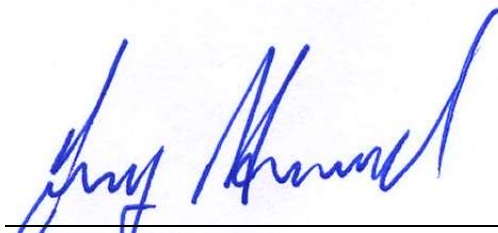


A P P E N D I X F

G E O L O G Y A N D S O I L S D A T A

APPENDIX F1:
DUE DILIGENCE REPORT

Type of Services	Due Diligence Report - Geotechnical Feasibility
Project Name	Notre Dame de Namur University
Location	1500 Ralston Avenue Belmont, California
Client	Stanford Real Estate
Client Address	Academy Hall 415 Broadway, 3rd Floor Redwood City, California, 94063
Project Number	105-130-1
Date	February 26, 2021

Prepared by 
Craig Harwood, P.G., C.E.G.
Senior Project Geologist





Erin L. Steiner, P.E., G.E.
Principal Engineer
Geotechnical Project Manager



EXECUTIVE SUMMARY

The attached geotechnical feasibility study was prepared based on our observations from site walks and our review of provided documents which including several previously prepared geotechnical reports. No additional field investigation or subsurface exploration was performed. The report discusses our preliminary geotechnical and geologic observations and conclusions regarding potential hazards and impacts to future site developments.

Generally, the subsurface conditions consist of alluvial and colluvial soils and fills over bedrock (chert, greenstone and sandstone). While none of the previous explorations encountered a stable groundwater table, we noted that an old water supply well exists in the front yard area of the Ralston Mansion. Seasonal drainage exists along the west property line and Belmont Creek is located at the south property line. Design team members have indicated water in mechanical rooms and catch basins around the campus during the due diligence period. As with all hillside environments, there is a potential for temporary perched groundwater conditions, especially during winter months.

From a geotechnical viewpoint, site development should be feasible provided the potential hazards and impacts are mitigated during design and construction. The preliminary concerns identified during our review include the presence of undocumented fill, expansive soils, shallow groundwater and/or perched water, the potential for fault surface rupture, potential for seismic-induced settlements, bedrock excavability, and potential slope instability.

Our review of available documents and aerial photographs indicate that the northeastern area of campus has previously undergone quarrying activities and has variable amounts of undocumented fill overlying the existing bedrock. Rock stability, undocumented fills and slope stability should be evaluated before further development in the former quarry area.

A potential fault contact was noted in the East Parking Lot that extends into the former quarry area. Future development planned for the quarry area and East Park Lot should consider the appropriateness of investigating this fault to further define the activity level of this fault and any potential hazard it might pose.

Future foundations for new development can likely be on shallow footings provided grading for cut and fill pads and mitigation for undocumented fills is performed. Further discussion of these potential hazards and impacts to future development are included in the attached report.

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Type of Services	Geotechnical Feasibility Study
Project Name	Due Diligence Report – Notre Dame de Namur University
Location	Belmont, California

SECTION 1: INTRODUCTION

This geotechnical feasibility study report has been prepared as part of the due diligence efforts for the potential future development at the Notre Dame de Namur University (NDNU). The location of the site is shown on the Vicinity Map, Figure 1. For our use, we were provided and reviewed the following documents:

- A fact sheet titled “NDNU, Due Diligence – Preliminary Fact Sheet”
- A Building Document Summary titled “NDNU – Building Summary – 01.27.21”
- A campus map titled “Notre Dame de Namur University, 1500 Ralston Avenue, Belmont, CA,” dated February 23, 2021
- A utility map titled “Topographic Survey of The College of Notre Dame, San Mateo,” Prepared by Brian Kangas Foulk (BKF) Consulting Engineers, dated February 7, 1995.
- A utility map titled “NDNU Existing Utilities,” prepared by BKF, dated February 9, 2021
- An topographic map titled “NDNU Existing Site,” prepared by BKF, dated February 9, 2021, based on the aerial flown in 1995.
- A letter titled “Pool Backfill Compaction Test, 1500 Ralston Avenue, Belmont, CA,” prepared by CalGeotech, dated May 9, 2018.
- An Initial Study Master plan titled “Initial Study/MND College of Notre Dame Master Plan Project,” prepared by Wagstaff and Associates, dated April 27, 2000, pages 43 through 112.
- A geotechnical report titled “Geotechnical Investigation, Proposed Student housing & Technology Center Projects, and Surface Parking Areas, College of Notre Dame Campus, Belmont, California,” prepared by Bay Area Geotechnical Group (BAGG), dated August 7, 1996, missing Plates 3 and 4.

- A geotechnical report titled “Geotechnical Investigation, Proposed Phase One of Master Plan, 1500 Ralston Avenue, Belmont, California,” prepared by BAGG, dated July 25, 2001.
- A geotechnical report titled “Geotechnical Investigation Ralston Hall, Notre Dame de Namur University, Belmont, California,” prepared by Rollo & Ridley, dated December 15, 2016.

1.1 PROJECT DESCRIPTION

The project site is located at 1500 Ralston Avenue, Belmont, California. The site consists of two parcels, north of Ralston Avenue, 044-360-120, and 044-360-170, consisting of approximately 46 acres. Twelve of the 46 acres are deemed as “off limits” for development due to proximity of neighbors, steep slopes, and distress. The project does not include Notre Dame Elementary and Notre Dame High School buildings/campus.

The site is currently occupied by 26 buildings, where multiple buildings are considered “Historic”. We understand that the Conditional Development Permit (CDP) would allow for additional building area (120,000 square feet), under strict, prescribed conditions, and would require a parking structure with 400+ spaces as well as “green” spaces. We understand that a geotechnical feasibility study report is needed as part of the due diligence efforts.

Based on discussions during meetings we understand future improvements could include renovations to the existing buildings, demolish and rebuild, as well as site improvements for accessibility.

The site is bounded by Laxague Drive and Notre Dame Elementary and High School to the west, Ralston Avenue to the south, and residential properties to the north and east (refer to Figure 2).

1.2 SCOPE OF SERVICES

Our scope of services was presented in our agreement dated February 4, 2021, and includes geologic research and consolidation of data, site reconnaissance, identification of potential geologic, seismic and geotechnical impacts, a discussion of potential mitigation measures, drafting and report preparation.

SECTION 2: REGIONAL SETTING

2.1 GEOLOGIC SETTING

2.1.1 Regional Geologic Setting

The site is located within the foothills of the peninsula segment of the Santa Cruz Mountains within the western portion of the San Mateo 7.5-minute quadrangle. The San Francisco Peninsula is a northerly extension of the Santa Cruz Mountains separating the Pacific Ocean from San Francisco Bay. This represents one mountain range in a series of northwesterly-aligned mountains forming the Coast Ranges geomorphic province of California that stretches

from the Oregon border nearly to Point Conception. In the San Francisco Bay area, most of the Coast Ranges have developed on a basement of tectonically mixed Cretaceous- and Jurassic-age (70- to 200-million years old) rocks of the Franciscan Complex. Locally these basement rocks are capped by younger sedimentary and volcanic rocks. Most of the Coast Ranges are covered by still younger surficial deposits that reflect geologic conditions of the last million years or so.

In the San Francisco Bay area, most of the Coast Ranges have developed on a basement of tectonically mixed Cretaceous- and Jurassic-age (70- to 200-million years old) rocks of the Franciscan Complex. Locally these basement rocks are capped by younger sedimentary and volcanic rocks. Most of the Coast Ranges are covered by still younger surficial deposits that reflect geologic conditions of the last million years or so.

Several regional scale geologic maps have been published covering the mid-peninsula region and San Mateo 7.5-minute quadrangle including those by; Lajoie et al. (1974), Leighton (1976), Brabb and Pampeyan (1983), Wentworth et al. (1985), Pampeyan (1994), Brabb et al. (1998) and California Geological Survey (2018). These maps generally depict similar geologic units underlying the site and immediate vicinity. A partial reproduction of the regional map of Pampeyan (1994) is presented as Figure 3 in this report.

The foothills within the western portion of Belmont in the area of the site are underlain by bedrock units of the Franciscan Complex (Pampeyan, 1981, 1994, and Brabb et al., 1998). Younger Quaternary colluvial deposits have accumulated on and at the base of slopes and alluvial has accumulated within drainages that dissect the hillside terrain in the area.

Just to the east of the site, these Franciscan bedrock units are cut by the Belmont Hill Fault (a pre-Quaternary fault) (see Fault Surface Rupture).

2.1.2 Local Geologic Setting

The published maps of the California Geological Survey (2018) and the map of Pampeyan for the San Mateo 7.5-minute Quadrangle (1994) shows the site in an area that is underlain by an extensive surface outcrop of chert of the Franciscan Complex ("fc") and transitions into colluvial deposits ("Qsr") on the gentler slopes around the extensively developed portion of the campus within the western portion of the campus. Old alluvium ("Qoa") is shown as underling the largely flat areas beyond the west and south of the small seasonal creek that extends along the west property line. Pampeyan's map shows chert juxtaposed against a large body of Franciscan sandstone ("fs") by the northwesterly trending Belmont Hill Fault approximately 1,080 feet east of the site. Greenstone and sandstone are other subunits shown as underlying the upland areas in the general area of the site. Pampeyan (1994) described the chert as:

Massive to rhythmically thin bedded, white, green, grayish-green, yellowish orange and brown, hard, brittle radiolarian chert. Commonly with thin interlayers of reddish brown shale. In some exposures chert has been recrystallized and cut by crystalline quartz veins; in other exposures, as along the Belmont Hill Fault, chert has been hydrothermally altered to clay minerals. Largest bodies of chert are in Belmont and San Carlos.

The greenstone is an altered volcanic rock type and is described by Pampeyan as: agglomerate, flow breccia and tuff.

Site specific studies previously conducted at the site and our surface mapping revealed a more complex geologic site setting and several other geologic units than are shown on the published maps (see subsequent sections of this report). The above-mentioned published map of Pampeyan (1994) was used as the base for our Vicinity Geologic Map, Figure 3.

2.2 REGIONAL SEISMICITY

The San Francisco Bay area is one of the most seismically active areas in the country. While seismologists cannot predict earthquake events, geologists from the U.S. Geological Survey have recently updated earlier estimates from their 2015 Uniform California Earthquake Rupture Forecast (Version 3: UCERF 3) publication. The estimated probability of one or more magnitude 6.7 earthquakes (the size of the destructive 1994 Northridge earthquake) expected to occur somewhere in the San Francisco Bay Area has been revised (increased) to 72 percent for the period 2014 to 2043. This report was subsequently summarized in Aagaard et al., (2016). The faults in the region with the highest estimated probability of generating damaging earthquakes between 2014 and 2043 are the Hayward (33%), Calaveras (26%), and San Andreas Faults (22%). In this 30-year period, the probability of an earthquake of magnitude 6.7 or larger occurring is 22 percent along the San Andreas Fault and 33 percent for the Hayward Fault.

Faults considered capable of generating significant earthquakes are generally associated with the well-defined areas of crustal movement, which trend northwesterly. Table 1 presents the State-considered active faults within a 25-kilometer (approximately 15 miles) radius of the project.

Local faults are indicated on the Regional Fault Map, Figure 4, illustrating the distances of the site to significant fault zones.

Table 1: Approximate Fault Distances within 25-Kilometers

Fault Name	Distance (miles)	Distance (kilometers)
San Andreas	2.9	4.7
Monte Vista-Shannon	9.9	15.9
San Gregorio	10.7	17.1
Hayward (SE Total)	15.3	24.6

SECTION 3: SITE CONDITIONS

3.1 GEOMORPHOLOGY AND RECENT HISTORY

The site is located in on the top of a hillside that has received some grading in order to accommodate improvements during previous development projects (buildings and roads,

parking areas, etc.). Aerial photographs listed in the References show the site vicinity at several different times spanning the period from 1939 to 1990 and additional photos were reviewed through Google Earth® that show the site and vicinity from 1991 through 2012.

Historic topographic maps: The USGS map of 1901 shows a single loop road traversing the site and a residence on the ridgetop. A seasonal drainage is shown as trending through the central portion of the campus which delivers runoff to the lower elevation area on the south of the site.

The 1949 USGS San Mateo 7.5-minute quadrangle shows the Ralston Hall (Building 1), Weigand Gallery (Building 2) and Cullany Hall (Building 3) buildings. The 1957 version of the quadrangle indicates a quarrying operation located in the canyon in northeast portion of the campus. Additional development at the campus is difficult to discern due to the scale of the mapping.

Aerials: The 1930 through 1946 photos show the western portion of the campus as developed (including Ralston Hall, Weigand Gallery and Cuvilly Hall buildings) and the eastern portion of the campus undeveloped and obscured by a heavy tree canopy. The 1956 photos show this same portion of the campus as recently cleared of forest. The sequence of development within some portions of the site is difficult to discern through the available aerial imagery due to scale of the photography however the construction year for the various campus buildings is available through records available through the property owners.

3.2 SITE RECONNAISSANCE AND SURFACE DESCRIPTION

Our Certified Engineering Geologist and Principal Geotechnical Engineer performed a reconnaissance of the site on February 3rd and 10th, 2021. For the purposes of ease in site description, we have divided the subject site into two properties a northerly half, and a southerly half, as seen in Figures 2A and 2B.

The property is divided into two parcels, assessor parcel numbers (APN) 044-360-120, and 044-360-170. The southern parcel, APN 044-360-120, includes the Koret Athletic Field, two tennis courts, and NDNU Theatre, and is separated from the remainder of the campus by a slope that leads up to Laxague Drive. The parcel is bounded by Ralston Avenue to the south and east, Laxague Drive to the north and the Notre Dame High School facilities to the west. The larger parcel, 044-360-070, is occupied by the majority of the existing structures on campus and is bounded by Laxague Drive to the south and west and residential development to the north and east.

The northern parcel consists of three main clusters of structures/development. The first cluster is on the west side of the parcel and is comprised of the Toso Residences (Courtrai Hall, Namur Hall, and Compiègne Hall), Cuvilly Hall, Gavin Hall, an existing bookstore, Tabard Inn, the Madison Art Center & Wiegand Gallery and the Ralston Hall mansion. The second cluster of development lies at the center of the parcel and includes the Cunningham Chapel, Gleason Center Gymnasium, the New Hall residences (West 1 Hall, West 2 Hall, and East Hall), St. Joseph's Hall, and the Gellert Library. The third main cluster of development lies on the southern half of the parcel and consists of the Campus Center (dining hall and admissions building), Julie Billiard Hall, St. Mary's Hall, the Apartment Complex residences (Wilkie Hall, Kane Hall, and Carroll Hall), and the Oaks and an infilled pool. An at-grade parking lot sits

adjacent to the gym, library and Campus Center buildings, and wraps between the residence halls. A second at-grade parking lot exists northeast of the campus entrance in addition to the Taube Conference Center and surrounding at grade parking that lies to the northwest of the campus entrance and connects to the upper parking lot via a paved pedestrian path.

From our review of the provided documents, we understand that the pool adjacent to the Oaks building was infilled May of 2018. The Field Daily Report by CalGeotech outlines the backfill methodology and compaction efforts and includes compaction testing records. The pool appears to have been backfilled with a sandy clay/clayey sand with gravel import material, compacted to a minimum of 90 percent relative compaction. The pool was backfilled with imported soil to 8 to 10 inches below surrounding grade and topped with concrete. Based on our site visits, the concrete overlying the fill appears to be in fair shape with little to no indication of cracking or settlement.

The developed portion of the site was created by making a series of cuts into the otherwise moderately to gently sloping areas. Laxague Drive was created by making cuts into an otherwise moderate to steep hillside. The cut for the roadway is supported by a crude stone gravity "rockery" wall that varies from 5 feet to 14 feet tall and is inclined generally 1:5 (H:V). The main entrance access road ascends a gently inclined hill and provides access to a large parking lot in the central portion of the site. A small parking lot is located off this road adjacent to the southeast property corner (East Parking Lot). This parking lot was created by making cuts into the bedrock and placing fill to the south edge of the lot. A rock quarry area is located north of the Chapel Annex building. This area is undeveloped. The canyon has a massive outcrop of bedded chert on the west edge and on the adjacent hilltop, and the central area of the rock quarry area is a local low depression or basin where stockpiles and berms of fill have been placed. The northern edge of the basin in rock quarry area is adjacent to a fill slope that was placed for development of the adjacent residential lots. Small soil slumps are present on this fill slope. The ground surface in this basin and the adjacent slopes on the east of the basin have been previously disturbed by machine grading for quarrying operations. Many small berms of fill exist in the area however the bedrock is very generally shallow throughout the rock quarry area. There are cuts for the building pad in the Toso residence area. These cuts expose greenstone at the ground surface.

Pavement distress was observed around the developed portion of the site, typically associated with fill wedges. This is visible in the parking lot south of Julie Billiard Hall. The fill in this area appears to extend over the top of a previous cut slope above the Apartment Complex comprised of Buildings 23 to 25 where rather steep (1:1) slopes were observed.

3.3 PREVIOUS EXPLORATIONS AND GEOLOGIC UNITS

The majority of the campus has been developed which affords only rare opportunities to observe subsurface conditions. Other areas located primarily in the east and northeast portions of the campus have extensive outcrops. To our knowledge, only two geotechnical consultant's studies have been conducted on portions of the site. These studies include: BAGG (1996 and 2001), and Rollo & Ridley (2016).

BAGG in 1996 conducted a geotechnical investigation for several campus buildings including: Student Housing Center (in the area of the former rock quarry), Academic and Technology

Center Building (between St. Mary's and Julie Billiart Hall) and surface improvements for a parking lot immediately adjacent to Wilkie Hall. Their investigation included the excavation and logging of thirteen test pit explorations in the area of the former Quarry, drilling and logging three exploratory borings in the parking lot area, and drilling and logging two exploratory borings in the area of the proposed buildings. The proposed Student Housing Center was to be located at the base of the former quarry (see below). Plates 3 and 4 showing the location of the borings and trenches was missing from the provided document, however, the boring logs, trench logs, laboratory data, and seismic refraction data were available.

BAGG in 2001 conducted a geotechnical investigation for the proposed Phase One of Master Plan for the College, which encompassed various parking lots, a proposed residence hall (later constructed and named the New Hall residences), a proposed three-story Campus Center building, and surface improvements. Their investigation included the drilling and logging of ten exploratory borings spread throughout the campus, four near the proposed residence hall, one between the Library and St. Joseph Hall, one in the parking lot between the Library and Gym, three on driveways and access roads, and one in the southeastern parking lot. Three seismic refraction lines were performed, two near the proposed residence hall and one between the Library and St. Joseph Hall. In the lower campus areas, two of their borings encountered undocumented fill soils to 6½ to 8½ feet while in the upper campus areas undocumented fill was only encountered in the boring between the Library and St. Joseph Hall below the existing pavement to a depth of 3 feet, the adjacent seismic refraction line suggested between 6 and 10 feet of fill soils may exist over the bedrock. In general, they noted that near-surface bedrock is present in the upper campus at depths ranging from immediately below pavement to a depth of 5 feet below existing grade, with the upper 10 feet of bedrock containing a considerable amount of clay seams.

Riley & Rollo (2016) performed a soil engineering investigation for a structural upgrade and remodeling to the Ralston Mansion. That study included the excavation and logging of six shallow, hand-excavated test pits. At this location BAGG encountered or identified the foundation bearing materials as fill and "alluvial deposits". They estimated that bedrock could be at a depth of 20 feet below the ground surface although it should be noted that the building steps down the hillside and the adjacent ground surface varies considerably in elevation.

Our site observations are organized by geographic area within the property as follows:

Lexague Drive

A cutslope exists along much of the uphill side of Lexague Drive on the south side of the "Apartment Complex" (Buildings 23 through 25 inclusive). This cutslope is retained by a crudely constructed rockery wall consisting of blocks of chert bedrock. This cut (and rockery face) are inclined at an angle of 1: 6 (H:V) and the rockery varies from 5 feet to 14 feet tall. Although the cut has been obscured by the rockery wall, a small stone-lined tunnel built into the rocker wall extends horizontally 10 feet into the cut and provides an exposure of vertically dipping, bedded chert. We noted no evidence of slope instability along this steep slope.

Toso Residence area and adjacent Sloping Areas (to the east)

Areas where the grass and surface soil have been scraped off or cuts created at the upslope edge of building pads (i.e., Gavin hall and Courtrai Residence (Building 8)) exposes bedrock consisting of volcanic flow breccia associated with the Franciscan greenstone. This material is

generally very dark reddish brown, consists of subangular gravel sized fragments in a matrix of well consolidated (weak to moderately strong in terms of rock hardness) silty sand material.

Former Quarry and Adjacent Areas to the East

BAGG investigated this area in 1996 for a proposed Student Housing Center that was to be sited within the base of the former quarry. In addition, they conducted three seismic refraction array lines (two 100-foot long and one 90-foot long survey line) in this area. The proposed project was never actually implemented at this location. Their 1996 report indicates that in 1967 fill was placed as sheets and stockpiles within the excavated base of the former quarry. They characterized this area as “scattered fill soils overlying residual soil and bedrock.” Within their test pits excavated in this areas, BAGG encountered chert within the western and far eastern portions, and sandstone with associated chert and Mélange (highly sheared sandstone and shale) within the central portion as well as (locally) greenstone. They noted seepage associated with the chert/sandstone contact (see Fault Surface Rupture). Their test pit logs indicate the chert varies from fresh to severely weathered, and with very closely spaced fracturing. They noted the uppermost portions of the chert is severely weathered to a soil that is expansive. The sandstone is characterized as “massive and hard to excavate”. A fill slope placed during development of residential parcels located at the north property line (adjacent to the Quarry area) shows evidence of slumping of the fill material (see Landsliding). Two small scale slumps were noted on this downslope. One of these slides was identified during the 1996 BAGG investigation of the quarry area. These slumps are probably the result of failure and creep within the fill that may be exacerbated from runoff or springing in the immediate area.

Our reconnaissance revealed this area contains substantial surface outcrops of bedded chert on the high ground (in the west) and by chert on the higher ground on the east of the quarry bottom. The bedded chert dips gently to moderately to the west and southwest at the surface outcrops. A line of springs was noted on the east side of the quarry bottom.

Parking Lot immediately upslope of Apartment Complex (Buildings 23 to 25)

The earlier investigation by BAGG indicates this area is underlain by sandstone in their exploratory borings drilled in this area. We infer this parking lot (similar to the other parking lots on campus) were created by making minor cuts on the uphill side and placing slivers and wedges of fill on the downslope side of the parking lots. This parking lot has minimal signs of pavement distress much of which is concentrated within the southerly perimeter in an area where a fill wedge was placed during the grading of the parking lot. The fill in this area appears to extend over the top of the cut slope adjacent to the northeast side of the Apartment Complex comprised of Buildings 23 to 25 where rather steep slopes (1:1) were observed.

Sloping areas located north of East Parking Lot

Chert is exposed sporadically on slopes located east of the easterly perimeter road. In this area the chert dips moderately toward the southwest and west, as well as nearly horizontal further to the eastern property line. The irregular topography along the east side of the perimeter road in this stretch suggests this area was previously quarried for chert.

East Parking Lot

Historic aerials available through Google Earth indicates this small parking lot was created

sometime in late spring of 2003. This is after the previous site investigations and the mapping of Pampeyan (1994) and the CGS (2018) and therefore provides a glimpse of the geologic conditions not previously available to geologists studying the immediate area. It was created by making substantial cuts into the hillside and placing fill within the southern portion of the parking lot. The eastern cutslope exposes highly sheared Franciscan interbedded sandstone and shale, as well as a volcanic andesitic tuff associated with the greenstone. Thin bedded chert is exposed at the west and north perimeters of the parking lot and the lithologic (geologic) contact between these two bedrock units appears to be highly sheared and may represent a faulted contact. Landforms located above and adjacent to this contact suggests possible quaternary activity (see Fault Surface Rupture section and Preliminary Conclusions section). The tall cutslope at the east edge of the parking lot has experienced sloughing and spalling of bedrock since the parking lot's construction (in 2003). This material forms lobes near the base of the slope just beyond the short retaining wall along the east edge of the parking lot (see sections on Landsliding, and Preliminary Conclusions).

Sloping Areas North of New Hall Building Complex (Buildings 10, 11, and 12)

Extensive cuts were made to create the building pad for the New Hall complex. These cuts are retained by a 5-foot tall retaining wall along much of the length. These cuts slope expose Chert throughout. The chert is bedded variably to the east, southwest and west. We noted no signs of slope instability along this tall cut.

3.4 GROUNDWATER

The California Geological Survey does not show a groundwater table in the immediate area of the site or within the adjacent Belmont Creek drainage valley (CGS, 2018). With the exception of localized seepage, no groundwater table was encountered in any of the previous excavations conducted at the site (BAGG, 2000; Rollo & Ridley, 2016). It should be noted however that an old water supply well exists in the nearly flat front yard area of the Ralston Mansion. This water well is of a construction style appears to date to the late nineteenth/early twentieth centuries and presumably is a hand excavated, brick concrete lined structure that taps water localized within the underlying colluvium. The well is capped by a locked hatch and we did not have access to this well while onsite. The seasonal drainage that exists along the west property line has occasional runoff and Belmont Creek located at the south property line carries surface runoff throughout much of the year. The valley fill alluvium that occupies the low-lying areas in the southern portion of the site likely contains a groundwater table.

We also note that design team members have indicated water in mechanical rooms and catch basins around the campus during the due diligence period.

As with all hillside environments, there is a potential for temporary perched groundwater conditions, especially during winter months. Fluctuations in ground water levels occur due to many factors including seasonal fluctuation, underground drainage patterns, regional fluctuations, and other factors.

SECTION 4: GEOLOGIC HAZARDS

This section presents our review and comments concerning potential geologic hazards affecting the proposed project.

4.1 FAULT SURFACE RUPTURE

As discussed above several significant faults are located within 25 kilometers of the site. However our review of published sources indicates that no faults have been mapped as projecting through the site or immediately adjacent to it (Pampeyan, 1970, 1993; Brabb and Olsen, 1986; USGS/ICBO 1998; Brabb, Graymer and Jones, 2000; California Geological Survey Fault and Fold Database, 2006; Dibblee Geological Foundation, 2007, and Jennings and Bryant, 2010). Accordingly, the site is not located within a state-designated Alquist-Priolo Earthquake Fault Zone (CDMG, 1974).

We did encounter three bedrock faults that cut Franciscan geologic units in the eastern portion of the site. For the purpose of description and discussion, these faults are named in this report as F1, F2 and F3 (See Figure 2A). Two of these faults (F1 and F2) extend from the small parking lot (at the southeast property corner) and trend through the eastern portion of the site to the former quarry. Fault F2 branches into an additional fault (F3) at the quarry. Both F2 and F3 are confined within the chert on the west side of the quarry. These faults appear to be pre-Quaternary structures and therefore are unlikely to experience surface rupture in the future. An additional (3rd) fault encountered in the small eastern parking lot (Fault F1) juxtaposes highly sheared M $\acute{e}$ lange (sandstone, shale and conglomerate) on the east against chert (on the west). This faulted contact (F3) may represent a southern continuation of a lithologic contact noted in BAGG's test pits (P-4 and P-5) excavated within the base of the former quarry. The similar lithologic relationships (sandstone and M $\acute{e}$ lange against chert) noted at the parking lot exposure and at the quarry suggests the continuity of the feature extending from the parking to the quarry where springing activity is present in the area immediately adjacent to this contact. The published mapping covering the area has not noted any evidence of a fault trending through this immediate area, however the location, trend and lithologic relationships (chert against sedimentary units) exhibited at the easternmost fault suggests that F1 may be a splay fault coming off the Belmont Hill Fault located just to the east of the site, although this notion is equivocal. The Belmont Hill Fault is described by Pampeyan (1981) as: "a steeply dipping to vertical northwest striking fault" which "cuts through the hills and passes under alluvium at either end." The Belmont Hill Fault is confined to Franciscan Complex geologic units and cuts Franciscan chert and graywacke (sandstone), both of which have been locally altered to clay minerals along the fault. The geologic relationships shown on Pampeyan's map suggests the fault is a high angle reverse fault with the west side up versus the east side. The maps of Pampeyan and the CGS do not show or suggest the slope wash/ravine fill (Qsr unit) located on trend with this fault has been offset, however a vertical movement along the fault may not have been detectable at the scale of the mapping. Geomorphic features that extend across the fault in the parking lot area suggest the slope above the fault may have been affected by previous fault movement (see Preliminary Conclusions). This fault trends along the east side of the perimeter road and has no implications for any existing structures. Future development planned for the quarry area or East Parking Lot area should consider the appropriateness of investigating this fault to further define the activity level of this fault and any potential hazard it might pose. A hand excavated trench along the ridgetop at the north end of the small parking lot would be a suitable location to assess the activity status of the fault.

In our opinion, there is a low potential for the developed portion of the campus to be directly impacted by fault surface rupture.

4.2 STRONG GROUND SHAKING

Moderate to severe (design-level) earthquakes can cause strong ground shaking, which is the case for most sites within the Bay Area. While a seismic hazard analysis was not prepared as part of the preparation of this report, strong ground shaking should be expected at the site during the life of the improvement.

4.3 HISTORICAL GROUND FAILURES

Strong to severe ground shaking accompany previous large earthquakes within the bay area region have affected the area in the past. Youd and Hoose (1978) compiled reports and locations of earthquake damage resulting from the 1906 earthquake throughout the bay area. They show three occurrences of ground failure (cracking, settlement and miscellaneous effects) located adjacent to the bay waterfront 1.5 miles northeast of the site and also landslides located in the San Carlos area about 1.5 miles south of the site. No reported occurrences of earthquake damage were shown at or proximal to the site. The mapping of Pampeyan and Loney (1995) show areas of reported damage following the 1989 Loma Prieta Earthquake. Tinsley et al. show occurrences of ground settlement and cracking near the bay front in Foster City, however there are or were no reports of damage in the immediate area of the site (Pampeyan and Loney, 1995; Tinsley et al., 1998.)

4.4 LIQUEFACTION POTENTIAL

4.4.1 Background

The State of California has produced a series of quadrangle-scale seismic hazards maps and reports statewide. These maps are interpretive in nature and serve as a triggering mechanism to assist cities and counties in fulfilling their responsibilities for protecting the public safety from the effects of earthquake-induced ground failure as required by the [Seismic Hazards Mapping Act](#). While the majority of the site is currently not mapped as within a seismic hazard zone for liquefaction, the southernmost parcel (APN 044-360-120) of the campus is mapped as within a liquefaction seismic hazard zone (San Mateo Quadrangle, 2018). From our review, the theatre and lower/southern sports fields are within the liquefaction hazard zone defined by the State of California. The previous field investigations and reports of BAGG 1996 and Wagstaff and Associates 2000 indicate that there is a very low chance of liquefaction triggering occurring in the onsite soils, however we note that these reports were primarily focused on improvements in the northern half of the campus which is underlain by shallow bedrock and an area that is not mapped as within the liquefaction hazard zone. Groundwater is not mapped for the site by CGS, however evidence of seepage, perched groundwater and springs were encountered during the BAGG 1996 field investigation. As noted in the groundwater section of this report, the presence of a water well near the Ralston Residence suggests there may be a localized, seasonal groundwater table in that area and the largely flat-lying alluvial plain within the extreme southern portion of the site may also contain a groundwater table.

During strong seismic shaking, cyclically induced stresses can cause increased pore pressures within the soil matrix that can result in liquefaction triggering, soil softening due to shear stress loss, potentially significant ground deformation due to settlement within sandy liquefiable layers as pore pressures dissipate, and/or flow failures in sloping ground or where open faces are present (lateral spreading) (NCEER 1998). Limited field and laboratory data is available regarding ground deformation due to settlement; however, in clean sand layers settlement on the order of 2 to 3 percent of the liquefied layer thickness can occur. Soils most susceptible to liquefaction are loose, non-cohesive soils that are saturated and are bedded with poor draining materials, such as sand and silt layers bedded with a cohesive cap.

Based on guidelines set forth in CGS Special Publication 117A (CGS, 2008), “screening investigations” could be used to determine whether a particular site has “obvious indicators” for potential failure as a result of liquefaction. Three of these indicators include soil type, soil density, and depth to ground water. Based on the previous investigations on the site and mapped soil conditions, in our opinion, the potential for the presence of liquefiable sediments being present is low for the northern portion of the campus and should be further evaluated for the southern parcel (NDNU Theatre and Koret athletic field and tennis courts). We recommend the potential for liquefaction be further evaluated as part of design-level geotechnical investigations.

4.5 LATERAL SPREADING

Lateral spreading or lurching typically occurs as a form of horizontal displacement of relatively flat-lying material toward an open face such as an excavation, channel, or body of water. Generally, in soils, this movement is due to failure along a weak plane and may often be associated with liquefaction. The presence of a creek channel within the southwestern and southern portions of the site could potentially serve as a free-face for lateral spreading in a liquefaction event. Based on our reconnaissance there is about 8 feet of vertical relief to the creek bottom near the theater. We recommend this be further evaluated for future potential projects near the creek as part of design-level geotechnical investigations.

4.6 GROUND DEFORMATION AND SURFICIAL CRACKING

The methods used to estimate liquefaction settlements assume that there is a sufficient cap of non-liquefiable material to prevent ground deformation or sand boils. For ground deformation to occur, the pore water pressure within liquefiable soil layers will need to be great enough to break through the overlying non-liquefiable layer, which could cause ground deformation or surficial cracking. Because the potential for liquefaction at the site appears low for the northern portion of the site, the potential for ground deformation and surficial cracking at the site is very low, but should be further explored at the time of any site exploration. The potential for liquefaction, ground deformation and surficial cracking of the southern portion of the campus should be further evaluated during a design-level investigation.

4.7 SEISMICALLY INDUCED SETTLEMENT

Strong earthquake shaking can cause seismically induced settlement of soil strata, resulting in settlement of near-surface soils. Factors that affect this hazard include soil composition and consistency, the magnitude of loading on native soils, such as from fills and structures, and any

other changes in thickness or consistency abruptly over short distances. Based on our review of the previous field investigations and experience in the area the potential for seismically induced settlement in the surficial soils overlying bedrock is likely very low in the northern portion of the campus and should be further evaluated for the southern parcel containing the Theatre and southern sports fields.

4.8 EXPANSIVE SOILS

Expansive soils can undergo significant volume change with changes in moisture content. Expansive soils shrink and harden when dried and expand and soften when wetted. During our site reconnaissance we observed evidence of distress to existing flatwork on the east side of the Cunningham Chapel building. The existing concrete flatwork was uneven and experienced movement. The previously performed field explorations and laboratory testing indicate that portions of the native chert, when excavated, yield expansive clayey soils. The Plasticity Index tests (PI) performed on samples of the chert as part of the BAGG 1996 investigation, resulted in PIs of 23 to 27, indicating moderate to high expansion potential.

4.9 EXISTING UNDOCUMENTED FILLS

The site is extensively developed and some of that development extends back decades and possibly to the turn of the century (nineteenth/twentieth) when grading practices were unregulated and inconsistent, and were typically conducted without engineering oversight or documentation. As discussed above, the previous investigations identified that man-made fills exist in scattered locations across the northeastern corner of the site ranging in thickness from 1 to 9 feet. Some of the irregular topography in this area is due to past quarrying and access road grading operations and the presence of variable scattered undocumented fills. The remainder of the site is currently partially developed with existing residential halls, classrooms, and other structures. While these areas were not as well evaluated/investigated regarding the presence of undocumented fill, the BAGG 1996 report indicates that up to 3 feet of undocumented fill was encountered in their borings located between Julie Billiard Hall and St. Mary's Hall. The fill extending over the top of the cut slope adjacent to the northeast side of the Apartment Complex comprised of Buildings 23 to 25 where rather steep slopes (1:1) were observed should be investigated if any future improvements are planned in this area.

We note that developed sites are often blanketed by several feet of undocumented fill from past grading and previous developments. Fill materials resulting from previous development at the site are present locally, shows possible evidence of being expansive and should be further evaluated as part of the design-level geotechnical investigation for the planned site improvements. Likely mitigation would be removal and/or replacement with engineered fill. Provided the fill materials meet the requirements for engineered fill, they could be used on site. Otherwise, they could be stockpiled on site for future use in landscaping or non-structural fill areas.

4.10 LANDSLIDING AND SLOPE CREEP

The site is located in an area of variable topography which encompasses the southern and western flank of a hillside. The slopes that approach moderate to steep occur in the

northeastern corner (former quarry), areas just beyond (east of) the perimeter road in the eastern portion of the property, East Parking Lot, the slope above Lexague Drive (southeast of St. Mary's Hall) and the large cut slope on the north of New Hall Building Complex. As part of our work, we reviewed published landslide-themed maps covering the area of the site (Brabb and Pampeyan, 1972; Leighton and Associates, 1976; Ellen et al., 1982; Wentworth et al., 1997; Jayko et al, 1998; CGS, 2018 and 2016; San Mateo County, 2008).

No landslides are depicted on the maps as existing at or near the site and the site is not located within an area interpreted as having a potential for future debris flows (Brabb, et al., 1972; Ellen et al., 1997; San Mateo County, 2008). The state of California Seismic Hazard Report for the San Mateo 7.5-minute quadrangle shows two portions of the campus located within a regulatory zone for landslide hazards: 1) the steep, southwesterly facing slope along the uphill side of Lexague Drive, 2) the excavated bluff adjacent to the west edge of the former quarry, and 3) the steep cut slope adjacent to the northwest side of the New Hall Complex. This regulatory mapping is interpretive in nature and based on slope steepness. No site-specific information is incorporated into the state seismic hazard mapping program. Our observations along the steep slope above Lexague Drive is that we noted no evidence of slope creep or other evidence of instability along this slope. One local outcrop along the existing roadcut indicates the slope is underlain by chert bedrock which is vertically bedded with the bedding strike oriented at right angles to the slope contours. The hard consistency of the chert and its structural configuration would tend to produce stable slopes and that may be the reason that these steep, natural slopes have maintained stability despite the presence of a cut along the base of the hillside.

The excavated 40- to 50-foot-high bluff adjacent to the west edge of the former quarry exposes chert throughout. The rock here is thin bedded and hard (brittle). Bedding is generally moderately dipping toward the southwest and west which is in general a stable configuration. Fractures and joints exist within the upper vertical portion of the bedrock bluff. While this slope appears grossly stable, theoretically some of these fractures and joints could result in block or wedge failures (see Preliminary Conclusions).

The fill slope located at the north property line (adjacent to the Quarry Area) shows evidence of slumping of the fill material. Two small scale slumps were noted on this downslope. One of these slides was identified during the 1996 BAGG investigation of the quarry area. Our mapping of landsliding in this immediate area of the quarry revised somewhat the earlier mapping of BAGG (1996). These slumps are probably the result of rotational failure and creep within the fill that may be exacerbated from runoff or springing in the immediate area. As there are no improvements in this portion of the site these relatively minor slope movements do not impact the campus property (see Preliminary Conclusions).

The tall cut on the east side of the easterly small parking lot has signs of slope instability which has formed since it was excavated in 2003. Here the rock cut face has sloughed and soil toppled behind the short retaining wall at the east perimeter of the parking lot. The slope was over steepened by the grading of the parking lot in 2003 and therefore the slope has only been in the current configuration for a few decades. To date these slope failures have been relatively minor however they will eventually overtop the retaining wall and perhaps impact some of the parking stalls over time. The bedrock here is highly sheared sedimentary rock (sandstone, shale and minor conglomerate) and is marginally stable in this excavated (over-steepened) condition (see Preliminary Conclusions).

4.11 SEISMICALLY INDUCED WAVES

The terms tsunami or seiche are described as ocean waves or similar waves usually created by undersea fault movement or by a coastal or submerged landslide. Tsunamis may be generated at great distance from shore (far field events) or nearby (near field events). Waves are formed, as the displaced water moves to regain equilibrium, and radiates across the open water, similar to ripples from a rock being thrown into a pond.

Tsunamis have affected the coastline along the Pacific Northwest during historic times. The Fort Point tide gauge in San Francisco recorded approximately 21 tsunamis between 1854 and 1964. The 1964 Alaska earthquake generated a recorded wave height of 7.4 feet and drowned eleven people in Crescent City, California. More recently the 2011 Japanese earthquake generated a tsunami that damaged docks and boats at the Santa Cruz Yacht harbor, located 33 miles south so the subject site.

Based on the study of tsunami inundation potential for the San Francisco Bay Area (Ritter and Dupre, 1972), areas most likely to be inundated are marshlands, tidal flats, and former bay margin lands that are now artificially filled, but are still at or below sea level, and are generally within 1½ miles of the shoreline. The site is approximately 3.3 miles inland from the open waters of the San Francisco Bay shoreline, and is not located within an identified Tsunami inundation zone (California Emergency Management Agency, 2009; Tsunami Working Group, 2013). The potential for inundation due to tsunami or seiche is nil.

4.12 FLOODING/DAM INUNDATION

As shown on the Federal Emergency Management Agency (FEMA) website for "Flood Insurance Rate Map" (FIRM), the site is located within an area with "minimal flood hazards". The area where the entrance road intersects Ralston Avenue is included with a specific zone.

Flood Areas Zone AE which includes; "the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 2% annual chance flood with a 1% annual chance flood with a flood depth of less than one foot." We recommend the project civil engineer be retained to confirm this information and verify the base flood elevation, if applicable

The California Division of Safety of Dams has compiled an interactive map showing Dam Failure Breach Inundation Maps. Based on our review of these maps, the site is not located within a dam inundation zone for a postulated a dam failure at the Water Dog Lake (dam embankment: "Notre Dame No. 619-0") located on Belmont Creek about 1.3 miles west of the campus.

4.13 SEASONAL EROSION

The western ¾ of the campus is extensively developed with some sloping areas located adjacent to roads, and building pad areas. While surface runoff is generally controlled in this part of the campus, some moderate to locally steep slopes are present. We noted no evidence of moderate or severe erosion adjacent to structures or improvements in this developed portion of the campus. The eastern ¼ of the site is only sparsely developed with southwesterly, southerly and westerly slopes being common, some of which are steep to very steep. Surface runoff in this region is generally uncontrolled, except at the eastern (upslope) edge of the

easterly perimeter access road where a concrete lined surface swale collected runoff coming from upslope areas and delivering it to drainage facilities at Belmont Creek. Upslope areas located to the north and northeast of the former quarry drain into the basin within the bottom of the quarry and standing water accumulated in this area. During our site visit we noted recent rains have resulted in standing water and sediments in this area. Fill berms prevent of surface runoff from continuing downslope toward the perimeter road.

In general the site should be inspected to assure that surface runoff is being collected and directed away from improvements and from slopes (natural, modified and accumulations of fill.) Surface drainage facilities should be inspected and cleared of debris and maintained.

4.14 NATURALLY OCCURRING ASBESTOS

Chrysotile and amphibole asbestos occur naturally in certain geologic settings in the San Francisco Bay area most commonly in serpentinite and other ultramafic rocks. The most common type of asbestos is chrysotile, which is commonly found in serpentinite rock formations. When disturbed by construction, grading, quarrying, or surface mining operations, asbestos-containing dust can be generated. Exposure to asbestos can result in lung cancer, mesothelioma, and asbestosis. In July 2001, the California Air Resources Board approved an Asbestos Airborne Toxic Control measure for Construction, Grading, Quarrying, and Surface Mining activities in areas where naturally occurring asbestos (NOA) will likely be found and to provide best dust mitigation measures and practices. These are mountainous areas or areas of shallow bedrock that could be encountered during construction.

As already mentioned, a number of published geologic maps were reviewed as part of our site evaluation [Brabb and Pampeyan (1983), Wentworth et al. (1985), Pampeyan (1994), Brabb et al. (1998) and Brabb et al. (2000) and California Geological Survey (2018)]. The subject site is not underlain by ultramafic rocks nor is it located near any known deposits of ultramafic rocks. These published geologic maps indicate the nearest mapped outcrop of rock that could potentially contain NOA is an extensive, northwest trending band of Franciscan serpentinite and ultramafic rocks located within the foothill region approximately 2.8 miles west of the site.

Our review of geologic maps and our review of previous investigations conducted in the area revealed only Holocene alluvium in the immediate vicinity. These alluvial deposits extend to a depth of several hundred feet are underlain by bedrock at that depth range. These earth materials are very unlikely to contain serpentinite or another ultramafic rock with NOA. Therefore, in our judgment, NOA should not be a hazard at the subject site.

SECTION 5: PRELIMINARY CONCLUSIONS

From a geotechnical viewpoint, the project should be feasible provided the potential hazards and impacts are mitigated during design and construction. Our discussion of preliminary impacts and mitigation follows.

5.1 PRELIMINARY IMPACTS

Descriptions of our preliminary concerns follow the listed concerns.

- Strong Ground Shaking
- Presence of Shallow Groundwater
- Presence of Undocumented Fill
- Potential for Seismic-Induced Settlements
- Presence of Expansive Soils and Bedrock
- Landsliding and Potential Slope Instability
- Potential for Hard Bedrock
- Potential for Fault Surface Rupture Constraints

5.1.1 Strong Ground Shaking

Strong to severe ground shaking is expected at this site, as with most sites in the Bay Area, during a major earthquake in the area.

To mitigate the effects of strong ground shaking, all planned structures should be designed in accordance with the recommendations in a final design-level geotechnical report, and the most recent California Building Code.

5.1.2 Shallow Groundwater

Although a groundwater depth has not been mapped in the site area, it is possible that a groundwater table exists within the lower elevation, southwestern and southern portions of the site. In addition, as with all hillside environments, there is a potential for temporary perched water conditions, especially in winter months. Our experience with similar sites in the vicinity indicates that shallow ground water could significantly impact grading and underground construction. These impacts typically consist of potentially wet and unstable pavement subgrade, difficulty achieving compaction, and difficult underground utility installation. Dewatering and shoring of utility trenches may be required for deeper gravity utilities. The depth of ground water and potential impacts and mitigations should be further determined during any future geotechnical investigations conducted in the low lying southwestern and southern portions of the campus.

5.1.3 Presence of Undocumented Fill

Undocumented fill was noted in several areas of the campus during previous investigations and during our site reconnaissance. The undocumented fill in the northeastern section of the site originates from past quarrying activities and varies from 1 to 9 feet in thickness. Towards the center of the campus, between the Julie Billiart Hall and St. Mary's Hall structures, 3 feet of undocumented fill was encountered during previous field investigations. The presence of undocumented fill in the northern parcels, by Ralston Hall and the Bookstore, and the area adjacent to the northeast side of the Buildings 23 through 25 (inclusive), and the southern parcel, the Theatre and south sports fields, have not been evaluated during the previous field investigations, but we anticipate that several feet of undocumented fills may be encountered due to past grading activities and development. Undocumented fills should be further characterized during design, and potential impacts mitigated. Potential mitigation could include overexcavation and replacement of the undocumented fill with engineered fill. Undocumented fills not meeting the requirement for general fill would need to be removed from the site or

stockpiled for use in landscaped areas. Future grading likely will include cut and transition fill pads with over excavation for uniform pad and foundation support.

5.1.4 Potential for Seismic-Induced Settlement

As previously discussed, based on mapped soil conditions and the previous field investigations, in our opinion, the potential for liquefaction and seismic induced settlements in the northern parcels is low, and in agreement with mapping by the State of California. We note that updated mapping by the California Geological Survey (CGS) indicates that the south parcel, the theatre and southern sports fields fall within a liquefaction seismic hazard zone (San Mateo Quadrangle, 2018). From our review of the provided reports, this parcel/section of campus was not evaluated as part of the previous field investigations. We recommend the potential for liquefaction and seismic induced settlements, be evaluated as part of the design-level geotechnical investigation.

In our opinion, if liquefiable layers or layers prone to seismic-induced settlement are present, the effects can be mitigated. Mitigation methods typically differ based on the soils conditionals actually encountered, the depth of liquefiable sediments, and the magnitude of expected settlement due to reconsolidation of liquefaction and seismically-induced sediments. Typical mitigation methods include designing foundations to tolerate the expected settlement, ground improvement, or the use of deep foundations.

5.1.5 Potential for Presence of Expansive Soils

Moderately to highly expansive surficial soils most likely blanket much of the project site both as native soil and as fills which was probably derived from the native soils. To reduce the potential for damage to the planned structures and other improvements, the expansive properties of the native soils will be considered in developing design recommendations for foundations, slabs-on-grade, exterior concrete flatwork, pavements, and other site improvements. In addition, it is important to limit moisture changes in the surficial soils by using positive drainage away from buildings and other hardscaped areas, as well as limiting landscaping watering.

5.1.6 Landsliding/Potential Slope Instability

As discussed above, two limited portions of the site are mapped as within a landslide hazard regulatory zone by the California Geologic Survey (CGS, San Mateo Quadrangle 2018). Future site studies should include slope stability screening analyses in order to conform to state guidelines in areas of identified seismic hazards. During our site visit and as noted in the BAGG 1996 field investigation and in the 2000 Master Plan report prepared by Wagstaff and Associates, several onsite slope instability features were observed, such as the two slumps adjacent to the north side of the former quarry, and the sloughing cutslope at the small easterly parking lot. The vertical rock bluff at the west edge of the former rock quarry contains structural features that could potentially produce rock falls in the future. Any development planned near these above described areas should be evaluated for slope stability prior to development. In addition to these noted slope instability features, several steeper slopes exist throughout the campus, which have not been analyzed. We recommend that further field investigation and analysis be performed during any future design level geotechnical investigations for proposed improvements that would be placed near any moderate to steep slopes at the site.

5.1.7 Fault Surface Rupture

As discussed above, we noted three previously unknown faults (F1, F2 and F3 in this report) trending through the extreme eastern portion of the property. This portion of the site is presently undeveloped. These faults were not identified when previous geologic mapping of the area was performed. Faults F2 and F3 appear to be Pre-Quaternary features and therefore should not be considered constraints for development however, fault F1 is not clear in terms of recency of activity. Land surface features located astride the F1 fault and on the north of the fault suggest they may have been impacted by previous (Quaternary) fault movement. Quaternary faults are typically avoided with habitable structures and some other critical infrastructure improvements. If the F1 fault is a Quaternary feature, it would present a physical constraint to development near its surface trace within that portion of the campus which extends from the East Parking Lot northwest to the former rock Quarry. We recommend that a field investigation be performed during a future design level investigation to further evaluate the recency of movement along this fault (F1) in areas where improvements will be constructed. A hand excavated test pit over the fault exposure at the top of the cut slope may provide meaningful information to determine the recency of movement of this feature.

5.1.8 Potential for Hard Bedrock

As mentioned above, several seismic refraction lines were performed during the BAGG 1996 field investigation. BAGG describes the upper portions of the native bedrock in the northeastern portion of the site to be weathered and easily excavated with conventional construction equipment, however they note that the lower portions of the bedrock, specifically graywacke sandstone, are hard and would require heavy ripping. The chert was observed to be in a generally hard condition where exposed. Contractors should anticipate using appropriate means and methods to excavate through the bedrock. Difficult excavations and drilling conditions resulting in slower production should be anticipated in areas where graywacke sandstone and chert is anticipated and these bedrock types underlie extensive areas within the eastern half of the campus. Based on the previous test pits and borings, our observations of surface outcrops, and our experience, we anticipate that the Franciscan bedrock may vary from moderately difficult to very difficult to excavate while the chert bedrock could range from difficult to very difficult and may require specialized equipment.

5.2 FEASIBLE FOUNDATIONS

We have reviewed the mapped conditions at the site, and the conditions indicated by the previous field explorations at the site. The northern portion of the site appears to be underlain by shallow colluvium overlying native bedrock while the southern end of the site is underlain by alluvial soils overlying colluvium. In general, these soils can support structures on shallow foundations; however, structures are generally limited to three- or four-story structures. This general guideline will vary somewhat depending on actual site conditions. Future grading likely includes cut/fill pads with over excavation for uniform pad and foundation support.

If total settlement due to static loads and seismic shaking are excessive, then deep foundations may be required. The feasibility of these foundations should be evaluated during the design-level investigation.

5.3 FINAL DESIGN-LEVEL GEOTECHNICAL REPORT

The preliminary information in this report is based upon review of available published information and our site reconnaissance. No exploration was completed for this initial study. Therefore, we recommend that a final geotechnical investigation including exploration, laboratory testing, and analysis be completed once final development details are available.

SECTION 6: CLOSURE AND LIMITATIONS

We hope this report provides the information needed at this time. This report, an instrument of professional service, has been prepared for the sole use of Stanford Real Estate and their representatives specifically to support their review of the Notre Dame de Namur University Due Diligence project in Belmont, California. The opinions and conclusions presented in this report have been formulated in accordance with accepted geotechnical engineering and engineering geology practices that exist in Northern California at the time this report was prepared. No warranty, expressed or implied, is made or should be inferred.

Recommendations in this report are based upon literature review and professional experience. No subsurface exploration of the project area was performed for this study. If variations or unsuitable conditions are encountered during construction, Cornerstone should be contacted to provide supplemental recommendations, as needed.

Stanford Real Estate may have provided Cornerstone with plans, reports and other documents prepared by others. Stanford Real Estate understands that Cornerstone reviewed and relied on the information presented in these documents and cannot be responsible for their accuracy.

Cornerstone prepared this report with the understanding that it is the responsibility of the owner or his representatives to see that the recommendations contained in this report are presented to other members of the design team and incorporated into the project plans and specifications, and that appropriate actions are taken to implement the geotechnical recommendations during construction.

Conclusions and recommendations presented in this report are valid as of the present time for the development as currently planned. Changes in the condition of the property or adjacent properties may occur with the passage of time, whether by natural processes or the acts of other persons. In addition, changes in applicable or appropriate standards may occur through legislation or the broadening of knowledge. Therefore, the conclusions and recommendations presented in this report may be invalidated, wholly or in part, by changes beyond Cornerstone's control. This report should be reviewed by Cornerstone after a period of three (3) years has elapsed from the date of this report. In addition, if the current project concept is changed, then Cornerstone must review the proposed changes and provide supplemental recommendations, as needed.

An electronic transmission of this report may also have been issued. While Cornerstone has taken precautions to produce a complete and secure electronic transmission, please check the electronic transmission against the hard copy version for conformity.

Recommendations provided in this report are based on the assumption that Cornerstone will be retained to provide observation and testing services during construction to confirm that conditions are similar to that assumed for design, and to form an opinion as to whether the work has been performed in accordance with the project plans and specifications. If we are not retained for these services, Cornerstone cannot assume any responsibility for any potential claims that may arise during or after construction as a result of misuse or misinterpretation of Cornerstone's report by others. Furthermore, Cornerstone will cease to be the Geotechnical-Engineer-of-Record if we are not retained for these services.

SECTION 7: REFERENCES

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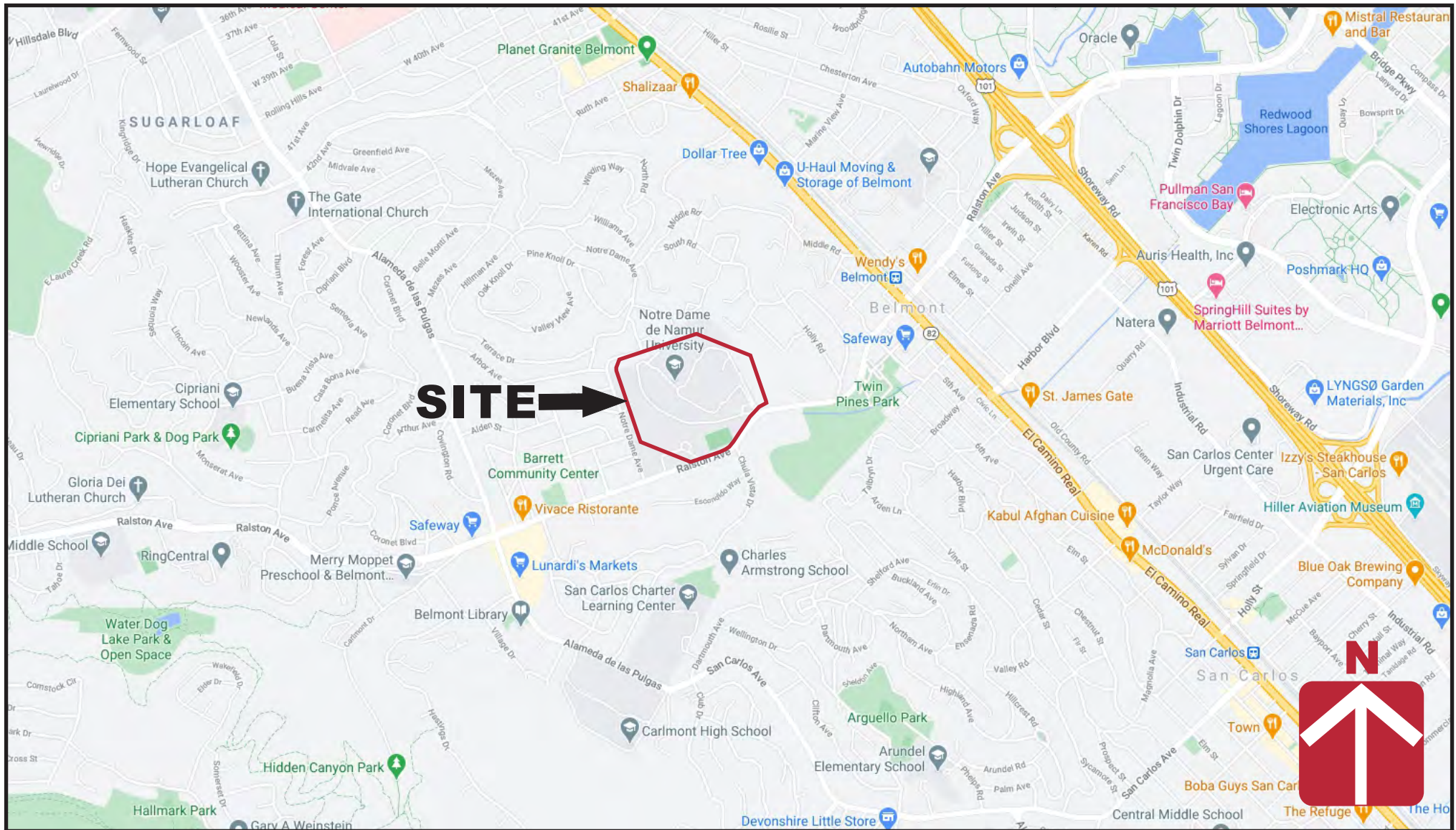
12.1 Aerial Photographs

Aerial photos reviewed through Netronline and Google Earth:

Date	Flight	Frames	Scale	Type
1939	N/A	N/A		vertical black & white
1946	N/A	N/A	1"= 500'	vertical black & white
1956	N/A	N/A	1"= 500'	vertical black & white
1960	N/A	N/A	1"= 500'	vertical black & white
1968	N/A	N/A	1"= 500'	vertical black & white
1980	N/A	N/A	1"= 500'	vertical black & white
1993	N/A	N/A	1"= 500'	vertical natural color
2002	N/A	N/A	1"= 500'	vertical natural color
2005	N/A	N/A	1"= 500'	vertical natural color
2009	N/A	N/A	1"= 500'	vertical black & white
2010	N/A	N/A	1"= 500'	vertical natural color
2012	N/A	N/A	1"= 500'	vertical natural color
2014	N/A	N/A	1"= 500'	vertical natural color
2016	N/A	N/A	1"= 500'	vertical natural color

Stereo aerial pairs (photos)

Date	Flight	Frames	Scale	Type
1939	1939A	A-7, A-8	1:20,000	vertical black & white
1965	Cas-65-120	2-11, 2012	1:12,000	vertical black & white



**CORNERSTONE
EARTH GROUP**

Vicinity Map

**Due Diligence
Notre Dame de Namur University
Belmont, CA**

Project Number

105-130-1

Figure Number

Figure 1

Date

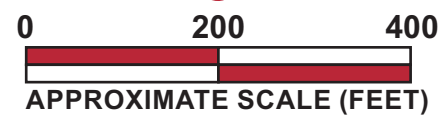
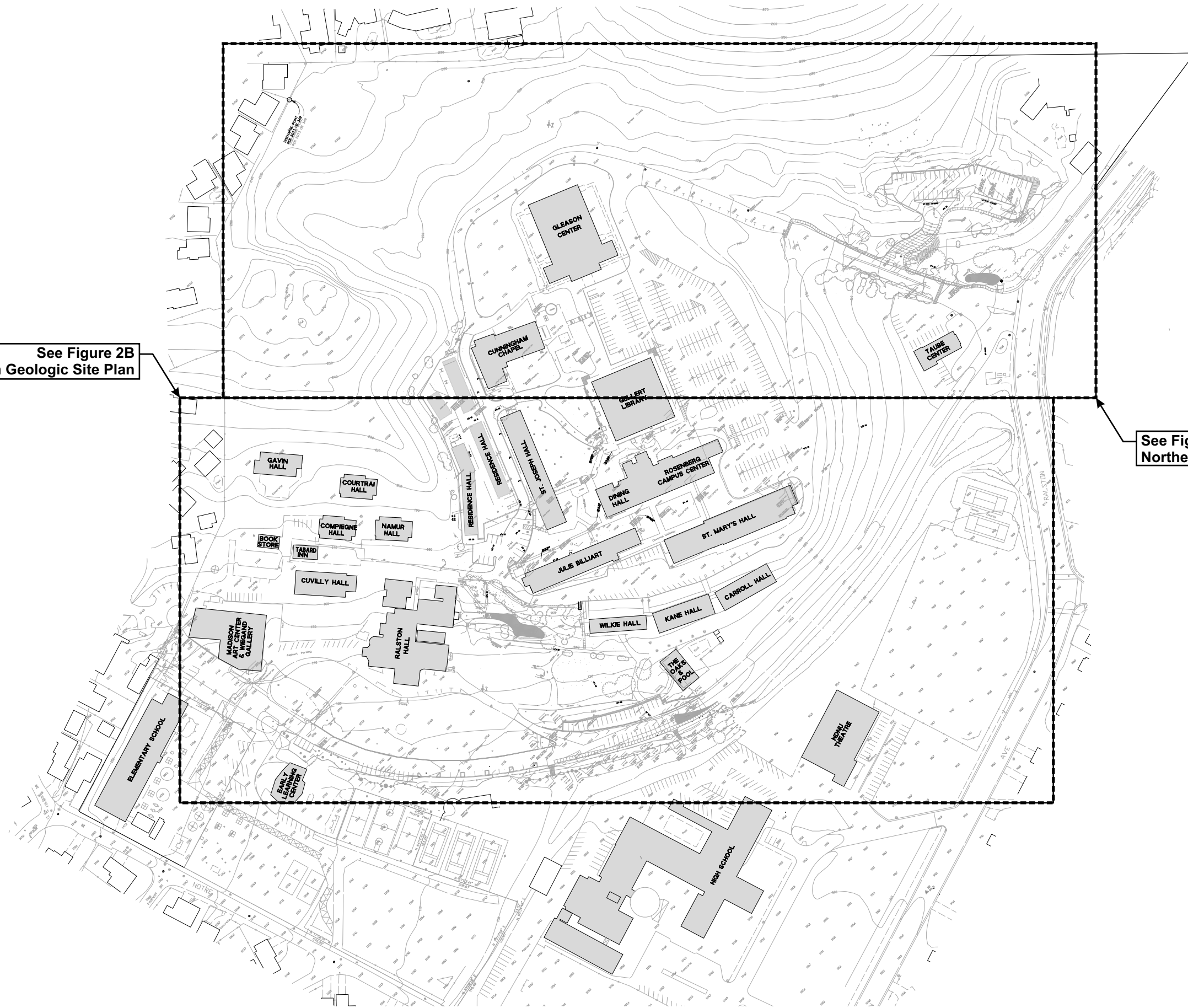
February 2021

Drawn By

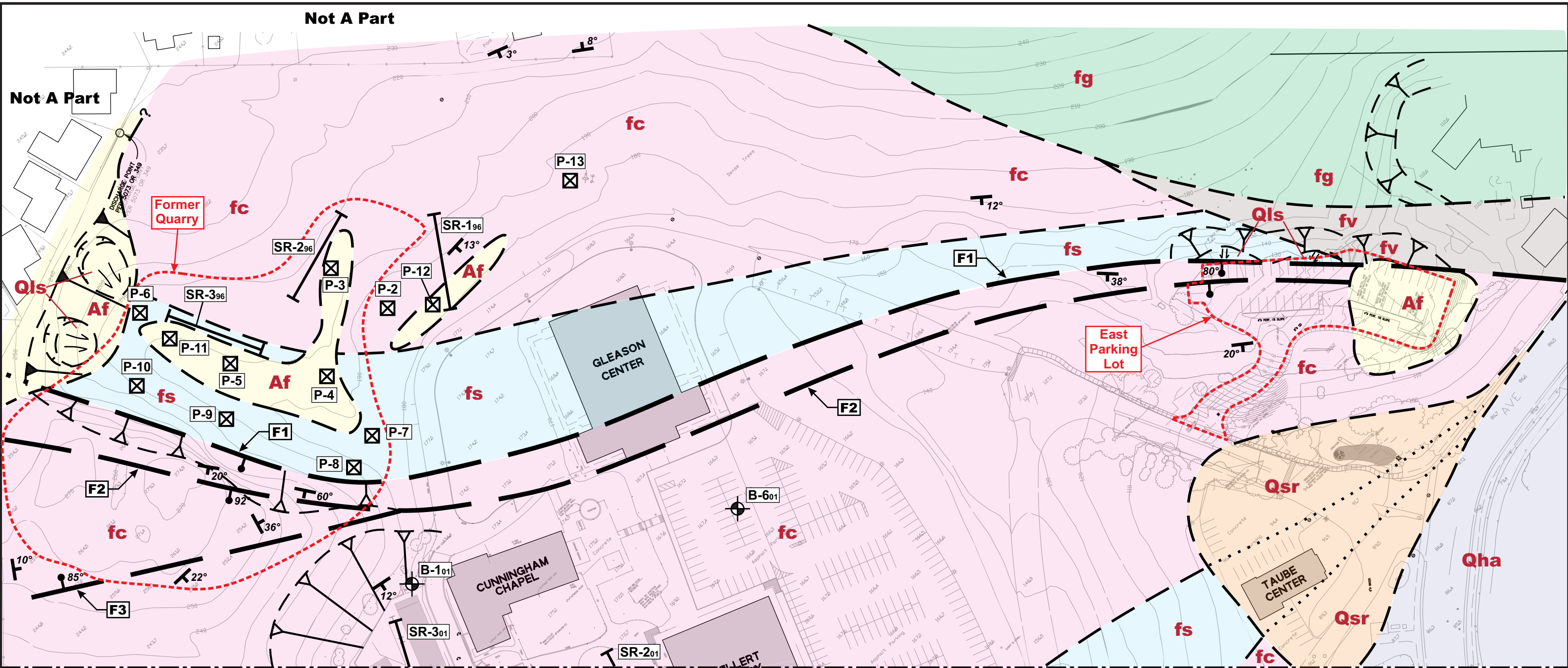
RRN

See Figure 2B
Southern Geologic Site Plan

See Figure 2A
Northern Geologic Site Plan



 CORNERSTONE EARTH GROUP	Overall Site Plan		Project Number 105-130-1	
	Due Diligence Notre Dame de Namur University Belmont, CA		Figure Number Figure 2	
			Date February 2021	
			Drawn By	RRN

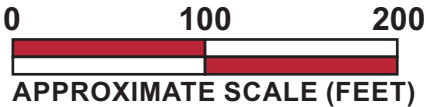


Explanation

- B-101 Approximate location of exploratory boring (BAGG, 2001)
- SR-101 Approximate location of seismic refraction array (BAGG, 2001)
- SR-196 Approximate location of seismic refraction array (BAGG, 1996)
- P-2 Approximate location of test pit (BAGG, 1996)
- 20° Bedding attitude
- 80° Dip slip fault (F1 vs. F2 vs. F3: see text)
- Geologic contact - dotted were concealed
- Cutslope, fillslope
- Landslide

Geologic Units

- | | |
|--|---|
| Af Artificial fill | fv Volcanics (andesitic tuff) |
| fs Sandstone with minor shale and chert | Qha Holocene alluvium |
| fc Chert, thin-bedded | Qsr Pleistocene slope wash/ravine fill [colluvium] |
| fg Greenstone | Qls Landslide |

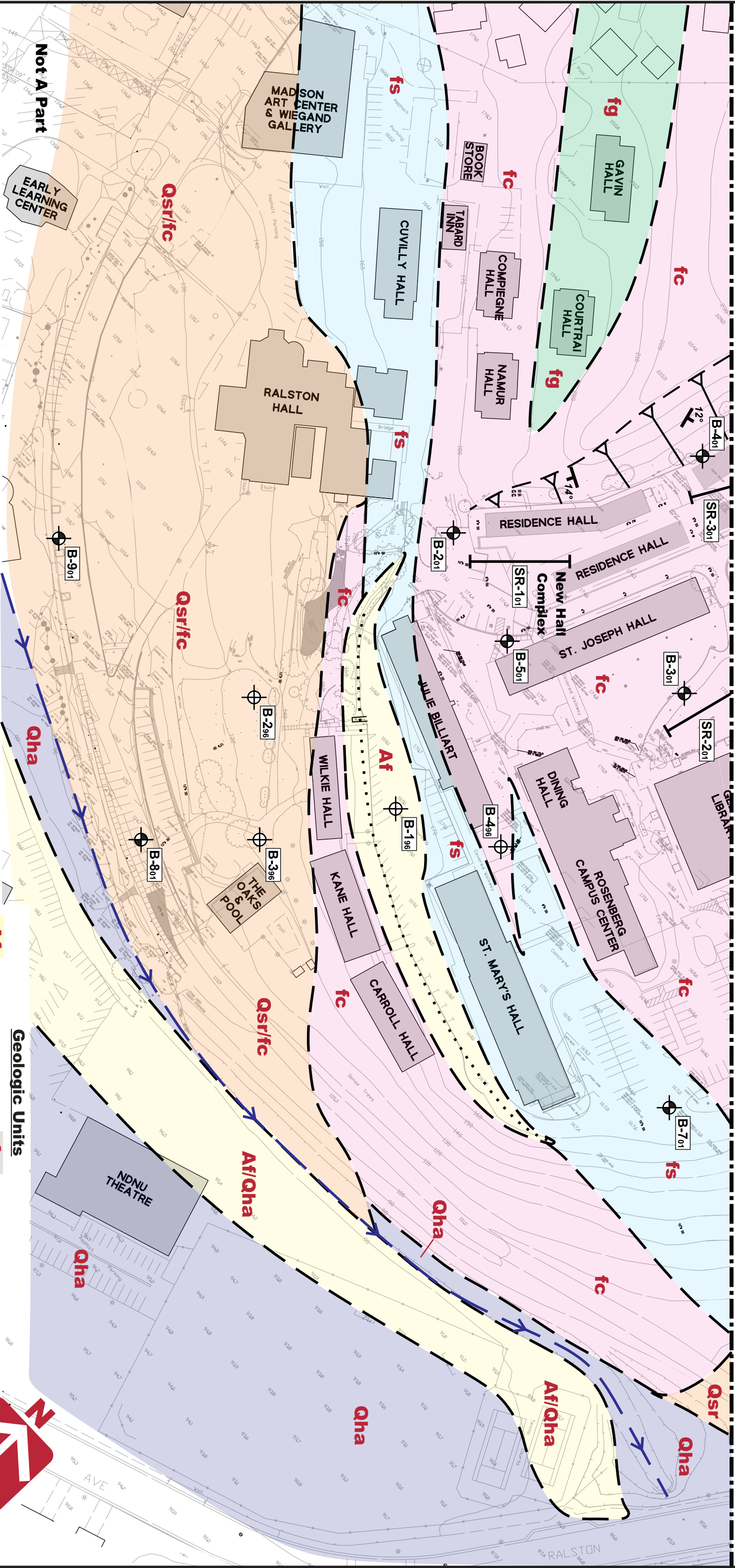


Northern Geologic Site Plan

Due Diligence
Notre Dame de Namur University
Belmont, CA

Project Number	105-130-1
Figure Number	Figure 2A
Date	February 2021
Drawn By	RRN

Matchline: See Figure 2A



Explanation

- B-201 Approximate location of exploratory boring (BAGG, 2001)
- B-196 Approximate location of exploratory boring (BAGG, 1996)
- SR-101 Approximate location of seismic refraction array (BAGG, 2001)
- T_{20°} Bedding attitude

Geologic contact - dotted were concealed

Cutslope, fillslope

Seasonal creek

Geologic Units

- Af** Artificial fill
- fs** Sandstone with minor shale and chert
- fc** Chert, thin-bedded
- fg** Greenstone
- fv** Volcanics (andesitic tuff)
- Qha** Holocene alluvium
- Qsr** Pleistocene slope wash/ravine fill [colluvium]



Southern Geologic Site Plan

Project Number

105-130-1

Figure Number

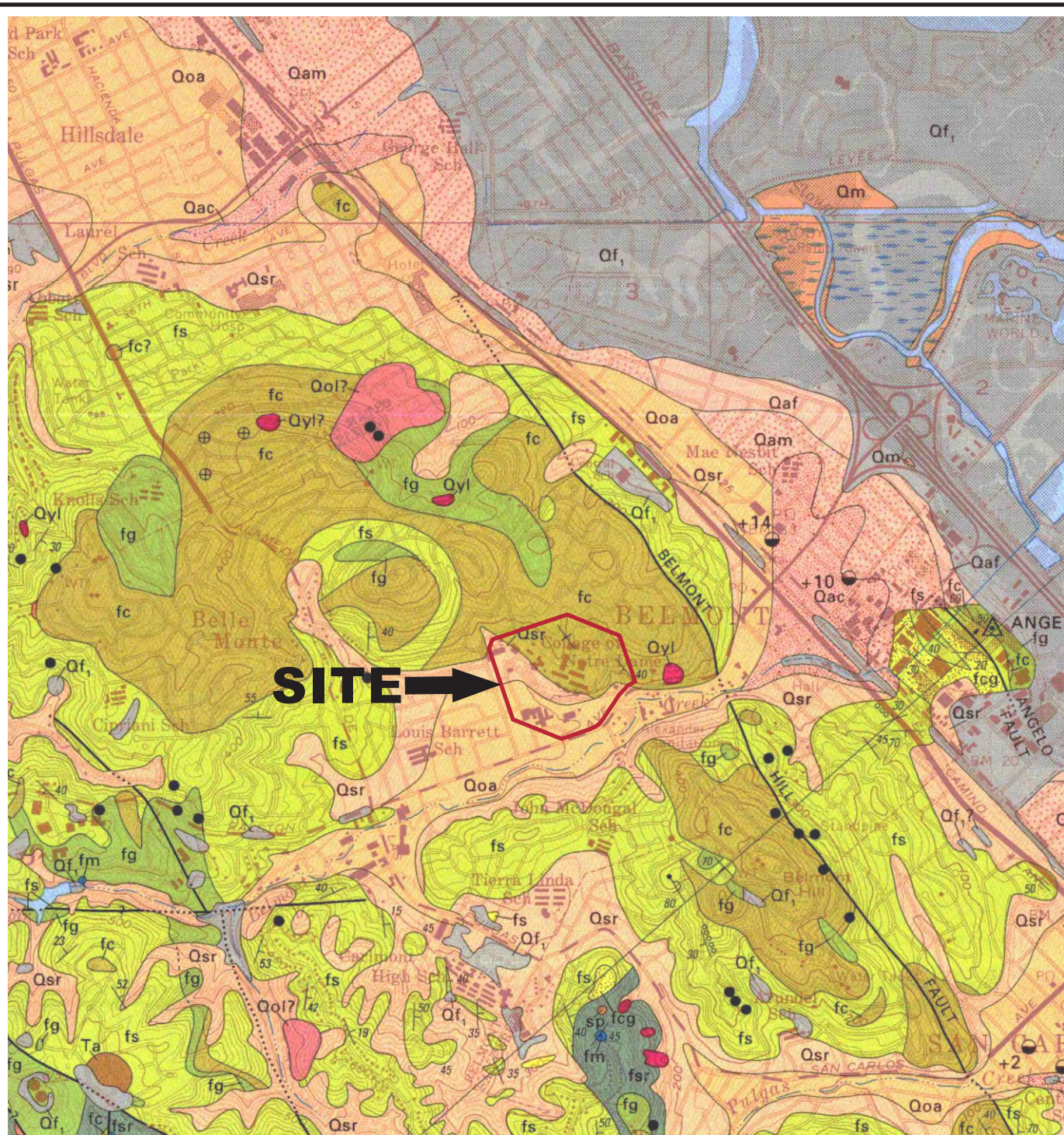
Figure 2B

Due Diligence

Notre Dame de Namur University

Belmont, CA





Geologic Units

- Qsr** Slope wash, ravine fill, and colluvium (Holocene)
- Qyl** Younger landslide deposits (Holocene)
- Qoa** Older alluvium (Pleistocene)
- fs** Sandstone
- fg** Greenstone
- fc** Chert

Explanation

— Contact - dashed where approximate, dotted where concealed

— Fault - dashed where approximate, dotted where concealed



APPROXIMATE SCALE (FEET)

Base: USGS, Geologic Map of the Montara Mountain and San Mateo 7.5' Quadrangles, San Mateo County, California, by Pampeyan, 1994



Vicinity Geologic Map

Due Diligence
Notre Dame de Namur University
Belmont, CA

Project Number

105-130-1

Figure Number

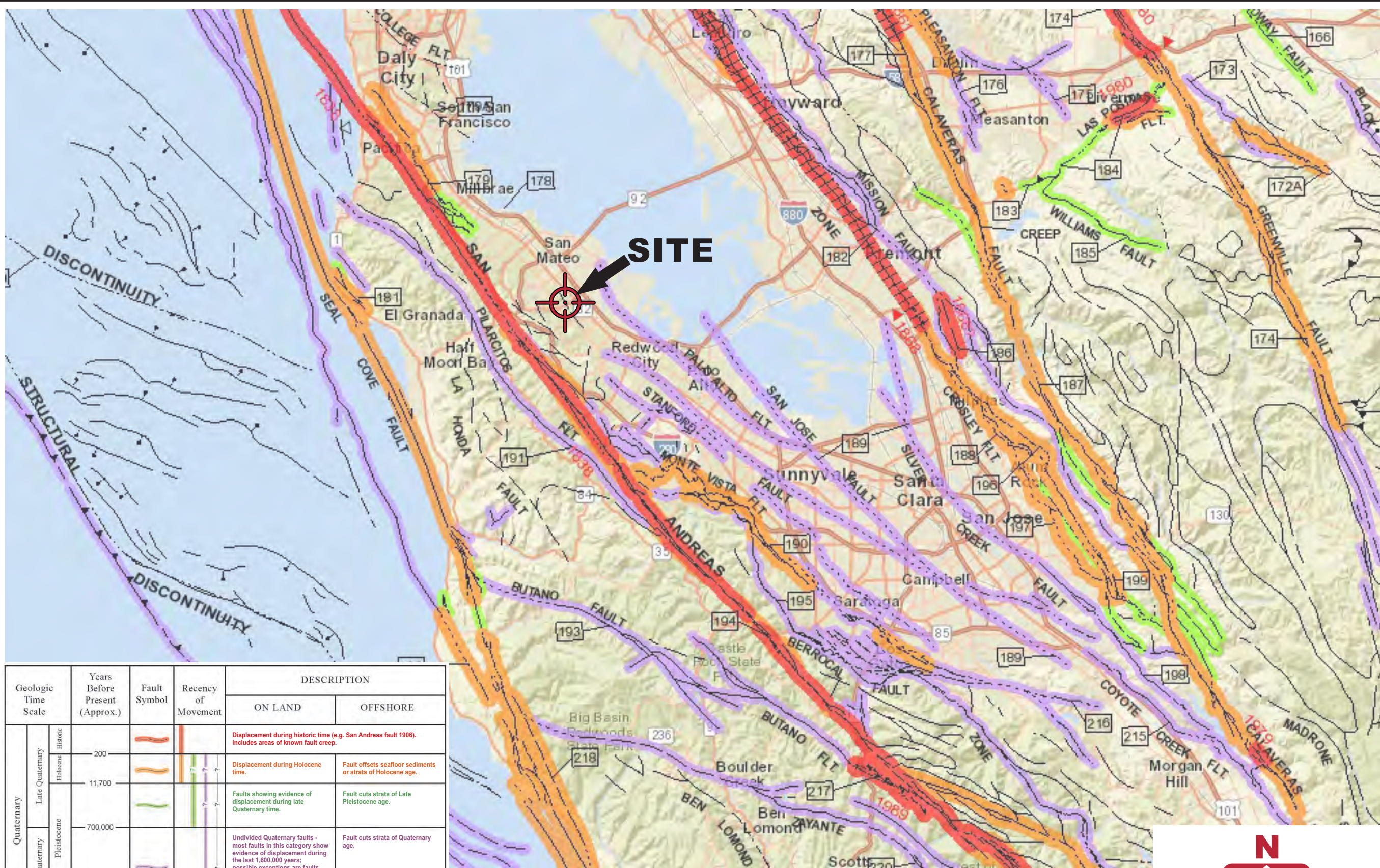
Figure 3

Date

February 2021

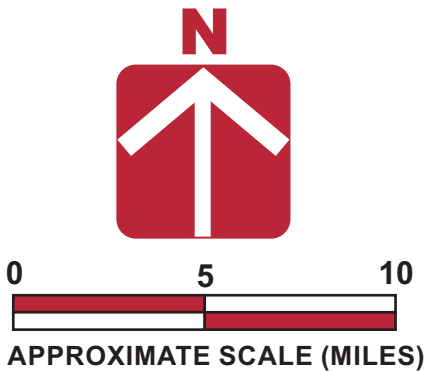
Drawn By

RRN



Geologic Time Scale		Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
					ON LAND	OFFSHORE
Quaternary	Late Quaternary	Holocene			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		200			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	Pleistocene	11,700			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
		700,000			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
		1,600,000				
Pre-Quaternary					Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
		4.5 billion				

Base by California Geological Survey - 2010 Fault Activity Map of California (Jennings and Bryant, 2010)



Project Number105-130-1

Figure NumberFigure 4

DateFebruary 2021

Drawn ByRRN

Regional Fault Map

Due Diligence
Notre Dame de Namur University
Belmont, CA

CORNERSTONE
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APPENDIX F2:
PRELIMINARY EVALUATION OF
FAULTING

Date: February 7, 2022
Project No.: 105-130-2
Prepared For: Ms. Kathleen Kavanaugh
STANFORD REAL ESTATE
415 Broadway, 3rd Floor
Academy Hall, MC 8873
Redwood City, CA 94063
Re: Preliminary Evaluation of Faulting - Cut Slope Logging
Stanford at Belmont NDNU
1500 Ralston Avenue
Belmont, California

Dear Ms. Kavanaugh:

We performed a feasibility evaluation for the site and presented results in a report titled “Due Diligence Report – Geotechnical Feasibility, Notre Dame de Namur University” dated February 26, 2021. In our report we noted a potential fault contact in the East Parking Lot that extends into the former quarry area. We recommended future development planned for the quarry area and East Park Lot should consider the appropriateness of investigating this fault to further define the activity status of this fault and any potential hazard it might pose.

This letter is to summarize our investigation of the existing cut slope in the eastern parking lot to determine recent fault activity. Please refer to Figure 1 Vicinity Map for the location. The February 2021 should be referred to for information not in this letter.

Background

During our previous geotechnical feasibility study of the campus (in 2021) we noted evidence of three faults trending in a northerly direction through the campus (designated in our study: F1, F2 and F3). Refer to Figure 2 for the locations of these faults. As a result of that initial feasibility evaluation, it was determined that faults F2 and F3 are Pre-Quaternary faults (last movement occurring prior to the start of the Quaternary period) and therefore do not require mitigation for habitable and other critical structures. However, Fault F1 exhibited features that suggested it might be a quaternary fault (i.e. most recent offset during the Quaternary geologic period). The fault was poorly exposed at the ground surface and the activity status of this fault remained uncertain. The purpose of this current investigation is to expose the fault in the field and determine the activity status through a direct observation in an exploration trench.

Fault Field Investigation

Methodology: Our current field investigation included the excavation and logging of a continuous 11-foot-long hand-excavated trench on the north side of the parking lot bluff which spans the mapped projection of the contact between two bedrock units: chert (on the west) and volcanic rocks (on the east). In addition to the trench we also cleared, examined and logged an exposure of these same geologic units exposed at the top of a cutslope (bluff) just 15-20 feet south of the trench T-1.

The trench was generally 30 inches wide and extended to depths of between 2 feet and 4 feet deep below the nearest adjacent ground surface. The trench was excavated with hand tools (picks and shovels) and the exposed soil profile cleared of soil smear using hand (soil) picks and wide blade “putty” knives. Trenching occurred on January 19, 2022 and on January 20, 2022 the subsurface conditions were logged by our Certified Engineering Geologist.

After examining the trench southerly wall we also examined, cleared with hand tools the upper several feet of the adjacent parking lot cutslope located adjacent to the south of the trench T-1. The approximate location of the trench and logged cutslope exposure is shown on the Site Geologic Map (Figure 2) and a more detailed, smaller-scale view of that exploration area is shown on the Inset Geologic Map (Figure 3). The Figure 4 (Photo Plate) shows the bluff-top exposure and an upclose view of the fault shearing after it had been cleared of loose soil. Detailed graphic logs of T-1 and the parking lot bluff-top exposure located adjacent to T-1 are presented in Figure 5.

Geology Exposed in the Trench and Bluff-top Exposure: Our trench T-1 revealed a surficial residual soil which overlies two bedrock units in the immediate area. This soil exhibits features that suggest a Pleistocene age (heavy accumulation of translocated clays, well developed blocky pedogenic soil structure). This soil overlies two juxtaposed bedrock units: chert (on the west) and volcanic rocks (Andesetic tuff) on the east.

The chert is dark reddish brown, thin bedded, moderately weathered, jointed and well indurated (very hard). The bedding within the unit dips steeply to moderately toward the west in the area of the parking lot. The volcanic rocks are comprised of an Andesitic Tuff which was found to be: medium to light yellow and reddish brown, very severely weathered, massive in structure, and generally soft (in rock terms) and is weathered to a soil like consistency within the uppermost 14 inches of the unit profile. The tuff exhibits shearing near the contact with the chert (see Fault Surface Rupture).

Fault Surface Rupture

The bluff-top exposure and adjacent trench at the north side of the southeast parking lot exposed a zone of faulting that consists of a narrow (12 to 16 inch-wide), anastomosing pattern of shears that are concentrated near and against the contact between the Chert and Andesitic Tuff. Because the stratigraphic succession between these two geologic units has not been established and no grooves or striations were noted on the shear surfaces within the fault zone,

it was not possible to determine the relative movement direction (i.e. dip-slip or strike slip). A Pleistocene soil overlies the shear zone and therefore spans the contact between the chert and the tuff. The shears appear to die out vertically within the upper 14 inches of the volcanic unit and the overlying residual soil does not appear to be deformed, truncated or offset by previous movement within the underlying shears. We infer that this sheared contact is a pre-Quaternary fault feature that probably developed early in the evolution and tectonic history associated with the emplacement of the Franciscan Complex in the region. It is our opinion that fault F1 does not pose a constraint for the siting of habitable structures or other critical facilities planned for the project site. No mitigation is necessary along the trend of the three identified faults.

Closure

This letter has been prepared for the sole use of Stanford Real Estate and their design consultants for the referenced Stanford at Belmont NDNU project site in Belmont, California. Our professional services were performed, our findings obtained, and our conclusions prepared in accordance with generally accepted engineering geologic and geotechnical engineering principles and practices at this time and location. No warranties are either expressed or implied.

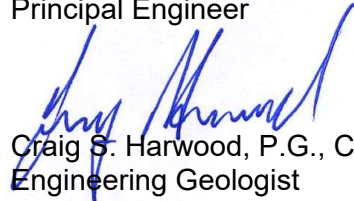
If you have any questions or need any additional information, please call and we will be glad to discuss them with you.

Sincerely,

CORNERSTONE EARTH GROUP, INC.



Erin L. Steiner, P.E., G.E.
Principal Engineer

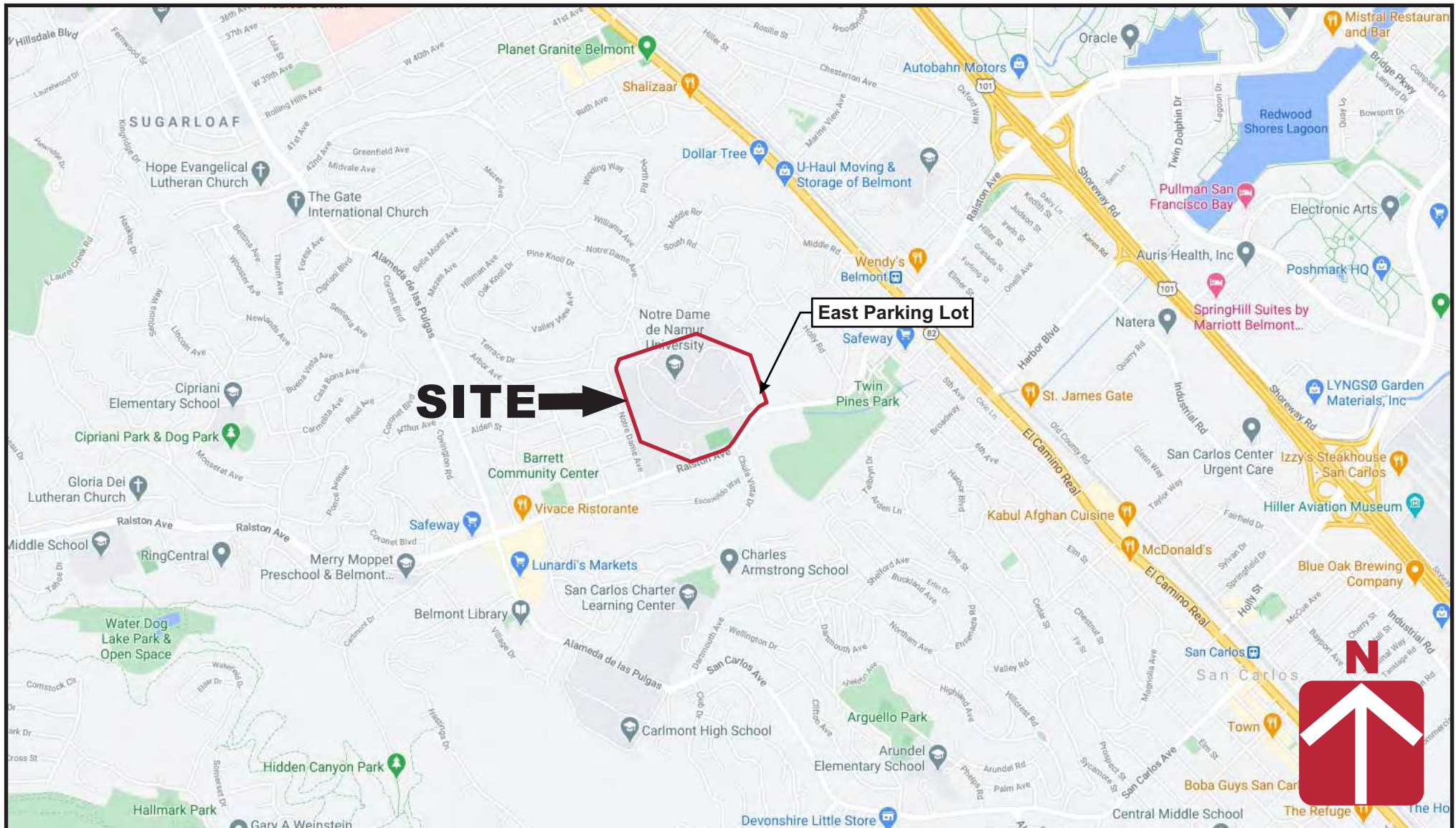


Craig S. Harwood, P.G., C.E.G
Engineering Geologist



Copies: Addressee (1 via email)

Attachments: Figure 1 – Vicinity Map
Figure 2 – Northern Geologic Site Plan
Figure 3 – Inset Geologic Map
Figure 4 – Photo Plate
Figure 5 – Log of T-1 and Exposure Log



**CORNERSTONE
EARTH GROUP**

Vicinity Map

**Stanford Belmont NDNU
Belmont, CA**

Project Number

105-130-2

Figure Number

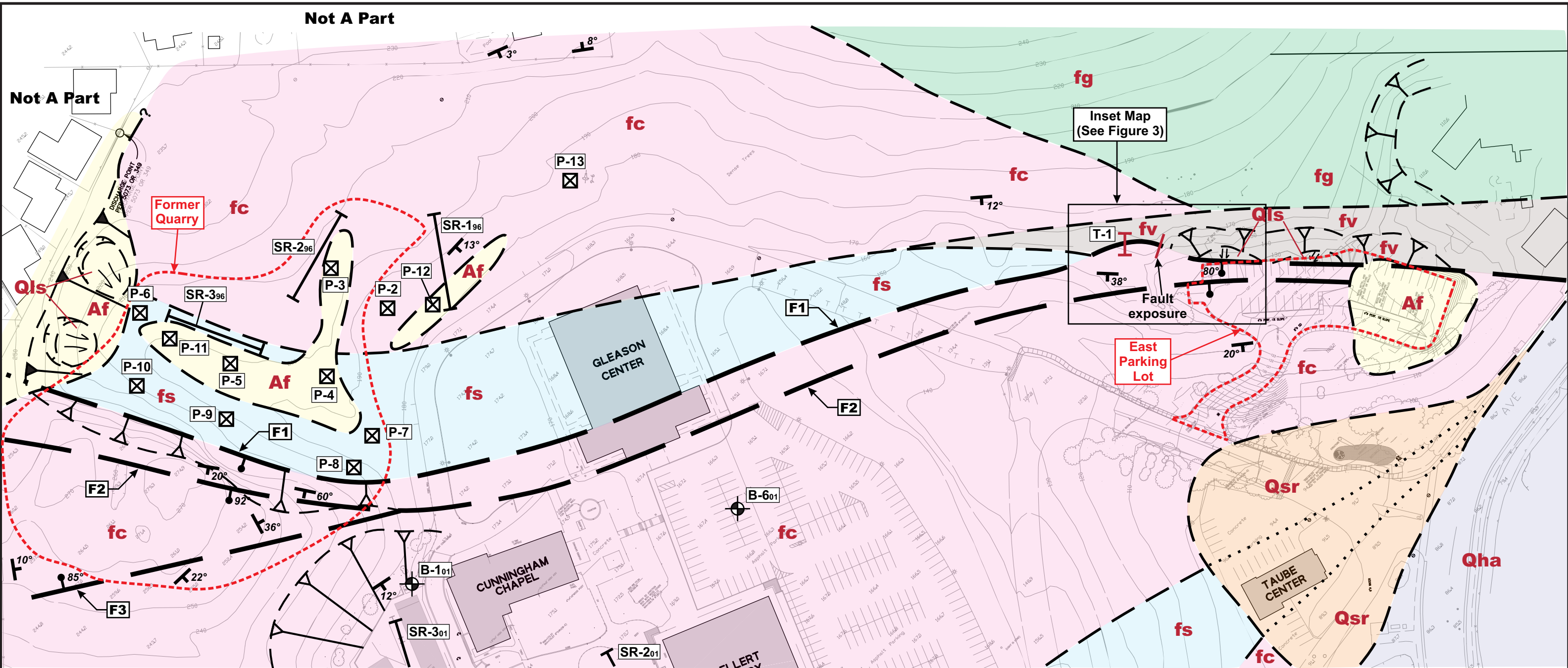
Figure 1

Date

February 2022

Drawn By

RRN



Explanation

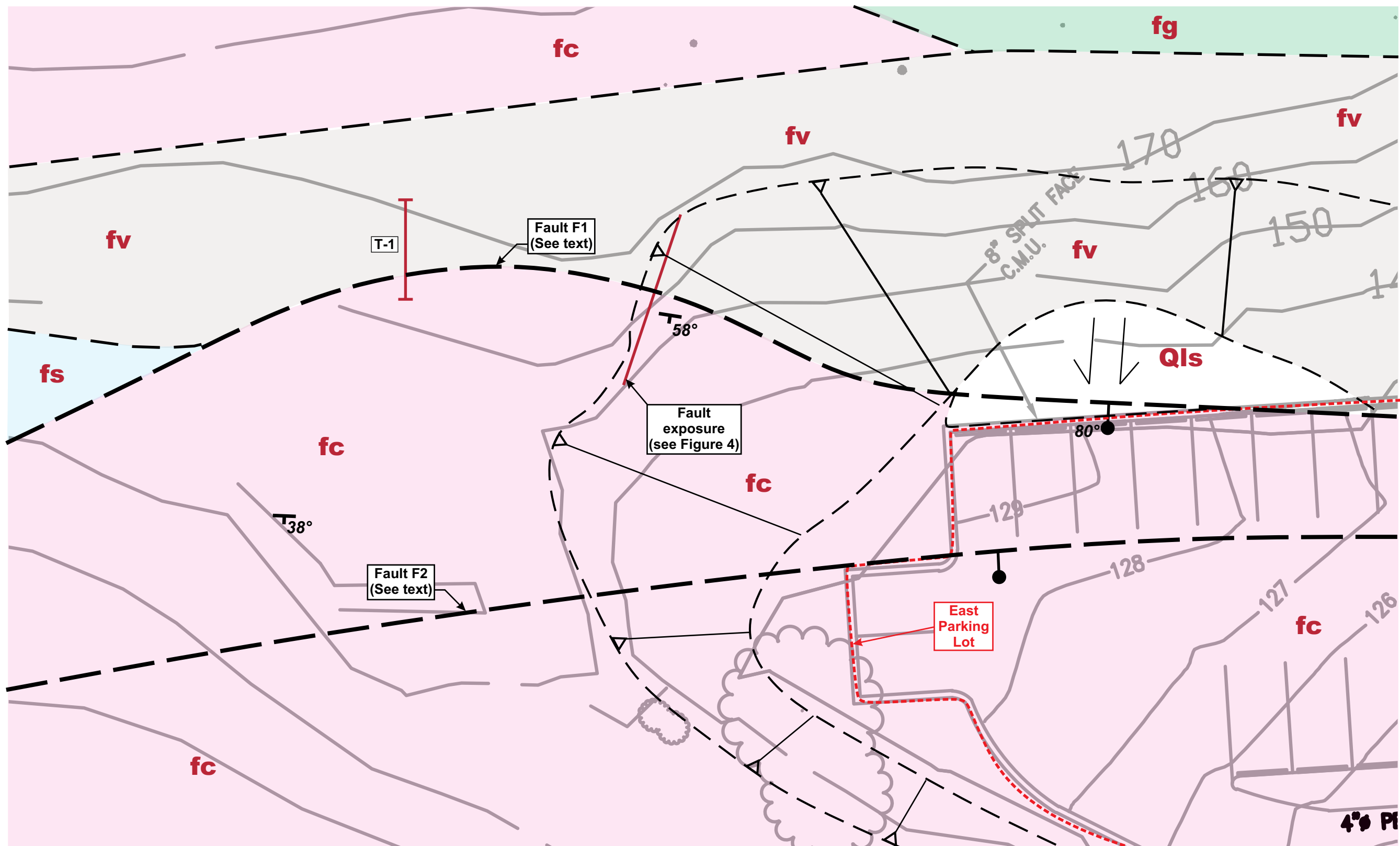
- T-1 Approximate location of fault trench (Cornerstone, 2022)
- B-101 Approximate location of exploratory boring (BAGG, 2001)
- SR-101 Approximate location of seismic refraction array (BAGG, 2001)
- SR-196 Approximate location of seismic refraction array (BAGG, 1996)
- P-2 Approximate location of test pit (BAGG, 1996)
- T20 Bedding attitude
- 80° Dip slip fault (F1 vs. F2 vs. F3: see text)
- Geologic contact - dotted were concealed
- Cutslope, fillslope
- Landslide

Geologic Units

- | | | | |
|-----------|--------------------------------------|------------|--|
| Af | Artificial fill | fv | Volcanics (andesitic tuff) |
| fs | Sandstone with minor shale and chert | Qha | Holocene alluvium |
| fc | Chert, thin-bedded | Qsr | Pleistocene slope wash/ravine fill [colluvium] |
| fg | Greenstone | Qls | Landslide |

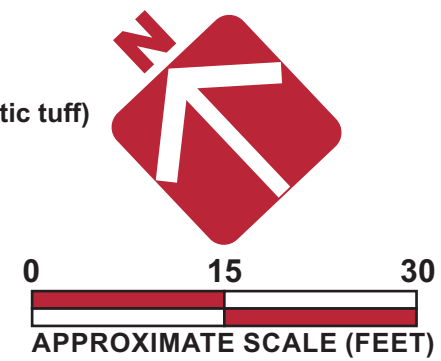


0 100 200
APPROXIMATE SCALE (FEET)



- Explanation**
- T-1 Approximate location of fault trench (Cornerstone, 2022)
 - 20° Bedding attitude
 - 80° Dip slip fault (F1 vs. F2 vs. F3: see text)
 - Geologic contact - dotted were concealed
 - Cutslope, fillslope
 - Landslide

- Geologic Units**
- fs** Sandstone with minor shale and chert
 - fc** Chert, thin-bedded
 - fg** Greenstone
 - fv** Volcanics (andesitic tuff)
 - Qls** Landslide



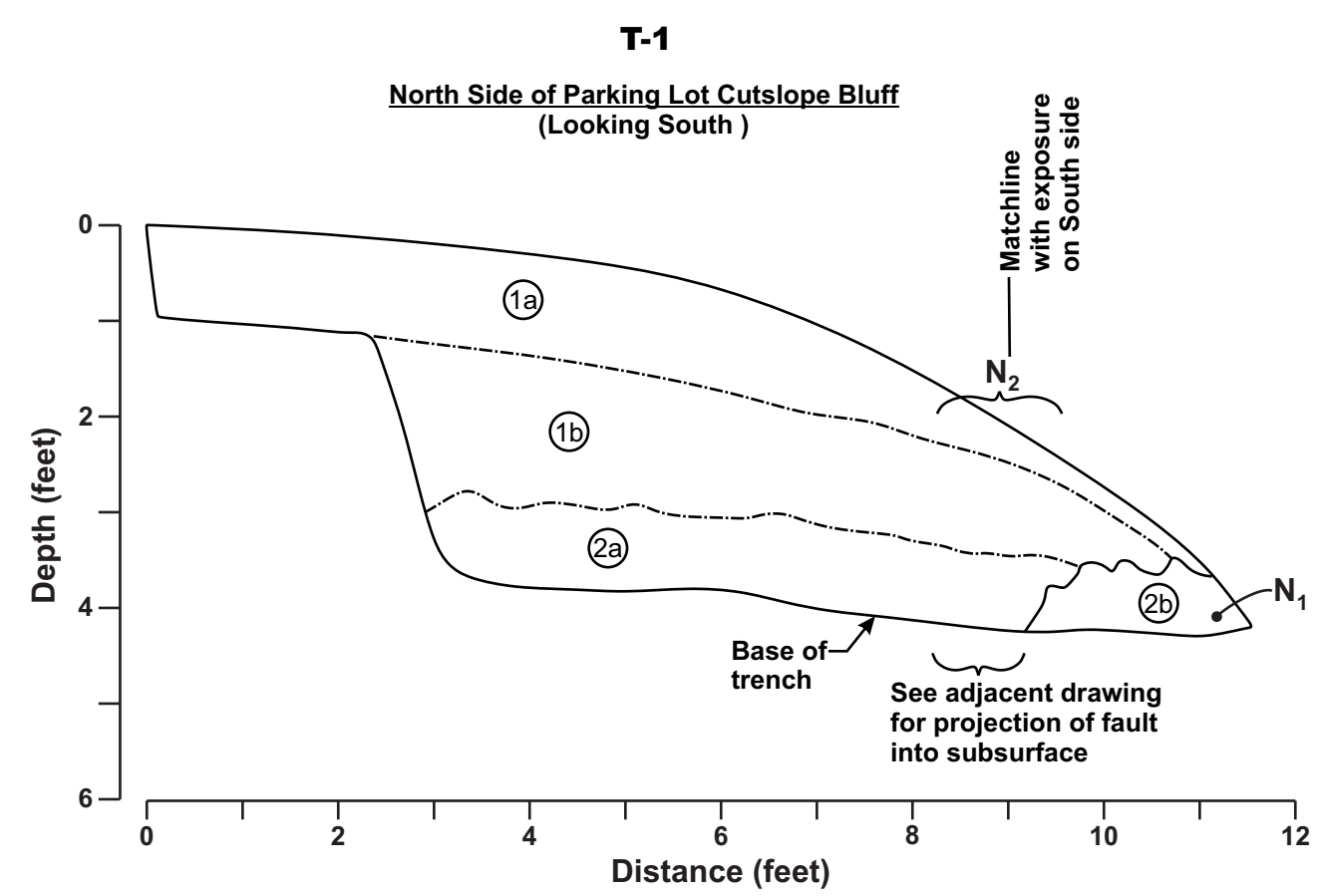
Project Number	105-130-2	Figure Number	Figure 3	Date	February 2022	Drawn By	RRN
	Inset Geologic Map Stanford Belmont NDNU Belmont, CA						
CORNERSTONE EARTH GROUP							



Looking north at the northern cut for the parking lot. Chert bedrock is on the left and Volcanic rocks (tuff) is on the right. The fault is in the center.



Closeup of shear zone. Chert is the on left and sheared volcanic rock is in the center (shearing is spanned by the measuring tape).



Explanation

Residual Soil (Holocene)

①a **Sandy Clay:** dark reddish brown, slightly moist, firm, fine to coarse sand.

Subsoil (Pleistocene)

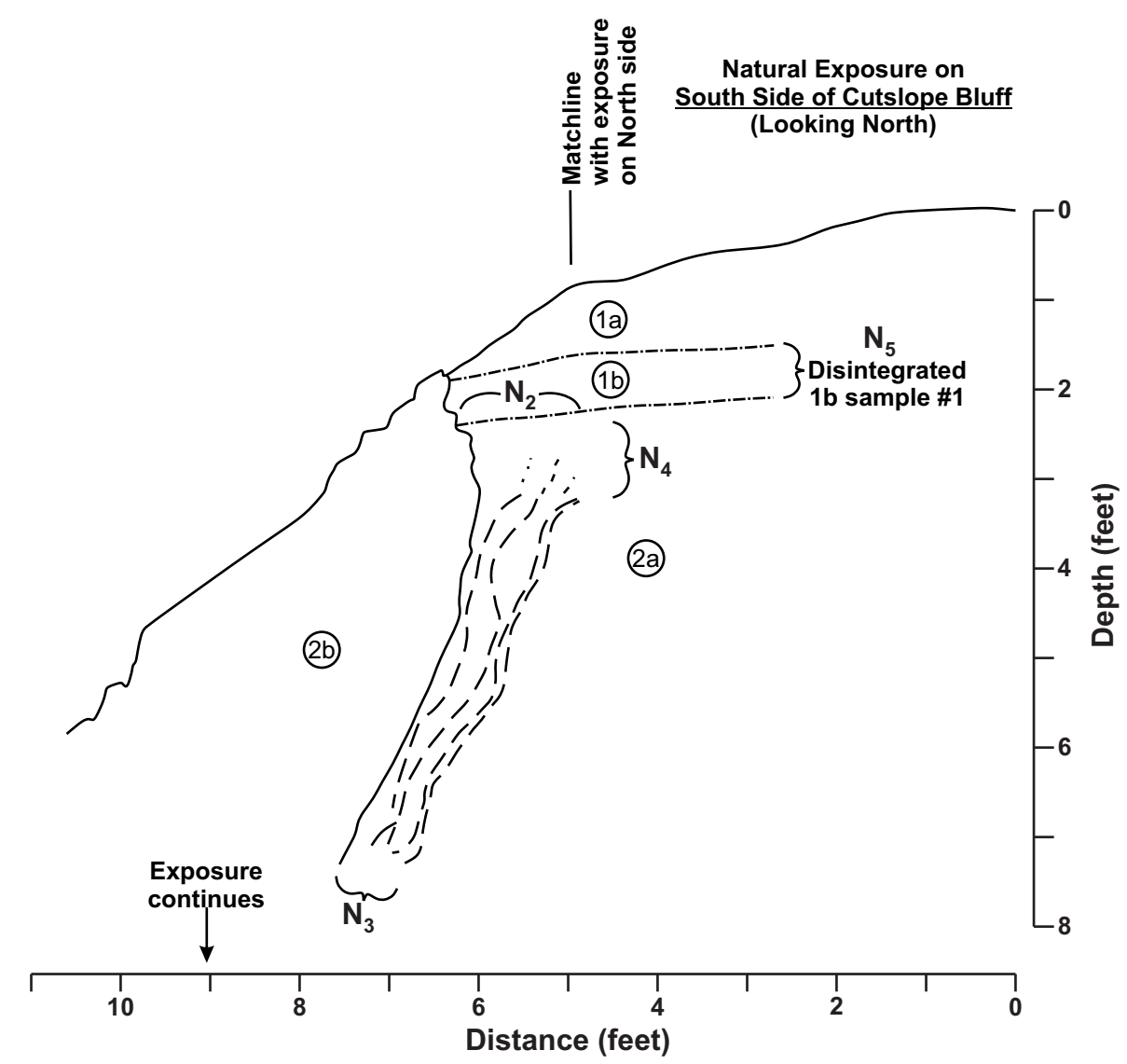
①b **Fat Clay:** dark reddish brown, very moist, firm, contains some sand, well developed clay skins on ped surfaces. No surfaces or sheers present over 2a/2b contact.

Volcanics (fg)

②a **Andesitic Tuff:** variegated medium yellow-brown, dark reddish brown and light gray, decomposed to a soil-like consistency (clayey sand), very dense, relict fabric apparent, translocated clays on sand grains.

Chert (fc)

②b **Chert:** dark reddish brown to dark gray, damp, hard, thin bedded, jointed.



Notes:

- N₁ = N33°W/58°SW: thin bedding in chert.
- N₂ = no truncation, offset or warping of unit 1b across 2a/2b contact.
- N₃ = sheered fabric within 2a adjacent to contact with 2b. Pre-Quaternary fault zone.
- N₄ = sheering at 2a/2b contact does not extend up into this upper portion of 2b.
- N₅ = bulk sample collected for potential radio carbon age date analysis.

Scale: 1" = 2'