21 May 2003

Tony Coe, City Engineer
City of Lafayette
P.O. Box 1968
3675 Mount Diablo Boulevard, Suite 210
Lafayette, California 94549-1968

RE: Geotechnical Investigation and Report
Proposed City Library
Parcel at the Southeast Corner of Mt. Diablo Boulevard and First Street
Lafayette, California

Dear Mr. Coe:

At your request, we have completed our geologic and geotechnical investigation for the proposed library you are planning to construct on the property located at the southeast corner of Mt. Diablo Boulevard and First Street in Lafayette, California. Enclosed are five copies of our report for your use.

Please note that the subsurface investigation, geotechnical analyses, and report were completed based on the conceptual-level design information available to us as of the beginning of our involvement with the project. Should the actual configuration of the project change from that indicated in the report, we should be consulted to determine if additional subsurface exploration, testing, and/or analyses are warranted based on the changes.

We trust this report provides you with the information required to proceed. If you have any questions, please call us.

Yours truly,

CAL ENGINEERING & GEOLOGY, INC.

Phillip Gregory, P.E., G.E.	Stephen M. Watry, C.E.G., G.E.
Principal Engineer	Senior Geologist/Engineer

FOUNDATION EXPLORATION REPORT
for
PLANNED LAFAYETTE CITY LIBRARY
MT. DIABLO BOULEVARD AND FIRST STREET
LAFAYETTE, CALIFORNIA

prepared for

City of Lafayette
Engineering Department

by

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1870 Olympic Boulevard, Suite 100
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21 May 2003

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Principal Engineer

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INTRODUCTION

The City of Lafayette is planning to construct a new city library on the property located at the southeast corner of Mt. Diablo Boulevard and First Street and bordered to the south by Golden Gate Way in Lafayette, California (Figure 1). The planned project will include construction of an approximately 20,000 square foot library over one and two stories of basement parking. The remaining portions of the site will be improved with landscaping. Our review of the conceptual architectural plans indicates that site grading will consist of excavation for basement parking to an elevation roughly the same as that of Golden Gate Way. Shoring will be required along the northern portion of the site and the northern portions of the west and east sides of the site to accommodate the basement excavation. The purposes of our investigation were to develop information regarding the surface and subsurface conditions in the vicinity of the proposed improvements and to provide geotechnical recommendations for site grading and design and construction of the building foundation system and pavements.

SCOPE OF WORK

Our scope of work has included a review of published soil and geologic maps of the area, evaluation of the type, depth, and physical properties of the soil materials in the vicinity of the proposed site improvements, laboratory testing of selected samples recovered from the exploratory drilling, engineering analyses, and completion of this geotechnical report. The subsurface soil conditions at the site were explored by drilling and sampling seven test borings in the vicinity of the proposed building (Figure 2). The results of our geologic research, exploratory borings, laboratory testing, and engineering analyses are summarized in this report.

We have not been asked to evaluate the possible presence of surface or subsurface hazardous materials at the site. Our investigation has been specifically limited to developing information regarding the soil conditions within the vicinity of the development area.

SITE CONDITIONS

The site consists of a graded, developed lot located at the southeast corner of the intersection of Mt. Diablo Boulevard with First Street, in Lafayette, California. Mt. Diablo Boulevard extends along the north side of the property while First Street is located along the west side of the site. The south edge of the property faces onto Golden Gate Way.

Prior to development, a subtle, south trending bedrock ridge was present in the northeast portion of the property. The southern and western portions of the property are underlain by alluvium associated with a south trending drainage course the axis of which roughly follows the alignment of First Street. The property slopes gently downward towards Lafayette Creek located about 150 feet south of Golden Gate Way.

Past grading on the property has consisted of minor cutting and filling to create a building pad and parking areas. The gentle bedrock ridge at the extreme northeast corner of the property has been cut and fill has been placed over alluvium along the west and south sides of the property. The property drops in elevation approximately 20 feet over a distance of approximately 250 feet between Mt. Diablo Boulevard and Golden Gate Way.

A one and two-story Veteran's Hall building located on the central portion of the property contains meeting rooms, a kitchen, and an office. The age of the building was not determined but a WPA date stamp in the concrete sidewalk along the north side of the property lists the year of construction as 1940. The building has stucco-sided walls over wood frame and is supported on a slab-on-grade foundation. The northeast portion of the building extends about 3 feet below the ground surface with the grade change being accommodated by poured concrete retaining walls that support the perimeter walls. Planters and a lawn are located to the north of the building. A concrete walkway extends from the entry on the north side of the building to an asphalt-paved parking area in the northern portion of the property. A sparse lawn and some trees exist in the sloping yard area east of the building. Planters are located along the west side of the building. A concrete deck extends from an entrance on the west side of the building to an asphalt-paved parking area on the west side of the property. A yard area with a sparse lawn and some shrubs is located south of the building. A very gentle slope descends about 3 to 10 feet to an asphalt-paved parking area at the extreme south edge of the property. A narrow planter and a sidewalk separate the southern parking area from Golden Gate Way.

As previously noted, the north, west, and south sides of the property are bordered by city streets. The northern half of the east side of the property is adjoined by a parking lot for adjacent businesses. A wood retaining wall up to about three feet high supports the parking lot on the adjoining property along the east property line at a location commencing from a point due east of the projection of the northeast corner of the existing Veteran's Hall building and extending about 30 feet to the south. A wood retaining wall supported by concrete columns tied with a grade beam extends about another 30 feet to the south along the east property line. This wall then turns to the east and supports the south edge of the parking lot on the adjoining property to the east. This wall has a height of about 5 feet. An irregular 2:1 slope that is up to about 8 feet high descends from the south edge of the parking lot on the adjoining property to a level paved parking area that is accessed from Golden Gate Way. A short wood retaining wall is located at the toe of the 2:1 slope along the north side of the offsite parking area.

Roof drainage from the existing building on the property is controlled by gutters. The gutters discharge into downspouts. The downspouts discharge onto the ground or into a flex-hose pipe that extends over the ground surface away from the building or into a subsurface clay pipe. Site drainage is generally to the south and west over the contour of the land toward Golden Gate Way. An inlet for a storm drain that is located beneath the west side of the property is present near the southwest corner of the property. This inlet takes some of the site drainage. A drain inlet was observed in the paving near the southeast corner of the property but it is unclear if this drain receives much surface water.

CONDITION OF EXISTING BUILDING

A cursory observation was made of the existing Veteran's Hall building. The existing building has some stucco cracks. The cracks are located along the base of the wood-framed wall where it attaches to the concrete footing and near the corners of windows and doorways. Some of the stucco cracks have been patched in the past. Minor interior wall cracks were observed. No obvious cracks were observed in the painted floor slabs. The distress is not considered unusual for a building of this age and type of construction.

Some cracks and separations most likely associated with tree root growth were observed in the concrete sidewalk north of the existing building. Cracks in the concrete decking located near the northwest corner of the building appear to be the result of shrinkage and/or long-term earth movement. Additionally, we observed cracks in the asphalt paved parking areas. The majority of the cracks appear to be the result of long-term subgrade failure while others in the vicinity of the southwest corner of the building are most likely the result of tree roots.

SOIL AND GEOLOGIC CONDITIONS

SURFACE SOILS

The surficial soils in the vicinity of the site generally have been mapped by the Soil Conservation Service (1977) as Cut and fill land-Diablo complex. The soils are described as heavy clay loam, silty clay, and clay derived from shale and fine-grained sandstone. Soil along the west and south edges of the site have been mapped as Clear Lake clay. These soils typically classify as low to high plasticity clay or silty clay (CL or CH) and have a moderate to high shrink/swell potential.

SITE GEOLOGY

The geology of the area has been mapped by Saul (1973), Wagner (1978), Dibblee (1980), Crane (1995)(Figure 3), and Knudsen et al (1997). All of these maps indicate that the site is underlain by Quaternary age alluvium. The mapping by Knudsen et al more specifically identifies the alluvium as late Pleistocene to Holocene age alluvial fan deposits. Bedrock was mapped by all of the aforementioned just to the north of the site and north of Mt. Diablo Boulevard. However, Nilsen (1975) in his map of landslides and surficial deposits, shows bedrock ridges extending to the south below Mt. Diablo Boulevard on the west and east sides of First Street.

Alluvium was encountered in borings excavated during our site exploration along the south and west sides of the property with the depth of the alluvium deepening to the southwest. The borings also encountered bedrock at shallow depths in the eastern portion of the site, indicative of a subtle bedrock ridge extending below Mt. Diablo Boulevard and onto the northeastern portion of the site. The map by Nilsen is most consistent with our site observations.

The bedrock encountered in the exploratory test borings is consistent with the bedrock mapped by others in the area. The bedrock encountered consists primarily of silty sandstone, with lesser amounts of sandy siltstone. Dibblee has mapped these earth materials as being Pliocene age nonmarine sediments. Projection of geologic structure in nearby outcrops as mapped by Saul, Dibblee, and Crane suggests that bedding below the site dips at steep to moderate angles to the southwest.

SEISMIC HAZARDS

The site is located within the seismically active San Francisco Bay area. The site is not located within the Fault Study Zone delineated by the State Geologist (CDMG, 1982). However, there are several active fault systems within an effective distance from the property which could cause significant ground shaking at the site. The known active faults include the San Andreas, Hayward, Rodgers Creek, Greenville, Concord, and Calaveras faults. A large magnitude earthquake on any of these fault systems has the potential to cause ground shaking at the site. The intensity of ground shaking that is likely to occur at the property will be dependant upon the magnitude of the earthquake and the distance to the epicenter. In general, the greater the distance to the epicenter, the lesser the intensity of the anticipated ground shaking that is likely to occur at the site. The Hayward fault system, is located approximately 11 kilometers southwest of the site, the Calaveras fault approximately 8 kilometers southeast of the site, and the Concord fault about11 kilometers to the northeast of the site. These are the closest known active fault systems (CDMG, 1982).

A liquefaction susceptibility map prepared by William Lettis and Associates for the Association of Bay Area Goverments (ABAG) based upon Knudsen and others (2000) maps the site as having a moderate susceptibilty to liquefaction.

SUBSURFACE EXPLORATION PROGRAM

GENERAL

The subsurface conditions at the site were investigated by drilling and sampling seven exploratory borings. The borings were drilled using a truck mounted drill rig equipped with 8-inch diameter hollow stem augers. The borings were drilled to depths ranging between 20 3/4 feet and 41½ feet below grade. Drive samples of the site materials were obtained using both Standard Penetration Test (SPT) and California Modified (CM) samplers. Samples obtained from the borings were retained for laboratory testing and analyses. The approximate locations of the borings are shown on Figure 2 along with our interpretation of the geologic conditions underlying the site.

The materials encountered in the borings were logged in the field by a geologist. The soils were visually classified in the field and office, using the Unified Soil Classification System. The logs of the borings and a key for the Unified Soil Classification System are included in Appendix A.

SUBSURFACE CONDITIONS

Soil and Bedrock Materials

The exploratory borings revealed that the northeast corner of the property is underlain by a subtle south trending bedrock ridge. The bedrock generally consists of fine-grained sandstone with some beds of siltstone. Fill was encountered overlying the bedrock in boring B-1 near the northeast corner of the property. A rind of weathered bedrock a few feet thick was encountered in all the borings except boring B-1 where it was likely removed during site grading. Soil consisting of a clayey silt was encountered overlying the weathered bedrock in boring B-7 located in the north-central portion of the property. The soil thickens to the south and west and grades into alluvium that is deepest along the western edge of the property. The alluvium generally consists of sandy clayey silt to clayey sandy silt that is medium firm to firm. The thickest alluvium encountered was 17 feet in boring B-5 which is located in the southwest portion of the property. The alluvium overlies a thin rind of weathered bedrock that in turn overlies the bedrock. Fill blankets most of the site. The fill as encountered in the test borings consists of clayey silt to silty sand. The fill is less than 4 feet thick where encountered in the borings except at boring B-2 where 8 feet was encountered.

Groundwater

Groundwater was encountered at between 7½ and 16 feet below the ground surface in borings 1, 2, 4, and 5. The augers were removed and the borings allowed to stay open for several hours prior to measurment of the static water level. In boring 5, the augers were allowed to remain in the hole when the groundwater level was measured at 13 feet below the ground surface. Following removal of the augers and some collapsing of the hole, groundwater was measured at 10½ feet below the ground surface. As a result of the clay soils encountered, it is unknown if the measured groundwater levels are representative of the actual groundwater table, however, based upon our exploration it is anticipated that some water will be encountered at or very near the proposed basement subgrade elevation in the northern portion of the site and within foundation excavations in the western and southern portion of the site. The potential for encountering groundwater during construction is greater in the alluvium located above the weathered bedrock along the west edge of the site that adjoins the filled drainage course located beneath First Street. Some groundwater may be perched in the bedrock. Schematic cross-sections depicting the site geologic conditions described above are shown on Figures 4 through 7. Additionally, more detailed descriptions of the earth materials encountered in the borings and the groundwater measurements are included in the boring logs in Appendix A.

LABORATORY TESTING PROGRAM

Our laboratory testing program was directed toward a quantitative evaluation of the mechanical properties of the soil samples recovered from the subsurface exploration program. Tests were completed in general accordance with ASTM standards or contemporary practices of the geotechnical engineering profession. Tests performed included moisture content, dry unit weight, Atterberg Limits, sieve analysis (passing #200), and direct shear testing. The results of the laboratory tests are included on the attached boring logs in Appendix A.

Atterberg Limits tests performed on a samples of alluvium from boring B-5 at 7½ feet and Boring 6 at 12½ feet yielded liquid limits of 56 and 47 and plasticity indices of 39 and 33, respectively. Atterberg limit tests on a sample of the weathered bedrock from boring B-3 at 10 feet yielded a liquid limit of 92 and a plasticity index of 62. Sieve analyses of samples of the alluvium from boring B-2 at 15 feet and boring B-6 at 12½ measured 79 percent and 85 percent passing the #200 sieve, respectively.

Empirically derived relationships between plasticity and expansion potential suggest that the alluvium has a high expansion potential and that some portions of the weathered bedrock have a very high expansion potential.

CONCLUSIONS

GENERAL

Based on the results of our geotechnical investigation, it is our opinion that the site is suitable for construction of the proposed library and basement parking from a geologic and geotechnical point of view. This opinion is contingent upon the recommendations presented herein being adhered to and implemented during the design and construction phases of the project.

GEOTECHNICAL AND CONSTRUCTION CONSIDERATIONS

The primary geotechnical concern with the proposed construction is the encountering of dissimilar earth materials (alluvium and bedrock) at the elevation of the proposed basement. Differential settlement/movement of conventional foundations founded both in bedrock and alluvium would likely occur. This adverse condition can be mitigated by the use of deepened foundations in the southern and western portion of the basement building pad area where alluvium is present at the basement elevation. The deepened foundations can consist of drilled cast-in-place friction piles that extend through the alluvium and into the bedrock. Conventional spread footings may be used in the northern and eastern portions where the basement will encounter bedrock.

Some portions of the weathered bedrock and the alluvium exposed at the basement subgrade is highly expansive and will require a stiffer basement slab design. The basement slab design can be reduced if the expansive weathered bedrock and alluvium sections are removed to a depth of 3 feet below the slab subgrade and replaced with select fill derived from excavations in the sandstone bedrock.

Groundwater was encountered at elevations slightly above and below the proposed basement elevation. Basement walls and the basement floor slab should be provided with drainage systems to provide for effective long-term control of the site drainage conditions. The retaining wall designs provided in this report assume drained wall conditions. Based on the current plan it appears as though an existing storm drain that extends below the west side of the property will be removed. It is recommended that a new storm drain line be configured to handle water from drainage systems for the proposed structure and that it be connected into the existing storm drain line where it extends beneath Golden Gate Way near the southwest corner of the property.

Shoring piles will be required where deeper excavations are necessary to obtain the basement elevation and where excavations will be on or in close proximity to the property lines. The shoring piles along the north side of the proposed structure and the east side of the proposed structure will encounter bedrock which can be utilized to resist the lateral loads imposed on the shoring piles. The depth to bedrock along the west side of the structure is greater. Shoring piles along the west side of the structure may utilize the alluvium and weathered bedrock to resist lateral loading.

It is likely that shoring piles and foundation piles will encounter groundwater. It is anticipated that caving in most of the piles will be minimal and that piles can be drilled and poured if the work is done on the same day. Some pile excavations in the deeper fill and alluvium in the west and southwest portions of the property may require casing.

SEISMIC DESIGN CONSIDERATIONS

Fault Rupture and Ground Shaking

The site is not located within an Earthquake Fault Zone for active faults as defined by the State Geologist. The nearest mapped active fault is located approximately 8 kilometers southeast of the site. Therefore, it is our opinion that the potential for surface rupture due to faulting at the site is low.

Due to the proximity of the site to the numerous active fault systems which traverse the greater Bay Area, it is likely that the property will be subjected to the effects of a major earthquake during the design life of the proposed improvements. The effects are likely to consist of significant ground accelerations. These ground movements may cause damage to the proposed structures. Structural systems for the new building should be designed in accordance with the requirements of Chapter 16 of the 1997 Uniform Building Code for Seismic Zone 4 conditions, Soil Type S_c, and a Seismic Source Type B at a distance of 8 kilometers from the site or a Type A fault at a distance of 11 kilometers from the site.

Ground Failure and Liquefaction

Flat areas underlain by alluvial deposits can be susceptible to ground failure in response to seismically induced ground shaking. The most common seismically induced ground failures are liquefaction and liquefaction induced lateral spreading. The factors affecting liquefaction include depth of water table, thickness and location of granular layers, relative density of granular layers, maximum acceleration produced by earthquake shaking, and the number of cycles of strong shaking.

The bedrock that will be exposed at the basement elevation is not subject to liquefaction. The vast majority of the alluvium encountered in our borings consists of highly plastic clayey sandy silt and and clayey silt that are not considered to be liquefiable. Based on the geologic characteristics of alluvial deposits, it is our opinion that potentially liquefiable soils are limited to thin, isolated, discontinuous lenses of granular soil within the generally fine-grained alluvium. The proposed structure will be supported on foundations that extend into bedrock and should not be significantly effected by any minor liquefaction that may occur.

The potential for lateral spread of the alluvium to the south toward Lafayette Creek is considered very low due to the fine-grained and highly plastic nature of most of the alluvium, the significant distance to the creek, and as a result of the creek having been channelized with concrete sidewalls.

RECOMMENDATIONS

GRADING

General Site Preparation

The existing structure, concrete decking, and asphalt paving should be removed from the site. Existing trees that will not be incorporated into the proposed development should be removed from the site. It is our understanding that most of the site will be lowered for the basement level parking. It is anticipated that bedrock, weathered bedrock, and alluvium will be encountered at the basement subgrade elevation. The building foundations are to be supported entirely by the bedrock, but the basement floor slab may be supported on bedrock, weathered bedrock, firm alluvium, and engineered fill. Any existing fill and/or soft alluvium exposed at the basement slab subgrade elevation should be removed and recompacted. It may be desirable to overexcavate the basement subgrade section underlain by alluvium and locally expansive weathered bedrock and replace it with a select fill derived from the sandstone bedrock that will be encountered during excavation at the northeast corner of the property. The fill derived from the sandstone bedrock is considered to have a low expansion potential. The select fill compacted fill blanket should be a minimum of 3 feet thick. The select fill should be moisture conditioned to at least 3 percent above optimum, placed in lifts that do not exceed 8 inches in uncompacted thickness, and compacted to a minimum relative compaction of at least 90 percent relative compaction as determined by ASTM D1557. The firm alluvium and/or weathered bedrock on which the fill is placed should be pre-soaked prior to placing the select fill to further reduce the potential affects of expansion. Whatever option is chosen, it is recommended that the grading and compaction necessary to establish the basement subgrade be performed prior to excavation and construction of the conventional and deepened footings that will support the library.

Areas to be covered by concrete decking or paving outside the footprint of the basement should also have any existing fill and soft alluvium removed and recompacted to a minimum of 90 percent of the maximum dry unit weight determined according to ASTM D1557.

FOUNDATION SYSTEM

Based on the results of our field investigation and laboratory test results, it is our opinion that the proposed library can be supported on a foundation system consisting of conventional perimeter and interior spread footings where bedrock is encountered at or near the basement subgrade elevation. Drilled, cast-in-place friction piles can be utilized for support of the proposed library where the bedrock underlies the alluvium exposed at the basement subgrade elevation. We anticipate that the total settlement of the foundation system designed and constructed as recommended below will be less than 2 inches. Differential settlement across 50 feet of the structure is anticipated to be up to 1 inch. The following geotechnical parameters should be used in the design of the foundation system.

Spread Footings

Continuous and/or pad footings may be used to support the library, provided they are founded in dense bedrock. Continuous footings should be a minimum of 12 inches in width. Pad footings should be a minimum of 36 inches square. Design parameters are outlined in Table 1.

TABLE 1 - SPREAD FOOTING DESIGN PARAMETERS

Bearing Material	Minimum Depth into Bearing Material (Inches)	Vertical Bearing (psf)	Coefficient of Friction	Passive Earth Pressure (pcf)	Maximum Earth Pressure (psf)
Bedrock (strip footing)	18	3,500	0.4	400	5,000
Bedrock (pad footing)	18	5,000	0.4	400	8,000

Increases in the bearing value are allowable at a rate of 10 percent for each additional foot of footing width or depth to the maximum earth pressure.

The bearing value indicated above is for the total of dead and frequently applied live loads and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces. When combining passive and friction for lateral resistance, the passive component should be reduced by one third. For the purpose of bearing calculations, the weight of the concrete in the footing may be neglected.

All continuous footings should, at a minimum, be reinforced with four #5 steel bars, two placed near the top and two placed near the bottom of the footings. Footings greater than 3 feet in depth should be provided with vertical reinforcement consisting of #4 steel bars spaced 24 inches on center. Continuous footings should not exceed a total depth of 5 feet without special design from the structural engineer. The actual dimensions and reinforcement for the footing should be determined by the project structural engineer. Footing excavations should be cleaned of all loose material, moistened, and free of shrinkage cracks prior to placing concrete. Footing excavations should be pre-saturated prior to pouring concrete.

Deepened Foundations - Friction Piles

Friction piles may be used to support the proposed library where alluvium overlies the bedrock at the basement subgrade elevation. Piles should be a minimum of 24 inches in diameter and extend a minimum of 10 feet into bedrock. The piles may be designed assuming an average skin friction value of 600 pounds per square foot for that portion of pile in contact with bedrock located 10 to 20 feet into bedrock and 800 pounds per square foot for that portion of pile that exceeds an embedment depth of 20 feet into bedrock. Piles supporting the perimeter walls or interior walls should be tied with a grade beam. Interior piles supporting column loads may be independent, tied with a pile cap or tied to a grade beam at the discretion of the structural engineer.

Lateral Design

The skin friction values indicated above are for the total of dead and frequently applied live loads and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces. Resistance to lateral loading may be provided by passive earth pressure within the bedrock and alluvium. Passive earth pressure within the bedrock may be computed as an equivalent fluid having a density of 400 pounds per cubic foot, with a maximum earth pressure of 4,000 pounds per square foot. Passive earth pressure within the alluvium may be computed as an equivalent fluid having a density of 200 pounds per cubic foot, with a maximum earth pressure of 2,000 pounds per square foot. For design of isolated piles, the allowable passive earth pressure may be increased by 100 percent. Piles which are spaced more than three pile diameters on center may be considered isolated.

UTILITIES

Any footings located adjacent to utility trenches should have their bearing surface below an imaginary 1½ H:1V (horizontal:vertical) plane projected upward from the edge of the bottom of the adjacent trench. Utility trenches should be backfilled with material compacted to at least 90 percent relative compaction as determined by ASTM D1557. Utility penetrations through walls or footings should be tightly sealed.

Utilities bedded in sand can serve as conduits to bring subsurface water onto the site. It is recommended that a slurry or bentonite seal be placed around pipes at their entrance to the property to prevent the flow of subterranean water onto the site.

BUILDING FLOOR SLABS

The on-grade portion of the basement floor slab can be cast over dense, undisturbed bedrock, weathered bedrock, and alluvium. Any existing fill or soft alluvium beneath the basement slab footprint, as determined by a representative from Can Engineering & Geology, should be removed and recompacted. Because the weathered bedrock and alluvium have a high to very high expansion potential, it is recommended that the basement slab be a minimum of 6 inches thick and reinforced with #4 steel bars at 12 inches on center.

As on alternative, the expansive weathered bedrock and the alluvium can be removed and replaced with a 36 inch thick layer of select low-expansion engineered fill derived from the sandstone bedrock. A slab supported on the select compacted fill should be a minimum of 5 inches thick and reinforced with #3 steel bars at 18 inches on center.

Building floor slabs supported on grade that extend beyond the basement footprint should be supported on compacted fill, firm alluvium, weathered bedrock, or bedrock. The minimum slab dimensions and reinforcement noted for the basement floor slab may be utilized for other on-grade floor slab sections. The actual slab dimensions and reinforcement should be determined by the project structural engineer.

To reduce the potential for subsurface water or moisture causing wetness in the slabs, we recommend that two 10 mil plastic vapor barriers be placed directly beneath the slab. A 6-inch layer of compacted clean crushed rock or pea gravel should be placed under the vapor barrier to act as a capillary break. The base of the crushed rock or pea gravel layer should be contoured so that it slopes to under slab drains placed below the basement floor slab to maintain the groundwater level below the floor slab. The under slab drains should transfer the drainage to a storm drain or other approved location.

A 2-inch sand layer should be placed above the plastic vapor barrier to minimize potential damage to the barrier during placement of the concrete. For design purposes the crushed rock and sand can be part of the recommended 3 foot thickness of non-expansive engineered fill recommended above. Actually detailing of the under slab vapor control measures should be provided by the project structural engineer or architect.

RETAINING WALLS

We recommend that the retaining walls be supported on conventional spread footings or friction piers . The bearing and base friction values presented above for the foundation can should be used in the design of the retaining walls. The retaining wall design earth pressures are shown in Table 2.

TABLE 2 - RETAINING WALL DESIGN PRESSURE

Design Condition	Equivalent Fluid Pressure (pcf/ft)
Unrestrained (Active Pressure)	50
Restrained	80

The wall pressures for the soil and alluvium and the northern basement wall were analyzed assuming no traffic surcharge. The wall pressure for the basement wall section adjoining the concrete and wood retaining walls along the east property line was analyzed assuming that the basement wall is surcharged by the retained soil and by traffic loading. The values determined by the analyses were nearly the same value and it is therefor recommended that one uniform value be used for the permanent basement wall design. The values listed above are unfactored loads (have a factor of safety of 1.0) and should have the appropriate safety factors applied by the structural engineer. These values should be checked if the basement configuration is changed.

The above equivalent fluid pressures (restrained and unrestrained case) assume fully drained conditions behind the retaining walls. Therefore, the retaining walls should be provided with a full height back wall drainage system consisting of a 12 inch wide layer of Caltrans Class 2 Permeable or a 12 inch wide layer of ¾ inch crushed rock enclosed in a 6 ounce per square yard non-woven filter fabric. In lieu of a gravel column a drainage composite such as Miradrain may be used. A perforated ABS SDR 35 plastic pipe should be placed at the heel of the wall and should be located a minimum of 16 inches below adjacent concrete slab floors. The pipe should be placed with the perforations down and should be installed with a cross gradient of not less than 2 percent. Water collected by the drain at the base of the retaining wall should be directed into a solid drain pipe that directs the drainage into a sump in the basement, a storm drain, or other approved location.

The gravel backfill or drainage composite should extend within 2 feet of the ground surface. The upper 2 feet should be backfilled with compacted fill to prevent surface water from infiltrating into the back wall drainage. The onsite earth materials may be used for retaining wall backfill. The retaining wall backfill should be compacted to a minimum of 90 percent of the maximum density as determined by ASTM D1557.

Waterproofing of the retaining walls should be designed by the project architect or structural engineer.

TEMPORARY EXCAVATION STABILITY

Temporary 1:1 cuts in the existing fill, soil, and alluvium up to 8 feet high may be made where the temporary cuts are not surcharged and do not adjoin streets or property line improvements. Depending on the final configuration of the basement garage it may be possible to eliminate the necessity for shored vertical cuts along the southern portions of the west and east sides of the basement.

Temporary shoring piles will be required to support the higher vertical excavations along the north side of the proposed basement and the northern portions of the west and east sides of the proposed basement. We recommend that all shoring design and construction be the responsibility of the contractor. The shoring plans should be prepared and stamped by a California licensed civil engineer based on the design parameters presented in this report. The shoring design should be provided to us for review prior to construction.

The shoring design pressures are provided in the following table.

TABLE 3 - SHORING DESIGN EARTH PRESSURE

Unrestrained Active Equivalent Fluid Pressure	30 pcf/ft	North and West Shoring Walls and East Shoring Wall Not Adjoined by Existing Retaining Walls
Unrestrained Active Equivalent Fluid Pressure	40 pcf/ft	East Shoring Wall Adjacent to Existing Retaining Walls

The values listed above are unfactored loads and should have the appropriate safety factors applied by the structural engineer. The pressures determined for a foot-wide section of wall should be multiplied by the pile spacing to determine the load on the shoring pile.

Shoring piles along the north and northern portion of the east side of the proposed basement will encounter bedrock at the basement subgrade elevation. It is recommended that these shoring piles be a minimum of 18 inches in diameter and extend a minimum of 7 feet into bedrock below the base of the basement perimeter wall footing. The shoring piles that extend into bedrock may be designed for a skin friction of 600 pounds per square foot for that portion of the pile in contact with the bedrock below the basement wall footing.

The shoring piles along the west side of the proposed basement will generally encounter alluvium at the basement subgrade elevation. Shoring piles along this side of the building may gain support from the alluvium and weathered bedrock below the base of the basement perimeter wall grade beam. It is recommended that these shoring piles be a minimum of 24 inches in diameter and extend a minimum of 10 feet into alluvium and/or weathered bedrock below the base of the basement perimeter wall grade beam. The shoring piles that extend into alluvium and/or weathered bedrock may be designed for a skin friction of 400 pounds per square foot for that portion of the pile in contact with the alluvium and/or weathered bedrock below the basement perimeter wall grade beam. The recommended maximum center to center spacing of the piles is 8 feet, however, the actual spacing should be determined by the shoring engineer.

Shoring may be designed as cantilevered or raker-braced piles. Raker-braced piles may be used where the basement subgrade exposes bedrock for support of the pad footings for the raker-braced piles. The tops of pad footings for raker braced piles should be a minimum of 18 inches below the ground surface and 2 feet wide x 2 feet long. A bearing value of 2,500 pounds per square foot may be used for raker pad footings.

The bearing and skin friction values indicated above are for the total of dead and frequently applied live loads and may be increased by one third for short duration loading, which includes the effects of wind and seismic forces. Resistance to lateral loading may be provided by friction at the base of the foundations (raker pads only) and by passive earth pressure in the bedrock, weathered bedrock, and alluvium. An allowable coefficient of 0.4 may be used for the dead load forces on the raker pad footings. The passive earth pressure within the bedrock below the base of the basement wall footing may be computed as an equivalent fluid having a density of 400 pounds per cubic foot with a maximum earth pressure of 4,000 pounds per cubic foot. The passive earth pressure within the weathered bedrock and alluvium below the base of the basement wall grade beam may be computed as an equivalent fluid having a density of 200 pounds per cubic foot with a maximum earth pressure of 2,000 pounds per cubic foot. When combining passive and friction for lateral resistance, the passive component should be reduced by one third. For design of isolated piles, the allowable passive earth pressure may be increased by 100 percent. Piles which are spaced more than three diameters on center may be considered isolated.

Lagging will be required to retain loose earth materials around the top of the excavation. It is recommended that the upper 3 feet of the vertical excavations be shored. Lagging may also be required in areas of soft fill or alluvium or where seepage is present. The placement of lagging may also be necessary to protect workers from raveling and shallow pop-outs during wall construction and subdrain and waterproofing installation. Lagging should be designed in accordance with the Caltrans Shoring Manual.

A representative of Cal Engineering & Geology should be present during excavation of the shoring piles and grading and construction to observe temporary slopes. All excavations should be stabilized within 30 days of initial excavation. Water should not be allowed to pond within excavations nor to flow toward excavations. No vehicular surcharge should be allowed within 3 feet of the top of cuts unless accommodated by the shoring design. Temporary cuts should be covered with plastic and berms should be created to prevent water from overtopping the temporary excavation during the rainy season.

It is recommended that the City and/or shoring contractor photograph or video document the conditions of offsite structures and flatwork that adjoin the area to be shored so that distress that existed prior to the excavation can be discerned.

EXCAVATION CHARACTERISTICS

The test borings encountered generally clayey fill, soil, and alluvium over bedrock. Hard, cemented rock was not encountered during our exploration. Locally very hard sandstone layers and pebble conglomerate may be encountered in foundation piles and shoring piles which may require coring.

Groundwater will likely be encountered in many of the foundation and shoring piles. The location and infiltration rate of the water is variable. It is anticipated that some piles will be able to be drilled and remain dry if the steel and concrete is set and poured at the completion of drilling. Piles excavated along the west side of the site and in close proximity to the filled drainage course located roughly along the alignment of First Street are more likely to encounter groundwater. Casing may be necessary to prevent caving in those holes which encounter thicker deposits of alluvium below the water table. Groundwater should be pumped from the excavations prior to pouring or should be displaced by the concrete by being tremied from the bottom of the excavation.

EXTERIOR DECKING

The existing fill and the upper 24 inches of the alluvium are not considered satisfactory for support of exterior decking. The existing fill and alluvium outside the footprint of the basement that will underlie decking should be removed and recompacted to a minimum of 90 percent of the maximum dry unit weight determined according to ASTM D1557. The exterior decking should be cast over a firm subgrade and be a minimum of 5 inches thick. The decking should be reinforced with a minimum of #3 steel bars spaced 18 inches on center each way. The decking should be underlain by a minimum of 2 inches of sand to aid in the concrete cure.

Decking should be provided with frequent crack-control or expansion joints. In particular, joints are recommended at 90-degree corners and areas where the deck transitions to a narrower segment. Joints should be spaced a maximum of 8 feet on center. Decking which adjoins a lawn, planter or the top of a slope should be provided with an 8-inch-thick deepened edge. The deck reinforcement should be bent down into the edge. Additional #3 steel bars should be provided at the top and bottom of the deepened edge. Deck sections which contain parallel deepened edges should be provided with at least one crack-control joint parallel to and between the deepened edges.

Decking which caps a retaining wall should be provided with a flexible joint to allow for an anticipated (normal) 0.25 to 1 percent deflection of the retaining wall. Decking which does not cap a retaining wall should not be connected to the wall. The space between the wall and the deck will require periodic caulking to prevent moisture intrusions into the retaining wall backfill.

SURFACE DRAINAGE

Areas adjacent to the proposed building should be positively sloped away from the building to provide for rapid removal of surface runoff. Ponding of water under floors or seepage toward foundation systems at any time during or after construction should be prevented. To reduce the potential for ponding of water adjacent to the foundation system, we recommend the following be included in the design of the foundation.

- Finished grades and slabs within 5 feet of the structure should slope away from the structure at a minimum gradient of 5 percent to allow surface water to drain positively away from the structure.

- All storm water from roof downspouts should be collected in a solid pipe drain system which discharges into an appropriate facility.

- Planted areas should be avoided immediately adjacent to the building. If planting adjacent to the building is desired, the use of plants that require very little moisture is recommended. Irrigation of landscape areas should be limited strictly to that necessary for plant growth. Sprinkler systems should not be installed where they may cause ponding or saturation of foundation soils within 5 feet of retaining walls and/or under buildings.

The project landscape architect should be informed of the grading and surface drainage requirements included in this report.

LIMITATIONS

The conclusions and recommendations of this report are based upon information provided to us regarding the proposed improvements, subsurface conditions encountered at the boring locations, our geologic reconnaissance, the results of the laboratory testing program, and professional judgement. We have employed accepted geotechnical engineering and engineering geologic procedures, and our professional opinions and conclusions are made in accordance with generally accepted geotechnical engineering and engineering geologic principles and practices. This standard is in lieu of all other warranties, either expressed or implied.

It is the city's responsibility to make sure that the recommendations contained in the report are brought to the attention of the architect, engineers, and contractors working on this project. Furthermore, it is the city's responsibility to make that these recommendations are included in the design and construction of the project.

The locations of the exploratory borings were determined by taping from established site features and other points of reference and are considered to be approximate only. Site conditions described in the text are those existing at the time of our last field exploration and reconnaissance in April 2003, and are not necessarily representative of such conditions at other times or locations.

Unanticipated soil conditions are frequently encountered during construction and cannot be fully determined by drilling and sampling a limited number of exploratory borings. Additional expenditures may be required during the construction phases of the project as conditions vary. It is recommended that a contingency fund be established to cover potential adverse soil conditions which may be encountered during grading. If it is found during construction that subsurface conditions differ from those described on the boring logs, then the conclusions and recommendations in this report shall be considered invalid, unless the changes are reviewed and the conclusions and recommendations modified or approved in writing by Cal Engineering & Geology, Inc.

It should be noted that this report was prepared based on the conceptual level design of the library facility as of the beginning of April 2003. If the actual configuration of the project changes significantly, it is possible that additional subsurface exploration and geotechnical analyses may be warranted.

Cal Engineering & Geology, Inc. should be accorded the opportunity to review the final plans and specifications to determine if the recommendations of this report have been implemented in those documents. The review would be acknowledged in writing.

Field observation and testing services are essential parts of the proposed project. It is important that Cal Engineering & Geology, Inc. be retained to observe the earthwork, footing excavations, and other relevant construction operations. The recommendations of this report are contingent upon this stipulation.

Evaluation of the site with regard to hazardous or toxic materials was not within the scope of this investigation.

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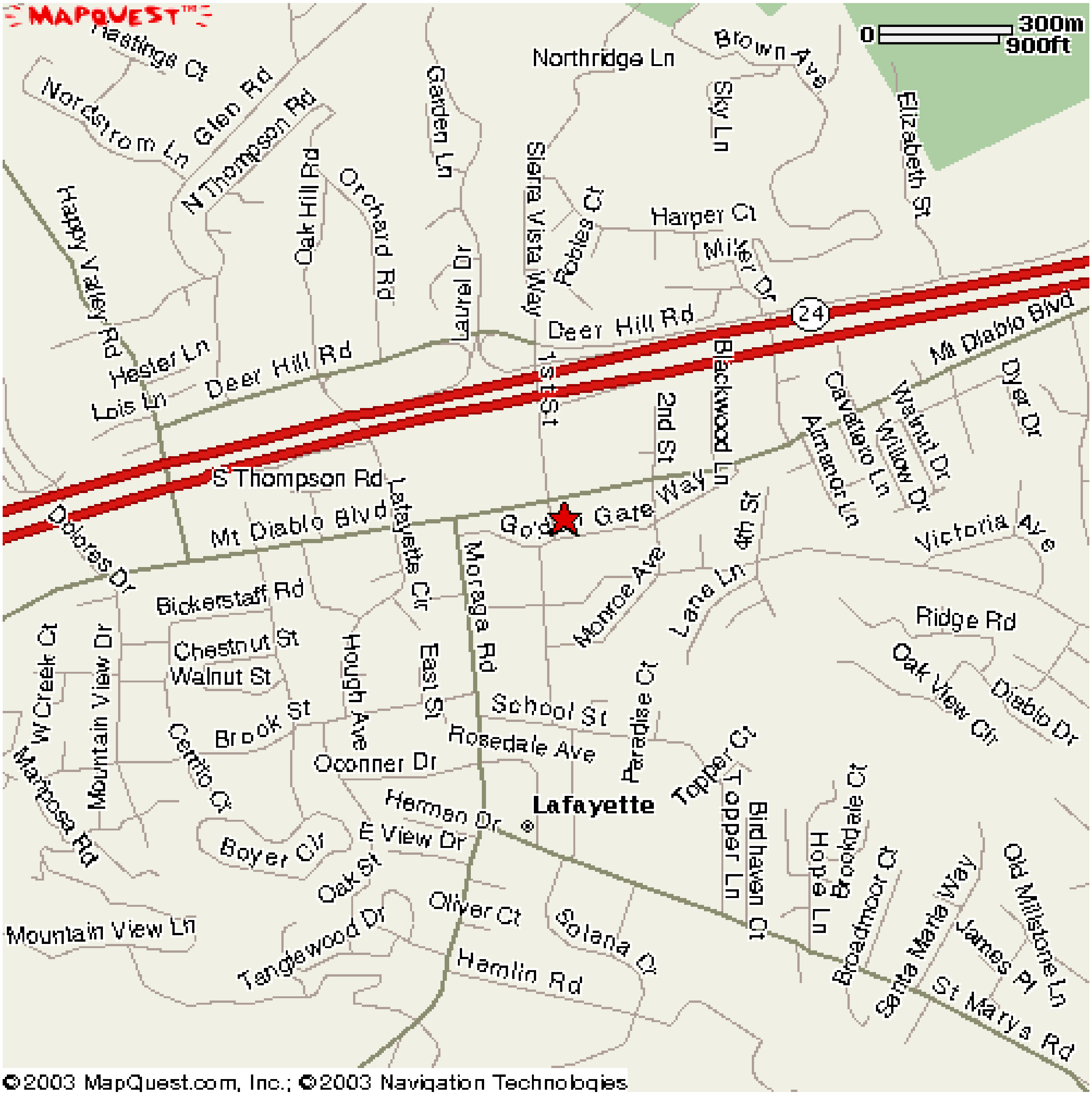

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★ APPROXIMATE SITE LOCATION

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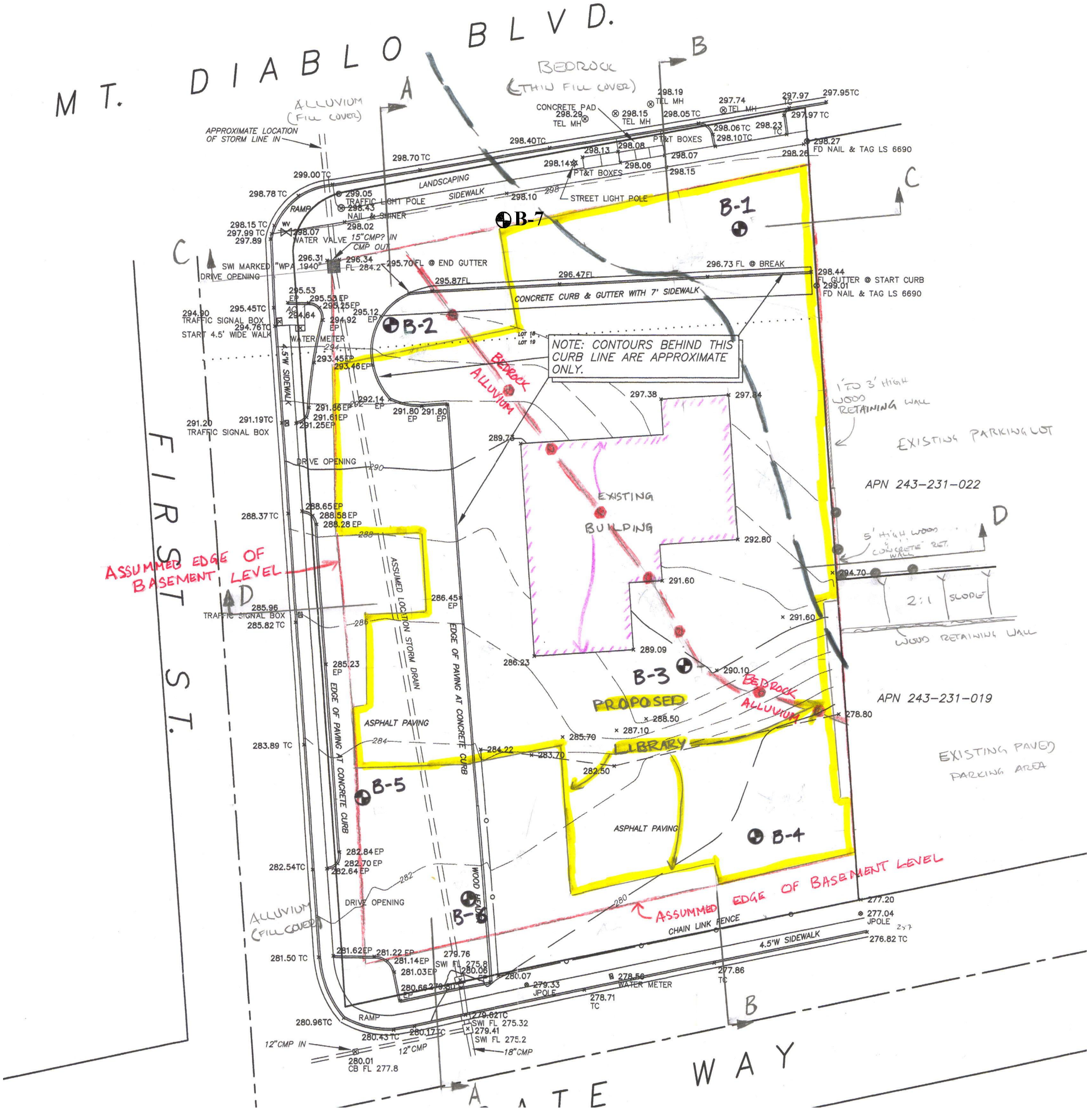
SITE LOCATION MAP	
PROPOSED CITY LIBRARY, LAFAYETTE, CA	
Project No. 030400	*FIGURE 1*



not to scale

LEGEND

B-7 ◐ LOCATION OF CEG BORING

GEOLOGIC CONTACT

BEDROCK ● ALLUVIUM BEDROCK/ALLUVIUM CONTACT AT ELEV. 278 □ (ASSUMED BASE SUBGRADE)

D D GEOLOGIC CROSS SECTION (SEE FIGURES 4-7)

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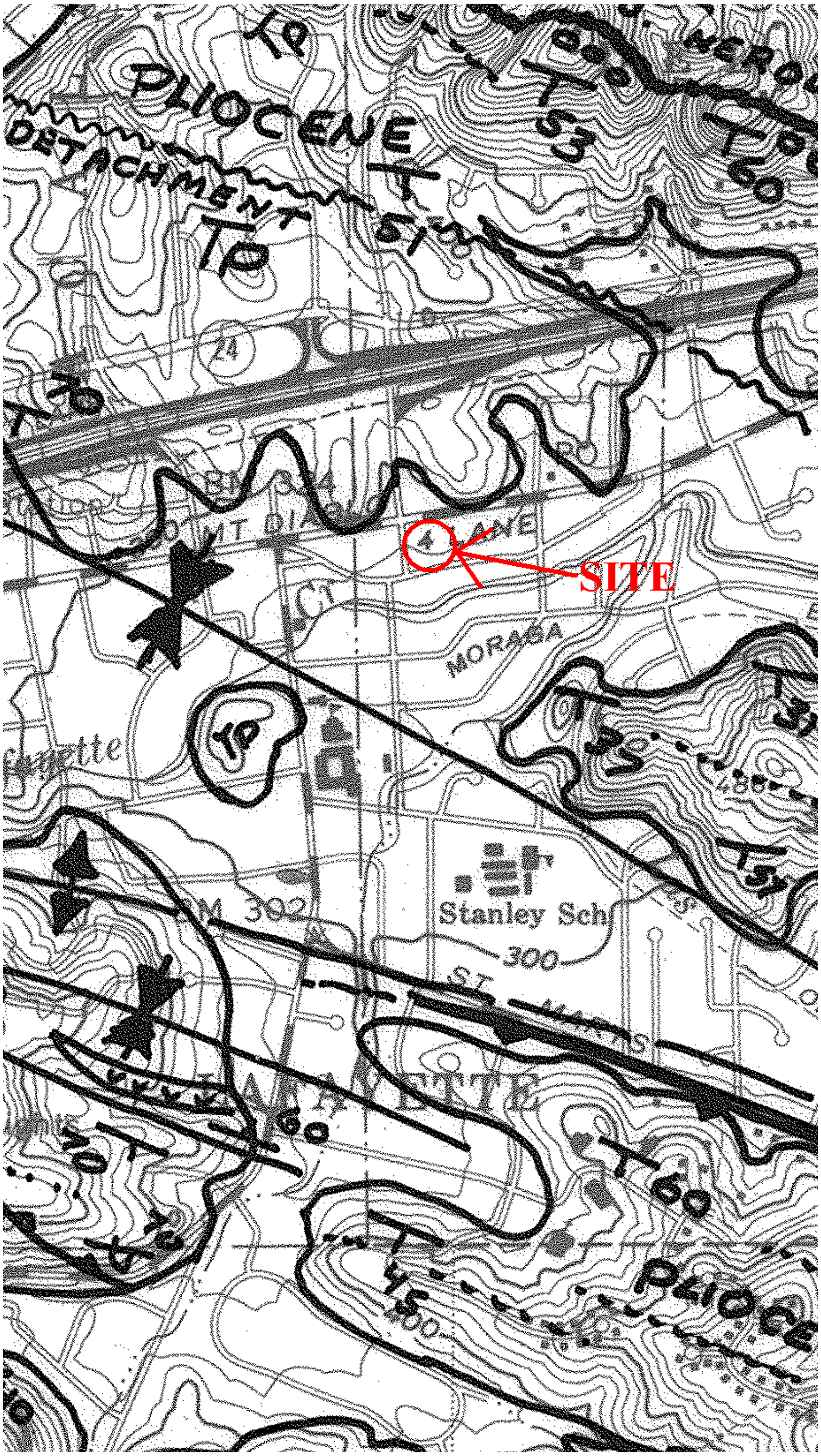
BORING AND CROSS SECTION LOCATION MAP

PROPOSED CITY LIBRARY, LAFAYETTE, CA

Project No. 030400	*FIGURE 2*

WALNUT CREEK

	HOLOCENE - 0 MY
Qa	ALLUVIUM
Qls	LANDSLIDES
〰	PLEISTOCENE - .1 MY
Qoa	Older ALLUVIUM
〰	PLIOCENE - 1.67 MY
TP	PLIOCENE Undifferentiated Includes U. MIOCENE beds
Tbr	BLACKHAWK RANCH Fm.
Tdi	DIABLO Fm.
TNe	NEROLY Fm.
TC	CIERBO Fm.
TB	BRIONES FM.
TMM	MONTEREY GROUP
Tr	RODEO Shale
Th	HAMBRE Fm.
Tt	TICE Shale
To	OURSAN Fm.
Tcl	CLAREMONT Fm.
Tso	SOBRANTE Sand
TSR	SAN RAMON Fm.
TE-O	EOCENE, Undifferentiated
Tmk	MARKLEY Fm.
TN	NORTONVILLE Shale
TD	DOMENGINE Fm.
TC	CAPAY Shale
Tmz	MARTINEZ Fm.
K	CRETACEOUS



Scale: 1 inch = 1000 feet

Source: Crane (1995)

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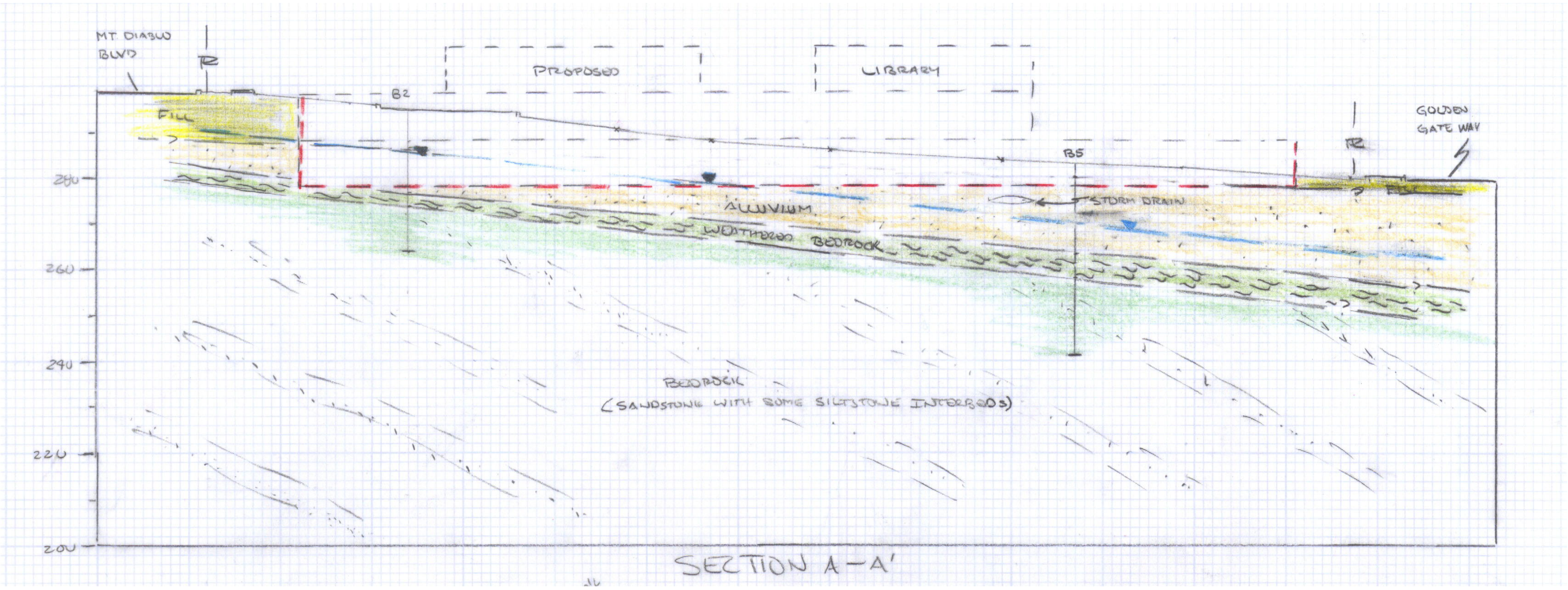
SITE GEOLOGY MAP	
PROPOSED CITY LIBRARY, LAFAYETTE, CA	
Project No. 030400	*FIGURE 3*



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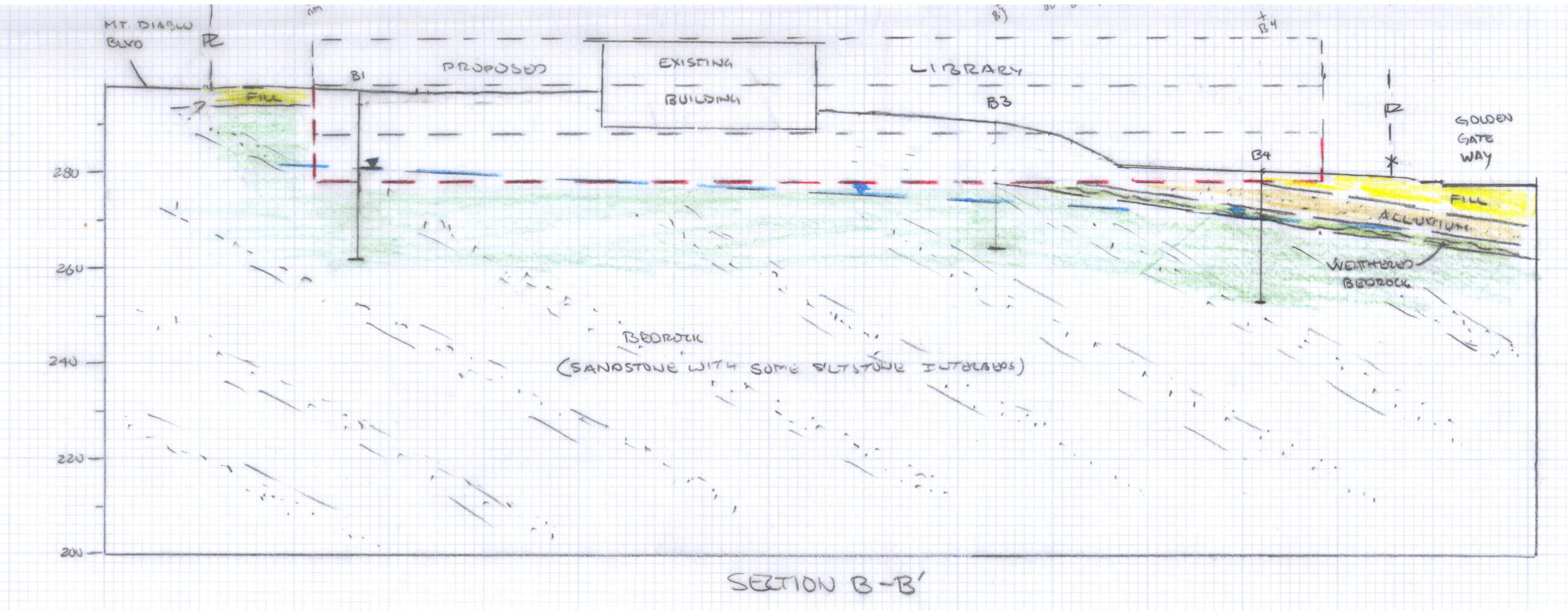
CROSS SECTION A-A	
PROPOSED CITY LIBRARY, LAFAYETTE, CA	
Project No. 030400	*FIGURE 4*



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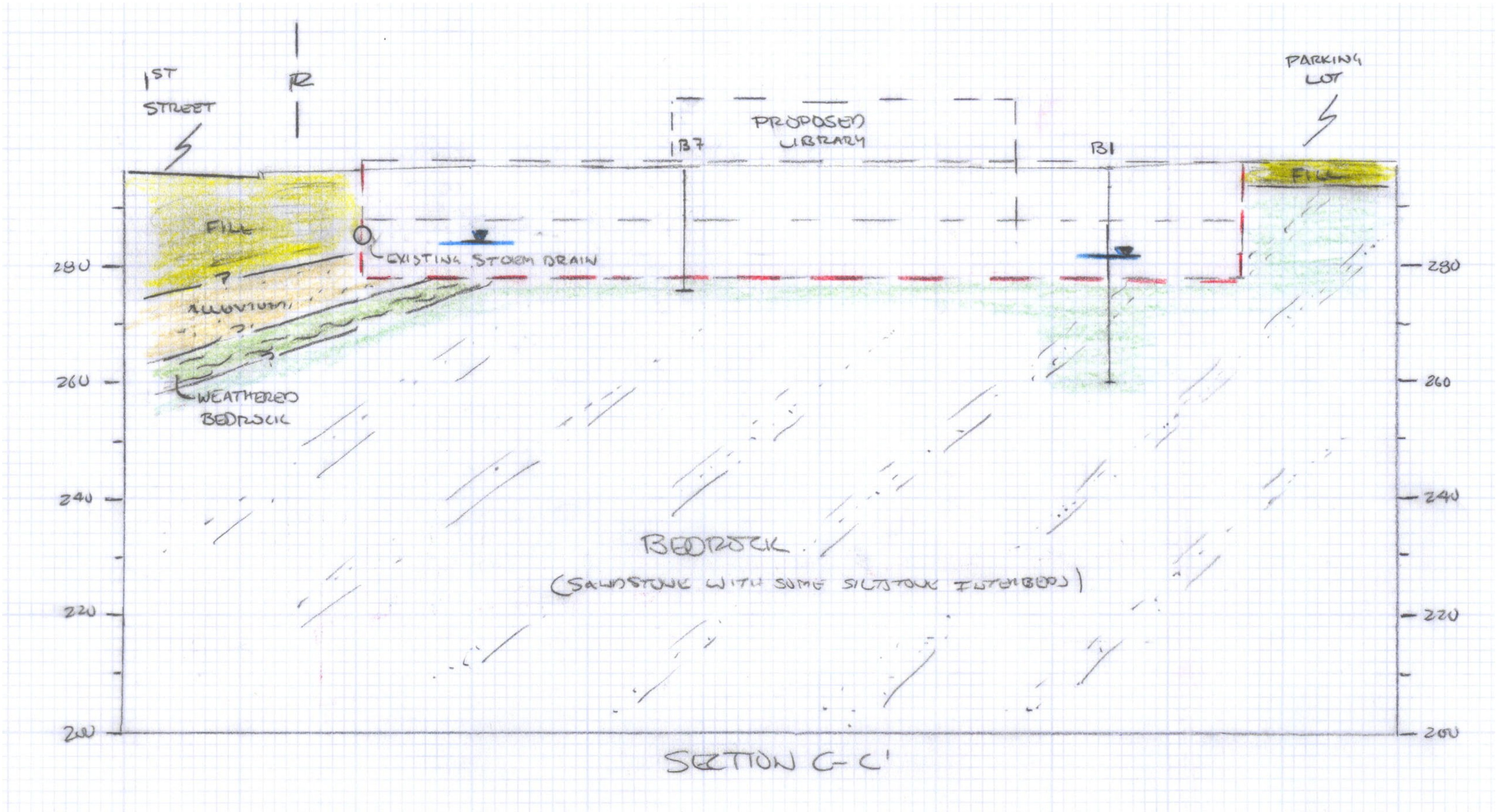
CROSS SECTION B-B	
PROPOSED CITY LIBRARY, LAFAYETTE, CA	
Project No. 030400	*FIGURE 5*



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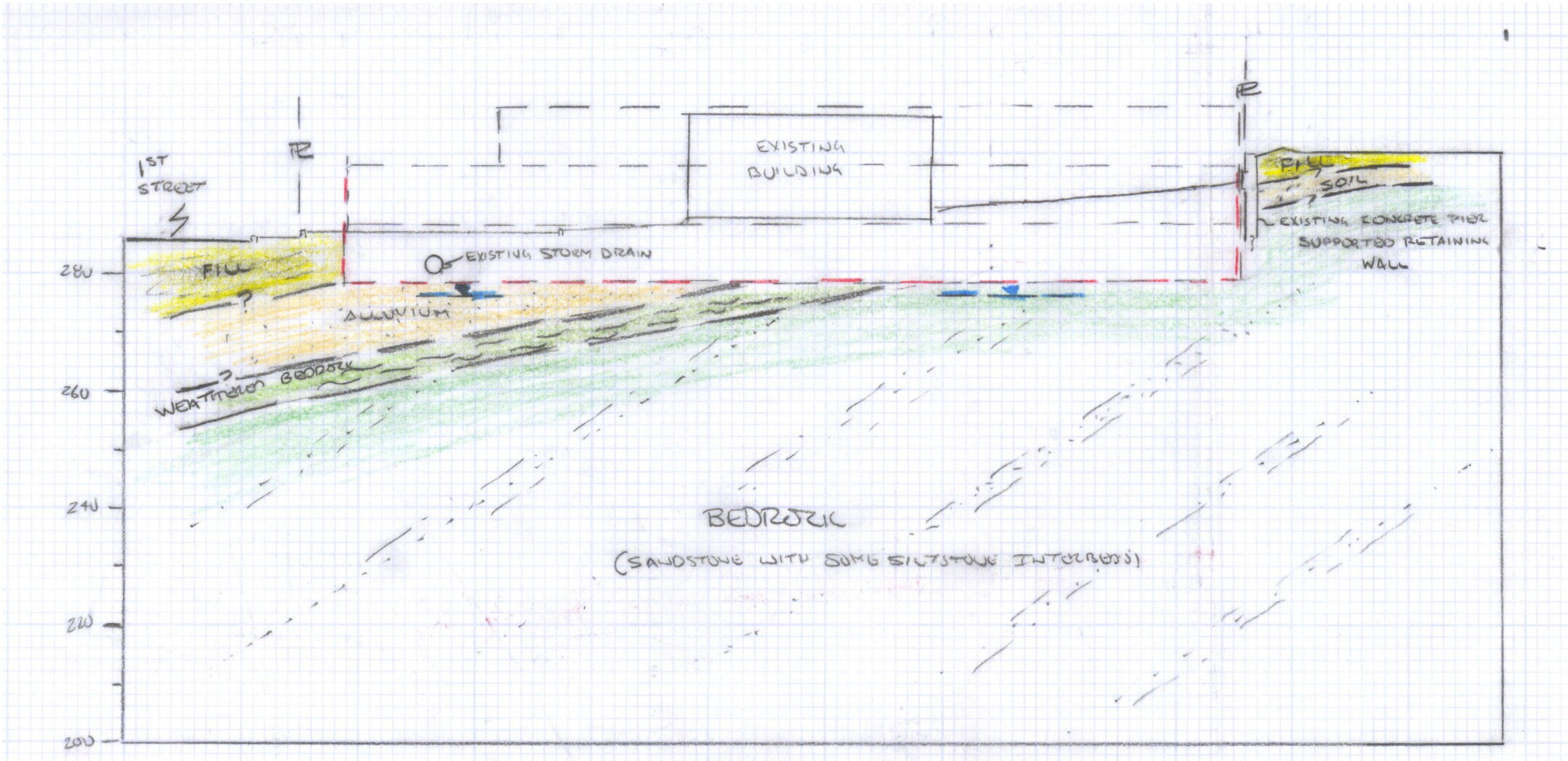
CROSS SECTION C-C

PROPOSED CITY LIBRARY, LAFAYETTE, CA

Project No. 030400	FIGURE 6



SECTION D-D'

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CROSS SECTION D-D

PROPOSED CITY LIBRARY, LAFAYETTE, CA

Project No. 030400	*FIGURE 7*

APPENDIX A - EXPLORATORY BORINGS

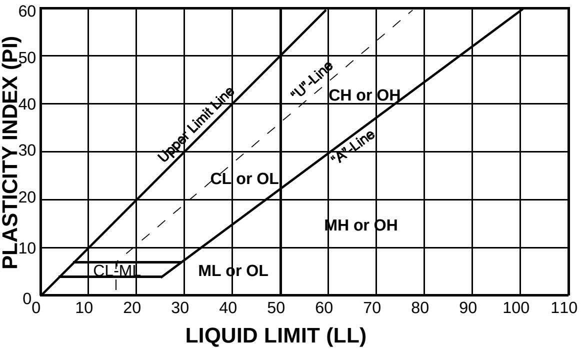
UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Field Identification			Group Symbol	Typical Names	Laboratory Classification Criteria		
Coarse-Grained Soils More than 50% of material is retained on the No. 200 sieve.	**Gravels** More than 50% coarse fraction retained on the No. 4 sieve	**Clean Gravels** < 5% Fines	**GW**	Well-graded gravels, gravel-sand mixtures, little or no fines	**CLASSIFICATION OF GRAVELS & SANDS WITH 5% TO 12% FINES REQUIRES DUAL SYMBOLS** GW/GM or GP/GM: Gravel/Silty Gravel GW/GC or GP/GC: Gravel/Clayey Gravel SW/SM or SP/SM: Sand/Silty Sand SW/SC or SP/SC: Sand/Clayey Sand	$C_U = D_{60} \div D_{10} \geq 4$ and $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) \geq 1$ & ≤ 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		$C_U = D_{60} \div D_{10} < 4$ and/or $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) < 1$ & > 3	
		Gravels with Fines >12% Fines	**GM**	Silty gravels, poorly graded gravel-sand-silt mixtures		Fines classify as ML or MH	If fines classify as CL-ML, use dual symbol GC/GM
			GC	Clayey gravels, poorly graded gravel-sand-clay mixtures		Fines classify as CL or CH	
	Sands More than 50% coarse fraction passes the No. 4 sieve	**Clean Sands** < 5% Fines	**SW**	Well-graded sands, gravelly sands, little or no fines		$C_U = D_{60} \div D_{10} \geq 6$ and $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) \geq 1$ & ≤ 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		$C_U = D_{60} \div D_{10} < 6$ and/or $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) < 1$ & > 3	
		Sands with Fines >12% Fines	**SM**	Silty sands, poorly graded sand-silt mixtures		Fines classify as ML or MH	If fines classify as CL-ML, use dual symbol SC/SM
			SC	Clayey sands, poorly graded sand-clay mixtures		Fines classify as CL or CH	
Fine-Grained Soils More than 50% of material passes the No. 200 sieve.	**Identification Procedures on Percentage Passing the No. 40 Sieve**						
	Silts & Clays Liquid Limit less than 50%		**ML**	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly, sandy, and/or silty clays, lean clays			
			OL	Organic silts, organic silty clays of low plasticity			
	Silts & Clays Liquid Limit greater than 50%		**MH**	Inorganic silts, micaceous or diatomaceous fine sandy/-silty soil, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
HIGHLY ORGANIC SOILS			**PT**	Peat and other highly organic soils			

PLASTICITY CHART

For Classification of Fine-Grained Soils and Fine-Grained Fraction of Coarse-Grained Soils

Equation of "A"-Line: PI = 4 @ LL = 4 to 25.5, then PI = 0.73 × (LL − 20)
Equation of "U"-Line: LL = 16 @ PI = 0 to 7, then PI = 0.9 × (LL − 8)



KEY TO SAMPLER TYPES AND OTHER LOG SYMBOLS

CS	California Standard Sampler
CM	California Modified Sampler
SPT	Standard Penetration Test Sampler
SHL	Shelby Tube Sampler
BU	Bulk Sample
LL	Liquid Limit of Sample (ASTM D-4318)
PI	Plasticity Index of Sample (ASTM D-4318)
Q_U	Unconfined Compression Test (ASTM D-2166)

∇	Depth at which Groundwater was Encountered During Drilling
▼	Depth at which Groundwater was Measured After Drilling
PP	Pocket Penetrometer Test
PTV	Pocket Torvane Test
-#200	% of Material Passing the No. 200 Sieve Test (ASTM D-1140)
PSA	Particle-Size Analysis (ASTM D-422 & D-1140)
C	Consolidation Test (ASTM D-2435)
TXUU	Unconsolidated Undrained Compression Test (ASTM D-2850)

KEY TO SAMPLE INTERVALS

CS	Length of Sampler Interval with a CS Sampler
CM	Length of Sampler Interval with a CM Sampler
SPT	Length of Sampler Interval with a SPT Sampler
SHL	Length of Sampler Interval with a SHL Sampler

BU	Bulk Sample Recovered for Interval Shown (i.e., cuttings)
⌶	Length of Coring Run with Core Barrel Type Sampler
NR	No Sample Recovered for Interval Shown

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UNIFIED SOIL CLASSIFICATION SYSTEM AND KEY TO BORING LOG

FIGURE **A-1**

DRILL RIG: CME-75
BORING TYPE: 7” HOLLOW STEM
DATE DRILLED: 4-16-03
LOGGED BY: SW
ELEVATION: N/A
HAMMER WT./DROP: 140#/30”

BORING LOG OF
B-1

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6”	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
ASPHALT CONCRETE (3”)							
SILTY SAND (SM), light brown, slightly moist, minor gravel, minor sandstone fragments, (ARTIFICIAL FILL).	1						
	2						
SILTY SAND (SM), light olive-brown, slightly moist, dense, minor gravel, minor sandstone fragments, (ARTIFICIAL FILL).	3	☒ 1		8* 30*/4”			
SANDSTONE, light olive-brown, slightly moist, medium soft to moderately hard, medium sand, (BEDROCK).	4						
	5	☒ 2		15* 30*/4”	10.9		DIRECT SHEAR UU* Ø=48.4°, C=262 PSF Ø=36.4°, C=205 PSF *–PEAK DIRECT SHEAR FOLLOWED BY ULTIMATE DIRECT SHEAR
	6						
	7						
–Color change to orange-brown at 7.5 feet.	8						
	9						
SILTY SANDSTONE, green, medium soft to moderately hard, moderately fractured, seam of steep dipping pebbles, fine sand.	10	☒ 3		14* 30*/3”	13.2	116.0	
	11						
	12						
SANDY SILTSTONE/SILTY SANDSTONE, green, moderately hard, fine sand.	13	☒ 4		30*/5”	11.2	115.5	
	14						
SANDY SILTSTONE/SILTY SANDSTONE, green to green-gray, moderately hard, fine sand.	15	☒ 5		30*/6”	11.6	108.4	
–Color change to gray at 15.5 feet.	16						
	17						
	18						
	19						
	20						

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LAFAYETTE LIBRARY
MOUNT DIABLO BOULEVARD
LAFAYETTE, CALIFORNIA

DRAWN BY: BW
CHECKED BY: PG
JOB: 030400
FIGURE A-2

DRILL RIG: **CME-75**	LOGGED BY: **BWW**	**BORING LOG OF**
BORING TYPE: **7” HOLLOW STEM**	ELEVATION: **N/A**	**B-1**
DATE DRILLED: **4-16-03**	HAMMER WT./DROP: **140#/30”**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6”	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
SILTY SANDSTONE, green-gray, moderately hard, fine sand.		☒ 6	▤	14* 30*/3”			
	21		▤				
	22		▤				
	23		▤				
	24		▤				
SILTY SANDSTONE, gray, moderately hard, fine sand.	▼ 25	☒ 7	▤	21* 30*/3”			
	26		▤				
	27		▤				
	28		▤				
	29		▤				
SANDSTONE, gray, moderately hard, fine sand.	30	☒ 8	▤	30*/5”			
	31		▤				
	32		▤				
	33		▤				
	34		▤				
SANDSTONE, gray, moderately hard, fine sand.	35	☒ 9	▤	30*/5”			
	36						
	37						
	38						
	39						
	40						

BORING TERMINATED AT 35.4 FEET.

GROUNDWATER MEASURED AT 25.0 FEET AFTER HOLLOW STEM EXTRACTED.

BORING BACKFILLED WITH PORTLAND CEMENT GROUT UNDER SUPERVISION OF CONTRA COSTA COUNTY ENVIRONMENTAL HEALTH.

* CALIFORNIA MODIFIED (CM) SAMPLER BLOW COUNTS PER 6 INCHES COVERTED TO STANDARD PENETRATION (SPT) BLOW COUNTS PER 6 INCHES USING A FACTOR OF 0.6 X CM.

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JOB: **030400**

FIGURE **A-3**

DRILL RIG: CME-75	LOGGED BY: SW	BORING LOG OF
BORING TYPE: 7" HOLLOW STEM	ELEVATION: N/A	B-2
DATE DRILLED: 4-16-03	HAMMER WT./DROP: 140#/30"	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
SANDY SILT (ML), brown, very moist, firm, (ARTIFICIAL FILL).	1 2						
SANDY SILT/SILTY SAND (ML/SM), mottled light brown and dark brown, very moist, firm, (ARTIFICIAL FILL).	3 4	10		2* 5* 5*	21.7	97.3	
	5 6 7	11		2* 3* 4*	23.4	102.0	
CLAYEY SANDY SILT to CLAYEY SILTY SAND (ML/SM), brown, very moist, firm to stiff, (ARTIFICIAL FILL).	8	12–13		1*	26.2	98.4	
CLAYEY SANDY SILT (ML), gray-brown, very moist, firm to stiff, (ALLUVIUM).	9			4* 5*	21.4		DIRECT SHEAR UU* Ø=10.1°, C=558 PSF Ø=8.4°, C=655 PSF *-PEAK DIRECT SHEAR FOLLOWED BY ULTIMATE DIRECT SHEAR
CLAYEY SANDY SILT (ML), dark brown and gray-brown, very moist, firm, (ALLUVIUM).	10 11	14		4* 5* 6*	23.7	101.8	
CLAYEY SANDY SILT (ML), brown, very moist, firm to stiff, (ALLUVIUM).	12 13 14	15		2* 5* 7*	20.8	107.2	
CLAYEY SANDY SILT (ML), brown, very moist, stiff, (ALLUVIUM).	15 16 17	16		4 6 7	15.0		#200=79%
WEATHERED SILTY SANDSTONE, mottled light brown and brown, very moist, severely weathered to firm sandy silt, (BEDROCK).	18 19 ▼ 20	17		2* 5* 6*	21.4	107.5	

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DRAWN BY: BW CHECKED BY: PG	JOB: 030400	FIGURE A-4

DRILL RIG: **CME-75**
BORING TYPE: **7" HOLLOW STEM**
DATE DRILLED: **4-16-03**
LOGGED BY: **BWW**
ELEVATION: **N/A**
HAMMER WT./DROP: **140#/30"**

BORING LOG OF

B-2

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
SILTY SANDSTONE, brown, moist, moderately hard, fine sand.	21	18-19	▤	2 3 13			
	22		▤				
	23		▤				
	24		▤				
SILTY SANDSTONE, gray, moderately hard, fine sand.	25	20	▤	23 50 5"			
	26		▤				
	27		▤				
	28		▤				
	29		▤				
SILTY SANDSTONE, green-brown, moderately hard, fine sand.	30	21	▤	32 50 5"			
BORING TERMINATED AT 31.9 FEET.	31						
GROUNDWATER MEASURED AT 20.0 FEET AFTER HOLLOW STEM EXTRACTED.	32						
BORING BACKFILLED WITH PORTLAND CEMENT GROUT UNDER SUPERVISION OF CONTRA COSTA COUNTY ENVIRONMENTAL HEALTH.	33						
* CALIFORNIA MODIFIED (CM) SAMPLER BLOW COUNTS PER 6 INCHES COVERTED TO STANDARD PENETRATION (SPT) BLOW COUNTS PER 6 INCHES USING A FACTOR OF 0.6 X CM.	34						
	35						
	36						
	37						
	38						
	39						
	40						

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FIGURE **A-5**

DRILL RIG: **CME-75**	LOGGED BY: **SW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-3**
DATE DRILLED: **4-16-03**	HAMMER WT./DROP: **140#/30"**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
CLAYEY SILT (ML), dark brown, very moist, firm, (ARTIFICIAL FILL).	1 2 3						
CLAYEY SANDY SILT (ML), mottled brown and dark brown, very moist, firm, (ALLUVIUM).	4 5 6 7 8 9	22		3 5 7			
WEATHERED SANDY SILTSTONE, brown-green, slightly moist, severely weathered, (BEDROCK).	10 11 12	23		6 11 12	38.7		LL=92 PL=30 PI=62
SANDY SILTSTONE, brown-green, slightly moist, moderately hard.	13 14	24		8 15 24			
SILTY SANDSTONE, brown-green, slighty moist, moderately hard, moderately fractured, tight, fine sand.	15 16 17 18 19 20	25		9 20 32			

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FIGURE **A-6**

DRILL RIG: **CME-75**	LOGGED BY: **BWW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-3**
DATE DRILLED: **4-16-03**	HAMMER WT./DROP: **140#/30"**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
SILTY SANDSTONE, brown-green, slightly moist, moderately hard, moderately fractured.		26	▤	21 40 50/5"			
	21		▤				
	22		▤				
	23		▤				
	24		▤				
	25		▤				
SILTY SANDSTONE, green-brown, slightly moist, moderately hard.		27	▤	21 50/5"			
BORING TERMINATED AT 25.9 FEET.	26						
NO GROUNDWATER ENCOUNTERED DURING DRILLING.	27						
BORING BACKFILLED WITH PORTLAND CEMENT GROUT UNDER SUPERVISION OF CONTRA COSTA COUNTY ENVIRONMENTAL HEALTH.	28						
	29						
	30						
	31						
	32						
	33						
	34						
	35						
	36						
	37						
	38						
	39						
	40						

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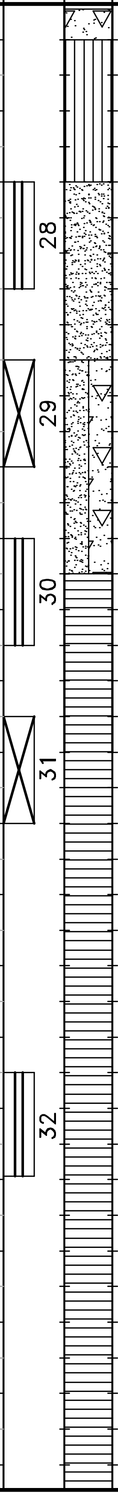
DRILL RIG: **CME-75**	LOGGED BY: **SW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-4**
DATE DRILLED: **4-16-03**	HAMMER WT./DROP: **140#/30"**	



SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
ASPHALT CONCRETE (1")							
SANDY GRAVEL (GP), orange, moist, medium dense, (ARTIFICIAL FILL).	1						
CLAYEY SANDY SILT (ML), dark brown, very moist, firm, (ARTIFICIAL FILL).	2						
GRAVELLY SILTY SAND (SP), brown and orange-brown, very moist, medium dense, (ALLUVIUM).	3	28		4 8 7			
	4						
GRAVELLY SILTY SAND TO SILTY SANDY GRAVEL (SP/GP), brown and orange-brown, very moist, medium dense, (ALLUVIUM).	5	29		3* 6* 7*			
	6						
	7						
WEATHERED SILTY SANDSTONE, light green, slightly moist, severely weathered, (BEDROCK).	8	30		2 9 15			
	9						
	10	31		2* 9* 18*			
SANDSTONE, light brown, green, slightly moist, medium soft to moderately hard, fine sand.	11						
	12						
	13						
	14						
SILTY SANDSTONE, light brown, green, slighty moist, moderately hard, fine sand.	15	32		15 40 50/5"			
	16						
	17						
	18						
	19						
	20						

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FIGURE **A-8**

DRILL RIG: **CME-75**	LOGGED BY: **BWW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-4**
DATE DRILLED: **4-16-03**	HAMMER WT./DROP: **140#/30"**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
		33		25 50 6"			
	21						
	22						
	23						
	24						
SANDSTONE, brown-green and green-brown, moderately hard, moderately fractured, tight.	25	34		21 50 5"			
BORING TERMINATED AT 25.9 FEET.	26						
NO GROUNDWATER ENCOUNTERED DURING DRILLING.	27						
BORING BACKFILLED WITH PORTLAND CEMENT GROUT UNDER SUPERVISION OF CONTRA COSTA COUNTY ENVIRONMENTAL HEALTH.	28						
	29						
* CALIFORNIA MODIFIED (CM) SAMPLER BLOW COUNTS PER 6 INCHES COVERTED TO STANDARD PENETRATION (SPT) BLOW COUNTS PER 6 INCHES USING A FACTOR OF 0.6 X CM.	30						
	31						
	32						
	33						
	34						
	35						
	36						
	37						
	38						
	39						
	40						

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FIGURE **A-9**

DRILL RIG: **CME-75**	LOGGED BY: SW	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: N/A	**B-5**
DATE DRILLED: **4-17-03**	HAMMER WT./DROP: 140#/30"	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
ASPHALT CONCRETE (2")							
SANDY GRAVEL (GP), green-gray, slightly moist, (ARTIFICIAL FILL).	1						
CLAYEY SILT (ML), light brown, moist, (ARTIFICIAL FILL).	2						
CLAYEY SILT (ML), light brown-green, moist to very moist, firm, (ARTIFICIAL FILL).	3	35		3 4 5			
SANDY CLAYEY SILT (ML), dark brown, moist to very moist, firm, (ALLUVIUM).	4						
	5						
	6	36		1* 2* 3*	27.9	96.5	
	7						
CLAYEY SILT (ML/OL), dark brown to black, very moist, firm to stiff, slight organic smell, (ALLUVIUM).	8	37		3 4 7	26.7		LL=56 PL=17 PI=39
	9						
	10						
	11	38		2* 4* 5*	27.8	93.8	
	12						
▼	13						
	14						
SANDY CLAYEY SILT (ML), dark brown to black, very moist, soft to firm.	15						
	16	39		2 4 6			
	17						
	18						
	19						
	20						

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FIGURE **A-10**

DRILL RIG: **CME-75**	LOGGED BY: **BWW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-5**
DATE DRILLED: **4-17-03**	HAMMER WT./DROP: **140#/30"**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
WEATHERED SILTY SANDSTONE, light brown-green, moist, severely weathered to sandy silt and silty sand (ML/SM), firm/medium dense, (RESIDUAL SOIL/WEATHERED BEDROCK).	21 22	40		3 4 8			
WEATHERED SILTY SANDSTONE, light brown, green, moist, soft, (RESIDUAL SOIL/WEATHERED BEDROCK).	23 24	41		4* 6* 9*	25.3	102.9	
SILTY SANDSTONE, light brown-green, moist, soft to medium soft, (BEDROCK).	25 26 27 28 29	42		6 12 15			
SILTY SANDSTONE, light brown-green, brown, moderately hard, fine to medium sand.	30 31 32 33 34	43		5* 10* 14*	20.9		DIRECT SHEAR UU* Ø=37.3°, C=427 PSF Ø=34.4°, C=196 PSF *-PEAK DIRECT SHEAR FOLLOWED BY ULTIMATE DIRECT SHEAR
SILTY SANDSTONE, light brown and green, moderately hard.	35 36 37 38 39 40	44		13 30 43			

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DRILL RIG: **CME-75**	LOGGED BY: **BWW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-5**
DATE DRILLED: **4-17-03**	HAMMER WT./DROP: **140#/30"**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
SILTY SANDSTONE, light brown-green, moderately hard.	41	45	▤	10 35 47			
BORING TERMINATED AT 41.5 FEET.	42						
GROUNDWATER ENCOUNTERED AT 13.0 FEET DURING DRILLING.	43						
BORING BACKFILLED WITH PORTLAND CEMENT GROUT UNDER SUPERVISION OF CONTRA COSTA COUNTY ENVIRONMENTAL HEALTH.	44						
* CALIFORNIA MODIFIED (CM) SAMPLER BLOW COUNTS PER 6 INCHES COVERTED TO STANDARD PENETRATION (SPT) BLOW COUNTS PER 6 INCHES USING A FACTOR OF 0.6 X CM.	45						
	46						
	47						
	48						
	49						
	50						
	51						
	52						
	53						
	54						
	55						
	56						
	57						
	58						
	59						
	60						

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FIGURE **A-12**

DRILL RIG: **CME-75**	LOGGED BY: **SW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-6**
DATE DRILLED: **4-17-03**	HAMMER WT./DROP: **140#/30"**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
ASPHALT CONCRETE (2")							
SANDY GRAVEL (GP), green-gray, very moist, (ARTIFICIAL FILL).	1						
CLAYEY SILT (ML), brown, very moist, (ARTIFICIAL FILL).	2						
SANDY CLAYEY SILT (ML), mottled brown and green, very moist, firm, (ARTIFICIAL FILL).	3	46		2 3 4			
CLAYEY SILT (ML), dark brown, very moist, soft to firm, (ALLUVIUM).	4						
CLAYEY SILT (ML), dark brown to black, very moist, soft to firm, (ALLUVIUM).	5	47		2 3 4			
	6						
	7						
CLAYEY SILY (ML), dark brown to black, moist, firm, (ALLUVIUM).	8	48		1 5 8			
	9						
SANDY CLAYEY SILT to CLAYEY SANDY SILT (ML), green-brown, very moist, firm, (ALLUVIUM).	10	49		4 5 8			
	11						
	12						
SANDY CLAYEY SILT (ML), green-brown and brown, moist, firm, (ALLUVIUM).	13	50		3 5 8	21.9		LL=47 PL=14 PI=33 #200=85%
	14						
WEATHERED SILTY SANDSTONE to SANDY SILTSTONE, light green-brown, very moist, severely weathered to sandy silt (ML), firm, (RESIDUAL SOIL).	15	51		3 5 8			
	16						
	17						
SANDY SILTSTONE to SILTY SANDSTONE, brown-green, moderately hard, intensely fractured, tight, (BEDROCK).	18	52		6 13 17			
	19						
	20						

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DRILL RIG: CME-75	LOGGED BY: BWW	BORING LOG OF B-6
BORING TYPE: 7" HOLLOW STEM	ELEVATION: N/A	
DATE DRILLED: 4-17-03	HAMMER WT./DROP: 140#/30"	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
SILTY SANDSTONE, brown-gray, moist, moderately hard, moderately fractured, tight.	21	53		12 32 36			
	22						
	23						
	24						
	25	54		15 50			
	26						
BORING TERMINATED AT 26.0 FEET. GROUNDWATER ENCOUNTERED MEASURED AT 17.0 FEET AFTER HOLLOW STEM EXTRACTED. BORING BACKFILLED WITH PORTLAND CEMENT GROUT UNDER SUPERVISION OF CONTRA COSTA COUNTY ENVIRONMENTAL HEALTH.	27						
	28						
	29						
	30						
	31						
	32						
	33						
	34						
	35						
	36						
	37						
	38						
	39						
	40						

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DRILL RIG: **CME-75**	LOGGED BY: SW	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: N/A	**B-7**
DATE DRILLED: **4-17-03**	HAMMER WT./DROP: 140#/30"	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
ASPHALT CONCRETE (2")							
CLAYEY SANDY SILT (ML), brown, moist, medium dense,(ARTIFICIAL FILL).	1						
CLAYEY SANDY SILT (ML), dark brown, moist, (ALLUVIUM).	2						
CLAYEY SANDY SILT (ML), light brown, moist, firm to stiff, (ALLUVIUM).	3						
	4						
	5			3*			
WEATHERED SANDY SILTSTONE, brown-green, severely weathered to sandy silt (ML), moist, firm to stiff, (RESIDUAL SOIL).	6	55		6* 8*	27.8	95.2	
	7						
SANDY SILTSTONE, brown, green, moist, moderately hard, moderately fractured, tight, (BEDROCK).	8	56		5* 10* 14*	22.3	97.8	
	9						
SILTY SANDSTONE, brown-green, moist, moderately hard, moderately fractured, tight.	10	57		5* 16*			
	11			21*	17.5		DIRECT SHEAR UU* Ø=7.5°, C=1685 PSF Ø=14.7°, C=1083 PSF *-PEAK DIRECT SHEAR FOLLOWED BY ULTIMATE DIRECT SHEAR
	12						
	13						
	14						
SILTY SANDSTONE, brown-green, moderately hard, moderately fractured, tight.	15	58		18 32 50			
	16						
	17						
	18						
	19						
	20						

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FIGURE **A-15**

DRILL RIG: **CME-75**	LOGGED BY: **BWW**	**BORING LOG OF**
BORING TYPE: **7" HOLLOW STEM**	ELEVATION: **N/A**	**B-7**
DATE DRILLED: **4-17-03**	HAMMER WT./DROP: **140#/30"**	

SOIL DESCRIPTION	DEPTH FT.	SAMPLE	SYMBOL	BLOWS PER 6"	WATER CONTENT %	DRY DENSITY pcf	OTHER TESTS
SILTY SANDSTONE. (continued)		59		35 50 3"	—	—	
BORING TERMINATED AT 20.75 FEET.	21						
NO GROUNDWATER ENCOUNTERED DURING DRILLING.	22						
BORING BACKFILLED WITH PORTLAND CEMENT GROUT UNDER SUPERVISION OF CONTRA COSTA COUNTY ENVIRONMENTAL HEALTH.	23						
* CALIFORNIA MODIFIED (CM) SAMPLER BLOW COUNTS PER 6 INCHES COVERTED TO STANDARD PENETRATION (SPT) BLOW COUNTS PER 6 INCHES USING A FACTOR OF 0.6 X CM.	24						
	25						
	26						
	27						
	28						
	29						
	30						
	31						
	32						
	33						
	34						
	35						
	36						
	37						
	38						
	39						
	40						

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FIGURE **A-16**