Earth Mechanics, Inc.

Geotechnical & Earthquake Engineering

TECHNICAL MEMORANDUM

EMI PROJECT NO: 99-136

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

3-12-2009

DATE: August 31, 2000

PREPARED FOR: Tayfun Saglam / Parsons Brinckerhoff

COPIES: Juan Murillo / Parsons Brinckerhoff

PREPARED BY: Lino Cheang and Mike Kapuskar/ Earth Mechanics, Inc.

SUBJECT: **Mt. Vernon OH (Replace), Bridge No. 54C-0066, EA 08-965120**
Final Preliminary Foundation Report (PFR) for Structure Type Selection

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INTRODUCTION

This memorandum has been prepared to provide the necessary geotechnical information to assist the structural designers in the type selection process for replacement of the Mt. Vernon OH. It includes preliminary geologic, geotechnical, seismic and foundation recommendations for the subject structure.

The recommendations provided in this memorandum are based on soil boring data collected in September 1997 for seismic retrofit of the subject structure. In September 1997, six hollow-stem auger borings were drilled as part of the Caltrans Phase II Retrofit Program to collect subsurface data for evaluation of the existing structure and to provide geotechnical parameters for foundation retrofit. Two Log-of-Test-Borings (LOTB) sheets were prepared for these six soil borings and these sheets are attached. The boring termination depth ranged from 70 to 95 feet below the existing ground surface.

SUMMARY OF SITE GEOLOGY AND SUBSURFACE CONDITIONS

Elevation of the existing ground surface is about 1,082 feet. The subject site is underlain by four main soil units. The site's existing ground surface and underlying soil stratigraphy is uniform and nearly horizontal along the entire length of the bridge. The table below summarizes the four soil units and the groundwater conditions encountered in our borings. As a result, a single soil column representative of the entire site was used for all bents for the purpose of foundation design.

Unit	Top Elevation of Unit (ft)	Design Top Elevation (ft)	Soil Unit Classification
I	1,082	1,082	Loose to Compact Silty Sand and Sandy Silt (SM/ML)
II	1,054 to 1,057	1,056	Dense to Very Dense Sand with Gravel (SP)
III	1,033 to 1,037	1,036	Stiff to Very Stiff Sandy Silts (ML)
IV	1,018 to 1,022	1,020	Dense to Very Dense Sand and Silty Sand with Gravel (SP/SM)
Note: Groundwater ranges from El. 1,019 to 1,037 ft. Design groundwater is El. 1,037 ft.			

In September 1997, groundwater was encountered in four borings at depths of 45 and 63 feet below the ground surface. For design, groundwater was assumed to be at the top of Soil Unit III which is at a depth of 46 feet below the existing ground surface.

SEISMIC DATA AND EVALUATION

Maximum Horizontal Bedrock Acceleration:	0.70 g (see Note 1)
Causative Fault:	San Jacinto fault
MCE Magnitude (see Note 2):	7.5
ARS Curve Recommendation:	Caltrans Seismic Design Criteria (SDC) Figure B.8 @ 0.7g/Soil Type D (Note 3)

Notes:

1. *Maximum horizontal bedrock acceleration recommendations are based on the Caltrans California Seismic Hazard Map, dated July 1996.*
2. *MCE = Maximum Credible Earthquake generated by causative fault.*
3. *Due to the proximity of the subject structure to the fault, the modification to ATC-32 should include a 20 percent increase of spectral accelerations for periods equal to or greater than 1 sec., no increase for periods less than 0.5 sec., and linear interpolation between periods of 0.5 and 1 sec.*

LIQUEFACTION EVALUATION

Based on the soil boring data, the saturated onsite soils consist of either dense to very dense sand or stiff to very stiff sandy silt. The relative density of the sandy soil is high enough to be resistant to liquefaction and the silty soil layer has sufficient fines and high enough Standard Penetration Test (SPT) blowcounts to resist widespread liquefaction. Therefore, liquefaction potential is not considered to be a design issue.

CORROSION EVALUATION

Laboratory test results indicate a minimum soil resistivity of 2,400 to 4,700 ohm-cm, pH values of 7.2 to 8.2, chloride content of 104 to 143 parts per million (ppm) and sulfate content of 100 to 160 ppm. Based on Caltrans Memo to Designers 3-1, dated May 1996, the site soils are classified as non-corrosive to concrete or bare metal.

PRELIMINARY FOUNDATION RECOMMENDATIONS

The surficial materials are loose and deep foundations are needed for support of the new structure. Four deep foundation types are considered in type selection: 30-inch and 6.5-foot diameter Cast-in-Drilled-Hole (CIDH), 14-inch square precast concrete (Caltrans Standard Alt. “X”) and 16-inch diameter pipe (Caltrans Standard Alt. “W”) piles. The estimated pile lengths for a design (service) load requirement of 100 tons are about 37 feet for the 30-inch diameter CIDH pile and 40 feet for the precast concrete and pipe piles.

For the 6.5-foot diameter CIDH pile type, the dead and live loads were specified to be 900 tons and 230 tons, respectively. For a total design (service) load of 1,130 tons, the pile length below existing grade is estimated to be about 100 feet.

CONSTRUCTION CONSIDERATIONS

Selection of the final pile type should be based on a cost analysis and the axial and lateral demands on the foundation.

Standard Piles. Installation of the Caltrans Standard Alt. "X" and "W" piles shall follow Section 49 of the Caltrans Standard Specifications.

The 14-inch square precast concrete pile will encounter hard driving when penetrating through gravelly zones, particularly within Soil Unit II. Therefore, undersized predrilling will be necessary in order to achieve the specified pile-tip elevation, but undersized predrilling could potentially reduce the uplift capacity by one-half. Therefore, this pile type may not be suitable if the tension demand on the piles is high.

The 16-inch diameter steel pipe pile will be able to endure some level of hard driving. If "refusal" is encountered above the specified tip elevation, center-relief drilling can be used to achieve deeper penetrations. This method of pile installation will allow the development of full tensile resistance (which can be up to 50 percent of the nominal resistance in compression).

CIDH Piles. A 30-inch diameter CIDH pile was selected so that the specified pile-tip elevation is at least 3 feet above the design groundwater depth. This could eliminate the need for "wet" construction. However, the use of this pile type may result in relatively large pile cap because of the need to maintain a 3 times pile diameter on-center spacing to minimize group effects. Even under "dry" condition, some caving and minor raveling may be encountered when drilling through Soil Unit II and other granular soil layers.

Wet construction will be required for the 6.5-foot diameter CIDH pile. In past Caltrans projects for CIDH piles underwater, the standard Caltrans SSP allows contractor to use slurry displacement method with or without a temporary casing. The contractor also has the option to select one of the three types of slurry: water, mineral or synthetic. However, a recent change in Caltrans policy disallows the use of a temporary casing for wet construction, and a reduced skin friction resistance must be used when slurry is used to stabilize the borehole. The reduced skin friction would result in a pile length significant longer than 100 feet. Therefore, if large-diameter pile extensions are needed, we recommend the following pile type:

(1) CIDH pile with permanent casing: concrete will be deposited underwater; per Caltrans latest requirement, permanent casing must be installed using impact hammers, or
(2) CISS pile with a soil plug (and concrete seal course, if necessary): concrete will be deposited in the dry.

The above two pile types are feasible from a design point of view. However, we are concerned with the availability and cost of pile driving hammers capable of installing 6.5-foot diameter casing or CISS piles. Therefore, it is prudent that the diameter of the CIDH or CISS pile be reduced to match experience of local pile driving contractors.

To inquire about equipment dimensions, we have contacted Anderson Drilling in Lakeside, California. According to Anderson, big (100-ton) drill rigs would be used for the 6.5-foot diameter drilled shaft using a approximately 10-foot long auger. Crawler-mounted drill rigs are 20 feet wide by 28 feet long and truck-mounted rigs are 24 feet wide (maximum) by 40 feet long. Minimum workspace dimensions to drill 24” to 78” CIDH piles are about 40 feet by 30 feet. The maximum tower height on either rig type is 90 feet.

According to Anderson, a 100-ft long 6.5-foot diameter drilled shaft can typically be drilled in about 6 hours. Construction and installation of cage and inspection tubes, and pouring of concrete require about 1 full day. For the 6.5-foot diameter shaft drilling and construction, a 6-man crew can be assumed. A loader is required to continuously haul soils dirt off-site.

ADDITIONAL FIELD WORK AND LABORATORY TESTING

If CIDH piles are selected, we propose drilling at least three soil borings to collect groundwater data. Additional soil data must also be collected down to a depth of at least 115 feet if the 6.5-foot diameter CIDH pile type is selected. These borings should be converted to groundwater monitoring wells so that measurements can be obtained up until the time of pile construction. Although it is ideal to locate these borings as close as possible to the proposed bridge support locations, these borings can be performed farther away from the train traffic because abrupt changes in groundwater level along the bridge alignment is not anticipated.

If one of the driven pile alternatives is selected for final design, it is also beneficial to drill additional soil borings. In September 1997, the number of borings was limited to six due to the great concerns of personnel safety and disruption of train operations during drilling. We expect to encounter similar concerns and finding new borehole locations for drilling would be difficult. If permissions are granted by the railroad company, our preferred borehole locations would be one boring near the southern approach embankment, one boring between existing Bents 4 and 8, one boring between Bents 8 and 13, and one boring between Bents 17 and 20.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	SBd				

REGISTERED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-2003 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

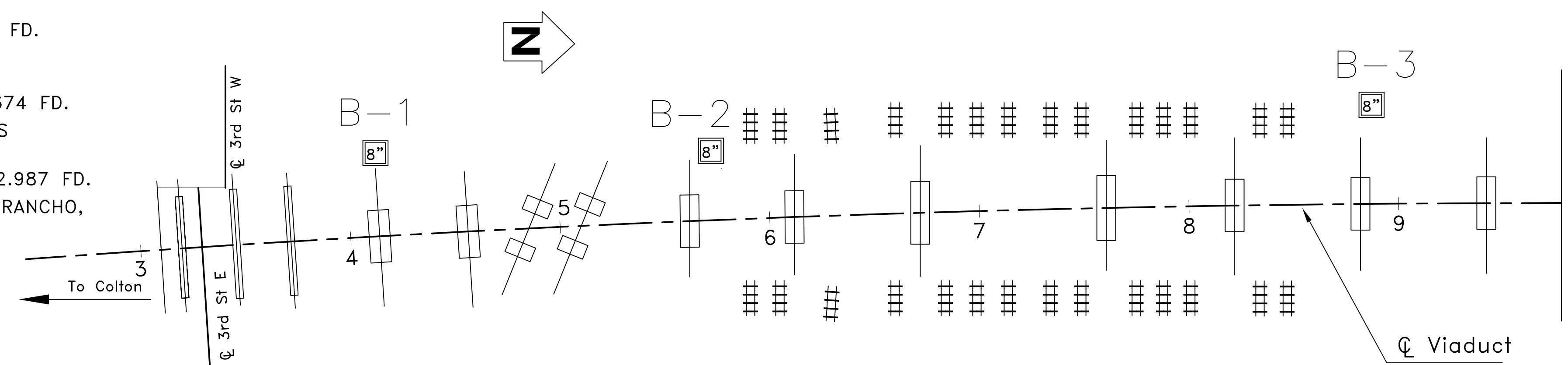
EARTH MECHANICS, INC.
17660 NEWHOPE ST., SUITE E
FOUNTAIN VALLEY, CALIFORNIA 92708

BENCHMARK

USC&GS "G39" ELEV. 1078.141 FD.
TABLET AT WEST SIDE STATION

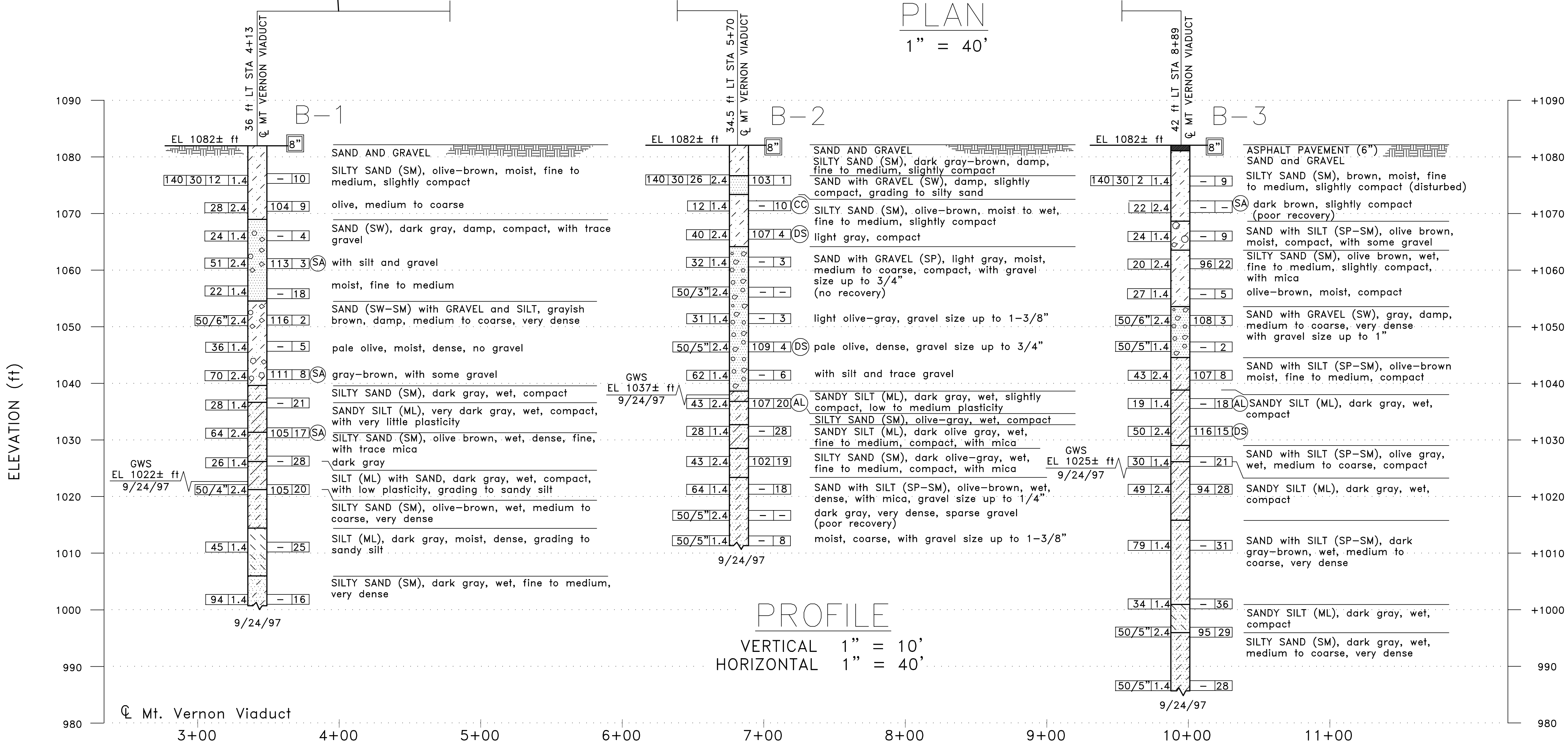
USC&GS "W-471" ELEV. 1066.674 FD.
WALL-TABLET, 3-RD & I-STREETS

USC&GS "RIALTO-F" ELEV. 1122.987 FD.
BRASS CAP MONUMENT EAST OF RANCHO,
NORTH OF RAILROAD



PLAN

1" = 40'



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS

GRAVEL, SAND, SILT, CLAY, SANDY CLAY or CLAYEY SAND, SANDY SILT or SILTY SAND, SILTY CLAY, CLAYEY SILT, PEAT and/or ORGANIC MATTER, FILL MATERIAL, IGNEOUS ROCK, SEDIMENTARY ROCK, METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (blows/ft)	Granular	Cohesive
0 - 4	Very Loose	Very Soft
5 - 9	Loose	Soft
10 - 19	Slightly Compact	Stiff
20 - 34	Compact	Very Stiff
35 - 69	Dense	Hard
> 70	Very Dense	Very Hard

Note: Classification of earth material as shown on this sheet is based on visual inspection and/or mechanical analysis where indicated.

Note 1: Boring Sizes are in Millimeters

Note 2: Soil Tests

DS Direct Shear, C Consolidation, MD Maximum Density, SA Sieve Analysis, SE Sand Equivalent, W Wash #200, CC Chemical Testing, TX Triaxial UU, PP Pocket Penetrometer, AL Atterberg Limits

DESIGN	BY M. KAPUSKAR 11/2/97	D. CHAN FIELD INVESTIGATOR
CHECKED	BY L. CHEANG 11/11/97	DATE 9/24/97 - 9/29/97

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

L. CHEANG
PROJECT ENGINEER

BRIDGE No. 54C-0066
POSTMILE

EARTHQUAKE RETROFIT
MOUNT VERNON YARD OVERHEAD
LOG OF TEST BORINGS NO. 1

DESIGN OVERSIGHT
SIGNOFF DATE

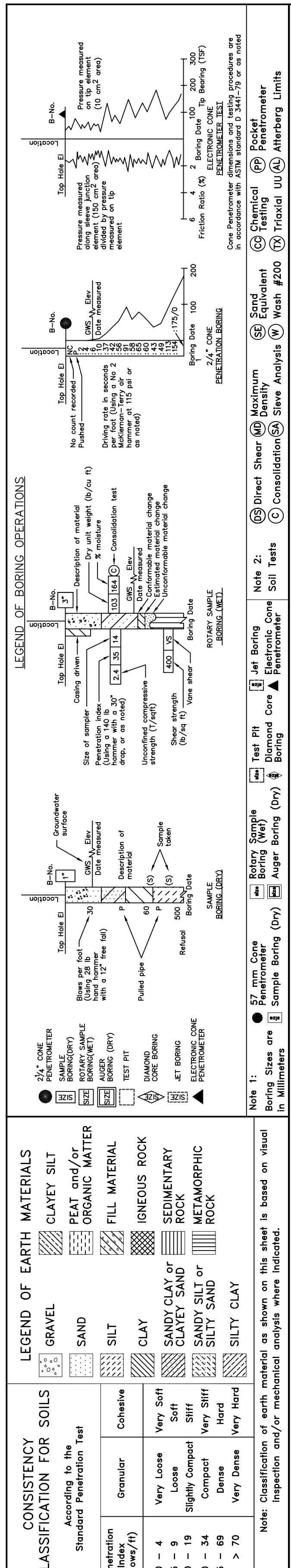
ORIGINAL SCALE IN inches FOR REDUCED PLANS 0 1 2 3 4

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 10-6-99

SHEET OF



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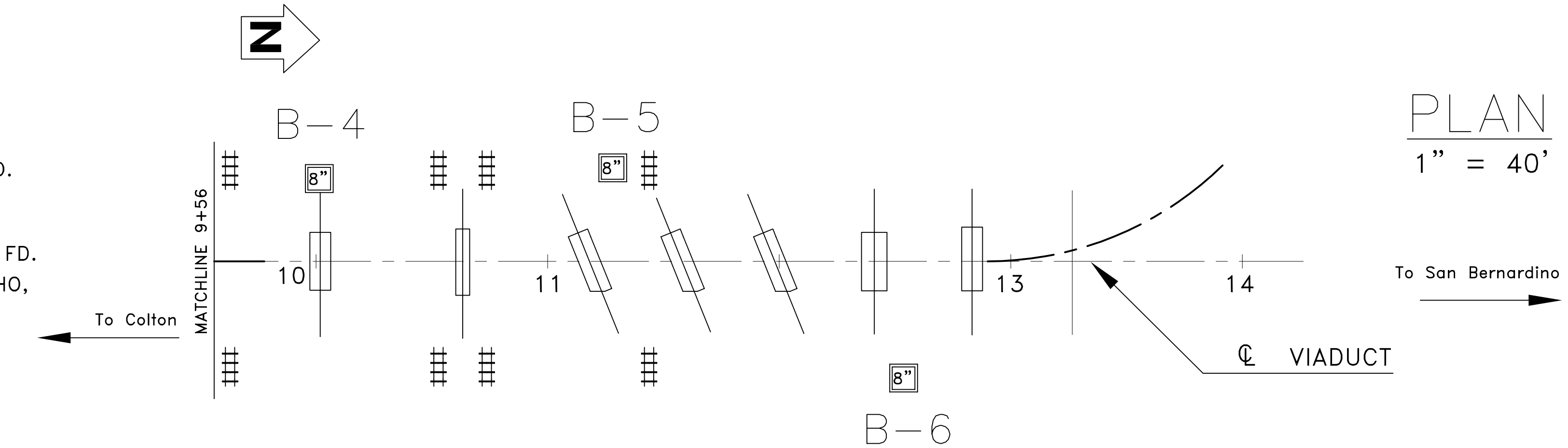

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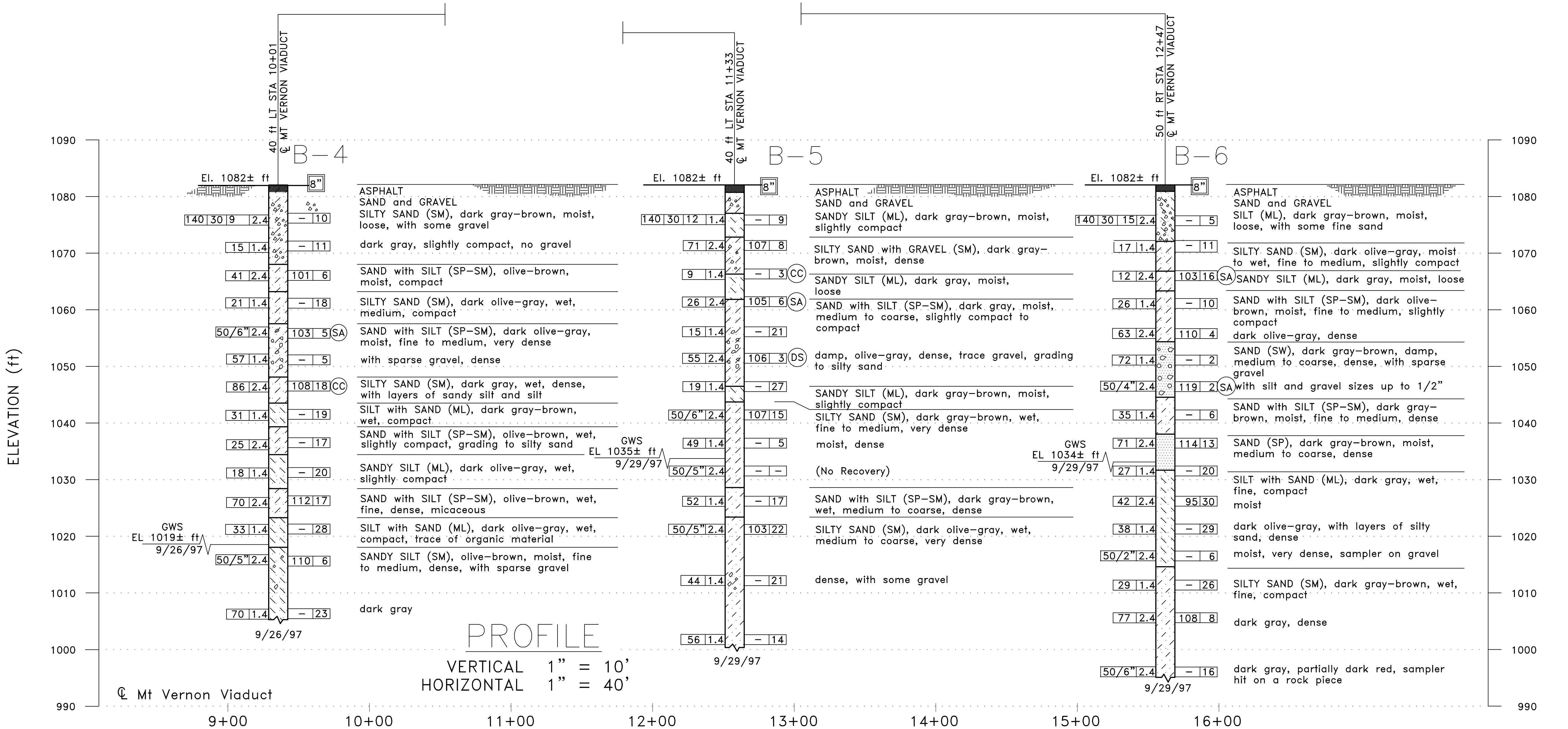

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EARTHQUAKE RETROFIT

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CHECKED	BY L. CHEANG 11/10/97	DATE 9/24/97 - 9/29/97			POSTMILE

MOUNT VERNON YARD OVERHEAD
LOG OF TEST BORINGS NO. 2

DESIGN OVERSIGHT

SIGNOFF DATE

ORIGINAL SCALE IN inches FOR REDUCED PLANS 0 1 2 3 4

CU
EA

DISREGARD PRINTS BEARING EARLIER REVISION DATES 10-6-99

REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF