COUNTY OF SAN MATEO - PLANNING AND BUILDING DEPARTMENT

ATTACHMENT D

GEOTECHNICAL INVESTIGATION FOR PROPOSED IMPROVEMENTS UPDATE at the Odyssey School 201 Polhemus Road San Mateo, California

Report Prepared for:

Education Facilities Consultants

Report Prepared by:

GeoForensics, Inc.

November 2017

GEOFORENSICS INC. Consulting Soil Engineering
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File: 217316
November 16, 2017

Education Facilities Consultants
3742 Brunswick Court
South San Francisco, CA 94080

Attention: Kay McGough

Subject: **Odyssey School Expansion**
201 Polhemus Road
San Mateo, California
GEOTECHNICAL REPORT UPDATE

Ms. McGough:

This letter has been prepared to update our original report prepared for previously proposed improvements to the Odyssey School at the subject site. We understand that it is currently being proposed to construct some new classrooms upslope of the existing school facility on the subject property. This report summarizes our previous report, comments upon any changes to the site since our original work, and provides updated recommendations for the proposed new construction.

Previous Report

Our original report was prepared in 2002 and focused on protecting the site from potential damage due to debris flow failures in the creek channel to the east of the site, falling rocks from a large outcrop directly upslope of the site, and identification of other geologic threats to the site (landsliding to the south). As a result of that work, a concrete debris flow deflection wall was constructed along the western margins of the creek channel, and a rock fall containment fence was installed upslope (southeast) of the school building. The old slide identified to the south was not mitigated, but a buffer zone was established to keep the school buildings out of line of any anticipated future movement of that slide.

After the original work was completed, conceptual plans were floated for the possible construction of a new modular building on the slope above the existing school building. Our new report for the additional building was dated April 24, 2008. In preparing that report, we drilled a boring on the subject site, performed laboratory testing on collected soil samples, and reviewed our previous report.

Our boring was drilled in the vicinity of the currently proposed buildings, and encountered firm to dense gravelly, sandy clays of low plasticity to the depths explored (10.5 feet). The boring terminated due to drilling refusal, likely on a large rock, or possibly hard bedrock material. No free ground water was encountered in the boring.

Based upon our investigation, we recommended that the new modular building be supported on either spread footings or drilled piers.

Current Site Conditions

We returned to observe the current site conditions in early November 2017. During our visit we noted:

1 – there have been no significant changes to the site since the completion of our previous work.

2 – minor amounts of rock debris has accumulated against the upslope rock fence, but none larger than about 6 inches in nominal diameter;

3 – there has not been any accumulation of debris flow materials against the debris flow wall, despite a very heavy rainfall season earlier this year;

4 – no movement of the old southern landslide was indicated in the form of a newly denuded headscarp areas nor toe bulging.

RECOMMENDATIONS

Based upon our review of our previous investigation and our current site observations, it is our opinion that the site may be safely developed for the new class room buildings.

The recommendations in this report should be incorporated into the design and construction of the proposed new buildings and associated improvements.

Seismicity

The greater San Francisco Bay Area is recognized by Geologists and Seismologists as one of the most active seismic regions in the United States. Several major fault zones pass through the Bay Area in a northwest direction which have produced approximately 12 earthquakes per century strong enough to cause structural damage. The faults causing such earthquakes are part of the San Andreas Fault System, a major rift in the earth's crust that extends for at least 700 miles along western California. The San Andreas Fault System includes the San Andreas, San Gregorio, Hayward, Calaveras Fault Zones, and other faults.

During 1990, the U.S. Geological Survey cited a 67 percent probability that an earthquake of Richter magnitude 7, similar to the 1989 Loma Prieta Earthquake, would occur on one of the active faults in the San Francisco Bay Region in the following 30 years. Recently, this probability was increased to 70 percent, as a result of studies in the vicinity of the Hayward Fault. A 23 percent probability is still attributed specifically to the potential for a magnitude 7 earthquake to occur along the San Andreas Fault by the year 2020.

Ground Rupture - The lack of mapped active fault traces through the site, suggests that the potential for primary rupture due to fault offset on the property is low.

Ground Shaking - The subject site is likely to be subject to very strong to violent ground shaking during its life span due to a major earthquake in one of the above-listed fault zones. Current (2016) building code design may be followed by the structural engineer to minimize damages due to seismic shaking, using the following input parameters from the USGS Java Ground Motion Parameter Calculator based upon ASCE 7-10 design parameters:

Site Class - C	$SM_S = 2.517$	$SM_1 = 1.573$	$SD_S = 1.678$	$SD_1 = 1..048$

Landsliding - The subject site and the surrounding area are gently to steeply sloping. Fortunately, the site is underlain by competent bedrock material at relatively shallow depths above the site, but there is a deposit of old landside debris to the south of the site. That debris is believed to be comprised of predominantly clay rich materials which should have limited displacement possible due to any seismic shaking. Further, even if there was to be significant movement, the slide displacements would occur to the south of the proposed building site and would not impact the proposed structures. Therefore, the hazard due to seismically-induced landsliding is, in our opinion, low for the site.

Liquefaction - Liquefaction most commonly occurs during earthquake shaking in loose fine sands and silty sands associated with a high ground water table. These conditions were demonstrated to be absent down to the site bedrock. Therefore, it is our opinion the liquefaction is unlikely to occur on the subject property.

Ground Subsidence - Ground subsidence may occur when poorly consolidated soils densify as a result of earthquake shaking. Since the proposed building site is underlain at shallow depths by resistant materials, the hazard due to ground subsidence is, in our opinion, considered to be low.

Lateral Spreading - Lateral spreading may occur when a weak layer of material, such as a sensitive or liquefiable silt or clay, loses its shear strength as a result of earthquake shaking. Such conditions are not present at the site, hence, the hazard due to lateral spreading is, in our opinion, considered to be low.

Site Preparation and Grading

All debris resulting from the demolition of existing improvements should be removed from the site and may not be used as fill. Any existing underground utility lines to be abandoned should be removed from within the proposed building envelope and their ends capped outside of the building envelope.

Any vegetation and organically contaminated soils should be cleared from the building area. All holes resulting from removal of tree stumps and roots, or other buried objects, should be over-excavated into firm materials and then backfilled and compacted with native materials.

The placement of fills at the site is expected to include: utility trench backfill, retaining wall backfill, slab subgrade materials, and finished drainage and landscaping grading. These and all other fills should be placed in conformance with the following guidelines:

Fills may use organic-free soils available at the site or import materials. Import soils should be free of construction debris or other deleterious materials and be non-expansive. *A minimum of 3 days prior to the placement of any fill, our office should be supplied with a 30 pound sample (approximately a full 5 gallon bucket) of any soil or baserock to be used as fill (including native and import materials) for testing and approval.*

All areas to receive fills should be stripped of organics and loose or soft near-surface soils. Fills should be placed on level benches in lifts no greater than 6 inches thick (loose) and be compacted to at least 90 percent of their Maximum Dry Density (MDD), as determined by ASTM D-1557.

All unretained fills to be placed on slopes steeper than 6 to 1 (horizontal to vertical, H:V) will need to be keyed and benched into competent native materials. Any retained fills will need to be benched into competent native materials, however, a formal keyway is not required. The entire base of any keyway should extend into competent native soils, located about 7 feet below grade. The entire bases of all benches should extend into competent colluvial soils, as identified in the field by representatives from our office. It should be anticipated that the outer edge of bench excavations will extend at least 7 feet below native grade. Keyways and benches should be sloped back into the hillside at a minimum 2% gradient.

For fills over 5 feet thick, or where deemed necessary by our personnel, a blanket drain should be provided within any keyway excavations, and chimney drains should be provided at the back of any benches identified by our office in the field. The blanket drain should cover the entire keyway and consist of a minimum 6 inch thick layer of clean crushed drain rock completely covered (top and sides) with filter fabric (Mirafi 140N or approved equivalent). Chimney drains should consist of a minimum 6 inch wide column of clean crushed drain rock, also wrapped with filter fabric, for at least half the height and for the full width of the bench. These systems should drain to 4 inch diameter perforated pipes, placed at the base of the drain rock. The pipes should consist of Schedule 40 PVC or SDR 35. No flexible, corrugated pipe may be used within any drainage system installed as part of this project. The bench drain pipes may connect to the keyway blanket drain pipe. A solid line should be used to convey the water to an appropriate discharge point. We note that *Caltrans Class 2 permeable rock* is an acceptable substitution for clean drain rock and filter fabric.

Temporary, dry-weather, vertical excavations should remain stable for short periods of time to heights of 5 feet. All excavations should be shored or sloped in accordance with OSHA standards.

Even moderately deep cuts are likely to encounter hard bedrock boulders. Heavy excavation equipment may be required. Similarly, it may be necessary to utilize hand-held jackhammers to clean out the footing excavations.

Permanent cut and/or fill slopes should be no steeper than 2:1 (H:V). However, even at this gradient, minor sloughing of slopes may still occur in the future. Positive drainage improvements (e.g. drainage swales, catch basins, etc.) should be provided to prevent water from flowing over the tops of cut and/or fill slopes.

Foundations - Piers

Due to the relatively steep site slopes, drilled piers should be used where grading operations do not flatten the slope to a gradient of less than 5H:1V.

If used, piers should penetrate a minimum of 10 feet below lowest adjacent grade, and 5 feet into competent native materials, whichever is deeper. It should be assumed that up to 7 feet of overburden will exist at the site, so nominal pier depths may range from 10 to 12 feet below lowest adjacent grade.

The piers should have a minimum diameter of 16 inches and be nominally reinforced with a minimum of four #4 bars vertically. Piers should be spaced a maximum of 10 feet center to center, and be spaced no closer than 4 diameters, center to center.

A friction value of 500 psf may be assumed to act on that portion of the pier below a depth of 7 feet (as measured from existing grades). A lateral creep force of 35 pcf Equivalent Fluid Weight (EFW) should be applied to all piers on any portion of the site where grading operations do not flatten slopes to less than 5:1 (H:V). This creep force should be applied over 3 projected pier diameters to a depth of 5 feet. Lateral support may be assumed to be developed along the length of the pier below 7 feet, using a passive pressure of 350 pcf Equivalent Fluid Weight (EFW), starting at a value of 750 psf. Passive resistance may be assumed to act over 1.5 projected pier diameters. Above 7 feet, no frictional or lateral support may be assumed. These design values may be increased 1/3 for transient loads (i.e. seismic and wind).

Even though piers are designed to derive their vertical resistance through skin friction, the bases of the piers holes should be clean and firm prior to setting steel and pouring concrete. If more than 6 inches of slough exists in the base of the pier holes after drilling, then the slough should be removed. If less than 6 inches of slough exists, the slough may be tamped to a stiff condition. Piers should not remain open for more than a few days prior to casting concrete. In the event of rain, shallow groundwater, or caving conditions it may be necessary to pour piers immediately.

All perimeter piers, and piers under load-bearing walls, should be connected by concrete grade beams. Perimeter grade beams should penetrate a minimum of 6 inches below crawlspace grade (unless a perimeter footing drain is installed to intercept water attempting to enter around the perimeter). Interior grade beams do not need to penetrate below grade.

All improvements connected directly to any pier supported structure, also need to be supported by piers. This includes, but is not limited to: porches, decks, entry stoops and columns, etc. If the designer does not wish to pier support these items, then care must be taken to structurally isolate them (with expansion joints, etc.) from the pier supported structure.

If the above recommendations are followed, total foundation settlements should be less than 1 inch, while differential settlements should be less than ½ inches.

Foundations – Spread Footings

Where grading flattens the slope to less than a 5H:!V gradient, the foundations may consist of conventional spread footings bearing on either native soils or engineered fill.

All footings should be a minimum of 12 inches wide. Strip footings should be embedded a minimum of 30 inches below exterior grade and 24 inches below interior grade, *whichever is deeper*. Stepped footings need only be embedded 24 inches below exterior grade at the toe. Isolated footings (e.g. interior pads or exterior post supports) should be embedded at least 30 inches below lowest adjacent grade.

The footings should be founded below an imaginary line projecting at a 1:1 slope from the base of any adjacent, parallel utility trenches. The footings must be embedded so that there is a minimum of 20 feet of horizontal cover between the face of the footings and any adjacent, parallel slope.

The footings should be designed to exert pressures on the ground, which do not exceed 2500 psf for Dead plus Live Loads. The weight of the embedded portion of the footings may be neglected when determining bearing pressures. Lateral pressures may be resisted by friction between the base of the footings and the ground surface. A friction coefficient of 0.40 may be assumed. Alternatively, lateral pressures may be resisted by a passive pressure of 350 pcf EFW assumed to be acting against the face of the footings (or shear keys, if required). These values may be increased 1/3 for transient loads (i.e. seismic and wind).

Footings should be nominally reinforced with four #4 bars (two at top and two at bottom). The designer should determine actual width, embedment and reinforcement for the footings.

If the above recommendations are followed, total foundation settlements should be less than 1 inch, while differential settlements should be less than ¾ inches.

Retaining Walls

Retaining walls which are located on, or within 10 feet of the crest of, slopes steeper than 5:1 (H:V); should utilize a pier and grade beam foundation system. Site retaining walls which are located in level areas (flatter than 5:1, H:V) may be supported by drilled piers or by spread footings depending upon wall type. Where site walls are attached to buildings, they should have the same foundation type used for the building. Segmental block walls may be used in lieu of spread footing walls.

Wall Forces - Any unrestrained retaining walls required for the proposed construction should be designed to resist an active pressure of 45 pcf Equivalent Fluid Weight (EFW) in supporting soils with retained slopes less than 4:1 (H:V). An active pressure of 65 pcf EFW should be utilized for retained slopes with an inclination of 2:1 (H:V). Where retained slopes are greater than 4:1, though less than 2:1, the designer should linearly interpolate between 45 and 65 pcf EFW.

Any restrained retaining walls required should be designed for the aforementioned active pressures with an additional uniform pressure of 8H psf, where H is the height of the wall in feet. We leave it to the design professional's judgment in determining whether a wall is restrained or not. An additional force of 10H psf may be applied to account for seismic forces on the wall, although it is our opinion that such forces need not be applied.

All retaining walls should also be designed to resist a point load applied at the midpoint of the wall, equal to ½ the maximum applied surcharge.

Drilled Piers - Any wall which is structurally connected to the house, or that is located on, or within 10 feet of the crest of, slopes steeper than 5:1 (H:V) should utilize a drilled pier foundation system. Additionally, any site walls for which expansive soil shifting is unacceptable should use drilled piers. We note that pier-supported walls <u>may not</u> rely upon a toe footing to resist overturning forces. All vertical and lateral forces should be resisted by piers. This may require the use of a staggered, double row of piers, depending upon the wall height and any surcharges.

If used, drilled piers should penetrate a minimum of 10 feet below the lowest adjacent grade, and at least 5 feet into competent native materials, *whichever is deeper.* The piers should have a minimum diameter of 16 inches. Pier should be spaced no closer than 4 diameters, center to center. Actual pier depth, diameter, reinforcement, and spacing should be determined by the structural engineer.

Please refer to the *Foundation-Piers* section of this report for the applicable pier design recommendations.

If drilled piers are utilized beneath a concrete or block wall, they will need to be connected by a concrete grade beam. No grade beam is required for a wood lagging wall.

Spread Footings - Walls located 20 or more feet from the crest of slopes steeper than 5:1 (H:V) may utilize a spread footing foundation system. Refer to the *Foundation-Spread Footings* section of this report for the applicable spread footing design recommendations.

Wall Drainage - The above values have been provided assuming that back-of-wall drains will be installed to prevent build-up of hydrostatic pressures behind all walls. This drainage system may consist of a prefabricated drainage panel (i.e. Miradrain) or a gravel and filter fabric type system. We also recommend that any interior retaining walls, or walls through which efflorescence transmission would be undesirable, should be waterproofed. The waterproofing should be specified by the designer, though we suggest the use of Bituthene, Miradri, or other similar waterproofing membrane. Surface drainage above the wall should preclude overtopping of the wall, and should also preclude ponding on the ground surface above the wall. *Additionally, the ground surface above all walls should form a drainage swale to carry water to the sides of the wall and/or to area drain locations.*

The back-of-wall drain systems should be installed with a minimum 3-inch diameter perforated pipe placed a minimum of 4 inches below the top of the footing (preferably at the base of the footing heel). The pipe should not be placed on top of the heel of the wall footing unless seepage through the base of the wall is acceptable. Perforations should be placed face-down (at 5 and 7 o'clock). The perforated pipe should connect to a solid discharge line, which discharges away from the new structures. This solid line should not connect to surface water drain lines (i.e. downspout and area drain lines). If water transmission through the base of a wall is not a concern, then weep holes may be used in place of the pipe.

If used, the gravel system should consist of a minimum 12 inch wide column of drain rock (3/8 to ¾ inch clean, crushed rock) extending the full width of the wall. The rock should continue to within 12 inches of finish grade. Prior to backfilling with the drain rock, a layer of filter fabric (Mirafi 140N or approved equivalent) should be placed against all soil surfaces to separate the rock and soil. The filter fabric should wrap over the top of the gravel and then a 12 inch thick cap of native soils should be placed at the top of the drain. If concrete flatwork is to directly overlay the back-of-wall drain, or if the drain is located in a crawlspace area, then the soil cap should be eliminated.

If prefabricated drainage panels are used, a packet of filter fabric-wrapped drain rock should be placed around the perforated collector pipe at the base of the panel. The tops of the panels should be sealed and secured in accordance with the manufacturer's recommendations. The base of the drainage panels should extend down below the top of the filter fabric-wrapped drain rock.

We note that Caltrans Class II permeable rock may be utilized in lieu of clean drain rock and filter fabric. The Class II permeable rock needs to be compacted into place, and needs to be certified by the quarry or rockery that it meets the Caltrans Class II permeable rock specifications.

Basement Foundations, Walls, and Floors

No basements are proposed for these buildings. IF plans change to include basements, please contact our office for further recommendations.

Slabs-on-Grade

The building floors should not consist of conventional concrete slabs-on-grade. If a concrete floor slab is desired, please contact our office for recommendations for structural floor slabs.

Any sidewalks or patios may consist of conventional concrete slabs-on-grade, though it should be expected that some post-construction shifting and cracking of such slabs may occur. We have provided guidelines to help reduce post-construction movements and cracking, however, it is nearly impossible to economically eliminate all movement/cracking.

To help reduce cracking, we recommend slabs be a minimum of 4 inches thick and be nominally reinforced with #4 bars at 18 inches on center, each way. Slabs which are thinner or more lightly reinforced may experience undesirable cosmetic cracking. However, actual reinforcement and thickness should be determined by the structural engineer based upon anticipated usage and loading.

In large non-interior slabs (e.g. patios, garage, etc.), score joints should be placed at a maximum of 10 feet on center. In sidewalks, score joints should be placed at a maximum of 5 feet on center. All slabs should be separated from adjacent improvements (e.g. footings, porches, columns, etc.) with expansion joints. Interior floor slabs will experience shrinkage cracking. These cosmetic cracks may be sealed with epoxy or other measures specified by the architect.

Exterior landscaping flatwork (e.g. patios and sidewalks) may be placed directly on proof-rolled soil subgrade materials (e.g. no granular subgrade), however, they will be potentially subject to shifting and moisture transmission.

Drainage

Surface Drainage - Adjacent to any buildings, the ground surface should slope at least 5 percent away from the foundations within 5 feet of the perimeter. Impervious surfaces should have a minimum gradient of 2 percent away from the foundation.

Surface water should be directed away from all buildings into drainage swales, or into a surface drainage system (i.e. catch basins and a solid drain line). "Trapped" planting areas should not be created next to any buildings without providing means for drainage (i.e. area drains).

All roof eaves should be lined with gutters. The downspouts may be connected to solid drain lines, or may discharge onto paved surfaces which drain away from the structure. The downspouts may be connected to the same drain line as any catch basins, but must not connect to any perforated pipe drainage system. If splash blocks are preferred, then a perimeter footing drain system **must** be installed.

Footing Drain - Due to the potential for changes to surface drainage provisions, it would be wise (though not required) to install a perimeter footing drain to intercept water attempting to enter the crawlspace. If a footing drain is not installed, some infiltration of moisture into the crawlspace may occur. Such penetration should not be detrimental to the performance of the structure, but can possibly cause humidity and mildew problems within the building, or seepage up through the slab floors.

The footing drain system, if installed, should consist of a 12 inch wide gravel-filled trench, *dug at least 12 inches below the elevation of the adjacent crawlspace*. The trench should be lined with a layer of filter fabric (Mirafi 140N or equivalent) to prevent migration of silts and clays into the gravel, but still permit the flow of water. Then 1 to 2 inches of drain rock (clean crushed rock or pea gravel) should be placed in the base of the lined trench. Next a perforated pipe (minimum 3 inch diameter) should be placed on top of the thin rock layer. The perforations in the pipe should be face down. The trench should then be backfilled with more rock to within 6 inches of finished grade. The filter fabric should be wrapped over the top of the rock. Above the filter fabric 6 inches of native soils should be used to cap the drain. If concrete slabs are to directly overlay the drain, then the gravel should continue to the base of the slab, without the 6 inch soil cap. This drain should not be connected to any surface drainage system.

Drainage Discharge - The surface drain lines should discharge at least 15 feet away from the buildings, preferably at the street or adjacent creek channel. The discharge location(s) may need to be protected by energy dissipaters to reduce the potential for erosion.

The footing drain (if installed) and any back-of-wall drain lines should discharge independently from the surface drainage system. The surface and subsurface drain systems should not be connected to one another.

Drainage Materials - Drain lines should consist of hard-walled pipes (e.g. SDR 35 or Schedule 40 PVC). In areas where vehicle loading is not a possibility, SDR 38 or HDPE pipes may be used. Corrugated, flexible pipes may not be used in any drain system installed at the property.

Surface drain lines (e.g. downspouts, area drains, etc.) should be laid with a minimum 2 percent gradient (¼ inch of fall per foot of pipe). Any subsurface drain systems (e.g. footing drains) should be laid with a minimum 1 percent gradient (1/8 inch of fall per foot of pipe).

Plan Review and Construction Observations

The use of the recommendations contained within this report is contingent upon our being contracted to review the plans, and to observe geotechnically relevant aspects of the construction.

We should be provided with a full set of plans to review at the same time the plans are submitted to the building/planning department for review. A minimum of one working week should be provided for review of the plans.

At a minimum, our observations should include: key and bench excavations; compaction testing of fills and subgrades; footing excavations; pier drilling; slab subgrade preparation; installation of any drainage system (e.g. back-of-wall, under-slab, footing, and surface), and final grading. A minimum of 48 hours notice should be provided for all construction observations.

File: 217316
November 16, 2017

LIMITATIONS

This report has been prepared for the exclusive use of the addressee, and their architects and engineers for aiding in the design and construction of the proposed development. It is the addressee's responsibility to provide this report to the appropriate design professionals, building officials, and contractors to ensure correct implementation of the recommendations.

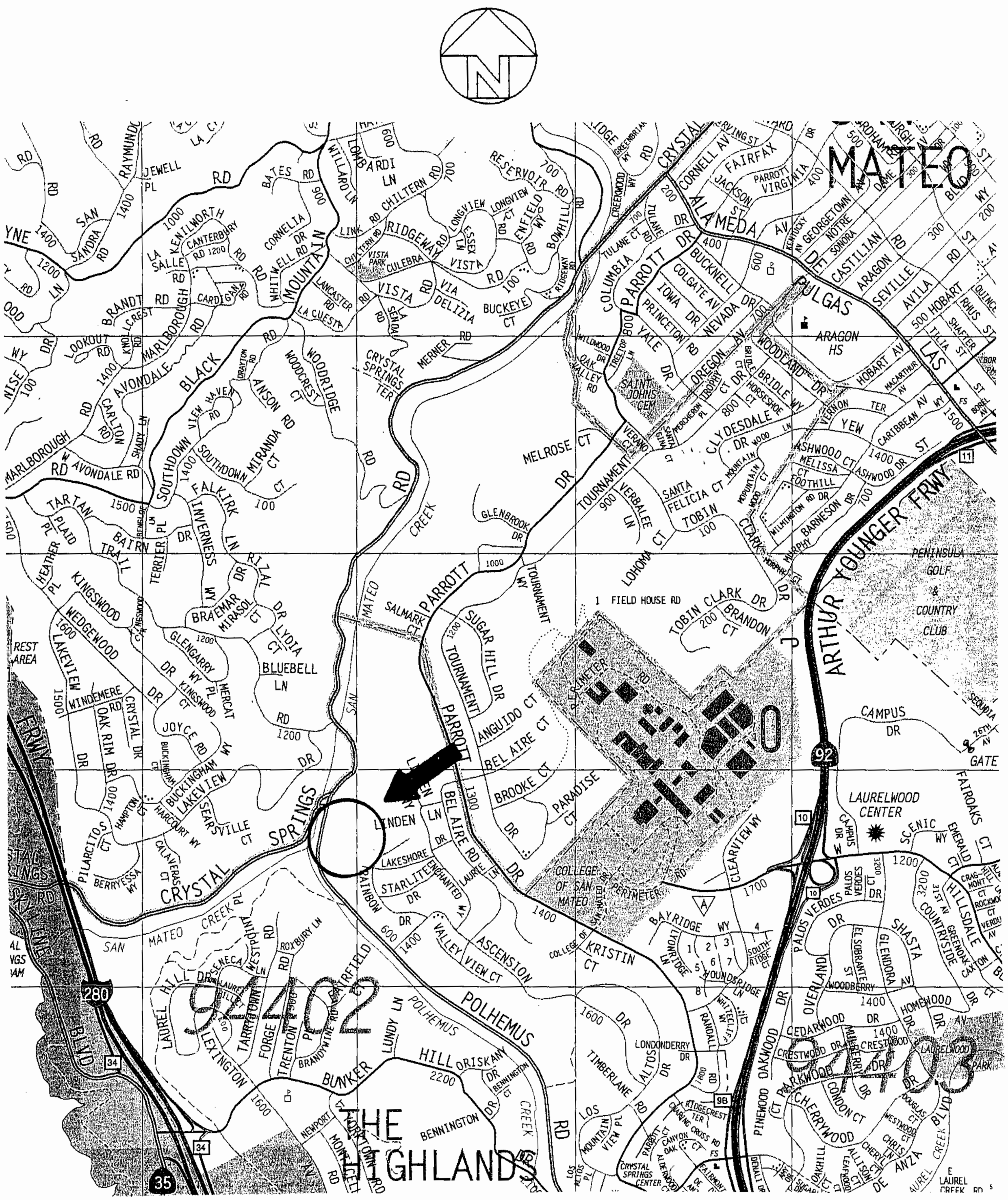
The opinions, comments and conclusions presented in this report were based upon information derived from our field investigation and laboratory testing. Conditions between or beyond our borings may vary from those encountered. Such variations may result in changes to our recommendations and possibly variations in project costs. Should any additional information become available, or should there be changes in the proposed scope of work as outlined above, then we should be supplied with that information so as to make any necessary changes to our opinions and recommendations. Such changes may require additional investigation or analyses, and hence additional costs may be incurred.

Our work has been conducted in general conformance with the standard of care in the field of geotechnical engineering currently in practice in the San Francisco Bay Area for projects of this nature and magnitude. We make no other warranty either expressed or implied. By utilizing the design recommendations within this report, the addressee acknowledges and accepts the risks and limitations of development at the site, as outlined within the report.

Respectfully Submitted;
GeoForensics, Inc.

Daniel F. Dyckman, PE, GE
Senior Geotechnical Engineer, GE 2145

cc: 5 to addressee



Source: Thomas Bros. Guide

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Figure 1 - Site Location

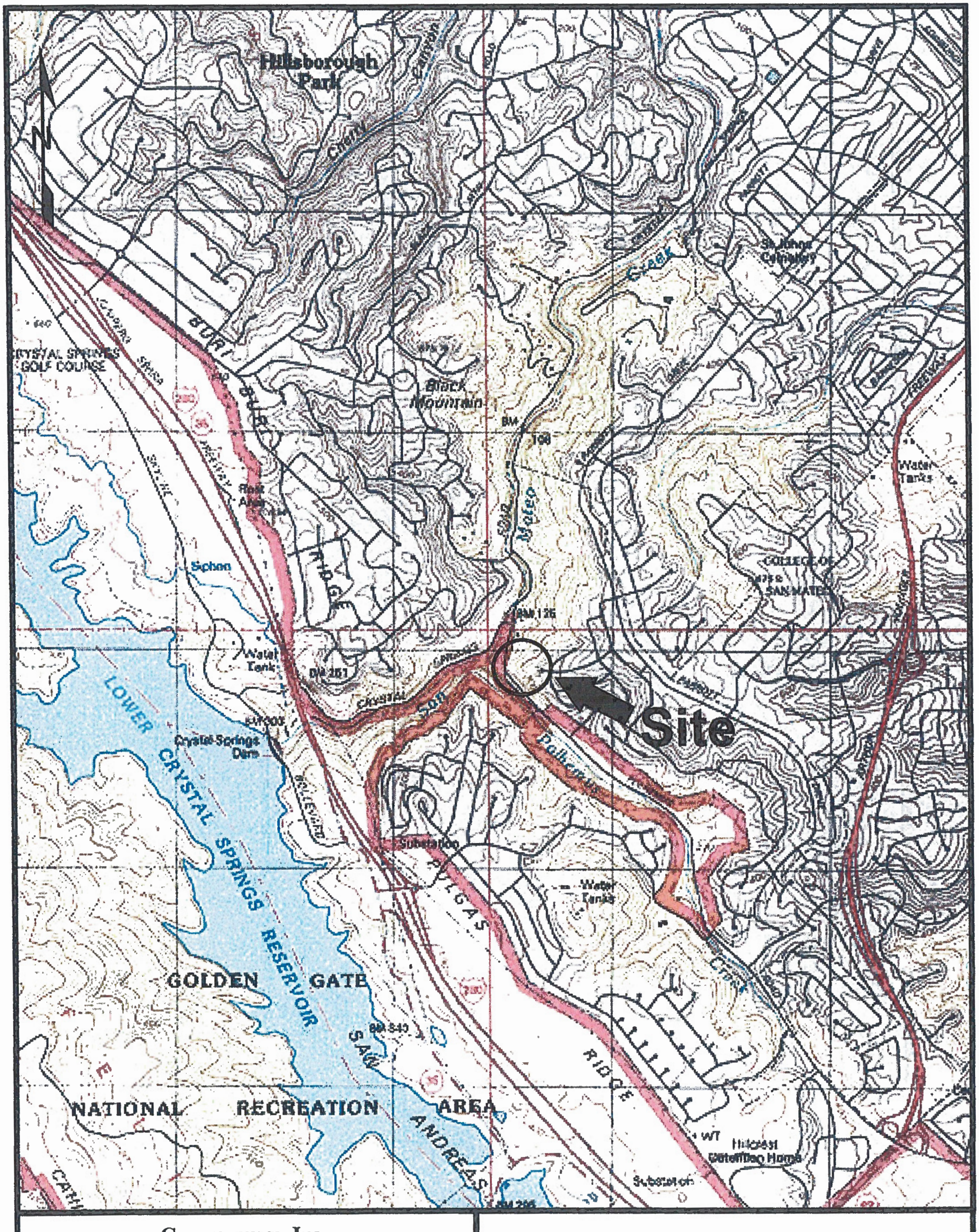

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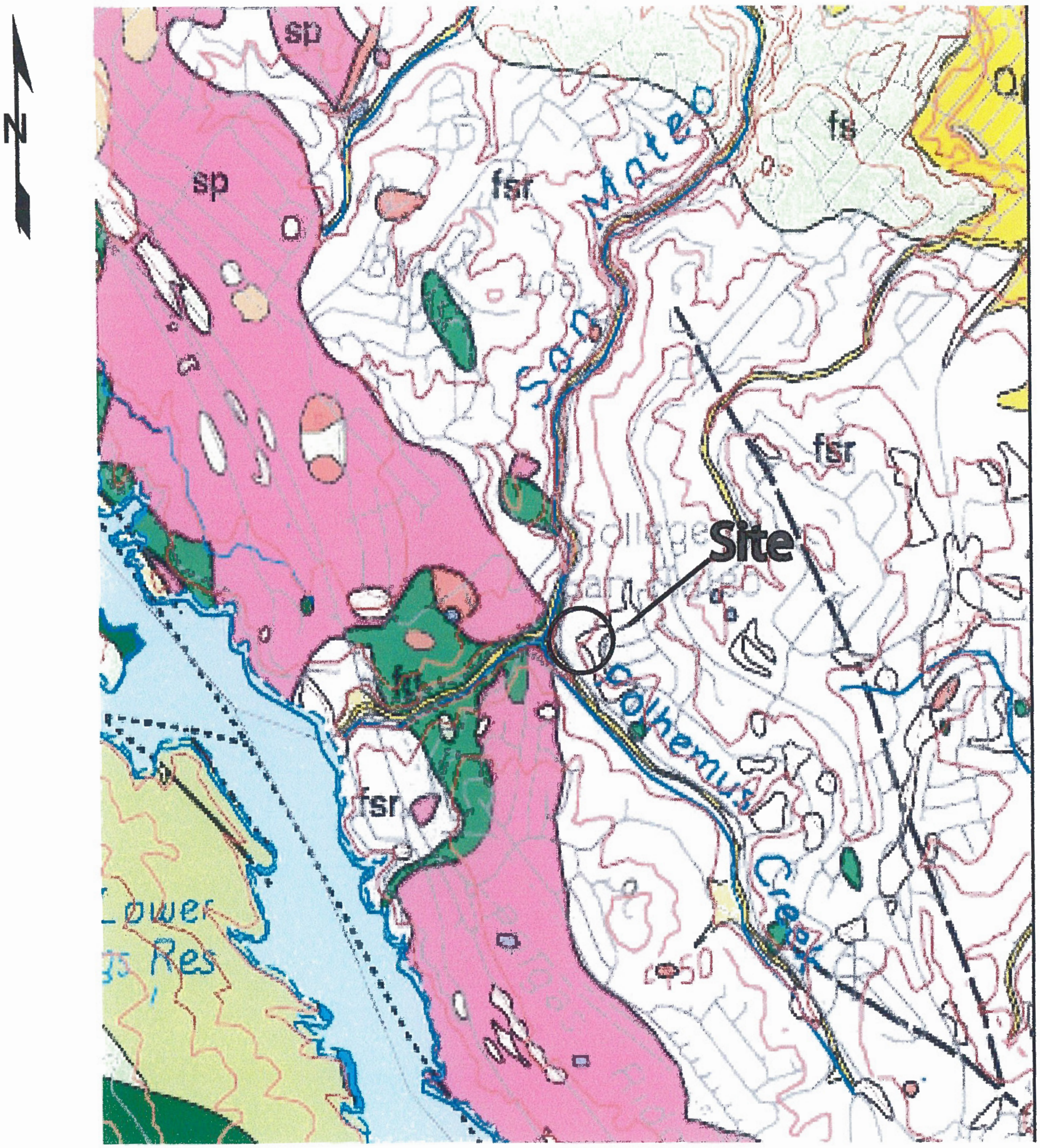
Figure 2 - Vicinity Topography



fsr	**Sheared rock (melange)** —Predominantly graywacke, siltstone, and shale, substantial portions of which have been sheared, but includes hard blocks of all other Franciscan rock types. Total thickness of unit is unknown, but is probably at least several tens of meters

Source: Geology of the onshore part of San Mateo County, California: Derived from the digital database Open-File 98-137.

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Figure 3 - Geologic Map

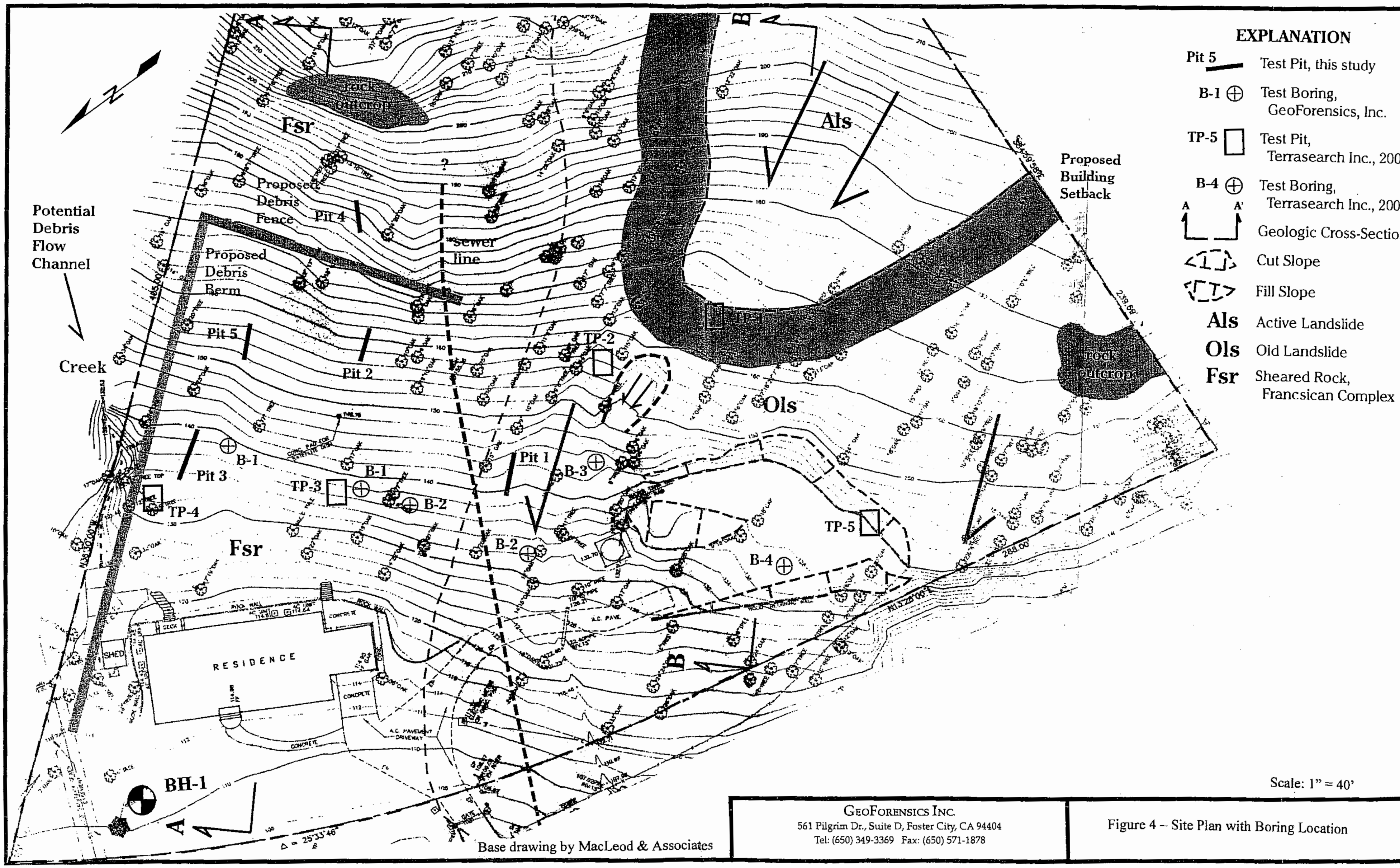

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Figure 4 – Site Plan with Boring Location

APPENDIX A - BORING LOGS

LOG OF BORING

DEPTH (ft)	SAMPLE NO.	SAMPLE LOC.	BLOW COUNTS (12 Inches)	DESCRIPTION	DRY DENSITY (pcf)	MOISTURE CONTENT (%)
	3 - 1		46	silty fine gravelly sandy CLAY - dark brown & olive-brown; slightly moist; stiff (CL, maybe CH)	-	-
5	3 - 2		19	silty CLAY with sand & some gravels & rootlets - olive-brown & green-brown; slightly moist; firm (CH)	-	-
	3 - 3		93	silty fine to large gravelly sandy CLAY - red-brown; slightly moist; very stiff (CL, maybe CH)	118.0	15.3
10	SPT 3 - 4		85	as above; hard (CJ, maybe CH)	-	10.9

Depth scale: 15, 20, 25, 30, 35

Drilling refusal at 10.5 feet.

No groundwater encountered.
Bottom of boring at 11.5 feet
Drilled on 03/04/08
Logged by ba
Minute Man portable drilling rig
Modified California & Split Spoon samplers
70# hammer

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Figure A3 - Log of Boring 3

APPENDIX B - LABORATORY TEST RESULTS

Moisture-Density-Porosity Report

Cooper Testing Labs, Inc.

Job No:	060-1920	**Date:**	03/14/08
Client:	GeoForensics	**By:**	RU
Project:	Odessey - 208026	**Remarks:**	

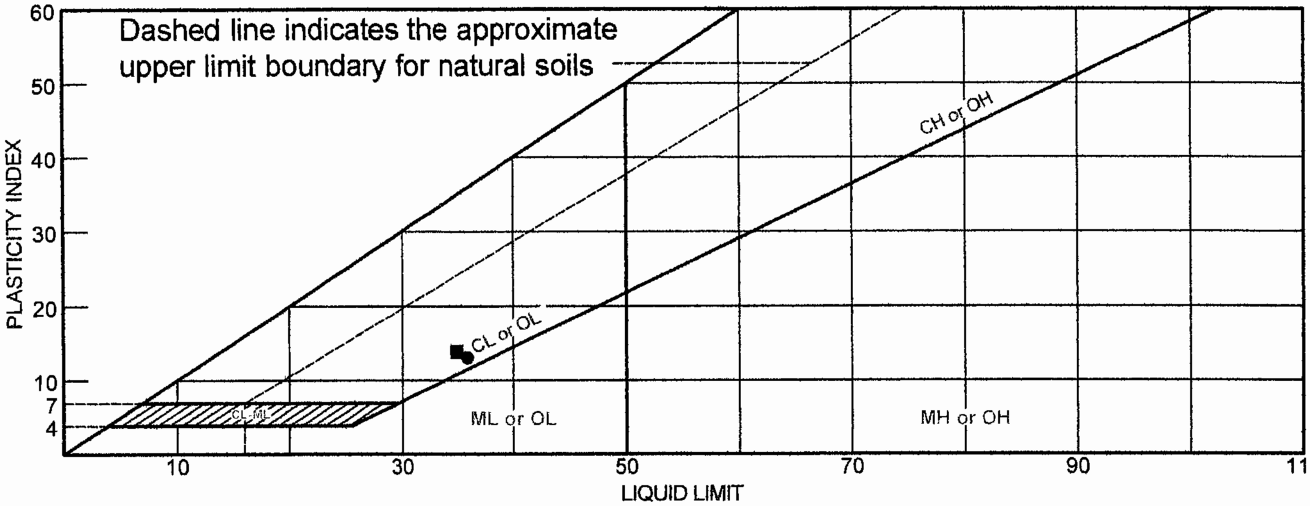
Boring:	1-3	1-4						
Sample:								
Depth, ft:	8	11						
Visual Description:	Brown Clayey SAND w/ Gravel	Brown Clayey SAND w/ Gravel						
Actual G_s								
Assumed G_s	2.70							
Total Vol cc	112.2							
Vol Solids,cc	78.5							
Vol Voids,cc	33.7							
Moisture, %	15.3	10.9						
Wet Unit wt, pcf	136.0							
Dry Unit wt, pcf	118.0							
Saturation, %	95.9							
Porosity, %	30.0							
Air filled Poros.,%	1.2							
Water filled Poros.,%	28.8							
Void Ratio	0.43							
Series	1	2	3	4	5	6	7	8

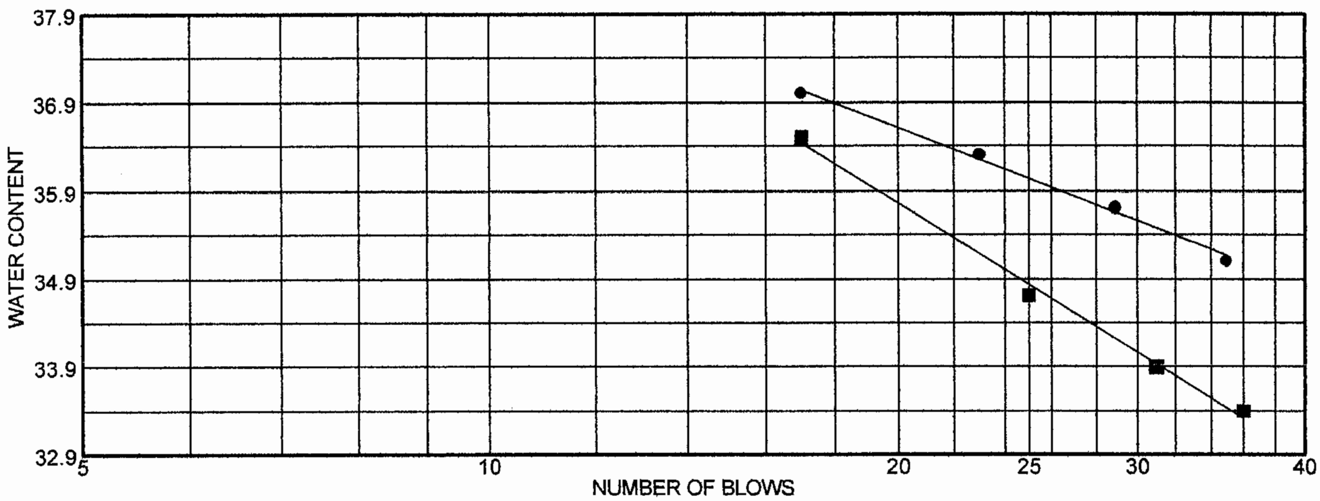
Note: If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

COOPER TESTING LABORATORY

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown Lean Clayey SAND w/ Gravel	36	23	13			
■	Brown Lean Clayey SAND w/ Gravel	35	21	14			

Project No. 060-1920 **Client:** GeoForensics

Project: Odessey - 208026

● **Source:** 1-1 **Elev./Depth:** 2'

■ **Source:** 1-2 **Elev./Depth:** 4.5'

Remarks:

●

■

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COOPER TESTING LABORATORY

Figure