



GEOLOGIC AND GEOTECHNICAL FEASIBILITY EVALUATION

SITE DEVELOPMENT

APN 2724-004

SAN FRANCISCO, CALIFORNIA

Prepared for

Midtown Lands LLC

1888 Geneva Avenue, #407

San Francisco, California 94134

November 2022

Project No. 6088-1



November 30, 2022
6088-1

Midtown Lands LLC
1888 Geneva Avenue, #407
San Francisco, California 94134

**RE: GEOTECHNICAL AND GEOLOGIC
SERVICES
FEASIBILITY EVALUATION
SITE DEVELOPMENT APN 2724-004
SAN FRANCISCO, CALIFORNIA**

Attention: Mr. James Keith

Gentlemen:

In accordance with your request, we have performed a geotechnical and geologic feasibility evaluation of development at the vacant subject property, APN 2724-004, located southwest of the cul-de-sac of Farview Court in San Francisco, California. The accompanying report summarizes the results of our field observations, site research, and geologic conclusions related to the subject site. The purpose of this investigation was to evaluate the site and provide our opinion regarding slope stability and potential geologic hazards and geotechnical concerns. This report and our discussion are based on visual observations, reconnaissance, research, air photo interpretation, and multiple test pit excavations.

We refer you to the text of our report for specific recommendations.

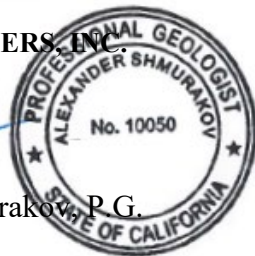
Thank you for the opportunity to work with you on this project. Please call if you have questions or comments about site conditions or the findings and recommendations from our evaluation.

Very truly yours,

ROMIG ENGINEERS, INC.

A handwritten signature in blue ink, appearing to read 'Shmurakov', is written over the circular professional seal of Alexander Shmurakov.

Alexander Shmurakov, P.G.



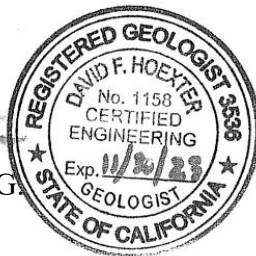
A handwritten signature in blue ink, appearing to read 'Lucas Ottoboni', is written over the circular professional seal of Lucas J. Ottoboni.

Lucas J. Ottoboni, P.E.



A handwritten signature in blue ink, appearing to read 'D. Hoexter', is written over the circular professional seal of David F. Hoexter.

David F. Hoexter, C.E.G.



Copies: Addressee (via email)

**GEOTECHNICAL AND GEOLOGIC FEASIBILITY EVALUATION
FOR SITE DEVELOPEMENT**

APN 2724-004

SAN FRANCISCO, CALIFORNIA 94114

PREPARED FOR:

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NOVEMBER 2022



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**GEOTECHNICAL AND GEOLOGIC EVALUATION
FOR
SITE DEVELOPMENT
APN 2724-004
SAN FRANCISCO, CALIFORNIA**

INTRODUCTION

This report presents the results of our geotechnical and geologic feasibility evaluation of development at the vacant subject property, APN 2724-004, in San Francisco, California. The vacant parcel is situated on the undeveloped slope south of Sutro Tower, southwest of Farview Court cul-de-sac, and upslope and north of the existing single-family residences along Panorama Drive and Dellbrook Avenue. The location of the property is shown on the Vicinity Map, Figure 1.

Project Description

At this time, the proposed development is in the conceptual stage and may consist of hillside affordable housing apartment buildings, where each building is expected to be 6 to 8 stories and will be constructed at the upslope and downslope sides of a central access roadway. The structures at the upslope side of the central access roadway will be primarily cut into the slope, requiring large cuts up to about 40 feet tall. The structures on the downslope side will be constructed at/near/over the existing slope grades and may descend in height with the slope. The new access roadway will extend west of the current cul-de-sac of Farview Court into the subject site. The buildings will generally be situated downslope of and south of Sutro Tower within the upslope, higher elevation portion of the site.

The approximately 3-acre site slopes steeply down to the south at an average declination of 2:1 (horizontal:vertical). The “Surface Conditions” section of this report provides a more specific description of slopes within the site. In addition, Figures 2 and 4 (Engineering Geologic Reconnaissance Plan and LIDAR map, respectively), provide a visual perspective of the site.

Scope of Work

The scope of our work for this investigation was presented in our agreement with you, dated September 28, 2022. In order to accomplish our investigation, we performed the following work.

- Coordinated with the property owner to provide direction on the locations of the temporary access paths to be cleared, and the locations of the test pits.



- Our Certified Engineering Geologist and Professional Geologist observed the excavated test-pits (dug by others), logged and measured various geologic features, collected samples, and sketched and drafted the subsurface strata and geologic features encountered in the pits and exposed road cuts.
- Our Certified Engineering Geologist and Professional Geologist evaluated the geologic hazard concerns at the site based on review and analysis/interpretation of the above investigative work as well as performing a site reconnaissance (mapping), review of applicable geologic maps and reports, and interpretation of aerial photographs of the site.
- Preparation of a geologic and geotechnical feasibility report presenting the results of the opinions and conclusions from the study outlined above. The report summarizes our findings and includes our conclusion/opinion regarding the feasibility of the development of the site. Note that supplemental investigation will be required to finalize geologic and geotechnical conclusions and recommendations for project design.

Limitations

This letter report has been prepared for the exclusive use of Midtown Lands LLC for specific application to evaluating the geologic setting for the proposed development located at APN 2724-004 in San Francisco, California. We make no warranty, expressed or implied, for the services performed for this project. Our services have been performed in accordance with the geotechnical and geologic engineering principles generally accepted at this time and location. This report was prepared to provide engineering geologic opinions and recommendations only. Supplemental geotechnical engineering analysis will be required for each future residence planned for the site. In the event there are any changes in the nature, design or location of the project, or if any future improvements are planned, the conclusions and recommendations contained in this report should not be considered valid unless 1) the project changes are reviewed by us, and 2) the conclusions and recommendations presented in this report are modified or verified in writing.

The analysis, conclusions, and recommendations presented in this letter report are based on site conditions as they existed at the time of our investigation; the currently planned improvements; review of readily available reports relevant to the site conditions; and laboratory test results. In addition, it should be recognized that certain limitations are inherent in the evaluation of subsurface conditions, and that certain conditions may not be detected during an investigation of this type. Changes in the information or data gained from any of these sources could result in changes in our conclusions or recommendations. If such changes occur, we should be advised so that we can review our report in light of those changes.

BRIEF OVERVIEW OF RECENT SITE AND VICINITY HISTORY

The following brief overview of recent site history provides background for the geologic discussions which follow. This overview is based on a review of topographic maps, air photos, web sites (Sutro Tower) and discussions with the property owner, and is intended to be an informative summary to set the framework of the subject property and surrounding development (subject to revision as site investigations go forward).

Late 19th century to early 20th century: Eucalyptus groves planted in large areas of western San Francisco, likely including the grove currently occupying the subject site.

1930's: Sutro Mansion construction at the crest of hill north of subject site, the current Sutro Tower location, present in 1935 and 1938 air photos).

1946: Preparation of Sutro Reservoir south (downslope) of subject site, tree clearing completed.

1948: Excavation of Sutro Reservoir is completed (newly excavated).

1955: Subject site and immediate downslope area remain ungraded and eucalyptus forest is present. Mass grading for residential subdivisions to the southeast has occurred, not impacting the subject site.

1956: Trees removed from lower subject site slope and residential subdivision location in vicinity of Dellbrook Avenue and Panorama Drive; these roads and Farview Court not graded.

1958: Grading (excavation) of lower subject site and grading of Panorama Drive adjacent to subject site have occurred, and north side (upslope) residences along Panorama Drive adjacent to site have been constructed; Dellbrook Avenue is a rough path, not graded, no residence construction adjacent to site. No evident grading to subject site post 1958

Approximately 1957 to 1964: construction of downslope adjacent residences (per review of representative residence permit/construction entries on Zillow website).

1968: Existing residences along Farview Court, Dellbrook Avenue, and Panorama Drive are present.

1971 to 1973: Sutro Tower immediately upslope/north of site constructed.

Subsequent: Site and near vicinity essentially unchanged.

SITE EXPLORATION AND RECONNAISSANCE

Site reconnaissance and subsurface exploration were performed on October 20 and 21, 2022. Subsurface exploration was performed using a Xuzhou Xugong Excavator Machinery Co. XE210CU excavator. Ten exploratory test pits were advanced to depths of up to 11 feet. Two rough-graded temporary access paths/tracks, one upper and one lower were initially excavated after clearing vegetation. Only the upslope portion of the site was deemed accessible at the time of the excavation as the steeper lower slope could not be accessed at the time of the investigation. All test pits were excavated either in the center of the temporary access path or at the upslope face of temporary road cut. Our field logging included both the excavated test pits and the adjacent slope area exposed by the temporary access path excavations. The approximate locations of the pits are shown on the Site Plan, Figure 2. The test pit logs are attached in Appendix A.

We note that the temporary access paths were done in accordance with the temporary grading permit and excavated in areas safely accessible to the excavator. We were not able to explore further downslope due to the limited access and concern with dislodging soil or rock which could have rolled down towards the downslope residences. The area explored with test pits roughly approximates the area currently planned for building construction, and thus the area investigated is representative of the area to be developed.

The temporary site grading/exploration permit was then fulfilled with the test pits and roads being backfilled/graded by others to their approximate original state. This was confirmed and documented in a letter dated November 10, 2022. We note that we did not test compaction during backfilling.

Surface Conditions

The vacant site is located on a relatively steep hillside to the north of Panorama Drive and Dellbrook Avenue and below Sutro Tower. The site is accessed from the end of cul-de-sac of Farview Court, which extends toward the site from the east. Prior to our investigation, the site was generally densely vegetated with a dense grove of eucalyptus trees. Trees were removed to facilitate excavation of the temporary access paths excavated for our field investigation. An existing trail was located at the upslope portion of the property near the northern property line; there was no additional access to the site. Access across and up/down within the slope was difficult due to the dense vegetation and slope steepness.

We observed evidence of prior road grading located downslope of the temporary access paths, located at the eastern portion of the property. The grading consisted of an approximately 10 to 15 foot-wide previously graded road cut which terminated at a cut

that was approximately 10 feet tall. The grading was heavily overgrown with vegetation and not accessible to the available excavation equipment. As shown on Figure 4, the road appears to originate from above Clairview Court, extending along the cut below Farview Court.

The area of the planned development sloped down to the south at an average inclination of 2.5:1 (horizontal: vertical). The downslope portions of the property consisted of a 40- to 50-foot high cut slope with a relatively consistent inclination of 1.5:1 (horizontal:vertical) which extended up from the adjacent residences along the north side of Panorama Drive and Dellbrook Avenue. Local areas as steep as 0.5:1 (horizontal:vertical) were noted. These oversteepened areas appear to have resulted from past grading of a now-abandoned graded path. The site was located at elevations of 630 to 780 feet above sea level.

Subsurface Conditions

Two series of test pits were excavated, identified as TPU- for pits located along the upper temporary access path, and TPL- for pits located along the lower temporary access path. In general, the test pits exposed varying thicknesses of soil overlying bedrock components of the Franciscan Complex. As described below, various Franciscan Complex bedrock lithologies were encountered. The rock was commonly fractured/jointed, and ranged from bedded to massive. Measurements of bedding plane orientations and of fracture/joint orientations are documented on the individual test pit logs.

At the location of Test Pit TPU-1, which was excavated on the west end of the upper temporary access path, we generally encountered approximately 1 to 1.5 feet of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained abundant roots and primarily chert rock fragments. The colluvium was underlain by chert bedrock of the Franciscan Complex. The bedrock was intensely weathered, fractured, and massive, with no discernable bedding orientation visible in the test pit. Note that although the chert exposed in Test Pit TPU-1 was massive, a nearby ground surface chert outcrop, approximately 30 to 40 feet upslope, was bedded with a strike of approximately east-west and dip (inclination) of 32 degrees north.

At the location of Test Pit TPU-2, we generally encountered approximately 1 foot of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained abundant roots and primarily chert rock fragments. The colluvium was underlain by chert bedrock of the Franciscan Complex. The rock was thinly bedded and significantly folded with a large apparently recumbent fold visible in the center of the test pit wall.

At the location of Test Pit TPU-3, which was excavated near the center of the upper temporary access path, we generally encountered approximately 1.5 to 2 feet of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained abundant roots and primarily chert rock fragments. The colluvium was underlain by thinly bedded chert bedrock of the Franciscan Complex. We observed a possible shear zone or infill feature within the chert bedrock. This feature was a different color from the host bedrock and was primarily composed of small rock fragments within a clayey matrix. Sheared rocks within the Franciscan Complex are common and are associated with tectonic events which occurred millions of years in the past, and are thus not of present concern.

At the location of Test Pit TPU-4, which was excavated near the center of the upper temporary access path, we generally encountered approximately 1 to 2 feet of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained abundant roots and primarily chert rock fragments. The colluvium was underlain by a lighter colored residual soil comprised of a sandy lean clay with a relict rock fabric/texture. The residual soil was underlain by sandstone bedrock of the Franciscan Complex. The rock was massive with no observable bedding, and heavily fractured along three observed fracture set orientations.

At the location of Test Pit TPU-5, which was excavated near the east end of the upper temporary access path, we generally encountered approximately 5 feet of colluvium or possible shallow slide debris. This unit was composed of sandy lean clay of moderate plasticity and contained abundant roots and primarily chert rock fragments within the first 2.5 feet, and contained significantly fewer rock fragments at a depth of 2.5 to 5 feet. The colluvium was underlain by bedrock of the Franciscan Complex of different lithologies. The first 2 feet of rock encountered was very severely weathered sandstone and siltstone, which was then followed by 4 to 6 feet of mixed sandstone with shale and claystone interbeds. This unit contained an internal shear plane which dipped to the south in the direction of the slope. This rock unit was further underlain by massive, more competent sandstone bedrock.

At the location of Test Pit TPU-6, which was excavated at the east end of the upper temporary access path closest to Farview Court, we generally encountered approximately 1.5 to 3 feet of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained abundant roots and primarily chert rock fragments. The colluvium was underlain by chert bedrock of the Franciscan Complex. The bedrock was intensely weathered and sheared with irregular bedding and pockets of intensely weathered clay throughout.

At the location of Test Pit TPL-1, which was excavated at the west end of the lower temporary access path, we generally encountered approximately 1 foot of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained roots and primarily chert rock fragments. The colluvium was underlain by sandstone bedrock of the Franciscan Complex. The bedrock encountered was generally massive, fractured, and severely weathered. The first 3 feet of bedrock exposure appeared to be relatively consistent sandstone while the bedrock observed below a depth of 3 feet contained chert and shale inclusions. Three general fracture set orientations were observed in this pit with several fracture planes that did not belong to a fracture set grouping.

At the location of Test Pit TPL-2, which was excavated east of Test Pit TPL-1 on the lower temporary access path, we generally encountered approximately 2 to 2.5 feet of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained roots and primarily chert rock fragments. The colluvium was underlain by residual soil composed of sandy lean clay with an apparent strong relict rock fabric/texture. The residual soil was underlain by sandstone bedrock of the Franciscan Complex. The rock was massive, fractured, and included chert and shale. We obtained multiple fracture orientations however clear fracture sets were not apparent. We also observed a 1 to 2 foot thick zone of highly fractured and jumbled sandstone within the larger rock unit.

At the location of Test Pit TPL-3, which was excavated near the east end of the lower temporary access path, we generally encountered approximately 5 to 6 feet of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained roots and primarily chert rock fragments. The colluvium was underlain by a residual soil composed of a sandy lean clay with an apparent strong relict rock fabric/texture and rock fragments. The residual soil unit was underlain by sandstone bedrock of the Franciscan Complex. The bedrock was very severely weathered, friable, and massive. The bedrock and residual soil units were separated by what appeared to be a slide shear plane that was approximately 6 inches thick and clayey. The slide shear plane dipped to the southeast, in a similar direction to the slope of the site.

At the location of Test Pit TPL-4, which was excavated at the east end of the lower temporary access path, we generally encountered approximately 3 to 3.5 feet of colluvium. The colluvium was composed of sandy lean clay of moderate plasticity and contained roots and primarily chert rock fragments. The colluvium was underlain by 5 feet of sandstone bedrock of the Franciscan Complex followed by a transition to claystone and siltstone bedrock. The bedrock was very severely weathered, massive, with no clear fracture or bedding orientations.

Ground Water

Free ground water was not encountered in the test pits during our investigation, and there were no visual indications of the presence of shallow ground water. The test pits were backfilled with the excavated soil and rock immediately after completion of the second day of investigation; therefore, a stabilized ground water level was not obtained. Please be cautioned that fluctuations in the level of ground water can occur due to variations in rainfall, landscaping, and other factors. It is also possible and perhaps even likely that seasonal or perched ground water conditions could develop in the soils and near the surface of the bedrock during and after significant rainfall.

GEOLOGIC SETTING**Regional Geology**

The site is located within the central region of the Coast Ranges Geomorphic Province, which extends from the Oregon border south to the Transverse Ranges. The general topography is characterized by sub-parallel, northwest trending mountain ranges and intervening valleys. The region has undergone a complex geologic history of sedimentation, volcanic activity, folding, faulting, uplift and erosion.

The geology underlying and in the immediate vicinity of the site is shown on the Vicinity Geologic Map, Figure 3 (Schlocker, 1974). The site is located in an area underlain by various units of Franciscan Complex rock units. Specifically, the site is underlain by chert and shale, map unit KJc (Schlocker, et al 1958 and Schlocker, 1974; also shown on Johnson & Bartow, 2018). A sandstone unit KJss is mapped upslope of and to the northeast of the property, and a greenstone unit KJg is mapped downslope of the property to the south of Panorama Drive. The Franciscan Chert unit is described as radiolarian chert and shale with alternating beds of hard brittle chert, 1-5 inches thick, and firm to brittle shale beds up to ½-inch thick, with local bodies of massive chert. The nearby Franciscan Sandstone unit is described as a thickly bedded and massive graywacke sandstone which is interbedded with thin layers of shale and fine grained sandstone, and the nearby Franciscan Greenstone unit is described as aphanitic to medium grained altered volcanic rock often interbedded with radiolarian chert and shale.

Bedding within the chert in the local vicinity generally strikes east to west and dips to the north (into the slope at the subject site location). One mapped bedding plane orientation immediately upslope of the site shown on Schlocker (1974) indicates an inclination of 32 degrees to the north. This is consistent with the strike-dip measurement taken on the chert outcrop noted on Figure 2.

Schlocker identifies a landslide, map unit Ql, located approximately 500 feet east of the property. This landslide does not impact the site or the proposed development, and there are no mapped landslides within or adjacent to the site.

There are no faults, shear zones or fracture/joint systems indicated by Schlocker et al (1958) in the immediate site vicinity, and no mapped faults projecting towards the site.

Aerial Photographs

Eight sets of stereo pair aerial photographs, ranging from 1935 to 2001, were interpreted to supplement our on-site engineering geologic observations. The stereo imagery scales ranged from 1:6,600 to 1:20,000. We also reviewed historic aerial photographs on Google Earth, from 1938 and 1946, and additional imagery extending to 2022, as well as images from the website HistoricAerials.com, ranging from 1946 to 2020. The stereo photograph sets are listed in the References section of this report. We were able to locate the site on all of the images. Note, the previous section titled, “Brief Overview of Recent Site and Vicinity History” provides a timeline of development within and adjacent to the subject site.

The 1935 and 1938 imagery indicate that the subject site was covered with a dense tree canopy (primarily previously planted eucalyptus trees). The trees obscured the ground surface, and thus were of limited use for geologic interpretation, although there were no indications of deep-seated landslides within or impacting the subject site. A landslide descending from the upslope side of Farview Court near Marview Way was evident, and the area of sliding looked to be of greater extent (wider) than as portrayed by Schlocker. This area of sliding was lateral from and did not extend to the subject site. The nearby upslope Sutro residence (subsequently removed) was present.

The 1948 imagery indicated that the site continued to be within dense tree canopy, which obscured the ground surface. The tree canopy surface was slightly uneven, but there were no indications of deep-seated landslides within or impacting the subject site. The downslope Sutro Reservoir excavation was apparent, and the upslope Sutro residence remains. The site remained with the dense tree canopy in the 1955 imagery, which indicated that the two offsite upslope reservoirs had been constructed. Mass grading for residential subdivisions had occurred to the southeast. The Sutro residence and an adjacent radio tower (not the currently existing Sutro Tower) were present.

The 1958 imagery indicated that the lower part of the site had been excavated, steepening the slope (see approximate location on Figure 2) (the 1956 HistoricAerials imagery indicated the tree removal and preliminary grading). The ground surface was locally

darker on portions of the excavated slope, which suggested surficial ground water seepage had occurred. Farview Court and Panorama Way were graded and constructed (1958), with newly constructed residences apparent on the upslope side of Panorama Way adjacent to (immediately below) the subject site. Dellbrook Avenue was a very rough-graded path, and thus residences had not yet been constructed along this road.

The 1969 imagery shows the Dellbrook Avenue and Farview Court residence construction. The upslope (ungraded) portion of the subject site remained essentially the same as in previous imagery; the downslope graded portion was essentially unchanged from 1958 except for incipient vegetation (shrubs) growth. The adjacent (existing) Sutro Tower was present in the 1981 imagery, and the Sutro residence and former radio tower were removed. The site and nearby vicinity were essentially unchanged in the 2001 imagery.

Reconnaissance and Site Geology

Reconnaissance and engineering geologic observations were conducted on October 20 and 21, 2022 by our Certified Engineering Geologist, David Hoexter, and Professional Geologist, Alexander Shmurakov. Details of our observations are presented on Figure 2 (Engineering Geologic Site Plan). Although Figure 2 indicates only the immediate vicinity of the planned development, our reconnaissance included a larger area surrounding the site.

At the time of our reconnaissance, the site was undeveloped, save for the existing trail located at the northern property line. As a part of the exploration for this study, two temporary access paths had been excavated. The two access paths were roughly parallel, with center lines approximately 30 feet apart. Due to the steepness of the slopes, the temporary access path excavations included several cuts along the upslope sides of the native hillside which exposed bedrock.

During site reconnaissance, we observed several different rock types on the property. We observed chert bedrock outcrops in the lower portions of the site on the east side, as well as a chert outcrop on the exposed rock slope, viewed from Dellbrook Avenue, and an additional chert outcrop along the path near the upslope property line. Test pits TPU-1, TPU-2, TPU-3, and TPU-6 also exposed chert bedrock. Test pits TPU-4, TPU-5, TPL-1, TPL-2, TPL-3, and TPL-4, exposed hard, fine grained, sandstone bedrock. Test pits TPU-5 and TPL-4 exposed claystone and siltstone bedrock. While the site is entirely mapped within a chert unit of the Franciscan Complex, it is not unusual to see various other sedimentary lithologies interbedded or mixed with the chert unit as they are all part of a larger sedimentary sequence resulting from significant tectonic forces that have juxtaposed different stratigraphic layers against each other.

Bedding plane orientation was primarily measured on chert outcrops and exposures within the test pits. The sandstone and claystone rock did not exhibit obvious bedding planes. Based on our measurements, the chert generally dipped into the hillside. We did observe that the chert in TPU-2 and TPU-6 were highly folded and irregularly bedded, respectively, thus indicating that there may be areas within the site where we did not obtain measurements that could dip in a different direction. However, bedding measured in the field generally agrees with the single strike-and-dip measurement on the Schlocker map (1958). This into slope bedding appears representative of the site, although localized occurrences of out of slope bedding may occur.

We observed several locations with potential slide/shear planes that dip along the direction of the slope, specifically in test pits TPU-5 within the sandstone bedrock and TPL-3, juxtaposing soil and sandstone bedrock. Although only vaguely visually apparent as surficial features, our TPU-5 and TPL-3 observations of thickened soil and downslope-oriented shear planes indicate the likelihood of past shallow landsliding which may (especially at the location of TPU-5 included the shallow bedrock, as approximated on Figure 2.

Based on our visual observations, there appeared to be a previously graded road located below the temporary access paths. This road is apparent on Figure 4. The previously graded road was overgrown with vegetation so we were not able to ascertain the full extent of this grading in the field. We also confirmed that the southern slopes of the property were cut slopes from the original development of the neighborhood. The slope excavation exposed several chert outcrops, however we did not confirm the rock type definitively of some locations as we could not approach these locations by foot.

We did not observe surficial or geomorphic features that indicate active landsliding, slumps, or flow within or potentially impacting the location of the proposed development. There were also no indications of springs or seeps. The relatively shallow landsliding suggested by test pits TPU-5 and TPL-3 should be addressed in subsequent design-level investigations, but are likely to be removed during site grading as currently conceived.

Oversteepened slopes of limited lateral extent are shown on Figure 2 topography and are apparent on Figure 4. These occurrences appear to be primarily related to the previously noted rough-graded path, and are not the result of landsliding. Elsewhere, variability in slope inclinations are likely due to differential weathering of the underlying bedrock.

We noted a “nose” or topographic feature on the cut slope, as indicated on Figure 2. This feature did not appear on aerial photographs or the LIDAR imagery (Figure 4), and we

did not observe it during our site reconnaissance. There is no indication that it results from landsliding or another geologic process; it may be related to a surveying error, although this should be further evaluated during future design level investigation. It would not impact the proposed upslope development.

Landslide / Slope Stability Discussion

The site is located within a State of California earthquake-induced landslide zone (CGS, 2000) and within an area of “Few Landslides” (Wentworth et al., 1997). One limited area of landsliding was identified by Schlocker et al (1958) approximately 500 feet east of the site, but is lateral along the slope and would not impact or be impacted by the development at the subject site. The property is identified as laterally adjacent to an area to the west within or directly downslope of a potential debris flow source (Ellen et al., 1997). The site is within the generalized “Area of Potential Landslide Hazard” on the Figure 4 (Landslide Locations) of URS/John A. Blume & Associates (1974), although there are no landslides within the site. However, we note that the landslide identified and discussed above by Schlocker et al is also shown on the Blume & Associates (1974) map. The SF DBI/Planning map (2018) indicates the site generally has slopes steeper than 4H:1V.

Based on our geologic reconnaissance and field mapping, there were no surficial indications of large-scale landslides, debris flows, slope movement, or erosion gullies and channels on the subject site or adjacent properties. The landslide identified to the east of the site on the Schlocker (1958), and Blume & Associates (1974) maps will not impact the slope stability of the subject site. In addition, this feature has graded/developed with streets and residences. The nearby potential debris flow source or deposit areas on the west of the site are, similarly, not of concern.

Based on our geologic reconnaissance, mapping, and subsurface exploration, there were generally no indications of deep-seated landslides. We did, however, find evidence of a potential slide/shear features in our test pits TPU-5 and TPL-3. The potential slide plane identified was found in the top 10 feet of soil, and likely represents a former shallow landslide in the surface rock/colluvial soil. There was no evidence of this potential slide as being active, as we did not observe any surficial features of active sliding, nor an increased amount of moisture at the location of the slide plane. The planned development will likely be excavated far below the depth of this possible surface slide, well into competent bedrock, thus this feature is not likely to affect future development. Our observations of the rock bedding planes indicated that the bedding dips primarily into the slope, thus not producing a dip-slope condition that would lead to deeper seated landsliding. We did not observe any seeps, springs, debris flows, soil slumps, or other

shallow landslides on the property, although our air photo interpretation noted dark tones on the recently graded lower slope which might indicate ground water seepage.

Faulting and Seismicity

There are no mapped through-going faults within or adjacent to the site and the site is not located within a State of California Earthquake Fault Zone (formerly known as a Special Studies Zone), an area where the potential for fault rupture is considered probable. The closest active fault is the San Andreas fault, which is located approximately 4.8 miles southwest of the property. Thus, the likelihood of surface rupture occurring from active faulting at the site is low.

The San Francisco Bay Area is an active seismic region. Earthquakes in the region result from strain energy constantly accumulating because of the northwestward movement of the Pacific Plate relative to the North American Plate. On average about 1.6-inches of movement occur per year. Historically, the Bay Area has experienced large, destructive earthquakes in 1838, 1868, 1906, and 1989. The faults considered most likely to produce large earthquakes in the area include the San Andreas, San Gregorio, Hayward, and Calaveras faults. The San Gregorio fault is located approximately 8.0 miles southwest of the site. The Hayward and Calaveras faults are located approximately 14 and 24 miles northeast of the site, respectively. These faults and significant earthquakes that have been documented in the Bay Area are listed in Table 1, and are shown on the Regional Fault and Seismicity Map, Figure 4.

**Table 1. Earthquake Magnitudes and Historical Earthquakes
The Peaks Site Development
San Francisco, California**

<u>Fault</u>	<u>Maximum Magnitude (Mw)</u>	<u>Historical Earthquakes</u>	<u>Estimated Magnitude</u>
San Andreas	7.9	1989 Loma Prieta	6.9
		1906 San Francisco	7.9
		1865 N. of 1989 Loma Prieta Earthquake	6.5
		1838 San Francisco-Peninsula Segment	6.8
		1836 East of Monterey	6.5
Hayward	7.1	1868 Hayward	6.8
		1858 Hayward	6.8
Calaveras	6.8	1984 Morgan Hill	6.2
		1911 Morgan Hill	6.2
		1897 Gilroy	6.3
San Gregorio	7.3	1926 Monterey Bay	6.1

In the future, the subject property will undoubtedly experience severe ground shaking during moderate and large magnitude earthquakes produced along the San Andreas fault or other active Bay Area fault zones. Using information from recent earthquakes, improved mapping of active faults, ground motion prediction modeling, and a new model for estimating earthquake probabilities, a panel of experts convened by the U.S.G.S. have concluded there is a 72 percent chance for at least one earthquake of Magnitude 6.7 or larger in the Bay Area before 2043. The Hayward fault has the highest likelihood of an earthquake greater than or equal to magnitude 6.7 in the Bay Area, estimated at 33 percent, while the likelihood on the San Andreas and Calaveras faults is estimated at approximately 22 and 26 percent, respectively (Aagaard et al, 2016).

Summary/Recap of Geologic Hazards

We have reviewed the potential for geologic hazards to impact the site and/or a possible future development, considering the geologic setting and the soils encountered during our previous investigation.

- **Fault Rupture** – The site is not located in an Earthquake Fault Zone or area where fault rupture is considered likely. Based on the regional geologic mapping (Schlocker, 1958), there are no faults underlying or projecting towards the site. Therefore, active faults are not believed to exist beneath the site and the potential for fault rupture at the site is low.
- **Ground Shaking** – The site is located in an active seismic area. Moderate to large earthquakes are probable along several active faults in the greater Bay Area over a 30 to 50 year design life. Strong ground shaking should therefore be expected several times during the design life of the development, as is typical for sites throughout the Bay Area. The structures should be designed in accordance with current/local earthquake resistance standards.
- **Liquefaction and Differential Compaction** – Liquefaction occurs when saturated sandy soils lose strength during earthquake shaking. Ground settlement often accompanies liquefaction. Soils most susceptible to liquefaction are saturated, loose, sandy silts, silty sands, and uniformly graded sands. Saturated sands were not encountered during our investigation. Due to the presence of shallow bedrock across the site, composition of upper colluvial soils, and limited risk for permanent ground water conditions to develop locally, the potential for liquefaction to affect the proposed development is very low. In addition, the subject site is not located within a liquefaction hazard zone (CGS, 2000).

- Slope Stability – Based on our study as described in detail above, there are no indications of regional slope instability which would impact the site. In addition, there were no indications of deep landsliding, or debris flow sources or paths observed or mapped within the immediate site vicinity. One relatively shallow and laterally limited landslide was identified at the subject site during this feasibility investigation. However, due to the shallow nature and limited size, shallow features such as this may be remediated during site grading.
- Large Cuts – Due to the steep slopes, relatively high cuts along the upslope side may be required and could be approximately 40 feet high and will retaining slopes of about 2:1 (horizontal:vertical). To accommodate these large cuts, we anticipate that shoring such as a soldier beam and lagging wall or a tieback/soil nail system may be required during excavation and prior to permanent retaining wall support. Design level recommendations should be provided once the scope of the project has been developed and upon further exploration, if appropriate. We also note that due to the steep slopes, depending on the location of the structures, freeboard may need to be considered.

As documented on our test pit logs, local but inconsistent occurrences of out of slope bedding plane and fractures/joints may occur throughout the site. When exposed during site excavations, there is a potential for failures to occur within open excavations during construction due to the presence of weak planes. This condition can be mitigated by limiting the height of exposed excavations, construction of pre-excavation retaining walls, and shoring.

In addition, there is also a potential for some sloughing or caving of exposed soils within the upper portions of excavations. In our opinion, these conditions are unlikely to result in long-term instability; however, on a short-term basis, temporary excavations should be supported as recommended by the shoring engineer and/or contractor.

- Surrounding/Downslope Development – It should be noted that the site is relatively steep and that residences are located at the base of the site slope. Development plans will need to consider the slope inclination and ensure that downslope residences are protected from downslope debris migration. This should be considered as the design for the project moves forward.

CONCLUSIONS

Based on our site reconnaissance, review of historical imagery, and the test pits excavated throughout the site, indications of slope instability, landslides, or faulting on or within the immediate vicinity of the subject site that would significantly impact the proposed development were not observed.

Therefore, from a geologic viewpoint, development of the site appears to be feasible with typical geotechnical concerns associated with hillside development, some of which are listed below:

- Steep slopes, likely requiring pier support for downslope structures
- Large cuts, as discussed above, requiring shoring consisting of earth anchor systems, or conventional cantilever retaining walls, depending on the height of the cut. On a preliminary basis, structures supported in large cuts will likely expose bedrock at their foundation levels and may be supported on a mat slab foundation.
- Consideration of drainage to avoid impacting the existing homes downslope.
- Large fills may be difficult to retain and on a preliminary basis should be limited.
- Shallow slide features should be remediated using grading, i.e., benching and repairing the slope.

Once the project is further defined, we can perform further exploration/analysis/testing (as appropriate) and issue design level recommendations.



REFERENCES

Aerial Photographs and Published Topographic Maps

United States Geologic Survey Library, Menlo Park, California (USGS), and Pacific Aerial Surveys, Oakland, California (PAS): black and white vertical stereo pairs; and WAC Corporation, Eugene, Oregon (WAC): color vertical stereo pairs; Google Earth (GE) San Francisco Public Library Rumsey Map Collection.

Source	Imagery	Date	Scale
PAS	AV-248-04-06/07	1935	1:16,500
PAS	AV-08-03-/05/06	3/21/38	1:20,000
PAS	AV-07-09/10	7/28/48	1:7,600
PAS	AV-170-04-07/08	5/10/55	1:10,000
PAS	AV-279-05-10/11	4/23/58	1:7,200
PAS	AV-933-04-6/7	10/29/69	1:12,000
PAS	AV-2020-03-06/07	6/19/81	1:12,000
PAS	AV-7091-07-10/11	6/17/01	1:6,600

Source	Photo Dates
Google Earth (mono)	1938, 1946, subsequent through 2022
HistoricAerials.com	Representative mono images 1946 – 2020
USGS	Representative topographic maps 1:24,000 to 1:62,500 from 1895-2018.

Plans

Transamerican Engineers, Architectural Topographic Survey, September 2020.

Publications

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Schlocker, Julius, Bonilla, M.G. and Radbruch, D.H, 1958, Geology of the San Francisco North Quadrangle, California, USGS Miscellaneous Geologic Investigation Map I-272, scale 1:24,000.

Wentworth, Carl M, Graham, Scott E, Pike, Richard J, Beukelman, Gregg S, Ramsey, David W, and Barron, Andrew D, 1997, Summary Distribution of Slides and Earth Flows in San Francisco County, California, San Francisco Bay Region Landslide folio, Part C, USGS OFR 97-745C, Sheet 6 of 11, Scale 1:125,000.

United States Geological Survey, 2018, United States Seismic Design Maps, Earthquake Hazards Program, <http://earthquake.usgs.gov/designmaps/us/application.php>

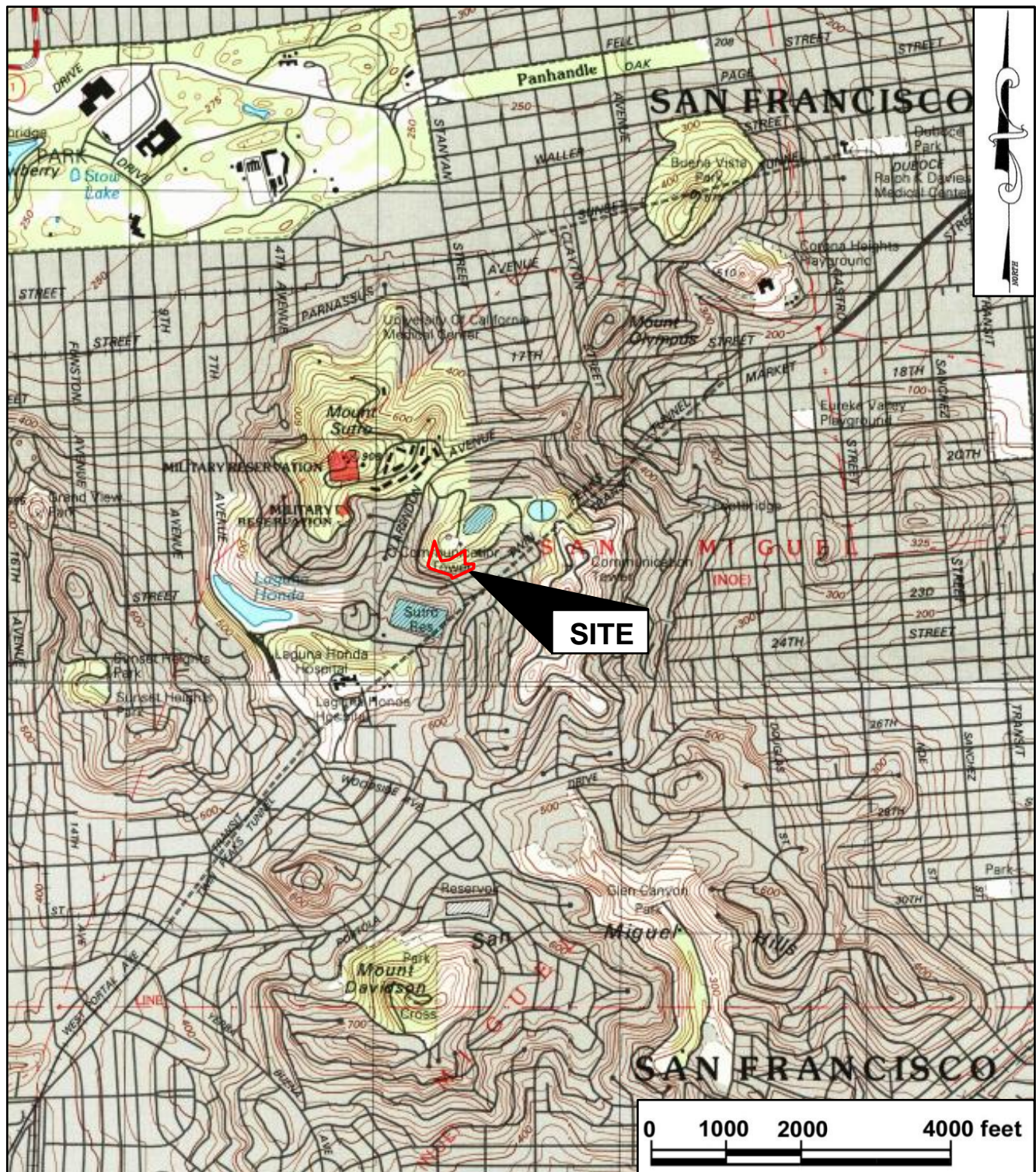
United States Geologic Survey, Topographic Maps:

San Francisco South Quadrangle, 1995, scale 1:24,000.

San Francisco North Quadrangle, 1995, scale 1:24,000.

URS/John A. Blume & Associates, 1974, San Francisco Seismic Safety Investigation, June 1974. See Figure 4, "Landslide Locations".



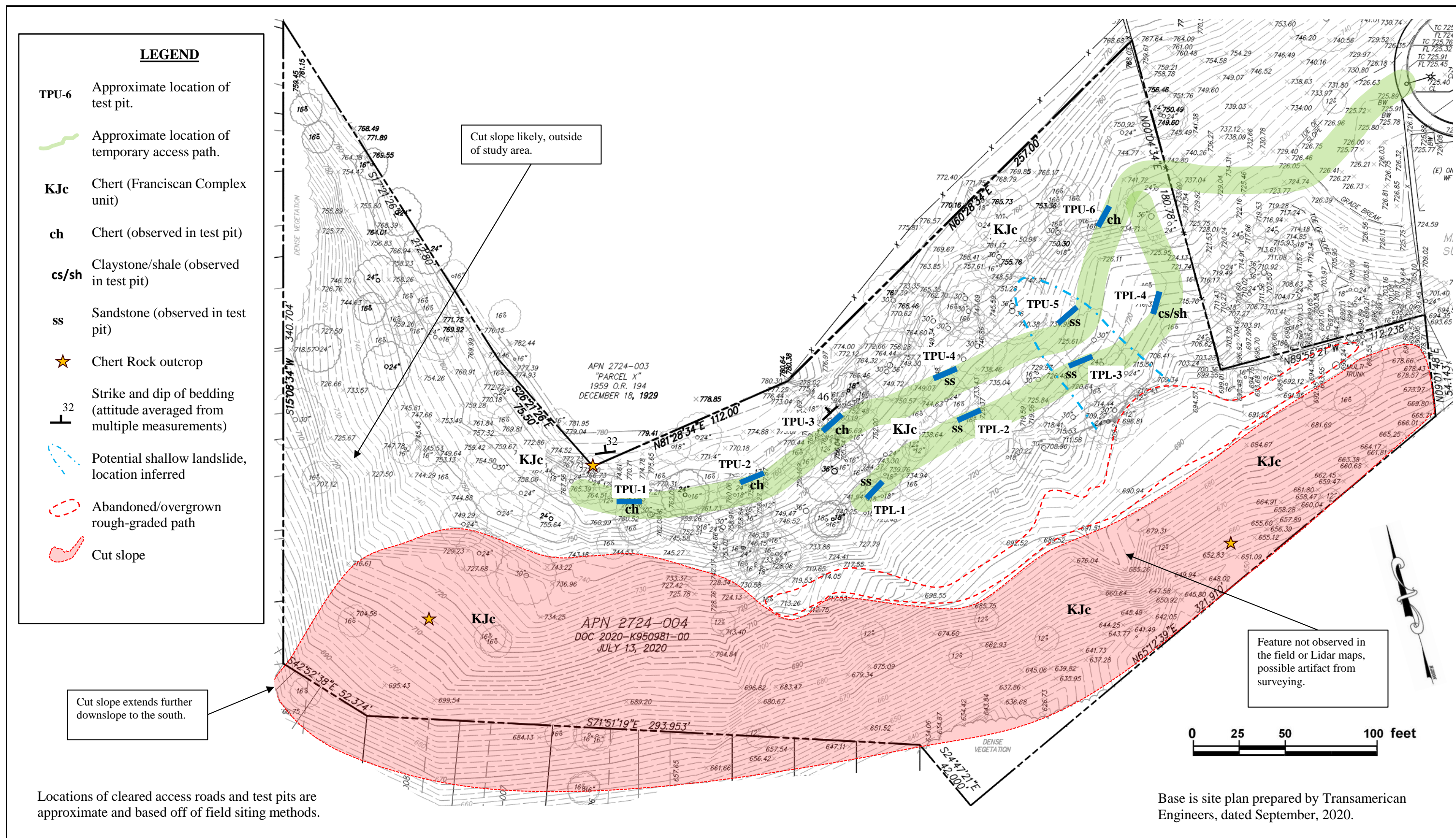


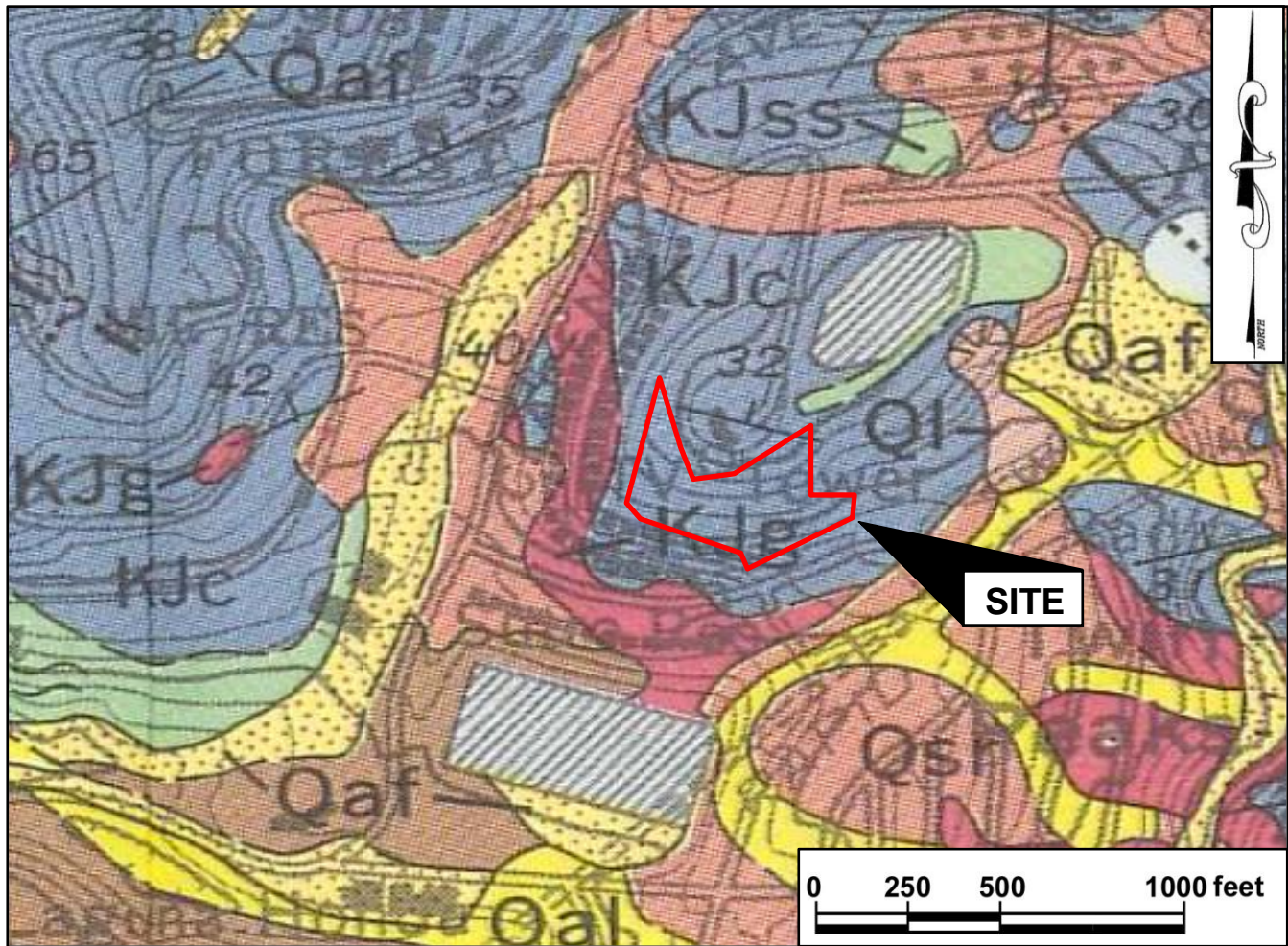
Scale: 1 inch = 2000 feet

Base is United States Geological Survey San Francisco South and North 7.5 Minute Quadrangles, dated 1995.

VICINITY MAP
 THE PEAKS FEASIBILITY EVALUATION
 SAN FRANCISCO, CALIFORNIA

FIGURE 1
 NOVEMBER 2022
 PROJECT NO. 6088-1





MAP LEGEND

Qaf	Artificial fill (Holocene)
Ql	Landslide deposits (Quaternary)
Qal	Alluvium (Quaternary)
Qsr	Slope debris and ravine fill (Quaternary)
Qc	Colma formation (Pleistocene)

KJss	KJsh	KJs
------	------	-----

KJc
KJg

Franciscan Complex (Jurassic and Cretaceous):

Clastic sedimentary rock.

KJss - Sandstone

KJsh - Shale and Sandstone

KJs - Sandstone and Shale

KJc - Radiolarian chert and shale.

KJg - Greenstone

Geologic Contact - dashed where approximate, dotted where inferred.

35

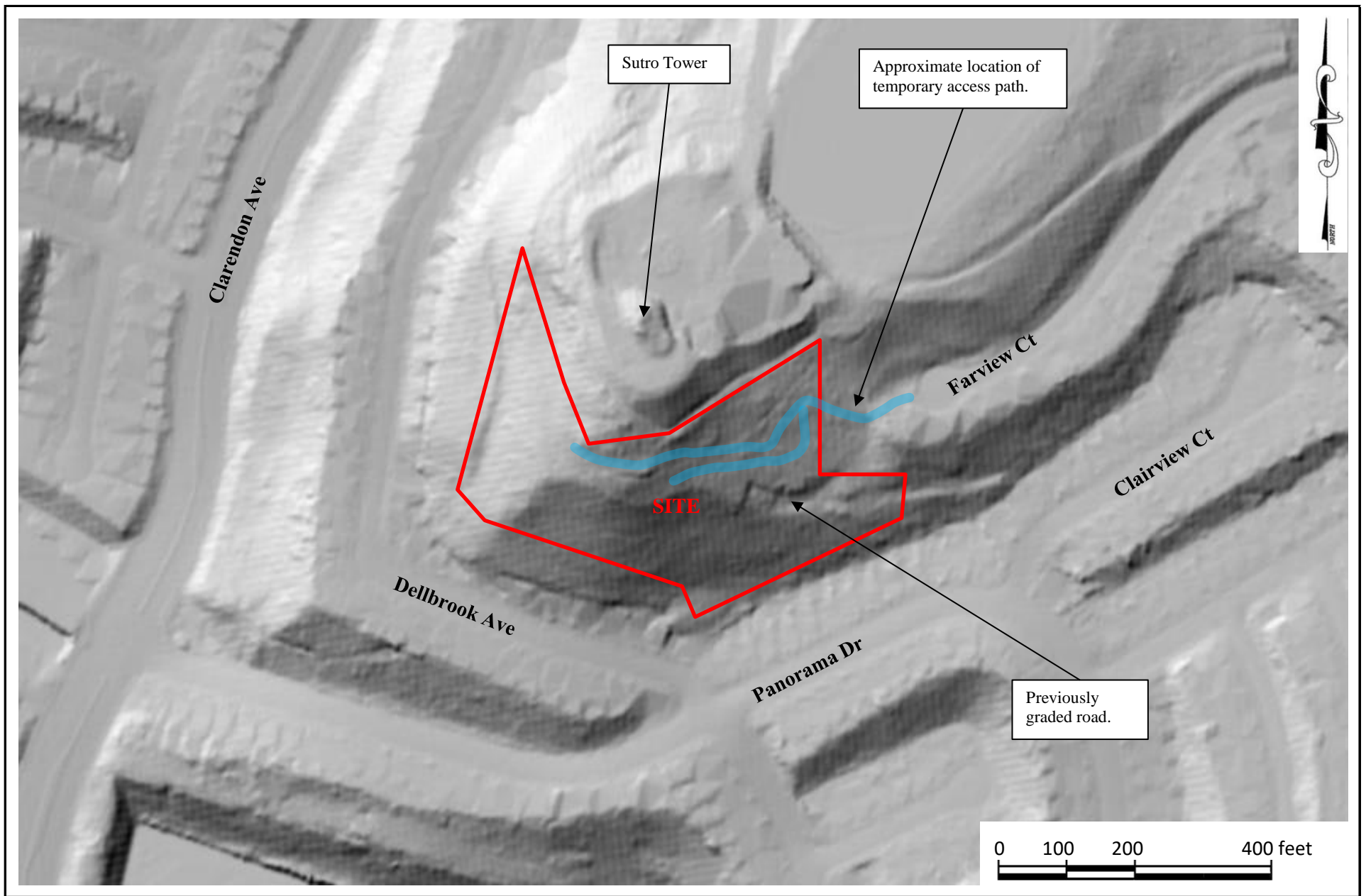
Strike and dip of bedding

Scale: 1 inch = 500 feet

Base is Geology of the San Francisco North Quadrangle, California (Schlocker, 1974).

VICINITY GEOLOGIC MAP
THE PEAKS FEASIBILITY EVALUATION
SAN FRANCISCO, CALIFORNIA

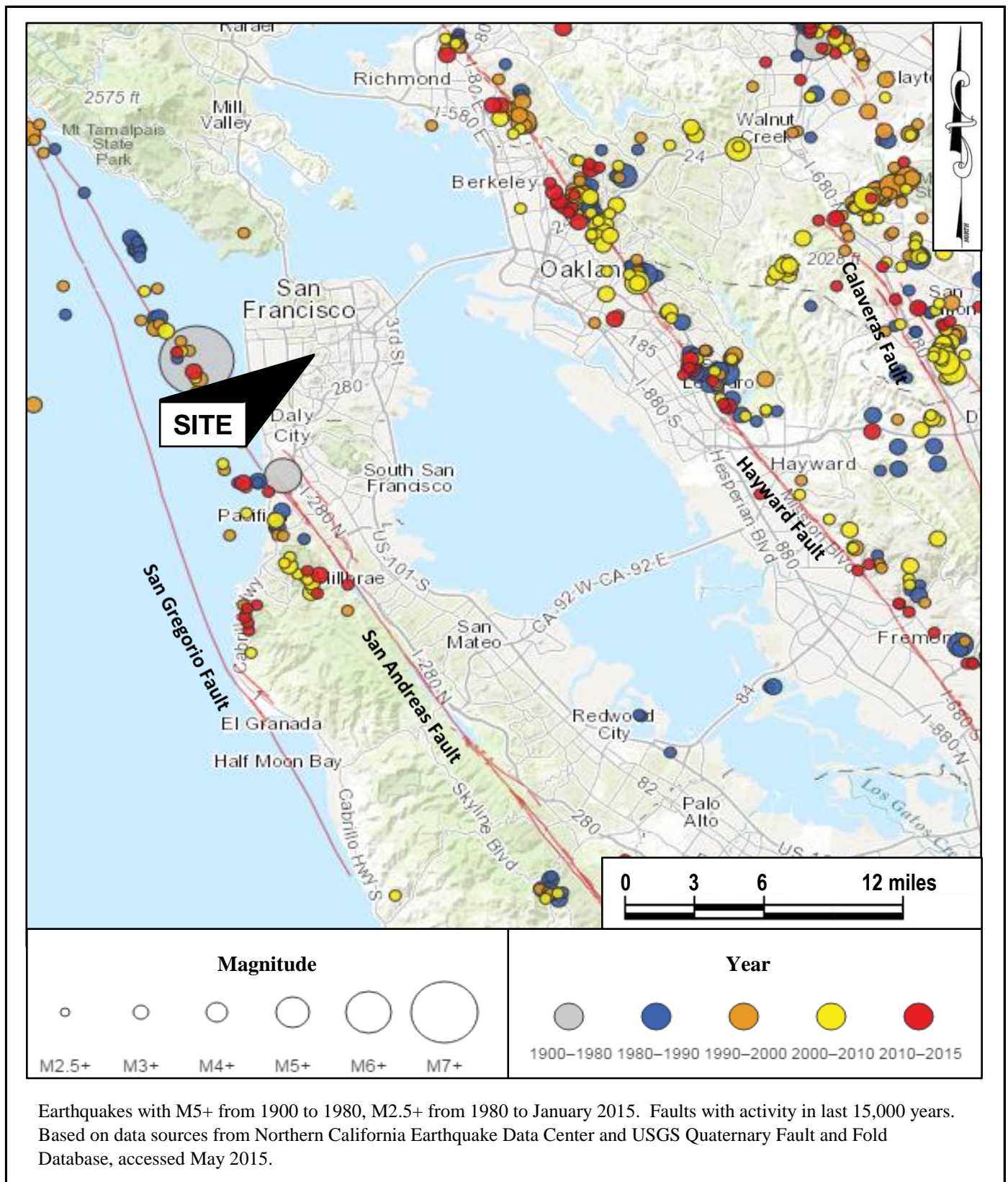
FIGURE 3
NOVEMBER 2022
PROJECT NO. 6088-1



VICINITY LIDAR MAP
THE PEAKS FEASIBILITY EVALUATION
SAN FRANCISCO, CALIFORNIA



FIGURE 4
NOVEMBER 2022
PROJECT NO. 6088-1



REGIONAL FAULT AND SEISMICITY MAP
 THE PEAKS FEASIBILITY EVALUATION
 SAN FRANCISCO, CALIFORNIA

FIGURE 5
 NOVEMBER 2022
 PROJECT NO. 6088-1

APPENDIX A

FIELD INVESTIGATION

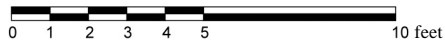
The soils encountered during the subsurface exploration were logged by our representatives and attitude measurements were taken where applicable.

The locations and elevations of the test pits were established by pacing using the site topographic survey prepared Transamerican Engineers, dated September 2020. The locations and elevations of the borings should be considered accurate only to the degree implied by the method used.

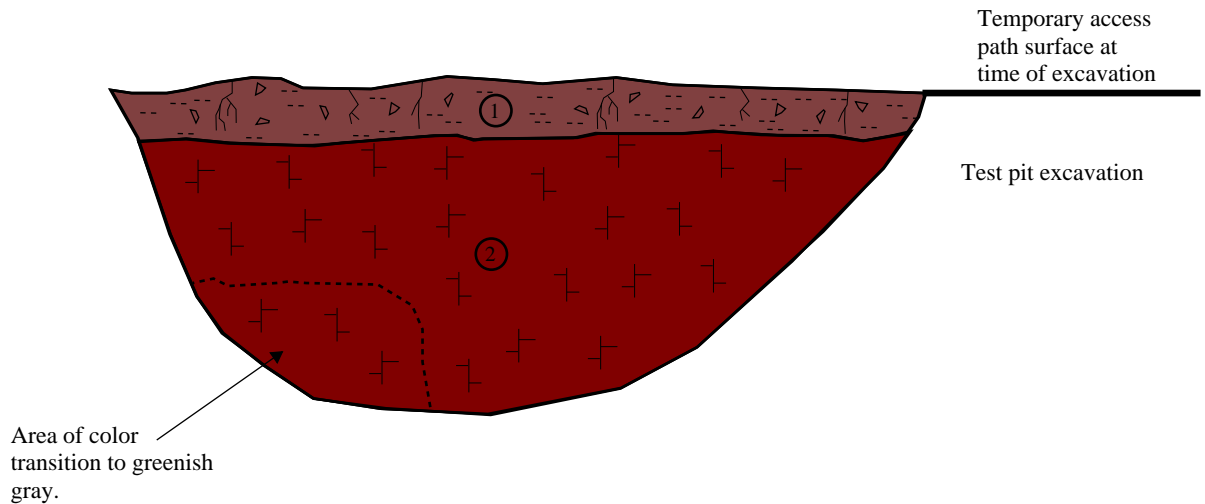
The test pits and related information depict our interpretation of subsurface conditions only at the specific location and time indicated. Subsurface conditions and ground water levels at other locations may differ from conditions at the location where sampling was conducted. The passage of time may also result in changes in the subsurface conditions.



Date Excavated and Logged: 10/20/22



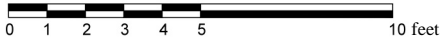
TPU-1



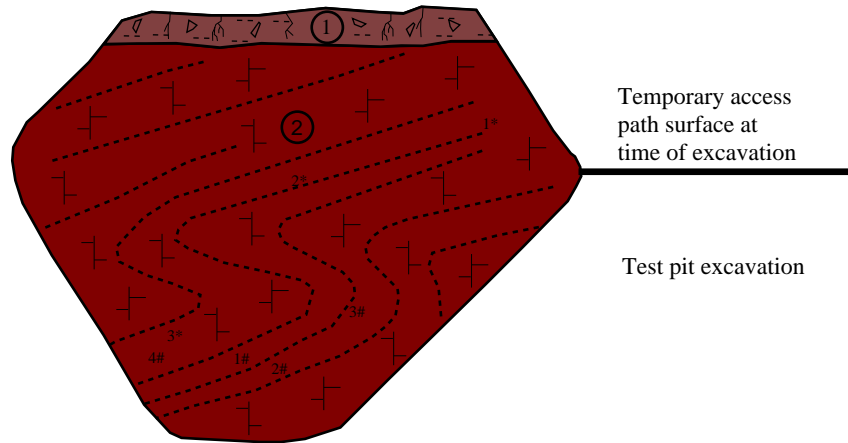
1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular rock fragments up to 4 inches in width, abundant roots.

2. Franciscan Complex (BR): Reddish brown and greenish gray, chert, moist, intensely weathered, fractured, massive, manganese oxide staining on fractures.

Date Excavated and Logged: 10/20/22



TPU-2



1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular rock fragments up to 4 inches in width, abundant roots.

2. Franciscan Complex (BR): Dark reddish brown to grayish black, Chert, moist, very severely weathered, fractured, folded, red-brown clay development between beds.

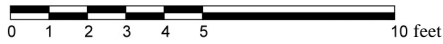
Bedding orientation:

1* - N10°W 29°NE
2* - N70°E 15°NW
3* - N52°E 29°NW

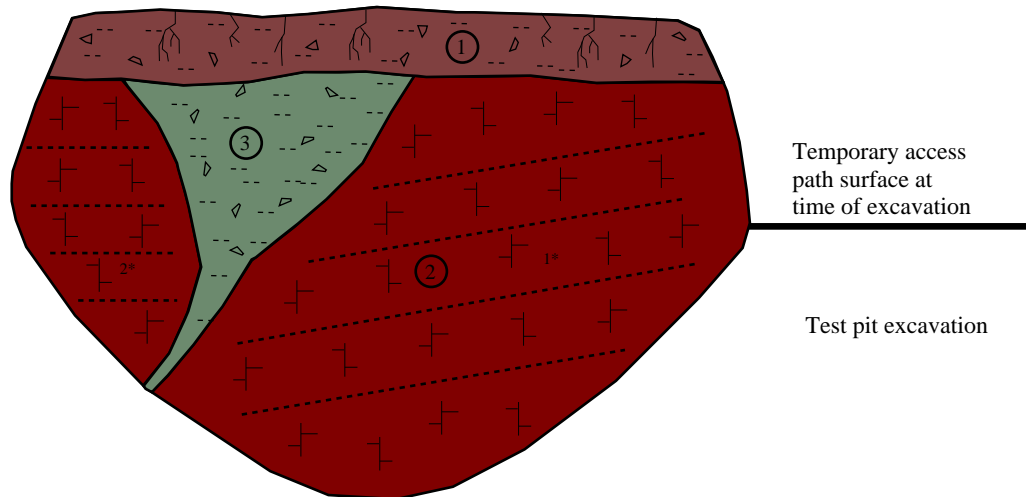
Fracture Orientation:

1# - N55°W 85°SW
2# - N66°E 65°SE
3# - N59°E 58°SE
4# - N32°W Vertical

Date Excavated and Logged: 10/20/22



TPU-3



1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular rock fragments up to 4 inches in width, abundant roots. .

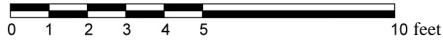
2. Franciscan Complex (BR): Reddish brown and greenish gray, chert, moist, intensely weathered, fractured, massive, manganese oxide staining on fractures.

3. Possible Shear Zone: Greenish gray to white, orange-red clayey matrix with small rock fragments, moist, intensely weathered. Possibly secondary infill.

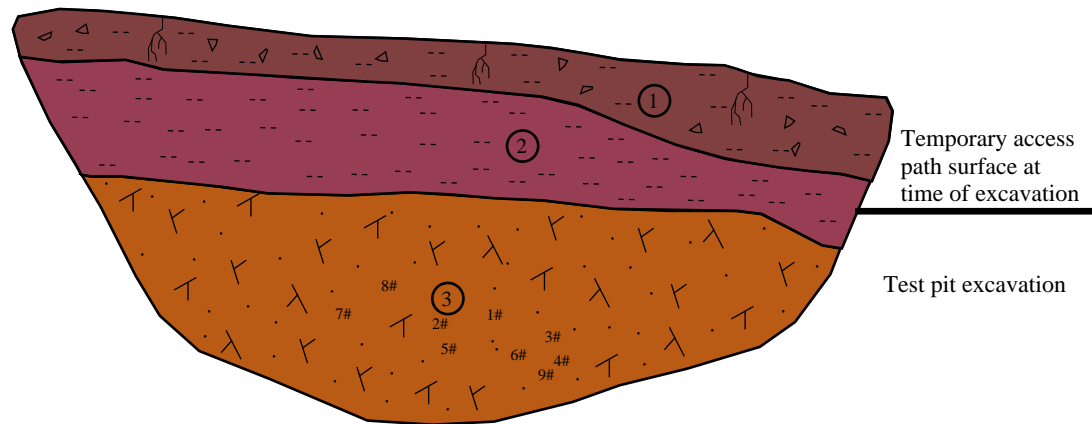
Bedding orientation:

1* - N60°E 47°NW
2* - N40°E 45°NW

Date Excavated and Logged: 10/20/22



TPU-4



1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, abundant roots.

2. Residual Soil (CL): Yellowish tan, Sandy Lean Clay, fine to medium grained, strong relict rock texture, roots.

3. Franciscan Complex (BR): Yellowish tan, Sandstone, moist, very severely weathered, fractured, massive, reddish brown to dark brown oxidation staining, 3 fracture planes observed and measured.

Fracture set 1 orientation:

1# - N40°E Near Vertical
2# - N45°E Vertical
3# - N30°E 85°NW
4# - N42°E Near Vertical

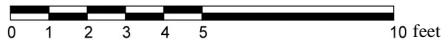
Fracture set 2 orientation:

5# - N65°W 65°NE
6# - N70°W 70°NE
7# - N75°W 65°NE

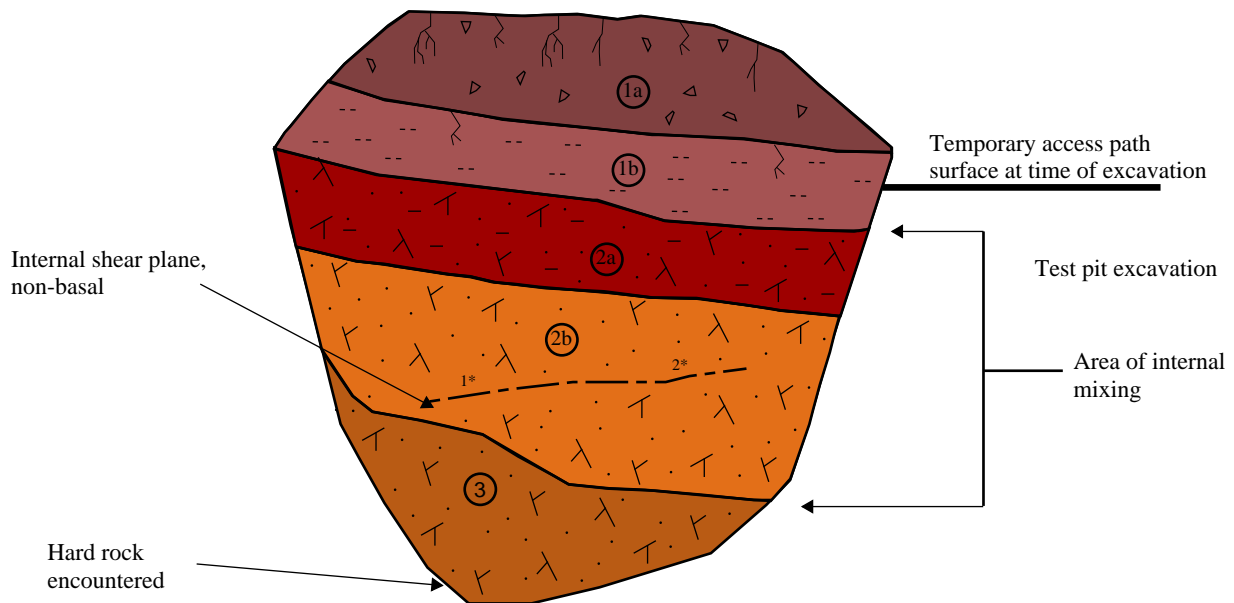
Fracture set 3 orientation:

8# - N32°W Vertical
9# - N32°W Vertical

Date Excavated and Logged: 10/20/22



TPU-5



1a. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular rock fragments up to 4 inches in width, abundant roots.

1b. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, few rock fragments, few roots.

2a. Franciscan Complex (BR): Reddish brown to tan brown, Sandstone and Siltstone, very severely weathered.

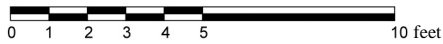
2b. Franciscan Complex (BR): Primarily dark grayish brown to dark reddish brown, Sandstone, moist, intensely weathered Shale/claystone interbeds, mixed, disseminated manganese oxide staining.

3. Franciscan Complex (BR): Yellowish tan, Sandstone, moist, very severely weathered, massive, fine grained.

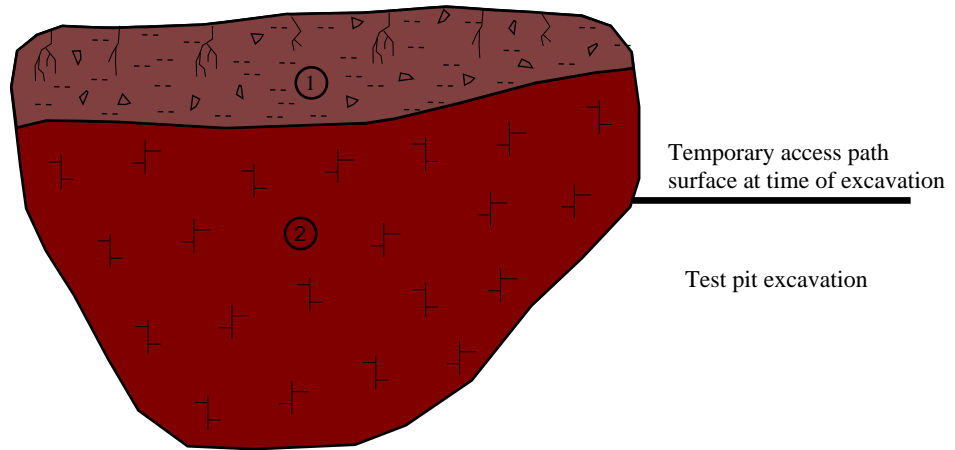
Shear plane orientation:

1* - EW 36°S
2* - EW 22°S

Date Excavated and Logged: 10/20/22



TPU-6



1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular fragments up to 4 inches in width, abundant roots.

2. Franciscan Complex (BR): Reddish brown and greenish gray, chert, moist, intensely weathered, irregular bedding, intensely sheared, intensely weathered pockets of clay throughout, massive, abundant polished manganese oxide staining, minor quartz? deposition.

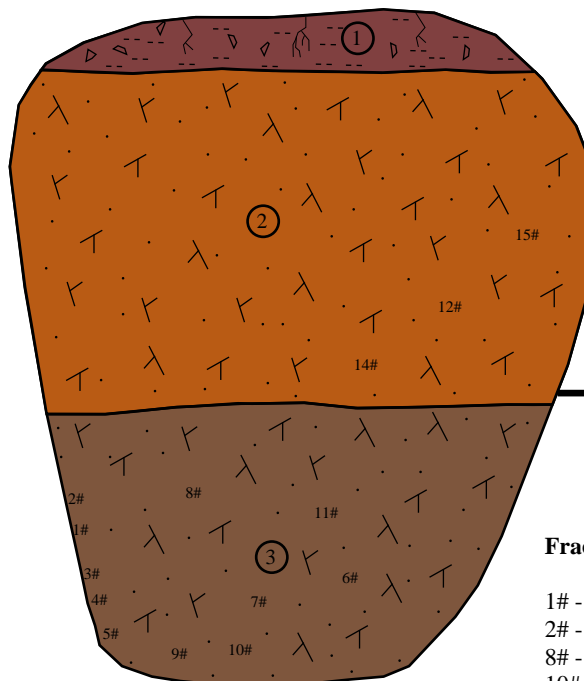
Date Excavated and Logged: 10/21/22



TPL-1

Note: Fracture spacing <1" to 6", variably oriented.

Measurements #1 through #5 obtained from side wall of excavation.



Temporary access path surface at time of excavation

Test pit excavation

Fracture set 1 orientation:

1# - N34°E 76°SE
2# - N30°E 75°SE
8# - N55°E 65°SE
10# - N53°E 85°SE
13# - N64°E 75°SE

Fracture set 2 orientation:

3# - N56°W 72°SW
4# - N56°W 65°SW
9# - N40°W 85°SW

Fracture set 3 orientation:

6# - N78°E 75°NW
7# - N70°E 75°NW
11# - N55°E 55°NW
16# - N64°E 57°NW

Other fracture orientations:

5# - NS 65°SW
12# - EW 78°S
14# - N22°W 72°SW
15# - N75°W 85°NE

1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular chert fragments up to 4 inches in width, roots.

2. Franciscan Complex (BR): Reddish brown to tan brown, Sandstone, severely weathered, fractured, manganese oxide staining on fracture planes.

3. Franciscan Complex (BR): Grayish tan to reddish brown, Sandstone, fractured, massive, fine grained, manganese oxide staining, includes chert and shale, generally hard.

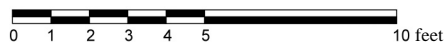
TEST PIT

THE PEAKS FEASIBILITY EVALUATION
SAN FRANCISCO, CALIFORNIA

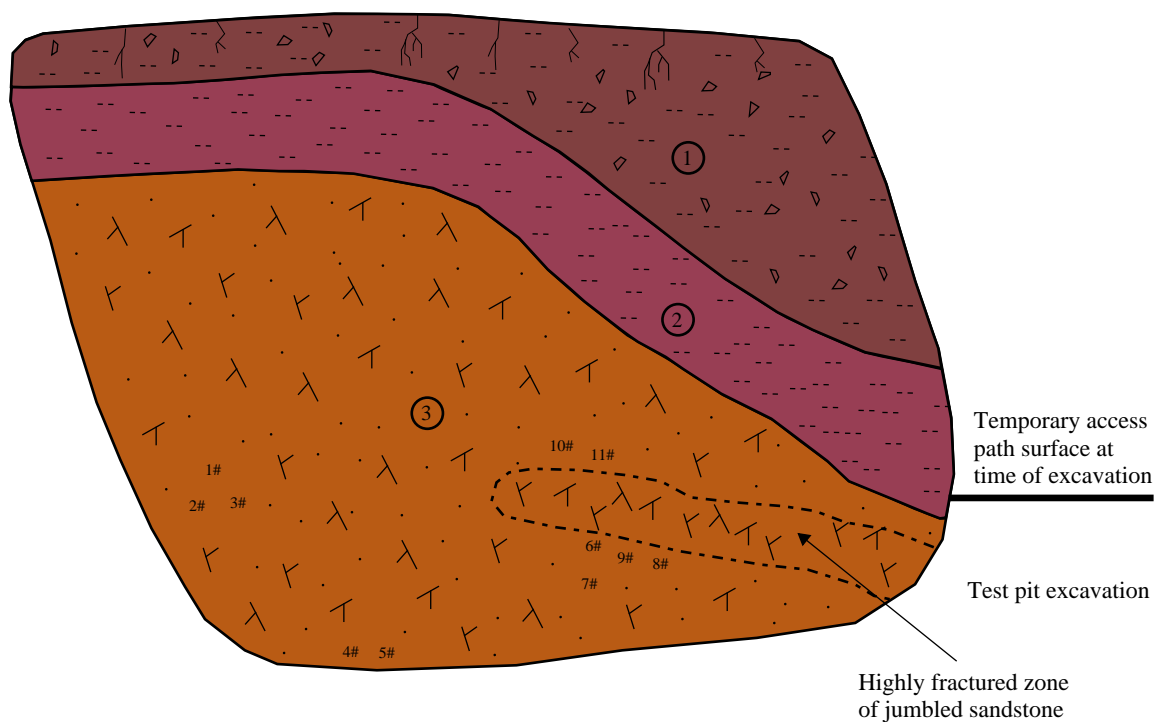
TPL-1

NOVEMBER 2022
PROJECT NO. 6088-1

Date Excavated and Logged: 10/21/22



TPL-2



1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular rock fragments, roots.

2. Residual Soil (CL): Tan brown to light reddish brown, Sandy Lean Clay, fine to medium grained, strong relict rock texture, roots, grained sand.

3. Franciscan Complex (BR): Grayish tan to reddish brown, Sandstone, fractured, massive, fine grained, manganese oxide staining, includes chert and shale, generally hard.

Fracture orientations:

- 1# - N6°E Vertical
- 2# - N85°E 63°NW
- 3# - N4°W 58°SW
- 4# - N38°E Vertical
- 5# - N88°E 75°NW
- 6# - N28°W 63°SW
- 7# - N82°E 62°NW
- 8# - N80°W 49°SW
- 9# - N53°E 48°SE
- 10# - EW 48°S
- 11# - N42°E Vertical

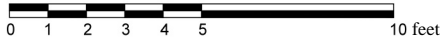
TEST PIT

THE PEAKS FEASIBILITY EVALUATION
SAN FRANCISCO, CALIFORNIA

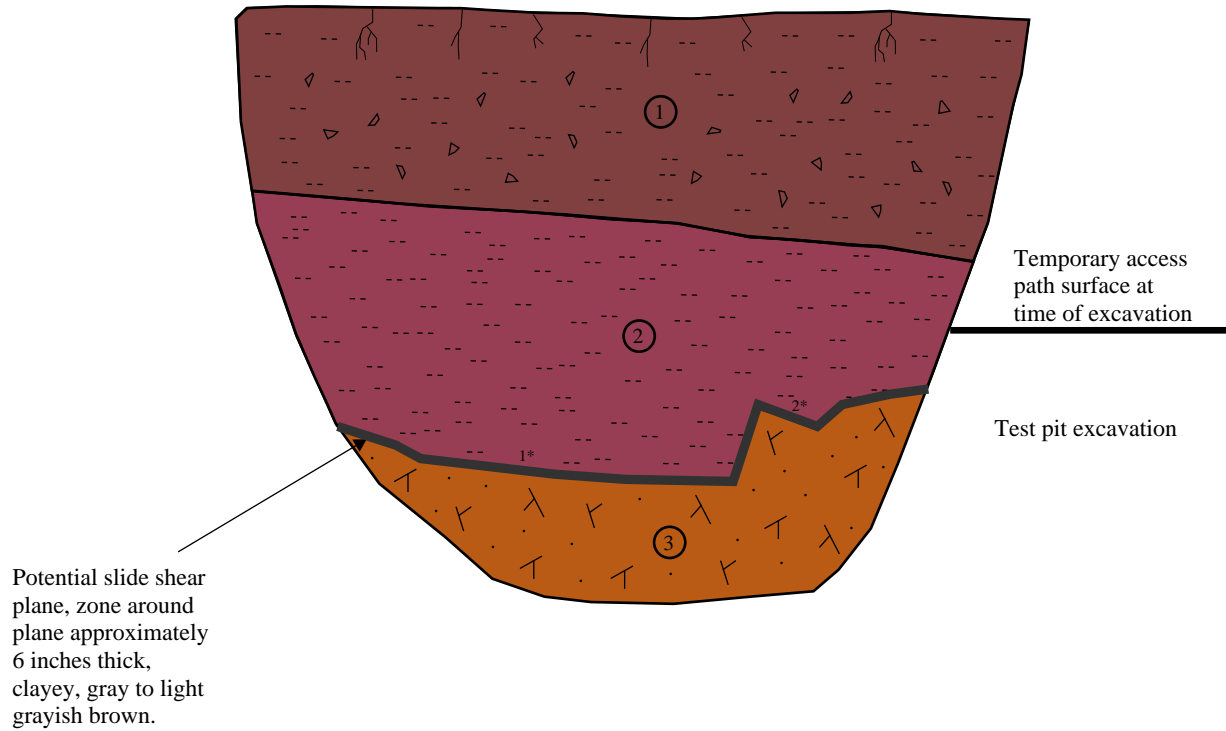
TPL-2

NOVEMBER 2022
PROJECT NO. 6088-1

Date Excavated and Logged: 10/21/22



TPL-3



1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular rock fragments, roots.

2. Residual Soil (CL): Dark reddish brown, Sandy Lean Clay, moist, fine to medium grained, strong relict rock texture, rock sandstone fragments.

3. Franciscan Complex (BR): Yellowish tan, Sandstone, moist, very severely weathered, friable, massive, soft.

Shear plane orientation:

1* - N65°E 42°SE

2* - N80°E 40°SE

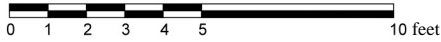
TEST PIT

THE PEAKS FEASIBILITY EVALUATION
SAN FRANCISCO, CALIFORNIA

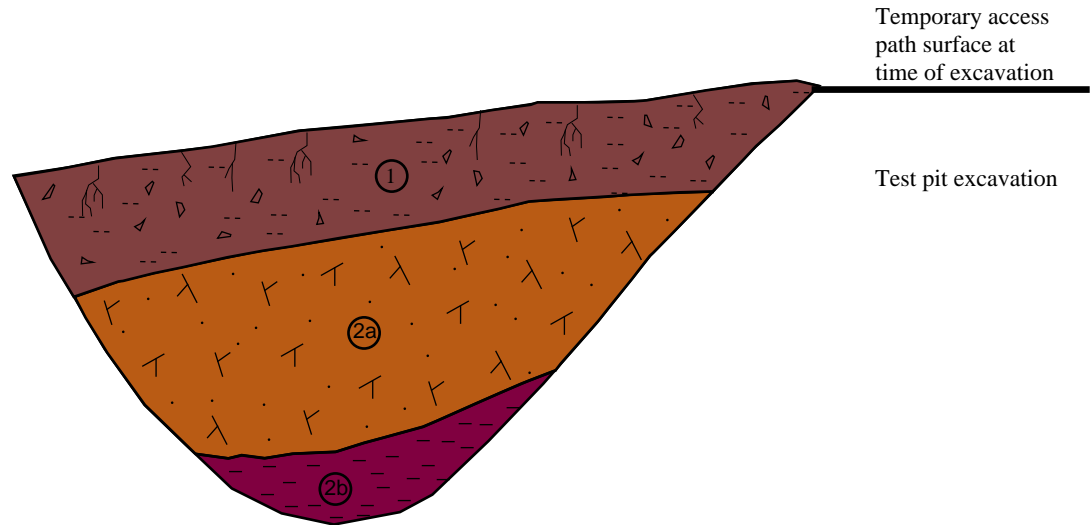
TPL-3

NOVEMBER 2022
PROJECT NO. 6088-1

Date Excavated and Logged: 10/21/22



TPL-4



1. Colluvium (CL): Dark brown to dark reddish brown, Sandy Lean Clay, moist, moderate plasticity, angular chert fragments, roots.

2a. Franciscan Complex (BR): Reddish brown to tan brown, Sandstone, moist, very severely weathered, fine grained, massive, red to black oxidation staining, no preferred fracture orientation, soft.

2b. Franciscan Complex (BR): Reddish brown to tan brown, Claystone and Siltstone, moist, very severely weathered, massive, red to black oxidation staining, no preferred fracture orientation, soft.



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