate the attenuation with distance from the construction activities. These programs should be reviewed by the geotechnical engineer, the general contractor and their ground improvement/foundation subcontractors to assess whether modifications need to be made to the construction activities to reduce the potential for damage to nearby improvements. The conditions of buildings and improvements within 150 feet of the site should be photographed and surveyed to document existing conditions prior to the start of construction and monitored periodically during construction. In addition, construction activities can create a high level of noise. Time and day of specific construction activities may be restricted.

## 9.0 RECOMMENDATIONS

Our recommendations regarding earthwork, foundations, ground improvement, floor slabs, pavement design, construction monitoring, seismic design, and other geotechnical aspects of this project are presented in the following sections.

### 9.1 Earthwork

This section presents earthwork recommendations for site preparation and grading. We anticipate earthwork will consist of site preparation, subgrade preparation for slabs and pavements, excavation for footings, engineered fill placement, backfill utility trenches, overexcavations, and general site grading.

#### 9.1.1 Site Preparation

Site demolition should include the removal of all slabs, foundations, retaining walls, pavements, utilities, and other below-grade improvements that will interfere with the proposed construction. Following demolition or removal of existing structures, all areas to receive fill and improvements should be prepared in accordance with subgrade preparation recommendations in Section 9.1.3.

Demolished asphalt and concrete at the site may be crushed to provide recycled construction materials, including sand and Class 2 aggregate base (AB) provided it is acceptable from an environmental standpoint. Where recycled Class 2 AB will be used beneath pavements, it should meet requirements of the current Caltrans Standard Specifications.

Where utilities that are removed extend off site, they should be capped or plugged with lean concrete or cement grout at the property line. Where existing utility lines will not interfere with the planned construction, they may be abandoned in place, provided the lines are filled with lean concrete or cement grout to the limits of the project. Voids resulting from demolition activities should be properly backfilled with engineered fill, as recommended in Section 9.1.4, or lean concrete.

### 9.1.2 Excavation and Cut Slopes

Excavations deeper than five feet entered by workers should be shored or sloped for safety in accordance with the CAL-OSHA standards (29 CFR Part 1926). Inclinations of temporary slopes should not exceed those specified in local, state, or federal safety regulations. As a minimum, the requirements of the current OSHA Health and Safety Standards for Excavations (29 CFR Part 1926) should be followed. The contractor should be responsible for the design, construction, and safety of temporary shoring. We judge that temporary cuts in fill that are less than 10 feet in height, and inclined no steeper than 1.5:1 (horizontal to vertical) should be stable. We should evaluate cuts greater than 10 feet.

Temporary slopes should not be open for an extended period of time. If temporary slopes are open for extended periods of time, exposure to weathering and rain could result in sloughing and erosion.

All vehicles and other surcharge loads should be kept at least 10 feet away from the top of temporary slopes. During construction, the slopes should be protected from excessive saturation by rain or other external causes.

### 9.1.3 Subgrade Preparation

The material exposed at the bottom of the proposed excavations and cuts is expected to consist either rock or undocumented fill consisting of mainly medium stiff clay with varying amounts of sand and gravel. Soft or loose soil at the bottom of the excavations should be removed prior to placement of structural concrete. The resulting overexcavation may be backfilled with lean or structural concrete. If overexcavations are required outside the building footprint, they may be backfilled with engineered fill or lean concrete.

Within areas to receive new improvements (such as sidewalks, flatwork, slab-on-grade), we recommend the upper eight inches of the existing subgrade soil be scarified, moisture-conditioned to above optimum moisture content, and compacted to at least 90 percent relative compaction. The upper six inches in pavement areas should be compacted to at least 95 percent relative compaction. Clean sand (with less than 10 percent passing the No. 200 sieve) should also be compacted to 95 percent relative compaction. If the compacted subgrade is disturbed during utility trench or foundation installation, the subgrade should be re-rolled to provide a smooth, firm surface for slab support.

### 9.1.4 Engineered Fill Placement and Compaction

We anticipate earthwork will consist of fill placement and compaction, and utility trench backfill. Excavated on-site soil is generally not suitable from a geotechnical perspective for reuse as engineered fill or backfill due to the moderate expansion potential of the soil. However, this soil may be used as general fill outside of the building footprint if at least 12 inches of material is placed over it, provided that material meets the requirements herein. All materials to be used as engineered fill should have a low corrosion potential (unless the corrosion potential has been designed for), be non-hazardous, free of organic material, contain no rocks or lumps larger than three inches in greatest dimension, and have a low to moderate expansion potential (defined by a liquid limit of less than 40 and a plasticity index lower than 12), and is approved by Langan.

Fill should be placed in lifts not exceeding eight inches in loose thickness and compacted to at least 90 percent relative compaction[4]. However, if the total fill thickness will be thicker than five feet or the fill contains less than 10 percent fines (percent passing the No. 200 sieve) the fill should be compacted to at least 95 percent relative compaction.

During construction, we should check that the on-site and any proposed import material is suitable for use as fill; we expect that much of the on-site soil will likely be acceptable for re-use as engineered fill provided that it is free of hazardous material. Corrosivity tests indicate that the existing fill at the site is moderately corrosive to corrosive. Therefore, if it is placed around buried iron, steel, cast iron, ductile iron, galvanized steel, dielectric coated steel, or iron, the metal should be properly protected against corrosion. More information about the corrosivity of the fill is outlined in Appendix D.

Flowable cement grout, lean concrete, lightweight cellular concrete, or geofoam may be used to backfill areas not accessible to compaction equipment. Uniformly-graded, clean, ½- to ¾-inch crushed rock or angular gravel may also be used as backfill in these areas provided it is tamped in place and wrapped in filter fabric to prevent the migration of fines.

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[4] Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557 laboratory compaction procedure.

All rigid, flexible, and interlocking pavements should be underlain by aggregate base thicknesses, as described in Section 9.5, compacted to at least 95 percent relative compaction. The aggregate base materials can contribute to the thickness of engineered fill.

Langan should approve all sources of fill at least three days before use at the site. The grading contractor should provide analytical test results or other suitable environmental documentation indicating the imported fill is free of hazardous materials at least three days before use at the site. If this data is not available, up to two weeks should be allowed to perform analytical testing on the proposed import material. A bulk sample of approved fill should be provided to us at least three working days before use at the site in order to obtain a compaction curve (ASTM D 1557).

### 9.1.5 Utilities and Utility Trenches

Utility trench excavations should conform to the current OSHA requirements for side slopes, shoring, and other safety concerns. Where necessary, trench excavations should be shored and braced, in accordance with all safety regulations, to prevent cave-ins. The thickness and type of bedding material required for utility conduits will depend on the soil or rock conditions at the utility trench bottom. As a minimum, bedding should extend at least D/4 (with D equal to the outside pipe diameter) below the bottom of the pipe and should be at least four inches thick. After the pipes and conduits are tested, inspected (if required), and approved, they should be covered to a depth of at least six inches with sand or fine gravel, which should be mechanically tamped to at least 90 percent relative compaction. If backfill material with less than 10 percent fines is used, or if the trench is greater than 5 feet deep, the entire depth of the fill should be compacted to at least 95 percent relative compaction. Jetting of trench backfill should not be permitted. Poor compaction could cause excessive settlements, resulting in damage to the improvements. Special care should be taken when backfilling utility trenches in pavement areas. Utilities should be designed for the corrosive soil conditions if installed in fill.

## 9.2 Foundations

As discussed in Section 8.1, and because of the presence of up to 20 feet of undocumented fill and variable depths to native soil and rock at the site, we recommend the following foundation systems be used:

- shallow foundations bearing in bedrock (or on lean concrete that extends to bedrock)

- shallow foundations on ground improvement bearing solely in either competent native soil or bedrock (for each individual structure, the ground improvement should extend to similar material)
- deep foundations to bedrock

Considering variable rock depths within portions of the site, a combination of shallow foundations, shallow foundations over ground improvement, and/or deep foundations, all bearing in rock, may be used across a single building footprint. As previously discussed, ground improvement elements may bear in competent native material, provided that ground improvements elements for a single structure bear in the same material i.e. competent native soil or bedrock. The general contractor and structural engineer should review Figures 3a and 3b (depth/elevation of bottom of fill) and Figures 4a and 4b (depth/elevation of top of bedrock) and determine the most appropriate foundation type(s).

### 9.2.1 Shallow Foundations

Footings bearing on bedrock may be designed for an allowable bearing capacity of 10,000 pounds per square foot (psf) for dead plus live loads, with a one-third increase for total design loads, including wind and/or seismic. The ground improvement design-build contractor should provide estimates of bearing pressures for their system; however, for preliminary estimating, we conclude footings bearing on improved ground, extending into native soil above bedrock, or into bedrock should be able to achieve allowable bearing capacities of 6,000 psf or 10,000 psf, respectively, for dead plus live loads, with a one-third increase for total design loads, including wind and/or seismic.

Overexcavations to remove soft, wet, loose, or otherwise deleterious material may be required to expose competent bearing material. The overexcavations should be backfilled with lean concrete. Allowable bearing capacity for improved ground should be confirmed by the design-build contractor. To design footings/mats using the modulus of subgrade reaction method, we recommend moduli of subgrade reaction of 240 kips per cubic foot (kcf) for a mat bearing on bedrock. For mats/footings bearing on ground improvement extending to native soil or bedrock, we judge moduli of 72 or 120 kcf, respectively, are appropriate starting points; these values should be reviewed and confirmed by ground improvement design-build contractor. The modulus value is representative of the anticipated settlement under the building loads. After the foundation analysis is completed, we should review the computed settlement and bearing pressure profiles to check that the modulus value is appropriate.

Continuous footings should be at least 18 inches wide and isolated footings should be at least 24 inches wide. Footings should be bottomed at least 12 inches into rock. Ground improvement elements should extent at least 12 inches into native competent soil or rock. If lean concrete is used to extend footings to rock, the lean concrete should also extend 12 inches into rock and should have a compressive strength of at least 150 psi. Footings adjacent to utility trenches or other footings should bear below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the utility trench or adjacent footings.

### 9.2.2 Deep Foundations

Where the finished floor of buildings will be sufficiently above the top of bedrock, we recommend structures be supported on deep foundations consisting of ACIP piles. The piles would gain support through friction and end-bearing in bedrock.

#### *9.2.2.1 Axial Capacity of Deep Foundations*

Auger-Cast-in-Place (ACIP) piles in the San Francisco Bay Area are also designed and installed by design-build contractors. Therefore, we can only provide preliminary capacities; the foundation should be bid on a performance criteria basis. The piles will primarily gain capacity from skin friction in the stiff to hard clay and from a combination of skin friction and end bearing in bedrock. The vertical and lateral capacities presented below for auger cast piles are preliminary and may be used in pricing and estimating. Final design capacities should be verified by a load test program as discussed in Section 9.2.2.2.

For ACIP capacity estimating purposes, we recommend using ultimate skin friction values of 500 psf in the undocumented fill, 1,500 psf in the native soil and 5,000 psf in bedrock and a preliminary ultimate value of 20,000 psf end-bearing in bedrock could be used. Final design axial pile capacities for auger cast piles should be determined by the design-build contractor and confirmed by load testing. Load tests should be performed to confirm the allowable compression and uplift capacities. Factors of safety of 2.0 for dead plus live sustained loads and 1.5 may be used for total loads including seismic should be applied to ultimate load test values to obtain allowable, design values.

Piles should be spaced at least three pile diameters center-to-center to prevent vertical capacity reductions due to pile group interaction effects; the outer auger-tip diameter should be used when determining the pile spacing for auger cast piles. The piles should also be designed to account for the presence of corrosive soil; a corrosion consultant should be retained to provide specific recommendations regarding the long term corrosion protection of pile elements.

#### *9.2.2.2 Indicator and Test Pile Program*

We recommend a test pile program be performed to provide data for choosing production pile lengths. Test piles may be installed at column locations and can be used for support of the buildings. Test piles should be installed at locations selected by us and approved by the structural engineer. They should be installed with the same equipment that will be used to install the production piles.

We recommend at least one compression load tests and one tension load test per building be performed. The static compression load tests should be performed in accordance with ASTM D1143 and the tension tests should be performed in accordance with ASTM D3689. Equipment used for the test (load frame, jacks, and reaction piles) should be capable of applying at least two times the allowable dead plus live design load plus the contribution in soil friction and at least 1.5 times the total design load plus the contribution in soil friction. The load tests should be interpreted using accepted criteria per the 2019 CBC to determine the ultimate capacities of the piles. The test pile locations should be selected by us and approved by the structural engineer.

### 9.2.3 Lateral Load Resistance

#### *9.2.3.1 Lateral Load Resistance of Shallow Foundations and Pile Caps*

Lateral loads can be resisted by a combination of passive resistance acting against the vertical faces of the footings, mats or pile caps and friction along their bases.

The passive pressure mobilized against pile caps and shallow foundations/other below-grade elements is a function of the height (thickness) of the pile cap/below-grade element and the lateral movement of the pile cap/below-grade element. Table 6 presents the passive resistance and deformation relationship for use on this project based on the relationship presented in ASCE 41-17.

Passive resistance may be calculated using a uniform ultimate pressure (rectangular distribution) of 1,000 psf for undocumented fill, 2,000 psf in stiff to very stiff native soils, and 3,500 psf in bedrock; these values are for soils above the water table. The upper foot of soil should be ignored unless confined by a concrete slab or pavement. These ultimate passive pressures do not incorporate a factor of safety; they are, instead, intended to be used in the development of deformation-dependent spring values. If a deformation-based approach is not used, a factor of safety of 1.5 should be applied to the ultimate passive resistances discussed above.

## TABLE 6
## Passive Resistance and Deformation Relationship

| Deformation (δ/H) | $P / P_{ult}$ |
|---|---|
| 0.0 | 0.00 |
| 0.002 | 0.32 |
| 0.005 | 0.46 |
| 0.01 | 0.55 |
| 0.02 | 0.70 |
| 0.03 | 0.83 |
| 0.04 | 0.90 |
| 0.05 | 0.96 |
| 0.06 | 1.00 |

Notes: 1. δ/H denotes the ratio of lateral deformation (δ) over the height of the foundation element (H).

2. $P/P_{ult}$ denotes the ratio of mobilized passive resistance over the ultimate passive resistance.

To calculate a specific horizontal soil modulus (spring), the structural designer should iterate between the demand loading and allowable deformation performance of the walls.

Frictional resistance should be computed using a base friction coefficient of 0.5 for concrete to rock interfaces, or 0.3 if waterproofing is placed below the mat or footings if waterproofing is not used. These values represent ultimate values, i.e. no factor of safety. Mobilization of friction is also deformation-dependent; the full values should be realized at about ¼ inch of lateral movement of the structural element. Frictional stiffness, up to a ¼ inch of movement, can be calculated using the following relationships:

- Frictional Stiffness where waterproofing is used = 14 $\times \sigma_v'$, where $\sigma_v'$ = normal load at the base of the mat/footings (psf/ft);
- Frictional Stiffness where waterproofing is not used = 24 $\times \sigma_v'$.

Uplift loads may be resisted by the building loads, weight of the foundation, and any overlying soil. If foundations are inadequate to provide the necessary uplift resistance, drilled elements or anchors may be used. We can provide further uplift recommendations if needed.

### *9.2.3.2 Lateral Load Resistance of Piles*

The piles should develop lateral resistance from the passive pressure acting on the upper portion of the piles and their structural rigidity. The allowable lateral capacity of the piles depends on:

- the pile stiffness
- the strength of the surrounding soil
- the estimated amount of settlement
- axial load on the pile
- the allowable deflection at the pile top and the ground surface
- the allowable moment capacity of the pile.

For estimating lateral capacities, we recommend the soil properties presented in the tables below, for use in the computer program L-Pile produced by Ensoft; if a different program will be used, we should review the appropriateness of this set of soil properties in a different program. We should review the appropriateness of this set of soil properties in a different program. L-Pile soil properties for the Residential 5 development located the east side of the existing Macy's department store (where top of bedrock is deepest) are presented in Table 7. Once a pile size and lateral demand have been determined for this project, we should can be retained to perform additional analyses, as needed.

**TABLE 7**
**L-Pile Input Soil Properties – Residential 5**

| Soil/Bedrock Unit | L-Pile P-Y curve type | Elevation of Top of Layer (feet, NGVD29) | Effective Unit Weight (pcf) | Friction Angle (degrees) | Undrained Cohesion (psf) | $\varepsilon_{50}$ |
|---|---|---|---|---|---|---|
| Undocumented Fill | Stiff Clay without Free Water (Reese) | 33 | 130 | N/A | 1,000 | 0.005 |
| Native Soil | Stiff Clay without Free Water (Reese) | 17 | 53 | N/A | 2,000 | 0.005 |
| Bedrock | Stiff Clay without Free Water (Reese) | 5 | 73 | N/A | 3,500 | 0.005 |

* N/A – Not applicable

The lateral resistances computed using the program LPile are for single piles. Therefore, calculated lateral capacities are only appropriate for on isolated pile or a pile in a pile group with a pile spacing of at least six pile diameters.

To account for group effects, the lateral load capacity of a single pile should be multiplied by the appropriate reduction factors shown on Table 8. However, the maximum bending moment for a single pile with an unfactored load should be used to check the design of individual piles in a group. The reduction factors are based on a minimum center-to-center spacing of three piles diameters. Reduction for other pile group spacing can be provided once the number and arrangement of piles are known.

**TABLE 8**
**Lateral Group Reduction Factors**

| Number of Piles | Lateral Group Reduction Factor |
|---|---|
| 2 | 0.9 |
| 3 to 5 | 0.8 |
| ≥6 | 0.7 |

## 9.3 Ground Improvement

Where ground improvement is used for foundation support, the ground improvement should extend at least one foot into the native soil or bedrock. A qualified, design-build, specialty contractor, who has previously successfully performed ground improvement in similar subsurface soil conditions, should design and perform the ground improvement. We recommend the contractor be presented with our recommendations and the results of our site exploration.

If CAP or DDC ground improvement is used to support building loads, the ground improvement elements should be designed with sufficient strength and bearing to provide a bearing capacity factor of safety of at least 2.0 under dead plus live loads. The actual calculated bearing pressures from the project structural engineer should be used for this calculation. We recommend a minimum unconfined compressive strength (UCS) of 500 psi at 28 days for the CLSM used to construct DDCs; higher UCS may be required, depending on the foundation load requirements.

Installation of CAPs and DDCs will cause vibrations on adjacent sites. These vibrations can cause settlement of the fill materials surrounding the site or could adversely affect nearby improvements. We recommend that the conditions of buildings and improvements within 50 feet of the site be photographed and surveyed to document existing conditions prior to the start of construction and that they be monitored during the test section. Based on the results of the vibration monitoring during the test section, periodic vibration monitoring may also be required during production. The design-build contractor should determine the offset needed to prevent damage to adjacent buildings; however, at a minimum a 10-foot offset should be used for installing ground improvement elements adjacent to existing buildings.

We should be involved throughout the ground improvement contractor bidding and selection process and provide additional detailed recommendations and input on specifications and procedures.

### 9.3.1 Ground Improvement Criteria, Requirements, and Quality Control

We recommend at least two compression load tests per building be performed on ground improvement elements prior to production installation. Additionally, if the DDC elements will be used to resist uplift loads, we recommend at least one load test in tension be performed per building. We should choose the locations of the tests and review the ground improvement contractor’s submittals for the proposed testing procedures.

Compression load tests should be performed in accordance with ASTM D1143, and the tension tests should be performed in accordance with ASTM D3689. We should review the load test parameters and confirm that the CAP or DDC elements have an acceptable factor of safety. We should also observe the installation and testing of the CAP or DDC elements. The installation of ground improvement elements should be consistent with the installation methods used to install the test sections.

## 9.4 Floor Slabs

Although the near-surface soil over large portions of the site is undocumented fill, we judge it is adequate to support new building slabs-on-grade. Likewise, where the building bears directly on native soil and/or bedrock, the slabs may be supported on grade. Slab-on-grade subgrade should be prepared as discussed in Section 9.1.3.

Moisture is likely to condense on the underside of the slabs, even though they will be above the design groundwater table. Consequently, a moisture barrier should be installed beneath the slabs if movement of water vapor through the slabs would be detrimental to its intended use. A typical moisture barrier consists of a capillary moisture break and a water vapor retarder. A capillary moisture break consists of at least four inches of clean, free-draining gravel or crushed rock. The vapor retarder should meet the requirements for Class C vapor retarders stated in ASTM E1745. The vapor retarder should be placed in accordance with the requirements of ASTM E1643. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder. The particle size of the gravel/crushed rock and sand should meet the gradation requirements presented in Table 9.

**TABLE 9**
**Gradation Requirements for Capillary Moisture Break**

| Sieve Size | Percentage Passing Sieve |
|---|---|
| *Gravel or Crushed Rock* | |
| 1 inch | 90 – 100 |
| 3/4 inch | 30 – 100 |
| 1/2 inch | 5 – 25 |
| 3/8 inch | 0 – 6 |

If moisture is acceptable on the slab, the capillary break and vapor retarder can be replaced with at least 4 inches of Class 2 AB.

Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and results in excessive vapor transmission through the slab. Therefore, concrete for the floor slab should have a low w/c ratio - less than 0.45. The slab should be properly cured. Before the floor covering is placed, the contractor should check that the concrete surface and the moisture emission levels (if emission testing is required) meet the manufacturer’s requirements.

### 9.5 Pavement Design and Concrete Flatwork

We recommend that the exposed soil subgrade for exterior slabs, concrete flatwork, pavers and pavements be prepared in accordance with our recommendations in 9.1.3.

All rigid, flexible, and interlocking pavements should be underlain by aggregate base thicknesses as detailed in the following subsections and compacted as described in Section 9.1.4

Additional recommendations regarding rigid, flexible, and interlocking pavement, as well as permeable pavers, are included in the following subsections.

### 9.5.1 Rigid Pavement

Recommended thickness for Portland cement concrete pavement (PCCP) in vehicular areas, for various service levels are presented in Table 10. The concrete should be underlain by at least six inches of Class 2 aggregate base.

**TABLE 10**
**Portland Cement Concrete**

| **Service Level** | **Portland Cement Concrete (inches)** |
|---|---|
| Light<br>(Schools, office buildings, etc.) | 5.0 |
| Medium<br>(Shopping centers, commercial areas with truck service drives) | 6.0 |
| Heavy<br>(Industrial) | 7.0 |

The modulus of rupture of the Portland cement concrete should be at least 500 pound per square inch (psi) at 28 days (corresponds to a 28-day unconfined compressive strength of about 3,000 psi). Contraction joints should be constructed at 15-foot spacing. Where the outer edge of a concrete pavement meets asphalt pavement, the concrete slab should be thickened by 50 percent at a taper not to exceed a slope of 1 to 10. The slab edges should be confined by curbs or pavement, and slabs should have dowels connecting adjacent slabs. In addition, at areas subject to vehicles with heavy axle loads, we recommend the slabs be reinforced with a minimum of No. 4 bars at 16-inch-spacing in both directions. Recommendations for subgrade preparation and aggregate base compaction are described in Section 9.1.3.

### 9.5.2 Flexible Pavement

The State of California flexible pavement design method was used to develop the recommended asphalt concrete pavement sections. We expect the final soil subgrade in asphalt-paved areas will generally consist of clay or clayey sand. A laboratory test indicates that the near-surface soil has a resistance value (R-value) of 7.

The State of California resistance value (R-value) method for asphaltic concrete (AC) pavement design was used to develop recommendations for asphalt concrete pavement sections.

Recommendations for pavement sections for Traffic Indices (TI) ranging from 4.0 to 8.0 are presented in Table 11, based on an R-Value of 7. We can provide pavement section recommendations for other TIs, if requested by the project civil engineer.

### TABLE 11

### AC Pavement Section
### R-Value = 7

| TI | Asphalt Concrete (inches) | Class 2 Aggregate Base (R=78) (inches) |
|---|---|---|
| 4.0 | 3.0 | 6.5 |
| 5.0 | 3.5 | 8.5 |
| 6.0 | 3.5 | 12.5 |
| 7.0 | 4.0 | 15 |
| 8.0 | 5.0 | 17 |

Recommendations for subgrade preparation and aggregate base compaction are described in Section 9.1.3.

## 9.6 Site Drainage

Positive surface drainage should be provided around the buildings so that surface runoff is not permitted to pond, particularly adjacent to foundations, roadways, pavements, retaining walls, or slabs. Surface runoff should be directed away from foundations and other improvements and collected in lined ditches or drainage swales. In addition, roof downspouts should be discharged into controlled drainage facilities to keep the water away from the foundations. The water collected should be directed to a storm drain or stormwater detention areas.

## 9.7 2019 California Building Code Site Class and Seismic Design Criteria

In accordance with the 2019 California Building Code (CBC) and ASCE 7-16, we recommend the new buildings be designed using seismic Site Class C or D depending on the thickness of fill in the vicinity of the structure. Figure 7 presents a delineation plan indicating areas where Site

Class C or Site Class D should be used for design. For seismic design in accordance with the provisions of 2019 CBC, we recommend the following:

Site Class C:

- Risk-Targeted Maximum Considered Earthquake ($MCE_R$) $S_s$ and $S_1$ of 1.500g and 0.600g, respectively.
- Site Coefficient $F_a$ and $F_v$ of 1.2 and 1.4, respectively, assuming the structure meets the exceptions of Section 11.4.8;
- $MCE_R$ spectral response acceleration parameters at short periods, $S_{MS}$, and at one-second period, $S_{M1}$, of 1.8g and 0.84g, respectively
- Design Earthquake (DE) spectral response acceleration parameters at short period, $S_{DS}$, and at one-second period, $S_{D1}$, of 1.2g and 0.56g, respectively.
- $PGA_M$ of 0.605g

Site Class D:

- Risk-Targeted Maximum Considered Earthquake ($MCE_R$) $S_s$ and $S_1$ of 1.500g and 0.600g, respectively.
- Site Coefficient $F_a$ and $F_v$ of 1.0 and 2.5, respectively, assuming the structure meets the exceptions of Section 11.4.8;
- $MCE_R$ spectral response acceleration parameters at short periods, $S_{MS}$, and at one-second period, $S_{M1}$, of 1.500g and 1.500g, respectively
- Design Earthquake (DE) spectral response acceleration parameters at short period, $S_{DS}$, and at one-second period, $S_{D1}$, of 1.000g and 1.000g, respectively.
- $PGA_M$ of 0.554g

During the design-level study of the project, the project structural engineer will need to determine if the structure meets the exceptions in Section 11.4.8 of ASCE 7-16. If the structure does not meet the exceptions in Section 11.4.8 of ASCE 7-16, site-specific spectra will be required.

## 10.0 ADDITIONAL SERVICES DURING DESIGN, CONSTRUCTION DOCUMENTS, AND CONSTRUCTION QUALITY ASSURANCE

Langan should be retained to consult with the design team as geotechnical questions arise during final design. Technical specifications and design drawings should incorporate Langan's recommendations. Langan should assist the design team in preparing specification sections related to geotechnical issues such as earthwork, foundations, and excavation support. Langan should review the project plans, as well as Contractor submittals relating to materials and construction procedures for geotechnical work, to check that the designs incorporate the intent of our recommendations.

Langan has investigated and interpreted the site subsurface conditions and developed the foundation design recommendations contained herein, and is therefore best suited to perform quality assurance observation and testing of geotechnical-related work during construction. The work requiring quality assurance confirmation and/or special inspections per the Building Code includes, but is not limited to, earthwork, backfill, installation of ground improvement, and shallow foundations and pile installations. We will review monitoring data provided by the surveyor pertaining to settlement of adjacent structures.

Recognizing that construction observation is the final stage of geotechnical design, quality assurance observation during construction by Langan is necessary to confirm the design assumptions and design elements, to maintain our continuity of responsibility on this project, and allow us to make changes to our recommendations, as necessary. The foundation system and general geotechnical construction methods recommended herein are predicated upon Langan reviewing the final design and providing construction observation services for the owner. Should Langan not be retained for construction observation services, we cannot assume the role of geotechnical engineer of record during construction operations, and the entity providing the construction observation services must serve as the engineer of record instead.

## 11.0 CONTRACTOR RESPONSIBILITIES

Construction activities that can alter the existing ground conditions, such as excavation, fill placement, foundation construction, dewatering, etc., can also induce stresses, vibrations, and movements in nearby structures and utilities, and disturb occupants. Contractors should be responsible to ensure that their activities will not adversely affect the structures and utilities. Contractors should also take all necessary measures to protect the existing structures, utilities, etc. during construction.

## 12.0 LIMITATIONS

The conclusions and recommendations provided in this report result from our interpretation of the geotechnical conditions existing at the site inferred from a limited number of borings and data in the vicinity as well as information provided by the project team. Actual subsurface conditions may vary. Recommendations provided are dependent upon one another and no recommendation should be followed independent of the others. Any proposed changes in structures or their locations should be brought to Langan's attention as soon as possible so that we can determine whether such changes affect our recommendations. Information on subsurface strata and groundwater levels shown on the boring logs represent conditions encountered only at the locations indicated and at the time of investigation. If different conditions are encountered during construction, they should immediately be brought to Langan's attention for evaluation, as they may affect our recommendations.

This report has been prepared to assist the Owner, architect, and structural engineer in the design process and is only applicable to the design of the specific project identified. The information in this report cannot be used or depended on by engineers or contractors who are involved in evaluations or designs of facilities on adjacent properties, which are beyond the limits of that which is the specific subject of this report.

# REFERENCES

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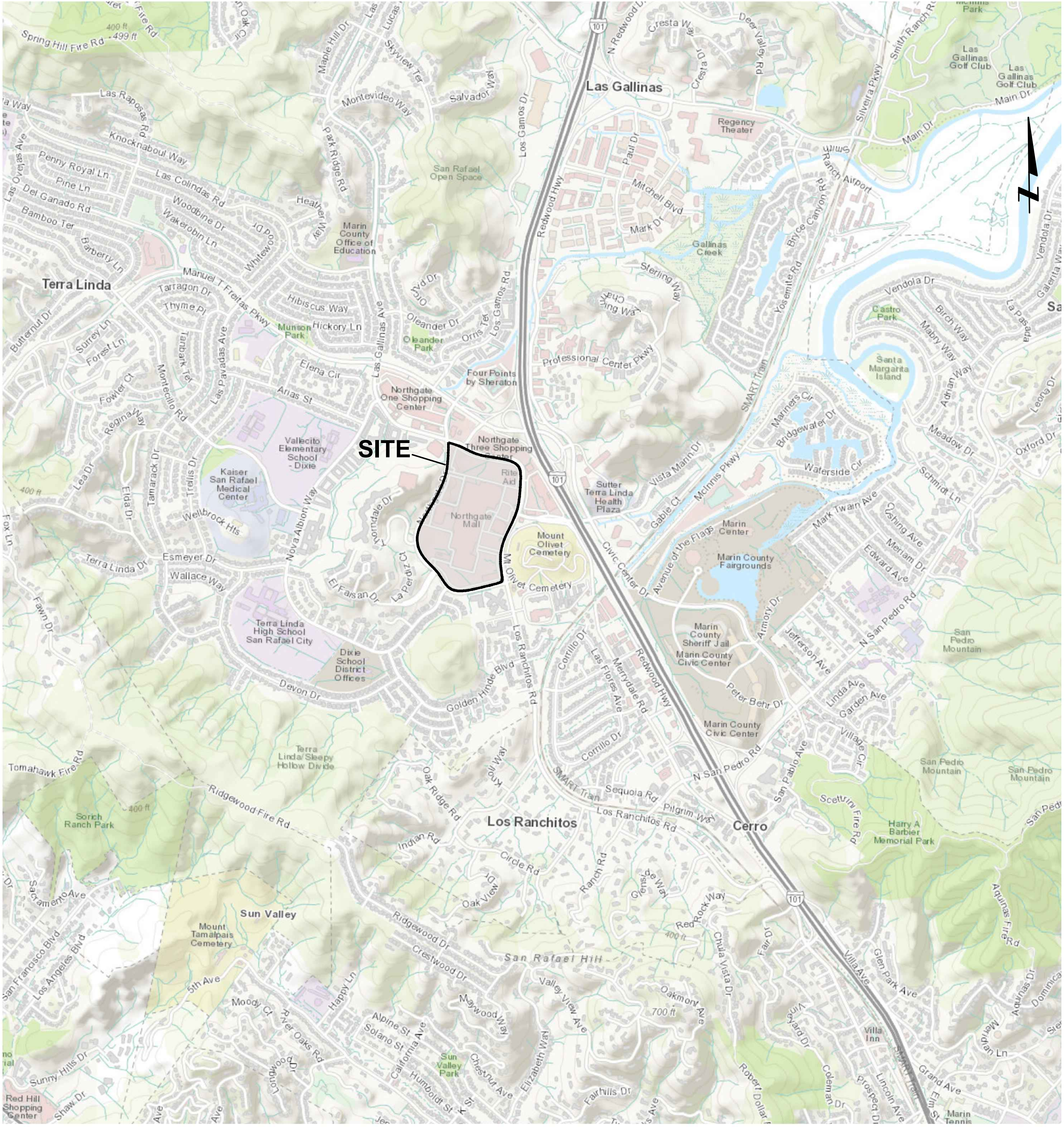
# FIGURES



Note:
Topographic base map is provided through Langan's Esri
Arc GIS software licensing and Arc GIS online,
National Geographic Society, i-cubed.

0 2,000 Feet
Approximate scale

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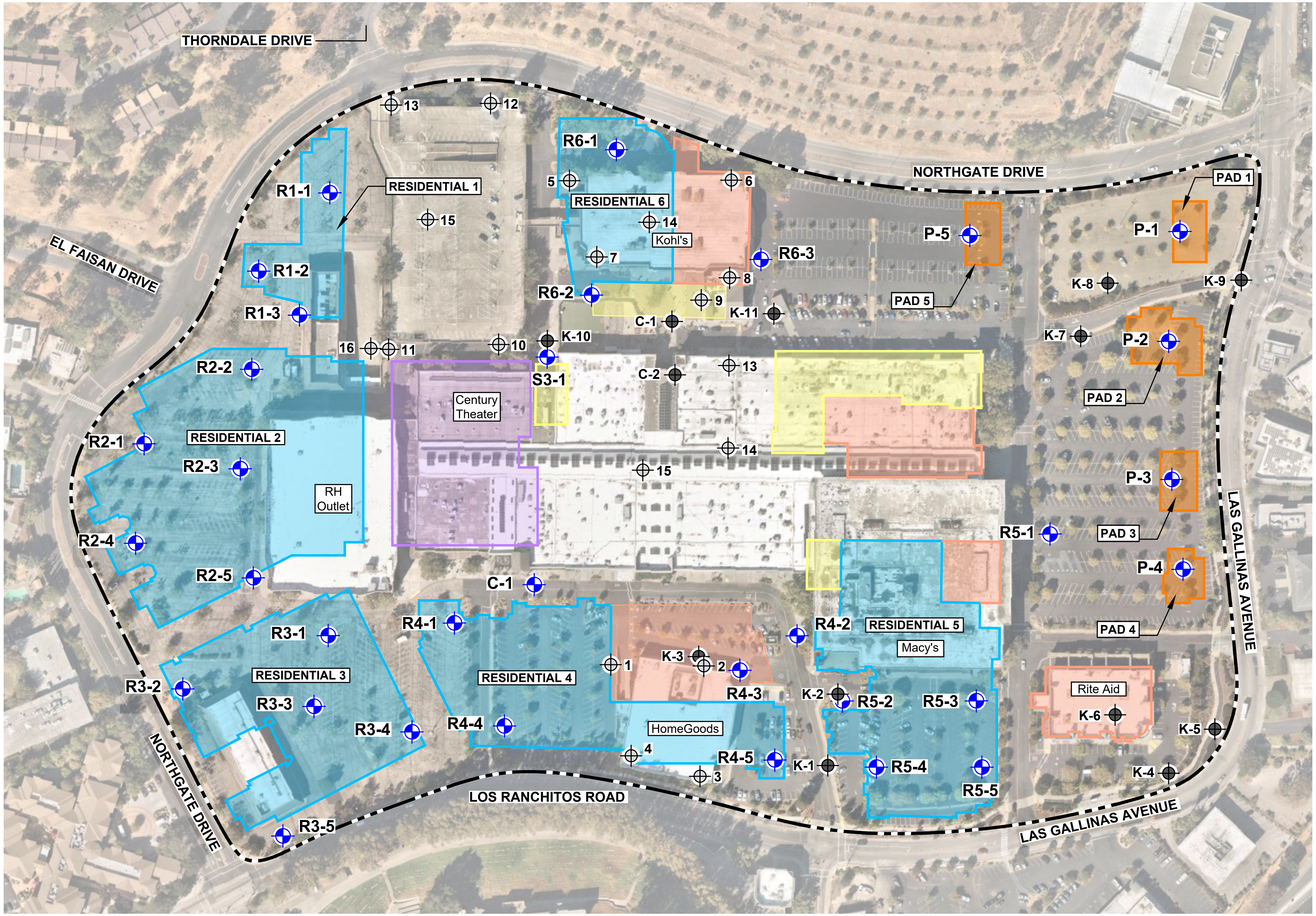
| Project | Figure Title | Project No. | Figure |
|---|---|---|---|
| NORTHGATE TOWN SQUARE<br>SAN RAFAEL<br>MARIN COUNTY CALIFORNIA | SITE LOCATION MAP | 731759601 | 1 |
| | | Date<br>11/11/2021 | |
| | | Drawn By<br>AG | |
| | | Checked By<br>HS | |

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731759601-B-GI0101-SLM-FM-MMS.dwg Date: 11/18/2021 Time: 17:21 User: agekas Style Table: Langan.stb Layout: Figure 1 Site Loc



**EXPLANATION**

| | |
|---|---|
| C-1<br>P-1<br>R1-1<br>S-1 ⊕ | Approximate location of borings by Langan, October and November 2021 |
| C-1<br>K-1 ⊕ | Approximate location of borings by Kleinfelder, August and October 2007 |
| 5 ⊕ | Approximate location of borings by Woodward-Clyde Consultants, October 1982 |
| ▭ | Approximate area of proposed residential parcel |
| ▭ | Approximate area of proposed restaurant pad |
| ▭ | Approximate area of proposed retail shops |
| ▭ | Approximate area of cinema |
| ▭ | Approximate area of anchor stores |
| — · — | Site boundary |

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet

Approximate scale

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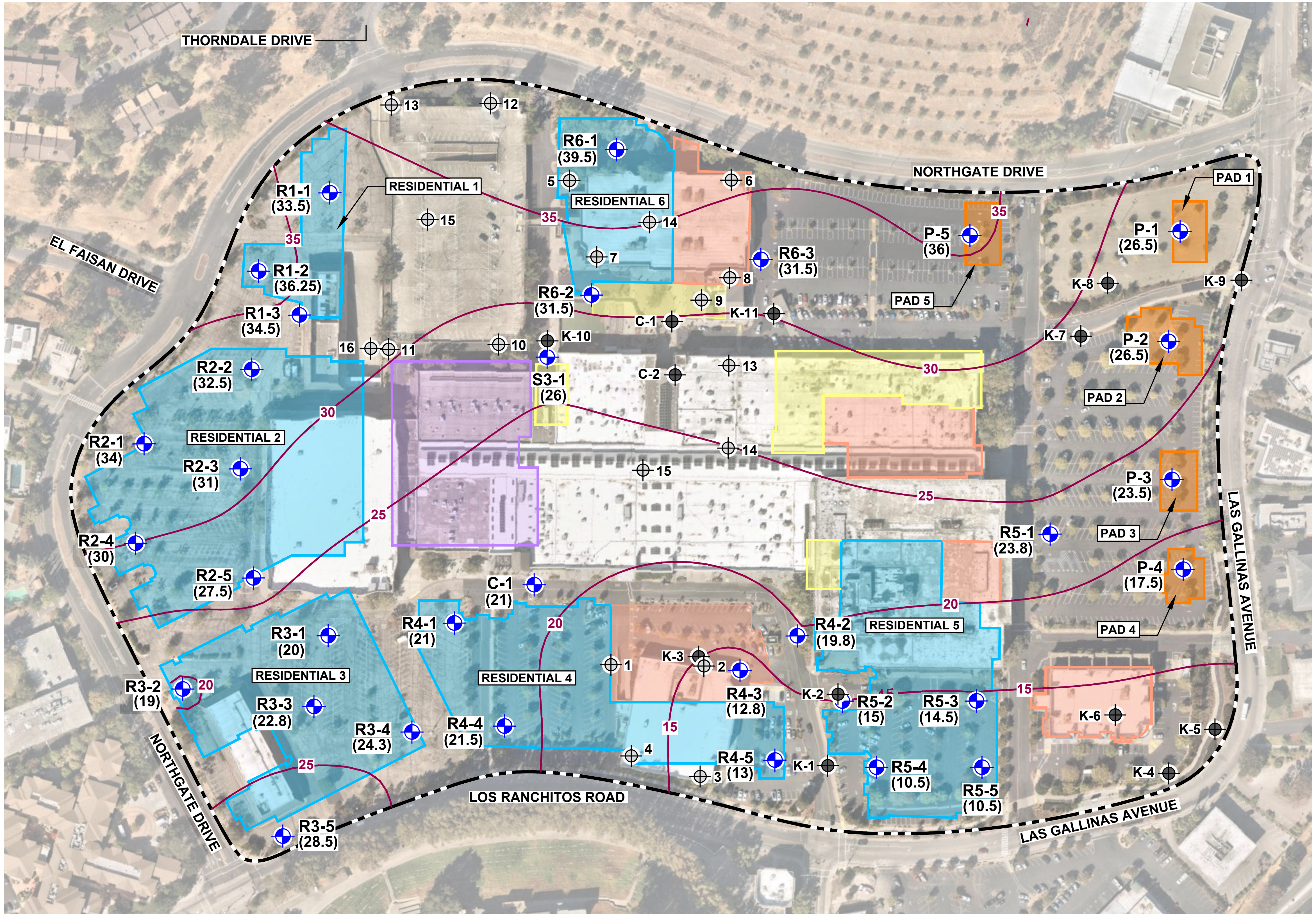
Project
NORTHGATE TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
SITE PLAN

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
2
Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:35 User: agekas Style Table: Langan.stb Layout: Site Plan



## EXPLANATION

| | |
|---|---|
| C-1<br>P-1<br>R1-1<br>S-1 ⊕ | Approximate location of borings by Langan, October and November 2021 |
| (3) | Estimated bottom of fill elevation (feet) |
| C-1<br>K-1 ⊕ | Approximate location of borings by Kleinfelder, August and October 2007 |
| 5 ⊕ | Approximate location of borings by Woodward-Clyde Consultants, October 1982 |
| 🟦 | Approximate area of proposed residential parcel |
| 🟧 | Approximate area of proposed restaurant pad |
| 🟨 | Approximate area of proposed retail shops |
| 🟪 | Approximate area of cinema |
| 🟥 | Approximate area of anchor stores |
| — - — | Site boundary |
| —10— | Datum: North American Vertical Datum of 1988 (NAVD88) |

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet
Approximate scale

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Project
NORTHGATE
TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
CONTOUR OF
BOTTOM OF FILL
ELEVATION

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
3a
Sheet of

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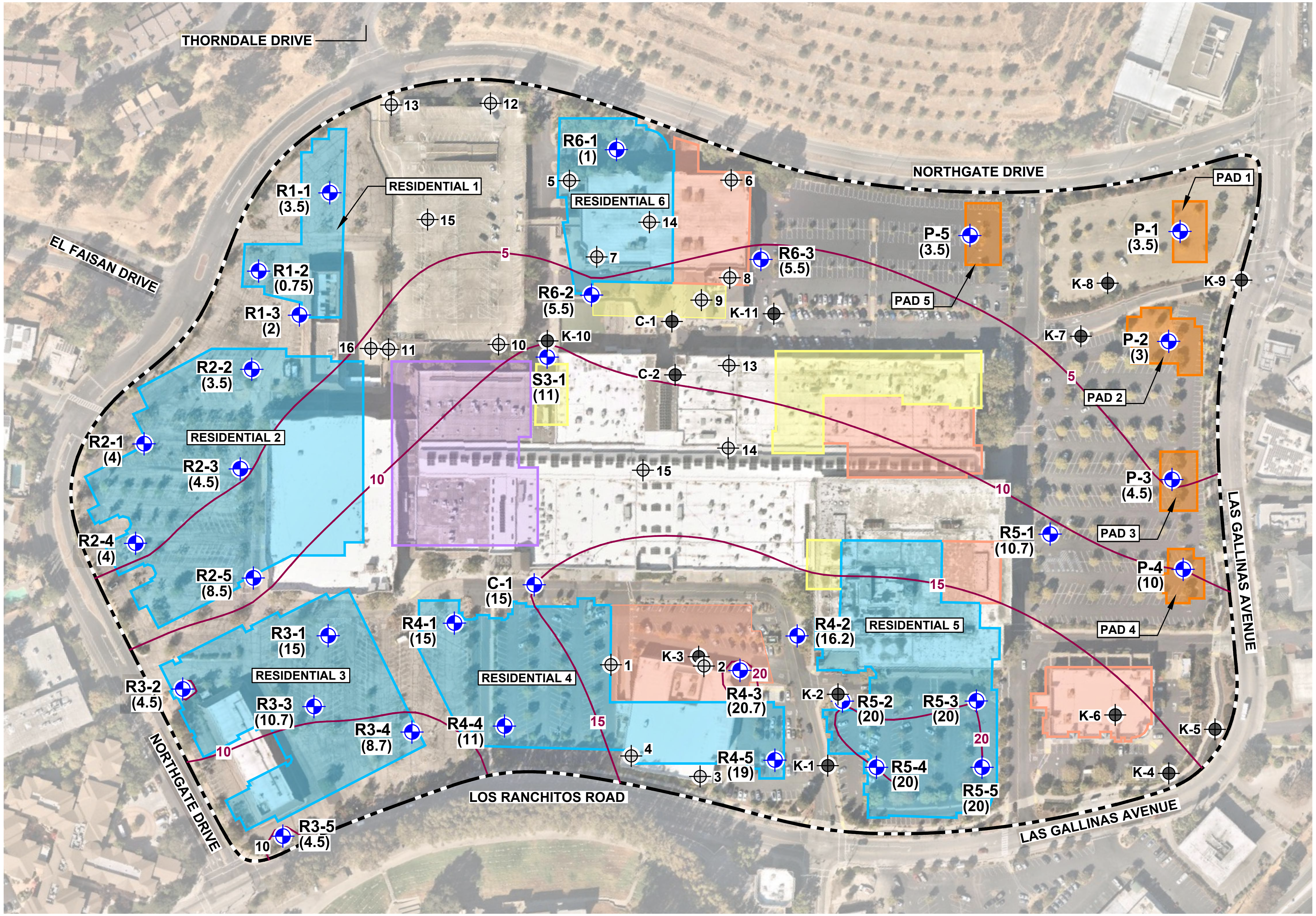

## EXPLANATION

| | |
|---|---|
| C-1<br>P-1<br>R1-1<br>S-1 ⊕ | Approximate location of borings by Langan, October and November 2021 |
| (3) | Estimated depth to bottom of fill below existing ground surface (feet) |
| C-1<br>K-1 ⊕ | Approximate location of borings by Kleinfelder, August and October 2007 |
| 5 ⊕ | Approximate location of borings by Woodward-Clyde Consultants, October 1982 |
| 🟦 | Approximate area of proposed residential parcel |
| 🟧 | Approximate area of proposed restaurant pad |
| 🟨 | Approximate area of proposed retail shops |
| 🟪 | Approximate area of cinema |
| 🟥 | Approximate area of anchor stores |
| — · — · | Site boundary |
| —10— | Depth to bottom of fill contour (feet) |

REFERENCE: Aerial by Nearmaps 2021.

N

0 180 Feet

Approximate scale

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Project
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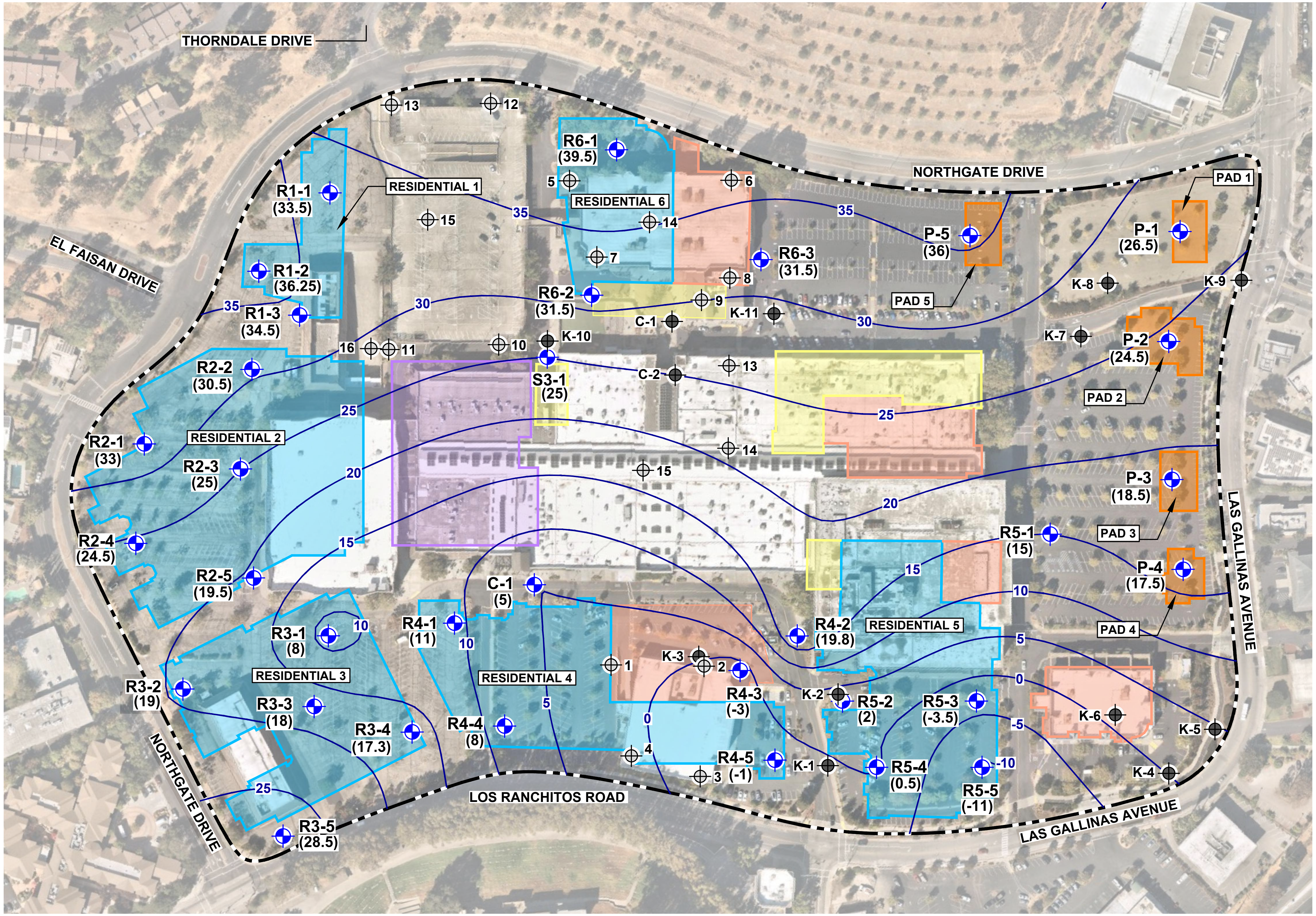
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
CONTOURS OF DEPTH TO BOTTOM OF FILL

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure 3b
Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:33 User: agekas Style Table: Langan.stb Layout: Depth Of FILL_3b



## EXPLANATION

| | |
|---|---|
| C-1<br>P-1<br>R1-1<br>S-1 ⊕ | Approximate location of borings by Langan, October and November 2021 |
| (5) | Estimated top of bedrock elevation (feet) |
| C-1<br>K-1 ⊕ | Approximate location of borings by Kleinfelder, August and October 2007 |
| 5 ⊕ | Approximate location of borings by Woodward-Clyde Consultants, October 1982 |
| 🟦 | Approximate area of proposed residential parcel |
| 🟧 | Approximate area of proposed restaurant pad |
| 🟨 | Approximate area of proposed retail shops |
| 🟪 | Approximate area of cinema |
| 🟥 | Approximate area of anchor stores |
| — · — | Site boundary |
| 10 | Datum: North American Vertical Datum of 1988 (NAVD88) |

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet
Approximate scale

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Project
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MARIN COUNTY CALIFORNIA

Figure Title
CONTOURS OF TOP OF BEDROCK ELEVATION

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
4a
Sheet of

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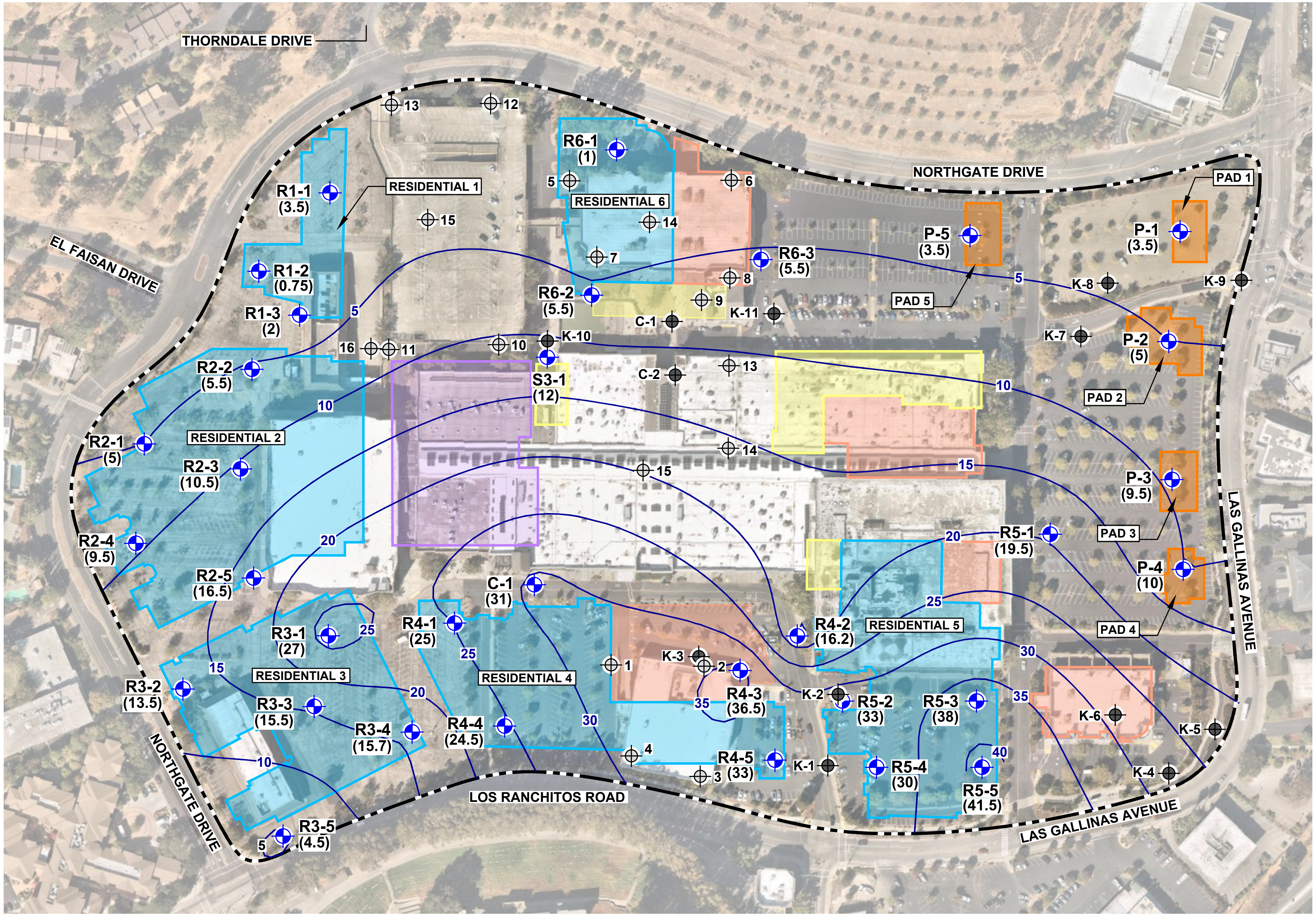

## EXPLANATION

| | |
|---|---|
| C-1<br>P-1<br>R1-1<br>S-1 ⊕ | Approximate location of borings by Langan, October and November 2021 |
| (5) | Estimated depth of top of bedrock below existing ground surface (feet) |
| C-1<br>K-1 ⊕ | Approximate location of borings by Kleinfelder, August and October 2007 |
| 5 ⊕ | Approximate location of borings by Woodward-Clyde Consultants, October 1982 |
| 🟦 | Approximate area of proposed residential parcel |
| 🟧 | Approximate area of proposed restaurant pad |
| 🟨 | Approximate area of proposed retail shops |
| 🟪 | Approximate area of cinema |
| 🟥 | Approximate area of anchor stores |
| — · — · | Site boundary |
| —10— | Depth to top of bedrock contour (feet) |

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet

Approximate scale

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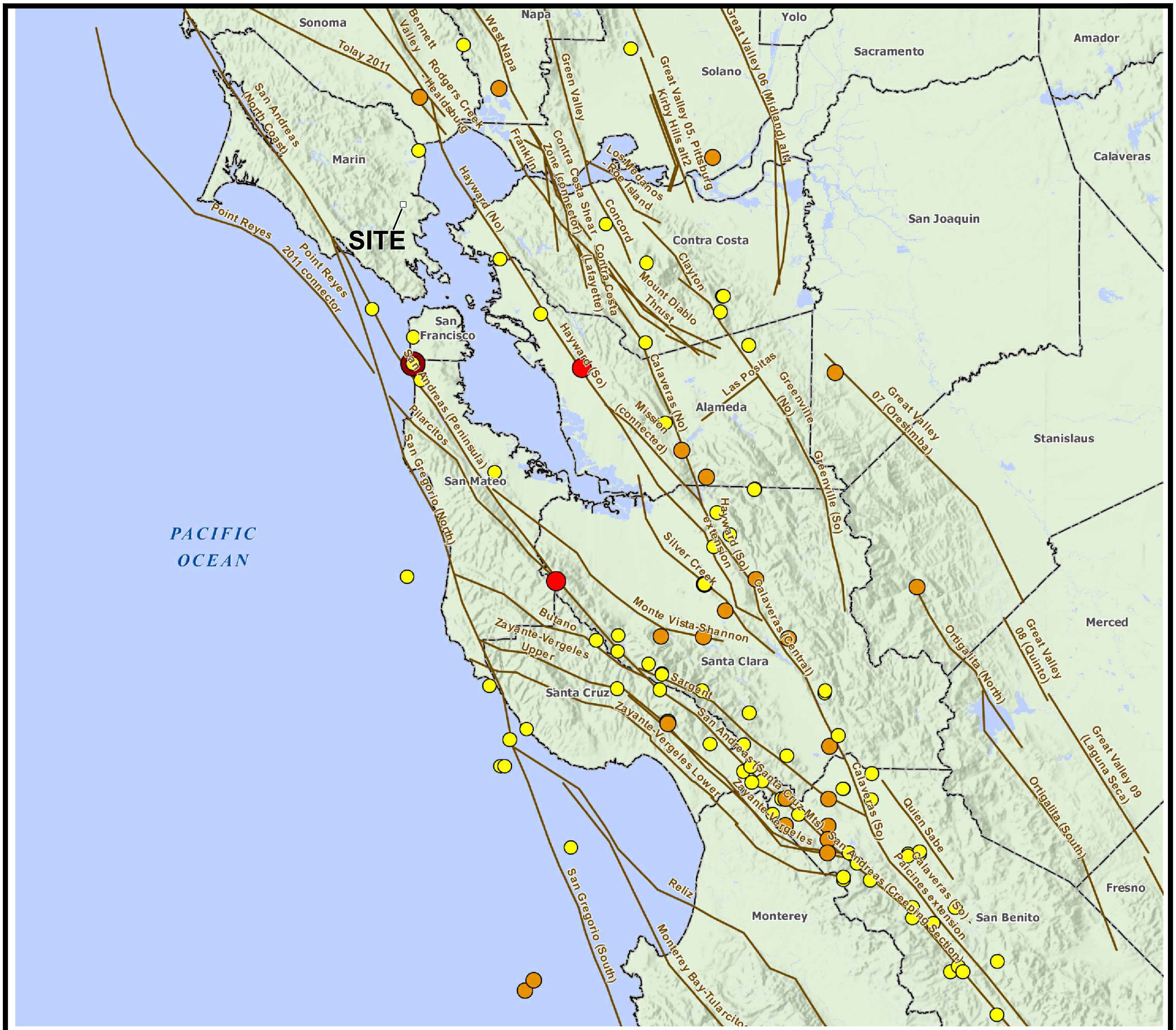
Project
NORTHGATE TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
CONTOURS OF DEPTH TO TOP OF BEDROCK

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure 4b
Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:30 User: agekas Style Table: Langan.stb Layout: Depth Of BEDROCK_4b



## LEGEND

- ⬚ County Boundary
- — Fault

**Earthquake Epicenter Magnitude**

- ● Magnitude 5 to 5.9
- ● Magnitude 6 to 6.9
- ● Magnitude 7 to 7.4
- ● Magnitude 7.5 to 8

0 20 Miles

Approximate scale

**Notes:**

1. Quaternary fault data displayed are provided by the CGS Map Sheet 48: Fault based seismic sources used in the Uniform California Earthquake Rupture Forecast, Version (UCERF3).
2. The Earthquake Epicenter (Magnitude) data is provided by the U.S Geological Survey (USGS) and is current through 2015.
3. Basemap hillshade and County boundaries provided by USGS and California Department of Transportation.
4. Map displayed in California State Coordinate System, California (Teale) Albers, North American Datum of 1983 (NAD83), Meters.

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Project

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TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title

MAP OF MAJOR
FAULTS AND EARTHQUAKE
EPICENTERS IN THE
SAN FRANCISCO BAY AREA

Project No.
731759601
Date
11/11/2021
Drawn By
AG
Checked By
HS

Figure
5

**I Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced.**

Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.

**II Felt indoors by a few people, especially on upper floors of multi-story buildings, and by sensitive or nervous persons.**

As in Grade I, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.

**III Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.**

Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.

**IV Felt indoors by many, outdoors by a few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.**

Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeably.

**V Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.**

Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.

**VI Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.**

Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows break. Knickknacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.

**VII Frightens everyone. General alarm, and everyone runs outdoors.**

People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.

**VIII General fright, and alarm approaches panic.**

Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.

**IX Panic is general.**

Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings - some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.

**X Panic is general.**

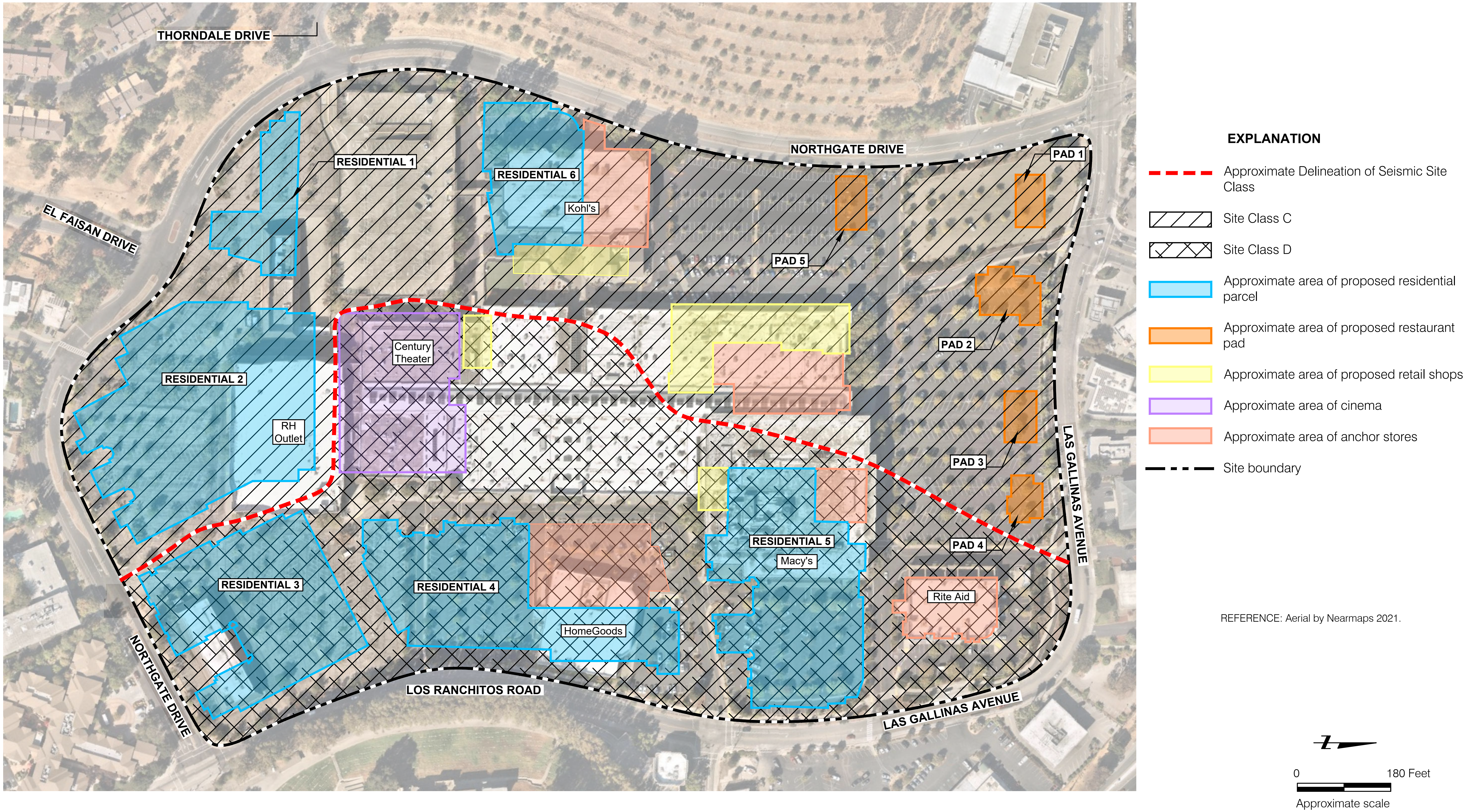
Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.

**XI Panic is general.**

Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially near shock centers, great to dams, dikes and embankments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly and some thrust endwise. Pipe lines buried in earth are put completely out of service.

**XII Panic is general.**

Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.



REFERENCE: Aerial by Nearmaps 2021.

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Project
NORTHGATE
TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
SEISMIC SITE CLASS
DELINEATION PLAN

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
7
Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 17:08 User: agekas Style Table: Langan.stb Layout: Figure 7

# APPENDIX A

# LOGS OF BORINGS

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring C-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2

Date started: 10/29/21

Date finished: 10/29/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches

Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES<br>Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 36 feet[2] | LABORATORY TEST DATA<br>Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| | | | | | | SANDY CLAY (CL)<br>yellow-brown to brown, moist, fine sand [FILL] | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | BAG | ☒ | | | | LL = 26, PI = 11, see Figure C-3 | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | very stiff, sandstone fragments | | | | | | |
| 6 | S&H | ■ | 10<br>10<br>11 | 17 | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | CL | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | gray, with shale fragments | | | | | | |
| 11 | S&H | ■ | 4<br>8<br>10 | 14 | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | SANDY CLAY (CL)<br>light gray with orange mottling, medium stiff to stiff, moist, fine sand | | | | | | |
| 16 | S&H | ■ | 5<br>4<br>6 | 8 | | | PP | | 1,000 | | | |
| 17 | | | | | CL | | | | | | | |
| 18 | | | | | | ∇ (10/29/21, 8:30 AM) | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | ∇ (10/29/21, 7:40 AM) | | | | | | |
| | | | | | | SANDY CLAY (CL)<br>gray-brown, very stiff, wet, fine sand, some fine rounded gravel | | | | | | |
| 21 | S&H | ■ | 12<br>16<br>21 | 29 | | | PP | | >4,500 | | 19.2 | 112 |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | CL | increased gravel content | | | | | | |
| 26 | SPT | ◩ | 5<br>10<br>12 | 29 | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

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Project No.: 731759601

Figure: A-1a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring C-1

PAGE 2 OF 2

| DEPTH (feet) | SAMPLES: Sampler Type | SAMPLES: Sample | SAMPLES: Blows/ 6" | SAMPLES: SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft | LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft | LABORATORY TEST DATA: Fines % | LABORATORY TEST DATA: Natural Moisture Content, % | LABORATORY TEST DATA: Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | SPT | ◩ | 8<br>16<br>25 | 54 | CL | SANDY CLAY (CL) (continued)<br>hard | | | | | | |
| | | | | | | SANDSTONE and SHALE<br>yellow-brown to brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK] | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | |
| 35 | SPT | ◩ | 50/<br>4" | 66/<br>4" | | gray, moderately hard, moderately strong, little weathered | | | | | | |
| 36 | | | | | | | | | | | | |
| 37 | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | |
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| 56 | | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 35.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

**LANGAN**

Project No.: 731759601

Figure: A-1b

| PROJECT: | **NORTHGATE TOWN SQUARE**<br>**San Rafael, California** | **Log of Boring P-1**<br>PAGE 1 OF 1 |
|---|---|---|

Boring location: See Site Plan, Figure 2

Date started: 11/3/21 | Date finished: 11/3/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES<br>Sampler Type | SAMPLES<br>Sample | SAMPLES<br>Blows/ 6" | SAMPLES<br>SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA<br>Type of Strength Test | LABORATORY TEST DATA<br>Confining Pressure Lbs/Sq Ft | LABORATORY TEST DATA<br>Shear Strength Lbs/Sq Ft | LABORATORY TEST DATA<br>Fines % | LABORATORY TEST DATA<br>Natural Moisture Content, % | LABORATORY TEST DATA<br>Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Ground Surface Elevation: 30 feet[2] | | | | | | |
| | | | | | | 6 inches asphalt concrete (AC)<br>6 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | | | | | | | |
| 2 | | | | | SC | CLAYEY SAND (SC)<br>gray, moist, fine-grained [FILL]<br>LL = 29, PI = 15, see Figure C-3 | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | SANDSTONE and SHALE<br>gray, crushed, low hardness, friable, moderately weathered [BEDROCK] | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | SPT | ◩ | 32<br>27<br>21 | 63 | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | SPT | ◩ | 29<br>30<br>31 | 80 | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
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| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 11.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601 | Figure: A-2

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PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring P-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/3/21 | Date finished: 11/3/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 29.5 feet[2] | LABORATORY TEST DATA Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–0.5 | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 0.5–1 | | | | | | 5 inches aggregate base (AB) | | | | | | |
| 1–5 | | | | | | SANDY CLAY (CL)<br>olive-gray, moist, fine sand [FILL]<br>R-Value Test, see Figure C-4 | | | | | | |
| 3 | GRAB | ☒ | | | CL | | | | | | | |
| 5–11.5 | | | | | | SANDSTONE and SHALE<br>olive-gray to gray-brown, crushed, weak, deeply to moderately weathered [BEDROCK] | | | | | | |
| 5–6 | S&H | ■ | 18<br>37<br>50/ 3" | 69/ 9" | | | | | | | | |
| 10–11 | SPT | ◩ | 29<br>35<br>35 | 92 | | dark brown to yellow-brown | | | | | | |

Boring terminated at a depth of 11.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601 | Figure: A-3

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PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring P-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/3/21 | Date finished: 11/3/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES: Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 28 feet[2] | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 |  |  |  |  |  | 4 inches asphalt concrete (AC) |  |  |  |  |  |  |
|  |  |  |  |  |  | 6 inches aggregate base (AB) |  |  |  |  |  |  |
| 1–4 |  |  |  |  | CL | SANDY CLAY (CL)<br>brown to yellow-brown, moist, fine sand [FILL] |  |  |  |  |  |  |
| 3 | GRAB | ☒ |  |  |  |  |  |  |  |  |  |  |
| 4–6 |  |  |  |  | CL | SANDY CLAY (CL)<br>gray-brown, stiff, wet |  |  |  |  |  |  |
| 5–6.5 | S&H | ■ | 2<br>5<br>13 | 14 |  |  | PP<br>PP |  | 700<br>2,200 |  |  |  |
| 6–10 |  |  |  |  | CL | SANDY CLAY (CL)<br>light gray with red mottling, stiff, wet, fine sand [RESIDUAL SOIL] |  |  |  |  |  |  |
| 10–16.5 |  |  |  |  |  | SHALE<br>gray, crushed, low hardness, weak, moderately to deeply weathered, oxidized [BEDROCK] |  |  |  |  |  |  |
| 10–11.5 | S&H | ■ | 17<br>20<br>22 | 33 |  |  |  |  |  |  |  |  |
| 15–16.5 | SPT | ◪ | 16<br>21<br>45 | 86 |  |  |  |  |  |  |  |  |

Depth scale: 1 through 30 feet.

Boring terminated at a depth of 16.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601 | Figure: A-4

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring P-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/22/21 Date finished: 10/22/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 27.5 feet[2]

| | SAMPLES | | | | | | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (feet) | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| 0 | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 0.5 | | | | | | 3 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>yellow-brown, moist, fine to medium sand [FILL] | | | | | | |
| 3 | BAG | ☒ | | | CL | | | | | | | |
| 5 | | | | | | SANDY CLAY (CL)<br>gray-brown to gray, stiff, moist, fine sand [FILL] | | | | | | |
| 6 | S&H | ■ | 6<br>8<br>7 | 12 | | | PP | | 3,600 | | 13.1 | 117 |
| 8 | | | | | CL | | | | | | | |
| 10 | | | | | | SANDSTONE<br>olive, crushed, low hardness, friable to weak, deeply to moderately weathered | | | | | | |
| 11 | S&H | ■ | 18<br>29<br>28 | 45 | | | | | | | | |
| 12 | | | | | | SHALE<br>gray-brown, crushed, low hardness, friable, moderately weathered [BEDROCK] | | | | | | |
| 21 | SPT | ◩ | 14<br>15<br>25 | 53 | | gray | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 21.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601
Figure: A-5

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PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring P-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21 Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 39.5 feet[2]

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 2 | | | | | CL | SANDY CLAY (CL)<br>brown to gray, moist | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | SANDSTONE and SHALE<br>gray to gray-brown, crushed, low hardness, friable to weak, deeply to moderately weathered<br>[BEDROCK] | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | SPT | ◩ | 23<br>28<br>37 | 85 | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | SPT | ◩ | 50/<br>5.5" | 66/<br>5.5" | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
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| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 10.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-6

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R1-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21

Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches

Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford

Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 37 feet[2] | LABORATORY TEST DATA Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| | | | | | | SANDY CLAY with GRAVEL (CL)<br>brown, moist, fine sand, coarse angular gravel [FILL] | | | | | | |
| 2 | | | | | CL | | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | SHALE<br>gray to olive-gray with red mottling, crushed, low hardness, weak, little weathered [BEDROCK] | | | | | | |
| 5 | SPT | ◪ | 28<br>35<br>50/ 2.5" | 111/ 8.5" | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | SPT | ◪ | 56/ 2" | 66/ 2" | | dark gray, moderately hard, moderately strong | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
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| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 10.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-7

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R1-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21
Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 37 feet[2] | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 5 inches asphalt concrete (AC) | | | | | | |
| 1 | SPT | ◪ | 50/ 3" | 66/ 3" | | 4 inches aggregate base (AB) | | | | | | |
| 2 | | | | | | SANDSTONE<br>olive-gray to gray, crushed, hard, moderately strong, little weathered [BEDROCK] | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | SPT | □ | 50/ 2" | 66/ 2" | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
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| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 5.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-8

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R1-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21
Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES<br>Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 36.5 feet[2] | LABORATORY TEST DATA<br>Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 1 | | | | | CL | SANDY CLAY with GRAVEL (CL)<br>yellow-brown to gray, moist [FILL] | | | | | | |
| 2 | BAG | ☒ | | | | | | | | | | |
| 3 | | | | | | SILTSTONE and SHALE<br>olive-gray to gray, crushed, low to moderate hardness, weak, highly to moderately weathered [BEDROCK] | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | SPT | ◪ | 18<br>50/<br>5" | 66/<br>5" | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 5.9 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

---

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-9

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R2-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21
Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

| DEPTH (feet) | SAMPLES Sampler Type | SAMPLES Sample | SAMPLES Blows/ 6" | SAMPLES SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 38 feet[2] | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 2 | | | | | | SANDY CLAY (CL)<br>red-brown to gray with orange mottling, moist | | | | | | |
| 3 | BAG | ☒ | | | CL | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | S&H | ■ | 12<br>20<br>37 | 45 | | SANDSTONE<br>yellow-brown to olive-gray with yellow mottling, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK] | | | | | 14.4 | 121 |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | SHALE<br>gray with yellow mottling, crushed, low hardness, friable to weak, moderately weathered [BEDROCK] | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | SPT | ◪ | 15<br>29<br>50/<br>3" | 103/<br>9" | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 11.25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-10

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R2-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21 | Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES<br>Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 36 feet[2] | LABORATORY TEST DATA<br>Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 3 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY with GRAVEL (CL)<br>light gray with yellow mottling, moist, fine sand, coarse subangular gravel [FILL] | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | BAG | ☒ | | | CL | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | SPT | ◪ | 15<br>33<br>50/ 2" | 109/ 8" | | | | | | | | |
| 6 | | | | | | SHALE<br>gray to yellow-brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK] | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | SPT | ◪ | 50/ 5" | 66/ 5" | | deeply weathered | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 10.4 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

---

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-11

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R2-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/2/21 Date finished: 11/2/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION Ground Surface Elevation: 35.5 feet[2] | LABORATORY TEST DATA Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 2 | | | | | | SANDY CLAY (CL)<br>gray-brown to yellow-brown, moist, trace fine gravel<br>[FILL] | | | | | | |
| 3 | BAG | ☒ | | | CL | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | SANDY CLAY (CL)<br>yellow-brown with orange mottling, hard, fine sand | | | | | | |
| 6 | S&H | ■ | 7<br>18<br>24 | 33 | | | PP | | >4,500 | | | |
| 7 | | | | | CL | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | S&H | ■ | 16<br>36<br>44 | 63 | | SHALE<br>gray to olive-brown, crushed, low hardness, friable to weak, deeply to moderately weathered<br>[BEDROCK] | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | SPT | ◪ | 18<br>50/<br>6" | 66/<br>6" | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 16 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-12

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R2-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/1/21 Date finished: 11/1/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 34 feet[2]

| DEPTH (feet) | SAMPLES: Sampler Type | SAMPLES: Sample | SAMPLES: Blows/ 6" | SAMPLES: SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| | | | | | | SANDY CLAY (CL)<br>yellow-brown, moist [FILL] | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | BAG | ☒ | | | CL | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | SANDY CLAY (CL)<br>light gray to yellow-gray with orange mottling, very stiff | | | | | | |
| 6 | S&H | ■ | 9<br>15<br>22 | 29 | | | PP | | 4,500 | | | |
| 7 | | | | | CL | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | S&H | ■ | 32<br>50/<br>5" | 40/<br>5" | | SANDSTONE<br>yellow-brown with light gray and light gray chlorite zones, crushed, low hardness, weak, deeply to moderately weathered [BEDROCK] | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | SPT | ◪ | 50/<br>3" | 66/<br>3" | | brown to gray-brown, crushed | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 15.25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-13

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R2-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21 | Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 36 feet[2] | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 1<br>2<br>3 | BAG | ☒ | | | CL | SANDY CLAY (CL)<br>olive-gray, moist [FILL] | | | | | | |
| 4<br>5<br>6<br>7 | S&H | ▨ | 8<br>10<br>10 | 16 | GC | CLAYEY GRAVEL (GC)<br>brown to gray, medium dense, moist, fine- to coarse-grained [FILL] | | | | 23.5 | 12.4 | 118 |
| 8<br>9<br>10<br>11<br>12<br>13<br>14 | SPT | ◩ | 1<br>2<br>2 | 5 | CL | SANDY CLAY (CL)<br>gray, medium stiff, moist, fine sand, trace fine gravel | | | | | | |
| 15<br>16 | S&H | ▨ | 9<br>14<br>17 | 24 | CL | SANDY CLAY (CL)<br>light gray to yellow-brown, very stiff, moist, fine sand | | | | | | |
| 17<br>18 | | | | | | SHALE<br>gray-brown to gray, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK] | | | | | | |
| 19<br>20 | SPT | ◩ | 30<br>50/<br>5" | 66/<br>5" | | SANDSTONE<br>yellow-brown to gray-brown, crushed, low hardness, weak, deeply weathered [BEDROCK] | | | | | | |
| 21<br>22<br>23<br>24<br>25<br>26<br>27<br>28<br>29<br>30 | | | | | | | | | | | | |

Boring terminated at a depth of 20.9 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3 respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601 | Figure: A-14

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R3-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/28/21
Date finished: 10/28/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES: Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 35 feet[2] | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 4 inches asphalt concrete (AC)<br>4 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>gray, moist, fine to coarse sand [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 5–6 | S&H | ■ | 19<br>7<br>8 | 12 | | gray-brown, stiff, shale fragments<br>Triaxial Test, see Figure C-1 | TxUU | 750 | 1,140 | | 15.9 | 117 |
| 8 | | | | | CL | | | | | | | |
| 10–11 | S&H | ⊡ | 3<br>7<br>8 | 12 | | | | | | | | |
| 15–16 | S&H | ■ | 7<br>12<br>14 | 21 | | SANDY CLAY (CL)<br>brown with orange mottling, very stiff, moist | PP | | >4,500 | | | |
| 18 | | | | | CL | | | | | | | |
| 20–21 | SPT | ◪ | 6<br>5<br>8 | 17 | | ▽ (10/28/21, 14:53 PM)<br>SANDY CLAY (CL)<br>yellow-brown to orange mottling, very stiff, wet, fine sand | | | | | | |
| 23 | | | | | CL | | | | | | | |
| 25–26 | SPT | ◪ | 8<br>7<br>13 | 26 | CL | SANDY CLAY (CL)<br>yellow-brown to olive-brown, very stiff, wet, fine sand [RESIDUAL SOIL] | | | | | | |
| 27 | | | | | | SANDSTONE<br>gray, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK] | | | | | | |
| 29 | | | | | | SHALE<br>[BEDROCK] | | | | | | |
| 30 | | | | | | | | | | | | |

**LANGAN**

Project No.: 731759601
Figure: A-15a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R3-1

PAGE 2 OF 2

| DEPTH (feet) | SAMPLES<br>Sampler Type | <br>Sample | <br>Blows/ 6" | <br>SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA<br>Type of Strength Test | <br>Confining Pressure Lbs/Sq Ft | <br>Shear Strength Lbs/Sq Ft | <br>Fines % | <br>Natural Moisture Content, % | <br>Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | SPT | ◩ | 26<br>36<br>40 | 100 |  | SHALE (continued)<br>gray, crushed, low hardness, friable to weak, moderately weathered [BEDROCK] |  |  |  |  |  |  |
| 32 |  |  |  |  |  |  |  |  |  |  |  |  |
| 33 |  |  |  |  |  |  |  |  |  |  |  |  |
| 34 |  |  |  |  |  |  |  |  |  |  |  |  |
| 35 |  |  |  |  |  |  |  |  |  |  |  |  |
| 36 |  |  |  |  |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |
| 38 |  |  |  |  |  |  |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  |  |
| 40 |  |  |  |  |  |  |  |  |  |  |  |  |
| 41 |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |
| 44 |  |  |  |  |  |  |  |  |  |  |  |  |
| 45 |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |
| 48 |  |  |  |  |  |  |  |  |  |  |  |  |
| 49 |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |
| 54 |  |  |  |  |  |  |  |  |  |  |  |  |
| 55 |  |  |  |  |  |  |  |  |  |  |  |  |
| 56 |  |  |  |  |  |  |  |  |  |  |  |  |
| 57 |  |  |  |  |  |  |  |  |  |  |  |  |
| 58 |  |  |  |  |  |  |  |  |  |  |  |  |
| 59 |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

Boring terminated at a depth of 31.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

Project No.: 731759601
Figure: A-15b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R3-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/21/21
Date finished: 10/21/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES | | | | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | | Ground Surface Elevation: 32.5 feet[2] | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| | | | | | | 4 inches asphalt concrete (AC)<br>2 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | CLAY (CL) | | | | | | |
| 2 | | | | | CL | yellow-brown with orange mottling, moist, trace fine sand and fine gravel [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | SILTY SAND (SM)<br>yellow-brown with orange mottling, dense, moist, fine- to medium-grained, trace fine to coarse angular to rounded gravel and clay [FILL] | | | | | | |
| 5 | | | | | SM | | | | | | | |
| 6 | S&H | ■ | 17<br>17<br>23 | 31 | | | | | | | | |
| 7 | SPT | ◩ | 12<br>7<br>3 | 13 | GP | GRAVEL (GP)<br>yellow-brown, medium dense, moist, cobble [FILL] | | | | | | |
| 8 | | | | | | SILTY SAND (SM)<br>yellow-brown, medium dense, moist [FILL] | | | | | | |
| 9 | | | | | SM | | | | | | | |
| 10 | | | | | | very dense | | | | | | |
| 11 | S&H | ■ | 5<br>17<br>48 | 50 | GP | GRAVEL (GP)<br>yellow-brown, very dense, moist, cobble [FILL] | | | | | | |
| 12 | | | | | SM | SILTY SAND (SM)<br>yellow-brown, very dense, moist, fine-grained [FILL] | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | SHALE<br>gray, crushed, low to moderate hardness, weak, moderately weathered [BEDROCK] | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | SPT | ◩ | 5<br>38<br>31 | 88 | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | SPT | ◩ | 42<br>21<br>42 | 31 | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | SPT | ◩ | 19<br>50/<br>3" | 64/<br>3" | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 25.7 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

---

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-16

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R3-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/20/21
Date finished: 10/20/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

Ground Surface Elevation: 33.5 feet[2]

| DEPTH (feet) | SAMPLES Sampler Type | SAMPLES Sample | SAMPLES Blows/ 6" | SAMPLES SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 4 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 2 inches aggregate base (AB) | | | | | | |
| 2 | | | | | CL | SANDY CLAY (CL)<br>gray-brown, moist, fine to medium sand, trace coarse subangular grave [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | CLAY (CL)<br>dark brown, medium stiff to stiff, moist, trace fine sand [FILL] | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | S&H | ▨ | 3<br>5<br>5 | 8 | | | PP | | 500 | | | |
| 7 | | | | | CL | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | dark brown with orange mottling, soft to medium stiff | | | | | | |
| 11 | S&H | ▨ | 3<br>2<br>3 | 4 | | SANDY CLAY (CL)<br>olive-gray, soft to medium stiff, moist | PP | | 500 | | 20.8 | 106 |
| 12 | | | | | | | | | | | | |
| 13 | | | | | CL | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | S&H | ▨ | 6<br>14<br>37 | 39 | | SILTSTONE<br>yellow-brown with orange mottling, moist, crushed, low hardness, friable, deeply weathered [BEDROCK] | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | SHALE<br>gray-brown, crushed, low hardness, friable, deeply weathered [BEDROCK] | | | | | | |
| 20 | SPT | ◪ | 30<br>50/<br>6" | 64/<br>6" | | | | | | | | |
| 21 | | | | | | ▽ (10/20/21, 11:00 AM) | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 21 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 21 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

**LANGAN**

Project No.: 731759601
Figure: A-17

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R3-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/20/21 Date finished: 10/20/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 33 feet[2]

| DEPTH (feet) | SAMPLES: Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 4 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 2 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | CLAY (CL)<br>gray and yellow-brown, moist, with asphalt debris [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 5 | | | | | CL | very stiff | | | | | | |
| 6 | S&H | ▨ | 11<br>14<br>11 | 19 | | cobble fragments | | | | | | |
| 8 | S&H | ▨ | 5<br>4<br>5 | 7 | | | | | | | | |
| 9 | | | | | | CLAY (CL)<br>gray-brown with orange mottling, medium stiff, moist | PP | | 3,200 | | | |
| 11 | S&H | ▨ | 4<br>2<br>1 | 2 | | soft | | | | | 22.1 | 102 |
| 12 | | | | | CL | | | | | | | |
| 15 | | | | | | very stiff | PP | | 2,500 | | | |
| 16 | S&H | ▨ | 5<br>12<br>17 | 22 | | CLAYSTONE<br>yellow-brown with orange and gray mottling, crushed, low hardness, low plasticity, deeply weathered [BEDROCK] | | | | | | |
| 21 | SPT | ▨ | 6<br>30<br>50/<br>6" | 102 | | SHALE<br>gray, crushed, low hardness, friable, deeply weathered [BEDROCK] | | | | | | |

Boring terminated at a depth of 21 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

---

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

**LANGAN**

Project No.: 731759601
Figure: A-18

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PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R3-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 10/28/21 | Date finished: 10/28/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES | | | | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | | Ground Surface Elevation: 33 feet[2] | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| | | | | | | 3 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>yellow-brown to brown, moist, fine to course sand [FILL] | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | BAG | ☒ | | | CL | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | S&H | ■ | 35<br>50/<br>6" | 66/<br>6" | | SANDSTONE<br>yellow-brown, crushed, low hardness, weak, deeply to moderately weathered [BEDROCK] | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | SPT | ◩ | 38<br>43<br>50/<br>3" | 123/<br>9" | | yellow-brown with orange mottling | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 11.25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-19

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/29/21 Date finished: 10/29/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

| DEPTH (feet) | SAMPLES: Sampler Type | SAMPLES: Sample | SAMPLES: Blows/ 6" | SAMPLES: SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 36 feet[2] | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | 4 inches asphalt concrete (AC) |  |  |  |  |  |  |
| 1 |  |  |  |  |  | 4 inches aggregate base (AB) |  |  |  |  |  |  |
| 2 |  |  |  |  |  | SANDY CLAY (CL)<br>yellow-brown to light gray, moist, fine sand [FILL]<br>R-value Test, see Figure C-4 |  |  |  |  |  |  |
| 3 | BAG | ☒ |  |  | CL |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  | CLAYEY SAND (SC)<br>yellow-brown, medium dense, moist, fine-grained, sandstone fragments [FILL] |  |  |  |  |  |  |
| 6 | S&H | ■ | 8<br>15<br>20 | 28 |  |  |  |  |  |  | 13.5 | 119 |
| 7 |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  | SC |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |  |  |  |  |
| 11 | SPT | ◪ | 4<br>6<br>7 | 17 |  | SANDY CLAY (CL)<br>gray, very stiff, moist, coarse sand [FILL] |  |  |  |  |  |  |
| 12 |  |  |  |  |  |  |  |  |  |  |  |  |
| 13 |  |  |  |  | CL |  |  |  |  |  |  |  |
| 14 |  |  |  |  |  |  |  |  |  |  |  |  |
| 15 |  |  |  |  |  |  |  |  |  |  |  |  |
| 16 | S&H | ■ | 9<br>16<br>21 | 29 |  | SANDY CLAY (CL)<br>yellow-brown with orange mottling, very stiff, moist, fine sand |  |  |  |  |  |  |
| 17 |  |  |  |  |  |  |  |  |  |  |  |  |
| 18 |  |  |  |  |  |  |  |  |  |  |  |  |
| 19 |  |  |  |  |  |  |  |  |  |  |  |  |
| 20 |  |  |  |  | ▽ | (10/29/21, 10:00 AM)<br>olive-gray to yellow-brown with orange mottling, very stiff, wet, fine sand |  |  |  |  |  |  |
| 21 | S&H | ■ | 9<br>14<br>18 | 25 | CL |  |  |  |  |  |  |  |
| 22 |  |  |  |  |  |  |  |  |  |  |  |  |
| 23 |  |  |  |  |  |  |  |  |  |  |  |  |
| 24 |  |  |  |  |  |  |  |  |  |  |  |  |
| 25 |  |  |  |  |  |  |  |  |  |  |  |  |
| 26 | SPT | ◪ | 18<br>20<br>33 | 70 |  | SANDSTONE<br>brown to olive-brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK] |  |  |  |  |  |  |
| 27 |  |  |  |  |  |  |  |  |  |  |  |  |
| 28 |  |  |  |  |  |  |  |  |  |  |  |  |
| 29 |  |  |  |  |  | SHALE<br>gray, crushed, low hardness, friable, moderately weathered [BEDROCK] |  |  |  |  |  |  |
| 30 |  |  |  |  |  |  |  |  |  |  |  |  |

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Project No.: 731759601
Figure: A-20a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-1

PAGE 2 OF 2

| | SAMPLES | | | | | | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (feet) | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| | SPT | ◪ | 50/ 5" | 66/ 5" | | SHALE (continued) | | | | | | |
| 31 | | | | | | | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | |
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| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 30.4 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

**LANGAN**

Project No.: 731759601

Figure: A-20b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-2

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/25/21
Date finished: 10/25/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

Ground Surface Elevation: 36 feet[2]

| DEPTH (feet) | SAMPLES: Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 3 inches asphalt concrete (AC)<br>2 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY with GRAVEL (CL)<br>gray-brown, moist, fine to coarse sand, fine to coarse angular to rounded gravel [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 5-6 | S&H | ■ | 10<br>7<br>8 | 12 | | stiff | PP | | 1,500 | | | |
| 8 | | | | | CL | | | | | | | |
| 10-11 | S&H | ■ | 8<br>7<br>10 | 13 | | gray-brown to gray | PP | | 2,750 | | | |
| 15-16 | S&H | ■ | 10<br>15<br>15 | 24 | | | | | | | | |
| 16 | | | | | | SHALE<br>gray-brown, crushed, soft, plastic, deeply weathered [BEDROCK] | | | | | | |
| 20 | | | | | | ▽ (10/25/21, 2:30 PM) | | | | | | |
| 20.5-21 | S&H | ■ | 5<br>10<br>12 | 17 | | SANDSTONE<br>yellow-brown, crushed, low hardness, friable, deeply weathered [BEDROCK] | | | | | | |
| 23 | | | | | | ▽ (10/25/21, 2:50 PM) | | | | | | |
| 25-26 | S&H | ■ | 13<br>18<br>28 | 36 | | | | | | | | |
| 30 | | | | | | | | | | | | |

LANGAN

Project No.: 731759601
Figure: A-21a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-2

PAGE 2 OF 2

| DEPTH (feet) | SAMPLES: Sampler Type | SAMPLES: Sample | SAMPLES: Blows/ 6" | SAMPLES: SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft | LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft | LABORATORY TEST DATA: Fines % | LABORATORY TEST DATA: Natural Moisture Content, % | LABORATORY TEST DATA: Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | SPT | ◩ | 12<br>25<br>34 | 77 | | SANDSTONE (continued)<br>yellow-brown to gray-brown, crushed, low harness, friable, moderately weathered | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | |
| 35 | SPT | ◩ | 21<br>29<br>50/<br>3" | 103/<br>9" | | | | | | | | |
| 36 | | | | | | | | | | | | |
| 37 | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | |
| 39 | | | | | | | | | | | | |
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| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 36.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-21b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-3

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2

Date started: 10/21/21 | Date finished: 10/21/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 33.5 feet[2]

| DEPTH (feet) | SAMPLES: Sampler Type | SAMPLES: Sample | SAMPLES: Blows/ 6" | SAMPLES: SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | 4 inches asphalt concrete (AC) |  |  |  |  |  |  |
| 1 |  |  |  |  |  | 2 inches aggregate base (AB) |  |  |  |  |  |  |
| 2 |  |  |  |  | GP | GRAVEL (GP)<br>gray, moist, fine- to coarse-grained, angular to rounded gravel, trace medium-grained sand [FILL] |  |  |  |  |  |  |
| 3 | BAG | ☒ |  |  |  | SANDY CLAY (CL)<br>gray-brown, stiff to very stiff, moist, fine to medium sand, trave fine angular to rounded gravel [FILL] |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | S&H | ■ | 4<br>8<br>11 | 15 |  |  | PP |  | 3,500 |  |  |  |
| 7 |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  | CL |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |  |  |  |  |
| 11 | S&H | ■ | 6<br>13<br>13 | 20 |  |  | PP |  | 3,500 |  |  |  |
| 12 |  |  |  |  |  | yellow-brown and olive-gray, very stiff<br>asphalt debris |  |  |  |  |  |  |
| 13 |  |  |  |  |  |  |  |  |  |  |  |  |
| 14 |  |  |  |  |  | CLAYEY SAND with GRAVEL (SC)<br>gray, medium dense, moist, fine- to course-grained, subangular [FILL] |  |  |  |  |  |  |
| 15 |  |  |  |  |  |  |  |  |  |  |  |  |
| 16 | S&H | ■ | 5<br>9<br>11 | 15 |  | LL = 37, PI = 22, see Figure C-3 |  |  |  | 38.6 | 10.9 | 114 |
| 17 |  |  |  |  | SC |  |  |  |  |  |  |  |
| 18 |  |  |  |  |  |  |  |  |  |  |  |  |
| 19 |  |  |  |  |  |  |  |  |  |  |  |  |
| 20 |  |  |  |  |  | gray-brown, moist, fine-grained<br>LL = 36, PI = 20, see Figure C-3 |  |  |  | 45.9 | 12.8 |  |
| 21 | S&H | ■ | 6<br>5<br>4 | 7 |  | SANDY CLAY (CL)<br>gray-brown, medium stiff, moist, fine sand | PP |  | 1,250 |  |  |  |
| 22 |  |  |  |  |  |  |  |  |  |  |  |  |
| 23 |  |  |  |  |  |  |  |  |  |  |  |  |
| 24 |  |  |  |  | CL |  |  |  |  |  |  |  |
| 25 |  |  |  |  |  | gray with orange mottling, very stiff |  |  |  |  |  |  |
| 26 | S&H | ■ | 7<br>14<br>20 | 35 |  |  |  |  |  |  |  |  |
| 27 |  |  |  |  |  | SANDY CLAY (CL)<br>light gray with orange mottling, stiff, moist, fine sand |  |  |  |  |  |  |
| 28 | S&H | ■ | 5<br>7<br>10 | 13 | CL |  |  |  |  |  |  |  |
| 29 |  |  |  |  |  |  |  |  |  |  |  |  |
| 30 |  |  |  |  |  | ▽ (10/21/21, 11:00 AM) |  |  |  |  |  |  |

LANGAN

Project No.: 731759601

Figure: A-22a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-3

PAGE 2 OF 2

| DEPTH (feet) | SAMPLES: Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | S&H | ● | 7<br>11<br>17 | 22 |  | SANDY CLAY (CL) (continued) |  |  |  |  |  |  |
| 32 | SPT | ◢ | 10<br>19<br>25 | 56 |  | yellow-brown, wet, stiff to hard |  |  |  |  |  |  |
| 33 |  |  |  |  | CL |  |  |  |  |  |  |  |
| 34 |  |  |  |  |  |  |  |  |  |  |  |  |
| 35 | SPT | ◢ | 13<br>35<br>50/ 5" | 104/ 11" |  |  |  |  |  |  |  |  |
| 36 |  |  |  |  |  | SILTSTONE<br>yellow-brown and gray-brown, crushed, low hardness, friable, deeply weathered [BEDROCK] |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |
| 38 |  |  |  |  |  |  |  |  |  |  |  |  |
| 39 |  |  |  |  |  | SHALE<br>gray, crushed, low hardness, friable, deeply weathered [BEDROCK] |  |  |  |  |  |  |
| 40 | SPT | ◢ | 14<br>40<br>50/ 2" | 115/ 8" |  |  |  |  |  |  |  |  |
| 41 |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |
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| 45 |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  |  |  |  |  |  |  |
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| 51 |  |  |  |  |  |  |  |  |  |  |  |  |
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| 55 |  |  |  |  |  |  |  |  |  |  |  |  |
| 56 |  |  |  |  |  |  |  |  |  |  |  |  |
| 57 |  |  |  |  |  |  |  |  |  |  |  |  |
| 58 |  |  |  |  |  |  |  |  |  |  |  |  |
| 59 |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

Boring terminated at a depth of 41.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 30 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-22b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-4

Boring location: See Site Plan, Figure 2
Date started: 10/28/21 Date finished: 10/28/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

Ground Surface Elevation: 32.5 feet$^2$

| DEPTH (feet) | SAMPLES: Sampler Type | Sample | Blows/ 6" | SPT N-Value$^1$ | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 3 inches asphalt concrete (AC)<br>6 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>yellow-brown to dark brown, moist, fine sand [FILL] | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | medium stiff to stiff | | | | | | |
| 6 | S&H | ■ | 4<br>4<br>6 | 8 | CL | | PP | | 2,500 | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | S&H | ■ | 5<br>8<br>5 | 10 | | SANDY CLAY (CL)<br>dark brown, stiff, moist, fine sand | PP | | 750 | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | CL | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | ▽ (10/28/21, 11:35 AM)<br>▼ (10/28/21, 12:10 PM) | | | | | | |
| 16 | S&H | ■ | 2<br>5<br>9 | 11 | | SANDY CLAY (CL)<br>light gray to brown with orange mottling, stiff, wet, fine to medium sand | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | CL | very stiff | | | | | | |
| 21 | S&H | ■ | 16<br>14<br>16 | 24 | | | PP | | 3,750 | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | SANDSTONE<br>yellow-brown to olive-gray, crushed, low hardness, friable to weak, moderately weathered [BEDROCK] | | | | | | |
| 26 | SPT | ◩ | 18<br>20<br>22 | 55 | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

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Project No.: 731759601
Figure: A-23a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-4

PAGE 2 OF 2

| | SAMPLES | | | | | | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (feet) | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| | SPT | ◩ | 50/ 6" | 66/ 6" | | SANDSTONE (continued)<br>weak | | | | | | |
| 31 | | | | | | | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | |
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| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 30.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 15 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-23b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-5

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/25/21 Date finished: 10/25/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 32 feet[2]

| DEPTH (feet) | SAMPLES | | | | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | | | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| | | | | | | 2 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 3 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>olive-gray, moist, fine to coarse sand [FILL] | | | | | | |
| 2 | | | | | CL | | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | SANDY CLAY (CL)<br>brown, stiff, moist, fine to medium sand, trave fine to coarse gravel [FILL] | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | S&H | ■ | 4<br>6<br>11 | 13 | | increase gravel content | PP | | 1,250 | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | gray, very stiff, trace cobble | | | | | | |
| 11 | S&H | ■ | 9<br>18<br>11 | 23 | CL | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | S&H | ■ | 6<br>8<br>10 | 14 | | stiff | PP | | 3,500 | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | SANDY SILTY CLAY (CL-ML)<br>dark brown, stiff, moist, fine sand<br>LL = 21, PI = 7, see Figure C-3 | | | | | | |
| 21 | S&H | ■ | 4<br>6<br>10 | 13 | CL-ML | | | | | 59.8 | 16.5 | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | ∇ (10/25/21, 8:10 AM) | | | | | | |
| 25 | | | | | | SANDY CLAY (CL)<br>yellow-brown with orange mottling, very stiff, wet, fine to medium sand | | | | | | |
| 26 | S&H | ■ | 14<br>16<br>14 | 24 | | | PP | | >4,500 | | | |
| 27 | | | | | CL | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

TEST GEOTECH LOG 731759601_5800 NORTHGATE.GPJ TEMPLATE_CA-MODIFIED - COPY.GDT 12/6/21

LANGAN

Project No.: 731759601
Figure: A-24a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R4-5

PAGE 2 OF 2

| DEPTH (feet) | SAMPLES: Sampler Type | SAMPLES: Sample | SAMPLES: Blows/ 6" | SAMPLES: SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | S&H | | 9<br>15<br>22 | 29 | CL | SANDY CLAY (CL) (continued) | PP | | 2,500 | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | SILTSTONE<br>olive-gray, crushed, low hardness, friable, deeply weathered [BEDROCK] | | | | | | |
| 34 | | | | | | | | | | | | |
| 35 | S&H | | 21<br>50/<br>5" | 40/<br>5" | | | | | | | | |
| 36 | | | | | | | | | | | | |
| 37 | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | |
| 39 | | | | | | SHALE<br>gray, crushed, low hardness, friable, deeply weathered [BEDROCK] | | | | | | |
| 40 | | | | | | | | | | | | |
| 41 | SPT | | 14<br>24<br>31 | 71 | | | | | | | | |
| 42 | | | | | | | | | | | | |
| 43 | | | | | | | | | | | | |
| 44 | | | | | | | | | | | | |
| 45 | SPT | | 32<br>50/<br>6" | 66/<br>6" | | | | | | | | |
| 46 | | | | | | | | | | | | |
| 47 | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | |
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| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 46 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 24 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3 respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

**LANGAN**

Project No.: 731759601

Figure: A-24b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/28/21
Date finished: 10/28/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION Ground Surface Elevation: 34.5 feet[2] | LABORATORY TEST DATA Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 4 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 3 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>yellow-brown, moist, fine sand, trace cobbles [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 5 | S&H | ■ | 3<br>8<br>12 | 16 | CL | gray to gray-brown, very stiff | PP | | 2,700 | | | |
| 10 | S&H | ▨ | 9<br>9<br>10 | 15 | | | | | | | | |
| 11 | | | | | CL | SANDY CLAY (CL)<br>gray-brown, stiff to very stiff, moist, fine to medium sand | | | | | | |
| 15 | SPT | ◩ | 5<br>8<br>12 | 26 | CL | SANDY CLAY (CL)<br>brown with orange mottling, very stiff, moist, fine sand | | | | | | |
| 20 | SPT | ◩ | 50/<br>3" | 66/<br>3" | | SANDSTONE<br>yellow-brown, crushed, low hardness, weak, moderately weathered [BEDROCK] | | | | | | |
| 25 | SPT | ◩ | 50/<br>4.5" | 66/<br>4.5" | | | | | | | | |

Boring terminated at a depth of 25.4 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-25

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-2

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/26/21
Date finished: 10/26/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 35 feet[2]

| DEPTH (feet) | SAMPLES | | | | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | | | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| 0 | | | | | | 3 inches asphalt concrete (AC) | | | | | | |
| 0.5 | | | | | | 3 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>yellow-brown, moist, fine sand [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 5–6.5 | S&H | ■ | 6<br>7<br>10 | 13 | | brown, stiff, moist | PP | | 3,700 | | | |
| 9 | | | | | | increase sand content<br>yellow-brown with orange mottling, sandstone fragments | | | | | | |
| 10–11.5 | S&H | ■ | 7<br>12<br>20 | 25 | CL | | | | | | | |
| 15–16.5 | SPT | ◩ | 4<br>8<br>14 | 29 | | gray, very stiff, shale fragments | | | | | | |
| 20–21.5 | SPT | ◩ | 3<br>3<br>2 | 7 | | SANDY CLAY (CL)<br>dark brown, medium stiff, moist, fine sand | | | | | | |
| 22 | | | | | CL | | | | | | | |
| 25–26.5 | S&H | ■ | 9<br>14<br>20 | 27 | | SANDY CLAY (CL)<br>yellow-brown with orange mottling, very stiff, moist, fine sand | | | | | | |
| 28 | | | | | CL | | | | | | | |
| 30 | | | | | | | | | | | | |

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Project No.: 731759601
Figure: A-26a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-2

PAGE 2 OF 2

| DEPTH (feet) | SAMPLES Sampler Type | SAMPLES Sample | SAMPLES Blows/ 6" | SAMPLES SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA Type of Strength Test | LABORATORY TEST DATA Confining Pressure Lbs/Sq Ft | LABORATORY TEST DATA Shear Strength Lbs/Sq Ft | LABORATORY TEST DATA Fines % | LABORATORY TEST DATA Natural Moisture Content, % | LABORATORY TEST DATA Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | SPT | ◩ | 6<br>10<br>13 | 30 | CL | SANDY CLAY (CL) (continued)<br>yellow-brown to gray-brown with red mottling, very stiff to hard | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | ∇ (10/26/21, 9:00 AM) | | | | | | |
| 34 | | | | | | SANDSTONE and SHALE<br>light gray to yellow-brown, crushed, low hardness, friable, deeply to moderately weathered [FBEDROCK] | | | | | | |
| 35 | | | | | | | | | | | | |
| 36 | SPT | ◩ | 10<br>18<br>30 | 63 | | | | | | | | |
| 37 | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | |
| 39 | | | | | | | | | | | | |
| 40 | | | | | | friable to weak | | | | | | |
| 41 | SPT | ◩ | 14<br>35<br>50/<br>3" | 112/<br>9" | | | | | | | | |
| 42 | | | | | | | | | | | | |
| 43 | | | | | | | | | | | | |
| 44 | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | |
| 46 | | | | | | | | | | | | |
| 47 | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | |
| 49 | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | |
| 51 | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | |
| 53 | | | | | | | | | | | | |
| 54 | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | |
| 56 | | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 41.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 33 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-26b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-3

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/27/21
Date finished: 10/27/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| | SAMPLES | | | | | MATERIAL DESCRIPTION | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (feet) | Sampler Type | Sample | Blows/ 6" | SPT N-Value$^1$ | LITHOLOGY | Ground Surface Elevation: 34.5 feet$^2$ | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| | | | | | | 3 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 12 inches aggregate base (AB) | | | | | | |
| 2 | | | | | | GRAVEL (GW)<br>yellow-brown, moist, fine- to coarse-grained subrounded, trace fine sand [FILL] | | | | | | |
| 3 | GRAB | ☒ | | | GW | | | | | | | |
| 4 | | | | | | SANDY CLAY (CL)<br>gray, very stiff, moist,m fine sand stone fragments [FILL] | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | S&H | ■ | 7<br>9<br>11 | 16 | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | SPT | ◩ | 5<br>3<br>6 | 12 | | stiff<br>increase in clay content | | | | | | |
| 12 | | | | | CL | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | trace wood fragments, rootlets | | | | | | |
| 16 | S&H | ■ | 9<br>11<br>11 | 17 | | | PP | | 3,250 | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | ∇ (10/27/21, 9:30 AM) | | | | | | |
| 21 | S&H | ■ | 1<br>2<br>3 | 4 | | SANDY CLAY (CL)<br>olive-brown, soft to medium stiff, wet, fine sand | | | | | 18.7 | 112 |
| 22 | | | | | CL | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | ∇ (10/27/21, 10:25 AM) | | | | | | |
| 25 | | | | | | SANDY CLAY (CL)<br>yellow-brown to olive-gray, very stiff, wet, fine to coarse sand | | | | | | |
| 26 | S&H | ■ | 10<br>10<br>15 | 20 | | | | | | | | |
| 27 | | | | | CL | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

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Project No.: 731759601
Figure: A-27a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-3

PAGE 2 OF 2

| | SAMPLES | | | | | | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (feet) | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| 31 | SPT | ◩ | 5<br>6<br>10 | 21 | | SANDY CLAY (CL) (continued) | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |
| 34 | | | | | CL | | | | | | | |
| 35 | | | | | | increase clay content | | | | | | |
| 36 | SPT | ◩ | 5<br>9<br>10 | 25 | | | | | | | | |
| 37 | | | | | | | | | | | | |
| 38 | | | | | | SANDSTONE<br>yellow-brown to dark brown, crushed, low hardness, friable to weak, moderately to deeply weathered [BEDROCK] | | | | | | |
| 39 | | | | | | | | | | | | |
| 40 | | | | | | | | | | | | |
| 41 | SPT | ◩ | 15<br>36<br>50/<br>5" | 114/<br>11" | | | | | | | | |
| 42 | | | | | | | | | | | | |
| 43 | | | | | | | | | | | | |
| 44 | | | | | | | | | | | | |
| 45 | SPT | ◩ | 50/<br>4" | 66/<br>4" | | weak, moderately weathered to intensely weathered | | | | | | |
| 46 | | | | | | | | | | | | |
| 47 | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | |
| 49 | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | |
| 51 | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | |
| 53 | | | | | | | | | | | | |
| 54 | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | |
| 56 | | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 45.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-27b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-4

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/26/21 Date finished: 10/26/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 30.5 feet$^2$

| | SAMPLES | | | | | | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (feet) | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| 0 | | | | | | 3 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 3 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>brown, moist, fine sand, trace fine subangular gravel [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 5–6 | S&H | ■ | 4<br>4<br>9 | 10 | | olive-gray to yellow-brown with orange mottling, stiff | | | | | | |
| 10–11 | S&H | ■ | 9<br>10<br>9 | 15 | CL | gray, stiff to very stiff, shale fragments | | | | | | |
| 15–16 | S&H | ■ | 10<br>9<br>11 | 16 | | very stiff, sandstone fragments | | | | | | |
| 20–21 | S&H | ■ | 4<br>5<br>8 | 10 | | ∇ (10/26/21, 12:00 PM) | | | | | | |
| 21–22 | | | | | | SANDY CLAY (CL)<br>olive-brown, stiff, fine sand<br>∇ (10/26/21, 11:20 AM) | | | | | | |
| 23 | | | | | CL | | | | | | | |
| 25–26 | S&H | ■ | 7<br>9<br>14 | 18 | | SANDY CLAY (CL)<br>yellow-brown with brown and orange mottling, very stiff, moist, fine to coarse sand<br>Triaxial Test, see Figure C-2 | TxUU | 2,800 | 825 | | 19.5 | 111 |
| 28 | | | | | CL | | | | | | | |
| 30 | | | | | | | | | | | | |

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Project No.: 731759601 Figure: A-28a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-4

| DEPTH (feet) | SAMPLES: Sampler Type | SAMPLES: Sample | SAMPLES: Blows/ 6" | SAMPLES: SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA: Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | SPT | ◩ | 50/ 6" | 66/ 6" |  | SANDSTONE<br>olive-brown, crushed, low hardness, weak, moderately weathered [BEDROCK] |  |  |  |  |  |  |
| 31 |  |  |  |  |  |  |  |  |  |  |  |  |
| 32 |  |  |  |  |  |  |  |  |  |  |  |  |
| 33 |  |  |  |  |  |  |  |  |  |  |  |  |
| 34 |  |  |  |  |  |  |  |  |  |  |  |  |
| 35 | SPT | ◩ | 50/ 3" | 66/ 3" |  |  |  |  |  |  |  |  |
| 36 |  |  |  |  |  |  |  |  |  |  |  |  |
| 37 |  |  |  |  |  |  |  |  |  |  |  |  |
| 38 |  |  |  |  |  |  |  |  |  |  |  |  |
| 39 |  |  |  |  |  |  |  |  |  |  |  |  |
| 40 |  |  |  |  |  |  |  |  |  |  |  |  |
| 41 |  |  |  |  |  |  |  |  |  |  |  |  |
| 42 |  |  |  |  |  |  |  |  |  |  |  |  |
| 43 |  |  |  |  |  |  |  |  |  |  |  |  |
| 44 |  |  |  |  |  |  |  |  |  |  |  |  |
| 45 |  |  |  |  |  |  |  |  |  |  |  |  |
| 46 |  |  |  |  |  |  |  |  |  |  |  |  |
| 47 |  |  |  |  |  |  |  |  |  |  |  |  |
| 48 |  |  |  |  |  |  |  |  |  |  |  |  |
| 49 |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  |  |  |  |  |  |  |
| 51 |  |  |  |  |  |  |  |  |  |  |  |  |
| 52 |  |  |  |  |  |  |  |  |  |  |  |  |
| 53 |  |  |  |  |  |  |  |  |  |  |  |  |
| 54 |  |  |  |  |  |  |  |  |  |  |  |  |
| 55 |  |  |  |  |  |  |  |  |  |  |  |  |
| 56 |  |  |  |  |  |  |  |  |  |  |  |  |
| 57 |  |  |  |  |  |  |  |  |  |  |  |  |
| 58 |  |  |  |  |  |  |  |  |  |  |  |  |
| 59 |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |

Boring terminated at a depth of 35.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 22 feet below ground surface at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-28b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-5

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/26/21
Date finished: 10/26/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

Ground Surface Elevation: 30.5 feet[2]

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | 3 inches asphalt concrete (AC) | | | | | | |
| 0.5 | | | | | | 3 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>yellow-brown with orange mottling, moist, fine sand<br>[FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 6 | S&H | ■ | 4<br>5<br>6 | 9 | | stiff | PP | | 1,500 | | | |
| 7 | | | | | CL | | | | | | | |
| 11 | SPT | □ | 6<br>4<br>4 | 11 | | sandstone fragments | | | | | | |
| 13.5 | | | | | | GRAVELLY CLAY (CL)<br>gray-brown with orange mottling, very stiff, moist, fine subangular to subrounded gravel to cobbles<br>[FILL] | | | | | | |
| 16 | S&H | ■ | 12<br>12<br>11 | 18 | | | | | | | | |
| 17 | | | | | CL | | | | | | | |
| 20 | | | | | | ▽ (10/26/21, 15:15 PM)<br>SANDY CLAY (CL)<br>yellow-brown, stiff, wet, fine sand | | | | | | |
| 21 | S&H | ■ | 8<br>10<br>7 | 13 | | | | | | | | |
| 22.5 | | | | | CL | | | | | | | |
| 25 | | | | | | CLAYEY SILTY SAND (SC-SM)<br>brown with orange mottling, medium dense, wet, fine- to coarse-grained, trace coarse gravel<br>LL = 22, PI = 7, see Figure C-3 | | | | 28.6 | 16.2 | |
| 26 | SPT | ◩ | 7<br>11<br>10 | 28 | | | | | | | | |
| 27 | | | | | SC-SM | | | | | | | |
| 29 | | | | | CL | SANDY CLAY (CL) | | | | | | |
| 30 | | | | | | | | | | | | |

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Project No.: 731759601
Figure: A-29a

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R5-5

PAGE 2 OF 2

| DEPTH (feet) | SAMPLES<br>Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA<br>Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | SPT | ◪ | 6<br>9<br>11 | 26 | | SANDY CLAY (CL) (continued)<br>brown to gray-brown with orange mottling, very stiff, wet, fine sand | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | |
| 35 | | | | | | hard | | | | | | |
| 36 | SPT | ◪ | 9<br>11<br>16 | 36 | CL | | | | | | | |
| 37 | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | |
| 39 | | | | | | | | | | | | |
| 40 | | | | | | increase sand content | | | | | | |
| 41 | SPT | ◪ | 12<br>15<br>41 | 74 | | SHALE<br>gray to olive, crushed, low hardness, weak, moderately weathered [BEDROCK] | | | | | | |
| 42 | | | | | | | | | | | | |
| 43 | | | | | | | | | | | | |
| 44 | | | | | | | | | | | | |
| 45 | | | | | | gray to olive with yellow oxidation | | | | | | |
| 46 | SPT | ◪ | 19<br>21<br>50/<br>6" | 94 | | | | | | | | |
| 47 | | | | | | | | | | | | |
| 48 | | | | | | | | | | | | |
| 49 | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | |
| 51 | | | | | | | | | | | | |
| 52 | | | | | | | | | | | | |
| 53 | | | | | | | | | | | | |
| 54 | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | |
| 56 | | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |

Boring terminated at a depth of 45.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-29b

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R6-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21

Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches

Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford

Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES<br>Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 40.5 feet[2] | LABORATORY TEST DATA<br>Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 2 | | | | | | SANDSTONE<br>gray, intensely to closely fractured, moderately hard, weak to moderately strong, moderately to intensely weathered [BEDROCK] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | SPT | ◩ | 11<br>50/<br>3" | 66/<br>3" | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 5.8 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-30

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R6-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21 Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES | | | | LITHOLOGY | MATERIAL DESCRIPTION | LABORATORY TEST DATA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | | Ground Surface Elevation: 37 feet[2] | Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
| | | | | | | 8 inches asphalt concrete (AC) | | | | | | |
| 1 | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 2 | | | | | | CLAY with SAND (CL)<br>light gray with orange mottling, moist [FILL] | | | | | | |
| 3 | BAG | ☒ | | | CL | LL = 38, PI = 23, see Figure C-3 | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | S&H | ■ | 2<br>13<br>17 | 24 | | SHALE and SANDSTONE<br>gray to yellow-brown, oxidation, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK] | | | | | 12.3 | 113 |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | SPT | ◩ | 18<br>43<br>50/<br>3" | 123/<br>9" | | olive-gray to gray | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 11.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601
Figure: A-31

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring R6-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21 | Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 37 feet[2] | LABORATORY TEST DATA Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 1 | | | | | | SANDY CLAY (CL)<br>gray, moist, fine sand, trace coarse gravel [FILL] | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4 | SPT | ◪ | 6<br>13<br>12 | 33 | CL | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | SPT | ◪ | 15<br>18<br>25 | 56 | | SANDSTONE<br>gray, crushed, fine to moderate hardness, weak to moderately strong, moderately to little weathered [BEDROCK] | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | SPT | ◪ | 50/<br>2" | 66/<br>2" | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

Boring terminated at a depth of 10.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601 | Figure: A-32

PROJECT: **NORTHGATE TOWN SQUARE**
**San Rafael, California**

# Log of Boring S3-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/1/21 Date finished: 11/1/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

| DEPTH (feet) | SAMPLES Sampler Type | Sample | Blows/ 6" | SPT N-Value[1] | LITHOLOGY | MATERIAL DESCRIPTION<br>Ground Surface Elevation: 37 feet[2] | LABORATORY TEST DATA Type of Strength Test | Confining Pressure Lbs/Sq Ft | Shear Strength Lbs/Sq Ft | Fines % | Natural Moisture Content, % | Dry Density Lbs/Cu Ft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 6 inches asphalt concrete (AC) | | | | | | |
| | | | | | | 6 inches aggregate base (AB) | | | | | | |
| 1<br>2 | | | | | | SANDY CLAY (CL)<br>yellow-brown, moist, fine sand [FILL] | | | | | | |
| 3 | BAG | ☒ | | | | | | | | | | |
| 4<br>5<br>6 | SPT | ◩ | 6<br>6<br>9 | 20 | CL | yellow-brown with orange mottling, very stiff, moist | | | | | | |
| 7<br>8<br>9<br>10<br>11 | SPT | ◩ | 4<br>6<br>8 | 18 | | | | | | | | |
| 12 | | | | | CL | SANDY CLAY (CL)<br>light gray with yellow mottling, very stiff, moist, rock fragments [RESIDUAL SOIL] | | | | | | |
| 13<br>14<br>15 | SPT | ◩ | 50/<br>4" | 66/<br>4" | | SANDSTONE<br>yellow-brown to olive-gray, crushed, low to moderate hardness, weak to moderately strong, moderately weathered [BEDROCK] | | | | | | |
| 16<br>17<br>18<br>19<br>20<br>21<br>22<br>23<br>24<br>25<br>26<br>27<br>28<br>29<br>30 | | | | | | | | | | | | |

Boring terminated at a depth of 15.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-33

## UNIFIED SOIL CLASSIFICATION SYSTEM

| Major Divisions | | Symbols | Typical Names |
|---|---|---|---|
| **Coarse-Grained Soils** (more than half of soil > no. 200 sieve size | **Gravels** (More than half 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 half 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 half of soil < no. 200 sieve size) | **Silts and Clays** LL = < 50 | **ML** | Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts |
| | | **CL** | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays |
| | | **OL** | Organic silts and organic silt-clays of low plasticity |
| | **Silts and Clays** LL = > 50 | **MH** | Inorganic silts of high plasticity |
| | | **CH** | Inorganic clays of high plasticity, fat clays |
| | | **OH** | Organic silts and clays of high plasticity |
| **Highly Organic Soils** | | **PT** | Peat and other highly organic soils |

## GRAIN SIZE CHART

| Classification | Range of Grain Sizes | |
|---|---|---|
| | **U.S. Standard Sieve Size** | **Grain Size in Millimeters** |
| Boulders | Above 12" | Above 305 |
| Cobbles | 12" to 3" | 305 to 76.2 |
| Gravel | 3" to No. 4 | 76.2 to 4.76 |
| coarse | 3" to 3/4" | 76.2 to 19.1 |
| fine | 3/4" to No. 4 | 19.1 to 4.76 |
| Sand | No. 4 to No. 200 | 4.76 to 0.075 |
| coarse | No. 4 to No. 10 | 4.76 to 2.00 |
| medium | No. 10 to No. 40 | 2.00 to 0.420 |
| fine | No. 40 to No. 200 | 0.420 to 0.075 |
| Silt and Clay | Below No. 200 | Below 0.075 |

▽ Unstabilized groundwater level

▼ Stabilized groundwater level

## SAMPLE DESIGNATIONS/SYMBOLS

| | |
|---|---|
| ⊟ | Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered |
| ◩ | Classification sample taken with Standard Penetration Test sampler |
| ◧ | Undisturbed sample taken with thin-walled tube |
| ☒ | Disturbed sample |
| ⊙ | Sampling attempted with no recovery |
| ◫ | Core sample |
| ◉ | Analytical laboratory sample |
| ▥ | Sample taken with Direct Push or Drive sampler |
| ▦ | Sonic |

## SAMPLER TYPE

C Core barrel

CA California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter

D&M Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube

O Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube

PT Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube

S&H Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter

SPT Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter

ST Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

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Project
NORTHGATE
TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
SOIL CLASSIFICATION CHART

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
A-34

## I FRACTURING

| Intensity | Size of Pieces in Feet |
|---|---|
| Very little fractured | Greater than 4.0 |
| Occasionally fractured | 1.0 to 4.0 |
| Moderately fractured | 0.5 to 1.0 |
| Closely fractured | 0.1 to 0.5 |
| Intensely fractured | 0.05 to 0.1 |
| Crushed | Less than 0.05 |

## II HARDNESS

1. **Soft** - reserved for plastic material alone.
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produced a little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

## III STRENGTH

1. **Plastic** or very low strength.
2. **Friable** - crumbles easily by rubbing with fingers.
3. **Weak** - an unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** - specimen will withstand a few heavy hammer blows before breaking..
5. **Strong** - specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** - specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

## IV WEATHERING - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

**D. Deep** - moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.

**M. Moderate** - slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.

**L. Little** - no megascopic decomposition of minerals; little of no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.

**F. Fresh** - unaffected by weathering agents. No disintegration of discoloration. Fractures usually less numerous than joints.

## ADDITIONAL COMMENTS:

## V CONSOLIDATION OF SEDIMENTARY ROCKS: usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

## VI BEDDING OF SEDIMENTARY ROCKS

| Splitting Property | Thickness | Stratification |
|---|---|---|
| Massive | Greater than 4.0 ft. | very thick-bedded |
| Blocky | 2.0 to 4.0 ft. | thick bedded |
| Slabby | 0.2 to 2.0 ft. | thin bedded |
| Flaggy | 0.05 to 0.2 ft. | very thin-bedded |
| Shaly or platy | 0.01 to 0.05 ft. | laminated |
| Papery | less than 0.01 | thinly laminated |

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Project
NORTHGATE
TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
PHYSICAL PROPERTIES CRITERIA
FOR ROCK DESCRIPTIONS

Project No.
731759601
Date
11/11/2021
Drawn By
AG
Checked By
HS

Figure
A-35

# APPENDIX B

# LOGS OF BORINGS AND LABORATORY TEST RESULTS BY OTHERS

ORTHGATE MALL ADDITIONS
San Rafael, California

# Log of Boring No. 1

d: October 29, 1982
ing: 6" Auger
Weight: 140 lbs.

Remarks: All sampling was performed with a Modified California Sampler (2-inch I.D., 2½-inch O.D.)

|  | Samples | Blows/Ft | MATERIAL DESCRIPTION | LABORATORY TESTS Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|---|
|  |  |  | Surface Elevation 30.5± |  |  |  |
|  |  |  | 4" Asphalt-Concrete and 6" Sandstone Fragment Base |  |  |  |
|  |  |  | SILTY CLAY FILL (CL) |  |  |  |
|  | 1 | 38 | Very stiff, mottled brown and gray-brown, sandy | 16 | 115 | 6240 |
| 5 |  |  | With sandstone and shale rock fragments |  |  |  |
|  | 2 | 29 |  | - | - | - |
| 10 |  |  |  |  |  |  |
|  | 3 | 25 |  | 12 | 124 | 2680 |
|  |  |  | Becoming less stiff |  |  |  |
| 15 |  |  | ▽ Water Level at End of Drilling |  |  |  |
|  |  |  | (FILL) |  |  |  |
|  | 4 | 18 | SILTY CLAY (CL) | 19 | 109 | 4300 |
|  |  |  | Very stiff, brown mottled orange-brown, sandy |  |  |  |
| 20 |  |  | ▽ Water Level During Drilling |  |  |  |
|  | 5 | 45 | With fine rock fragments | - | - | - |

Proj. No. 15494A | **Woodward-Clyde Consultants** | Figure 2a

NORTHGATE MALL ADDITIONS
San Rafael, California

# Log of Boring No. 1

(Continued

| Depth | Sample | Blows/Ft | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength. |
|---|---|---|---|---|---|---|
| | | | SILTY CLAY (CL)......Cont'd | | | |
| 25 | | | SANDY CLAY (CL-SC)<br>Very stiff, mottled light gray and orange-brown, with trace of fine gravel | | | |
| | 6 | 35 | | 17 | 114 | 3900 |
| 30 | | | | | | |
| | | | SHALE<br>Very soft, weathered, gray | | | |
| | 7 | 50/6" | | - | - | - |
| | | | Becoming soft | | | |
| 35 | | | BOTTOM OF BORING @ 34½' | | | |
| 40 | | | | | | |
| 45 | | | | | | |

Proj. No.

**Woodward-Clyde Consultants**

Figure 2b

ORTHGATE MALL ADDITIONS
San Rafael, California

# Log of Boring No. 2

ed: October 29, 1982

oring: 6" Auger

r Weight: 140 lbs.

Remarks: See Figure 2a

| Depth | Samples | Blows/Ft | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|---|
| | | | Surface Elevation 30.5± | | | |
| | | | 4" Asphalt-Concrete and 5" Sandstone Fragment Base | | | |
| | | | SILTY CLAY FILL (CL) | | | |
| | 1 | 34 | Very stiff, dark brown, sandy | 15 | 118 | 8450 |
| | | | With shale fragments | | | |
| 5 | 2 | 27 | | 13 | 121 | 2780 |
| | | | FILL | | | |
| 10 | 3 | 20 | Silty clay and shale fragments,<br>stiff, dark gray | 11 | 121 | 3100 |
| | | | Becoming brown | | | |
| 15 | 4 | 28 | | 13 | 119 | 4870 |
| | | | (FILL) | | | |
| 20 | 5 | 40 | ▽ CLAYEY SAND (SC)<br>Dense, orange-brown<br>Water Level 10 Minutes After Drilling | - | - | - |
| | | | SANDY CLAY (CL)<br>Very stiff, orange-brown mottled light gray | | | |

Proj. No. 15494A

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Figure 3a

RTHGATE MALL ADDITIONS
an Rafael, California

# Log of Boring No. 2

(Continued)

| | Blows/Ft. | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|
| | | SANDY CLAY (CL)......Cont d | | | |
| | | ▽ Very stiff, orange-brown mottled light gray | | | |
| 6 | 32 | Water Level During Drilling | 17 | 112 | 2470 |

BOTTOM OF BORING @ 26½'

30

35

40

45

Proj. No. 15494A

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Figure 3b

ect NORTHGATE MALL ADDITIONS
San Rafael, California

# Log of Boring No. 3

Date Drilled: October 29, 1982

Type of Boring: 6" Auger

Hammer Weight: 140 lbs.

Remarks: See Figure 2a

| Depth, Ft | Samples | Blows/Ft | MATERIAL DESCRIPTION | LABORATORY TESTS Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|---|
| | | | Surface Elevation 27.0± | | | |
| | | | 2-3/4" Asphalt and 7" Sandstone Fragment Base | | | |
| | 1 | 13 | FILL<br>Silty clay with shale and sandstone rock fragments, loose, dark gray and brown | - | - | - |
| 5 | | | | | | |
| | 2 | 50 | FILL· Brown sandstone and dark gray shale fragments | - | - | - |
| 10 | | | SANDY CLAY FILL (CL)<br>Very stiff, dark brown | | | |
| | | | ▽ Water Level at End of Drilling | | | |
| | 3 | 20 | (FILL) | 15 | 118 | 4050 |
| 15 | | | SANDY CLAY (CL)<br>Very stiff, mottled orange-brown and light gray | | | |
| | 4 | 37 | | 18 | 112 | 5760 |
| 20 | | | | | | |
| | 5 | 57 | SHALE<br>Soft, dark brown | - | - | - |

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Figure 4a

THGATE MALL ADDITIONS
San Rafael, California

# Log of Boring No. 3

(Continued)

|  | Blows/ft. | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|
|  |  | SHALE (Cont'd): Soft, dark brown |  |  |  |
|  |  | Becoming moderately hard |  |  |  |
| 30 |  | BOTTOM OF BORING @ 28½' |  |  |  |
| 35 |  |  |  |  |  |
| 40 |  |  |  |  |  |
| 45 |  |  |  |  |  |

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Figure 4b

ctober 30, 1982 Remarks: See Figure 2a

6" Auger

ght: 140 lbs.

| | Sam | Blows/Ft. | MATERIAL DESCRIPTION | LABORATORY TESTS | | |
|---|---|---|---|---|---|---|
| | | | | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
| | | | Surface Elevation 27.7± | | | |
| | | | Asphalt-Concrete | | | |
| | 1 | 14 | FILL<br>Silty clay with sandstone and shale fragments, loose, dark gray and brown | - | - | - |
| 5 | 2 | 18 | SANDY CLAY FILL (CL)<br>Stiff, dark gray-brown<br>(FILL) | 20 | 106 | 2490 |
| 10 | 3 | 30/6" | SILTY CLAY (CL)<br>Very stiff, orange-brown mottled light gray, sandy | 18 | 110 | 9690 |
| 15 | 4 | 60/4" | SANDSTONE<br>Soft to moderately hard, yellow-brown to brown | - | - | - |
| 20 | | | BOTTOM OF BORING @ 20' | | | |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 5

GATE MALL ADDITIONS
Rafael, California

# Log of Boring No. 5

tober 28, 1982 Remarks: See Figure 2a
6" Auger
140 lbs.

| | Sa | Blows/Ft | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|---|
| | | | Surface Elevation 35.6± | | | |
| | | | 2½" Asphalt-Concrete and 7" Sandstone Fragment Base | | | |
| | 1 | 18 | SILTY CLAY WITH SHALE FRAGMENTS<br>Stiff, dark gray to dark brown<br>(Reworked Material ?) | - | - | - |
| | | | S H A L E | | | |
| | 2 | 60/5" | Soft to moderately hard, highly fractured, dark gray | - | - | - |
| 5 | | | Becoming moderately hard | | | |
| | | | ← Seepage | | | |
| 10 | 3 | 60/6" | Becoming soft | - | - | - |
| | | | BOTTOM OF BORING @ 10-3/4' | | | |
| 15 | | | | | | |
| 20 | | | | | | |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 6

Rafael, California

# Log of Boring No. 6

ctober 28, 1982

6" Auger

ght: 140 lbs.

Remarks See Figure 2a

| Sam | Blows/Ft | MATERIAL DESCRIPTION | LABORATORY TESTS<br>Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|
| | | Surface Elevation 38.8± | | | |
| | | 2-3/4" Asphalt-Concrete | | | |
| | | SHALE | | | |
| 1 | 50 | Very soft to soft, dark brown-gray | 7 | 139 | 3040 |
| | | Moderately hard to hard, silicious, and dark gray | | | |
| 2 | 60/4" | Seepage | - | - | - |
| | | REFUSAL - BOTTOM OF BORING @ 6½' | | | |

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Figure 7

ober 28, 1982 Remarks: See Figure 2a

'' Auger

140 lbs.

|  |  |  |  | LABORATORY TESTS |  |  |
|---|---|---|---|---|---|---|
|  |  | Blows/Ft. | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|  |  |  | Surface Elevation: 33.4± |  |  |  |
|  |  |  | 1½'' Asphalt-Concrete and 6½'' Sand & Gravel Base |  |  |  |
|  | 1 | 31 | SHALE<br>Very soft, weathered, dark gray-brown to brown | 14 | 114 | 4800 |
|  | 2 | 27/6'' | -Becoming soft | - | - | - |
| 5 |  |  |  |  |  |  |
|  | 3 | 60/2½'' | SANDSTONE<br>Moderately hard, silicious, brown | - | - | - |
| 10 |  |  |  |  |  |  |
|  | 4 | 50/3'' | SHALE<br>Moderately hard, highly fractured, dark gray | - | - | - |
|  |  |  | BOTTOM OF BORING @ 13½' |  |  |  |
| 15 |  |  |  |  |  |  |
| 20 |  |  |  |  |  |  |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 8

TE MALL ADDITIONS
afael, California

# Log of Boring No. 8

ber 28, 1982

Auger

140 lbs.

Remarks: See Figure 2a

| | Blows/ft | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|
| | | Surface Elevation 35.0± | | | |
| | | 2½" Asphalt-Concrete | | | |
| 1 ▨ | 10/1" | SILTY CLAY & SANDSTONE FRAGMENTS<br>Dense, gray-brown<br>(Reworked Material ?) | 9 | 122 | 4080 |
| | | SANDSTONE: Moderately hard, gray-brown | | | |
| 2 ▨ | 60/2½" | SHALE | - | - | - |
| | | Soft to moderately hard, dark brown | | | |
| | | --With hard, silicious zones | | | |
| 3 ▨ | 60/2" | | - | - | - |
| | | BOTTOM OF BORING @ 10¼' | | | |

j. No. 15494A

**Woodward-Clyde Consultants**

Figure 9

TE MALL ADDITIONS
afael, California

# Log of Boring No. 9

ober 28, 1982

Remarks: See Figure 2a

6" Auger

140 lbs.

| | Sa | Blows/Ft. | MATERIAL DESCRIPTION | LABORATORY TES Moisture Content,% | Dry Density, pcf | Unconfined Compressive Strength. |
|---|---|---|---|---|---|---|
| | | | Surface Elevation 33.2± | | | |
| | | | 3¼" Asphalt-Concrete | | | |
| | | | CLAYEY SANDSTONE | | | |
| | 1 ▨ | 60/5" | Moderately hard, weathered, fractured, brown | - | - | - |
| 5 | | | Becoming less fractured | | | |
| | | | SHALE<br>Moderately hard, dark brown | | | |
| 10 | 2 ▨ | 60/3" | | - | - | - |
| | | | BOTTOM OF BORING @ 10½' | | | |
| 15 | | | | | | |
| '0 | | | | | | |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 10

MALL ADDITIONS
ael, California

# Log of Boring No. 10

r 29, 1982
Auger
140 lbs.

Remarks See Figure 2a

| | | Blow | MATERIAL DESCRIPTION | LABORATORY TESTS Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength psf |
|---|---|---|---|---|---|---|
| | | | Surface Elevation 33.4± | | | |
| | | | 2" Asphalt-Concrete and 6" Sand & Gravel Base | | | |
| | | | SILTY CLAY (CL) | | | |
| | 1 | 31 | very stiff to hard, orange-brown mottled brown, sandy | 17 | 110 | 8860 |
| 5 | | | Becoming sandier with fine rock fragments | | | |
| | 2 | 26 | | 11 | 115 | 2200 |
| 10 | | | | | | |
| | 3 | 50/10½" | SHALE | 12 | 120 | 5280 |
| | | | Soft, weathered, brown | | | |
| 15 | | | Becoming moderately hard | | | |
| | 4 | 60/2½" | | - | - | - |
| | | | BOTTOM OF BORING @ 17½' | | | |
| 20 | | | | | | |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 11

MALL ADDITIONS
el, California

# Log of Boring No. 11

28, 1982

Remarks See Figure 2a

uger

lbs.

Surface Elevation 34.4±

| Depth | Sample | Bl | MATERIAL DESCRIPTION | LABORATORY TESTS Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|---|
| | | | 3" Asphalt-Concrete | | | |
| | 1 | 46<br>9" | SANDY CLAY (CL)<br>Very stiff to hard, mottled brown, orange-brown, and light gray<br>(Highly Weathered Sandstone) | 16 | 114 | 8940 |
| 5 | 2 | 47 | | 16 | 115 | 9660 |
| 10 | 3 | 40<br>6" | SANDSTONE<br>Soft, brown<br>-Becoming moderately hard | - | - | - |
| 15 | 4 | 60<br>2" | | - | - | - |
| | | | BOTTOM OF BORING @ 15½' | | | |
| 20 | | | | | | |

roj. No. 15494A

**Woodward-Clyde Consultants**

Figure 12

ALL ADDITIONS
el, California

# Log of Boring No. 12

r 28, 1982

uger

40 lbs.

Remarks. See Figure 2a

| | | | MATERIAL DESCRIPTION | LABORATORY TESTS<br>Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|---|
| | | | Surface Elevation 39.4± | | | |
| | | | Asphalt-Concrete | | | |
| | 1 | 61 | SHALE FRAGMENTS<br>Medium dense, dark gray<br>(Reworked Material) | - | - | - |
| | | | SHALE<br>Moderately hard, silicious, gray | | | |
| 5 | 2 | $\frac{40}{6''}$ | SHALE<br>Soft to moderately hard, gray | - | - | - |
| | | | SHALE<br>Hard, silicious, dark gray | | | |
| 10 | | | REFUSAL - BOTTOM OF BORING @ 8½' | | | |
| 15 | | | | | | |
| 20 | | | | | | |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 13

MALL ADDITIONS
ael, California

# Log of Boring No. 13

r 29, 1982
Auger
140 lbs.

Remarks: See Figure 2a

| | | | | LABORATORY TESTS | | |
|---|---|---|---|---|---|---|
| | | | MATERIAL DESCRIPTION | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
| | | | Surface Elevation 38.8± | | | |
| | | | 2" Asphalt-Concrete and 6" Shale Fragment Base | | | |
| 1 | ▨ | 30/2½" | SHALE<br>Soft, weathered, dark brown and brown | 10 | 124 | 5195 |
| | | | SHALE<br>Soft to moderately hard, gray, with silicious zones | | | |
| | | | ← Seepage | | | |
| 2 | ▨ | 60/5" | | - | - | - |
| | | | BOTTOM OF BORING @ 10½' | | | |

el, California

# Log of Boring No. 14

28, 1982

Remarks: See Figure 2a

der

lbs.

Surface Elevation: 34.8±

| | | | MATERIAL DESCRIPTION | LABORATORY TESTS | | |
|---|---|---|---|---|---|---|
| | | | | Moisture Content, % | Dry Density, pcf | Unconfined Compressive Strength, psf |
| | | | 2-3/4" Asphalt-Concrete and 10" Sand & Gravel Base | | | |
| | ▨ | 30/6" | SHALE | 6 | 134 | 4720 |
| | | | Very soft to soft, dark gray | | | |
| 2 | ▨ | 47/7" | | - | - | - |
| | | | Becoming moderately hard with silicious layers | | | |
| | | | Becoming hard | | | |
| | | | BOTTOM OF BORING @ 10' | | | |

j. No. 15494A | **Woodward-Clyde Consultants** | Figure 15

, California

# Log of Boring No. 15

29, 1982

ger

lbs.

Remarks: See Figure 2a

| | | | MATERIAL DESCRIPTION | LABORATORY TEST<br>Moisture Content, % | <br>Dry Density, pcf | <br>Unconfined Compressive Strength, |
|---|---|---|---|---|---|---|
| | | | Surface Elevation. 33.6± | | | |
| | | | 2'' Asphalt-Concrete and Sandstone Fragment Base | | | |
| | 1 | 47 | SHALE<br>Very soft to soft, weathered, dark brown and brown | 9 | 128 | 6590 |
| 5 | | | | | | |
| | | | SHALE<br>Moderately hard, silicious, dark gray | | | |
| 10 | | | | | | |
| | 2 | 60/4'' | | - | - | - |
| | | | BOTTOM OF BORING @ 12½' | | | |
| 15 | | | | | | |
| 20 | | | | | | |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 16

Project. NORTHGATE MALL ADDITIONS
San Rafael, California

# Log of Boring No. 16

Date Drilled: October 30, 1982

Remarks: See Figure 2a

Type of Boring: 6'' Auger

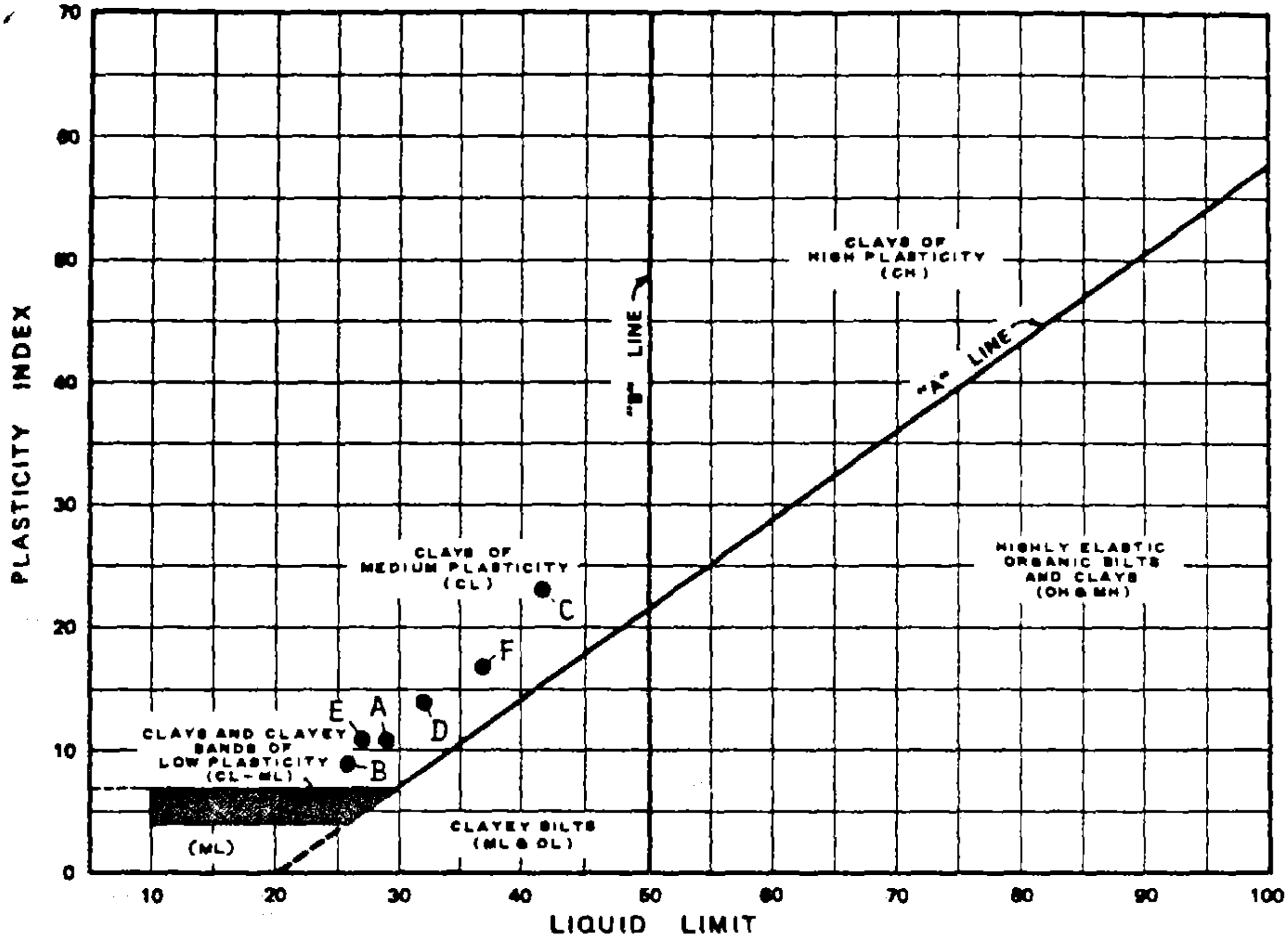
Hammer Weight: 140 lbs.

| Depth, Ft | Samples | Blows/Ft | MATERIAL DESCRIPTION | LABORATORY TESTS<br>Moisture Content, % | <br>Dry Density, pcf | <br>Unconfined Compressive Strength, psf |
|---|---|---|---|---|---|---|
| | | | Surface Elevation 34.4± | | | |
| | | | SILTY CLAY FILL<br>Stiff, dark gray-brown | | | |
| | 1 | 40/6'' | SILTY SAND FILL (SM-SP) | - | - | - |
| 5 | | | Coarse- to fine-grained, dense, brown, with fine gravel | | | |
| | 2 | 18/6'' | | - | - | - |
| 10 | | | Becoming medium dense | | | |
| | 3 | 27 | | - | - | - |
| 15 | | | SANDY GRAVEL FILL<br>Loose, with cobbles | | | |
| | | | (FILL) | | | |
| | 4 | 60/½'' | CONCRETE | - | - | - |
| | | | BOTTOM OF BORING @ 18½' | | | |
| 20 | | | | | | |

Proj. No. 15494A

**Woodward-Clyde Consultants**

Figure 17



| SAMPLE IDENTIFICATION | | | | ATTERBERG LIMITS | | |
|---|---|---|---|---|---|---|
| LETTER DESIG'N | BORING NO. | SAMPLE NO. | DEPTH, FT. | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX |
| A | 1 | 1 | 3 | 29 | 18 | 11 |
| B | 2 | 1 | 3 | 26 | 17 | 9 |
| C | 7 | 1 | 2 | 42 | 19 | 23 |
| D | 10 | 1 | 3 | 32 | 18 | 14 |
| E | 14 | 1 | 2 | 27 | 16 | 11 |
| F | 15 | 1 | 3 | 37 | 20 | 17 |

Project No. 15494A

**Woodward-Clyde Consultants**

PLASTICITY CLASSIFICATION

NORTHGATE MALL ADDITIONS

Figure 18

# *UNIFIED SOIL CLASSIFICATION SYSTEM*

| MAJOR DIVISIONS | | | | | DESCRIPTIVE NAMES |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS<br>More than Half > #200 sieve | **GRAVELS**<br>MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE | CLEAN GRAVELS WITH LITTLE OR NO FINES | **GW** | ○ | WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES |
| | | | **GP** | ○ | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES |
| | | GRAVELS WITH OVER 15% FINES | **GM** | ○ | SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES |
| | | | **GC** | ▨ | CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES |
| | **SANDS**<br>MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE | CLEAN SANDS WITH LITTLE OR NO FINES | **SW** | ░ | WELL GRADED SANDS, GRAVELLY SANDS |
| | | | **SP** | ░ | POORLY GRADED SANDS, GRAVELLY SANDS |
| | | SANDS WITH OVER 15% FINES | **SM** | ░ | SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES |
| | | | **SC** | ▨ | CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES |
| FINE GRAINED SOILS<br>More than Half < #200 sieve | **SILTS AND CLAYS**<br>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 CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | **SILTS AND CLAYS**<br>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 SILTS |
| **HIGHLY ORGANIC SOILS** | | | **Pt** | | PEAT AND OTHER HIGHLY ORGANIC SOILS |

## *FIELD SAMPLING*

| | |
|---|---|
| ◧ | CALIFORNIA SAMPLE 2.5" I.D. |
| ■ | MODIFIED CALIFORNIA SAMPLE 2" I.D. |
| ☒ | DISTURBED, BAG OR BULK SAMPLE |
| ◪ | STANDARD PENETRATION TEST |
| ⧄ | SHELBY TUBE SAMPLE |
| ▥ | 3-1/2" I.D. CONTINUOUS CORE SAMPLE |
| ☐ | UNRETAINED PORTION OF SAMPLE |
| ▼ | WATER LEVEL OBSERVED IN BORING (at given post-drilling time) |
| ▽ | WATER LEVEL OBSERVED IN BORING (at time of drilling) |

## *LABORATORY TESTS*

| | |
|---|---|
| LL | LIQUID LIMIT |
| PI | PLASTICITY INDEX |
| SA | SIEVE ANALYSIS |
| #200 | PERCENT PASSING #200 SIEVE |
| RV | RESISTANCE VALUE |
| EI | EXPANSION INDEX |
| DS | DIRECT SHEAR |
| Tx/UU | TRIAXIAL SHEAR-UNCONSOLIDATED UNDRAINED |
| UC | UNCONFINED COMPRESSION |
| SG | SPECIFIC GRAVITY |
| PP | POCKET PENETROMETER SHEAR STRENGTH (tsf) |

NOTES: Blow counts represent the number of blows of a 140-pound hammer falling 30-inches required to drive a sampler the last 12-inches of an 18-inch penetration. Field blow counts (not-converted).

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil strata and groundwater observed at the boring location on the date of drilling only.

**KLEINFELDER**

PROJECT NUMBER **86393** DATE **Oct 2007**

**BORING LOG LEGEND**

**Northgate Mall Improvements**
**Access Roads**
**San Rafael, California**

PLATE
**A-1**

## WEATHERING

**Fresh** - No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces. **Weathering Grade I.**

**Slightly Weathered** - Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition. **Weathering Grade II.**

**Moderately Weathered** - Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or corestones. **Weathering Grade III.**

**Highly Weathered** - More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones. **Weathering Grade IV.**

**Completely Weathered** - All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact. **Weathering Grade V.**

**Residual Soil** - All rock material is converted to a soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported. **Weathering Grade VI.**

## STRENGTH (OF INTACT ROCK PIECES

| Grade | Description | Field Identification | Approx. UCS (Mpa) | Approx. UCS (psi) |
|---|---|---|---|---|
| R0 | Extremely Weak Rock | Identified by thumbnail | 0.25 - 1.0 | 50 - 150 |
| R1 | Very Weak Rock | Crumbles under firm blows with point of geological hammer | 1.0 - 5.0 | 150 - 750 |
| R2 | Weak Rock | Can be peeled by a pocket knife, specimen can be fractured with single firm blow of geological hammer | 5.0 - 25 | 750 - 3,500 |
| R3 | Moderately Strong Rock | Cannot be scraped or peeled with pocket knife, specimen can be fractured with single firm blow of geological hammer | 25 - 50 | 3,500 - 7,500 |
| R4 | Strong Rock | Specimen requires more than one blow of geological hammer to fracture it | 50 - 100 | 7,500 - 15,000 |
| R5 | Very Strong Rock | Specimen requires many blows of geological hammer to fracture it | 100 - 250 | 15,000 - 35,000 |
| R6 | Extremely Strong Rock | Specimen can only be chipped with geological hammer | >250 | >35,000 |

## DISCONTINUITY SPACING

| | English | Metric |
|---|---|---|
| 1. Extremely close | <1.0 in. | (<20 mm) |
| 2. Very close | 1.0 - 2.5 in. | (20 - 60 mm) |
| 3. Close | 2.5 - 8.0 in. | (60 - 200 mm) |
| 4. Moderately | 8.0 in - 2.0 ft. | (200 - 600 mm) |
| 5. Wide | 2.0 - 6.5 ft. | (600 - 2,000 mm) |
| 6. Very wide | 6.5 - 20.0 ft. | (2 - 6 m) |
| 7. Ext. wide | >20.0 ft. | (>6 m) |

## APERTURE WIDTH

| | |
|---|---|
| Very tight | <1.0 mm |
| Tight | 0.1 - 0.25 mm |
| Partly open | 0.25 - 0.5 mm |
| Open | 0.5 - 2.5 mm |
| Moderately wide | 2.5 - 10 mm |
| Wide | 10 mm - 1 cm |
| Very wide | 1 - 10 cm |
| Extremely wide | 10 - 100 cm |
| Cavernous | >1 m |

## ROCK QUALITY DESIGNATION

| RQD% | Rock Quality |
|---|---|
| 90 - 100 | Excellent |
| 75 - 90 | Good |
| 50 - 75 | Fair |
| 25 - 50 | Poor |
| 0 - 25 | Very Poor |

$$\text{RQD} = \frac{\text{Sum of Intact Pieces >4 inches (100 mm)}}{\text{Total Core Run Length}}$$

| | |
|---|---|
| ■ | Hand-Driven Tube Sample |
| P.P. +4.5 | Pocket Penetrometer (tons per square foot, tsf) |

KLEINFELDER

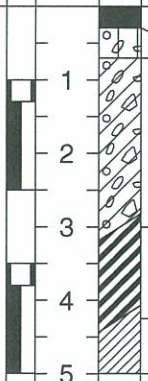
# ROCK DESCRIPTION CRITERIA

**Northgate Mall Improvements**
**Access Roads**
**San Rafael, California**

PLATE

**A-2**

PROJECT NUMBER **86393** DATE **Oct 2007**



| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | A.C. | **ASPHALT = 3.5 INCHES THICK** |
| | | | | | | 1 | | GM | **SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1" diameter (Aggregate Baserock) |
| 114 | 15.2 | | | 38 | | 2 | | GC | **CLAYEY GRAVEL WITH SAND -** light brown, brown and yellow brown, moist, medium dense, fine to coarse sand to coarse subrounded to angular gravel to 1" diameter (Fill) |
| | | | | | | 3 | | | |
| 115 | 17.6 | | | 36 | | 4 | | CH | **SANDY CLAY -** olive brown, moist, firm, fine to coarse sand |
| | | | | | | | | CL | **SANDY CLAY -** mottled brown, gray and red-brown, moist, hard, fine to medium sand |
| | | | | | | 5 | | | |
| | | | | | | 6 | | | BOTTOM OF BORING K-1 @ 5 FEET<br>No Free Water Encountered |
| | | | | | | 7 | | | |
| | | | | | | 8 | | | |
| | | | | | | 9 | | | |
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| | | | | | | 19 | | | |
| | | | | | | 20 | | | |

* Field blow counts (not-converted).

**

SURFACE ELEVATION: **Not Available ****

TOTAL DEPTH: **5.0 feet**

GROUND WATER DEPTH: ∇ **feet at time of drilling**

▼ **feet**

LOGGED BY: **R. Padgett**

EQUIPMENT: **Mobile B-53**

DIAMETER of BORING: **6**

DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393**

DATE **Oct 2007**

## LOG OF EXPLORATION
## BORING K-1

**Northgate Mall Improvements**
**Access Roads**
**San Rafael, California**

PLATE

**A-3**

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 4 INCHES THICK** |
| | | | | | | 1 | | GM | **SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse angular gravel to 0.75 inch diameter (Aggregate Baserock) |
| 120<br>131 | 13.1<br>6.7 | | LL=26<br>PI=12 | 48 | | 2 | | CL | **SANDY CLAY WITH GRAVEL -** brown, light brown and yellow brown, moist, hard, fine to coarse sand to fine subrounded gravel to 0.5 inch diameter |
| | | | | | | 3 | | | |
| | | | | | | 4 | | GC | **CLAYEY GRAVEL WITH SAND -** olive gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1" diameter |
| | | | | 34 | | 5 | | | >2.5 inch diameter sandstone gravel at 5.5 feet |
| | | | | | | 6 | | | BOTTOM OF BORING K-2 @ 5.5 FEET<br>No Free Water Encountered |
| | | | | | | 7 | | | |
| | | | | | | 8 | | | |
| | | | | | | 9 | | | |
| | | | | | | 10 | | | |
| | | | | | | 11 | | | |
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| | | | | | | 15 | | | |
| | | | | | | 16 | | | |
| | | | | | | 17 | | | |
| | | | | | | 18 | | | |
| | | | | | | 19 | | | |
| | | | | | | 20 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **5.5 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

# LOG OF EXPLORATION BORING K-2

**Northgate Mall Improvements Access Roads San Rafael, California**

PLATE

**A-4**

1 of 1

PROJECT NUMBER **86393** DATE **Oct 2007**

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 4 INCHES THICK** |
| | | | | | | 1 | | GM | **SILTY GRAVEL WITH SAND -** gray, moist, dense, fine to coarse sand to coarse subangular gravel to 0.75 inch diameter (Aggregate Baserock) |
| 119 | 14.1 | | | | | | | | |
| 122 | 11.0 | | -200=34% | 49 | | 2 | | GC | **CLAYEY GRAVEL WITH SAND -** olive brown, red brown and yellow brown, moist, dense, fine to coarse sand to coarse subrounded to angular gravel to 1.5 inch diameter (Fill) |
| | | | | | | 3 | | SC | **CLAYEY SAND -** light brown, moist, medium dense, fine to coarse sand (Fill) |
| 111 | 13.7 | | | | | | | | |
| 129 | 13.2 | | | 49 | | 4 | | CL | **SANDY CLAY -** light brown, moist, firm, fine to medium sand (Fill) |
| | | | | | | | | GC | **CLAYEY GRAVEL WITH SAND -** olive brown, moist, dense, fine to coarse sand, to coarse subrounded to subangular gravel to 3 inch diameter |
| | | | | | | 5 | | | |
| | | | | | | 6 | | | |
| | | | | | | 7 | | | BOTTOM OF BORING K-3 @ 5 FEET |
| | | | | | | 8 | | | No Free Water Encountered |
| | | | | | | 9 | | | |
| | | | | | | 10 | | | |
| | | | | | | 11 | | | |
| | | | | | | 12 | | | |
| | | | | | | 13 | | | |
| | | | | | | 14 | | | |
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| | | | | | | 16 | | | |
| | | | | | | 17 | | | |
| | | | | | | 18 | | | |
| | | | | | | 19 | | | |
| | | | | | | 20 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **5.0 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

# LOG OF EXPLORATION BORING K-3

## Northgate Mall Improvements Access Roads San Rafael, California

PLATE

**A-5**

1 of 1

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 5 INCHES THICK** |
| | | | | | | 1 | | GM | **SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular to subrounded gravel to 1 inch diameter |
| 102 | 6.6 | | -200=16% | 62/9" | | 2 | | | |
| | | | | | | 3 | | GC | **CLAYEY GRAVEL WITH SAND -** dark gray, moist, dense, fine to coarse sand to coarse angular shale gravel to 2 inch diameter (Fill) |
| | | | | 60/3" | | 4 | | | sandstone gravel/cobble >2.5 inch diameter |
| | | | | | | 5 | | | BOTTOM OF BORING K-7 @ 4.5 FEET<br>No Free Water Encountered |
| | | | | | | 6 | | | |
| | | | | | | 7 | | | |
| | | | | | | 8 | | | |
| | | | | | | 9 | | | |
| | | | | | | 10 | | | |
| | | | | | | 11 | | | |
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| | | | | | | 15 | | | |
| | | | | | | 16 | | | |
| | | | | | | 17 | | | |
| | | | | | | 18 | | | |
| | | | | | | 19 | | | |
| | | | | | | 20 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **4.5 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

**KLEINFELDER**

PROJECT NUMBER **86393** DATE **Oct 2007**

## LOG OF EXPLORATION
## BORING K-7

**Northgate Mall Improvements**
**Access Roads**
**San Rafael, California**

PLATE
**A-6**
1 of 1

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 4.5 INCHES THICK** |
| | | | | | | 1 | | GM | **SILTY GRAVEL WITH SAND -**<br>gray, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock) |
| 137 | 6.9 | | | 65/10" | | 2 | | GC | **CLAYEY GRAVEL WITH SAND -**<br>dark gray, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Fill) |
| | | | | 50/2" | | 3<br>4 | | | **SHALE -**<br>dark gray, very fine grained, very weak (R1), fissile, finely laminated |
| | | | | | | 5 | | | BOTTOM OF BORING K-8 @ 4 FEET<br>No Free Water Encountered |
| | | | | | | 6 | | | |
| | | | | | | 7 | | | |
| | | | | | | 8 | | | |
| | | | | | | 9 | | | |
| | | | | | | 10 | | | |
| | | | | | | 11 | | | |
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| | | | | | | 16 | | | |
| | | | | | | 17 | | | |
| | | | | | | 18 | | | |
| | | | | | | 19 | | | |
| | | | | | | 20 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **4.0 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

# LOG OF EXPLORATION
# BORING K-8

**Northgate Mall Improvements
Access Roads
San Rafael, California**

PLATE
**A-7**
1 of 1

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 2 INCHES THICK** |
| | | | | | | | | GM | **SILTY GRAVEL WITH SAND -** |
| | | | | | | 1 | | | gray, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock) |
| | | | | 50/2" | | 2 | | | **SANDSTONE -**<br>gray, fine to medium grained, weak (R2) |
| | | | | | | 3 | | | |
| | | | | 39 | | 4 | | | **SHALE -**<br>dark gray, very fine grained, very weak (R1), fissile |
| | | | | | | 5 | | | BOTTOM OF BORING K-9 @ 4.5 FEET<br>No Free Water Encountered |
| | | | | | | 6 | | | |
| | | | | | | 7 | | | |
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| | | | | | | 15 | | | |
| | | | | | | 16 | | | |
| | | | | | | 17 | | | |
| | | | | | | 18 | | | |
| | | | | | | 19 | | | |
| | | | | | | 20 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **4.5 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

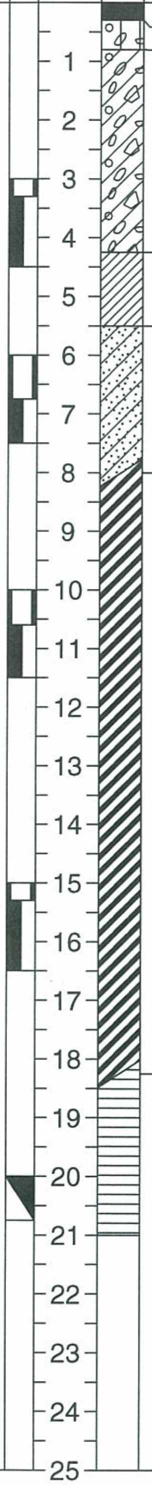
# LOG OF EXPLORATION
# BORING K-9

## Northgate Mall Improvements
## Access Roads
## San Rafael, California

PLATE
**A-8**

1 of 1

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 4 INCHES THICK** |
| | | | | | | | | GM | **SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subrounded to subangular gravel to 1" diameter (Aggregate Baserock) |
| 124 | 12.6 | | | 50 | | | | GC | **CLAYEY GRAVEL WITH SAND -** olive brown, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Fill) |
| | | | | | | | | CL | **SANDY CLAY -** mottled red brown, brown and yellow brown, moist, stiff, fine to medium sand (Fill) |
| 159 | 7.3 | | | 55/8" | | | | SC | **CLAYEY SAND WITH GRAVEL -** red brown, brown and olive gray, moist, very dense, fine to coarse sand to coarse angular gravel to 1 inch diameter (Fill) |
| | | | | 63 | | | | CH | **CLAY WITH SAND -** mottled red brown, yellow brown and dark brown, moist, stiff, fine to medium sand, some manganese mineralization |
| | | | | 72 | | | | | Hard |
| | | | | 85/11" | | | | | **SHALE -** reddish brown, very fine grained, very weak (R1), very closely fractured |
| | | | | | | | | | BOTTOM OF BORING K-4 @ 21 FEET<br>No Free Water Encountered |



* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **21.0 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

**KLEINFELDER**

# LOG OF EXPLORATION BORING K-4

## Northgate Mall Improvements
## Proposed Rite Aid Building
## San Rafael, California

PLATE **A-3**

1 of 1

PROJECT NUMBER **86393** DATE **Oct 2007**

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 5 INCHES THICK** |
| | | | | | | 1 | | GM | **SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock) |
| 131 | 10.8 | | | 61 | | 2 | | CL | **SANDY CLAY WITH GRAVEL -** mottled red brown, olive gray and yellow brown, moist, very stiff, fine to coarse sand to fine angular gravel to 0.5 inch diameter, some organics (Fill) |
| | | | | | | 3 | | GC | **CLAYEY GRAVEL WITH SAND -** olive brown, moist, dense to very dense, fine to coarse sand to coarse subrounded gravel to 1 inch diameter (Fill) |
| | | | | | | 4 | | GC | **CLAYEY GRAVEL WITH SAND -** light brown, moist, dense, fine to coarse sand to coarse subangular to angular gravel to >2.5 inch diameter |
| 140 | 7.6 | | | 46 | | 5 | | | BOTTOM OF BORING K-5 @ 5 FEET<br>No Free Water Encountered |
| | | | | | | 6 | | | |
| | | | | | | 7 | | | |
| | | | | | | 8 | | | |
| | | | | | | 9 | | | |
| | | | | | | 10 | | | |
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| | | | | | | 22 | | | |
| | | | | | | 23 | | | |
| | | | | | | 24 | | | |
| | | | | | | 25 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **5.5 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

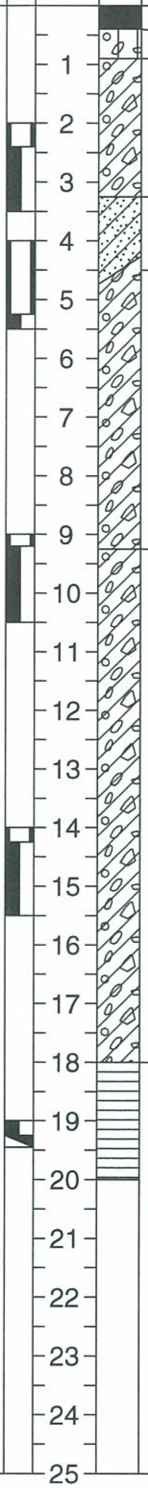
PROJECT NUMBER **86393** DATE **Oct 2007**

# LOG OF EXPLORATION
# BORING K-5

## Northgate Mall Improvements
## Proposed Rite Aid Building
## San Rafael, California

PLATE

**A-4**



| LABORATORY | | | | FIELD | | | |
|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | U.S.C.S. Designation | SOIL DESCRIPTION | |
| | | | | | AC | **ASPHALT = 4 INCHES THICK** | |
| | | | | | GM | **SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular to angular gravel to 0.75 inch diameter (Aggregate Baserock) | |
| | 8.1<br>10.4 | | -200=22%<br>LL=30<br>PI=14 | 43 | GC | **CLAYEY GRAVEL WITH SAND -** red brown, brown, gray and yellow brown, moist, dense, fine to coarse sand to coarse subrounded gravel to 1 inch diameter (Fill) | |
| | | | | | SC | **CLAYEY SAND WITH GRAVEL -** red brown, yellow brown and dark gray, moist, dense, fine to medium sand, some fine angular gravel to 0.5 inch diameter (Fill) | |
| | 10.1 | | | 51 | GC | **CLAYEY GRAVEL WITH SAND AND COBBLES -** light brown and brown, moist, dense, fine to coarse sand to coarse subrounded gravel/cobbles to >2.5 inch diameter (Fill) | |
| | | | | 52<br>26 | GC | **CLAYEY GRAVEL WITH SAND -** olive, moist, dense, fine to coarse sand to coarse subangular gravel to 2 inch diameter | |
| | | | | 50/3"<br>50/2" | | **SHALE -** red brown, very fine grained, slightly weathered, weak (R2), fissile | |
| | | | | | | BOTTOM OF BORING K-6 @ 20 FEET<br>No Free Water Encountered | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **20.0 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

# LOG OF EXPLORATION
# BORING K-6

**Northgate Mall Improvements**
**Proposed Rite Aid Building**
**San Rafael, California**

PLATE
**A-5**
1 of 1

PROJECT NUMBER **86393** DATE **Oct 2007**

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 4 INCHES THICK** |
| | | | | | | 1 | | GM | **SILTY GRAVEL WITH SAND -**<br>gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter |
| | | | | | | 2 | | CL | **SANDY CLAY -**<br>mottled red brown, brown and olive brown, moist, very stiff, fine sand (Alluvium) |
| 116 | 17.0 | | TXUU=7387psf | 49 | | 4 | | | |
| | | | | | | 6 | | CL/CH | **SANDY CLAY -**<br>mottled olive brown, red brown, moist, very stiff, fine to medium sand, trace rounded fine gravel to 0.25 inch diameter (Alluvium) |
| 109 | 19.6 | | | 47 | | 7 | | | |
| | | | | | | 8 | | SC | **CLAYEY SAND -**<br>mottled brown, red brown and olive brown, moist to wet, medium dense, fine sand (Alluvium) |
| 109 | 20.5 | | | 26 | | 10 | | | |
| | | | | | | 12 | | | **SHALE -**<br>olive brown and red brown, very fine grained, extremely weak (R0), intensely fractured, fissile, slaky, Mn staining on fracture faces |
| | | | | 50/4" | | 14 | | | |
| | | | | | | 16 | | | ▼harder drilling |
| | | | | 50/2" | | 19 | | | ▽ |
| | | | | | | 19.5 | | | BOTTOM OF BORING K-10 @ 19.5 FEET |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **19.5 feet**
GROUND WATER DEPTH: ▽ **19.0 feet at time of drilling**
▼ **16.0 feet +0.5 HR**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

# LOG OF EXPLORATION
# BORING K-10

**Northgate Mall Improvements**
**Proposed Restaurants**
**San Rafael, California**

PLATE
**A-3**
1 of 1

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | AC | **ASPHALT = 4 INCHES THICK** |
| | | | | | | | | GM | **SILTY GRAVEL WITH SAND -**<br>gray, dry, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock) |
| | | | LL=34<br>PI=16 | 50/6" | | 1 | | | |
| | | | | | | 2 | | | |
| | | | | | | | | | **SILTSTONE -**<br>olive gray and brown, fine grained, slightly weathered, very weak (R1), very closely fractured, thinly laminated |
| | | | | 50/4" | | 3 | | | |
| | | | | | | 4 | | | |
| | | | | | | 5 | | | |
| | | | | | | 6 | | | |
| | | | | | | 7 | | | |
| | | | | | | | | | **SANDSTONE -**<br>gray, fine to medium grained, slightly weathered, weak (R2) |
| | | | | | | 8 | | | |
| | | | | 50/1" | | 9 | | | |
| | | | | | | | | | BOTTOM OF BORING K-11 @ 9.5 FEET<br>No Free Water Encountered |
| | | | | | | 10 | | | |
| | | | | | | 11 | | | |
| | | | | | | 12 | | | |
| | | | | | | 13 | | | |
| | | | | | | 14 | | | |
| | | | | | | 15 | | | |
| | | | | | | 16 | | | |
| | | | | | | 17 | | | |
| | | | | | | 18 | | | |
| | | | | | | 19 | | | |
| | | | | | | 20 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **9.5 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

# LOG OF EXPLORATION
# BORING K-11

## Northgate Mall Improvements
## Proposed Restaurants
## San Rafael, California

PLATE
**A-4**
1 of 1

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | | **MORTAR** - 0.25 inches thick |
| | | | | | | | | | **BRICK** - 4 inches thick<br>red brick in mortar |
| | | | | | | | | | **MORTAR** -1 inch thick |
| | | | | | | 1 | | | **CONCRETE** - 8.5 inches thick, porous, no steel observed |
| | | | | | | | | GP | **SANDY GRAVEL** -<br>gray brown, moist, medium dense (FILL) |
| | | | LL = 27<br>PI = 10 | | | | | CL | **SANDY CLAY WITH GRAVEL** -<br>medium brown, moist, medium stiff |
| 112 | 17.0 | | EI = 26 | | | 2 | | CL | **SANDY CLAY** -<br>medium brown, moist, medium stiff to stiff |
| 115 | 15.8 | | | | | | | | |
| | | | | | | 3 | | | BOTTOM OF BORING C-1 @ 2.1 FEET<br>No Free Water Encountered |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: ******
TOTAL DEPTH: **2.1 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **S. Carroll**
EQUIPMENT: **4" core barrel**
DIAMETER of BORING: **4**
DATE DRILLED: **8-29-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

## LOG OF EXPLORATION
## BORING C-1

**Northgate Mall Improvements**
**Proposed Restaurants**
**San Rafael, California**

PLATE
**A-5**
1 of 1

| LABORATORY | | | | FIELD | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dry Density (pcf) | Moisture Content (%) | Shear Strength (ksf) | Other Tests | Blows/foot * | Sample | Depth (feet) | Lithology Symbol | U.S.C.S. Designation | SOIL DESCRIPTION |
| | | | | | | | | | **CONCRETE** - 5.5 to 6 inches thick, no steel observed, visqueen at base of concrete |
| | | | | | | | | SP | **SAND** - 3 inches thick with visqueen at base of sand, gray brown, moist, loose, fine grained (FILL) |
| 111 | 13.5 | | | | | | | | **SANDY CLAY** - medium brown, moist, soft to medium stiff (FILL) |
| 123 | 12.2 | | | | | | | | |
| | | | | | | 1 | | | |
| | | | LL = 25<br>PI = 10 | | | | | CL | |
| 110 | 12.0 | | | | | | | | |
| | | | | | | 2 | | | BOTTOM OF BORING C-2 @ 1.8 FEET<br>No Free Water Encountered |
| | | | | | | 3 | | | |

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **
TOTAL DEPTH: **1.8 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **S. Carroll**
EQUIPMENT: **4" core barrel**
DIAMETER of BORING: **4**
DATE DRILLED: **8-29-07**

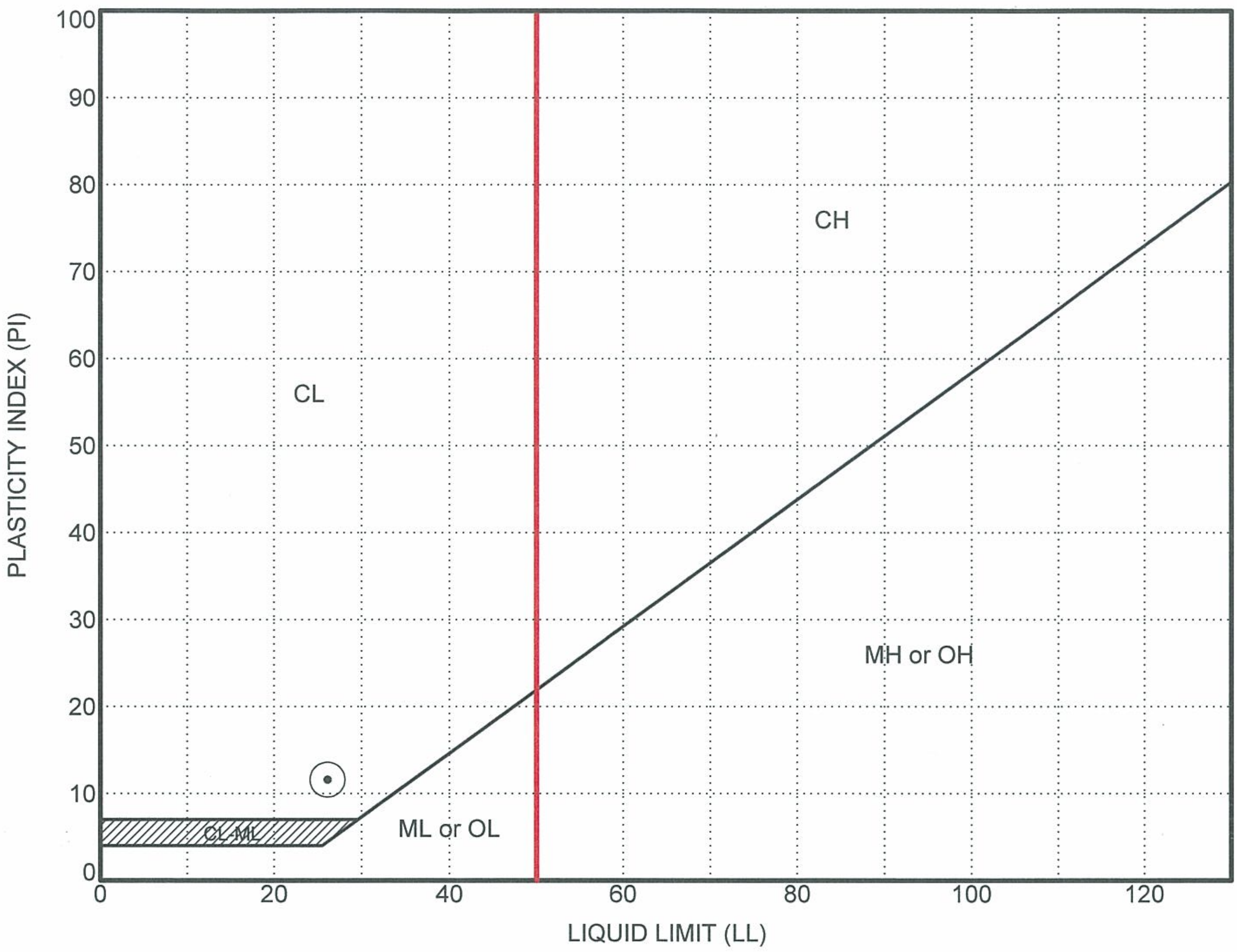
KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

## LOG OF EXPLORATION
## BORING C-2

**Northgate Mall Improvements**
**Proposed Restaurants**
**San Rafael, California**

PLATE
**A-6**
1 of 1



| SAMPLE SOURCE | CLASSIFICATION | LIQUID LIMIT (%) | PLASTIC LIMIT (%) | PLASTICITY INDEX (%) | % PASSING #200 SIEVE |
|---|---|---|---|---|---|
| ⊙ K-2 @ 2.0' | Sandy Clay (CL) | 26 | 15 | 12 | |

**KLEINFELDER**

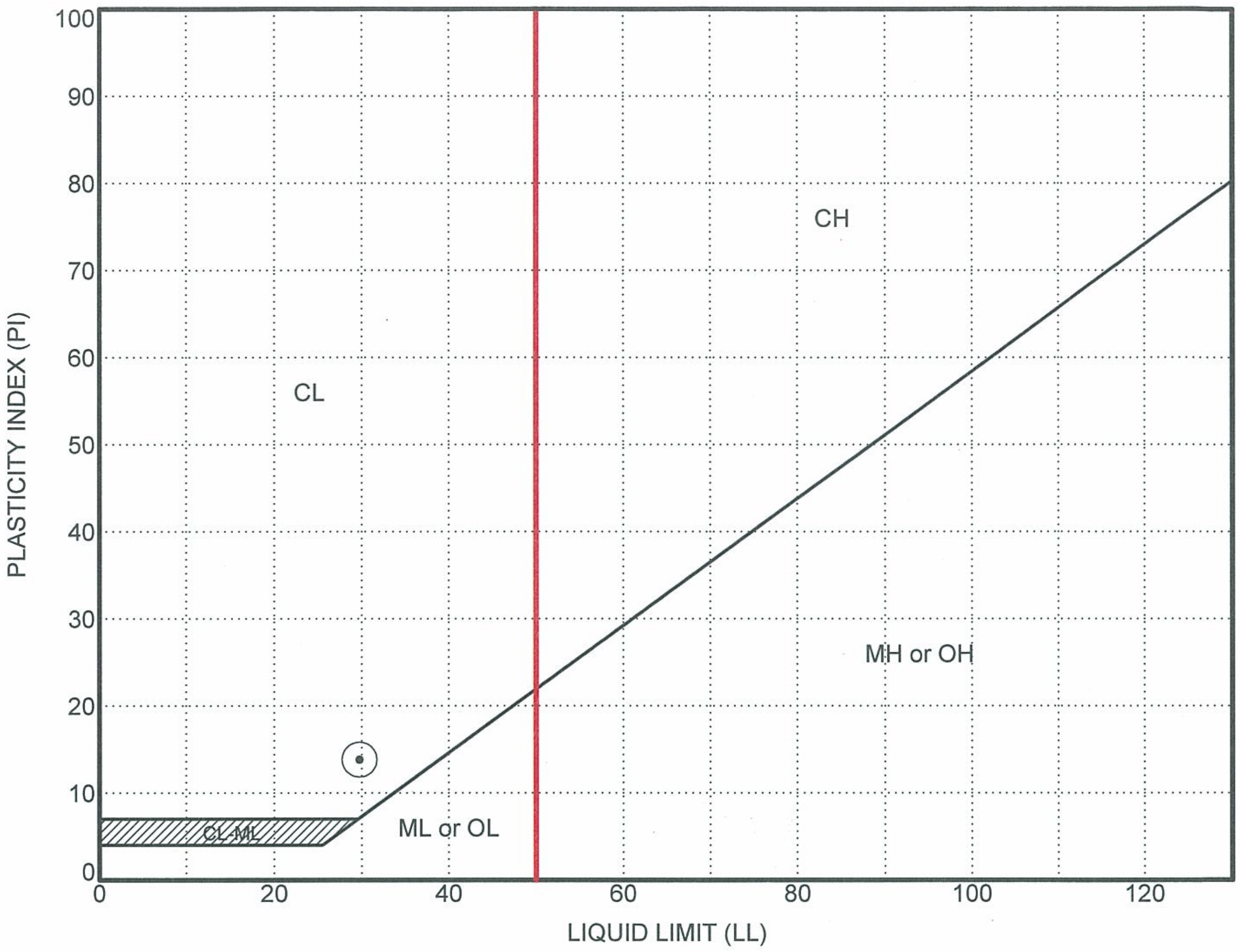
PROJECT NUMBER **86393** DATE **Oct 2007**

## PLASTICITY CHART

**Northgate Mall Improvements**
**Access Roads**
**San Rafael, California**

PLATE

**B-1**



| SAMPLE SOURCE | CLASSIFICATION | LIQUID LIMIT (%) | PLASTIC LIMIT (%) | PLASTICITY INDEX (%) | % PASSING #200 SIEVE |
|---|---|---|---|---|---|
| ⊙ K-6 @ 3.0' | Clayey Sand (SC) | 30 | 16 | 14 | |

**KLEINFELDER**

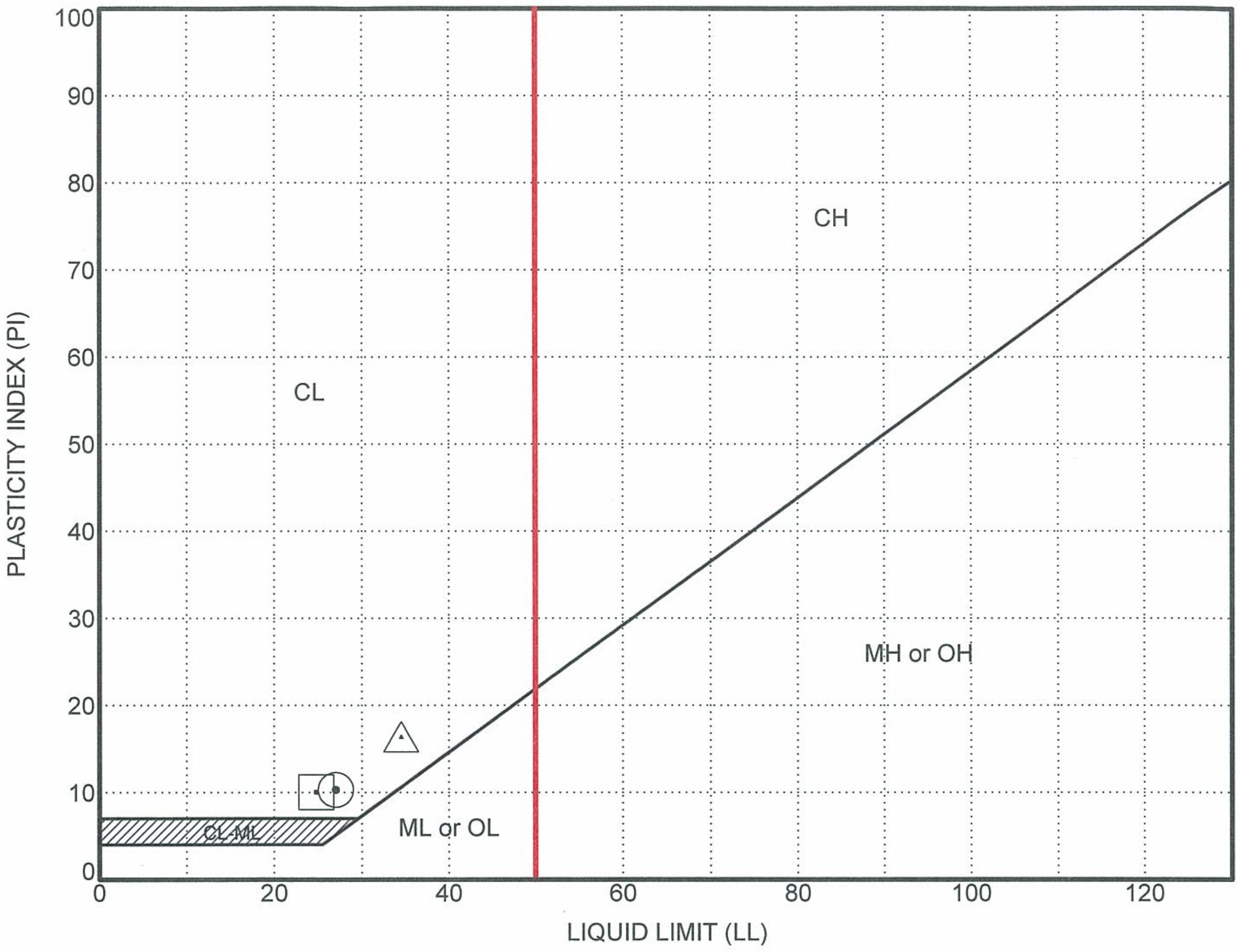
PROJECT NUMBER **86393** DATE **Oct 2007**

# PLASTICITY CHART

**Northgate Mall Improvements**
**Proposed Rite Aid Building**
**San Rafael, California**

PLATE

**B-2**



| SAMPLE SOURCE | CLASSIFICATION | LIQUID LIMIT (%) | PLASTIC LIMIT (%) | PLASTICITY INDEX (%) | % PASSING #200 SIEVE |
|---|---|---|---|---|---|
| ⊙ C-1 @ 1.6' | Sandy Clay (CL) | 27 | 17 | 10 | |
| ⊡ C-2 @ 1.3' | Sandy Clay (CL) | 25 | 15 | 10 | |
| △ K-11 @ 1.0' | Siltstone | 34 | 18 | 16 | |

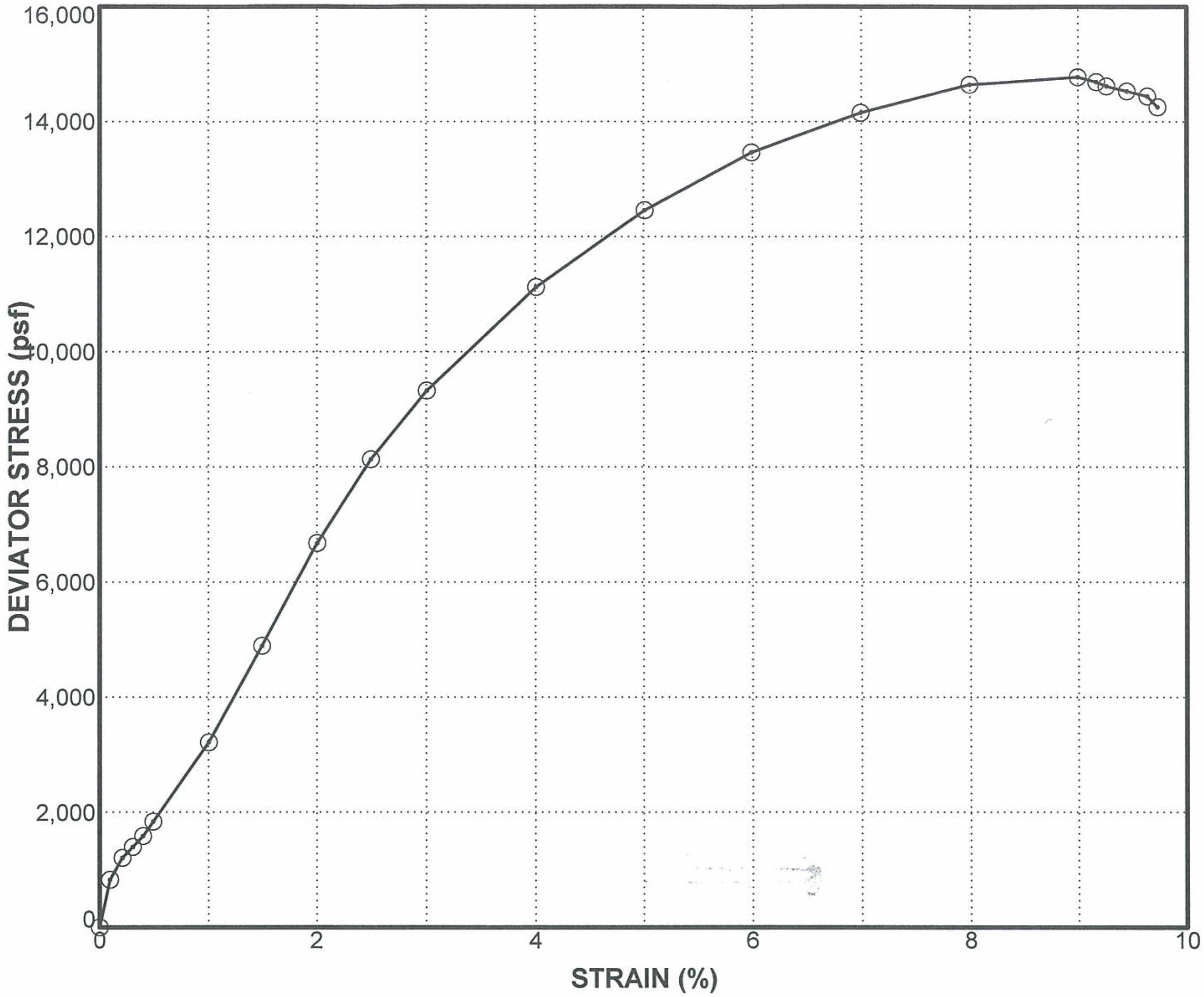
KLEINFELDER

# PLASTICITY CHART

**Northgate Mall Improvements**
**Proposed Restaurants**
**San Rafael, California**

PLATE
**B-2**

PROJECT NUMBER **86393** DATE **Oct 2007**



| Sample Source | Classification | Type of Test | Confinement Pressure (psf) | Shear Strength (psf) | Strain (%) | Dry Density (pcf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|
| ⊙ K-10 @ 4.0' | Sandy Clay (CL) | TXUU | 576 | 7387 | 9 | 116 | 17.0 |

UC = Unconfined Compression

TX/UU = Unconsolidated Undrained Triaxial

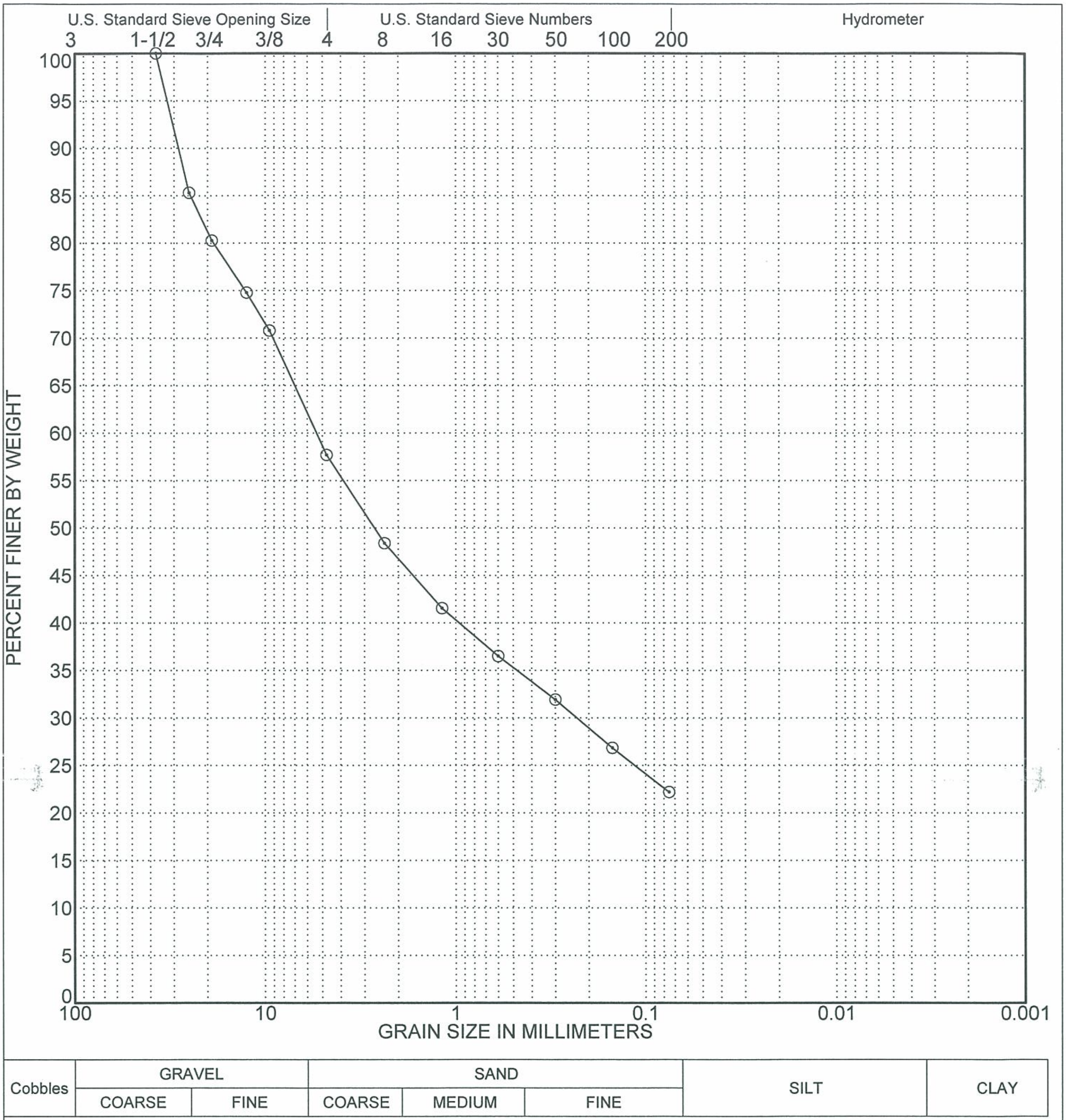
KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

## STRENGTH TEST DATA

**Northgate Mall Improvements**
**Proposed Restaurants**
**San Rafael, California**

PLATE
**B-1**



| SYMBOL | SAMPLE SOURCE | CLASSIFICATION |
|---|---|---|
| ⊙ | K-6 @ 2.5' | CLAYEY GRAVEL with SAND (GC) |

**KLEINFELDER**

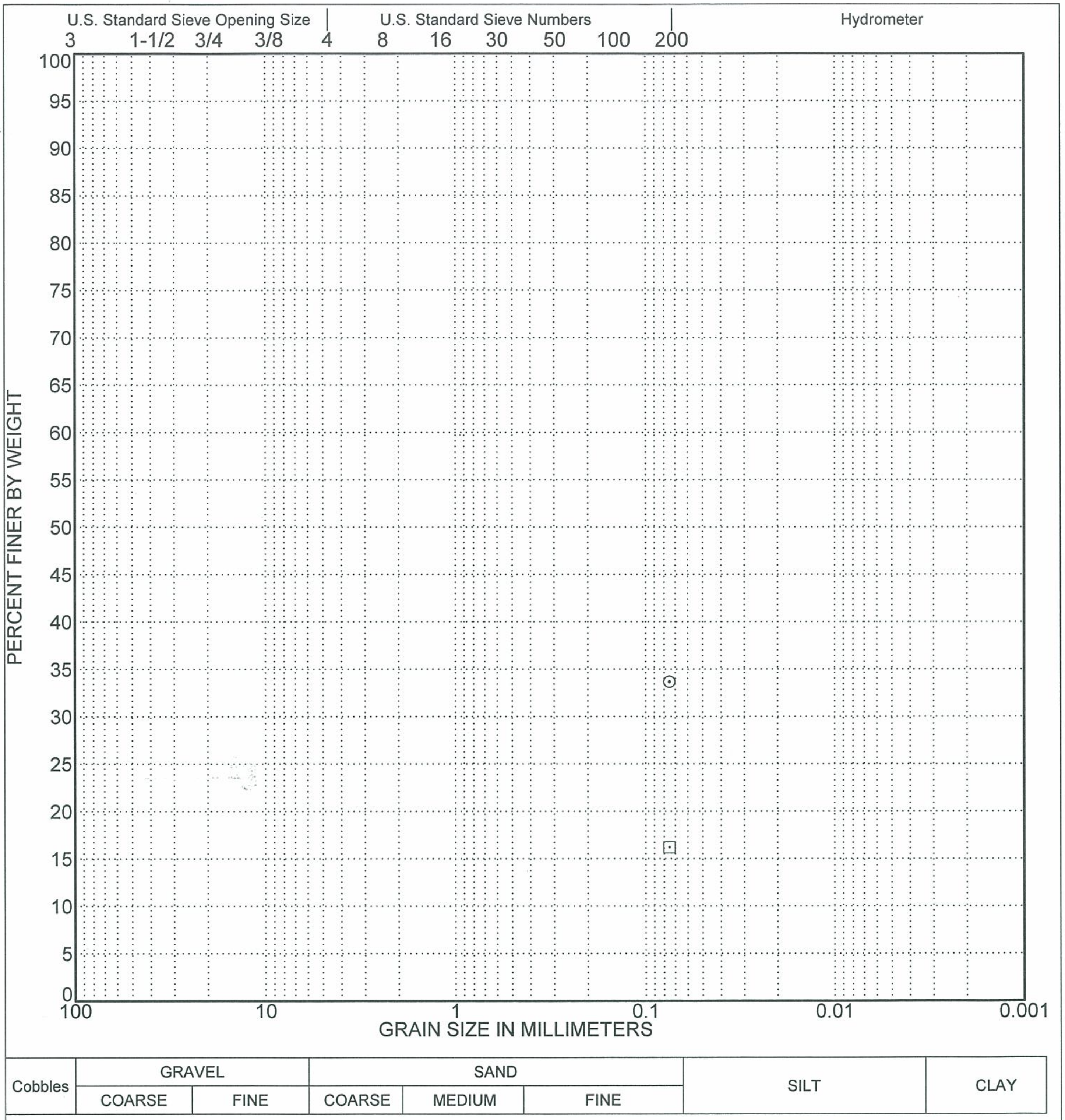
PROJECT NUMBER **86393** DATE **Oct 2007**

# PARTICLE SIZE ANALYSIS

**Northgate Mall Improvements**
**Proposed Rite Aid Building**
**San Rafael, California**

PLATE

**B-1**



| SYMBOL | SAMPLE SOURCE | CLASSIFICATION |
|---|---|---|
| ⊙ | K3-2&K3-1 combined @ 1.0' - 2.0' | Clayey Gravel with Sand |
| ⊡ | K-7 @ 1.5' | Clayey Gravel with Sand |

**KLEINFELDER**

PROJECT NUMBER **86393** DATE **Oct 2007**

# PARTICLE SIZE ANALYSIS

**Northgate Mall Improvements**
**Access Roads**
**San Rafael, California**

PLATE

**B-2**

# KLEINFELDER
# LABORATORY TESTING SERVICES

**Project Name:** Northgate Mall
**Project Number:** 86393
**Report Date:** 9/14/07
**Sample ID:** C1 @ 2.0'
**Material Description:** Sandy Clay

## Expansion Index Test (UBC 18-2)

| | |
|---|---|
| Expansion Index: | 26 |
| Dry Density (PCF): | 112.9 |
| Initial Moisture Content (%) | 8.1 |
| Final Moisture Content (%) | 22.7 |

## Classification of expansive soil

| **Expansion Index** | **Expansion Potential** |
|---|---|
| 0-20 | Very Low |
| 21-50 | Low |
| 51-90 | Medium |
| 91-130 | High |
| Above 130 | Very High |

Reviewed By

KLEINFELDER

PROJECT NUMBER 86393 DATE October 2007

EXPANSION INDEX
Northgate Mall
Proposed Rite Aid Building
San Rafael, California

PLATE
**B-3**

# KLEINFELDER
# LABORATORY TESTING SERVICES

September 26,2007

| | |
|---|---|
| Project: | Northgate Mall |
| Job No.: | 86393 |
| Sample: | K-1,2,3 Combined Bulk A |
| Description: | Sandy Clay with Gravel to Clayey Gravel with Sand |

## Testing Program

The testing program included R-Value determination. The testing was performed in accordance with ASTM D2844. The results are presented below.

*Note:*
*Material extruded under mold during loading operation. R-value reported as "Less than 5"*
*ref: ASTM D2844, Section 6, Note 2.*

R- Value <5

Reviewed By ____________

**ETS**

**Environmental Technical Services**

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

***Serving people and the environment so that both benefit.***

COMPANY: Kleinfelder Associates, 2240 Northpoint Parkway, Santa Rosa, CA 95407
ATTN: Mark H. Stanley
JOB SITE: Northgate Mall, Santa rosa, California.
FILE #: 86393

DATE RECEIVED: 9/6/2007
DATE of COMPLETION: 9/13/2007
ANALYST(S): D. Salinas, S. Santos
SUPERVISOR: D. Jacobson
LAB DIRECTOR: G.S. Conrad PhD

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SOIL pH -log[H+] | NOMINAL RESISTIVITY ohm-cm | ELECTRICAL CONDUCTIVITY µmhos/cm | SULFATE SO4 ppm | CHLORIDE Cl ppm |
|---|---|---|---|---|---|---|---|
| 02766-1 | NM1/SR | KL1-1 | **8.15** | **2,630** | **[380]** | **42** | **88** |
| Method | Detection | Limits ---> | --- | 1 | 0.1 | 1 | 1 |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SALINITY ECe mmhos/cm | SOLUBLE SULFIDES (S=) ppm | SOLUBLE CYANIDES (CN=) ppm | REDOX mV | PERCENT MOISTURE % |
|---|---|---|---|---|---|---|---|
| 02766-1 | NM1/SR | KL1-1 | | | | **+298.6** | |
| Method | Detection | Limits ---> | --- | 0.1 | 0.1 | 1 | 0.1 |

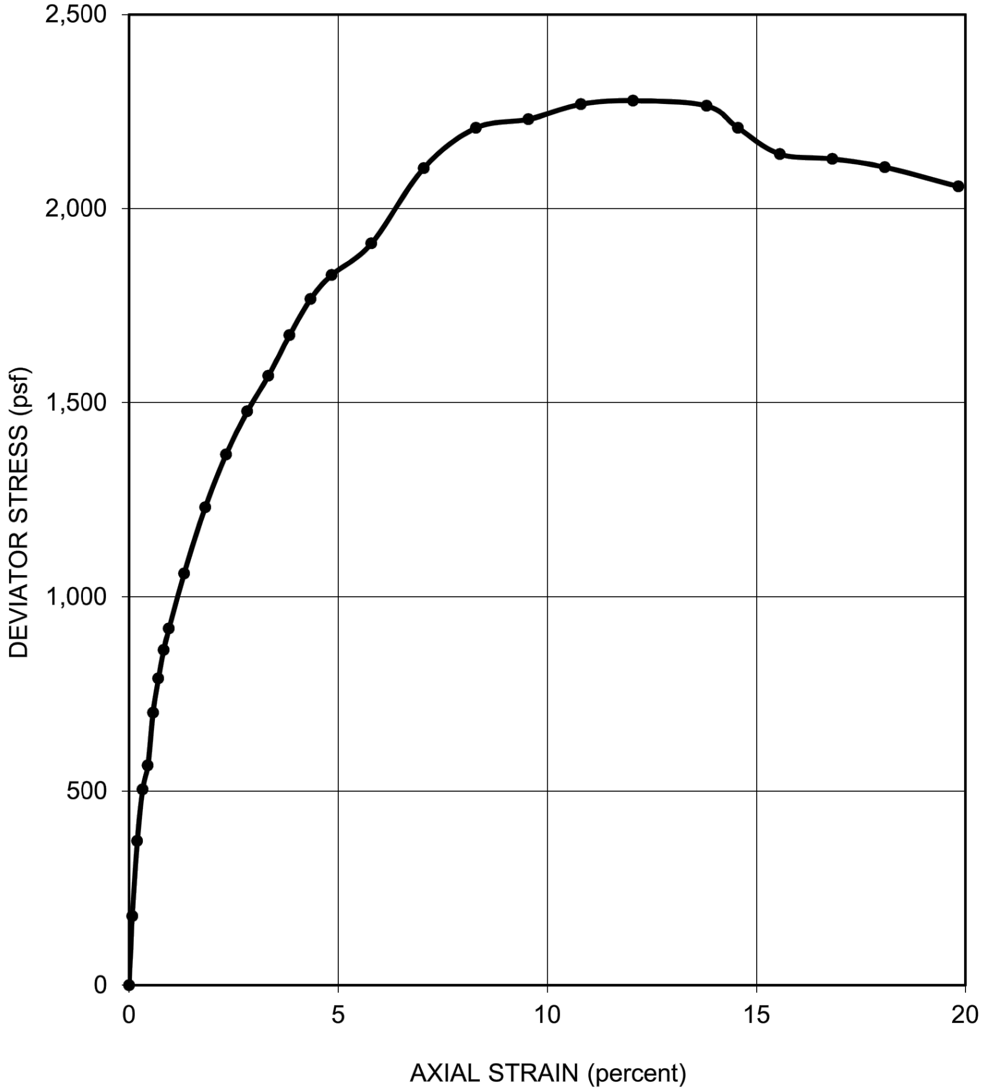
************************************************** COMMENTS **************************************************

Resistivity is over 2,000 ohm-cm but is mediocre, and soil reaction (i.e., pH) is moderately alkaline which does help; both sulfate and chloride are low; and redox is mild. The CalTrans times to perforation for this soil are as follows: for 18 ga steel the time to perforation is 37 yrs, and for 12 ga it goes up to over 81 yrs. The <u>average</u> pitting rate determination for steel in this soil is 0.07 mm/yr, thus pitting to a depth of 2 mm would be ≈28.5 yrs, and to a 4 mm depth it would be ≈57 yrs. Chlorides are so low that there should be no significant corrosion impact on concrete steel reinforcement; and sulfates are also low thus no measureable adverse impact should occur to concrete, mortar, grout or cement. The redox value is mild enough that no significant added adverse impact on construction materials should be expected. As concerns buried metals, this soil would not benefit at all from alkaline treatment since it pH is already alkaline enough. To increase metals longevity any more in this soil would require further upgrading (i.e., heavier gauge or more resistant steel); and/or other actions could be taken (e.g. special engineering fill, special coatings, cathodic protection, plastic pipe, etc.). Last, standard concrete mixes and related materials should be fine in this soil based on these results.

\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

# APPENDIX C

# LABORATORY TEST RESULTS



| | | | | | |
|---|---|---|---|---|---|
| SAMPLER TYPE: Sprague & Henwood | | | SHEAR STRENGTH: | 1,140 | psf |
| DIAMETER (in.): 2.38 | HEIGHT (in.): 4.79 | | STRAIN AT FAILURE: | 12.1 | % |
| MOISTURE CONTENT: | 15.9 | % | CONFINING PRESSURE: | 750 | psf |
| DRY DENSITY: | 117 | pcf | STRAIN RATE: | 0.75 | % / min |
| DESCRIPTION: SANDY CLAY (CL), gray-brown | | | SOURCE: | R3-1 at 6 feet | |

**LANGAN**

Langan Engineering and
Environmental Services, Inc.
135 Main Street, Suite 1500
San Francisco, CA 94105

T: 415.955.5200 F: 415.955.5201 www.langan.com

Project

NORTHGATE
TOWN SQUARE
SAN RAFAEL

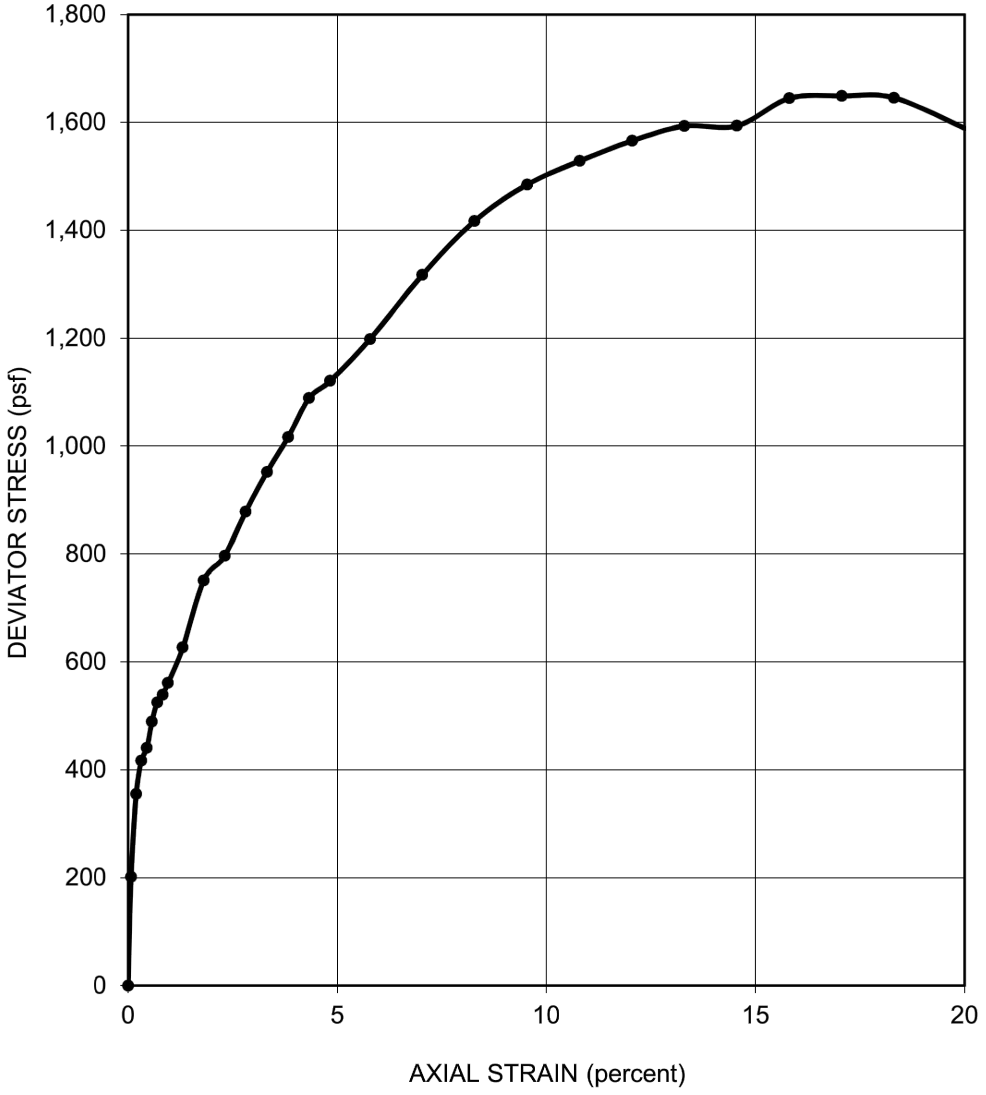
MARIN COUNTY CALIFORNIA

Figure Title

UNCONSOLIDATED-UNDRAINED
TRIAXIAL COMPRESSION TEST

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure C-1



| | | | |
|---|---|---|---|
| SAMPLER TYPE: Sprague & Henwood | | SHEAR STRENGTH: 820 | psf |
| DIAMETER (in.): 2.38 | HEIGHT (in.): 6 | STRAIN AT FAILURE: 17.1 | % |
| MOISTURE CONTENT: 19.5 | % | CONFINING PRESSURE: 2,800 | psf |
| DRY DENSITY: 111 | pcf | STRAIN RATE: 0.75 | % / min |
| DESCRIPTION: SANDY CLAY (CL), yellow-brown with brown and orange mottling | | SOURCE: R5-4 at 26 feet | |

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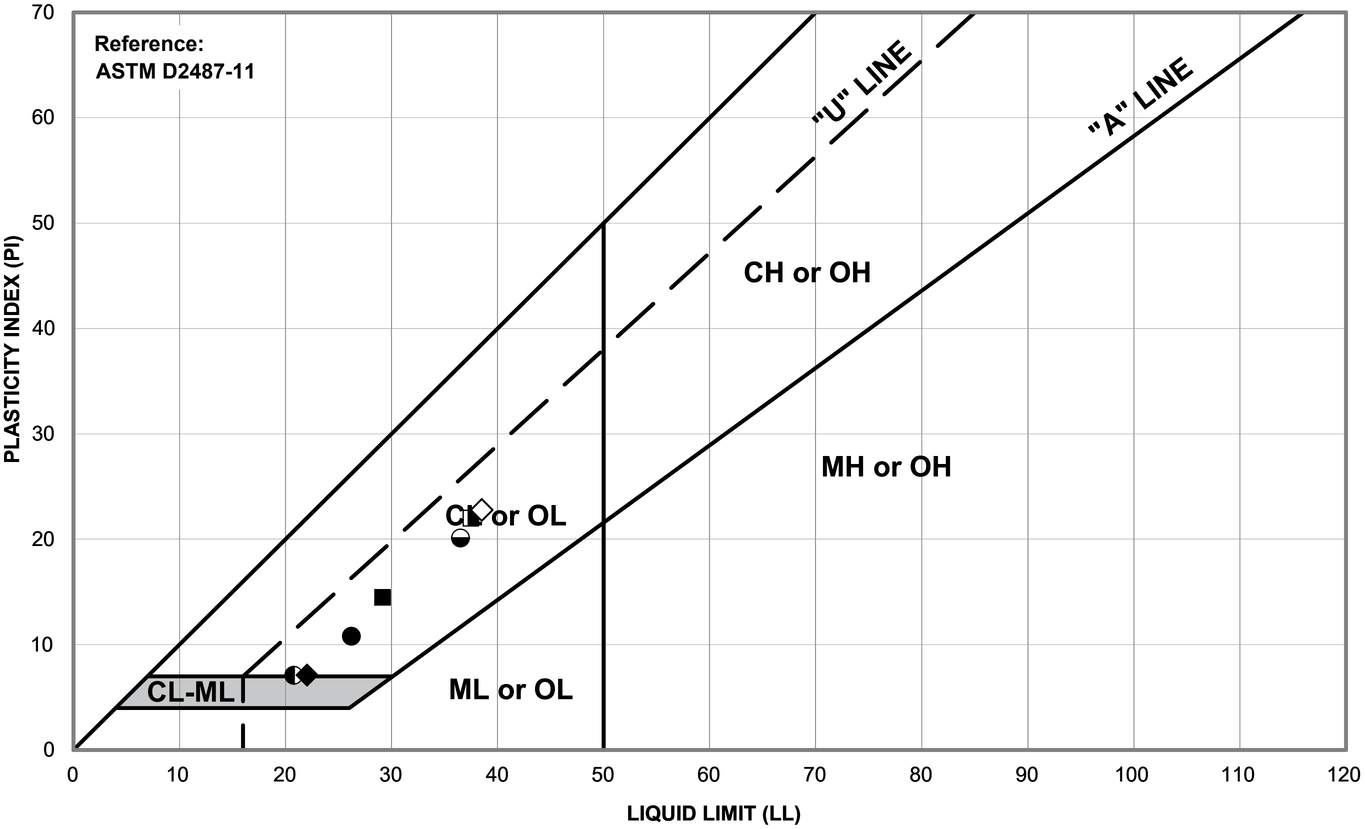
Project
**NORTHGATE TOWN SQUARE**
**SAN RAFAEL**
**MARIN COUNTY** **CALIFORNIA**

Figure Title
**UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST**

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
C-2

# PLASTICITY CHART



| Symbol | Source | Description and Classification | Natural M.C. (%) | Liquid Limit (%) | Plasticity Index (%) | % Passing #200 Sieve |
|---|---|---|---|---|---|---|
| ● | C-1 at 2.5 feet | SANDY CLAY (CL), yellow-brown to brown | -- | 26 | 11 | -- |
| ■ | P-1 at 2.5 feet | CLAYEY SAND (SC), gray | -- | 29 | 15 | -- |
| ◨ | R4-3 at 16 feet | CLAYEY SAND with Gravel (SC), gray | 10.9 | 37 | 22 | 38.6 |
| ◒ | R4-3 at 20.5 feet | CLAYEY SAND with Gravel (SC), gray-brown | 12.8 | 36 | 20 | 45.9 |
| ◐ | R4-5 at 21 feet | SANDY SILTY CLAY (CL-ML), dark brown | 16.5 | 21 | 7 | 59.8 |
| ◆ | R5-5 at 25 feet | CLAYEY SILTY SAND (SC-SM), brown | 16.2 | 22 | 7 | 28.6 |
| ◇ | R6-2 at 2.5 feet | CLAY WITH SAND (CL), light gray with orange mottling | -- | 38 | 23 | -- |
| | | | | | | |

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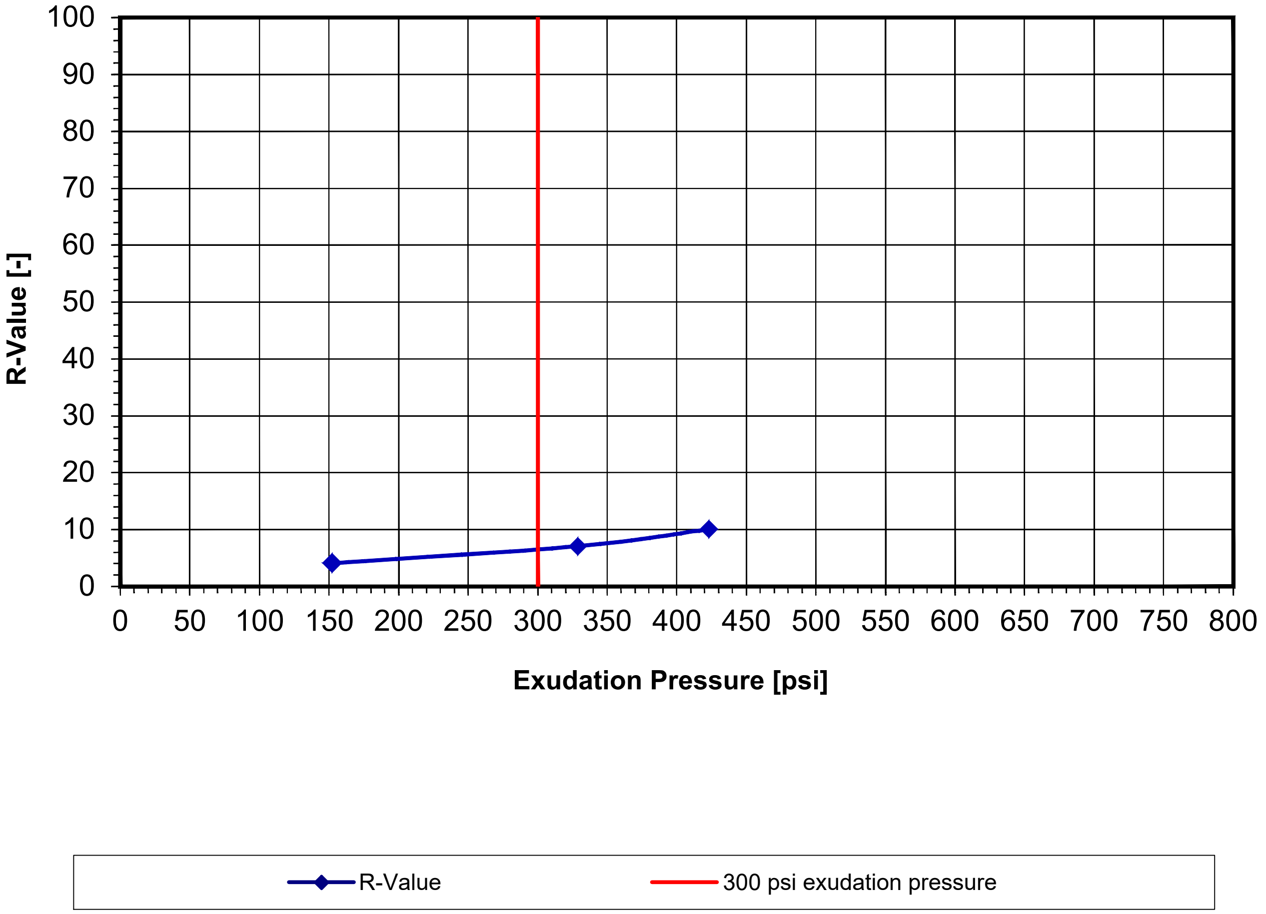
Project
NORTHGATE
TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
PLASTICITY
CHART

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
C-3



| Sample ID | A | B | C | D |
|---|---|---|---|---|
| Water Content (%) | 16.2 | 14.9 | 13.6 | -- |
| Dry Density (pcf) | 114.5 | 118.6 | 121.0 | -- |
| Exudation Pressure (psi) | 152 | 329 | 423 | -- |
| Expansion Pressure (psf) | 0.0 | 0.0 | 0.0 | -- |
| Resistance Value (R) | 4.0 | 7.0 | 10 | -- |

| Sample Source | Sample Description | Sand Equivalent | Expansion Pressure | R-Value |
|---|---|---|---|---|
| R4-1 and P-2 Composite at 1 to 5 feet | SANDY CLAY (CL), yellow-brown to olive-gray | -- | -- | 7 |

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Project
**NORTHGATE TOWN SQUARE**
**SAN RAFAEL**
**MARIN COUNTY** **CALIFORNIA**

Figure Title
**RESISTANCE VALUE TEST REPORT**

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
C-4

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731759601-B-GI0101_Lab-Classification.dwg Date: 11/22/2021 Time: 15:37 User: agekas Style Table: Langan.stb Layout: R-VALUE TEST REPORT_1

# APPENDIX D

# CORROSIVITY ANALYSIS WITH BRIEF EVALUATION

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

Client: Langan
Client's Project No.: 731759601/700/030.0
Client's Project Name: Northgate Mall Redevelopment
Date Sampled: 11/1 & 2/21
Date Received: 11/09/21
Matrix: Soil
Authorization: Chain of Custody

Date of Report: 22-Nov-2021

| 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)* |
|---|---|---|---|---|---|---|---|---|
| 2111013-001 | R2-4, 2.5' | 330 | 6.91 | - | 3,000 | - | 39 | 65 |
| 2111013-002 | P-5, 2.5' | 360 | 7.94 | - | 1,100 | - | N.D. | 210 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Method: | ASTM D1498 | ASTM D4972 | ASTM D1125M | ASTM G57 | ASTM D4658M | ASTM D4327 | ASTM D4327 |
| Reporting Limit: | - | - | 10 | - | 50 | 15 | 15 |
| Date Analyzed: | 16-Nov-2021 | 16-Nov-2021 | - | 19-Nov-2021 | - | 16-Nov-2021 | 16-Nov-2021 |

* Results Reported on "As Received" Basis

N.D. - None Detected

Shawn Moore

for Cheryl McMillen
Laboratory Director

**<u>Quality Control Summary</u> - All laboratory quality control parameters were found to be within established limits**

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

22 November, 2021

Job No. 2111013
Cust. No. 12242

Mr. Herman Sok
Langan
1 Almaden Blvd., Suite 590
San Jose, CA 95113

Subject: Project No.: 731759601.700.030.0
Project Name: Northgate Mall Redevelopment
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Sok:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on November 9, 2021. Based on the analytical results, a brief evaluation is enclosed for your consideration.

Based upon the resistivity measurements, Sample 002 is classified as "corrosive" and Sample 001 is "moderately 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 concentrations are none detected and 39 mg/kg and they are determined to be insufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations are 65 and 210 mg/kg and are determined to be sufficient to potentially be detrimental to reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The pH of the soils are 6.91 and 7.94, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials are 330 and 360-mV and are indicative of potentially "slightly corrosive" soils resulting from anaerobic 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.**
Moore
for J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

# Chain of Custody 2111013

Page 1 of 1

Concord, CA 94520-1006
925 462 2771
Fax: 925 462 2775

CERCO analytical

| Job No. | CU# | | Client Project I.D. |
|---|---|---|---|
| 731759601/700/030.0 | | | Northgate Mall Redevelopment |

| Schedule | | Date Sampled | Date Due |
|---|---|---|---|
| Analyte | | 11/1-2/2021 | Standard |

**Full Name** 12242 ✓

Herman Sok, hsok@langan.com

**Phone** 408-283-3629 X

**Fax**

**Cell** ☒

**Company and/or Mailing Address**

Langan, 1 South Almaden Blvd, #590, San Jose, CA 95113

**Sample Source**

Hollow stem auger boring

**ANALYSIS** **ASTM**

| Lab No. | Sample I.D. | Date | Time | Matrix | Contain. | Size | Preserv. | Qty. | Redox Potential | pH | Sulfate | Chloride | Resistivity-100% Saturated | | | Brief Evaluation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | R2-4, 2.5' | 11/1/21 | 11:00a | Soil | Bag | | | 1 | x | x | x | x | x | | | x | | | | | | |
| 2 | P-5, 2.5' | 11/2/21 | 3:00p | Soil | Bag | | | 1 | X | X | X | X | X | | | X | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
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**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**

| | | | |
|---|---|---|---|
| Relinquished By: | | Date 2021-11-05 | Time 2PM |
| Received By: | | Date 11/9/21 | Time 1130 |
| Relinquished By: | | Date | Time |
| Received By: | | Date | Time |
| Relinquished By: | | Date | Time |
| Received By: | | Date | Time |

**Comments:**

**THERE IS AN ADDITIONAL CHARGE FOR EXTRUDING SOIL FROM METAL TUBES**

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## DISTRIBUTION

| | |
|---|---|
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## QUALITY CONTROL REVIEWER

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