GEOTECHNICAL INVESTIGATION
EMERYVILLE SENIOR HOUSING PROJECT
4300-4328 SAN PABLO AVENUE
EMERYVILLE, CALIFORNIA
SCI 537.002

Prepared for:

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I INTRODUCTION

This report presents results of our geotechnical investigation for the proposed Emeryville Senior Housing Project in Emeryville, California. The project is located at 4300-4328 San Pablo Avenue, as shown on the Site Plan, Plate 1.

The site is currently occupied by a self-service carwash, a post office, unoccupied houses and garages, and parking areas. The buildings and pavement will be removed as part of the project. We understand that the site is to be developed with a multi-dwelling structure. The actual type of construction has not yet been determined, however, we anticipate that it will be 3- to 4-story, wood-framed structure with a slab-on-grade lower floor. Building loads (dead plus live) are unknown at this time. However, we anticipate that they will be less than about 3 kips per linear foot for walls and up to about 100 kips per column. Access to the site will be provided by asphalt concrete paved driveways and parking areas. Grading will consist of minor cuts and fills to provide a level building pad with proper drainage.

The purpose of this investigation, as outlined in our proposal dated August 8, 1989, was to explore subsurface conditions at the site and develop conclusions and recommendations regarding:

1. Subsurface conditions,

2. Site preparation and grading,

3. The most appropriate foundation type for the planned structure,

4. Design criteria for the recommended foundation type,

5. Estimates of foundation settlement, and

6. Slab-on-grade and asphalt pavement subgrade preparation.

II FIELD EXPLORATION AND LABORATORY TESTING

We explored subsurface conditions at the site by drilling a total of eight test borings, ranging from about 9 to 31 feet deep, at the approximate locations shown on the Site Plan. Borings 1 through 6 were drilled specifically for this geotechnical investigation. Borings 7 and 8 were drilled as part of a preliminary environmental assessment (Phase 2) of 4320-4328 San Pablo Avenue. However, information from these borings is useful from a geotechnical perspective, and is included in this report. The borings were drilled with a trailer-mounted rig equipped with 6-inch-diameter solid flight augers. Our field engineer observed drilling operations, obtained samples of the materials encountered and prepared logs of each test boring. The Logs of Test Borings are presented on Plates 2 through 6. Soils are classified in accordance with the Unified Soil Classification System described on Plate 7.

Relatively undisturbed soil samples were obtained using a modified California Drive sampler (outside diameter of 3.0

inches, inside diameter of 2.5 inches), or a California Drive sampler (outside diameter 2.5 inches, inside diameter 2.0 inches). The samplers were driven with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final 12 inches of each 18-inch penetration was recorded and presented on the Logs of Test Borings.

Soil samples were examined in our laboratory to check field classifications. Moisture content, dry density, classification (Atterberg Limits), and strength (unconfined compressive shear) tests were performed on selected samples. The test results are presented on the Logs of Test Borings. The results of the classification tests are also shown on Plate 8, Atterberg Limits Plasticity Data.

III SITE CONDITIONS

A. Geology and Seismicity

The site is located on a broad alluvial plain bordered by the Berkeley Hills to the east and San Francisco Bay to the west. According to a geologic map by Radbruch (1957)[1]. The site is underlain by the Temescal Formation, which is an alluvial fan deposit comprised of interfingered lenses of clayey gravel, sandy silty clay and sand-clay-silt mixtures. The historic alignment of Temescal Creek is about 1,000 north of the site.

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[1] "Areal and Engineering Geology of the Oakland West Quadrangle, California," U.S.G.S. Map I-239.

Several earthquake faults exist near the site. The most notable of these are the Hayward Fault, located about 2.5 miles to the northeast, and the San Andreas Fault, located about 17 miles to the southwest. Both of these faults are considered active with several major earthquakes, recorded on them during the last century. The site is not located within an Alquist-Priolo (AP) Special Studies Zone.

B. Surface Conditions

The relatively level, L-shaped site measures about 360 by 200 feet (in its longest and widest dimensions). It is bordered on the west by San Pablo Avenue, on the south by 43rd Street, and to the north and east by an office building, residences and the Veterans Memorial Building.

The site presently contains a self-service carwash facility, the Emeryville Post Office, unoccupied houses and garages, and parking areas. The site formerly contained a fuel station at 4300 San Pablo Avenue, and a residence at 4328 San Pablo Avenue. It is unknown if the fuel tanks were removed as part of demolition of the fuel station, and construction of the existing carwash. Vegetation at the site consists mostly of sparse grasses and bushes. The existing structures do not appear to have basements; however, they have foundations and utilities that are underground.

C. Subsurface Conditions

Based on the results of the test borings, subsurface conditions at the site consist of successively deeper layers of

fill, clays and sands. The fill was encountered in Borings 2, 3 and 4 to depths ranging up to 4.5 feet. The fill consists of medium stiff clays containing brick fragments. Beneath the fill, are medium stiff to stiff native clays, to a depth of 17 feet at Boring 1, and to the depths drilled elsewhere. Beneath the native clays at Boring 1, are interbedded layers of medium dense silty sands and stiff clays to the depth explored.

Based upon the Atterberg Limits Test results, the soils near the groundsurface, including the fill and native clays, are judged to have moderate expansion potential (i.e., a moderate potential to shrink and swell with moisture content changes).

Groundwater was encountered during drilling at depths of 17 feet in Boring 1, and 11 feet and in Boring 4. These depths are not likely to represent stabilized values.

IV DISCUSSION AND CONCLUSIONS

Based upon the results of our investigation, we conclude that the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications. The primary soil engineering considerations at the site are (1) the presence of surficial fills and existing subsurface foundations and utilities, and (2) the moderately expansive near-surface soils. Without mitigation, structures supported over areas containing these materials could undergo differential movement. Settlement

due to existing fill and subsurface structures can be mitigated by properly compacting the existing fill, and removing subsurface structures and backfilling the resulting excavation with compacted fill. Movements due to moderately expansive soils can be mitigated by construction of a layer of select fill (having low expansion potential) over the expansive soils, in order to maintain the expansive soils moisture content at a relatively uniform level, thus limiting their movement.

The structures should be founded on shallow spread footings, gaining support in properly compacted fill and/or firm native soils. We estimate that the post-construction settlement of foundations designed and constructed in accordance with the recommendations in this report should be less than about 1/2 inch.

Slabs-on-grade should be underlain by at least 18 inches of properly compacted select fill with a low expansion potential, and should be provided with steel reinforcement.

The site is located in a seismically active area. All of the faults in the area are capable of generating strong groundshaking during the anticipated life of the structure. Consequently, the structure should be designed to accommodate lateral forces generated by earthquake groundshaking, in accordance with current seismic design practice.

V RECOMMENDATIONS

A. Site Preparation and Grading

Prior to construction, the site should be cleared of existing structures, foundations, pavement, slabs, underground utilities and debris. If underground fuel tanks exist at the site, they should be removed in accordance with requirements of local and state regulatory agencies. Surface soils, containing vegetation and organic matter, should also be removed. Organic laden soils should not be reused in compacted fills. Due to the existing fill, and disturbance caused by subsurface foundation and utility removal, the area within each building footprint and the zone extending at least 5 feet beyond each building perimeter should be excavated to at least 3 feet below the planned subgrade elevation. Deeper excavation may be required where existing fills and/or soft soils are encountered.

Prior to fill placement, the upper 6 inches of exposed soil should be moisture conditioned, as necessary, and compacted to at least 90 percent relative compaction, in accordance with the ASTM D1557 test procedure. If soft or unstable areas are encountered during subgrade preparation, they should be overexcavated to expose firm soil. The extent of overexcavation should be determined by our field engineer. The overexcavations should be backfilled with properly compacted fill.

The suitability of all fill materials should be checked with the soils engineer prior to its use. Select fill, having low expansion potential, should be used in the upper 18 inches beneath structures and within 5 feet of their perimeter. Most of the material from on-site is not suitable for reuse as select fill. Hence, select fill will have to imported. All fill should be free of perishable materials and rocks greater than 6 inches in largest dimension. Select fill should have low expansion potential, as indicated by a Plasticity Index less than 15 percent and a Liquid Limit less than 40 percent.

All fill should be moisture conditioned to at least 2 percent above optimum moisture content, placed in layers not exceeding 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. The upper 6 inches of all pavement subgrades should be compacted to at least 95 percent relative compaction. The subgrade should be smooth and non-yielding under heavy equipment loads.

B. **Foundations**

The structures should be founded on shallow spread footings, gaining support in properly compacted fill or firm native soil. Allowable bearing pressures for spread footings should not exceed 3000 pounds per square foot (psf) for dead loads, 3600 psf for dead plus live loads, and 4500 psf for total loads, including wind or seismic. Wall and column footings should be at least 18- and 24-inches wide, respectively (regardless of load) and should be bottomed at least 24 inches below lowest adjacent grade.

Footing excavations should be cleaned of loose soil and water prior to concrete placement.

Resistance to lateral loads should be provided by frictional resistance along the footing bottoms and by passive pressure acting on the footing sides. A base friction coefficient of 0.35 times the net vertical dead load should be used to determine available friction resistance. A pressure of 300 pounds per cubic foot (pcf), equivalent fluid pressure, should be used to evaluate passive pressures. Passive resistance provided by the upper foot of soil should be neglected unless confined by slab or pavement.

C. Interior Slabs-on-Grade

Interior slabs-on-grade should be underlain by at least 18 inches of properly compacted, select fill, as recommended in the Site Preparation and Grading section of this report. The slab subgrade should be smooth and unyielding under heavy equipment loads. A layer of crushed rock, at least 4 inches thick, should be placed beneath interior slabs to provide a capillary moisture break. The crushed rock should consist predominately of 3/4 inch rock, with less than 3 percent passing a No. 200 sieve. Moisture vapor is likely to condense under the underside of slabs-on-grade. If the migration of moisture vapor through the slabs in unacceptable, a vapor barrier should be considered.

D. Drainage

Surface and roof drainage should be well controlled around the structure. The groundsurface adjacent to the structure should be sloped downward and away from the foundations. Roof downspouts should discharge onto concrete slabs that are sloped to drain into the street or be collected in closed pipes which discharge into a suitable stormdrain facility. Landscape activities should maintain surface gradients away from the structure.

E. Asphalt Pavement Subgrade

The subgrade in areas to be paved should be scarified to a depth of at least 6 inches, moisture conditioned to near optimum moisture content and compacted to at least 95 percent relative compaction. The pavement subgrade should be smooth, non-yielding and kept moist until aggregate base placement.

F. Geotechnical Services during Construction

We should review final plans and specifications to check them for conformance with the intent of our recommendations. During construction, our field engineer should observe and/or check the following:

1. Site preparation and grading,
2. Footing excavations,
3. Subgrade preparation for slabs-on-grade and pavements, and
4. Placement and compaction of aggregate base in areas to be paved.

These services will allow us to check that the geotechnical aspects of construction are performed in accordance with the plans and specifications.

List of Attached Plates:

Plate 1	Site Plan
Plates 2 thru 6	Logs of Test Borings 1 through 8
Plate 7	Unified Soil Classification System
Plate 8	Atterberg Limits - Plasticity Data

Distribution

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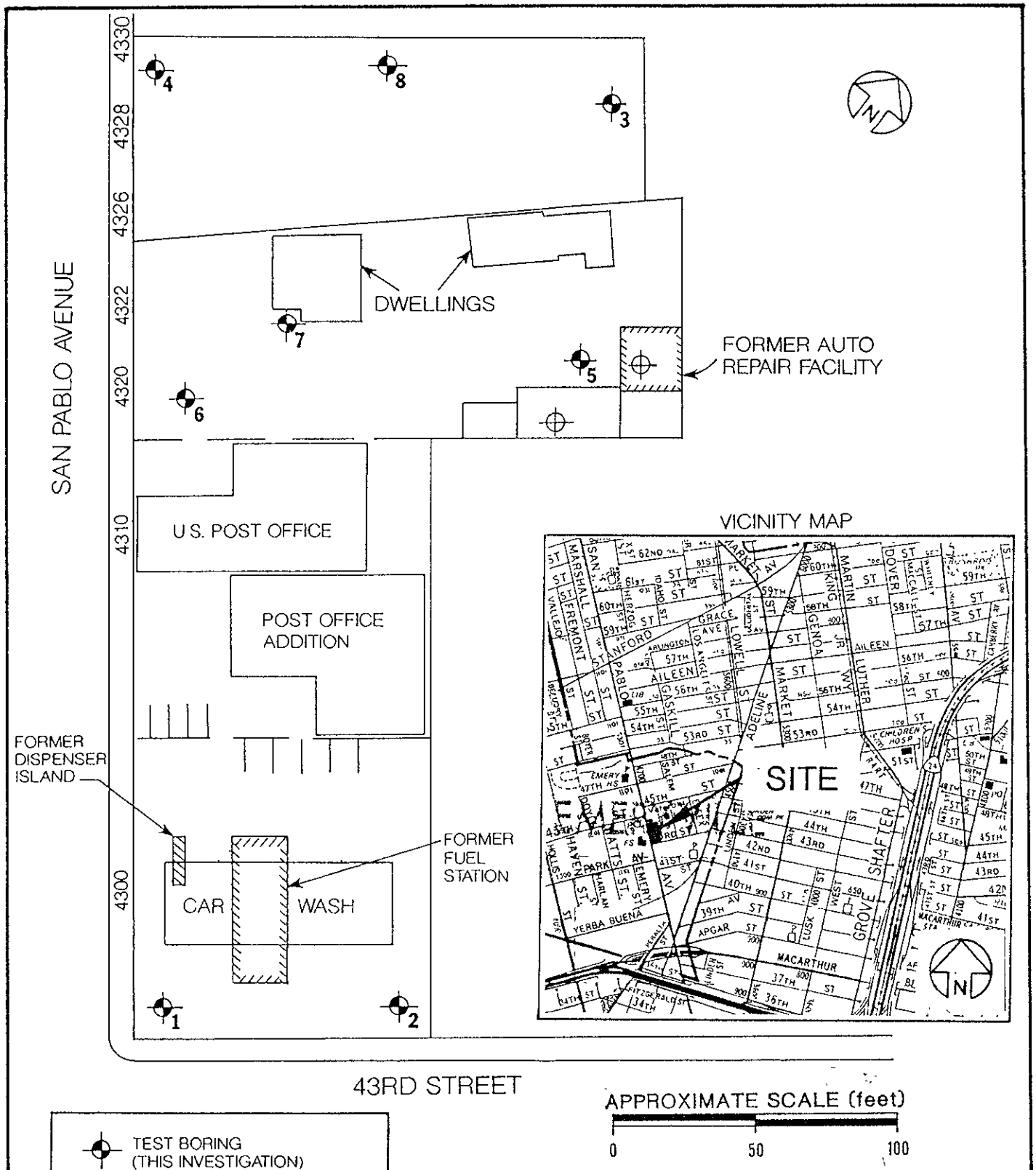

SITE PLAN

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EMERYVILLE SENIOR HOUSING – EMERYVILLE, CA

JOB NUMBER	DATE	APPROVED
537.002	10/27/89	

PLATE 1

LOG OF TEST BORING 1

EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --

LABORATORY TESTS	MOISTURE CONTENT %	DRY DENSITY (PCF)	DEPTH (FT)	SAMPLE	BLOWS PER FOOT	
			0			ASPHALTIC CONCRETE - 3" thick BASE ROCK - 4" thick BLACK SILTY CLAY (CL) stiff, moist, with trace of sand, slight petroleum odor
PI = 28% LL = 50%	22.1	90			19	
	22.0	102			25	
	18.1	110	5		27	dark gray-brown below 5'
	19.2	106	10		22	MOTTLED GRAY AND GREEN SILTY CLAY (CL) medium stiff, moist, with fine grained sand, slight petroleum odor to 16 feet orange-brown below 13'
	20.5	107	15		30*	
						GROUNDWATER LEVEL DURING DRILLING BROWN SILTY SAND (SM) medium dense, wet, fine grained
	25.0	98	20		32*	
						MOTTLED BROWN AND GRAY-BROWN SILTY CLAY (CL) medium stiff, wet
	22.6	105	25		12*	
						ORANGE-BROWN SILTY SAND (SM) medium dense, wet, fine grained, with gravel
	26.4	98	30		13*	
						borehole backfilled with cement grout
			35			
			40			

LL = LIQUID LIMIT(%)
PI = PLASTICITY INDEX(%)
UC = UNCONFINED COMPRESSIVE SHEAR STRENGTH

SAMPLER TYPE:
MODIFIED CALIFORNIA DRIVE:
OD: 3.0 inches
ID: 2.5 inches

*CALIFORNIA DRIVE.
OD 2.5 inches
ID 2.0 inches

HAMMER WEIGHT 140 pounds
HAMMER DROP 30 inches

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EMERYVILLE SENIOR HOUSING-EMERYVILLE

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537.002	1/15/90		2

LOG OF TEST BORING 2

EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --

LABORATORY TESTS	MOISTURE CONTENT %	DRY DENSITY (PCF)	DEPTH (FT)	SAMPLE	BLOWS PER FOOT	
			0			ASPHALTIC CONCRETE - 3" thick BASE ROCK - 4" thick
	27.6	93			18	BROWN SILTY CLAY (CL) medium stiff, moist, with sand and gravel (fill)
	19.8	104			15	
UC = 1970 psf	18.1	109	5		24	BLACK SILTY CLAY (CL) stiff, moist
	18.4	99	10		20*	ORANGE-BROWN SILTY CLAY (CL) medium stiff, moist
	18.3	108				with sand and gravel below 14'
	18.8	107	15		38*	NO GROUNDWATER ENCOUNTERED DURING DRILLING borehole backfilled with cement grout

LOG OF TEST BORING 3

EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --

LABORATORY TESTS	MOISTURE CONTENT %	DRY DENSITY (PCF)	DEPTH (FT)	SAMPLE	BLOWS PER FOOT	
			0			MOTTLED BLACK AND BROWN SILTY CLAY (CL) stiff, moist, with gravel and brick fragments (fill)
	16.8	82			31	
	17.2	104			21*	
			5			DARK BROWN SILTY CLAY (CL) stiff, moist, with gravel
UC = 1790 psf	23.6	98			22	
	17.4	106	10		13*	BROWN SILTY CLAY (CL) medium stiff, moist
	19.8	107	15		27*	MOTTLED GRAY AND ORANGE-BROWN SILTY CLAY (CL) stiff, moist, with gravel

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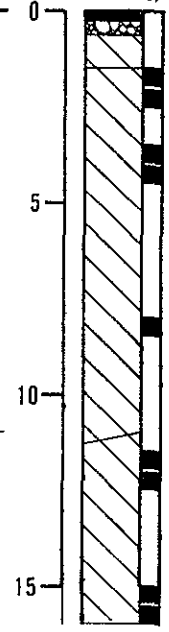
PLATE 3

LOG OF TEST BORING 4

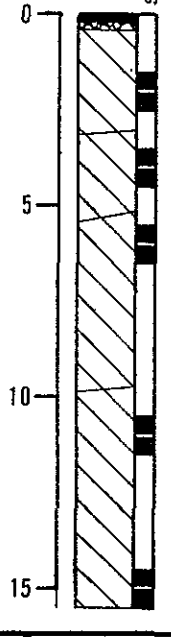
EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --



LABORATORY TESTS	MOISTURE CONTENT %	DRY DENSITY (PCF)	DEPTH (FT)	SAMPLE	BLOWS PER FOOT	
			0			ASPHALTIC CONCRETE - 3" thick BASE ROCK - 4" thick
	19.0	106			30	MOTTLED BROWN AND BLACK SILTY CLAY (CL) medium stiff, moist, with brick fragments (fill)
	20.9	103	5		19*	
	—	—			27	MOTTLED DARK BROWN AND GRAY SILTY CLAY (CL) stiff, moist, with fine grained sand
			10			GROUNDWATER LEVEL DURING DRILLING
	20.1	104			27*	ORANGE-BROWN GRAVELLY CLAY (CL) stiff, saturated, with sand
	11.4	118	15		65	borehole backfilled with cement grout

LOG OF TEST BORING 5

EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --



LABORATORY TESTS	MOISTURE CONTENT %	DRY DENSITY (PCF)	DEPTH (FT)	SAMPLE	BLOWS PER FOOT	
			0			ASPHALTIC CONCRETE - 2" thick BASE ROCK - 2" thick
	19.0	86			20*	DARK BROWN SILTY CLAY (CL) stiff, moist, with gravel
UC = 3380 psf	20.6	107			26	BROWN SILTY CLAY (CL) stiff, moist, with fine grained sand
	19.3	104	5		24*	GRAY-BROWN SILTY CLAY (CL) stiff, moist
			10			LIGHT BROWN SILTY CLAY (CL) stiff, moist, with gravel
	16.5	115			22	orange-brown below 12' NO GROUNDWATER ENCOUNTERED DURING DRILLING
	19.2	108	15		25*	borehole backfilled with cement grout

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PLATE 4

LOG OF TEST BORING 6

EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --

LABORATORY TESTS	MOISTURE CONTENT %	DRY DENSITY (PCF)	DEPTH (FT)	SAMPLE	BLOWS PER FOOT	
			0			DARK BROWN SILTY CLAY (CL) medium stiff, moist, with rootlets to 2.5 feet
PI = 22% LL = 43%	21.3	93			17	
	-	-			25	
	20.9	92	5		25	
	18.9	106	10		32	MOTTLED LIGHT BROWN AND ORANGE SILTY CLAY (CL) stiff, moist, with fine grained sand
	18.8	110	15		34	NO GROUNDWATER ENCOUNTERED DURING DRILLING borehole backfilled with cement grout

LOG OF TEST BORING 7

EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --

LABORATORY TESTS	MOISTURE CONTENT %	DRY DENSITY (PCF)	DEPTH (FT)	SAMPLE	BLOWS PER FOOT	
			0			DARK BROWN SILTY CLAY (CL) medium stiff, moist, with rootlets to 2 feet brown below 3 feet
	-	-			25*	
			5			
	-	-			33*	NO GROUNDWATER ENCOUNTERED DURING DRILLING borehole backfilled with cement grout
			10			
			15			

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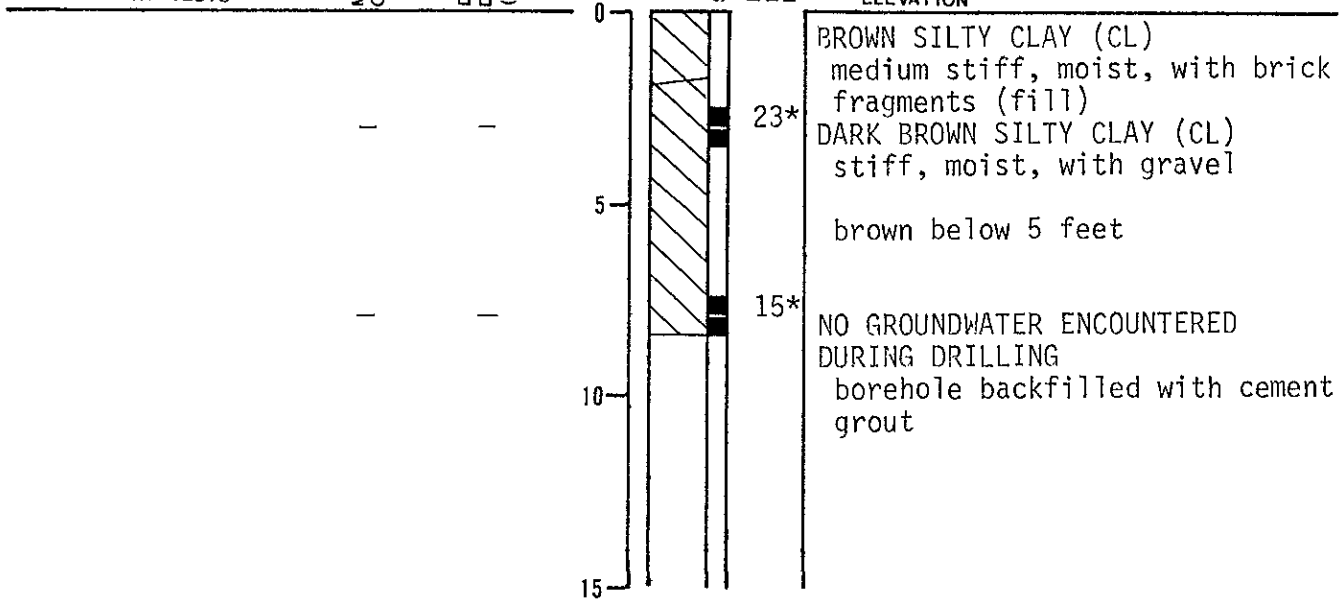
PLATE 5

LOG OF TEST BORING 8

EQUIPMENT 6" Solid Flight Auger
DATE DRILLED 1/4/90
ELEVATION --



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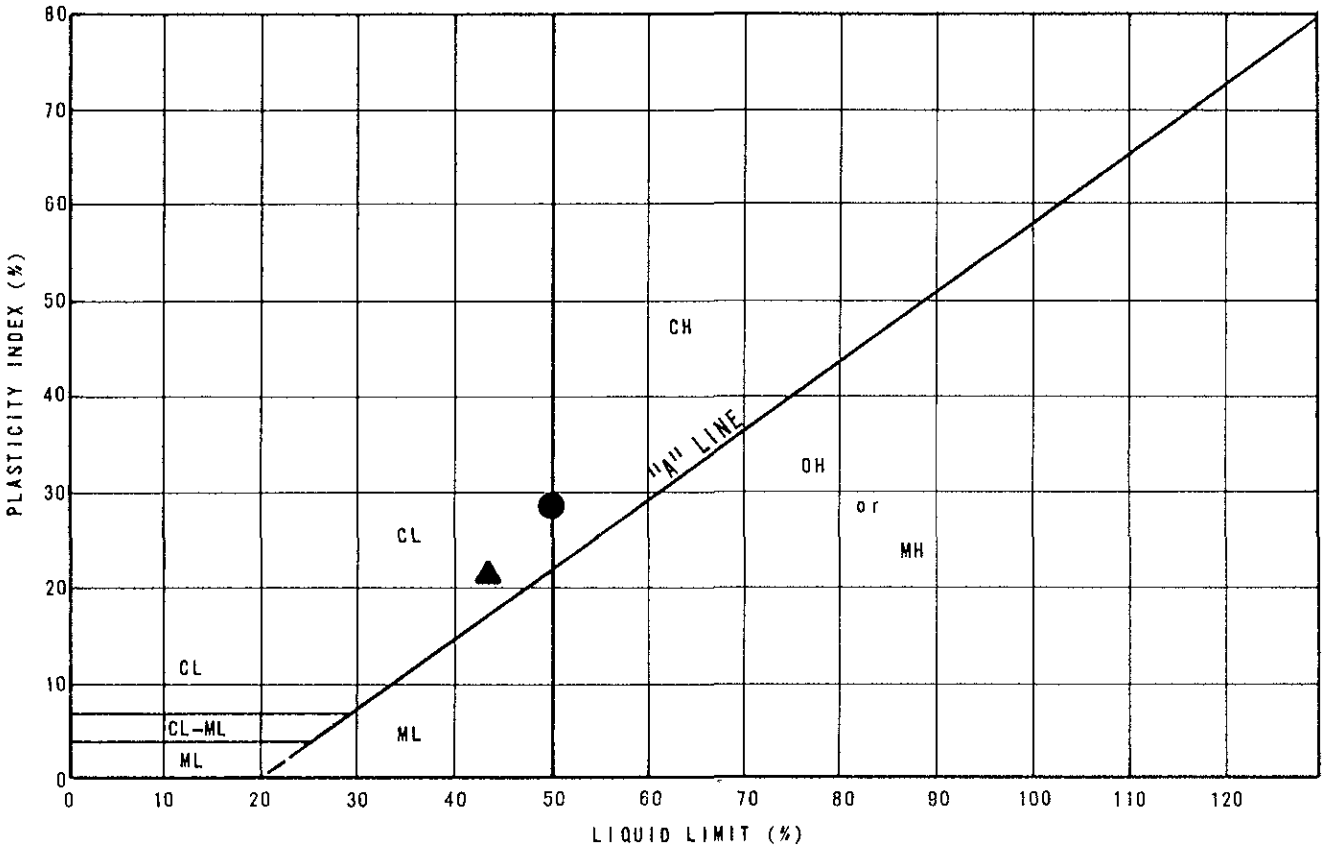
PLASTICITY CHART



PLASTICITY DATA

KEY SYMBOL	BORING NUMBER	DEPTH (ft)	NATURAL WATER CONTENT W (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX $\left(\frac{W-PL}{LL-PL}\right)$	UNIFIED SOIL CLASSIFICATION SYMBOL
●	1	2	22.1	22	50	28	0.00	CL
▲	6	2	21.3	21	43	22	0.02	CL

ATTERBERG LIMITS - PLASTICITY DATA

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PLATE 7

GENERAL SOIL CATEGORIES			SYMBOLS	TYPICAL SOIL TYPES
COARSE GRAINED SOILS More than half is larger than No. 200 sieve	GRAVEL More than half coarse fraction is larger than No. 4 sieve	Clean Gravel with little or no fines	GW	Well Graded Gravel, Gravel-Sand Mixtures
			GP	Poorly Graded Gravel, Gravel-Sand Mixtures
		Gravel with more than 12% fines	GM	Silty Gravel, Poorly Graded Gravel-Sand-Silt Mixtures
			GC	Clayey Gravel, Poorly Graded Gravel-Sand-Clay Mixtures
	SAND More than half coarse fraction is smaller than No. 4 sieve size	Clean sand with little or no fines	SW	Well Graded Sand, Gravelly Sand
			SP	Poorly Graded Sand, Gravelly Sand
		Sand with more than 12% fines	SM	Silty Sand, Poorly Graded Sand-Silt Mixtures
			SC	Clayey Sand, Poorly Graded Sand-Clay Mixtures
FINE GRAINED SOILS More than half is smaller than No. 200 sieve	SILT AND CLAY Liquid Limit Less than 50%		ML	Inorganic Silt and Very Fine Sand, Rock Flour, Silty or Clayey Fine Sand or Clayey Silt with Slight Plasticity
			CL	Inorganic Clay of Low to Medium Plasticity, Gravelly Clay, Sandy Clay Silty Clay, Lean Clay
			OL	Organic Clay and Organic Silty Clay of Low Plasticity
	SILT AND CLAY Liquid Limit Greater than 50%		MH	Inorganic Silt, Micaceous or Diatomaceous Fine Sandy or Silty Soils Elastic Silt
			CH	Inorganic Clay of High Plasticity, Fat Clay
			OH	Organic Clay of Medium to High Plasticity, Organic Silt
HIGHLY ORGANIC SOILS			PT	Peat and Other Highly Organic Soils

UNIFIED SOIL CLASSIFICATION SYSTEM

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PLATE 8